Keys To The Vascular Plants Of East Texas

KEY TO MAJOR VASCULAR PLANT GROUPS

1. Plants without seeds or flowers, reproducing by microscopic spores borne in sporangia (= spore cases), these either (usually) on the surface of leaves or leaf-like structures (Polypodiophyta—Ferns) OR at the base of quill-like leaves (*Isoetes*) OR in small, usually more or less cone-like structures (*Equisetum, Lycopodium,* and *Selaginella*); plants fern-like, moss-like, with quill-like leaves, or leaves reduced and stems green and hollow _____ **Lycopodiophyta, Equisetophyta, and Polypodiophyta**
(Pteridophytes = Ferns & Similar Plants)
see Key on pp. 309

1. Plants reproducing by seeds, these developing either from flowers or on the surface of thin or thick, sometimes woody cone scales; plants usually not with growth forms as above (Spermatophytes = Seed Plants).
   2. Plants without flowers, the seeds on the surface of thick or thin, sometimes woody cone scales (cone scales fleshy in *Juniperus* with berry-like cones or thin, becoming fleshy in *Ephedra*); leaves needle-like (*Pinus*) or linear to linear-lanceolate (*Taxodium*) OR very small, scale-like, and closely appressed to the stem (*Juniperus*) OR reduced to non-leaf-like scales in whorls at the joints of the stem (*Ephedra*) _____ **Pinophyta and Gnetophyta**
   (Gymnosperms ("naked seeds"))
   see Key on pp. 313
   2. Plants with flowers, the seeds developing inside a closed carpel, the base of which (= ovary) becomes the fruit; leaves usually broader, only rarely scale-like—Magnoliophyta (Angiosperms ("vessel seeds") = Flowering Plants).
      3. Plants with 2 or more of the following characters: leaves parallel-veined; cotyledon (= seed leaf) 1; floral parts in 3s or 6s; mostly herbaceous plants with vascular bundles of stem usually scattered throughout the pith; cambium usually absent _____ **Monocotyledonae**
      (Monocots)
      see Key on pp. 313
      3. Plants with 2 or more of the following characters: leaves net-veined; cotyledons 2; floral parts usually not in 3s or 6s (usually in 2s, 4s, or 5s); herbaceous and woody plants with vascular bundles of stem in a ring around the pith; cambium usually present except in some annuals _____ **Dicotyledonae**
      (Dicots)
      to be treated in Volumes 2 & 3 of the *Illustrated Flora of East Texas*

Key to Families of Ferns and Similar Plants (Pteridophytes)

1. Plants small floating aquatics; leaf blades < 4 cm long (usually much less).
   2. Leaf blades 7–30(–38) mm long, the upper (= adaxial) surface with conspicuous 4-branched hairs; roots absent but submerged leaves root-like, highly dissected _____ (*Salvinia*) **Salviniaceae**
   2. Leaf blades extremely small, usually < 1 mm long, the upper surface papillate, but without hairs; roots unbranched _____ (*Azolla*) **Azollaceae**
1. Plants not small floating aquatics, either terrestrial (rooted in soil or mud) OR aquatic (rooted on bottom) OR growing on rocks or tree trunks; leaf blades often, but not always, much > than 4 cm long.
   3. Stems nearly naked (without leaves), green, photosynthetic, erect, repeatedly branched dichotomously (= into 2 equal parts); leaves absent but minute scale-like stem appendages present, these 0.7–2.5 mm long; (2–)3 sporangia fused into a (2–)3-lobed cluster (= synangium) _____ (*Psilotum*) **Psilotaceae**

3. Stems various, not naked, usually not green (except in *Equisetum*), erect OR not so, often underground, not repeatedly branched dichotomously; leaves present, these varying from scale-like to large and compound; sporangia not fused into a cluster.
   4. Stems conspicuously jointed, green and hollow, the segments separating easily at the joints (= nodes); leaves reduced to small essentially non-photosynthetic (non-green) scales in whorls at the nodes; sporangia (= spore cases) in terminal strobili (= cone-like structures) on stems without green leaves _____ (*Equisetum*) **Equisetaceae**
   4. Stems not jointed, not green and hollow; leaves usually green; sporangia either on the surface of leaves or leaf-like structures OR in terminal strobili on leafy stems OR in short-stalked sporocarps at leaf bases.
      5. Leaves simple, linear, grass-like or thread-like, the blades not expanded; spore-bearing structures embedded in leaf bases or on very short stalks (1–2 mm long) at leaf bases; plants often rooted in mud or in temporary pools.
         6. Leaves tightly clustered together, arising from a corm-like rootstock, quill-like (larger at base); sporangia embedded in the leaf bases, borne one per leaf _____ (*Isoetes*) **Isoetaceae**
         6. Leaves scattered along a creeping rhizome, separate, not clustered, not quill-like; sporangia in stalked (stalks 1–2 mm long), globose, hairy sporocarps (= nut-like or hard bean- or pea-like sporangia-bearing cases) arising at the base of the leaves, the sporangia numerous per sporocarp _____ (*Pilularia*) **Marsileaceae**
      5. Leaves compound or simple, with expanded blades OR leaves needle-like or scale-like, neither grass-like nor thread-like; spore-bearing structures neither embedded in leaf bases nor on very short stalks at leaf bases; plants rooted in various substrates including mud or soil or on rocks or tree trunks.
         7. Plants distinctly vine-like (CLIMBING FERNS); leaves with indeterminate growth, climbing, vine-like, to 3(+) m long, the rachis elongate, twining, flexuous, stem-like (true stem below ground); sporangia borne on finger-like lobes of the fertile pinnules (= subdivisions of pinnae); species known in East TX from the s part of the Pineywoods _____ (*Lygodium*) **Lygodiaceae**
         7. Plants not vine-like: leaves various but neither climbing, vine-like, nor with a twining rachis; sporangia variously borne, but not on finger-like lobes of the fertile pinnules; including species widespread in East TX.
            8. Leaf blades deeply 4-parted (resembling a 4-leaf clover), on petioles usually much longer than the blades; sporangia in sporocarps borne near the base of the plant _____ (*Marsilea*) **Marsileaceae**
            8. Leaf blades variously compound or simple but not 4-parted; petioles usually much shorter than leaf blades to absent; sporangia not in sporocarps near the base of the plant.
               9. Leaves 8 mm or less long; plants with numerous, small, usually overlapping or divergent, scale-like or needle-like leaves, each with a single unbranched vein (this type of leaf is a microphyll); stems well-exposed above the ground surface, covered with the numerous small leaves; sporangia in the axils of the microphylls, these microphylls often aggregated into cone-like strobili.
                  10. Sporangia in cylindrical strobili at the tips of elongate, distinctly erect, leafy, fertile stems; leaves 4–8 mm long; plants homosporous (= with 1 spore type of a single size) _____ **Lycopodiaceae**
                  10. Sporangia in ± 4-angled strobili at the tips of leafy stems; fertile stems ascending or spreading, not distinctly erect; leaves 1–3 mm long; plants heterosporous (= with 2 spore types which are of different sizes) _____ (*Selaginella*) **Selaginellaceae**
               9. Leaves usually much more than 10 mm long; plants with relatively few large leaves with numerous branched veins (this type of leaf is a megaphyll); stems underground rhizomes or short crowns or caudices, not well-exposed above the ground

surface and relatively inconspicuous; sporangia in clusters (= sori) on the surface of the leaf blades (the blades can sometimes be considerably modified).

11. Plants with 1(–2) leaves per stem; leaves with 2 distinct parts, the sterile portion either entire or ternately (= in 3 parts) to pinnately compound to dissected, the fertile portion being an elongate stalk with a spike-like or panicle-like sporangia-bearing terminal part _____ **Ophioglossaceae**

11. Plants usually with numerous leaves per stem; leaves not as described above.

12. Lowermost 2 pinnae (= primary divisions of a leaf, here one on each side of the leaf) of the fertile leaf greatly elongated and bearing the sporangia near their tips _____ (*Anemia*) **Anemiaceae**

12. Lowermost 2 pinnae of the fertile leaf neither greatly elongated nor bearing the sporangia near their tips.

13. Sori linear-oblong, in one row on each side of, immediately adjacent to, and parallel with the costae (= midveins of the pinnae) or costules (= midveins of the pinnules), chain-like in arrangement _____ (*Woodwardia*) **Blechnaceae**

13. Sori various, but arrangement not chain-like in one row on each side of, immediately adjacent to, and parallel with the costae or costules.

14. Fertile and sterile leaves either completely different OR fertile portion of fertile leaves essentially without any blade tissue (leaves extremely dimorphic).

15. Plants aquatic or semiaquatic, usually rooted in mud in quiet or moving water of springs and adjacent rivers and lakes; leaf blades with adventitious buds or small plantlets in notches along margins; in East TX known only from extreme w margin of the area along the Balcones Fault at the edge of the Blackland Prairie and Edwards Plateau _____ (*Ceratopteris*) **Pteridaceae**

15. Plants terrestrial, sometimes in wet habitats, but usually not actually in water; leaf blades without adventitious buds or plantlets; including plants widespread in East TX.

16. Fertile leaves completely different from sterile leaves, essentially without photosynthetic tissue, solely sporangia-bearing, glabrous; sterile leaves 1-pinnatifid (= deeply divided but not completely pinnate), the rachis (= central axis of a fern frond/leaf) with a conspicuous flange or wing of photosynthetic tissue _____ (*Onoclea*) **Dryopteridaceae**

16. Fertile leaves either with numerous ± normal photosynthetic pinnae OR fertile leaves with conspicuous pubescence; sterile leaves pinnate (= pinnae narrowed to petiole-like attachment to rachis), the rachis without a flange or wing of photosynthetic tissue except possibly at very tip of blade _____ (*Osmunda*) **Osmundaceae**

14. Fertile and sterile leaves or portions of leaves similar or somewhat modified, the fertile portion never so different as to be without blade tissue (leaves not extremely dimorphic).

17. Sori marginal or submarginal (= located at or near the edges of the leaves) with leaf margins recurved over the sori, protecting them and forming a false indusium (= thin scale-like outgrowth covering the clusters of sporangia) (except not recurved in *Astrolepis* which has stellate or coarsely ciliate scales on the adaxial leaf surfaces).

18. Plants stout, to 1 m or more tall; leaf blades triangular in shape or nearly so, with 3 main divisions (each division usually bipinnate); petioles greenish or ± straw-colored; stems and petiole bases with slender hairs but without scales _____ (*Pteridium*) **Dennstaedtiaceae**

18. Plants slender, usually 0.1–0.5 m tall; leaf blades neither triangular nor with 3 main divisions; petioles often dark brown or black; stems and petiole bases generally with scales _____ **Pteridaceae**

17. Leaf margins never recurved to form a false indusium; sori variously located on the abaxial (= beneath) leaf surfaces, often near veins, occasionally near the margins of the leaves; adaxial leaf surfaces without stellate or coarsely ciliate scales.

19. Sori elongate along the veins; leaf blades 1-pinnate _____ (*Asplenium*) **Aspleniaceae**

19. Sori round or variously shaped, not elongate (in our species, except elongate in *Athyrium* with leaf blades 2-pinnate-pinnatifid); leaf blades in our species 1-pinnatifid, 1-pinnate, or more than 1-pinnate.

20. Leaf blades in our species only 1-pinnate or 1-pinnatifid, the pinnae not further subdivided into pinnules.

21. Leaf blades only pinnatifid (in our species), divided nearly but not all the way to the rachis (= midrib); pinnae essentially as wide at base as towards their tips; margins of pinnae (in our species) without any teeth or basal auricle; indusia lacking _____ (*Pleopeltis*) **Polypodiaceae**

21. Leaf blades pinnate, divided all the way to the rachis; pinnae narrowed basally to a very narrow petiole-like attachment to the rachis; pinnae with small teeth on the margins, sometimes with basal auricles; indusia present (but sometimes shriveled at maturity) _____ **Dryopteridaceae**

20. Leaf blades more than 1-pinnate, the pinnae themselves either pinnate or pinnatifid.

22. Lower leaf surfaces with at least some transparent needle-like hairs (particularly on the costae and veins, sometimes even on the intervening tissue or on the indusia—use hand lens or scope); ultimate leaf segments often (but not always) entire; petioles with 2 crescent-shaped vascular bundles basally, distally these united into a U-shape _____ **Thelypteridaceae**

22. Lower leaf surfaces without transparent needle-like hairs; ultimate leaf segments variously incised, serrate, dentate, crenate, or lobulate, not entire; petioles with 2 or more round or oblong vascular bundles _____ **Dryopteridaceae**

Key to Families of Gymnosperms

1. Shrubs 0.25–1 m tall; leaves inconspicuous, the main photosynthetic structures being the green to yellow-green stems; stems ± jointed; seed-producing cones 6–12 mm long, the scales thin, the inner scales becoming fleshy and red; longest internodes of twigs 2–5 cm long; plants neither resinous nor fragrant (Gnetophyta) _____ (*Ephedra*) **Ephedraceae**
1. Trees or shrubs much more than 1 m tall; leaves conspicuous (though often small) and serving as the primary photosynthetic structures; stems not jointed; seed-producing cones either large (15 mm or more long) and woody or small (to 10 mm long), berry-like, and blue to bluish black, bluish purple, reddish, or copper-colored; longest internodes of twigs usually 0–1 cm long; plants usually resinous and fragrant (Pinophyta).
   2. Adult foliage leaves needle-like, not flattened, 50–450 mm long, in fascicles of 2–5 surrounded at the base by a membranous sheath; seed-producing cones 40 mm or more long (often much longer) _____ (*Pinus*) **Pinaceae**
   2. Adult foliage leaves scale-like OR flat and linear, ca. 17 mm or less long, not in fascicles; seed-producing cones 5–25(–40) mm long _____ **Cupressaceae**

Key to Families of Monocots

1. Leaf blades palmately divided, fan-like, up to 1 m or more wide; plants palm-like (palms) _____ **Arecaceae**
1. Leaf blades simple or pinnatifid, usually much narrower; plants not palm-like.
   2. Plants epiphytic (= growing on branches of other plants, without roots in the ground) _____ (*Tillandsia*) **Bromeliaceae**
   2. Plants terrestrial or aquatic.
      3. Plants small (of 1–several fronds or thalli, each ca. 1 cm or less long) floating aquatics, without definite stems or leaves (duckweeds) _____ **Lemnaceae**
      3. Plants not as above, usually much larger, terrestrial OR aquatic and rooted in substrate OR floating; stems or leaves distinguishable.
         4. Stems woody.
            5. Leaves many, clustered close together, either all basal or in a crown, long (usually 0.2 m to 1.3 m long), sword-like or linear; inflorescences large terminal racemes or panicles with numerous flowers, the flowers with either large and conspicuous or small perianths; fruits capsules or 3-winged samaras.
               6. Flowers small (tepals 3.5 mm or less long), mostly unisexual (reduced parts of opposite sex present); leaves 2–14 mm wide (not including spike-like prickles if present); seeds 1–3 per fruit _____ **Nolinaceae**
               6. Flowers much larger, bisexual; leaves of various widths, 8–80 mm wide; seeds many per fruit _____ **Agavaceae**
            5. Leaves conspicuously scattered all along the elongate stem, variously shaped, but not sword-like; inflorescences not as above; perianths absent or inconspicuous; fruits berries or caryopses.
               7. Plants climbing or trailing vines with prickles and/or tendrils; fruits black to blue, red, or orange berries; leaf sheaths absent; stems solid, without distinct joints _____ (*Smilax*) **Smilacaceae**
               7. Plants erect, without prickles or tendrils; fruits caryopses; leaf sheaths present; stems hollow, with distinct joints _____ **Poaceae**
         4. Stems herbaceous (not woody).
            8. Plants climbing vines.
               9. Plants with tendrils; leaves alternate; flowers in pedunculate or sessile axillary umbels; ovary superior; fruits berries _____ (*Smilax*) **Smilacaceae**
               9. Plants without tendrils, climbing by twining; leaves (at least of lower nodes) opposite or whorled; flowers in paniculate or spike-like inflorescences; ovary inferior; fruits capsules _____ (*Dioscorea*) **Dioscoreaceae**

8. Plants not climbing vines.
   10. Plants aquatics growing completely submersed; leaves opposite or whorled.
      11. Leaves in distinct whorls of 3–8; flowers (staminate and/or pistillate) borne at the water surface on a thread-like stalk 3–6 cm long; perianth (staminate and/or pistillate) 3–10 mm long, white or translucent, visible with the naked eye _____ **Hydrocharitaceae**
      11. Leaves opposite (some can occasionally appear whorled where branches arise); flowers sessile or subsessile, borne underwater; perianth absent or minute, clearish or greenish, virtually indiscernable without a lens.
         12. Leaves obviously toothed to the naked eye _____ (*Najas*) **Hydrocharitaceae**
         12. Leaves not obviously toothed to the naked eye.
            13. Leaf blades usually very minutely denticulate (under a scope), sheathing basally; fruits not curved, not short stipitate, without a beak; flowers with a single carpel; sheathing stipules not present _____ (*Najas*) **Hydrocharitaceae**
            13. Leaf blades entire, not sheathing basally; fruits curved, short stipitate (= stalked), also with a beak to 1.5 mm long; flowers with 2–8 separate carpels; sheathing stipules present _____ (*Zannichellia*) **Zannichelliaceae**
   10. Plants terrestrial or aquatic, but if leaves completely submersed then alternate or basal.
      14. Plants free-floating aquatics with leaves in rosettes.
         15. Leaves sessile, velvety-hairy; perianth absent _____ (*Pistia*) **Araceae**
         15. Leaves distinctly petiolate, the petioles swollen OR not so, ca. as long as the blades or longer, the blades glabrous; perianth present.
            16. Petioles not swollen; leaf blades with a central disk of purplish spongy tissue underneath; perianth greenish white to yellowish, at most 1.4 cm long _____ (*Limnobium*) **Hydrocharitaceae**
            16. Petioles swollen; leaf blades without a central disk of spongy tissue underneath; perianth much larger, 4–6 cm long, bluish lavender, the upper segment with a yellow spot, very showy _____ (*Eichhornia*) **Pontederiaceae**
      14. Plants not free-floating, either terrestrial or aquatic, but rooted in substrate; leaves variously arranged.
         17. Plants completely submersed rooted aquatics with elongate, ribbon-like, basal leaves 8–60(–nearly 100) cm long; flowers at the water surface, the inflorescences never extending above the water _____ (*Vallisneria*) **Hydrocharitaceae**
         17. Plants either terrestrial or aquatic, with leaves various; if aquatic, then flowers usually held above the water surface.
            18. Inflorescence a peduncle terminated by a winged or ribbed spathe containing a single flower with white to pinkish petals 2–3 cm long; leaves usually all submersed, ± basal, petiolate, lanceolate to broadly ovate, with curving, ± parallel veins; rare introduced species known in East TX only from Jefferson Co. near se margin of area _____ (*Ottelia*) **Hydrochariaceae**
            18. Inflorescence and leaves various, not as above; including native and introduced species widespread in East TX.
               19. Plants without obvious leaves (only bladeless sheaths present); stems unbranched; perianth absent or of inconspicuous bristles or small scales _____ **Cyperaceae**
               19. Plants usually with obvious leaves (these rarely reduced to bracts); stems branched or unbranched; perianth various, ranging from conspicuous to absent.

20. Flowers in a single, small (4–40 mm long), dense head or spike terminating an elongate naked scape, the head or spike either cone-like with numerous, overlapping, brownish, thin, ± woody bracts (subtending yellow flowers) OR head whitish or grayish due to numerous hairs on the subtending involucral bracts and flower parts.
    21. Inflorescence cone-like, with spirally imbricated, brownish, thin, ± woody bracts, usually with a single yellow flower exposed per inflorescence _____ (*Xyris*) **Xyridaceae**
    21. Inflorescence a small whitish or grayish head, not cone-like, lacking brownish woody bracts, without yellow flowers _____ (*Eriocaulon*) **Eriocaulaceae**
20. Flowers not in a single, small, dense head or spike terminating an elongate naked scape; inflorescence neither cone-like with numerous overlapping brownish bracts subtending yellow flowers nor whitish nor grayish due to numerous hairs on the bracts and flower parts.
    22. Plants large (1–3 m tall) erect emergents with an extremely dense, large (12–40 cm long), brownish, cylindrical spike with thousands of very tiny flowers (cat-tails) _____ (*Typha*) **Typhaceae**
    22. Plants not as above, without a large, brown, cylindrical spike.
        23. Flowers and fruits in the axils of imbricate (= overlapping) or distichous (= 2-ranked) scales, concealed by the scales at least when young; fruits 1-seeded; perianth absent or represented by bristles or small scales (grasses and sedges).
            24. Stems typically round or flat in cross-section but never triangular, typically jointed (nodes obvious), with hollow or solid internodes; leaves usually 2-ranked, with sheaths normally split lengthwise on the side opposite the blade; each flower usually subtended by 2 scales _____ **Poaceae**
            24. Stems round or often triangular, typically not jointed, with solid internodes; leaves usually 3-ranked, with sheaths continuous around the stem or splitting only in age OR leaves reduced to sheaths only; each flower usually subtended by 1 scale _____ **Cyperaceae**
        23. Flowers and fruits not in the axils of imbricate or distichous scales, not concealed by scales, or if so, fruits more than 1-seeded; perianth absent or present, sometimes petal-like or with conspicuous petals.
            25. Inflorescence a fleshy spike (= spadix) of numerous, small, imperfect flowers, the inflorescence enclosed in a conspicuous, specially modified bract (= spathe) or diverging at an angle from the side of a spathe-like structure (in *Orontium*, which has a conspicuous yellow spadix, the spathe is apparently absent).
                26. Plants with elongate, linear, sword-like, parallel-veined leaves; spadix diverging from the side of, but not enclosed in, an elongate, linear, spathe-like structure _____ (*Acorus*) **Acoraceae**
                26. Plants without elongate, linear, sword-like, parallel-veined leaves; spadix enclosed in a spathe (except in *Orontium*) _____ **Araceae**
            25. Inflorescence not a fleshy spike; flowers usually perfect (sometimes unisexual); inflorescence usually neither enclosed in a spathe nor diverging at an angle from the side of a spathe-like structure.
                27. Plants emergent aquatics with 2-ranked, linear leaves and flowers in several dense, globose, unisexual heads _____ (*Sparganium*) **Sparganiaceae**
                27. Plants not as above.
                    28. Corollas absent (perianth absent or 28-merous and inconspicuous); plants aquatic with submersed or floating leaves; fruits drupe-like, 1-seeded.
                        29. Leaves all submersed OR some floating, variable in width, from 0.2–45 mm wide; inflorescence with flowers in 2–5 whorls on peduncle elongated above water surface; perianth 4-merous, though inconspicuous; stamens 4 _____ **Potamogetonaceae**
                        29. Leaves all submersed, all thread-like, 0.2–0.5 mm wide; inflorescence with flowers in 1 whorl on peduncle below water surface; perianth parts absent; stamens 2 _____ (*Ruppia*) **Ruppiaceae**

28. Corollas or corolla-like perianth parts present (often conspicuous); plants terrestrial or aquatic; fruits capsules, berries, or achenes (if achenes, these usually winged).
    30. Plants 1–2.5 m tall; leaves large, banana leaf-like, with prominent midrib and numerous side veins parallel or concentric with each other; stamens (some sterile and thus staminodes) petal-like, showy; fertile stamen 1.
        31. Ovary and fruit with warty surface; flowers large and showy, much more than 1 cm long, variously colored; inflorescence neither with zig-zag branches nor a white powdery appearance; fruit with several seeds _____ (*Canna*) **Cannaceae**
        31. Ovary and fruit with smooth surface; flowers 1 cm long or less, purplish; inflorescence a panicle with zig-zag branches and a striking white powdery appearance; fruit with only a single seed _____ (*Thalia*) **Marantaceae**
    30. Plants without the above combination of characters.
        32. Pistils 5–numerous per flower, free from each other or nearly so; fruits achenes or follicles, more than one developing from each flower; plants of aquatic or wet habitats (arrowhead and water-poppy families).
            33. Pistils 15–numerous per flower, each pistil developing into a 1-seeded indehiscent fruit (achene); petals white or rarely pink _____ **Alismataceae**
            33. Pistils 5–8 per flower, each pistil developing into a several-seeded, beaked follicle; petals light yellow to white with yellow base _____ (*Hydrocleys*) **Limnocharitaceae**
        32. Pistil 1 per flower, made up of a single carpel or of several carpels fused together; fruit various but often a many-seeded capsule, only one developing per flower; plants of various habitats.
            34. Plants aquatic, either completely submersed or partly floating or partly emersed, with leaves clustered in rosettes.
                35. Leaves all long-petiolate; leaf blades often reniform or cordate at base; inflorescence not subtended by a spathe-like bract; perianth greenish white to yellowish to white or pinkish _____ **Hydrocharitaceae**
                35. Leaves both sessile and long-petiolate; leaf blades various basally, but not cordate; inflorescence subtended by a spathe-like bract; perianth light blue to purplish blue to white, with 3 of the lobes yellow at base _____ (*Heteranthera*) **Pontederiaceae**
            34. Plants terrestrial OR if aquatic, then leaves not clustered in rosettes.
                36. Ovary inferior.
                    37. Plants very small, 5–20(–33) cm tall, usually in bogs or similar habitats; stems delicately thread-like; leaves scale-like, to only 5(–8+) mm long; flowers small (to only 15 mm long), purple or greenish white to cream, sometimes tinged with blue _____ **Burmanniaceae**
                    37. Plants usually > 20 cm tall, in various habitats; stems not thread-like; leaves not scale-like (except in saprophytic species); flowers small OR often large, variously colored.

38. Stamens 6 per flower.
    39. Perianth predominantly greenish white or yellowish (sometimes streaked or dotted with pink or brown, sometimes aging to deep rose, purple, or nearly brown); flowers in a spike-like raceme; leaves somewhat fleshy, often spotted, blotched, or mottled with darker green, brown, or reddish brown; plants scapose _____ (*Manfreda*) **Agavaceae**
    39. Perianth white to pink, red, wine, yellow, or orange-yellow (spotted purplish brown in one species with red to wine perianth); flowers usually in an umbellate inflorescence (or, if in a raceme, then with 7 or fewer flowers); plants scapose or with leafy stems [PLANTS WITH INFERIOR OVARIES PREVIOUSLY TREATED IN A BROADLY CONCEIVED POLYPHYLETIC LILY FAMILY].
        40. Plants with leafy stems; flowers with perianth segments red to wine, spotted purplish brown, greenish apically, distinct _____ (*Alstroemeria*) **Alstroemeriaceae**
        40. Plants scapose, the leaves in a basal rosette; flowers with perianth segments variously white to pink, red, yellow, or orange-yellow, united only at base or united into a tube.
            41. Perianth yellow, usually pilose, 18 mm or less long, without a crown (= corona); perianth segments united only at base; leaves narrowly linear, often pilose _____ (*Hypoxis*) **Hypoxidaceae**
            41. Perianth white to pink, red, yellow, or orange-yellow, not pilose, at least 20 mm long (usually much longer) OR with a crown OR perianth segments with yellowish green tips; perianth segments united only at base OR united into an often elongate conspicuous tube; leaves variously shaped, not pilose _____ **Amaryllidaceae**
38. Stamens 3 or fewer per flower.
    42. Flowers radially symmetrical; stamens 3 per flower; filaments present, separate or united; column absent; leaves distichous (= 2-ranked) _____ **Iridaceae**
    42. Flowers bilaterally symmetrical; stamens 1 or 2 per flower; filaments absent; male and female parts united into a column; leaves not distichous _____ **Orchidaceae**

36. Ovary superior (in a few cases only partly so).
    43. Plants small, moss-like or club-moss-like, aquatic or of wet areas; leaves numerous, spirally arranged, ± linear (1 mm or less wide); flowers stalked, radially symmetrical, whitish to pinkish or violet, borne individually from the upper leaf axils _____ (*Mayaca*) **Mayacaceae**
    43. Plants not as above.
        44. Perianth (sepals and petals) of 6 small, dry, bract-like segments, persistent; plants rush-like _____ **Juncaceae**
        44. Perianth not bract-like, at least some of the segments usually petaloid, at least the corolla usually not persistent; plants not rush-like.
            45. Plants with large woody bases or a thick, fibrous-rooted crown; inflorescence a large many-flowered raceme or panicle; leaves usually leathery or fleshy.
                46. Flowers small (tepals 3.5 mm or less long), mostly unisexual (reduced parts of opposite sex present); leaves 2–12 mm wide; seeds 1–3 per fruit _____ **Nolinaceae**
                46. Flowers much longer, bisexual; leaves of various widths, 8–80(–100) mm wide; seeds many per fruit _____ **Agavaceae**
            45. Plants neither woody-based nor with a thick, fibrous-rooted crown; inflorescences various; leaves various, usually neither leathery nor fleshy.
                47. Perianth pale yellow, united in lower part forming a slender tube; flower solitary; plants aquatic, usually completely submersed except for flowers _____ (*Heteranthera*) **Pontederiaceae**
                47. Perianth variously colored, usually of distinct segments (segments united in a few species, but these have multi-flowered inflorescences); flowers solitary to numerous in various types of inflorescences; plants of various habitats, often terrestrial.

48. Plant an emergent perennial with distinctly petioled leaves and rounded-truncate or often cordate-based leaf blades; flowers in a slender spike subtended by a spathe; perianth violet-blue, bilaterally symmetrical, the upper lobe with a central 2-lobed yellow-green or yellow spot _____ (*Pontederia*) **Pontederiaceae**

48. Plant not as above.
    49. Perianth segments dissimilar, of more than one type (some petaloid, some sepaloid); leaf bases usually sheathing; flowers bilaterally or radially symmetrical, often subtended by 1- or 2-bracted, leaf-like spathes; plants from fibrous or tuberous roots _____ **Commelinaceae**
    49. Perianth segments usually all similar (all petaloid) OR in a few species some petaloid and some sepaloid; leaf bases usually not sheathing; flowers radially symmetrical, not subtended by leaf-like spathes; plants often from rhizomes, bulbs, or corms [PLANTS WITH SUPERIOR OVARIES PREVIOUSLY TREATED IN A BROADLY CONCEIVED POLYPHYLETIC LILY FAMILY].
        50. Leaves (actually leaf-like bracts) in a single whorl of 3 at summit of the stem; flower 1 per plant _____ (*Trillium*) **Trilliaceae**
        50. Leaves alternate or basal, or if whorled then in more than 1 whorl; flowers 1 to numerous per plant.
            51. Perianth very large, 55–180 mm long, orange to orange-red, yellow, or white.
                52. Leaves alternate or whorled along the stem; flowers 1–few in an umbel-like cluster at the end of a leafy stem, orange red with purple spots OR white _____ (*Lilium*) **Liliaceae**
                52. Leaves basal; flowers at the end of a naked scape, predominantly orange or yellow, sometimes with patterns but never spotted _____ (*Hemerocallis*) **Hemerocallidaceae**
            51. Perianth smaller, 40 mm or less long, variously colored.
                53. Inflorescence with a basal involucre of a sheathing bract(s); flowers solitary, umbellate, or in head-like inflorescences; plants sometimes with onion or garlic odor.
                    54. Filaments separate; perianth white to yellowish, pink, or red, 12 mm or less long _____ **Alliaceae**
                    54. Filaments united; perianth lavender-blue or white with pale blue tinge, 16–28 mm long.
                        55. Flower(s) single, rarely 2, subtended by 2 partly or wholly united bracts; filaments without bifid apical appendages; perianth white with pale blue tinge, the lobes with a darker central line and brownish tinge on back; plant with onion or garlic odor _____ (*Ipheion*) **Alliaceae**
                        55. Flowers 1–6(–9), the inflorescence subtended by 3 or 4 separate bracts; filaments with bifid apical appendages forming a crown between the anthers; perianth, including lobes, lavender-blue; plant without onion odor _____ (*Androstephium*) **Themidaceae**
                53. Inflorescence bractless or flowers individually bracted; flowers solitary, racemose, paniculate, or corymbose; plants without onion odor.
                    56. Inflorescences axillary (= arising from axils of the leaves) or apparently so, with 1–9(–15) flowers per inflorescence; plant with an erect-arching leafy stem OR stem with numerous finely dissected leaf-like branches.

57. Leaves reduced to scales only; main stem with numerous finely dissected branches; fruit a red berry _____ (*Asparagus*) **Asparagaceae**
57. Leaves well-developed, lanceolate-elliptic to broadly elliptic, to 15 cm long and 7 cm wide; main stem unbranched or once-forked into 2 branches; fruit a dehiscent capsule or a blue-black berry.
    58. Flowers solitary, apparently axillary; perianth parts free; fruit a dehiscent capsule _____ (*Uvularia*) **Colchicaceae**
    58. Flowers in (1–)2–9(–15)-flowered axillary inflorescences; perianth parts fused nearly to tips; fruit a blue-black berry _____ (*Polygonatum*) **Convallariaceae**

56. Inflorescences at the tip of the aerial scape or stem, with 1–very numerous flowers per inflorescence; plant with leaves all or mostly basal (except stems leafy in *Maianthemum,* which has flowers 50–250 per inflorescence).
    59. Flower solitary; leaves 2 _____ (*Erythronium*) **Liliaceae**
    59. Flowers in racemes, corymbs, or panicles; leaves more than 2.
        60. Tepals connate for ca. 1/2 or more of their length, forming a basal tube.
            61. Perianth wrinkled and roughened externally (appearing mealy or farinose); plant from a short thick rhizome _____ (*Aletris*) **Nartheciaceae**
            61. Perianth smooth externally; plant from a bulb _____ **Hyacinthaceae**
        60. Tepals separate or nearly so.
            62. Stem leafy, the 5-13 conspicuous leaves alternate along most of the stem, the stems without a cluster of basal leaves; tepals < 2 mm long _____ (*Maianthemum*) **Convallariaceae**
            62. Stem essentially without leaves, the leaves all basal or at least mostly so; tepals 2.3–17 mm long.
                63. Tepals adnate in their lower portions to ovary; ovary with 1 style _____ (*Ophiopogon*) **Convallariaceae**
                63. Tepals free from ovary; ovary with 1 OR 3 styles.
                    64. Ovary with 3 styles, these distinct (= separate to base) or connate basally (in 1 species); plants from rhizomes or bulbs.
                        65. Pedicels each with 3 minute connate bracts just below the flower (and well above pedicel base); styles connate basally into column 1/4–2/3 their length; scape minutely glandular-pubescent below inflorescence _____ (*Triantha*) **Tofieldiaceae**
                        65. Pedicels without 3 minute connate bracts just below the flower (bracts various, typically at pedicel base); styles distinct; scape not glandular-pubescent (either glabrous or floccose pubescent) _____ **Melanthiaceae**
                    64. Ovary with only 1 style (however, the stigma can be 3-lobed); plants from bulbs or corms but never rhizomes.
                        66. Perianth yellow to yellow-orange, (7.5–)10–15(–17) mm long; plants from corms _____ (*Echeandia*) **Anthericaceae**
                        66. Perianth white, greenish white, light blue, blue-violet, or yellow, but if yellow only 4.5–7 mm long; plants from bulbs _____ **Hyacinthaceae**



Cypripedium kentuckiense

Ferns and Similar Plants (Pteridophytes)

Although ferns and similar seedless vascular plants (those reproducing by spores) were formerly lumped together as Division Pteridophyta, they are here segregated into four separate divisions (Equisetophyta, Lycopodiophyta, Psilophyta, and Polypodiophyta) to reflect the great diversity among these ancient plant groups. Thus, the group Pteridophyta is no longer formally recognized. Together, the four divisions have nearly 10,000 species (Wagner & Smith 1993), with some authorities indicating as many as 12,000 species (e.g., Hoshizaki & Moran 2001). The Psilophyta, a very small division of 4–8 species, is recognized as distinct by some authorities, while included in the Polypodiophyta (ferns) by others (see discussion under Psilophyta). Likewise, members of the Equisetophyta are sometimes classified as ferns (see discussion under Equisetophyta). While there are considerable differences between the various groups of ferns and similar plants, molecular and morphological analyses indicate that all living vascular plants (ferns and similar plants, gymnosperms, and flowering plants) represent a monophyletic lineage (Doyle 1998; Pryer et al. 2001). Ferns and similar plants (sometimes called "fern allies") dominated the extensive swamps of the Carboniferous Period (360–286 million years ago). Over geologic time, the compressed ancient remains of the plants from these swamps became coal (Hoshizaki & Moran 2001). For a Key to Ferns and Similar Plants see page 309.

REFERENCES: Thieret 1980; Tryon & Tryon 1982; Lellinger 1985; Snyder & Bruce 1986; Kramer & Green 1990; Wagner & Smith 1993; Hasebe et al. 1995; Manhart 1995; Kenrick & Crane 1997; Doyle 1998; Nauman et al. 2000; Nelson 2000; Hoshizaki & Moran 2001; Pryer et al. 2001; Moran 2004.

DIVISION **Psilophyta**
WHISK-FERNS

The group is represented by a single very small family of spore-bearing plants. Psilophyta lack roots (instead they have rhizomes with absorptive rhizoids and mycorrhizal fungi), have dichotomous branching, and in the East TX species have only small, veinless, scale-like outgrowths (= enations) on the stems (these are often not considered to be true leaves). This lack of true roots and leaves makes them morphologically the least complex of all terrestrial vascular plants. The structure of Psilophyta thus resembles (at least superficially) that of some of the earliest land plants (Mabberley 1997), and the group has traditionally been linked to the earliest known vascular plants from the Silurian and Devonian periods—e.g., the fossil genus *Rhynia* (Woodland 1997). Alternatively, it has been suggested (e.g., Bierhorst 1977; Judd et al. 2002) that the simple morphology of Psilophyta may instead be the result of reduction from an ancestral fern, possibly in association with mycotrophy (= obtaining food from decaying organic material via a special relationship with a symbiotic fungus). A number of molecular studies (e.g., Manhart 1995; Wolf 1997; Vangerow et al. 1999) have linked Psilophyta with the eusporangiate fern family Ophioglossaceae (*Botrychium* and *Ophioglossum*), which is usually considered the most isolated and basal among the modern plants normally classified as ferns (Wagner 1990). Since these molecular studies are based on several different data sets, this is a particularly intriguing connection that needs further study. However, other molecular, chemical, and morphological data are ambiguous (Cooper-Driver 1977; Wallace & Markham 1978; Gottlieb et al. 1990; Pryer et al. 1995), and Wolf (1997) noted that "there is no consensus on the relationships of Psilotaceae to other vascular plants." Further, based on a cladistic analysis using morphological characters, Rothwell (1999) concluded that a link between ferns and Psilophyta was not supported. However, the most recent phylogenetic research (Pryer et al. 2001), based on molecular

data from four different genes and morphology, strongly supports the link of Psilophyta with the Ophioglossaceae and suggests its inclusion within the Polypodiophyta (ferns). As a result, many pteridologists (e.g., Moran 2004) now consider the Psilotaceae to be a family of ferns. Nonetheless, because the group differs from all ferns and similar plants in many characters (Kaplan 1977; Wagner 1977), and until there is a clearer understanding of the evolutionary relationships of Psilophyta, we are tentatively following a number of authors who continue to recognize the group as a separate division (e.g., Wagner & Smith 1993; Woodland 1997). *Psilotum nudum* is the only species in the division known to occur in North America.

PSILOTACEAE Eichler
WHISK-FERN FAMILY

A very small family (2 genera, 4–8 species) found worldwide in tropical regions (Thieret 1993) and extending to warm areas. The genus *Tmesipteris* occurs from se Asia to Australia, New Zealand, and some Polynesian islands.

Family recognition in the field: the only species in the flora is a dichotomously branched, leafless, spore-bearing perennial with green photosynthetic stems 0.5 m or less tall.

REFERENCES: Bierhorst 1977; Cooper-Driver 1977; Gensel 1977; Kaplan 1977; Wagner 1977; White 1977; Kramer 1990a; Thieret 1993; Manhart 1995; Pryer et al. 1995; Wolf 1997; Vangerow et al. 1999; Rothwell 1999; Schneider & Carlquist 2000a; Pryer et al. 2001.

PSILOTUM Sw. WHISK-FERN, FORK-FERN

A genus of 2 or 3 species (Thieret 1993) with leafless, green, photosynthetic stems. The common name, whisk-fern, comes from the much-branched leafless stems which give the plant the appearance of a whisk broom. (Greek: *psilos*, naked, smooth, or bare, either in reference to the leafless stems or to the "naked" sporangia which are not covered by indusia)

REFERENCES: Correll 1960; Lodwick 1975.

Psilotum nudum (L.) P. Beauv., (bare, naked), whisk-fern. Terrestrial, sometimes epiphytic perennial with coral-like, short-creeping, rhizoid-bearing, branched rhizomes; roots absent (but rhizoids absorptive); aerial shoots erect to ascending, to 25(–50) cm tall (greenhouse material often more robust), photosynthetic, dichotomously branched 3–5 times, 3(–several)-ridged; stem appendages (= enations) veinless, scale-like, minute, 0.7–3 mm long; leaves absent; spores all of 1 kind (plants thus homosporous), produced in sporangia, these fused in groups of (2–)3 to form ± globose, (2–)3-lobed synangia; synangia 2–3 mm wide, solitary in axils of minute shoot appendages; gametophytes subterranean, with mycorrhizal fungi; chromosome number variable, n = 46–56, 104, 210 (Thieret 1993). Low woods, swamps, wet areas, wet peaty humus, and around bases of trees and stumps; Hardin Co. in s part of Pineywoods (TEX, Correll 1960—this collection from the Big Thicket was the first in the state; Lance Rosier led Correll to the location) and Freestone Co. in the Post Oak Savannah (TEX; Lodwick 1975); se U.S. from NC s to FL w to AR and TX, also AZ. Sporulating summer. [*Lycopodium nudum* L.] Grown as an ornamental in some areas, particularly Japan (Hyam & Pankhurst 1995); it can be a minor weed in greenhouses (Thieret 1993). Although extremely rare in TX, in some areas of the U.S. (e.g., FL) it can appear as a weed. The species can be epiphytic in situations such as on tree bases, stumps, old logs, or tree forks with accumulated debris (Nauman et al. 2000; Nelson 2000). The whisk broom or "leafless twig" appearance of the whisk-fern is nearly unique among pteridophytes (Nelson 2000). While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), because of its limited distribution in the state, we consider this species to be of conservation concern in TX. The rare (and often transitory) occurrence of certain pteridophytes beyond the margins of their main range (e.g., *Psilotum* in TX) has sometimes been attributed to transport of spores by major storms or hurricanes (J. Peck, pers. comm.). ⚠

DIVISION **LYCOPODIOPHYTA**
CLUB-MOSSES, SPIKE-MOSSES, QUILLWORTS

A group of 1,200–1,250 species in 12–17 genera arranged in three families (Flora of North America Editorial Committee 1993). Members of all three families, Isoetaceae, Lycopodiaceae, and Selaginellaceae, occur in East Texas. Extinct members of this ancient division (e.g., Lepidodendrales—scale trees to 55 m tall) were dominants of the Carboniferous forests that formed present-day coal deposits. It is one of the oldest plant groups, dating to the Lower Devonian Period (408–360 million years ago) (Benson 1979; Bell & Woodcock 1983; Jones & Luchsinger 1986; Raven et al. 1986; Moran 2004). The Lycopodiophyta are characterized by microphylls (= leaves with a single vein), and the group is sometimes referred to as the Microphyllophyta (Woodland 1997). Chloroplast DNA data (Raubeson & Jansen 1992) show that the living Lycopodiophyta (*Lycopodium* sensu lato, *Selaginella*, and *Isoetes*) share with the bryophytes (mosses, liverworts, hornworts) a particular mutation in contrast to all other vascular plants. These data, other molecular studies, and morphological evidence all indicate that among living vascular plants the lycopsids are the basal lineage (Raubeson & Stein 1995; Kenrick & Crane 1997; Doyle 1998; Duff 2000; Pryer et al. 2001). However, the situation is not completely resolved since gene sequence data are ambiguous, with the Lycopodiophyta sometimes appearing polyphyletic (e.g., Manhart 1995; Boivin 1996; Wolf 1997).

REFERENCES: Benson 1979; Bell & Woodcock 1983; Jones & Luchsinger 1986; Raven et al. 1986; Snyder & Bruce 1986; Bold et al. 1987; DiMichele & Skog 1992; Wagner & Smith 1993; Raubeson & Jansen 1992; Raubeson & Stein 1995; Woodland 1997; Duff 2000.

ISOETACEAE Rchb.
QUILLWORT FAMILY

A monogeneric, nearly cosmopolitan family of ca. 150 species (Taylor et al. 1993). QUILLWORTS range from perennial evergreen aquatics to ephemeral terrestrials. They are superficially unlike other Lycopodiophyta, but as in other members of the division, the leaves have a single vein; ligules (= minute, tongue-like, basal protuberance on a leaf) are present as in the Selaginellaceae; spores are differentiated into microspores and megaspores. The long linear leaves have a resemblance to the quills of feathers formerly used as writing implements. This in combination with the Old English, *wort*, (from Anglo-Saxon: *wyrt*), an herb, root, or plant, gives rise to the common name.

FAMILY RECOGNITION IN THE FIELD: the two East TX species are tufted, wet area plants with a corm-like rootstock and hollow quill-like leaves, giving them the appearance of garden chives, tiny green onions, or small sterile spike-rushes; *sporangia are in the leaf bases.*

REFERENCES: Pfeiffer 1922; Correll 1949, 1956, 1966a; Jermy 1990a; Taylor et al. 1993.

ISOETES L. QUILLWORT

Plants tufted perennials, terrestrial or becoming so, superficially resembling garden chives (*Allium*, Alliaceae) or a sterile spike-rush (*Eleocharis*, Cyperaceae); rootstock corm-like, globose, 2-lobed, persisting after the leaves die back during hot dry weather; leaves quill-like, linear, hollow, tightly clustered together; sporangia solitary, embedded in broadened basal cavity of leaf with ligule inserted above, often partly covered by a velum (= thin flap of tissue); spores of 2 types (plant heterosporous), the megaspores often with faint wrinkles or tubercles, the microspores much smaller.

Species are often difficult to identify, sometimes requiring microscopic examination of spores, and interspecific hybrids are known. The spores are reported to be dispersed in the excreta

of earthworms. (Greek: *isos*, equal, and *etos*, year, referring to the evergreen habit of some species)

REFERENCES: Taylor et al. 1975; Taylor & Taylor 1981a; Boom 1982; Lott et al. 1982; Taylor & Hickey 1992; Heafner 1997; Duff 2000; Rydin & Wikström 2002.

1. Leaves dull green to gray-green or yellow-green, lax and twisted; outer surface of leaf bases white to tan or brown, not shiny; megaspores (0.36–)0.48–0.65 mm in diam.; species known in East TX only from Comal Co. near extreme w margin of area _____ **I. butleri**
1. Leaves bright green, erect and not or little twisted; outer surface of leaf bases usually black (sometimes brownish), shiny; megaspores 0.25–0.45 mm in diam.; species widespread in East TX ___ **I. melanopoda**

Isoetes butleri Engelm., (for George Dexter Butler, 1850–1910, lawyer, teacher, botanist, correspondent of George Engelmann), BUTLER'S QUILLWORT. Leaves to 15(–30) cm long, dull green to gray-green or yellow-green, not shiny; velum covering less than 1/4 of sporangium; megaspores white. Seasonally saturated soils, temporary or shallow pools, usually on calcareous soils, but also on sandstone or granite (in these cases there is probably a source of calcium nearby influencing pH—Lott et al. 1982); in East TX known only from Comal Co. (Turner et al. 2003) near extreme w margin of area; otherwise known in TX only from Llano Co. (Lott et al. 1982). Collections are known from se Oklahoma—Choctaw, Johnston, and McCurtain cos. (Taylor & Taylor 1981a) just across the Red River from ne TX; IL s to GA w to KS and TX. Spores mature in late spring. Taylor et al. (1993) indicated that the "leaves yellow, wither, and disappear by late spring." While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), because of its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

Isoetes melanopoda J. Gay & Durieu ex Durieu, (black-footed), BLACK-FOOTED QUILLWORT. Leaves to 40 cm long, usually blackish and shiny toward very base; velum covering less than 3/4 of sporangium; megaspores white. Seasonally saturated soils, temporary or shallow pools, often on sandstone or non-calcareous substrates; widely scattered in East TX; Pineywoods and n Gulf Prairies and Marshes w to Cross Timbers and Prairies and e Edwards Plateau; e U.S. from VA s to GA w to NE and TX, also MT and UT. Sporulating Mar–Oct.

Isoetes lithophila N. Pfeiff., (rock-loving), ROCK QUILLWORT, the only other *Isoetes* species in TX, occurs just to the w of East TX on granite or gneiss outcrops in Burnet (BRIT), Mason (TOES 1993), Gillespie (Poole et al. 2002), and Llano (Turner et al. 2003) cos. It can be distinguished from the two species above by its velum covering the entire sporangium, the gray to gray-brown megaspores, and the leaves not or slightly twisted and pale toward base. Endemic to TX (Kartesz 1999; Carr 2002b, 2002c). Sporulating Apr–Jun. (TOES 1993: V; RARE 2002a: G2S2SOC) ⚠

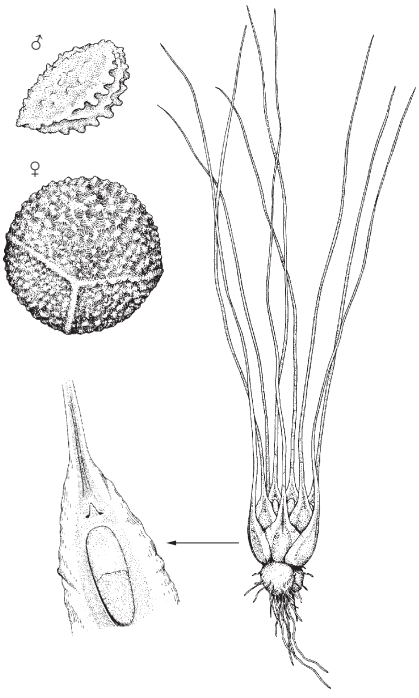
LYCOPODIACEAE P. Beauv. ex Mirb.
CLUB-MOSS FAMILY

Perennials with horizontal and upright shoots; roots produced along the horizontal shoots; leaves (= microphylls) numerous, small, with a single unbranched vein; upright shoots simple or branched, with terminal strobili (= cones); sporangia solitary per sporophyll (= spore-bearing leaf); spores all of 1 kind (plants homosporous).

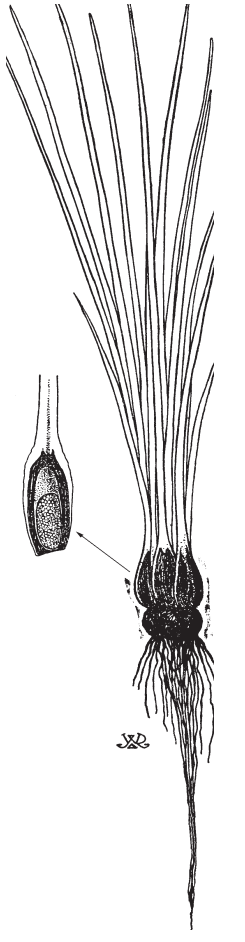
A diverse ancient family with a long fossil history dating to the late Paleozoic Era (Thomas 1992). It is cosmopolitan and contains 10–15 genera and ca. 350–400+ species (Wagner & Beitel 1993). They are terrestrial or epiphytic, evergreen, coarsely moss-like, vascular plants with scale- or needle-like leaves containing a single vein; ligules (= minute, tongue-like, basal protuberance on a leaf) are absent and spores are all of one type. The family "is widely regarded as a



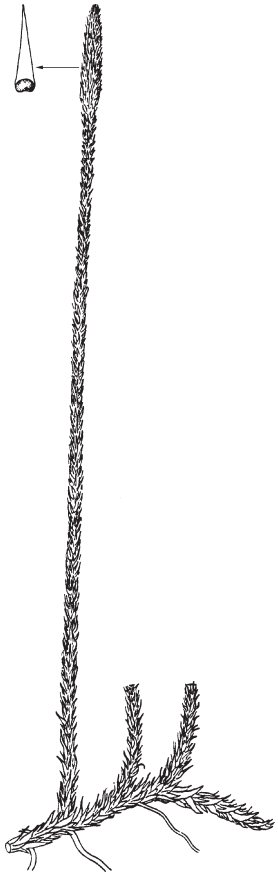
Psilotum nudum [KNO]



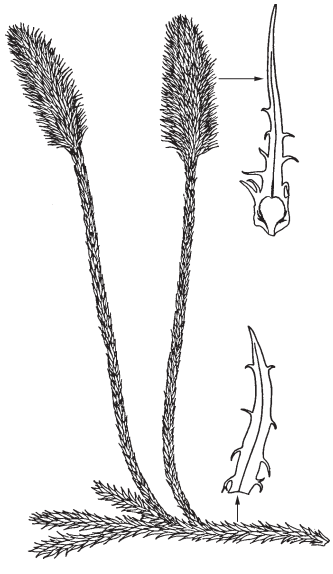
Isoetes butleri [TAY]



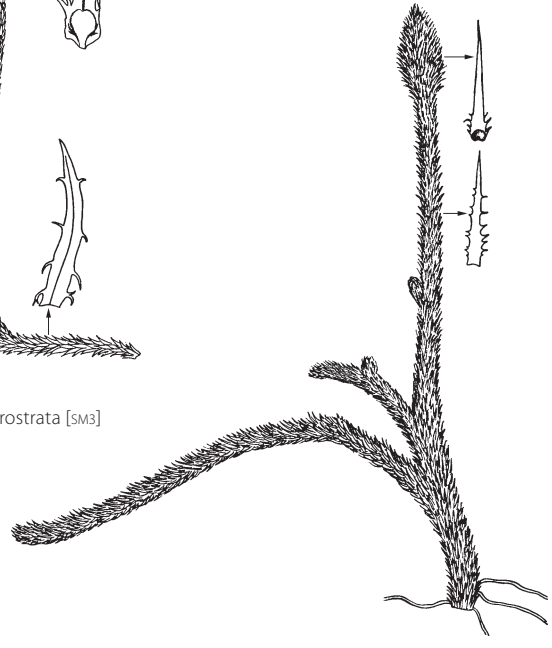
Isoetes melanopoda [LUN]



Lycopodiella appressa [LUN]



Lycopodiella prostrata [SM3]



Lycopodiella alopecuroides [LUN]

relict group, because living species bear a striking resemblance to early fossils and modern species diversity is low" (Wikström & Kenrick 2000). Many species were previously recognized in the large genus *Lycopodium*, which is now often divided into a number of segregate genera—three of these, *Lycopodiella*, *Palhinhaea*, and *Pseudolycopodiella*, are treated here. Some of these segregates are known to hybridize. Taxonomic opinion on the family differs, with Øllgaard (1987, 1992) recognizing only four genera. Certain species were in the past gathered for making Christmas wreaths, and in some areas (e.g., Appalachian Mts.) this resulted in populations being greatly reduced. The very flammable (due to presence of volatile oils) dust-like spores of some burn with a quick flash—as a result they were formerly used in fireworks, signal fires, for stage-lighting, and in photography as flash powder (Whitebread 1941; Jones & Luchsinger 1986). Also in the past, when pills were hand-made, the spores were used by pharmacists to coat pills and prevent them from sticking together. They were also once used as a powder on rubber surgical gloves, condoms, and suppositories, but they are considered dangerous for such uses (and have been replaced) because they can cause inflammation (Whitebread 1941; Hoshizaki & Moran 2001). Temperate species are reported to be difficult to cultivate, often requiring specific mycorrhizal fungi (Hoshizaki & Moran 2001). Family name from *Lycopodium*, CLUB-MOSS, now recognized as a mainly temperate and subarctic genus of 15–25 species (Wagner & Beitel 1993). (Greek: *lykos*, wolf, and *pous* or *podium*, foot, in reference to the resemblance of the branch tips of the type species *L. clavatum* L., to a wolf's paw, the numerous bristle-tipped leaves imparting a somewhat fur-like appearance—Moran 2004)

FAMILY RECOGNITION IN THE FIELD: evergreen, superficially somewhat moss-like herbs with stems covered by numerous, small, linear to linear-lanceolate or lanceolate, *1-veined leaves*; stems lying flat on the ground with upright shoots terminating in *cylindrical, spore-producing cones*.

REFERENCES: Correll 1949, 1956, 1966a; Holub 1983; Øllgaard 1987, 1990b; 1992; Thomas 1992; Wagner & Beitel 1992, 1993; Wikström & Kenrick 1997, 2000.

1. Upright shoots with many branches; strobili (= cones) many per shoot, nodding or pendant at the tips of the many branches _____ **Palhinhaea**
1. Upright shoots unbranched; strobili solitary per shoot, erect.
   2. Upright, unbranched shoots (serving as peduncles) with crowded leaves; horizontal stems lying flat on ground OR strongly arching; leaves of horizontal stems all ± the same size, neither spreading nor appearing 2-ranked _____ **Lycopodiella**
   2. Upright, unbranched shoots with only scattered, scale-like, subulate leaves; horizontal stems lying flat on ground; leaves of horizontal stems not all the same size, the lateral leaves larger than medial leaves, the lateral leaves spreading and appearing 2-ranked _____ **Pseudolycopodiella**

LYCOPODIELLA Holub BOG CLUB-MOSS

Plants perennial; horizontal stems evergreen at least at apex, prostrate or arching; leaves densely covering stems, linear to linear-lanceolate or lanceolate, entire to conspicuously toothed; upright, unbranched shoots (serving as peduncles) scattered along horizontal stems, densely leafy; strobili solitary, terminating peduncles; sporophylls appressed to wide-spreading, similar to but generally slightly longer than other leaves; sporangia globose or subglobose, solitary at base of upper side of sporophylls.

Lycopodiella has traditionally been treated as part of a more broadly defined *Lycopodium*. Molecular evidence, tentatively calibrated using fossils, places the split between *Lycopodium* and *Lycopodiella* during the early Jurassic Period (208 million years ago) (Wikström & Kenrick 2000), providing support for its recognition at the generic level. As treated here, *Lycopodiella* is a genus of 8–10 species of the n temperate region and tropical America (Wagner & Beitel 1993). Species of *Lycopodiella* hybridize readily and all possible hybrids (Thieret 1980; Wagner &

Beitel 1993) between the three East TX species are known from Texas: *L. alopecuroides* × *L. prostrata* (Jefferson Co.—TEX), *L. alopecuroides* × *L. appressa* (Jasper and Newton cos.—TEX), and *L. appressa* × *L. prostrata* (Jasper Co.—TEX; Snyder & Bruce 1986). (Name derived from the genus *Lycopodium* (Greek: *lykos*, wolf, and *pous* or *podium*, foot, in reference to the resemblance of the branch tips to a wolf's paw), plus the Latin diminutive suffix, *-ella*)
REFERENCES: Cranfill 1981; Øllgaard 1987; Wikström & Kenrick 2000.

1. Strobili 3–6(–9) mm wide (including leaves); sporophylls appressed; leaves of horizontal stems sparsely or not toothed; stems prostrate _____ **L. appressa**
1. Strobili 11–20 mm wide (including leaves); sporophylls usually ± spreading or wide-spreading; leaves of horizontal stems usually conspicuously toothed; stems prostrate OR strongly arching.
   2. Stems strongly arching, rooting at intervals; largest leaves on horizontal stems usually 0.5–0.7 mm wide; horizontal stems (excluding leaves) 2–4 mm in diam. _____ **L. alopecuroides**
   2. Stems prostrate, rooting throughout; largest leaves on horizontal stems usually 0.8–1.8 mm wide; horizontal stems (excluding leaves) 1–1.5 mm in diam. _____ **L. prostrata**

Lycopodiella alopecuroides (L.) Cranfill, (resembling *Alopecurus*, foxtail grass, apparently in reference to the resemblance of the strobili to the seed heads of that grass which superficially resembles a fox's tail), FOXTAIL BOG CLUB-MOSS, FOXTAIL CLUB-MOSS. Horizontal stems long-creeping, strongly arching, rooting at intervals, 2–4 mm in diam. (excluding leaves); leaves monomorphic, linear to linear-lanceolate, ca. 5–7 mm long, ca. 0.5–0.7 mm wide, with conspicuous marginal teeth, spreading to ascending; upright shoots unbranched, (6–)10–30(–45) cm tall, densely covered with leaves; strobili 2–6(–11) cm long, 11–20 mm wide; sporophylls wide-spreading. Wet places in savannahs, boggy areas in low open pinelands and seeps, in acidic soils; Hardin, Henderson, Jasper (BAYLU), Austin, Lamar, Newton, and Orange (Turner et al. 2003) cos., mainly Pineywoods; also Jefferson Co. in n Gulf Prairies and Marshes; e U.S. from NY s to FL w to AR and TX. Sporulating Jul–Nov. [*Lycopodium alopecuroides* L.] (TOES 1993: IV) ⚠

Lycopodiella appressa (Chapm.) Cranfill, (appressed or lying close, in reference to the appressed leaves), CHAPMAN'S CLUB-MOSS, SOUTHERN CLUB-MOSS, APPRESSED BOG CLUB-MOSS, TIGHT-LEAF CLUB-MOSS, SLENDER CLUB-MOSS, APPRESSED CLUB-MOSS, SOUTHERN APPRESSED CLUB-MOSS. Horizontal stems long-creeping, flat on ground, rooting throughout from lower surface, 1.5–2 mm in diam. (excluding leaves); leaves monomorphic, linear-lanceolate, ca. 5–7 mm long, ca. 0.8–1.2 mm wide, appressed, sparsely toothed or entire; upright shoots usually unbranched, 8–30(–40) cm tall, densely covered with leaves; strobili slender, ca. 2.5–7.5(–11) cm long, 3–6(–9) mm wide; sporophylls incurved, appressed. Depressions, bogs, moist areas; Pineywoods w to Austin, Henderson, Robertson (BRIT) Anderson, Leon (TAMU), and Wood (Turner et al. 2003) cos. in the Post Oak Savannah; also n Gulf Marshes and Prairies (Jefferson Co.—Turner et al. 2003); se Canada and e U.S. from ME s to FL w to KS and TX. Sporulating Jun-Oct. [*Lycopodium appressum* (Chapm.) F.E. Lloyd & Underw., *Lycopodium appressum* (Chapm.) F.E. Lloyd & Underw.] ⚅/291

Lycopodiella prostrata (R.M. Harper) Cranfill, (prostrate, in reference to the prostrate stems), CREEPING CLUB-MOSS, PROSTRATE BOG CLUB-MOSS, SOUTHERN CLUB-MOSS, FEATHER-STEM CLUB-MOSS. Horizontal stems long-creeping, flat on ground, essentially rooting throughout, 1–1.5 mm in diam. (excluding leaves); leaves linear-lanceolate, 3–8 mm long, 0.4–1.8 mm wide, with conspicuous marginal teeth, spreading, feathered into the horizontal plane, slightly dimorphic, those of the upper side slightly smaller (3–5 mm long); upright shoots usually unbranched, 15–35 cm tall, densely covered with leaves; strobili 4–8 cm long, 15–20 mm wide; sporophylls wide-spreading. Travis Co. (Correll 1956; Turner et al. 2003) near the w edge of the Blackland Prairie, also the range map in Wagner and Beitel (1993) indicates occurrence in the se part of the Pineywoods and the n part of the Gulf Prairies and Marshes; se U.S. from NC s to FL w to AR

and TX. Sporulating mainly summer–fall. [*Lycopodium alopecuroides* L. var. *pinnatum* (Chapm.) J. Lloyd & Underw. ex C.A. Br. & Correll, *Lycopodium inundatum* L. var. *pinnatum* Chapm., *Lycopodium prostratum* R.M. Harper] The Travis Co. site is significantly disjunct to the w from most of the range of the species. This species hybridizes with *L. alopecuroides* (Snyder & Bruce 1986) and has sometimes been lumped with it (Radford et al. 1968); however, most recent taxonomic treatments (e.g., Wagner & Beitel 1993; Nauman et al. 2000) recognize both species. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), because of its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

PALHINHAEA Vasc. & Franco NODDING CLUB-MOSS

Palhinhaea has traditionally been placed in a more broadly defined *Lycopodium* or by some authorities in *Lycopodiella* (e.g., Mabberley 1997; Wikström & Kenrick 2000). As treated here, following the treatment in *Flora of North America* (Wagner & Beitel 1993), *Palhinhaea* is a genus of 10–15 species, widespread mainly in the tropics and subtropics. (Named for Ruy Telles Palhinha, 1871–1950, Azores-born, Portuguese botanist)
REFERENCE: MacRoberts & MacRoberts 1995a.

Palhinhaea cernua (L.) Vasc. & Franco, (nodding, drooping, in reference to the drooping branch tips), NODDING CLUB-MOSS, STAG-HORN CLUB-MOSS. Plant overwintering as buried stem tips, the rest dying; horizontal stems branching, rooting where they touch the ground, with remote leaves; upright shoots to 45(–70) cm tall, many-branched (and resembling a miniature tree), with lateral branches drooping at tips; leaves linear-needle-like; strobili nodding, terminating branches, 4–8 mm long; sporophylls triangular-ovate, 1–2 mm long, coarsely toothed, wider than the sterile leaves; sporangia nearly globose, solitary at base of upper side of sporophylls. Hillside pitcher plant bog on wet but not inundated sand in full sun; Jasper Co. (Pineywoods) in the Angelina National Forest—known from two recently discovered plants and thus photographed but not collected (MacRoberts & MacRoberts 1995a; photos at TEX), Turner et al. (2003) also mapped Angelina and San Augustine cos.; se U.S. from SC s to FL w to AR and TX. Sporulating summer–fall. [*Lycopodiella cernua* (L.) Pic. Serm., *Lycopodium cernuum* L.] This species was previously known from the se U.S. w to LA; the TX location is ca. 125 km sw of the nearest known location in LA, and as such is the westernmost station for the species in the U.S. (MacRoberts & MacRoberts 1995a). This species, widespread in both the Old and New World tropics, is probably the world's most abundant CLUB-MOSS (Wagner & Beitel 1993). However, it is certainly one of the rarest native species in the East TX flora. It is easily distinguished by the many-branched upright shoots. The rare (and often transitory) occurrence of certain pteridophytes beyond the margins of their main range (e.g., *Palhinhaea cernua* in TX) has sometimes been attributed to transport of spores by major storms or hurricanes (J. Peck, pers. comm.). While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), because of its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

PSEUDOLYCOPODIELLA Holub BOG CLUB-MOSS

Pseudolycopodiella has traditionally been placed in a more broadly defined *Lycopodium* or by some authorities in *Lycopodiella* (e.g., Øllgaard 1987; Mabberley 1997; Wikström & Kenrick 2000). As treated here, following the treatment in *Flora of North America* (Wagner & Beitel 1993), *Pseudolycopodiella* is a widespread genus of 12 species, with only one species in North America. (Name derived from Greek: *pseudo*, false, and the genus *Lycopodium* (Greek: *lykos*, wolf, and *pous* or *podium*, foot; in reference to the resemblance of the branch tips to a wolf's paw), plus the Latin diminuative suffix, *-ella*)
REFERENCES: Bruce 1976; Holub 1983.

Pseudolycopodiella caroliniana (L.) Holub, (of Carolina, because its type specimen came from the "Carolinas," a region which historically included much of the se U.S.—Nelson 2000), slender bog club-moss, carolina club-moss, slender club-moss. Plant perennial; horizontal stems evergreen at least at apex, short-creeping, flat on ground, rooted throughout from lower surface, densely covered with leaves, 8–12 mm wide including leaves; horizontal stem leaves dimorphic, the lateral leaves spreading and appearing 2-ranked, lanceolate to lanceolate-ovate, 3.5–7 mm long, 1.2–2.1 mm wide, entire; median leaves smaller, ascending; upright shoots (serving as peduncles) unbranched, scattered along stems, 5–30 cm long, with only scattered, scale-like, subulate leaves; strobili solitary, terminating peduncles, slender, 9–80(–120) mm long, 2.5–5(–8) mm wide including sporophylls; sporophylls diverging, broadly ovate to deltate, acuminate, very different from the leaves of the peduncles; sporangia reniform (= kidney-shaped), solitary at base of upper side of sporophylls. Depressions in savannahs and open flat pinelands, in acidic soils, often with sphagnum moss; Angelina, Jasper, Tyler (BRIT), Hardin, Henderson (BAYLU), and San Augustine (TEX) cos. in s Pineywoods and Lee Co. (TEX) in the Post Oak Savannah; e U.S. from PA s to FL w to AR and TX. Sporulating Jul-Sep. [*Lycopodium carolinianum* L.] ⚅/296

SELAGINELLACEAE Willk.
SPIKE-MOSS FAMILY

An ancient, cosmopolitan but primarily tropical and subtropical family currently treated as a single genus with > 700 species (Valdespino 1993). According to Korall et al. (1999), "Greatest diversity occurs in lowland to midmontane primary tropical rain forest, but this cosmopolitan family is also widely distributed in subtropical, temperate, montane, and rarely subarctic regions." Selaginellaceae are usually terrestrial or epiphytic, superficially moss-like vascular plants bearing spores differentiated into microspores and megaspores (plants heterosporous). The leaves usually have a single vein and ligules (= minute, tongue-like basal protuberance on a leaf; the function is uncertain) are present. Recent molecular evidence supports the monophyly of the Selaginellaceae (Korall et al. 1999). This family is apparently only distantly related to the Lycopodiaceae and Isoetaceae.

FAMILY RECOGNITION IN THE FIELD: superficially somewhat moss-like, small herbs with numerous, scale-like, *1-veined leaves*; stems terminating in ± *4-angled, spore-producing cones.*

REFERENCES: Alston 1955; Correll 1956, 1966a; Jermy 1990b; Valdespino 1993; Korall et al. 1999.

SELAGINELLA P. Beauv. SPIKE-MOSS

East TX species small (ca. 12 cm or less tall), terrestrial or lithophytic (= growing on rocks) (plants epiphytic elsewhere); stems leafy; vegetative leaves small, with ligule on adaxial side near base, all alike or of 2 kinds; sporophylls (= spore-bearing leaves) modified, in strobili (= cones) at branch tips; sporangia solitary in axils of sporophylls, of 2 kinds (microsporangia and megasporangia).

[AAA]*Selaginella,* the only extant genus in the family, has an extremely long history in the fossil record—fossils resembling *Selaginella* are known from the Carboniferous Period onwards (Thomas 1992). It is currently most diverse in the tropics. A number have xerophytic (= drought tolerance) adaptations and some are well known as "resurrection" plants, capable of reviving after long periods of desiccation. Because of its heterogeneity, some authorities (e.g., Skoda 1997) recommend splitting *Selaginella* into several genera. Small (1938), for example, separated *S. apoda* and similar species into the genus *Diplostachyum*, and Thomas (1992) argued that, "The presence of both isophyllous and heterophyllous *Selaginella*-like plants in the Carboniferous [ca. 300 million years ago] supports the idea that the genus should be divided into at least two genera." However, splitting the genus would require name changes for all but two species (i.e., hundreds of name changes—J. Peck, pers. comm.), and we are following most recent authors

(e.g., Valdespino 1993; Korall et al. 1999) who continue treating all species in a single genus. Tropical species are known for their unusually colored leaves—reddish or bronze or iridescent blue-green (Hoshizaki & Moran 2001). (From *Selago*, an ancient name for *Lycopodium*, a genus resembling *Selaginella*, and the Latin diminutive suffix, *-ella*)
REFERENCES: Clausen 1946; Tryon 1955; Skoda 1997.

1. Plants of moist habitats, delicately thin-herbaceous; stem leaves not overlapping or only slightly so, in 4 ranks, 2 lateral and spreading, 2 smaller and appressed-ascending along the upper surface of the stem; under surface of the stem easily visible; plants annual _____ **S. apoda**
1. Plants of xeric habitats, rather rigid; stem leaves crowded, conspicuously overlapping, appressed to stem, not in 4 distinct ranks; surface of the stems not visible (concealed by leaves completely surrounding the stem); plants perennial _____ **S. arenicola**

Selaginella apoda (L.) Spring var. **apoda**, (footless, in reference to the prostrate habit), MEADOW SPIKE-MOSS, BASKET SELAGINELLA. Plant prostrate-creeping or ascending, often forming mats; leaves of 2 distinct kinds; lateral leaves ovate to ovate-elliptic, asymmetrical, ca. 1.35–2.25 mm long, 0.75–1.35 mm wide; appressed-ascending leaves smaller, to ca. 1.2(–1.6) mm long; strobili solitary or paired, obscurely quadrangular (= 4-sided)-flattened, 0.5–2 cm long; 2–4 mm in diam.; sporophylls apically acute to acuminate. Moist areas, low fields and woods; widespread in e TX w to Hays (BRIT), Lamar (Carr 1994), Bexar, Comal, Ellis, and Travis (Turner et al. 2003) cos., mainly Pineywoods and Post Oak Savannah and extreme w edge of East TX adjacent to the Edwards Plateau; also Gulf Prairies and Marshes and e Edwards Plateau; e U.S. from ME s to FL w to IL, OK, and TX. Sporulating May–Dec. A new variety of *S. apoda*, var. *ludoviciana* (A. Braun) B.F. Hansen & Wunderlin (based on *S. ludoviciana* (A. Braun) A. Braun), was recently named from the Gulf coastal plain (Hansen & Wunderlin 1998). This variety, which differs in minor ways (e.g., hyaline leaf margins) from var. *apoda*, is known from GA, FL, AL, MS, and se LA. ⊠/298

Selaginella arenicola Underw. subsp. **riddellii** (Van Eselt.) R.M. Tryon, (sp.: growing in sandy places or sand dweller; subsp.: for J.L. Riddell, 1807–1865, botanist), RIDDELL'S SELAGINELLA, RIDDELL'S SPIKE-MOSS. Vegetative part of plant erect to ascending, forming clumps, to ca. 12 cm tall, usually smaller; leaves essentially of 1 kind, narrowly triangular-lanceolate to linear-lanceolate, ca. 1.2–3 mm long, 0.4–0.5 mm wide, marginally ciliate, apically with whitish bristle; strobili solitary, sometimes with apical vegetative growth, quadrangular, ascending, (0.5–)1–3(–3.5) cm long and ca. 1.2 mm in diam.; sporophylls often with a bristle. Rocky areas, sandy or gravelly soils, longleaf pine sand ridges; widespread in East TX; e 1/3 of TX w to e Edwards Plateau; AL, AR, GA, LA, OK, and TX. Sporulating throughout the year. [*S. riddellii* Van Eselt.] There has long been disagreement over the taxonomy of *S. arenicola*. Tryon (1955) recognized three subspecies, while other authors (e.g., Clausen 1946; Snyder & Bruce 1986) treated the three taxa as separate species. Valdespino (1993) recognized two species in the complex, but maintained subsp. *riddellii* as a subspecies of *S. arenicola*. Nauman et al. (2000), did not recognize infraspecific taxa. Until further study is done, we are following Valdespino (1993) who treated all of the taxa occurring in North America.

Selaginella peruviana (J. Milde) Hieron., (of Peru, the species ranging to South America), PERUVIAN SPIKE-MOSS, [*S. sheldonii* Maxon], occurs just w of East TX (Burnet Co.—TEX, also Comanche Co.—Stanford 1971); Edwards Plateau and Trans-Pecos; NM, OK, and TX. It can be distinguished from *S. arenicola* subsp. *riddellii* as follows:

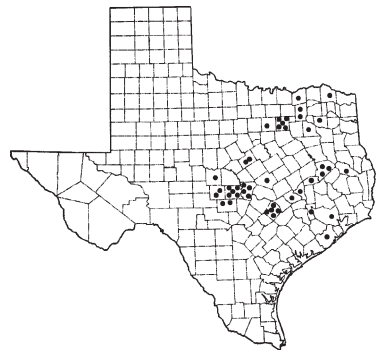
1. Vegetative part of plant erect to ascending; leaves not curving upward, the leaf-covered stems therefore appearing radially symmetrical _____ *S. arenicola*
1. Vegetative part of plant ± prostrate; leaves curving upward making the views of the leaf-covered stems from above and below distinctly different _____ *S. peruviana*



Psilotum nudum



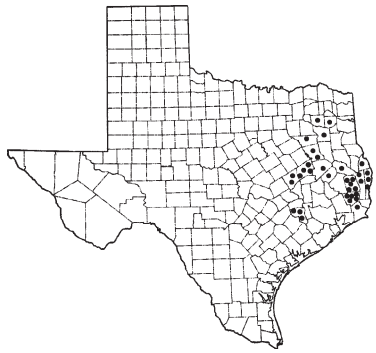
Isoetes butleri



Isoetes melanopoda



Lycopodiella alopecuroides



Lycopodiella appressa



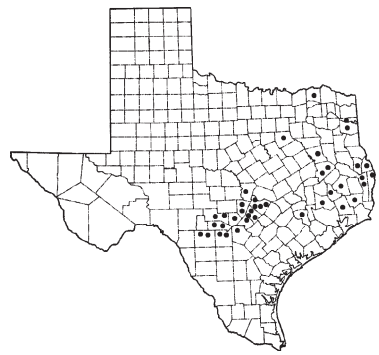
Lycopodiella prostrata



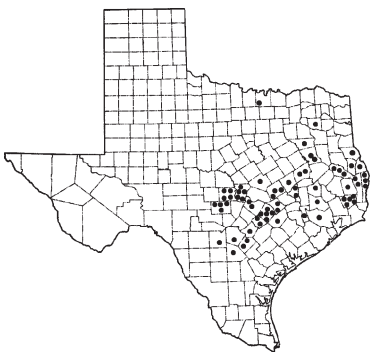
Palhinhaea cernua



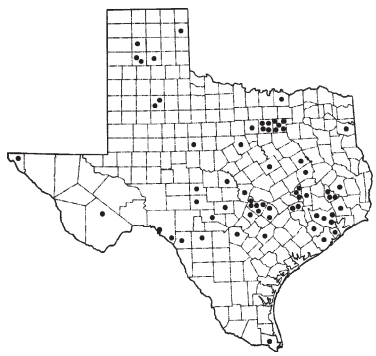
Pseudolycopodiella caroliniana



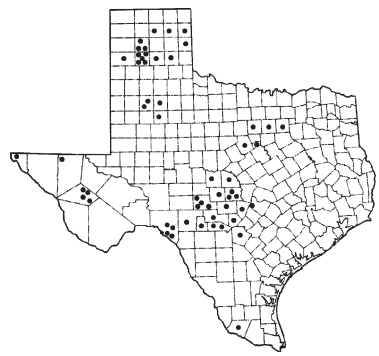
Selaginella apoda var. apoda



Selaginella arenicola subsp. riddellii



Equisetum hyemale subsp. affine



Equisetum laevigatum

DIVISION **EQUISETOPHYTA**
HORSETAILS

This is a very ancient group consisting of a single extant family. Fossil forms date to the Devonian Period (408–360 million years ago), and the division reached its maximum diversity and abundance in the Paleozoic Era. They were components of the Carboniferous Period's (360–286 million years ago) swamp forests that formed present-day coal deposits; some reached the proportions of trees (to 18 m tall) and were probably competitors of the tree Lycopodiophyta. The largest living species is the tropical *Equisetum giganteum* L., which may exceed 5 m in height (Bell & Woodcock 1983; Raven et al. 1986; Bold et al. 1987). The division is sometimes referred to as the Arthrophyta (Woodland 1997) or the Sphenophyta (Raven et al. 1986). The morphologically distinct Equisetophyta are characterized by whorled microphylls (= leaves with a single vein) and hollow, jointed, green stems. Some species have numerous small branches and bear a slight resemblance to a horse's tail—this, however, is not the true derivation of the common or scientific names as is often thought (note derivation of scientific name discussed in the generic synopsis of *Equisetum*). The evolutionary relationships of the group have been unclear, with recognition as a division reflecting the extreme morphological distinctiveness of *Equisetum*. However, recent phylogenetic studies indicate that *Equisetum* is embedded within the ferns, perhaps mostly closely related to the Marattiales (an ancient order extending back 340 mya, and often considered to be the second most basal group of living living ferns) (Pryer et al. 2001; Moran 2004). However, because of their morphological distinctiveness, and until this relationship is confirmed, we are tentatively following traditional treatments and recognizing the Equisetophyta as a separate division.

REFERENCES: Bell & Woodcock 1983; Raven et al. 1986; Bold et al. 1987; Wagner & Smith 1993; Woodland 1997; Pryer et al. 2001.

EQUISETACEAE Michx. ex DC.
HORSETAIL FAMILY

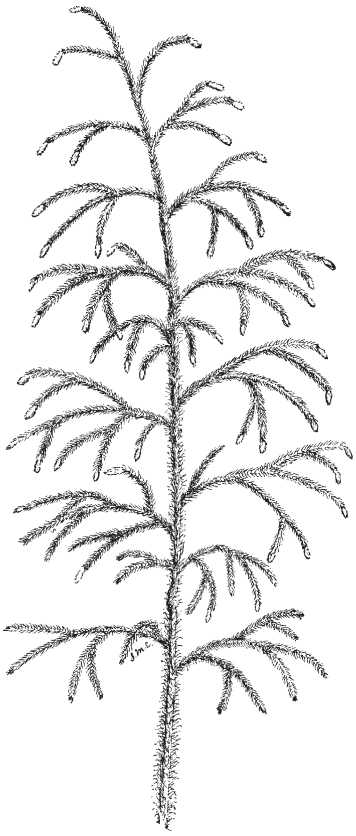
The family is represented in the modern world only by the distinctive genus Equisetum. It contains ca. 15 species (Hauke 1993) and is nearly cosmopolitan, being absent only from Australia and New Zealand (Hoshizaki & Moran 2001). While most botanists accept only a single genus (e.g., Hauke 1993), some (e.g., Skoda 1997) would segregrate a number of species into the genus Hippochaete. That genus, more commonly recognized as subgenus Hippochaete (SCOURING-RUSHES), is distinguished by its sunken stomates, versus stomates flush with the epidermis in subgenus Equisetum (HORSETAILS) (Hauke 1963, 1993; Skoda 1997). Both East TX species are in subgenus Hippochaete.

FAMILY RECOGNITION IN THE FIELD: plant body consisting primarily of hollow, jointed, green stems; leaves inconspicuous, scale-like, in whorls at the very distinct nodes; sporangia in small, terminal cones.

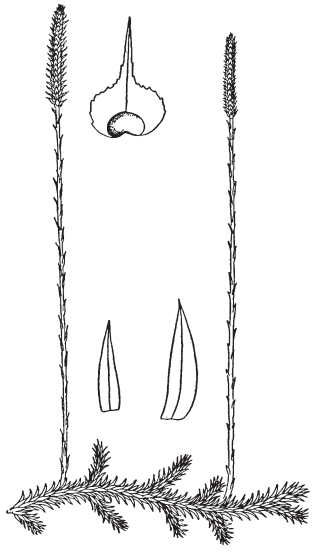
REFERENCES: Correll 1949, 1956, 1966a; Skoda 1997, Hauke 1960, 1963, 1978, 1990, 1993; Guillon 2004.

EQUISETUM L. HORSETAIL, SCOURING-RUSH

Plants perennial, rhizomatous; stems hollow in center, with a series of smaller canals, jointed with very distinct nodes, ridged, green and photosynthetic, usually unbranched (in East TX species) but some lateral branches forming if the apex is injured; leaves small, inconspicuous, whorled, scale-like, fused into sheaths surrounding the nodes but with tips free and tooth-like; sporangia on the undersurface of peltate sporophylls arranged in discrete terminal strobili (= cones); spores of 1 kind (plant homosporous).



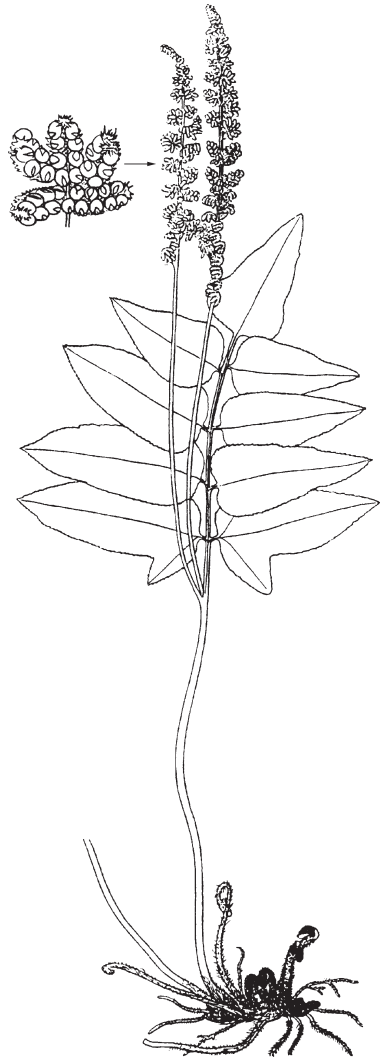
Palhinhaea cernua [CLU]



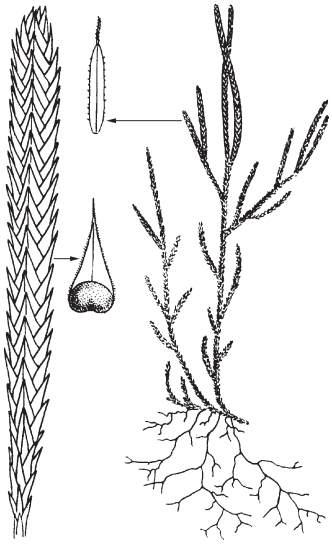
Pseudolycopodiella caroliniana [SM3]



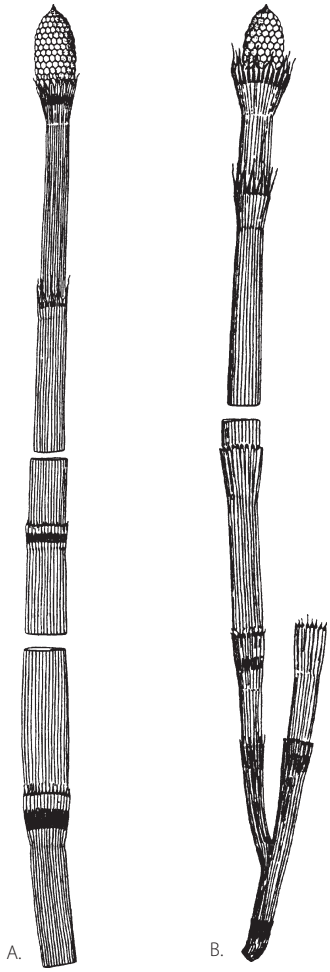
Selaginella apoda [LUN]



Anemia mexicana [LUN]



Selaginella arenicola subsp. riddellii [LUN]



A. Equisetum hyemale subsp. affine [LUN]
B. Equisetum laevigatum [LUN]

The coarse, somewhat abrasive stems contain silica and were used by early settlers to scour pots and pans (Woodland 1997)—hence the common name. While the common name, HORSETAIL, is sometimes said to be derived from species (in other geographic regions) with whorled branches, in reference to their bushy appearance (Hoshizaki & Moran 2001), it is actually derived from a translation of the scientific name, which refers to the roots (see below). ☠ Some species contain alkaloids or other toxins such as thiaminase, an enzyme that destroys thiamine and causes Vitamin B_1 deficiency; they can be poisonous to livestock (particularly horses) when included in hay. The condition produced, which includes neurological symptoms such as loss of muscular control, trembling, and staggering, has been referred to as equisetosis (Kingsbury 1964; Burlage 1968; Fuller & McClintock 1986; Weathers 1998; Burrows & Tyrl 2001). Species of *Equisetum* are sometimes difficult to distinguish due to several factors—variability within species, the fact that one plant may look quite different when grown under different environmental conditions, and frequent hybridization between species (Hauke 1963). *Equisetum* is often used in Japan in flower arrangements (Hoshizaki & Moran 2001). (Latin: *equis*, horse, and *seta*, bristle, referring to the coarse black roots of *E. fluviatile* L.—Hauke 1993)

1. Sheaths (= fused leaves) dark-girdled at most nodes of stem (in addition to thin dark line at sheath apex where teeth are shed), ashy-gray to brownish above girdle; aerial stems usually persisting more than one year; cone apex pointed; teeth of sheaths promptly shed OR persistent _____ **E. hyemale**
1. Most sheaths green, with only a thin dark line at sheath apex where teeth are shed, only some near stem base dark-girdled; aerial stems lasting less than a year, occasionally overwintering; cone apex rounded to pointed; teeth of sheaths promptly shed _____ **E. laevigatum**

Equisetum hyemale L. subsp. **affine** (Engelm.) Calder & R.L. Taylor, (sp.: of winter, in reference to the evergreen habit; subsp.: related), TALL SCOURING-RUSH, AMERICAN SCOURING-RUSH, COMMON SCOURING-RUSH, GREAT SCOURING-RUSH, ROUGH HORSETAIL, WINTER SCOURING-RUSH, CAÑUELA. Stems 18–220 cm tall; leaves 14–50 per node (number evident as teeth of sheaths). Stream banks, wet places, seepage areas, often forming large colonies; widespread from Pineywoods w nearly throughout TX; throughout Canada and the entire U.S. Sporulating Mar–late fall. [*E. hyemale* L. var. *affine* (Engelm.) A.A. Eaton, *E. prealtum* Raf.] Poisonous (Burlage 1968; Burrows & Tyrl 2001). ☠ ⚅/286

Equisetum laevigatum A. Braun, (smooth), SMOOTH HORSETAIL, SMOOTH SCOURING-RUSH, BRAUN'S SCOURING-RUSH, KANSAS HORSETAIL, KANSAS SCOURING-RUSH, SUMMER SCOURING-RUSH, COLA DE CABALLO, CAÑUELA. Stems 20–150 cm tall; leaves 10–32 per node. Dallas, Harris, Travis (BRIT), Brazos, Liberty, Robertson, Walker, Washington (TAMU), Bexar (Turner et al. 2003), and Waller (Correll 1956) cos.; widely scattered in TX; s Canada and through much of U.S. except ne and se. Sporulating May–Jul. [*E. kansanum* J.F. Schaffn.] Poisonous (Burlage 1968; Burrows & Tyrl 2001). ☠

These two species are often very difficult to distinguish in East TX and seem to intergrade. According to Hauke (1963, 1993), we are within the range of *E.* ×*ferrissii* Clute, FERRISS' SCOURING-RUSH, a hybrid between *E. hyemale* and *E. laevigatum*. Hauke (1960, 1993) distinguished *E.* ×*ferrissii* from the two parental species (with greenish spherical spores) by its white misshapen spores and cones which fail to open.

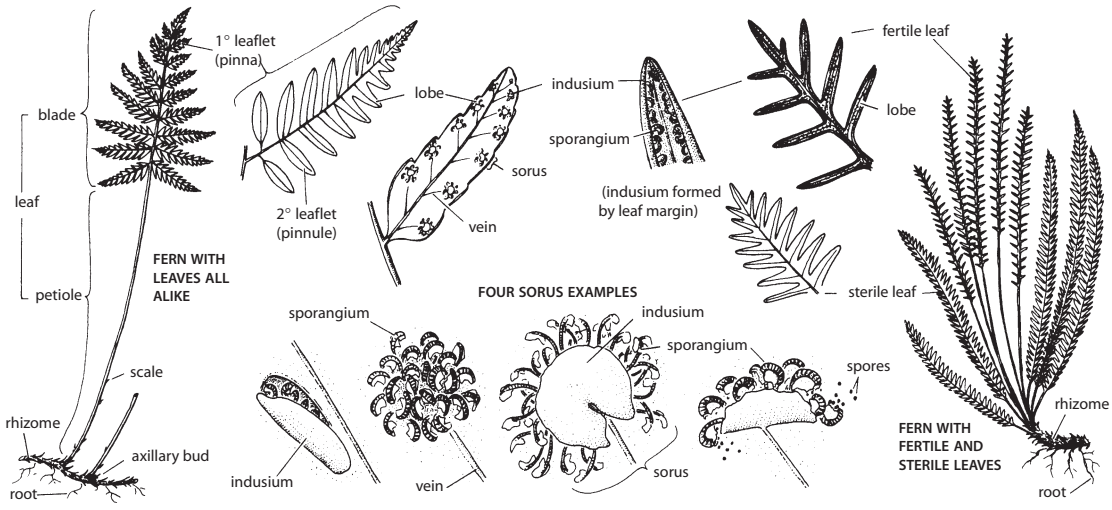
DIVISION **POLYPODIOPHYTA**
FERNS

A group of 8,550–10,000 species in 223 genera arranged in 33 families (Mabberley 1997; Schneider et al. 2004b). The fossil record of ferns dates to the Carboniferous Period (360–286 million years ago), and related groups occurred as early as the Devonian Period (408–360 mil-

lion years ago). While ferns are an ancient group and some individual living species have extremely long fossil histories (see further discussion under *Osmunda*), recent molecular evidence suggests that the polypod ferns, which make up > 80% of living fern species, diversified in the Cretaceous (145–65 mya) Period, possibly as a result of ecological opportunities associated with the rise of the angiosperms—e.g., modern polypods thrive in the low light conditions of angiosperm forests (Schneider et al. 2004b). The leaves of ferns are megaphylls (= with branched veins) which apparently are derived from modified branch systems; spores are of one type (plants homosporous—most living ferns) or two (plants heterosporous—Azollaceae, Marsileaceae, and Salviniaceae). Modern species range from tree ferns (to 24 m tall) to free-floating aquatics, but are mostly rhizomatous perennial herbs. The group is also referred to as the Filicophyta or the Pterophyta (Bell & Woodcock 1983; Raven et al. 1986). The ferns have traditionally been divided into a eusporangiate group and a leptosporangiate group. The eusporangiate ferns, consisting of only two families, the Ophioglossaceae and the Marattiaceae, have large thick-walled sporangia, each containing from several hundred to thousands of spores and have the sporangia developing from several initial cells. These plants are apparently only distantly related to all other ferns (see discussion under Ophioglossaceae). The leptosporangiate group (the rest of the ferns) have small delicate sporangia, each usually containing 128 spores or fewer and have the sporangia developing from a single cell or a small group of cells (Jones & Luchsinger 1986; Camus 1990; Wagner 1990; Doyle 1998). Recent phylogenetic research (Pryer et al. 2001) suggests that both the Psilophyta and Equisetophyta are derived from within the ferns. The word fern is "adapted from the Anglo-Saxon *fearn* and the German *farn* with a lineage that goes back to the Sanskrit *parna*, which originally meant a wing or feather" (Durant 1976). For a Key to Ferns and Similar Plants see page 309.

REFERENCES: Bush 1903; Reverchon 1903; Small 1938; Correll 1949, 1956, 1966a; Jermy et al. 1973; Thieret 1980; Tryon & Tryon 1982; Bell & Woodcock 1983; Taylor 1984; Lellinger 1985; Raven et al. 1986; Bold et al. 1987; Flora of North America Editorial Committee 1993; Wagner & Smith 1993; Peck & Taylor 1995; Pryer et al. 1995; Raubeson & Stein 1995; Smith 1995; Nauman et al. 2000; Nelson 2000; Hoshizaki & Moran 2001; Schneider et al. 2004b.

GENERAL CHARACTERISTICS OF THE FERNS [JEP]



ANEMIACEAE Link
ANEMIA OR FLOWERING FERN FAMILY

A family of 2 genera and ca. 119–124 species (Mickel 1993; Roux 1995) widespread in the tropics and subtropics, with most species in *Anemia*. The family is sometimes lumped with the Schizaeaceae (e.g., Kramer 1990f). *Mohria*, the other genus, with only 7 species (Roux 1995), is restricted to Africa, Madagascar, and Réunion Island; it includes *M. caffrorum* (L.) Desv. (FRANKINCENSE FERN), a cultivated ornamental with scented fronds. The common name, FLOWERING FERN, is said to be used because the fertile structures of some species are "held erect above the sterile fronds, and are conspicuously covered with yellow to golden brown sporangia which can be quite showy ..." (Nelson 2000).

FAMILY RECOGNITION IN THE FIELD: the single local species has 6 1-pinnate leaves with 2 conspicuously different types of pinnae: 4–6 pairs of sterile pinnae and below these a pair of *very long-stalked*, bipinnate, fertile pinnae.

REFERENCE: Mickel 1993.

ANEMIA Sw. FLOWERING FERN, PINELAND FERN

A genus of 117 species of tropical and subtropical regions of the world, especially Brazil and Mexico; only 3 species occur in the U.S.—2 in FL and 1 in TX (Mickel 1993). *Anemia* is sometimes placed in the Schizaeaceae (Kartesz 1994); however, we are following Mickel (1993—*Flora of North America*) and Kartesz (1999) in placing it in the Anemiaceae. (Greek: *aneimon*, without clothing or naked, referring to the absence of blade protection for the sporangia, the fertile pinnae lacking blade tissue or nearly so)

REFERENCES: Correll 1956, 1966a; Mickel 1981, 1982; Carlquist & Schneider 1998.

Anemia mexicana Klotzsch, (Mexican), MEXICAN FERN. Plant terrestrial or on rocks, to ca. 50 cm tall; stems (rhizomes) short-creeping, horizontal, covered with coarse dark hairs; leaves 1-pinnate (except for fertile pinnae), partially dimorphic, with 4–6 pairs of sterile pinnae distally and with the lowermost pair of pinnae (fertile) highly modified and extremely different in appearance; fertile pinnae bipinnate, with only a minute amount of blade tissue, very long-stalked, to 30 cm long, usually exceeding the sterile portion of the leaf in length; sterile pinnae trianglar-ovate to lanceolate, basally truncate, apically subobtuse to acute or acuminate, marginally serrulate, the lowermost sterile pinnae often lobulate; sporangia in 2 rows on ultimate segments (= smallest subdivisions) of fertile pinnae; indusia absent. Limestone outcrops, rocky slopes, banks of ravines; found primarily on limestone outcrops on the Edwards Plateau e and n to Bexar (BAYLU), Hays (TAES), Comal (Turner et al. 2003), and Travis (BRIT) cos. near the sw margin of East TX, also Austin Co. in se Blackland Prairie (Correll 1956); in the U.S. known only from TX (also n Mexico). Sporulating Feb–Oct.

ASPLENIACEAE Mett. ex A.B. Frank
SPLEENWORT FAMILY

A cosmopolitan family of ca. 700 species (Wagner et al. 1993) with centers of diversity in the Appalachians, Central American mts., Andes, and Himalayas. While all species are often treated as members of a single diverse genus *Asplenium* (e.g., Wagner et al. 1993 and as done here), other authorities cite molecular and anatomical evidence supporting a division of the family into two genera, *Asplenium* and *Hymenoasplenium* (Schneider 1997; Murakami et al. 1999).

FAMILY RECOGNITION IN THE FIELD: leaves 1-pinnate, all alike or the fertile slightly smaller; *sori elongate* along the veins; indusia attached along one side of the sori.

REFERENCES: Kramer & Viane 1990; Wagner et al. 1993; Schneider 1997; Murakami et al. 1999; Schneider et al. 2004a.

ASPLENIUM L. SPLEENWORT

East TX species terrestrial or on rocks; stems (rhizomes) short-creeping to erect; leaves clustered, 1-pinnate, monomorphic or slightly dimorphic, mostly evergreen; pinnae auricled basally, the auricle on the acroscopic side (= side toward the leaf apex) of the pinnae; sori elongate along veins; indusia attached along one edge of the sori.

A large and diverse, cosmopolitan genus of ca. 700 species (following Wagner et al. 1993) of terrestrial, epipetric (= on rocks), and epiphytic species. This is one of the largest genera of ferns, and the species range in size from those with leaves only a few centimeters long to the giant BIRD'S-NEST FERNS, with leaves more than 1 m long (Hoshizaki & Moran 2001). The genus is well known for its interspecific hybridization and complex polyploid series with numerous allopolyploids. Ploidy levels range from diploid to hexaploid, and three-fifths of the species are thought to be of hybrid, allopolyploid origin. A number of species are cultivated as ornamentals (e.g., *A. nidus* L.—BIRD'S-NEST FERN). (Greek: *splen*, spleen; thought by Dioscorides, Greek naturalist of the first century A.D., to be useful for treating spleen diseases)
REFERENCES: Wagner 1954; Correll 1956, 1966a; Wagner & Johnson 1981, 1983.

1. Pinnae (leaflets) usually alternate, with their basal auricles overlapping the rachis, their margins subentire to deeply serrate or incised; plants terrestrial or growing on rocks; leaves slightly dimorphic, the fertile erect, the sterile smaller and spreading _____ **A. platyneuron**
1. Pinnae opposite, usually not overlapping the rachis, their margins subentire to crenulate; plants usually growing on rocks; leaves monomorphic, all fertile, erect or ascending _____ **A. resiliens**

Asplenium platyneuron (L.) Britton, Sterns, & Poggenb., (broad-nerved, apparently based on an inaccurate early drawing—Nelson 2000), EBONY SPLEENWORT, BROWN-STEM SPLEENWORT, INDIAN-HAIR FERN. Leaves to 50 cm tall; leaf blades linear-lanceolate to narrowly elliptic-lanceolate in outline; petiole and rachis usually reddish brown to dark brown (rarely nearly black), shining. Sandy, moist, wooded banks and slopes, or on rocks; Pineywoods and Gulf Prairies and Marshes w to West Cross Timbers; se Canada and throughout e U.S. w to MN and AZ. Sporulating Apr–Dec. [*A. platyneuron* var. *bacculum-rubrum* (Fernald) Fernald] Two varieties are sometimes recognized in this species (e.g., Kartesz 1999). However, we are following Wagner and Johnson (1983), Wagner et al. (1993) and Yatskievych (1999) in not recognizing infraspecific taxa. According to Correll (1956), "... this is one of the commonest woodland ferns occurring in eastern Texas. It may be found not only as a solitary plant but also in extensive stands." Wagner et al. (1993) indicated that this species "... is remarkable in that it occurs in southern Africa as well as in North America. No other North American fern has this distribution." The species is also unusual in possessing trophopods; these modified petiole bases accumulate food reserves and persist after withering of the leaf blade (Wagner & Johnson 1981, 1983; Nauman et al. 2000). /276

Asplenium resiliens Kunze, (resilient, springing or bending back), LITTLE EBONY SPLEENWORT, BLACK-STEM SPLEENWORT. Leaves to ca. 35 cm tall, the blades linear-oblong to linear-lanceolate in outline, usually more coriaceous than in *A. platyneuron*; petiole and rachis black, shining. Usually growing on rocks; Bell, Grayson, Travis (BRIT), Bexar (TAES), Angelina, Bastrop, Comal, Hays, Orange, and Williamson (Turner et al. 2003) cos.; widely scattered in TX but primarily w 2/3; across s 1/2 of U.S. from PA s to FL w to NV and AZ. Sporulating Apr–Nov. This species is apogamous (= a type of asexual reproduction that does not involve fertilization; the sporophyte is formed directly from the gametophyte without gamete production), an adaptation for xeric environments (J. Peck, pers. comm.).

AZOLLACEAE Wettst.
AZOLLA, MOSQUITO FERN, OR WATER FERN FAMILY

A cosmopolitan family of a single genus and only ca. 7 species (Lumpkin 1993) of floating aquatics (sometimes stranded on mud) with highly reduced vegetative morphology (Saunders & Fowler 1992). Because of their minute size and numerous leaves, the plants superficially resemble mosses or liverworts. The family is often included in the Salviniaceae, but according to Lumpkin (1993), the relationship is not close. Three families of heterosporous water ferns occur in East TX (Azollaceae—*Azolla*, Marsileaceae—*Marsilea*, *Pilularia*, and Salviniaceae—*Salvinia*). These groups are quite distinct morphologically, and traditionally the marsileaceous (*Marsilea* and *Pilularia*) and salviniaceous (*Azolla* and *Salvinia*) lines were considered to have evolved independently from different homosporous fern ancestors. However, based on recent morphological, fossil, and molecular evidence, all three living heterosporous water fern families appear to comprise a monophyletic group (Rothwell & Stockey 1994; Hasebe et al. 1995; Pryer 1999).
FAMILY RECOGNITION IN THE FIELD: tiny, moss- or liverwort-like, free-floating or mat-forming plants that sometimes form conspicuous velvet-like, green to red mats on the surface of quiet waters.
REFERENCES: Schneller 1990a; Lumpkin 1993.

AZOLLA Lam. WATER FERN, MOSQUITO FERN, FAIRY-MOSS

Plants small, free-floating or mat-forming, superficially resembling some mosses or liverworts, monoecious; stems prostrate; leaves minute, deeply bilobed, imbricate, deep green to reddish (under stress); sporocarps in the leaf axils, of two kinds, the megasporocarps with 1 megasporangium producing 1 megaspore, the microsporocarps with numerous microsporangia containing numerous microspores.

Azolla species are considered the world's smallest ferns (Moran 1997). The upper emergent leaf lobes are hollow and inhabited by a symbiotic nitrogen-fixing cyanobacterium (= blue-green bacterium), *Anabaena azollae* Strasb., that combines, or "fixes" atmospheric nitrogen with hydrogen to make ammonia, which can be utilized by the plants (Moore 1969; Shi & Hall 1988; Hoshizaki & Moran 2001). Because of the resulting nitrogen content, *Azolla* species have been widely used agriculturally as a fertilizer, and economically are considered the world's most valuable ferns. "Cultivating *Azolla* as an organic fertilizer for rice has been a centuries-old practice in China and Vietnam ..." (Moran 1997), dating back perhaps to the 11th century or even before. Wagner (1997) reviewed the extensive literature on the uses of *Azolla* (e.g, biofertilizer, animal feed, human food, medicine, water purifier). Because of these uses, particularly as a biofertilizer, *Azolla* is considered by some to be the world's most economically important fern (Moran 1997). The common name, MOSQUITO FERN, is said to be "due to the belief that its dense covering on the surfaces of ponds retards or prevents the growth of mosquitoes" (Nelson 2000). Their small size and difficult to observe microscopic characters (e.g., megaspores), can make species of *Azolla* extremely hard to identify (Hoshizaki & Moran 2001). The two species occurring in East TX are quite similar, frequently confused, and of uncertain taxonomic status. Detailed study throughout their entire ranges will be needed to determine if the two should continue to be recognized at the specific level or lumped into a single variable species. The following key to species is slightly modified from those in Lellinger (1985) and Lumpkin (1993). (Greek: *azo*, to dry, and *ollyo*, to kill, alluding to death from drought, in reference to its dependence on water)
REFERENCES: Svenson 1944, Correll 1956, 1966a; Moore 1969; Lumpkin and Plucknett 1980; Perkins et al. 1985; Moran 1997; Wagner (G.M.) 1997; Dickinson & Miller 1998.

1. Plants usually 0.5–1 cm long, dichotomously branched nearly throughout; megaspores not pitted, densely covered with tangled filaments (high magnification required; also note: plants infrequently fertile); leaves not or scarcely imbricate, the upper lobes usually 0.5–0.6 mm long _____ **A. caroliniana**

1. Plants usually 1–1.5 cm long, pinnately branched from a central axis, dichotomously branched only at periphery; megaspores pitted, sparsely covered with a few long filaments; leaves slightly to greatly imbricate, the upper lobes usually at least 0.7 mm long _____ **A. mexicana**

Azolla caroliniana Willd., (of Carolina), MOSQUITO FERN, WATER FERN, CAROLINA MOSQUITO FERN, EASTERN MOSQUITO FERN. Plant fertile only infrequently. Still water of ponds, lakes, or slow-moving streams or stranded on mud; sporadically but widely scattered in e 1/2 of TX (since this species has long been considered to be the only one in East TX, some records may be the result of confusion with *A. mexicana*—see discussion below); B.C., Ont., and e U.S. from NH s to FL w to SD and TX. Sporulating summer–fall. Scanning electron micrographs of the megaspore apparatus of this and the following species can be seen in Perkins et al. (1985) and Lumpkin (1993). Where found, this species is often abundant, and huge numbers of individuals can at certain times of the summer turn the surface of ponds a striking red color. Fertile specimens are rarely collected (Nauman et al. 2000). According to Correll (1956), "Its occurrence in remote locations is doubtless due to its dissemination, in part, by water-fowl." The species is commonly cultivated as an aquatic ornamental in aquaria and decorative pools (Lellinger 1985). /277

Azolla mexicana Schlect. & Cham. ex C. Presl, (of Mexico), MEXICAN MOSQUITO FERN. Similar to *A. caroliniana* and distinguished as in the key above; frequently fertile. Still waters; TX distribution unclear and no county distribution map is provided; included based on range map in Peck and Taylor (1995) showing this species nearly throughout AR, including immediately adjacent to the ne border of East TX, and on the range map in Lumpkin (1993) showing it in OK immediately adjacent to the n border of East TX; B.C. and widespread in c and w U.S. Sporulating summer–fall. While this species has not previously been considered to be in East TX, there has long been confusion between this and *A. caroliniana* (J. Peck, pers. comm.). Lumpkin (1993) also stressed that because of inconsistent characters used in the past to identify *Azolla* species, "Literature that attributes a particular species of *Azolla* to a particular state or province must be questioned. ..." Further work needs to be done to clarify the distribution of these two similar species in East TX. *Azolla mexicana* was erroneously reported to be "generally less cold tolerant" and to have "a narrower environmental range than *A. caroliniana*" (Lumpkin 1993), but it occurs in the upper Mississippi River northward to Minneapolis-St. Paul, MN. The species is occasionally cultivated (Lellinger 1985).

BLECHNACEAE (C. Presl) Copel.
CHAIN FERN, DEER FERN, OR MIDSORUS FERN FAMILY

A family of ca. 10 genera and ca. 250 species (Cranfill 1993b); it is mostly tropical and s temperate except for the n temperate *Woodwardia*. Family name from *Blechnum*, DEER FERN, a mostly tropical, especially s hemisphere genus of ca. 220 species. (Greek: *blechnon*, classical name for ferns in general)

FAMILY RECOGNITION IN THE FIELD: sori *discrete, linear-oblong,* in a *chain-like row* along each side of the midvein of a pinna or pinnule; indusia attached by their outer margin, opening toward midvein.

REFERENCES: Kramer et al. 1990a; Cranfill 1993b.

WOODWARDIA Sm. CHAIN FERN

Terrestrial; stems (rhizomes) in East TX species long-creeping, with leaves scattered along the stems; leaves monomorphic or dimorphic, deciduous, the blades 1-pinnatifid or 1-pinnate; sori discrete, linear-oblong, in a single chain-like row along each side of the midvein; indusia attached by their outer margin, opening on side next to midvein, often obscured by dehisced (= opened) sporangia.

A genus of 14 species of North America, Central America, Mediterranean Europe, and e Asia (Cranfill 1993b). Some authorities (e.g., Nelson 2000) attribute the name chain fern "to the conspicuous netted, chain-like areoles that parallel both sides of the mid-vein on the lower sides of the pinnae and most pinnules, and impart a distinctive, chain-like appearance to the sori. These 'chains' are easily seen without magnification, especially when held up to light ..." (Named for Thomas Jenkinson Woodward, 1745–1820, English botanist)
REFERENCES: Correll 1956, 1966a.

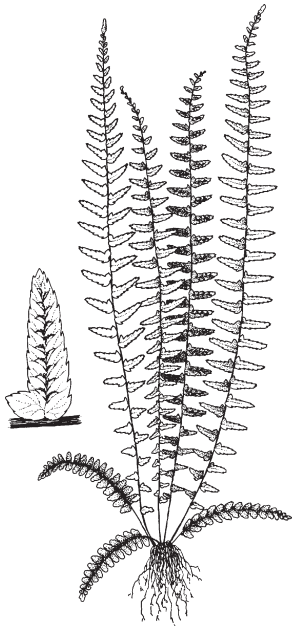
1. Leaves conspicuously dimorphic, the pinnae of fertile leaves contracted and linear in comparison with the much wider lanceolate pinnae of the sterile leaves; sterile blades 1-pinnatifid, with a wing of blade tissue several mm wide along much (at least upper half) of the rachis; pinnae themselves not pinnatifid, sometimes sinuate, the margins serrulate _____ **W. areolata**
1. Leaves monomorphic or nearly so, the pinnae of fertile and sterile leaves essentially the same; blades 1-pinnate, with no leaf tissue along the rachis; pinnae deeply pinnatifid with entire margins _____ **W. virginica**

Woodwardia areolata (L.) T. Moore, (with a network, checkered), NETTED CHAIN FERN, CHAIN FERN, NARROW-LEAF CHAIN FERN. Sterile leaves few, 40–58 cm long; pinnae of sterile leaves in 7–12 alternate pairs, 1–2.5 cm wide, the veins anastomosing into 2 or more rows of areoles (= small vein-enclosed areas) between midvein and margin; fertile blades with sori nearly completely covering surface of blade. Low, wet, usually sandy areas; Pineywoods and n Gulf Prairies and Marshes w to Fannin Co. (BRIT) in Red River drainage and Bastrop (Turner et al. 2003), Freestone (BAYLU), Milam, and Van Zandt (TAES) cos. near w margin of Post Oak Savannah; also n edge of Gulf Prairies and Marshes; e U.S. from NY s to FL w to IL, OK, and TX. Sporulating Mar–Nov. This species has sometimes been segregated into the genus *Lorinseria* [as *L. areolata* (L.) C. Presl]. The sterile leaves resemble those of *Onoclea* (subopposite pinnae with entire margins), except *W. areolata* usually has alternate pinnae with serrulate margins.

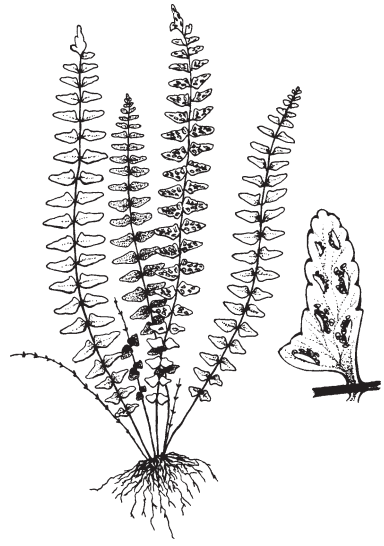
Woodwardia virginica (L.) Small, (of Virginia), VIRGINIA CHAIN FERN. Leaves numerous, 50–100 cm long; pinnae in 12–23 pairs, the middle pinnae 1–3.5 cm wide, the veins anastomosing to form a single row of areoles near midvein; rachis straw-colored, sometimes darkly so; sori covering only a small part of the blade surface. Low areas; Pineywoods and n edge of Gulf Prairies and Marshes w to Bastrop, Lee (TAMU), Gonzales (Turner et al. 2003), and Milam (Correll 1956) cos. on w margin of Post Oak Savannah; se Canada and e U.S. from ME s to FL w to IL, AR, and TX. Sporulating Apr–Dec. According to Nelson (2000), this species is sometimes "confused at a glance with *Osmunda cinnamomea*, with which it is sometimes found, but distinguished at some distance by the dark brown base of the petiole, mostly darker rachis, and by the fronds being well spaced rather than clump forming."

DENNSTAEDTIACEAE Lotsy
BRACKEN OR CUPLET FERN FAMILY

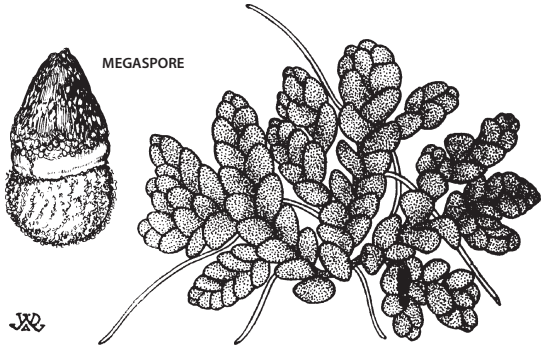
As currently recognized, the Dennstaedtiaceae is a cosmopolitan but mostly tropical family of ca. 20 genera and ca. 400 species (Cranfill 1993a). It has been variously circumscribed to include as few as 8 genera or in other cases nearly half the genera of higher ferns (Mickel 1973). Family name from *Dennstaedtia*, CUP FERN, a cosmopolitan but mostly tropical genus of ca. 70 species. (Named for August Wilhelm Dennstaedt, 1776–1826, German botanist, physician, and director of the Belvedere Garden)
FAMILY RECOGNITION IN THE FIELD: the single East TX species is a terrestrial plant with large leaves with 3 main divisions, each of these being 2-pinnate-pinnatifid; sori linear, *along margins* of the ultimate leaf segments (= smallest subdivisions of leaf) with the leaf *margins recurved* over sori to form a false indusium.
REFERENCES: Mickel 1973; Kramer 1990b; Cranfill 1993a; Wolf 1995.



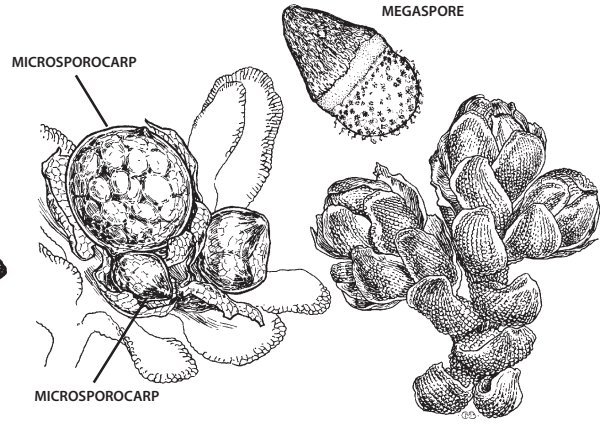
Asplenium platyneuron [YAT]



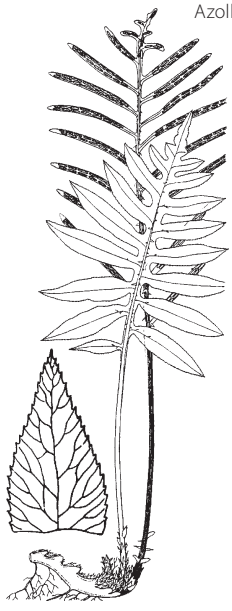
Asplenium resiliens [YAT]



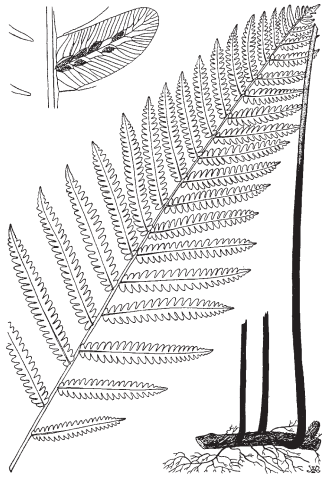
Azolla caroliniana [FNA, LUN]



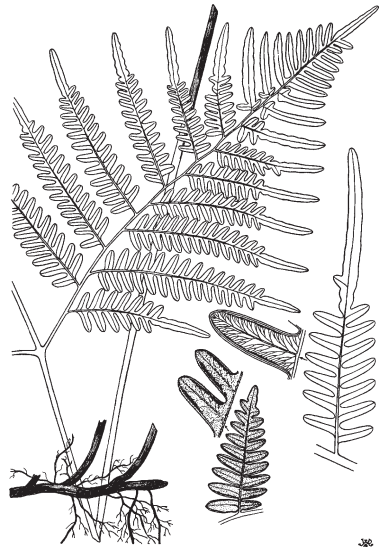
Azolla mexicana [FNA, MAS]



Woodwardia areolata [LUN]



Woodwardia virginica [LUN]



Pteridium aquilinum var. pseudocaudatum [LUN]

PTERIDIUM Gled. ex Scop. BRACKEN FERN

A monotypic, cosmopolitan genus (Jacobs & Peck 1993) sometimes placed in the Pteridaceae. *Pteridium* is treated here as a single species with 12 varieties in 2 subspecies (Tryon 1941; Tryon & Tryon 1982): subsp. *aquilinum* (including var. *pseudocaudatum*) and subsp. *caudatum* (L.) Bonap. Some authorities (Lellinger 1985; Mickel & Beitel 1988), however, recognize some of the infraspecific taxa as separate species. (Greek: *pteridon*, a small fern, from *pteron*, feather or wing, due to the shape of the leaves)

REFERENCES: Tryon 1941; Correll 1956, 1966a; Cooper-Driver 1976; Page 1976; Mickel & Beitel 1988; Jacobs & Peck 1993; Speer et al. 1998a[1999a], 1998b[1999b].

Pteridium aquilinum (L.) Kuhn var. **pseudocaudatum** (Clute) A. Heller, (sp.: eagle-like; var.: false-tailed), WESTERN BRACKEN FERN, PASTURE BRAKE, BRACKEN FERN. Terrestrial; stems (rhizomes) deeply buried, long-creeping; leaves monomorphic, deciduous, scattered along the stems, to 1 m or more tall; leaf blades glabrous or nearly so, broadly triangular to triangular-lanceolate in outline, usually of 3 main divisions, each division 2-pinnate-pinnatifid, the pinnae rigidly herbaceous to subcoriaceous; sori marginal, linear, continuous, covered by a false indusium formed by the recurved margin of the ultimate leaf segments (= smallest subdivisions of leaf) and an obscure inner, delicate, true indusium. Open woods, pastures, thickets, often in sandy soils; widespread in Pineywoods and n Gulf Prairies and Marshes w through Post Oak Savannah, also Red River drainage w to Grayson Co. (S. Crosthwaite, pers. comm.); s Canada and throughout most of the U.S. except NE. Sporulating Jun–Nov. This variable species, with numerous infraspecific taxa, is virtually worldwide in distribution and is the most widely distributed fern. It is considered by some to be the most widespread of all vascular plants (with the exception of a few annual weeds) (Page 1976). Its tenacity is shown by regeneration through several meters of volcanic ash on Mt. St. Helens in WA within 1–2 years of the volcanic eruption (Woodland 1997). The species has a deep rhizome, making it well-adapted to fire prone habitats and one of the first species to reappear following a fire (Nelson 2000). In some areas (e.g., British Isles) BRACKEN FERN is a problematic weed and the cause of "bracken staggers" or "bracken poisoning," a potentially fatal condition in livestock. Symptoms in livestock include a hemorrhagic syndrome, chronic hematuria ("red water"), bone marrow depression, fever, neurological symptoms and staggering, retinal degeneration ("bright blindness"), and cancer. Toxins reported include an enzyme, thiaminase, which can cause fatal thiamine (Vitamin B_1) deficiency in livestock, a glycoside (ptaquiloside—carcinogenic), and according to some sources, a cyanide-producing glycoside (prunasin). Ptaquiloside and possibly other carcinogens can be passed to humans via cow's milk. Human consumption (particularly in Japan) of the fiddleheads, which have high concentrations of ptaquiloside, has been suggested as a cause of stomach and esophagus cancer. Another interesting chemical defense employed by BRACKEN FERN is the production of phytoecdysones, a class of hormone-like compounds that disrupt ecdysis (= molting) in insects—insects eating the plant thus have their developmental sequence altered. BRACKEN FERN is also known to be allelopathic, with toxins leaching from the tissues adversely affecting surrounding plants (Mabberley 1987; Turner & Szczawinski 1991; Moran 1993a; Foster & Caras 1994; Weathers 1998; Bruneton 1999; Burrows & Tyrl 2001).

DRYOPTERIDACEAE Ching
WOOD FERN FAMILY

East TX species usually terrestrial or on rocks (*Nephrolepis* potentially epiphytic); leaves monomorphic or dimorphic; leaf blades 1-pinnatifid to 1–more-pinnate or pinnate-pinnatifid; sori on abaxial leaf surfaces on veins or vein tips, usually not marginal, or in berry-like or bead-like structures on fertile leaves conspicuously different from sterile leaves (*Onoclea*).

☙The family as broadly interpreted here follows Smith (1993b) and includes genera at times segregated into other families (e.g., *Athyrium, Nephrolepis, Onoclea, Woodsia*). It is cosmopolitan and has ca. 60 genera and ca. 3,000 species. Other authors (e.g., Lellinger 1985) have treated the family in a more restricted sense—32 genera and 850 species, with genera such as *Athyrium, Cystopteris, Onoclea*, and *Woodsia* segregated into the Woodsiaceae and *Nephrolepis* placed in the Davalliaceae. The family has sometimes been treated as the Aspidiaceae (an illegitimate name).

FAMILY RECOGNITION IN THE FIELD: sori in most species on veins or vein tips (usually not marginal) on lower leaf surfaces, or in *Onoclea* in berry-like or bead-like structures on fertile leaves conspicuously different from the sterile leaves; lower surfaces of leaf blades without transparent needle-like hairs (distinguishing this family from Thelypteridaceae which have such hairs); ultimate leaf segments (= smallest subdivisions of leaf) not entire.

REFERENCES: Correll 1956, 1966a; Kramer et al. 1990b; Smith 1993b; Sano et al. 2000.

1. Fertile and sterile leaves completely different; fertile leaves without typical blade tissue, the sori in berry-like or bead-like structures; sterile leaf blades 1-pinnatifid (deeply divided but not completely pinnate); rachis with a conspicuous flange of photosynthetic tissue _____ **Onoclea**
1. Fertile and sterile leaves or portions of leaves similar, the fertile portion never without blade tissue, the sori on blade tissue; leaf blades at least completely 1-pinnate, often more divided; rachis without a flange of photosynthetic tissue.
    2. Leaf blades only 1-pinnate, the pinnae themselves not further divided, neither pinnate nor pinnatifid (but large basal lobe(s) or auricles sometimes present on pinnae).
        3. Pinnae 1–2(–3) pairs in addition to a single terminal pinna (pinnae sometimes with large basal lobe(s) or auricles); plants primarily of the Edwards Plateau, in East TX known only from extreme w margin of area in Comal Co. _____ **Tectaria**
        3. Pinnae more than four pairs (usually many more) in addition to a single terminal pinna; plants widespread in East Texas.
            4. Pinnae ovate, conspicuously narrowed to an acuminate tip; fertile pinnae with sori scattered over whole lower surface (sometimes appearing as if in numerous rows) _____ **Cyrtomium**
            4. Pinnae ± oblong, ± parallel-sided (but often with a small basal auricle); fertile pinnae with sori in 2–4 distinct rows.
                5. Sori only on the uppermost, somewhat reduced, fertile pinnae (distal 1/3 to 1/2 of leaf); indusia orbicular, not at all kidney-shaped; pinnae margins with bristly teeth; stolons absent _____ **Polystichum**
                5. Sori not restricted to the uppermost pinnae, the fertile pinnae not reduced; indusia orbicular-kidney-shaped; pinnae margins without bristly teeth (small non-bristly teeth may be present); stolons present, wiry and widely creeping _____ **Nephrolepis**
    2. Leaf blades more than 1-pinnate, the pinnae themselves further divided, either pinnate or pinnatifid.
        6. Sori elongate, straight to hooked or curved; indusia with elongate attachment along one side, the attachment as long as the elongate sori _____ **Athyrium**
        6. Sori round or nearly so; indusia variously attached, but attachment not elongate.
            7. Leaf blades relatively large, 10–30 cm wide, 35–120 cm long; pinnules (= subdivisions of pinnae) of middle pinnae typically 5 mm or more wide at their bases, only shallowly toothed and thus not appearing subdivided; indusia attached at a narrow sinus, the round-kidney-shaped indusia usually obvious with the naked eye or at least with 10X magnification; petiole bases with 3 or more vascular bundles; plants rare in East TX _____ **Dryopteris**
            7. Leaf blades usually smaller, 3.5–10 cm wide, 8–40(–60) cm long; pinnules of middle pinnae typically less than 5 mm wide at their bases, at least some so deeply toothed or incised as to appear subdivided; indusia not attached at a narrow sinus (rather attached below sori and at first cup-like and completely enclosing sori, but later splitting into

several irregular lobes or flaps spreading around sori OR attached along one side of sori, hood- or pocket-like, arching over sori) (NOTE: indusia are often inconspicuous in mature sori); petiole bases with 2 vascular bundles; including plants widespread and common in East TX.

8. Petioles with scattered light brown scales and glandular pubescence, glabrate with age; indusia attached below sori and at first cup-like and completely enclosing sori, but later splitting into several irregular lobes or flaps spreading around sori (sometimes inconspicuous in mature sori); leaf blades usually broadest above the middle; veins of ultimate leaf segments (= smallest subdivisions of leaf) not reaching segment margins; rhizomes short, not protruding beyond attachment of current season's leaves; petiole bases persistent; plants widespread and common in East TX _____ **Woodsia**

8. Petioles glabrous except at very base; indusia attached by one side, hood- or pocket-like, arching over sori (sometimes inconspicuous in mature sori); leaf blades broadest at or below the middle; veins of ultimate leaf segments reaching segment margins; rhizomes long-creeping, protruding 1–5 cm beyond attachment of current season's leaves; petiole bases not persistent; plants rare in East TX _____ **Cystopteris**

ATHYRIUM Roth LADY FERN

A cosmopolitan genus of ca. 180 species (Kato 1993). Recent molecular data (Sano et al. 2000) suggest the genus is polyphyletic. (Greek: *athyros*, doorless; the sporangia only tardily push back the outer edge of the indusium)

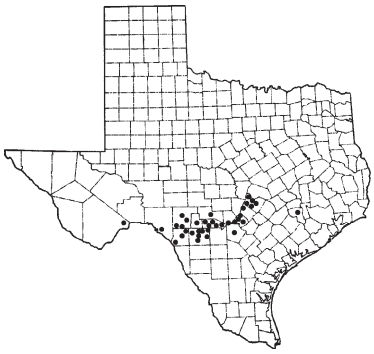
REFERENCES: Butters 1917a; Liew 1972; Kato 1993.

Athyrium filix-femina (L.) Roth subsp. **asplenioides** (Michx.) Hultén, (sp.: lady fern; subsp.: resembling *Asplenium*—spleenwort), SOUTHERN LADY FERN, LOWLAND LADY FERN, SPRING FERN. Stems (rhizomes) short-creeping; leaves monomorphic, deciduous, clustered, to 120 cm tall, 2-pinnate-pinnatifid (rarely sub-3-pinnate), the pinnae usually short-stalked; sori elongate, straight to hooked or curved, somewhat resembling those of *Asplenium*, in a single row on each side of the midvein, ca. midway between midvein and margin of ultimate leaf segments (= smallest subdivisions of leaf); indusia membranous, opening facing midvein. Moist woods, thickets, swamps, stream banks; Pineywoods and n Gulf Prairies and Marshes w through Post Oak Savannah to Williamson Co. (Correll 1956; Turner et al. 2003) in the Blackland Prairie and n to Red River (BRIT) and Bowie (BAYLU) cos.; e U.S. from NY s to FL w to KS and TX. Sporulating May–Nov. [*A. asplenioides* (Michx.) A.A. Eaton] This species is sometimes cultivated as an ornamental, and is said to be "one of the most dependable and often-used in fern gardening" (Nelson 2000). The cultivars are reported to be derived from the European variety, var. [subsp.] *filix-femina* (Hoshizaki & Moran 2001).

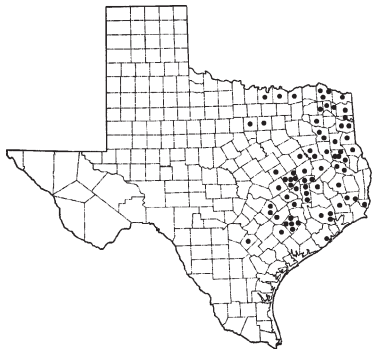
CYRTOMIUM C. Presl
HOLLY FERN, ASIATIC HOLLY FERN, NET-VEIN HOLLY FERN

A taxonomically difficult genus of ca. 15 species (Yatskievych 1993) mainly from Asia but also found in Africa, including Madagascar, and in the Hawaiian Islands. Some authorities treat it within *Polystichum* (e.g., Mabberley 1997), and according to Yatskievych (1993), it "might better be considered a subgenus of *Polystichum*, from which it is poorly differentiated morphologically." (Greek: *cyrtoma*, arch, in reference to the arched veins of some species)

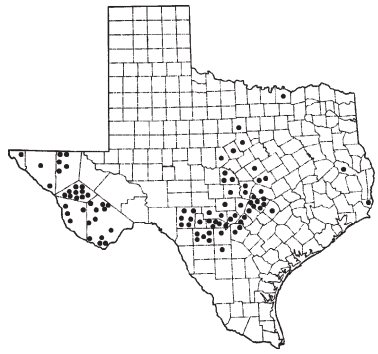
REFERENCES: Christensen 1930; Yatskievych 1993.



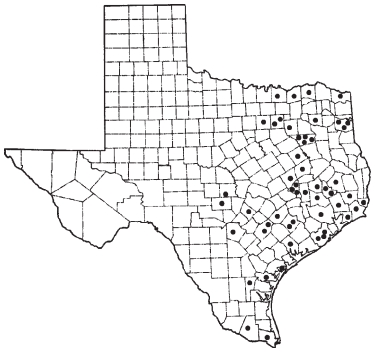
Anemia mexicana



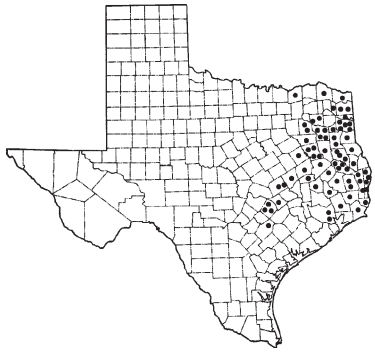
Asplenium platyneuron



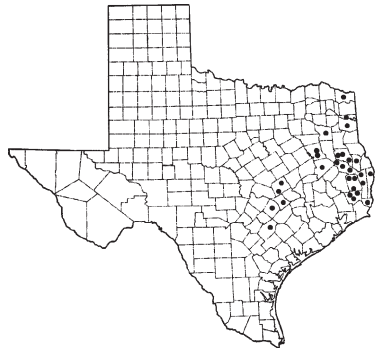
Asplenium resiliens



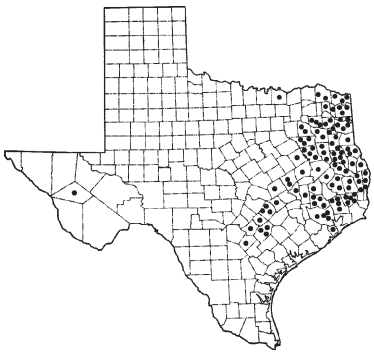
Azolla caroliniana



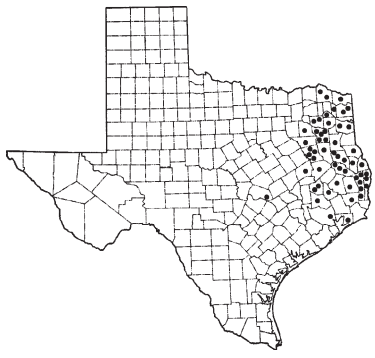
Woodwardia areolata



Woodwardia virginica



Pteridium aquilinum



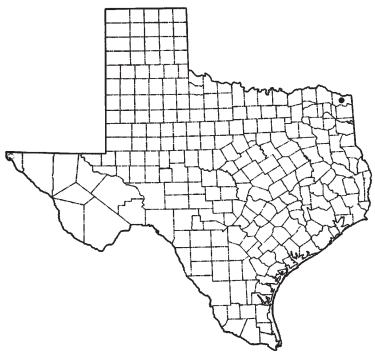
Athyrium filix-femina subsp. asplenioides



Cyrtomium falcatum



Cystopteris protrusa



Dryopteris celsa



Dryopteris ludoviciana

Cyrtomium falcatum (L.f.) C. Presl, (sickle-shaped, in reference to the curved pinnae), JAPANESE NET-VEIN HOLLY FERN, JAPANESE HOLLY FERN, HOUSE HOLLY FERN. Terrestrial or lithophytic; stems (rhizomes) short, stout, conspicuously scaly; leaves monomorphic, evergreen, 28–60(–100) cm long; leaf blades 1-pinnate, 15–35 cm long; pinnae short-stalked, 4–10(–12) pairs, 4–8.5(–11) cm long, 1.5–3 cm wide, obliquely ovate to lanceolate, usually falcate, sometimes with a short basal lobe, apically acuminate, undulate or irregularly and coarsely dentate marginally, bright green and shiny on adaxial (= upper) surface, leathery; petioles conspicuously scaly at least near base; sori round, conspicuous, scattered over whole abaxial (= lower) surface of pinnae (sometimes appearing to be in rows); indusia peltate. Widely cultivated and escaped; in the Pineywoods in Houston Co. (Davy Crockett Natl. Forest—*Stotts 38*, HPC) on remnant brick wall of old sawmill site and in San Jacinto Co. (*E. Keith 3*, BRIT) "growing out of the wall of a waterfall," also in the Post Oak Savannah on stream bank in Waller Co. (*E. McWilliams 1995-100*, BRIT) and on bluff in Burleson Co. (*Wilson s.n.*, TAMU), and near w margin of East TX in Hays Co. (*Carr 18255*, TEX) on limestone bluff; also Jefferson (BAYLU) and Harris (BRIT, TEX) cos. in n Gulf Prairies and Marshes and Tarrant Co. (Turner et al. 2003) in the Cross Timbers and Prairies; naturalized se U.S. from SC s to FL w to TX, also CA, NY, OH, OR, and VA. Sporulating spring–fall. Native of e Asia. [*Polypodium falcatum* L.f.] All U.S. plants appear to be apogamous triploids (Yatskievych 1993). This widely cultivated species is naturalized in many parts of the world (e.g., Australia, Azores, Great Britain), including various parts of the U.S. (Yatskievych 1993; Mabberley 1997). One of the most common cultivars is the ROCKFORD FERN (cv. 'Rockfordianum') (Hoshizaki & Moran 2001).

CYSTOPTERIS Bernh. BLADDER FERN, BRITTLE FERN

A cosmopolitan genus of ca. 20 species (Haufler et al. 1993). Polyploidy and hybridization are common in the genus and it is taxonomically difficult (Haufler et al. 1993). (Greek: *cystos*, bladder, and *pteris*, fern, in reference to the inflated young indusia covering the sori).
REFERENCES: Blasdell 1963; Haufler et al. 1985, 1993.

Cystopteris protrusa (Weatherby) Blasdell, (protruding, in reference to the stem apex extending beyond the point of leaf attachment), SOUTHERN BLADDER FERN, LOWLAND BLADDER FERN, LOWLAND BRITTLE FERN. Terrestrial; stems (rhizomes) long-creeping, protruding 1–5 cm beyond attachment of current season's leaves, with tan to light brown or golden scales and hairs; leaves appearing in early spring, clustered, seasonally somewhat dimorphic, erect to erect-spreading, to 45 cm long, the blades 1-pinnate-pinnatifid to 2-pinnate, ovate-lanceolate to elliptic, widest at or just below middle, to ca. 25 cm long and 12 cm wide; earliest leaves small, sterile, coarsely divided, with rounded teeth marginally; later leaves larger, fertile, more finely divided, with sharply pointed teeth marginally; sori round, on veins of ultimate leaf segments (= smallest subdivisions of leaf) between midvein and margin; indusia delicate, hood- or pocket-like, attached by one side, arching over sori toward segment margin, sometimes ephemeral or obscure at maturity. Moist deciduous forests; Gonzales Co. in the s Blackland Prairie (*H.B. Parks s.n.*, Jan 1939, TAES) (cited by Correll (1956) as *C. fragilis* var. *protusa*) and Harrison (*Ajilvsgi 4065*, BRIT—identified J. Peck) and Houston (Turner et al. 2003) cos. in the Pineywoods; also Edwards Co. (Devil's sink hole) (TAES) on the Edwards Plateau and Victoria Co. (Turner et al. 2003) in the Gulf Prairies and Marshes. *Cystopteris protrusa* is also known from McCurtain Co., OK, just n of the Red River (*Taylor & Taylor 28956*, BRIT). While the range map in Haufler et al. (1993) does not include TX and the species is apparently quite rare in the state, it is known from several TX localities; e U.S. from NH s to FL w to NE, OK, and TX (the TX populations are disjunct to the sw of most of the range of the species). Sporulating spring–summer. [*C. fragilis* (L.) Bernh. var. *protrusa* Weatherby] This species is very similar in general morphology to *Woodsia obtusa*, BLUNT-LOBE WOODSIA, a species that is much more common in East TX. The two can be distinguished by the indusia and other characters (e.g., whether veins reach leaf margins) as given in the key to genera of Dryopteridaceae. While not officially designated as such (e.g., TOES 1993;

Carr 2002d; Poole et al. 2002), because of its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

DRYOPTERIS Adans. WOOD FERN, SHIELD FERN

Plants terrestrial or on logs; rhizomes scaly; leaves 1-pinnate-pinnatifid, monomorphic to slightly dimorphic, the fertile leaves sometimes larger than the sterile leaves, the sterile leaves ± evergreen; pinnae with serrate segments; sori round, in a single row on each side of the midvein of the fertile segments, midway between midvein and margin; indusia round-reniform, attached at a narrow sinus.

A widely scattered but largely north temperate genus of ca. 250 species (Montgomery & Wagner 1993). A few occur in North America, but most are found in temperate Asia. Hybridization between species is common (Wagner 1970; Montgomery & Wagner 1993). The genus is widely cultivated in temperate gardens (Hoshizaki & Moran 2001). The n temperate *D. filix-mas* (L.) Schott, MALE FERN, is one of the oldest vermifuges (= a medicine that expels intestinal worms) known—it paralyzes tapeworms (which can then be removed) but is dangerous because it also paralyzes voluntary muscles of patients (Mabberley 1997). (Greek: *drys*, oak or tree, and *pteris*, fern; several species are associated with oak woodlands)

REFERENCES: Walker 1962; Wagner 1970; Thomas et al. 1973; Montgomery & Paulton 1981; Carlson & Wagner 1982; Montgomery 1982; Peck & Peck 1988; Fraser-Jenkins 1986; Werth et al. 1988; Montgomery & Wagner 1993; Hoshizaki & Wilson 1999; Peck 2000.

1. Segments of fertile pinnae nearly the same width as those of typical sterile pinnae, occupying distal 1/2 to nearly entire blade; teeth along segments of pinnae narrowed to a minute spine-like tip, often incurved (toward margin); species of extreme ne part of East TX _____ **D. celsa**
1. Segments of fertile pinnae distinctly narrower than those of typical sterile pinnae, occupying distal 1/3 to at most distal 1/2 of blade; teeth along segments of pinnae triangular, not incurved; species of se part of East TX _____ **D. ludoviciana**

Dryopteris celsa (W. Palmer) Knowlton, W. Palmer & Pollard, (held high, elevated), LOG FERN. Stems (rhizomes) short-creeping; petioles scaly at least at base; leaves ± evergreen; leaf blades 1-pinnate-pinnatifid, ovate-lanceolate, 22–80 cm long, the basal pinnae reduced; fertile pinnae in distal 1/2 of leaf blade to nearly the entire blade; segments of fertile pinnae nearly the same width as those of typical sterile pinnae, not more widely spaced. Rotting logs and piles of humus in swamps or seeps, acidic soils; included based on a 1925 Palmer collection (*29404*, MO, GH—Peck & Peck 1988) from Bowie Co. (cited in Correll 1956 and Correll & Johnston 1970 as *D. cristata)* in the extreme ne corner of e TX and the range map in Werth et al. (1988) showing ne TX; e U.S. from NY s to SC w to AR, MO, and TX, also MI. *Dryopteris cristata* (L.) A. Gray, CRESTED WOOD FERN, a circumboreal species of the ne U.S. and s Canada, was erroneously reported for TX (Correll 1956; Correll & Johnston 1970), but does not occur in the state (Thomas et al. 1973; Peck & Peck 1988; Peck 2000). Sporulating summer–fall. [*D. goldiana* (Hook. ex Goldie) A. Gray subsp. *celsa* W. Palmer] *Dryopteris celsa* is a fertile allotetraploid resulting from hybridization between *D. goldiana* (Hook. ex Goldie) A. Gray and *D. ludoviciana* (Walker 1962; Montgomery & Wagner 1993). It has been proposed that the two parent species, which no longer occur together, were pushed into contact by the climatic change accompanying glaciation (Taylor 1984). In various parts of its range, *D. celsa* is known to hybridize with six other species. The common name, LOG FERN, is derived from the tendency of the species to grow on logs or humus (Snyder & Bruce 1986). While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), because of its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

Dryopteris ludoviciana (Kunze) Small, (of Louisiana, where the species was first discovered), SOUTHERN WOOD FERN, LOUISIANA WOOD FERN. Stems (rhizomes) short-creeping, stout; petioles

scaly at base; leaves evergreen; leaf blades 1-pinnate-pinnatifid, lanceolate, 25–120 cm long, the basal pinnae much reduced; fertile pinnae in distal 1/2 of leaf blade; segments of fertile pinnae distinctly narrower than those of sterile pinnae, often more widely spaced, and sometimes contracted at base. Swamps and wet woods; Hardin (Watson, s.n. 1971, TEX—first confirmed collection for TX); Correll 1972a), Jasper (BRIT, TEX), and Polk (TEX) cos. in the Pineywoods. Correll (1956) said, "This species was reported by Reverchon (1903) as having been collected by J.M. Fetherolf in Newton County in the Timber Belt. It was also reported from Texas by Cory and Parks (1937). I have not seen any specimens of this species west of East Baton Rouge Parish, Louisiana." Correll (1972a) subsequently reported it for TX. This diploid species is endemic to the se U.S. (Montgomery & Wagner 1993), most collections being from the deep southeast with outliers in AR, LA, and TX. Sporulating spring–fall. [*Aspidium ludovicianum* Kunze; *Thelypteris ludoviciana* of authors] This species is reported to cross with *D. celsa* resulting in sterile hybrids (Werth et al. 1988; Montgomery & Wagner 1993). (TOES 1993: IV) ⚠

NEPHROLEPIS Schott BOSTON FERN, SWORD FERN

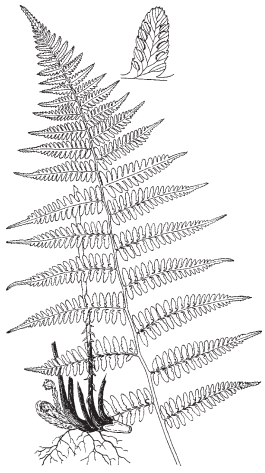
A genus of 25–30 species widespread in tropical areas (Nauman 1993c). *Nephrolepis* is sometimes placed in the Davalliaceae or Nephrolepidaceae (e.g., Kramer 1990d; Nauman et al. 2000). (Greek: *nephros*, kidney, and *lepis*, scale, in reference to the shape of the indusium)
REFERENCES: Nauman 1981, 1993c; Schneider & Carlquist 1999b.

Nephrolepis exaltata (L.) Schott, (very tall), SWORD FERN, BOSTON SWORD FERN, WILD BOSTON FERN. Stems (rhizomes) short, ± erect, with wiry, widely creeping stolons; leaves monomorphic, evergreen, clustered, 1-pinnate, usually 0.4–1.5 m long, the blades linear-lanceolate; sori roundish, somewhat closer to margin than to midvein of pinnae, the indusia ± orbicular-reniform. Escaped, persisting and spreading in yard in Highland Park, Dallas Co. (R. O'Kennon, pers. obs.), also Orange (BRIT), Nacogdoches (TAES), and Henderson (Turner et al. 2003) cos.; naturalized in several sites in East TX and on the Edwards Plateau; native to FL, the West Indies, and scattered Pacific Islands. Sporulating throughout most of the year (Correll 1956). This species is terrestrial or more often epiphytic in its native habitat. It is a commonly cultivated (particularly indoors) and commercially important fern with many cultivars including cv. 'Bostoniensis' (BOSTON FERN) and the locally developed DALLAS JEWEL FERN,™ commonly known as the DALLAS FERN. There is debate over the origin of the name BOSTON FERN, but it apparently originated in the late 1800s or early 1900s when plants of a particular form of *N. exaltata* became popular in nurseries in and around Boston, MA (Benedict 1916).

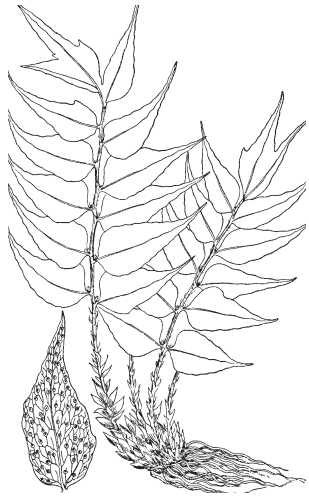
ONOCLEA L. SENSITIVE FERN

A monotypic genus of n temperate areas (Johnson 1993b); sometimes cultivated as an ornamental. (Greek: *onos*, vessel, and *cleisto*, closed, in reference to the "segments of the fertile frond that roll up into hard, bead-like structures enclosing the sori"—Moran 2004)
REFERENCES: Lloyd 1971; Beitel et al. 1981; Rothwell & Stocky 1991; Johnson 1993b.

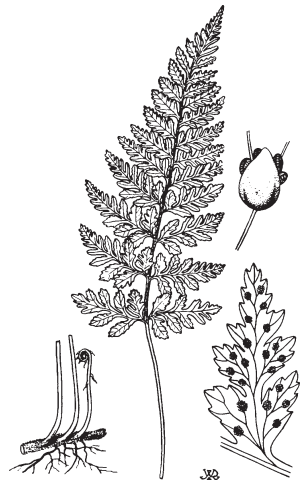
Onoclea sensibilis L., (sensitive), SENSITIVE FERN, BEAD FERN. Stems (rhizomes) creeping; leaves conspicuously dimorphic, of 2 very different types, scattered along the rhizome, erect, glabrous; sterile leaves to ca. 1(–1.3) m tall, thin herbaceous, deciduous, broadly triangular to ovate in outline, deeply pinnatifid with the pinnae few, the pinnae subopposite (especially the lowermost), undulate to irregularly deeply lobed, the margins entire, the veins reticulate and forming a series of linear to oblong areoles along the midvein (= costa), the rachis winged; fertile leaves persistent over winter, 2-pinnate, the blades greatly reduced, the ultimate blade segments (= smallest subdivisions of blade) rolled into globular, berry-like or bead-like structures concealing the sori, the whole fertile leaf superficially resembling a narrow panicle of small round fruits. Swamps, low woods, and wet areas; Pineywoods and n edge of Gulf Prairies and Marshes w through Post Oak Savannah to Milam, Upshur (BRIT), Red River, Henderson, Limestone, Falls



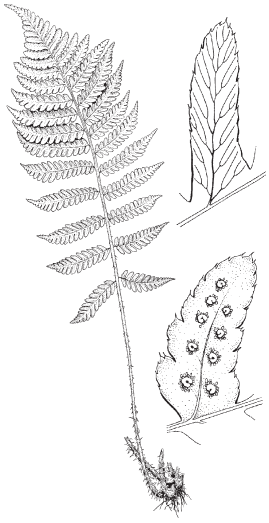
Athyrium filix-femina subsp.asplenioides [LUN]



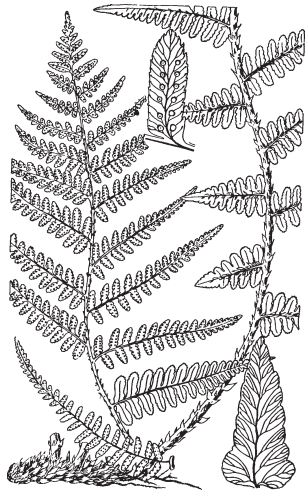
Cyrtomium falcatum [BA1]



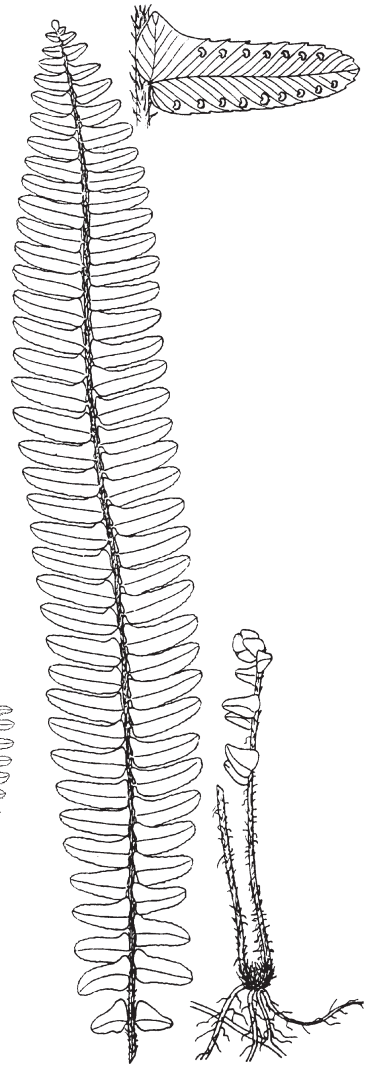
Cystopteris protrusa [LUN]



Dryopteris celsa [TAY]



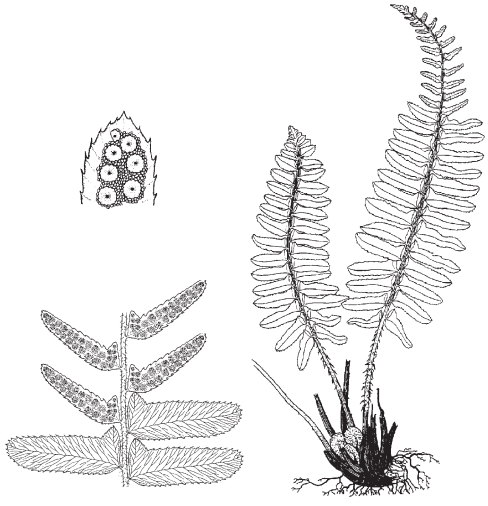
Dryopteris ludoviciana [SM3]



Nephrolepis exaltata [LUN]



Onoclea sensibilis [LUN]



Polystichum acrostichoides [LUN]

(Turner et al. 2003), and Wilson (Correll 1956; TAES) cos.; also e Edwards Plateau; se Canada and throughout e U.S. w to ND and TX. Sporophylls produced Apr–Oct, persisting through the winter and releasing the green spores in spring before expansion of the sterile leaves (Johnson 1993b). The common name is in reference to the sensitivity of the leaves to even a light frost (Johnson 1993b). The sterile leaves superficially resemble those of *Woodwardia areolata*, but that species has alternate pinnae with minutely serrulate margins. SENSITIVE FERN is native to both e North America and e Asia (Hoshizaki & Moran 2001); see generic synopsis of *Brachyelytrum* (Poaceae) for a discussion of this interesting disjunct distribution pattern. Fifty-seven million year old Paleocene Epoch fossils virtually identical to modern members of this species provide evidence that fern species can remain essentially unchanged over millions of years (Rothwell & Stockey 1991; Serbet & Rothwell 1999). Unusual leaves, intermediate in form between typical sterile and fertile leaves, are known in this species, possibly as a result of some type of injury (e.g., frost, defoliation) (Lloyd 1971; Beitel et al. 1981). This species is reported to be poisonous; horses are said to become unsteady and collapse upon ingesting large amounts of the plant. Other symptoms include walking in circles, difficulty in chewing (with food sometimes falling from the mouth), seizures, and death. The specific cause is not known with certainty but is thought to be thiaminase, an enzyme that destroys thiamine and causes Vitamin B_1 deficiency (Burlage 1968; Turner & Szczawinski 1991; Burrows & Tyrl 2001). ☠

POLYSTICHUM Roth CHRISTMAS FERN, SWORD FERN, HOLLY FERN

A cosmopolitan genus of ca. 180 species (Wagner 1993). *Cyrtomium* is related to *Polystichum* and some authorities lump it into *Polystichum* (e.g., Mabberley 1997). (Greek: *poly*, many, and *stichos*, row, presumably in reference to the rows of sori on each pinna)
REFERENCES: Wagner 1993; Noodén & Wagner 1997; Schneider & Carlquist 1997.

Polystichum acrostichoides (Michx.) Schott, (resembling *Acrostichum,* leather ferns, another genus of ferns with many crowded sori—Nelson 2000), CHRISTMAS FERN, DAGGER FERN. Stems (rhizomes) erect; leaves evergreen, clustered, to 70 cm long, the blades elliptic-lanceolate to lanceolate in outline, 1-pinnate; pinnae mostly alternate, auricled basally, the auricle on the acroscopic side (= side toward the leaf apex) of the pinna, the margins bristle-toothed; petioles densely scaly; leaf blades partially dimorphic, the proximal pinnae (those near blade base) sterile, the distal pinnae (those near blade tip) of some blades fertile and conspicuously contracted (but blade tissue still evident); sori round, crowded in 2–4 rows, medial, often confluent at maturity; indusia peltate, entire, persistent. Rich wooded slopes, moist areas; Pineywoods and Post Oak Savannah w to Anderson (Turner et al. 2003), Waller, Wood (Correll 1956; TAES), and Red River (BAYLU, BRIT) cos.; also n Gulf Prairies and Marshes; se Canada and throughout e U.S. w to MN and TX. Sporulating May–Nov. According to Correll (1956), "In some areas the evergreen fronds are gathered for decorative greens at Christmas time, hence the common name." Dunbar (1989) also noted that the prominent "ear" (auricle) at the base of each of the pinnae causes the pinnae, when held vertically, to resemble Christmas stockings. Experimental evidence (Noodén & Wagner 1997) indicated that the leaves being green in winter is beneficial. The two hypotheses for this benefit are: 1) extension of the period of photosynthesis into the winter, and 2) nutrient storage in the old leaves requiring only a single transfer of nutrients to the new leaves (versus two transfers if storage is in the rhizomes).

TECTARIA Cav. HALBERD FERN

A mostly tropical genus of ca. 200 species (Moran 1993b); some are cultivated as ornamentals. (Latin: *tectum*, roof, and *aria*, a suffix, in reference to the roof-like indusium of some species—Moran 1993b)
REFERENCES: Morton 1966; Moran 1993b.

Tectaria heracleifolia (Willd.) Underw., (with leaves superficially like *Heracleum*—cow parsnip, in the carrot family), BROAD HALBERD FERN. Stems (rhizomes) erect; leaves evergreen, clustered, to 90 cm long; leaf blades monomorphic, ovate to pentagonal in outline, (12–)20–45(–50) cm long, 1-pinnate, with 3–5(–7) pinnae (1–2(–3) pairs plus a single terminal pinna), thick-herbaceous to subcoriaceous; pinnae, particularly the proximal ones, with large basal lobe(s), the margins with shallow lobes, the apices acuminate to long-attenuate; lateral pinnae ± falcate; petioles glabrous, sparsely scaly basally; sori round, in single rows on either side of the side veins of the pinnae, to ca. 3 mm in diam.; indusia peltate, entire, persistent. Limestone sink-holes and cave entrances, occasionally in shaded canyons or shaded rock outcrops or railroad tunnels; in East TX known only from Comal Co. (Turner et al. 2003) near boundary of Blackland Prairie and Edwards Plateau; mainly Edwards Plateau; in the U.S. otherwise known only from FL. Sporulating Apr–Oct. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given this species' limited distribution in TX and its occurrence in only one other state in the U.S. (FL), we consider this species to be of conservation concern in TX. ⚠

WOODSIA R. Br. CLIFF FERN

A genus of ca. 30 species found mainly in n temperate regions and at high elevations in the tropics (Windham 1993d). The common name, CLIFF FERN, comes from the tendency of a number of species to grow on or among rocks (Hoshizaki & Moran 2001). (Named for Joseph Woods, 1776–1864, English botanist and architect)

REFERENCES: Brown 1964; Windham 1987a, 1993d; Carlquist et al. 1997.

Woodsia obtusa (Spreng.) Torr., (obtuse, blunt), COMMON WOODSIA, BLUNT-LOBE WOODSIA, BLUNT-LOBE CLIFF FERN, LARGE WOODSIA. Stems (rhizomes) short; leaves monomorphic, semi-evergreen, clustered, erect-ascending, to 40(–60) cm tall, often smaller, the blades elliptic-lanceolate to broadly lanceolate, 2-pinnate or 2-pinnate-pinnatifid; sori round, between midvein and lateral margins of ultimate segments (= smallest subdivisions) of leaf; indusia rather large, at first enclosing the sporangia and later splitting into several spreading, irregular lobes. Rocky areas, outcrops, well-drained, often sandy areas; Pineywoods w to Montague and Palo Pinto (BRIT) cos. in the Cross Timbers and Prairies; also e Edwards Plateau; se Canada and throughout e U.S. w to NE and TX. Two subspecies of *W. obtusa*, differing in chromosome number, are recognized by Windham (1993d, 1993e) and are separated by him as in the key to subspecies below—from Windham (1993e). Both are present across East TX. While some mature mid-season material can be clearly and consistently determined to subspecies, it is often difficult to distinguish many specimens. Windham (1993d) further indicated that the 2 subspecies hybridize in the area of sympatry and form sterile triploids with malformed spores. The range map provided for TX does not distinguish subspecies.

1. Spores averaging 42–47 µm [tetraploid]; proximal pinnules of lower pinnae usually shallowly lobed or merely dentate; blades coarsely cut and evidently 2-pinnate; stems compact to short-creeping, individual branches usually 5–10 mm diam. _____ subsp. **obtusa**
1. Spores averaging 35–42 µm [diploid]; proximal pinnules of lower pinnae usually deeply lobed or pinnatifid; blades finely cut, 2-pinnate-pinnatifid; stems short- to long-creeping, individual branches 3–5 mm diam. _____ subsp. **occidentalis**

subsp. **obtusa**. $2n = 152$ (tetraploid). Widely scattered in East TX (e.g., Grayson, Hopkins, and Milam (BRIT) cos.—identified J. Peck); also e Cross Timbers and Prairies (Tarrant Co.—BRIT); se Canada and e U.S. w to NE and e 1/3 of TX.

subsp. **occidentalis** Windham, (western). $2n = 76$ (diploid). Widespread in East TX (based on herbarium collections at BRIT, apparently more abundant in East TX than subsp. *obtusa*); also Cross Timbers and Prairies and e Edwards Plateau; AR, KS, OK, and e 1/2 of TX.

LYGODIACEAE C. Presl
CLIMBING FERN FAMILY

A very small family (1 genus, ca. 40 species) of tropical regions nearly worldwide, temperate areas of North America, Asia, and s Africa, and Pacific Islands (Nauman 1993a). The family is sometimes included in the Schizaeaceae (e.g., Correll 1956; Radford et al. 1968; Correll & Johnston 1970; Kramer 1990f; Mabberley 1997; Nauman et al. 2000). However, we are following Nauman (1993a) and Kartesz (1999) in recognizing it as a distinct family.

FAMILY RECOGNITION IN THE FIELD: the solitary species in the flora is the only twining/climbing, vine-like fern in TX.

REFERENCE: Nauman 1993a.

LYGODIUM Sw. CLIMBING FERN

A tropical and warm area genus of 40 species (Nauman 1993a) of climbing vine-like ferns with leaves having indeterminate growth (elongating rachises). The twining stem-like rachises are used for such things as basketry, fish-traps, mats, and yarn. Only one species, *L. palmatum* (Bernh.) Sw., AMERICAN CLIMBING FERN, is native to the U.S., endemic from ME s and w across the e U.S. as far as MI and MS. According to Hoshizaki and Moran (2001), "The evergreen fronds [of *L. palmatum*] used to be collected during the winter and used for Christmas decorations. This destroyed so many populations that in 1869 the Connecticut legislature enacted a law to protect the plant—the first plant conservation law passed in the United States." This native species is easily distinguished from *L. japonicum* by its 1-palmately lobed pinnules and petioles borne 10–40 mm apart. Another Old World species, ⊘ *Lygodium microphyllum* (Cav.) R. Br., OLD WORLD CLIMBING FERN, is considered a dangerous invasive weed in Florida (Pemberton 1998; Pemberton & Ferriter 1998; Nauman et al. 2000; Brandt & Black 2001) and is listed as a category I pest species by the Florida Exotic Pest Plant Council (Nelson 2000). (Greek: *lygodes*, flexible, in reference to the twining rachises—Nauman 1993a).

REFERENCES: Duek 1978; Nauman 1987; Pemberton 1998; Pemberton & Ferriter 1998; Carlquist & Schneider 1998; Lott et al. 2003.

Lygodium japonicum (Thunb. ex Murray) Sw., JAPANESE CLIMBING FERN, (of Japan). Terrestrial; stems (rhizomes) subterranean, 2–3 mm in diam., creeping, bearing petioles 2–7 mm apart; leaves with indeterminate growth, climbing, vine-like, to 3(+) m long, the rachis elongate, twining, flexuous, stem-like (true stem below ground); pinnae reduced to short stalks, these short stalks each bearing a pair of opposite pinnules and typically a dormant apical bud; pinnules usually 2–3-pinnate, sparsely to moderately pubescent on the abaxial (= lower) surfaces, the ultimate segments (= smallest subdivisions) of pinnules serrulate; fertile pinnules toward leaf apex, similar to sterile pinnules except having ultimate segments fringed with finger-like fertile lobes; sporangia in 2 rows, 1 on each side of midvein of oblong marginal lobes of ultimate segments, covered by hood-like flaps or flanges of tissue which serve as indusia. Naturalized in low woods, thickets, roadside ditches, circumneutral soils; Hardin, Harris, Jasper, Jefferson, Orange (BRIT), Liberty, Montgomery (TAMU), Tyler (TAES), Sabine (ASTC), Polk, San Jacinto, and Walker (Turner et al. 2003) cos. in s part of the Pineywoods and Madison Co. (TAMU; Neill & Wilson 2001) at the e margin of the Post Oak Savannah; also Chambers Co. (Turner et al. 2003) in the n Gulf Prairies and Marshes; in some areas (e.g., Jack Gore Baygall Unit of the Big Thicket National Preserve in Hardin Co.) it is so abundant and integrated into the vegetation that it appears native (G. Diggs, pers. obs.). Sporulating Apr–frost. Native of e Asia (China and Japan), now naturalized in the U.S. from NC s to FL w to AR and TX (Nauman 1993a). [*Ophioglossum japonicum* Thunb. ex Murray] This widely cultivated, introduced species has been reported as weedy in some areas of the se U.S.; its dense canopy can prevent the growth of underlying veg-

etation (Nauman 1993a). It is ranked as a category I species on the Florida Exotic Pest Plant Council's (EPPC) 1999 List of Florida's Most Invasive Species (Nauman et al. 2000). ⊘ ⮌ ⚅/291

MARSILEACEAE Mirb.
WATER-CLOVER OR PEPPERWORT FAMILY

Plants aquatic or of very wet habitats; stems (rhizomes) long-creeping; leaves scattered along the stems, long-petioled and palmately divided into 4 pinnae or else filiform and lacking expanded blades; sori contained in sporocarps (= hard bean- or pea-like structures which are apparently highly modified pinnae) on stalks from near base of petiole; sporangia of 2 kinds within the same sorus, the megasporangia with 1 megaspore, the microsporangia with numerous microspores.

☙A nearly cosmopolitan family of 3 genera and ca. 50 species (Johnson 1993a). Three families of heterosporous water ferns occur in East TX (Azollaceae—*Azolla*, Marsileaceae—*Marsilea*, *Pilularia*, and Salviniaceae—*Salvinia*). These groups are quite distinct morphologically, and traditionally the marsileaceous (*Marsilea* and *Pilularia*) and salviniaceous (*Azolla* and *Salvinia*) lines were considered to have evolved independently from different homosporous fern ancestors. However, based on recent morphological, fossil, and molecular evidence, all three living heterosporous water fern families are considered to comprise a monophyletic group (Rothwell & Stockey 1994; Hasebe et al. 1995; Pryer 1999).
FAMILY RECOGNITION IN THE FIELD: plants of wet areas with leaves resembling a *4-leaf clover* (in 1 species apparently rare in East TX the leaves thread-like and ± resembling those of a grass); sori in hard, *bean- or pea-like structures* near the base of the petioles.
REFERENCES: Correll 1956, 1966a; Kramer 1990c; Johnson 1993a; Lesho 1994; Pryer 1999; Schneider & Carlquist 2000b.

1. Leaf blades resembling a 4-leaf clover, palmately divided into 4 narrowly to broadly cuneate (= wedge-shaped) pinnae _____ **Marsilea**
1. Leaves filiform, very narrow, somewhat grass-like in appearance, without expanded blades _____ **Pilularia**

MARSILEA L. WATER-CLOVER, PEPPERWORT

Small plants, aquatic or of wet habitats, often forming dense colonies; leaves long petiolate with blades palmately divided into 4 pinnae; sporocarps on stalks, the tip of stalk often protruding as a bump or tooth (proximal tooth), a second distal tooth sometimes present on sporocarps beyond the attachment point of the stalk.

☙A nearly cosmopolitan genus of 45 species (Johnson 1993a). The leaves, with 4 pinnae (= leaflets), have a superficial resemblance to those of CLOVER; young plants can have unlobed leaves like *Pilularia*. ☠ An Australian member of the genus, the NARDOO FERN, (*M. drummondii* A. Braun), is particularly rich in the enzyme thiaminase (which breaks down vitamin B_1—thiamine) and is reported to have caused the suffering and death of members of the first scientific expedition to cross Australia from south to north (1860–61). Upon running out of food, the explorers ate the fern, which was known to be consumed by aborigines (but specially prepared by them). The consumption of the inadequately prepared fern resulted in beriberi (vitamin B_1 deficiency) affecting almost all members of the expedition. They experienced weakness, emaciation, partial paralysis of the legs, nerve damage, and in some cases death. The fatal poisoning of large numbers of Australian sheep by NARDOO FERN has also been reported (Earl & McCleary 1994; Moran 1995, 2004; Bruneton 1999). The sporocarps of *Marselia* are extremely durable and resistant to water loss, and spores may remain viable for up to 130 years (Johnson 1985; Moran 1995). When the sporocarp is moistened, the gelatinous interior takes up water and a worm-

like mass of gelatin is extruded, thus releasing the sori (Kramer 1990d). (Named for Count Luigi Ferdinandino Marsigli, 1656–1730, Italian mycologist at Bologna)
REFERENCES: Gupta 1957; Thieret 1977; Johnson 1986, 1988.

1. Pinnae 9–35 mm long, 8–39 mm wide; sporocarps densely villous with long spreading hairs; distal tooth of sporocarps absent or to 0.5 mm long, blunt; sporocarp stalks usually branched, with several sporocarps per stalk _____ **M. macropoda**
1. Pinnae 4–19 mm long, 4–16 mm wide; sporocarps pubescent with appressed hairs or often glabrate; distal tooth of sporocarps 0.4–1.2 mm long, acute; sporocarp stalks unbranched, with 1 sporocarp per stalk _____ **M. vestita**

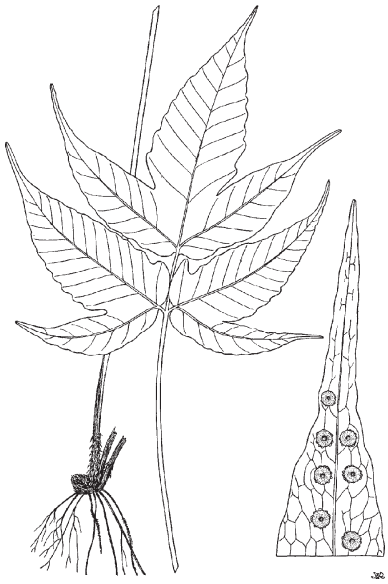
Marsilea macropoda Engelm. ex A. Braun, (large-footed), LARGE-FOOT PEPPERWORT, BIG-FOOT WATER-CLOVER, WATER-CLOVER. Petioles 5–39 cm long. Typically in mud, also shallow water; Travis (BRIT), Bexar, Fayette, Gonzales, and Wilson (Turner et al. 2003) cos. near the w margin of East TX and Harris Co. (Turner et al. 2003) near sw margin of Pineywoods; mainly c to s TX; AL, FL, LA, and TX. Sporocarps produced nearly year round. This is an attractive plant that is cultivated as an ornamental. /292

Marsilea vestita Hook. & Grev., (covered), HAIRY WATER-CLOVER, HOOKED PEPPERWORT, WATER-CLOVER, HAIRY PEPPERWORT, NARROW-LEAF PEPPERWORT. Pinnae varying in appearance, typically 1–2 times as long as wide, fan-shaped or broadly cuneate, apically entire or undulate-crenulate, but sometimes (when growing submerged) narrow in appearance, 3–7.5 times as long as wide, narrowly and obliquely cuneate, apically irregularly toothed or crenulate; petioles 2–20 mm long. Ponds, wet depressions, along streams and rivers; w part of East TX in Blackland Prairie and Post Oak Savannah and s margin of Pineywoods; widespread in TX except absent from most of the Pineywoods; sw Canada throughout w U.S. e to MN and LA and extending in the se U.S. e to FL. Sporocarps produced Mar–Oct. [*M. mucronata* A. Braun, *M. uncinata* A. Braun, *M. tenuifolia* Engelm. ex A. Braun, *M. vestita* subsp. *tenuifolia* (Engelm. ex A. Braun) D.M. Johnson] Plants with narrow pinnae are usually easily distinguished in the field and have sometimes been treated as a separate species (*M. tenuifolia*—e.g., Correll & Johnston 1970) or subspecies (*M. vestita* subsp. *tenuifolia*—e.g., Johnson 1986; Kartesz 1994; Diggs et al. 1999). However, this variant was not formally recognized by Johnson (1993a), Jones et al. (1997), or Kartesz (1999), and according to J.H. Peck (pers. comm.), it is an environmentally induced form that occurs when leaves develop submerged. We are therefore including it in *M. vestita*.

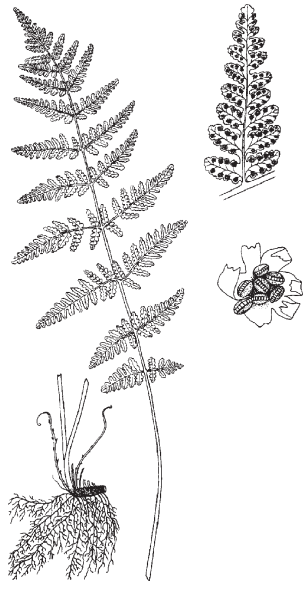
PILULARIA L. PILLWORT

A genus of 6 species of inconspicuous grass-like or sedge-like plants of North America, South America, Europe, Pacific Islands, Australia, and New Zealand (Johnson 1993a). It is sometimes placed in its own family. (Latin: *pilula*, a little ball, in reference to the spheric sporocarps)
REFERENCES: LaMotte 1940; Hill 1980; Dennis & Webb 1981; Culwell 1994.

Pilularia americana A. Braun, (of America), AMERICAN PILLWORT, WATER-PEPPER. Small inconspicuous aquatic, submersed or infrequently persisting on bare mud; leaves filiform, 1.6–10.2 cm long, lacking expanded blades; sporocarps produced just below ground surface, globose, 2–6(–10) mm long, 2–3 mm in diam. Temporary pools, ponds, and reservoir margins; J.H. Peck (pers. comm.) indicated that the best time to find this species is after reservoir drawdowns in fall. According to the range map in Johnson (1993a), *P. americana* occurs widely in the n part of East TX, and it is included here on that basis; the only nearby records we know of are from Burnet (Granite Mt.— just w of East TX, BRIT), Llano, Mason (Turner et al. 2003), and Wise (*O'Kennon & McLemore 18341*, BRIT) cos.; AR, CA, GA, KS, MO, NE, OK, OR, TN, and TX (Johnson 1993a). The species is so inconspicuous that it is rarely recognized or collected. A large population (ca. 150 sq. m) was discovered in AR (Culwell 1994), prompting the comment that the species "may be more common than herbarium specimens indicate" (Culwell 1994).



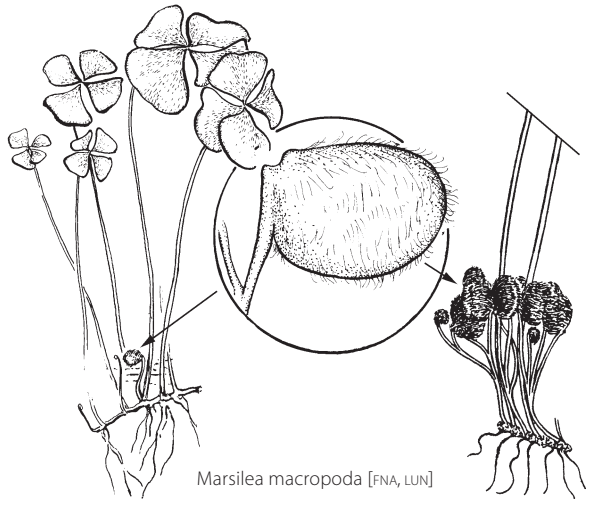
Tectaria heracleifolia [LUN]



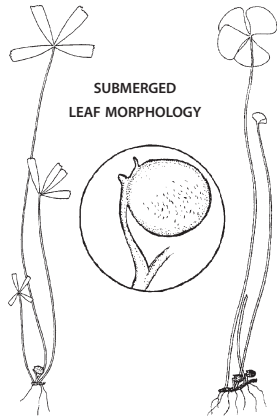
Woodsia obtusa subsp. obtusa [LUN]



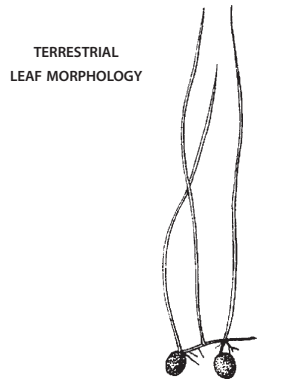
Lygodium japonicum [LUN]



Marsilea macropoda [FNA, LUN]



Marsilea vestita [FNA, LUN]



Pilularia americana [LUN]

OPHIOGLOSSACEAE (R. Br.) C. Agardh
ADDER'S-TONGUE FAMILY

East TX species terrestrial; stems ± subterranean, simple, unbranched, upright; leaves 1 or less commonly 2(–3) per stem, often ephemeral, divided into a blade portion (= trophophore) and a fertile sporangia-bearing portion (= sporophore); blade portion simple, divided, or compound; fertile portion lacking blade-like tissue, typically consisting of a long stalk with a terminal, branched or unbranched, sporangia-bearing area; sporangia large (in comparison with those of most other ferns), spherical, thick-walled, borne in 2 rows on each branch or on the unbranched sporangia-bearing area.

A nearly cosmopolitan family of 5 genera and ca. 70–80 species (Wagner & Wagner 1993) of eusporangiate ferns (= with large sporangia having hundreds to thousands of spores per sporangium). The Ophioglossaceae are thought by some (e.g., Kato 1988) to be only distantly related to other ferns. Wagner (1990) indicated that "Of modern plants normally classified as 'ferns,' the Ophioglossaceae are the most isolated." They are apparently relicts of an ancient lineage (Bell & Woodcock 1983), and a number of characteristics "... suggest closer affinities to progymnosperms or cycadophytes than to typical modern ferns" (Wagner 1990). Likewise, molecular evidence (e.g., Vangerow et al. 1999), suggests that Ophioglossaceae and Marattiaceae (e.g., *Angiopteris)* are in a clade which is the sister group to all other ferns. Recent phylogenetic work (Pryer et al. 2001) confirms the isolated position of Ophioglossaceae and Marattiaceae at the base of the fern lineage and indicates that the closest relative of these families is the Psilotaceae. The Ophioglossaceae is made up of two clearly defined subfamilies, Botrychioideae and Ophioglossoideae, sometimes recognized as distinct families. The young leaves unfold rather than having the form of an unrolling fiddlehead as in most ferns (conduplicate rather than circinate) (Kato 1988; Wagner 1990; Nelson 2000). Members of this family obtain minerals through fungi associated with their fleshy roots (which lack root hairs); in essence these ferns trade carbon compounds for minerals (J. Peck, pers. comm.). The following treatment draws heavily on Wagner and Wagner (1993).

FAMILY RECOGNITION IN THE FIELD: often small plants with only 1 or sometimes 2(–3) leaves; leaves with a blade portion (simple to compound) and an erect, spike-like, fertile portion consisting of an elongate stalk and a terminal, fertile, sporangia-bearing area.

REFERENCES: Clausen 1938; Correll 1956, 1966a; Thomas 1972, 1980; Kato 1988; Wagner 1990; Wagner & Wagner 1993; Vangerow et al. 1999; Pryer et al. 2001.

1. Leaf blades ternately-pinnately compound, divided, or lobed, the margins usually denticulate to serrate or lacerate; veins of leaf blades dichotomous (= equally 2-forked) and free (= with their distal ends unconnected to other veins); sporangia in a pinnately branched, panicle-like arrangement _____ **Botrychium**

1. Leaf blades simple, the margins entire; veins of leaf blades reticulate and anastomosing (= veins connecting by cross-veins to form a network); sporangia in an unbranched, linear, spike-like arrangement _____ **Ophioglossum**

BOTRYCHIUM Sw. GRAPE FERN, MOONWORT

Blade portion of leaf compound, divided or lobed, ovate to triangular or broadly triangular in outline, ± ternate (= divided into three ± equal parts); fertile portion of leaf consisting of an elongate stalk terminated by a 1–2-pinnate, panicle-like, sporangia-bearing region.

A nearly cosmopolitan genus of 50–60 species (Wagner & Wagner 1993) with greatest diversity at high latitudes and high elevations. Most species are quite variable vegetatively, resulting in considerable taxonomic confusion. Plants typically produce only one leaf each year (Nauman et al. 2000). (Latin: *botry*, bunch (of grapes), in reference to the sporangial clusters)

REFERENCES: Butters 1917b; Wagner 1960, 1992; Thomas 1979; Hauk 1995; Do et al. 1996; Holmes et al. 1996; Skoda 1997; Hauk & Haufler 1999.

1. Plants small, to only ca. 12 cm tall; blade portion of leaf prostrate on ground, small, only 3–8 cm long, short-stalked (petiole-like stalk 1.5–3 cm long); ultimate segments (= smallest subdivisions) of blade portion of leaf fan-shaped, their tips broadly rounded; leaves commonly 2 per plant _____ **B. lunarioides**

1. Plants usually larger, 8–75 cm tall; blade portion of leaf raised above the ground, not prostrate, usually larger, 4–30 cm long, either long-stalked (petiole-like stalk 3–20 cm long) OR sessile (petiole-like stalk absent) in *B. virginianum*; ultimate segments of blade portion of leaf not fan-shaped, their tips usually pointed or obtuse; leaf usually 1 per plant.
   2. Blade portion of leaf sessile (fertile stalk originating at very base of blade portion); blade finely divided, the ultimate segments numerous, small, with coarsely serrate to lacerate (= irregularly cut) margins; leaves absent in winter _____ **B. virginianum**
   2. Blade portion of leaf long-stalked, appearing to have a long petiole (blade portion well-separated from origin of fertile stalk); blade coarsely divided, the ultimate segments relatively few, large, with denticulate margins; leaves present in winter.
      3. Blade portion of leaf 2–3-pinnate (often 2-pinnate), ± papery/herbaceous; ultimate segments of blade portion mostly oblong to obliquely lanceolate to narrowly lanceolate, the margins nearly parallel, basally cuneate, apically relatively blunt _____ **B. biternatum**
      3. Blade portion of leaf mostly 3-pinnate, relatively leathery; ultimate segments of blade portion usually ± trowel-shaped (rarely linear), the margins usually not parallel, basally truncate or obtuse, apically relatively pointed _____ **B. dissectum**

Botrychium biternatum (Savigny) Underw., (twice-ternate), SOUTHERN GRAPE FERN, SPARSE-LOBE GRAPE FERN, WINTER GRAPE FERN. Plant ca. 10–35 cm tall; roots usually 10 or fewer, blackish; leaves present over winter, mostly green but rarely bronze in winter if exposed; new leaves appearing in late spring to early summer; sterile blade portion green to dark green, long-stalked (stalk 3–20 cm long), ± papery/herbaceous, to 18 cm long and 28 cm wide, usually smaller, 2–3-pinnate (often 2-pinnate), the ultimate segments (= smallest subdivisions) elongate, obliquely lanceolate to narrowly lanceolate, the margins nearly parallel, finely denticulate (marginal teeth finer and more uniform than in *B. dissectum*), the apices obtuse to short-acuminate. Low woods; Angelina, Bowie, Cass, Hardin, Harrison, Montgomery, Nacogdoches, Newton, Sabine, and Titus (BRIT—identified J. Peck) cos. in the Pineywoods; se U.S. from PA s to FL w to IL, OK, and TX. Spores maturing in the fall. [*B. tenuifolium* Underw., *B. dissectum* Spreng. var. *tenuifolium* (Underw.) Farw.] This species and *B. dissectum* are similar morphologically and are often confused (see discussion under *B. dissectum*). ⚄/277

Botrychium dissectum Spreng., (dissected), DISSECTED GRAPE FERN, OBLIQUE GRAPE FERN, CUT-LEAF GRAPE FERN. Plant similar to *B. biternatum*; leaves present over winter, often bronze or reddish bronze in winter if exposed (but more so in colder areas of the n U.S.); new leaves appearing in late spring; sterile blade portion shiny green, relatively leathery, to 20 cm long and 30 cm wide, mostly 3-pinnate, the ultimate segments usually ± trowel-shaped (rarely linear), the margins usually not parallel, denticulate to coarsely denticulate, the marginal teeth coarser and less uniform than in *B. biternatum*. In various habitats from open grassy areas to deep forests; Anderson, Bowie, Fannin (*Diggs & Beach s.n.*, 1999), Leon, and Walker (BRIT—all identified by J.H. Peck) cos., Pineywoods w to Post Oak Savannah and Red River drainage; Hatch et al. (1990) also cited the Blackland Prairie; while the range map in Wagner and Wagner (1993) shows this species in TX only on the extreme e margin of the Pineywoods, it occurs considerably further w; se Canada and throughout e U.S. w to KS, MN, OK, and TX. Spores maturing in the fall. [*B. dissectum* var. *obliquum* (Muhl. ex Willd.) Clute, *B. dissectum* var. *oblongifolium* (Graves) Broun, *B. obliquum* Muhl. ex Willd., *B. obliquum* var. *elongatum* Gilbert & Haberer] This is a highly

variable species (Wagner & Wagner 1993), one form of which (forma *dissectum*—northern entity occurring as close as c AR—Peck, pers. comm.) is highly dissected and quite distinctive. However, the only form occurring in TX (forma *obliquum*, previously treated as a variety) closely resembles *B. biternatum*. As a result, *B. dissectum* and *B. biternatum* have often been confused (particularly immature plants). According to Taylor (1984) "... there do not appear to be any stable characters which will always clearly distinguish these two taxa." Thomas (1980) indicated that the two intergrade and that some individual specimens puzzle even the experts. Nauman et al. (2000) lumped *B. dissectum* into *B. biternatum* saying, "they intergrade in Florida to such an extent that two species cannot be maintained." However, according to W.H. Wagner Jr. (pers. comm.) and Wagner and Wagner (1993), *B. dissectum* has leaves that are more dissected and the ultimate segments usually trowel-shaped (rarely linear), apically more pointed, and with the margins more lacerate. Likewise, J.H. Peck (pers. comm.) indicates that two species are distinct and that mature reproductive material can usually be distinguished without difficulty. We are therefore following Wagner and Wagner (1993) and J.H. Peck (pers. comm.) in recognizing *B. dissectum* as a distinct species. ⚅/277

Botrychium lunarioides (Michx.) Sw., (resembling moonwort—*Botrychium lunaria*), WINTER GRAPE FERN, PROSTRATE GRAPE FERN. Roots 20–30, yellow to brown; leaves appearing in late fall, overwintering and then dying in early spring (plant wholly underground and dormant for 8–9 months per year); sterile blade portion usually pale green, short-stalked, fleshy, to 12 cm wide, 2–3-pinnate-pinnatifid; ultimate leaf segments fan-shaped, with midvein absent, denticulate, rounded at apex. Open closely cut grassy areas, often in cemeteries; n Pineywoods and Post Oak Savannah w to Bastrop, Falls, Hunt, Kaufman, Lee, Limestone, Navarro (BAYLU), and Milam (Holmes et al. 1996) cos. on e edge of Blackland Prairie; se U.S. from NC s to FL w to OK and TX. Spores maturing Feb–Apr. [*Holubiella lunarioides* (Michx.) Skoda] According to Wagner and Wagner (1993), a "... peculiarity of this species is the tendency for the sporophores to remain curled in late fall and early winter and to become erect in February." This species was first collected in TX (San Augustine Co.) in 1972 (Thomas 1979). It was only recently reported from the Blackland Prairie by Holmes et al. (1996), who greatly expanded its known distribution within TX; it is now widely known in East TX. Wagner (1992) considered *B. lunarioides* to be distinct enough to place it in its own section. This species is easily overlooked. Nelson (2000) indicated that the "most effective way to find this fern is to search for it in closely cut lawns, especially cemeteries, by crawling on hands and knees or by laying one's face close to the ground, then looking laterally across the top of the grass for the fertile frond segments."

Botrychium virginianum (L.) Sw., (of Virginia), RATTLESNAKE FERN, VIRGINIA GRAPE FERN, COMMON GRAPE FERN. Plant erect, 8–75 cm tall; roots 15 or fewer, yellow to brown; leaves seasonal, appearing in early spring and dying in summer; sterile blade portion pale green, sessile, thin, herbaceous, 4–30 cm long and wide, 3–5-pinnate-pinnatifid; ultimate leaf segments linear, with midvein present, serrate to lacerate, pointed at apex. Moist, rich woods and thickets; Pineywoods w to Cross Timbers and Prairies (e.g., Tarrant Co.—BRIT); also e Edwards Plateau; throughout most of Canada and the U.S. Spores maturing Apr–Jun. The common name is probably derived from a resemblance of the clusters of sporangia to the rattles of a rattlesnake. Alternatively, it has "been reported that a salve made by boiling the roots of the plant was used by the Cherokee Indians in the treatment of snake bites" (Nelson 2000).

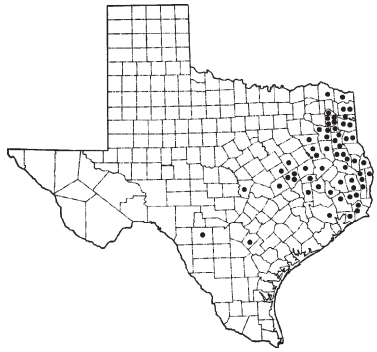
OPHIOGLOSSUM L. ADDER'S-TONGUE

Plants small, East TX species to ca. 25 cm tall; blade portion of leaf simple; fertile portion of leaf consisting of an elongate stalk terminated by an unbranched, linear, spike-like, sporangia-bearing region.

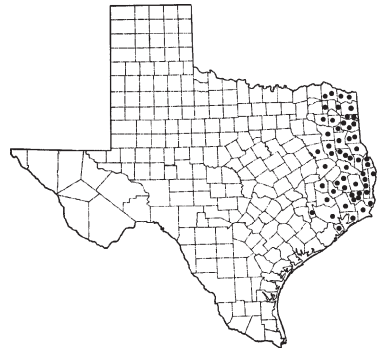
A nearly cosmopolitan, but mainly tropical and subtropical genus of 25–30 species (Wagner & Wagner 1993). *Ophioglossum* species have the highest chromosome numbers known for



Nephrolepis exaltata



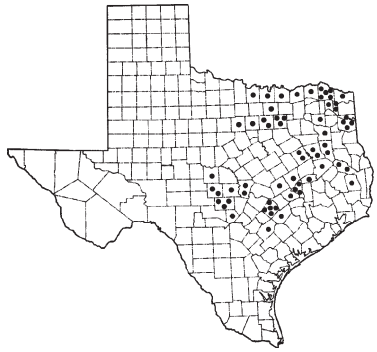
Onoclea sensibilis



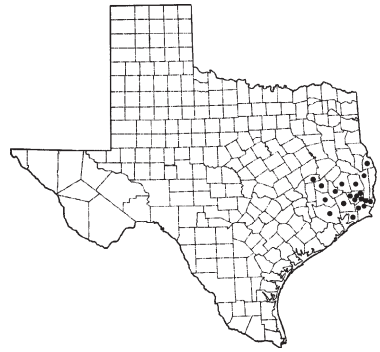
Polystichum acrostichoides



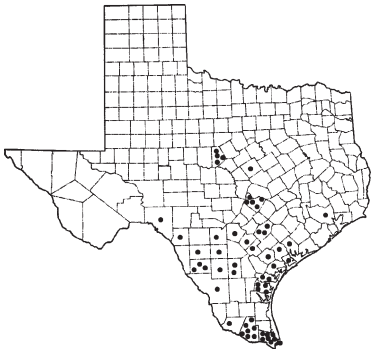
Tectaria heracleifolia



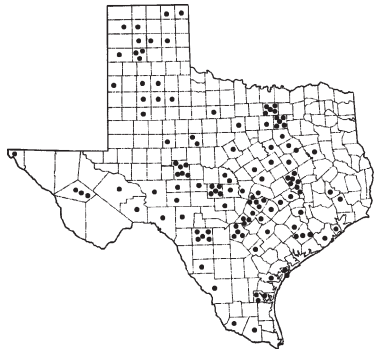
Woodsia obtusa



Lygodium japonicum



Marsilea macropoda



Marsilea vestita



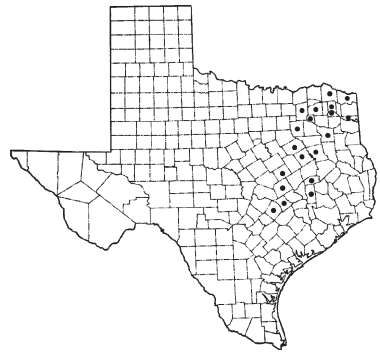
Pilularia americana



Botrychium biternatum



Botrychium dissectum



Botrychium lunarioides

vascular plants, with numbers as high as $2n = 1{,}200+$ being reported. The genus is noted for its taxonomic problems due to such factors as the inadequacy of herbarium collections, rarity of populations, subtlety of characters, and variability (Wagner et al. 1984). Many species are small and easily overlooked. They also superficially resemble other plants including *Plantago* species (PLANTAINS)—however, *Ophioglossum* species can be distinguished by the lack of a midvein on the leaf blades (Hoshizaki & Moran 2001). Leaf venation is particularly important for identification of some *Ophioglossum* species. Because this character is often difficult to observe in dried specimens, Wagner et al. (1984) suggested wetting the leaf by putting a few drops of 95% ethanol directly on the leaf surface and then observing using transmitted light. *Ophioglossum polyphyllum* A. Br., widespread in the Old World, but not previously known for North America, was recently reported from the Trans-Pecos of Texas (Zech et al. 1998); it had previously been confused with *O. engelmannii* (Zech & Manning 1996). (Greek: *ophis*, snake, and *glossa*, tongue, in reference to the tip of the sporangia-bearing structure)

REFERENCES: Thomas 1979; Wagner et al. 1984; Thomas et al. 1987; Zech et al. 1998; Schneider & Carlquist 1999a.

1. Stems (± subterranean and sometimes called rootstocks) globose-bulbose, 3–12 mm diam., nut-like; leaves emerging from cavity in top of stem, the blade portion usually near ground, spreading or nearly flat on ground, usually roughly triangular to orbicular-ovate or cordate, to only 3.5 cm long; sporangial clusters < 1 cm long; common stalk (to where blade portion and fertile stalk separate) usually < 3 cm long _____ **O. crotalophoroides**
1. Stems cylindric, upright, to ca. 5 mm diam.; leaves developing at top of stem, the blade portion usually well above ground, erect to spreading, usually ovate to lanceolate, to 12 cm long; sporangial clusters 0.5–4 cm long; common stalk varying from <1 to as much as 10 cm long.
   2. Blade portion of leaf with distinct and sometimes prominent apiculate tip, ± folded when alive or not so; principal veins of blade forming large primary areoles (= vein enclosed areas) in which are included numerous veinlets forming secondary areoles (which can enclose free veinlets).
      3. Blade portion of leaf (when alive) commonly folded, to 10 cm long and 4.5 cm wide, when dried uniformly green without pale central band; roots 0.5–1.5 mm in diam.; fertile stalk 1.3–2.5 times length of blade portion; leaves (blade portion and fertile portion combined) 1–2 per stem; widespread in East TX _____ **O. engelmannii**
      3. Blade portion of leaf (when alive) not folded, to 4.5 cm long and 1.7 cm wide, when dried commonly with a pale central band; roots 0.2–0.8 mm in diam.; fertile stalk 2–6 times length of blade portion; leaves 2–3 per stem; this large form of *O. nudicaule* may not occur within TX _____ **O. nudicaule** (large form)
   2. Blade portion of leaf without apiculate tip, usually rounded to acute at apex OR with small apiculate tip (in *O. nudicaule*), commonly plane (= not folded) when alive; principal veins of blade forming areoles but these inclding only free veinlets (= with one end not touching another vein).
      4. Blade portion of leaf rounded at apex, without apiculate tip, (2.5–)5–10 cm long and 1.5–4(–5.5) cm wide; leaves (blade portion and fertile portion combined) usually 1 per stem, appearing in a single flush once per year _____ **O. vulgatum**
      4. Blade portion of leaf acute at apex, with OR without apiculate tip, less than 4.5(–6) cm long and 1(–3) cm wide; leaves commonly 2–3 per stem, appearing in 1 or more flushes per year, depending on rains.
         5. Roots dark brown, usually fewer than 8 per shoot, the major roots generally straight, 0.8–1.3 mm in diam.; blade portion of leaf usually without apiculate tip, usually with coarse venation, the base cuneate to truncate or nearly cordate _____ **O. petiolatum**
         5. Roots yellowish to pale brown, usually more than 12 per shoot, often wavy, 0.2–0.8 mm in diam.; blade portion of leaf with short apiculate tip, usually with fine intricate venation, the base gradually tapered to cuneate _____ **O. nudicaule** (small form)

Ophioglossum crotalophoroides Walter, (from Greek: *krotalon,* a rattle, and *-oides,* like or resembling, due to the resemblance of the sporangial clusters to rattles or castanets), BULBOUS ADDER'S-TONGUE, DWARF ADDER'S-TONGUE FERN. Plant usually to only 15 cm tall; stems (± subterranean) globose-bulbose, 3–12 mm diam., nut-like or pea-sized; leaves (blade portion and fertile portion combined) 2 per stem; blade portion to 3.5 cm long and 2.5 cm wide, usually smaller, pale green; fertile stalk 1–5 times as long as blade portion; sporangia 4–8(–12) on each side of fertile stalk. Usually in moist sand, ditches, lawns, cemeteries, areas where grass is short; Pineywoods and Post Oak Savannah w to Fannin (BRIT), Bastrop, McLennan, Milam (BAYLU), and Hunt (Turner et al. 2003) cos. and from lawn in Dallas Co. (TAMU); also Bosque Co. (BAYLU) in Cross Timbers and Prairies, n Gulf Prairies and Marshes, and e Edwards Plateau; se U.S. from NC s to FL w to OK and TX. Leaves appearing late winter and early spring, sometimes later in season after heavy rains; usually sporulating Mar–May. The globose-bulbose stem is unique among TX members of the genus. According to Thomas (1979), "This species is probably the most common fern in East Texas and is found abundantly in early spring in almost every sandy area where grass is short, such as school lawns and cemeteries."

Ophioglossum engelmannii Prantl, (for George Engelmann, 1809–1884, German-born American botanist), ENGELMANN'S ADDER'S-TONGUE, LIMESTONE ADDER'S-TONGUE. Plant to 25 cm tall; leaves (blade portion and fertile portion combined) 1–2 per stem; blade portion to 10 cm long and 4.5 cm wide, commonly folded when alive, when dried uniformly pale green without pale central band, dull; fertile stalk 1.3–2.5 times as long as blade portion; sporangia 20–40 on each side of fertile stalk. Usually in thin black soils on limestone, wooded rocky slopes; Pineywoods and Gulf Prairies and Marshes w to West Cross Timbers, also e Edwards Plateau and Deaf Smith Co. in the Panhandle (Floyd Waller collection—J. Stanford, pers. comm.); e U.S. from PA s to FL w to NE, AR, and TX and in the sw to NM and AZ. Leaves appearing from early to late spring, often with a second flush of leaves following summer rains; usually sporulating Dec–Jun. ⊠/292

Ophioglossum nudicaule L., (naked stem), SLENDER ADDER'S-TONGUE, LEAST ADDER'S-TONGUE. Plant to ca. 12 cm tall; leaves (blade portion and fertile portion combined) commonly 2–3 per stem; blade portion to 4.5 cm long and 1.7 cm wide but often very small (< 4 mm long and 3 mm wide), green, dull, the largest with pale central band; fertile stalk 2–6 times as long as blade portion; sporangia 5–12 on each side of fertile stalk. Disturbed places (e.g., cemeteries, mowed areas around motels), ditches, grassy slopes, wet meadows, damp depressions in pinelands, moist open woods, bog margins; Shelby Co. (*Thomas 27493*, 16 Feb 1972—BRIT) near the LA border, also Hardin, Orange, San Augustine (Thomas 1979), and San Jacinto (E. Keith, pers. comm., BAYLU) cos. in the Pineywoods; se U.S. from VA s to FL w to OK and TX. Leaves appearing in late winter and early spring, sometimes with a second flush of leaves after heavy rains; usually sporulating Dec–Jun. [*O. dendroneuron* E.P. St. John, *O. ellipticum* Hook. & Grev., *O. mononeuron* E.P. St. John, *O. nudicaule* var. *minus* Clausen, *O. nudicaule* var. *tenerum* (Mett. ex Prantl) Clausen, *O. tenerum* Mett. ex Prantl] According to Wagner et al. (1984), this is the most variable and taxonomically confused species of *Ophioglossum* in the se U.S., with a complete transition series from small- to large-leaved (previously called *O. ellipticum*) forms.

Ophioglossum petiolatum Hook., (with a petiole or leaf stalk), STALKED ADDER'S-TONGUE, LONG-STEM ADDER'S-TONGUE. Plant to ca. 21 cm tall; leaves (blade portion and fertile portion combined) commonly 2–3 per stem; blade portion to 1.5–6 cm long and 0.6–3 cm wide, apically acute, gray-green, dull, flat or nearly so when alive; fertile stalk 0.8–7 times as long as blade portion; sporangia to 30 on each side of fertile stalk. Wet woods, disturbed places (e.g., cemeteries, mowed areas), ditches, moist meadows, depressions; Hardin, Orange (BRIT), Jasper, and Liberty (Thomas 1979; Thomas et al. 1987) cos. in the Pineywoods; also Jefferson Co. (Thomas 1979; Turner et al. 2003) in the n Gulf Prairies and Marshes; naturalized se U.S. from NC s to FL w to OK and TX. Leaves appearing during wet periods; usually sporulating Feb–Jun. Native of West Indies, Mexico, n South America, Asia (including India), and Pacific Islands. Wagner and

Wagner (1993) indicated that the earliest North American records date from 1900 to 1930, suggesting that the species is probably introduced. The first TX collection was from Jefferson Co. in 1937 (Thomas 1979). In cultivation (as an ornamental), this plant "is particularly known for developing root buds and a single plant can fill a pot quickly through root proliferation" (Nelson 2000). This species was apparently spread across the se U.S. in rural cemeteries through contaminated soil in pots that contained decoration plants (J. Peck, pers. comm.); STALKED ADDER'S TONGUE can also be found in nurseries in the pots of shrubs and trees.

Ophioglossum vulgatum L., (common), ADDER'S-TONGUE, SOUTHERN ADDER'S-TONGUE. Similar to *O. engelmannii*; leaf (blade portion and fertile portion combined) 1 per stem; blade portion (2.5–) 5–10 cm long and 1.5–4(–5.5) cm wide, dark green, somewhat shiny, apically rounded; fertile stalk 2–4 times as long as blade portion; sporangia 10–35 on each side of fertile stalk. Moist woods, meadows, swamps, usually in sandy soils; n Pineywoods, n Post Oak Savannah, and w in Red River drainage to Fannin Co. (BRIT); also reported for the Cross Timbers and Prairies (Denton Co.—Turner et al. 2003) and the n Gulf Prairies and Marshes (Jefferson Co.—Correll 1956); throughout most of the e U.S. w to IL, OK, and TX, also AZ (Wagner & Wagner 1993). Leaves appearing spring to early summer; usually sporulating Mar–Jun. [*O. pycnostichum* (Fernald) A. Löve & D. Löve, *O. vulgatum* var. *pycnostichum* Fernald]

OSMUNDACEAE Gérardin & Desv.
CINNAMON OR ROYAL FERN FAMILY

A nearly cosmopolitan family with 3 genera and up to ca. 36 species (Whetstone & Atkinson 1993), with some cultivated as ornamentals. It is one of the oldest living fern families, extending back to the late Permian Period (286–245 million years ago), and in some respects it is intermediate between eusporangiate and leptosporangiate ferns. The eusporangiate ferns, consisting of only two families, Ophioglossaceae and Marattiaceae, usually have thousands of spores per sporangium, the Osmundaceae have hundreds, and the other leptosporangiate ferns have 128 or more typically 64 or sometimes 32 (Lellinger 1985; Jones & Luchsinger 1986). Morphological and molecular evidence indicates the Osmundaceae is the most basal leptosporangiate fern family (or alternatively stated, it is the sister group of a clade containing all other leptosporangiate ferns) (Li & Haufler 1994; Pryer et al. 1995; Hasebe et al. 1995; Doyle 1998; Yatabe et al. 1999).
FAMILY RECOGNITION IN THE FIELD: leaves usually large, wholly or partly *dimorphic* (fertile leaves or pinnae conspicuously different from sterile); sporangia not in discrete sori.
REFERENCES: Correll 1956, 1966a; Hewitson 1962; Kramer 1990e; Whetstone & Atkinson 1993; Li & Haufler 1994; Phipps et al. 1998; Yatabe et al. 1999.

OSMUNDA L. CINNAMON FERN, INTERRUPTED FERN, ROYAL FERN

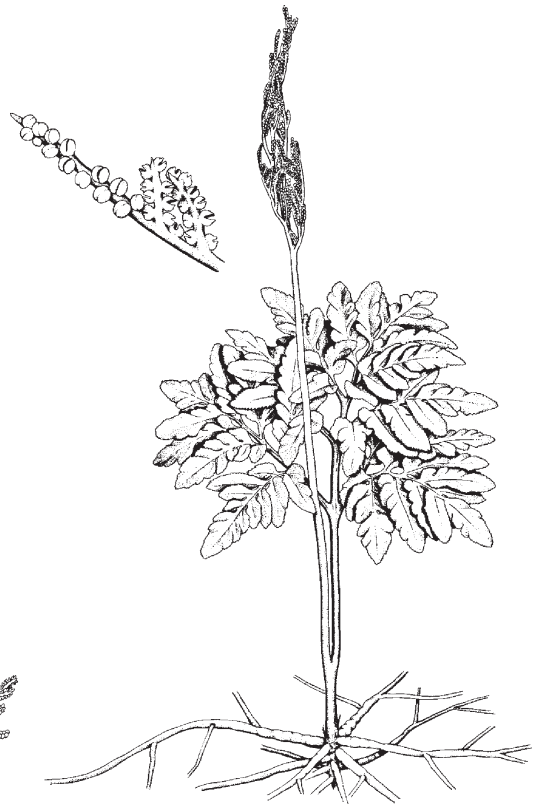
Terrestrial; leaves erect to spreading, in a vase-shaped cluster from a stout, woody, creeping to erect stem (rhizome), wholly or partly dimorphic; sori absent; sporangia clustered; indusia absent.

A nearly cosmopolitan genus of 10 species (Whetstone & Atkinson 1993). *Osmunda* fossils described from the Triassic (approx. 200 million years ago) of Antarctica were reported as similar to present day *O. claytoniana* L. (a widespread species native to e North America and Asia) and the fossils were cited as an example of evolutionary stasis (Phipps et al. 1998). However, Yatabe et al. (1999) more recently interpreted the same fossils as being more similar to *O. cinnamomea*—this time span represents the longest known duration of any living fern species (Moran 2004). (Saxon: *Osmunder*, name for Thor, Norse god of thunder and war)
REFERENCES: Miller 1967; Serbet & Rothwell 1999.

1. Fertile leaves not very leaf-like, without expanded blade tissue, completely different in appearance from sterile leaves; smallest subdivisions of sterile leaves not narrowed at base, the area of attachment as broad as segment _____ **O. cinnamomea**



Botrychium biternatum [TAY]



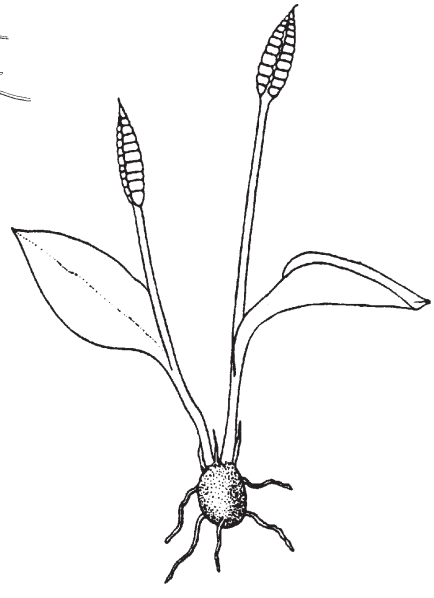
Botrychium dissectum [TAY]



Botrychium lunarioides [TAY]



Botrychium virginianum [TAY]



Ophioglossum crotalophoroides [LUN]

1. Fertile leaves similar in appearance to sterile leaves except with greatly reduced, sporangia-bearing pinnae at tip; smallest subdivisions of leaves greatly narrowed at very base, attached at one stalk-like point only _____ **O. regalis**

Osmunda cinnamomea L., (cinnamon-brown), CINNAMON FERN, BUCKHORN FERN, BUCKHORN BRAKE, FLOWERING FERN. Sterile leaves 1-pinnate-pinnatifid, ca. 0.3–1.5 m long, the smallest subdivisions with margins entire and usually apically mucronate; pinnae with a persistent tuft of tomentum at base; rachis greenish, with reddish brown hairs when young; fertile leaves with no expanded pinnae, densely tomentose, much narrower and shorter than sterile leaves; sporangia cinnamon-colored. Wet areas; Pineywoods and Gulf Prairies and Marshes w to Gonzales, Leon (BAYLU), Milam, (Correll 1956; Turner et al. 2003) Lee (BRIT), Henderson, and Van Zandt (Turner et al. 2003) cos. in the Post Oak Savannah and to Lamar Co. (BRIT) in Red River drainage; also disjunct to Edwards Co. (Turner et al. 2003) on the Edwards Plateau; se Canada and throughout e U.S. w to MN and TX. Sporulating Mar–Jul or later. Based on DNA evidence, *O. cinnamomea* is considered the most basal species in the family (Yatabe et al. 1999). If this interpretation is correct, the genus *Osmunda* is not monophyletic (unless *O. cinnamomea* is excluded). According to Yatabe et al. (1999), "When the *rbcL* trees, the fossil and morphological evidences are all taken into account, it can be concluded that the extant *Osmunda cinnamomea* has no other closely related living species in Osmundaceae, and it has evolutionarily very static morphology with no significant modification for more than 200 Myrs. Thus we can call extant *O. cinnamomea* a 'living fossil'." Further, recent fossil discoveries from the Upper Cretaceous (Serbet & Rothwell 1999) provide evidence that *O. cinnamomea* has been in North America "for at least 70 million years" and suggest that fern species can remain virtually unchanged over millions of years. A form of this species, forma *frondosa* (Torr. & A. Gray) Britton, is known (e.g, from FL, GA, and VA) with aberrant fertile leaves that can have sterile pinnae either apically or basally, or both (Werth et al. 1985; Carter & Faircloth 1986; Nelson 2000). It can thus rarely resemble *O. claytoniana* L., INTERRUPTED FERN, of the e U.S. which has fertile leaves with the middle fertile pinnae greatly reduced and the apical and basal sterile pinnae like those of the sterile leaves. Nelson (2000) indicated that, "According to many workers, this 'interrupted cinnamon fern' is likely an environmentally induced variant resulting from disturbances such as mowing, fire, or late season frosts." According to Nelson (2000), *O. cinnamomea* is "superficially similar to *Woodwardia virginica* but is easily distinguished at some distance by the latter's overall darker rachis." ⊠/293

Osmunda regalis L. var. **spectabilis** (Willd.) A. Gray, (sp.: royal; var. spectacular), ROYAL FERN, FLOWERING FERN. Leaves 2-pinnate; sterile leaves ca. 0.75–1 m long; pinnules lanceolate, the margins subentire to remotely dentate, apically acute to rounded; pinnae without a persistent tuft of tomentum at base, essentially glabrous; sporangia brown at maturity. Wet areas; Pineywoods and Post Oak Savannah w to Lamar Co. (Carr 1994) in Red River drainage and Travis (Correll 1956) and Bexar (Turner et al. 2003) cos. near the e edge of the Edwards Plateau; also n Gulf Prairies and Marshes; se Canada and through e U.S. w to MN and TX. Sporulating Mar–Jul. Variety *regalis* is native to Eurasia and is distinguished by black hair-like scales along the leaf rachis and a more robust habit (Nauman et al. 2000). ⊠/293

POLYPODIACEAE Bercht. & Presl
POLYPODY FERN FAMILY

A cosmopolitan family treated today as including ca. 40 genera and ca. 500 species (Smith 1993c). As previously circumscribed, the Polypodiaceae encompassed ca. 7,000 species or nearly two-thirds of the living ferns. Family name from *Polypodium*, POLYPODY, a cosmopolitan genus of ca. 100 species, currently more narrowly defined than previously. (Greek: *poly*, many,

and *pous* or *podium*, foot, referring to the rhizomes which "bear on their upper surface two rows of slightly elevated leaf bases known as phyllopodia. This imparts the appearance of an upside-down creeping caterpillar with its two rows of feet ..."—Moran 2004)
FAMILY RECOGNITION IN THE FIELD: the single East TX species is typically epiphytic or found growing on rocks; the *discrete round sori* without indusia are found in single rows on each side of the midvein of the lobes of the *deeply pinnatifid* leaves; the lower leaf surfaces are conspicuously covered with *peltate scales*.
REFERENCES: Weatherby 1939; Correll 1956, 1966a; de la Sota 1973; Hennipman et al. 1990; Smith 1993c.

PLEOPELTIS Humb. & Bonpl. ex Willd.
SHIELD-SORUS FERN, SCALY-POLYPODY

A widespread but primarily neotropical genus of ca. 50 species of mostly epiphytic ferns (Andrews & Windham 1993). Some of the species now treated in *Pleopeltis* were formerly included in *Polypodium* ("Early pteridologists placed any fern with round, non-indusiate sori in *Polypodium*"—Hoshizaki & Moran 2001). However, *Pleopeltis* species can be readily distinguished by having scales (hence the common name SCALY-POLYPODY) of a distinctive type scattered over the abaxial surface of the leaf blade (as well as many other characters differentiating them from *Polypodium*) (Windham 1993e). (Greek: *pleos*, many, and *pelte*, shield, in reference to the peltate scales covering immature sori)
REFERENCES: Andrews & Windham 1993; Windham 1993e; Moran 1998; Bush et al. 1999.

Pleopeltis polypodioides (L.) E.B. Andrews & Windham var. **michauxiana** (Weath.) E.B. Andrews & Windham (sp: resembling *Polypodium*; var.: for André Michaux, 1746–1803, French botanist and explorer of North America), RESURRECTION FERN, GRAY POLYPODY, TREE FERN. Usually epiphytic or sometimes growing on rocks; stems (rhizomes) slender, widely creeping, densely scaly; leaves monomorphic, evergreen, widely spaced; leaf blades oblong to triangular-oblong in outline, deeply pinnatifid, to 15 cm long and 5 cm wide, thick, opaque, hygroscopic, involute upon drying, the margins mostly entire, glabrous above except for a few scales along midvein, densely covered with peltate scales below; sori round, discrete, in single rows on each side of the midvein of the lobes near the margins, forming conspicuous bumps on the undersurface of leaves; indusia absent. Usually growing on various species of trees, especially oaks, sometimes on rocks, usually in shady damp situations; widespread in e 1/2 of TX; e U.S. from DE s to FL w to KS and TX. Previously lumped into the genus *Polypodium* [as *P. polypodioides* (L.) Watt var. *michauxianum* Weath.]. The common name, RESURRECTION FERN, refers to the leaves "... which become brown and appear dead during dry periods, but 'resurrect' themselves after rains and rapidly become green and lush" (Nelson 2000). This occurs because the special peltate scales on the lower surface of the leaf are able to absorb water and quickly channel it into the leaf. Each scale is made up of a disk-like portion composed of numerous dead cells and a stalk of living cells. When water is present, it is drawn into the dead cells by capillary action, then taken up by the living stalk cells, and subsequently transported into the leaf tissue (Moran 1998, 2004). The six known varieties of this species range from the se U.S. to Argentina and Africa (Nauman et al. 2000). ⊞/295

PTERIDACEAE Spreng. ex Jameson
MAIDENHAIR FERN OR BRAKE FAMILY

East TX species mostly on rocks, sometimes terrestrial (or in *Ceratopteris* aquatic or semi-aquatic); leaves monomorphic (rarely somewhat dimorphic or in *Ceratopteris* distinctly dimorphic); leaf blades 1–4(–5) pinnate or 1–more pinnate-pinnatifid; sporangia abaxial on the

blades, marginal or submarginal; margins of ultimate segments (= smallest subdivisions) of leaf blades recurved to form false indusia (except in *Astrolepis*).

The taxa included here in the Pteridaceae have been variously treated at the family level. For instance, some authorities (e.g., Carlquist & Schneider 2000a) segregate *Cheilanthes* and close relatives into the Cheilanthaceae, while others (e.g., Lellinger 1985) recognize some of the genera as Sinopteridaceae. We follow Windham's (1993a) treatment (slightly modified to include *Ceratopteris*—see discussion under that genus) and recognize the Pteridaceae as a cosmopolitan family of ca. 40 genera and ca. 1,000 species. Six genera occur in East TX. The newer name Adiantaceae has sometimes been applied to the family.

FAMILY RECOGNITION IN THE FIELD: plants typically growing *on rocks* (except 1 species aquatic or semi-aquatic); *sporangia at or near margins* of the ultimate leaf segments with the leaf *margins usually recurved* over sporangia to form false indusia (except in *Astrolepis*).

REFERENCES: Correll 1956, 1966a; Tryon et al. 1990; Windham 1993a; Gastony & Rollo 1998; Carlquist & Schneider 2000a.

1. Plants aquatic or semiaquatic; leaves distinctly dimorphic (the fertile quite different than the sterile); leaf blades with adventitious buds or small plantlets in notches along margins _____ **Ceratopteris**
1. Plants mostly on rocks, sometimes terrestrial; leaves usually monomorphic or in *Pellaea* somewhat dimorphic; leaf blades without adventitious buds or plantlets.
   2. Margins of ultimate leaf segments (= smallest subdivisions of leaf) not recurved to form false indusia; leaf blades 1-pinnate to 1-pinnate-pinnatifid throughout; lower (= abaxial) leaf surfaces densely covered with coarsely ciliate or stellate scales; upper (= adaxial) leaf surfaces usually with coarsely ciliate or stellate scales _____ **Astrolepis**
   2. Margins of ultimate leaf segments recurved to form false indusia; leaf blades 2–5 pinnate at least at base OR at least partially 2-pinnatifid (1-pinnate in 1 species of *Pteris*); lower leaf surfaces scaly, pubescent, or glabrous; upper leaf surfaces without coarsely ciliate or stellate scales.
      3. Rachis conspicuously winged in at least the distal 1/2 of leaf blade; leaf blades divided at most so that they are 2-pinnatifid (usually at least some pinnae are deeply palmately 3-divided) _____ **Pteris**
      3. Rachis not winged; leaf blades more divided, 2–5-pinnate at least at base.
         4. Ultimate leaf segments with only the apical margin recurved; sporangia borne directly on underside of recurved apical margins of ultimate leaf segments (= borne on the false indusium); veins of ultimate leaf segments prominent, dichotomously branched (= equally 2-forked), essentially parallel near the margins _____ **Adiantum**
         4. Ultimate leaf segments with apical and lateral margins recurved over sporangia; sporangia borne on lower leaf surface and covered by the recurved margins (= borne on blade tissue beneath the false indusium); veins of ultimate leaf segments obscure or, if prominent, pinnately branched and more divergent near the margins.
            5. Leaf blades usually 1-pinnate distally (2-pinnate below), glabrous on lower surface or nearly so; largest ultimate leaf segments > 4 mm wide _____ **Pellaea**
            5. Leaf blades 2–more pinnate or pinnate-pinnatifid nearly throughout, usually tomentose on lower surface (except sparsely pubescent to nearly glabrous in *Cheilanthes alabamensis*, *C. aemula*, and *Argyrochosma microphylla*) OR lower surface covered with conspicuous whitish powdery material; ultimate leaf segments < 4 mm wide.
               6. Leaf blades with conspicuous whitish powdery material and without pubescence abaxially _____ **Argyrochosma**
               6. Leaf blades lacking conspicuous whitish powdery material, often (but not always) tomentose abaxially.
                  7. Leaf blades glabrous abaxially; most distal ultimate segments of leaf blades ± cordate at base and attached only by distinct dark-colored stalks _____ **Argyrochosma**



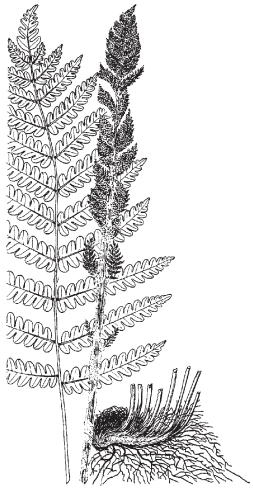
Ophioglossum engelmannii [TAY]



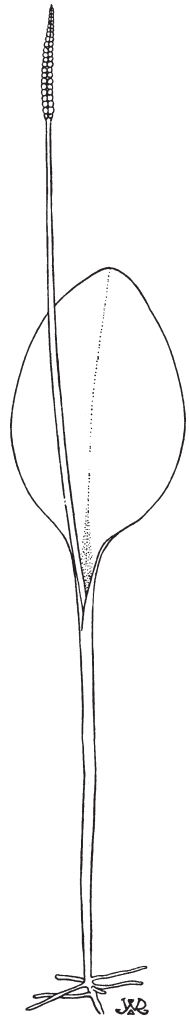
Ophioglossum nudicaule [TAY]



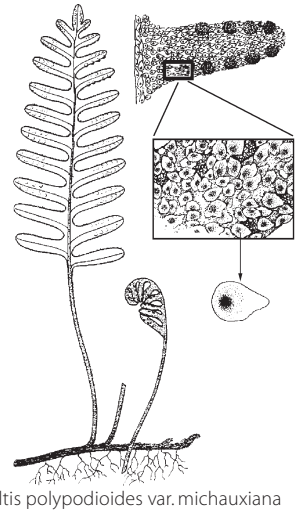
Ophioglossum petiolatum [TAY]



Osmunda cinnamomea [LUN]



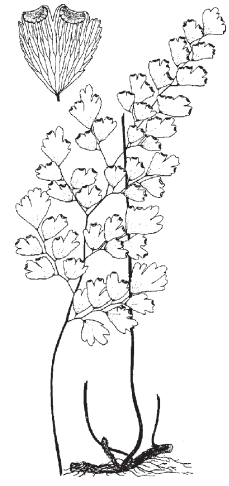
Ophioglossum vulgatum [LUN]



Pleopeltis polypodioides var. michauxiana [FNA, LUN]



Osmunda regalis var. spectabilis [LUN]



Adiantum capillus-veneris [LUN]

7. Leaf blades usually tomentose abaxially OR if glabrous then the most distal ultimate segments of leaf blades not cordate at base and ± sessile (attached at least partially by blade tissue) _____ **Cheilanthes**

ADIANTUM L. MAIDENHAIR FERN

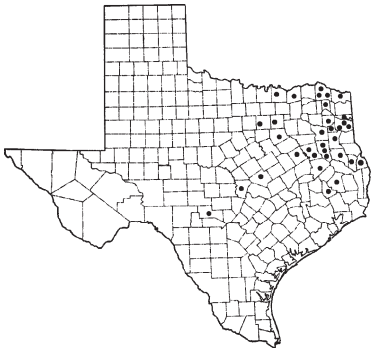
A genus of 150–200 species, nearly worldwide in distribution except at higher latitudes (> 60°), but most common in Andean South America (Paris 1993). It is sometimes placed in the Adiantaceae. Some species are used medicinally and a number are cultivated as ornamentals for their delicate, beautiful foliage. The position of the sporangia is definitive for identification—in other related ferns with false indusia (e.g., *Cheilanthes*, *Pellaea*), the sporangia are borne on the blade tissue beneath the false indusium, rather than on the false indusium itself as in *Adiantum*. The leaves "have the unusual property that, when wetted, water beads-up into silvery droplets that quickly roll off" (Hoshizaki & Moran 2001)—hence the scientific name. (Greek: *adiantos*, unwetted, for the glabrous leaves, which shed raindrops)
REFERENCES: Fernald 1950b; Paris 1993.

Adiantum capillus-veneris L., (Venus' hair), VENUS'-HAIR FERN, SOUTHERN MAIDENHAIR, CULANTRILLO, MATTRESS FERN. Terrestrial or on rocks; stems (rhizomes) short-creeping; leaves ± monomorphic, weakly deciduous, closely spaced, numerous, lax-arching or pendulous, 15–75 cm tall; leaf blades 2(–more) pinnate, glabrous, membranous to thin-herbaceous, bright green, the ultimate segments (= smallest subdivisions) usually wedge or fan-shaped to irregularly rhombic (= 4-sided, diamond-shaped), ca. as long as broad, stalked; apical leaf margins recurved to form false indusia; veins of ultimate leaf segments prominent, dichotomously branched (= equally 2-forked), essentially parallel near the margins, a distinct midvein absent; sporangia submarginal, borne on the abaxial (= beneath) surface of the false indusia. Continuously moist calcareous areas, particularly limestone bluffs, rocks and ledges along streams. Hays, Harris (BRIT), Bell, Bexar, Travis (BAYLU), Newton (TAES), Comal, Dallas, Kaufman, Hill, McLennan, Orange, Washington, and Williamson (Turner et al. 2003) cos.; scattered nearly throughout TX, common in some areas such as the Edwards Plateau; s 1/2 of U.S. from VA s to FL w to CA, also SD and B.C. Sporulating May–Jan. The species has long been used medicinally for conditions of the skin, scalp, and internal organs (Cheatham & Johnston 1995). Hoshizaki and Moran (2001) considered this species, widespread in warm-temperate to subtropical areas, to be one of the most widely distributed ferns in the world.

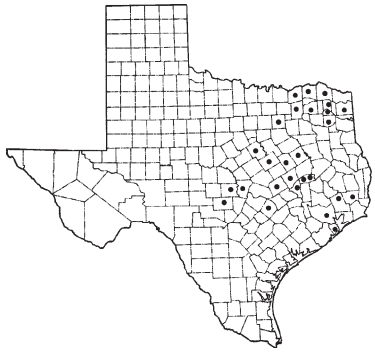
ARGYROCHOSMA (J. Smith) Windham FALSE CLOAK FERN

Plants usually on rocks; stems compact, erect to ascending; leaves monomorphic, clustered, to only 25 cm long; petioles, rachises, and stalks of ultimate leaf segments dark brown, lustrous; leaf blades 3–5 pinnate, deltate to ovate, the abaxial surfaces glabrous or covered by a whitish, mealy, powdery material (= farina); ultimate leaf segments (= smallest subdivisions of leaf) small (< 4 mm wide), their margins recurved to revolute, forming false indusia, these often concealing or partially concealing the sporangia; sporangia on the abaxial leaf surfaces, submarginal.

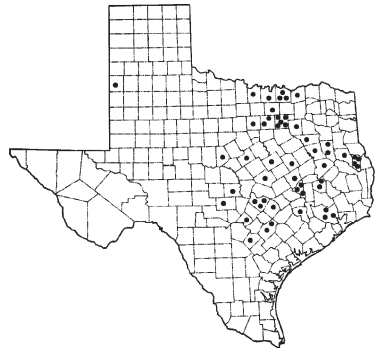
A New World genus of ca. 20 species (Windham 1993b). While the species have been variously treated in a variety of genera (e.g., *Cheilanthes*, *Notholaena*, and *Pellaea*), Windham (1987b) segregated *A. dealbata*, *A. microphylla*, and related species as the genus *Argyrochosma*. Morphological and chromosome evidence (x = 27—unique among cheilanthoid ferns) supports its separate recognition (Windham 1993b), as does more recent molecular evidence (Gastony & Rollo 1998). (Greek: *argyros*, silver, and *chosma*, powder, referring to whitish farina covering the abaxial surface of leaf blades in most species)
REFERENCES: Tryon 1956; Windham 1987b, 1993b.



Botrychium virginianum



Ophioglossum crotalophoroides



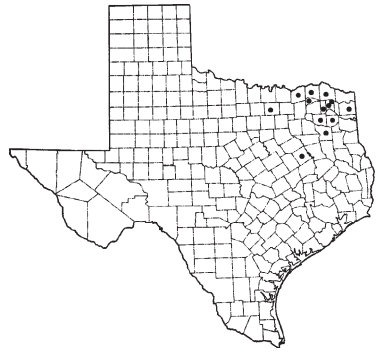
Ophioglossum engelmannii



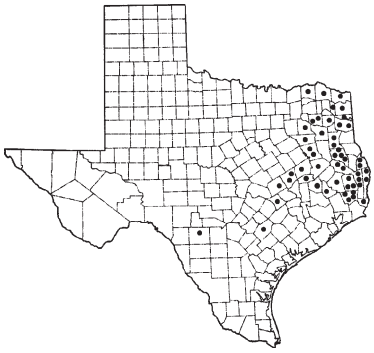
Ophioglossum nudicaule



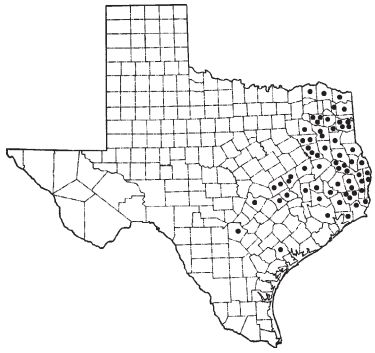
Ophioglossum petiolatum



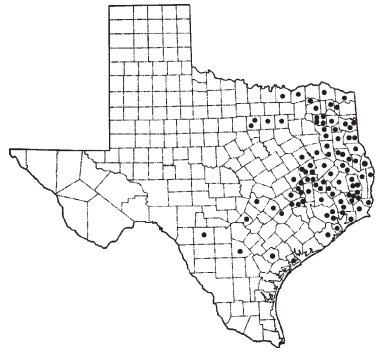
Ophioglossum vulgatum



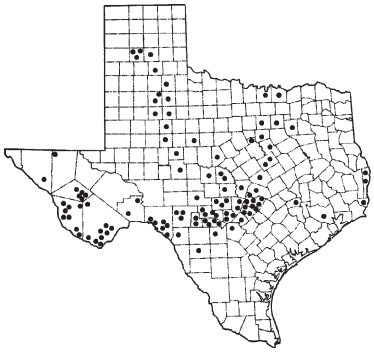
Osmunda cinnamomea



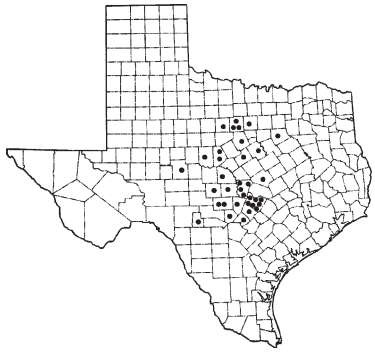
Osmunda regalis var. spectabilis



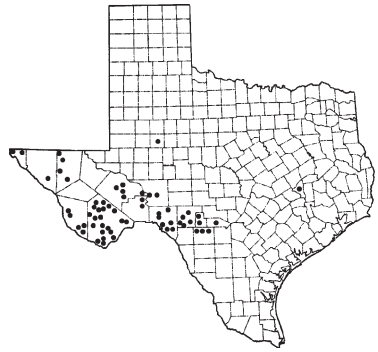
Pleopeltis polypodioides var. michauxiana



Adiantum capillus-veneris



Argyrochosma dealbata



Argyrochosma microphylla

1. Abaxial (= lower) surfaces of leaf blades obscured by a covering of a whitish powdery material (= farina); ultimate leaf segments not articulate (the dark brown color of the segment stalks continuing into the segment bases on the abaxial side) _____ **A. dealbata**
1. Abaxial surfaces of leaf blades without whitish covering; ultimate leaf segments articulate (the dark brown color of the segment stalks ending abruptly at the segment bases) _____ **A. microphylla**

Argyrochosma dealbata (Pursh) Windham, (white-washed), POWDERY FALSE CLOAK FERN, POWDERY CLOAK FERN, FALSE CLOAK FERN. Leaves to only ca. 15 cm long, evergreen; leaf blades 3–5-pinnate, less divided distally, somewhat herbaceous, the adaxial (= upper) surface bluish green, glabrous, the abaxial (= lower) surface with very conspicuous whitish powdery material. Crevices of limestone and other calcareous rocks; Bell (TAES), Travis (BRIT), Comal, Hays (Turner et al. 2003), and Ellis (Correll 1956) cos. near w margin of East TX; mainly Cross Timbers and Prairies and e Edwards Plateau; AR, IL, KS, KY, MO, NE, OK, and TX. Sporulating summer–fall. [*Cheilanthes dealbata* Pursh, *Notholaena dealbata* (Pursh) Kunze, *Pellaea dealbata* (Pursh) Prantl]

Argyrochosma microphylla (Mett. ex Kuhn) Windham, (small-leaved), SMALL-LEAF FALSE CLOAK FERN, SMALL-LEAF CLOAK FERN. Leaves 7–25 cm long; leaf blades 3–4-pinnate basally, 2-pinnate distally, leathery, glabrous on both surfaces, often glaucous. Limestone hillsides and cliffs; mainly occurring in Trans-Pecos and the Edwards Plateau, this species is reported as disjunct in East TX in Brazos Co. (Correll 1956); NM and TX. Sporulating summer–fall. [*Pellaea microphylla* (Mettenius ex Kuhn) Windham, *Cheilanthes parvifolia* (R.M. Tryon) Mickel, *Notholaena parvifolia* R.M. Tryon] It is easily distinguished from *A. dealbata* by the lack of whitish powdery material on the abaxial leaf surfaces. Reported to be poisonous to sheep (Correll 1956).

ASTROLEPIS D.M. Benham & Windham
STAR-SCALED CLOAK FERN, SCALY CLOAK FERN

Plants usually on rocks; stems (rhizomes) compact to short-creeping; leaves monomorphic, evergreen, clustered, 1-pinnate to 1-pinnate-pinnatifid, the abaxial (= lower) leaf surfaces with ciliate scales and usually underlying layer of stellate scales concealing the surface, the upper surfaces sparsely to densely covered with stellate or coarsely ciliate scales to glabrescent with age; sporangia marginal or nearly so, forming a ± continuous band; false indusium absent.

A New World genus of ca. 8 species (Benham & Windham 1993). The taxa treated here as *Astrolepis* have been previously lumped into various genera including *Notholaena* or *Cheilanthes*. Benham and Windham (1992) indicated that these and several related species are a monophyletic group worthy of recognition as the genus *Astrolepis*. (Greek: *astro*, star, and *lepis*, scale, in reference to the star-like scales on the adaxial surfaces of the leaf blades)
REFERENCES: Tryon 1956; Benham & Windham 1992, 1993; Carlquist & Schneider 1997.

1. Upper (= adaxial) leaf surfaces densely scaly, particularly near margins, the scales usually persistent, the body of the scales 5–7 cells wide; largest pinnae entire or slightly lobed _____ **A. integerrima**
1. Upper leaf surfaces only sparsely scaly to glabrescent, most scales deciduous with age, the body of the scales 1–2 cells wide; largest pinnae often conspicuously lobed _____ **A. sinuata**

Astrolepis integerrima (Hook.) D.M. Benham & Windham, (very entire), SOUTHWESTERN CLOAK FERN. Leaves 8–45 cm long; largest pinnae usually 7–15 mm long, entire or asymmetrically and shallowly lobed. Rocky slopes, outcrops, or cliffs, usually limestone or other calcareous substrates. Bexar and Comal (Turner et al. 2003) cos. on w margin of East TX; primarily w 1/2 of TX; mostly sw U.S. (AZ, NM, NV, OK, and TX), also reported from AL (Kartesz 1999). Sporulating summer–fall. [*Cheilanthes integerrima* (Hook.) Mickel, *Notholaena integerrima* (Hook.) Hevly, *Notholaena sinuata* (Lag. ex Sw.) Kaulf. var. *integerrima* Hook.]

Astrolepis sinuata (Lag. ex Sw.) D.M. Benham & Windham, (wavy-margined), BULB LIP FERN, WAVY SCALY CLOAK FERN, WAVY CLOAK FERN, LONG CLOAK FERN, JIMMY FERN. Leaves 11–130 cm long; longest pinnae 7–35 mm long, symmetrically 6- to 14-lobed. Rocky slopes, outcrops, or cliffs, calcareous or other substrates; Comal Co. (Turner et al. 2003) near w margin of East TX and Anderson Co. (Correll 1956); Hatch et al. (1990) also cited vegetational area 4, probably based on the Anderson Co. record from near the boundary of the Blackland Prairie and Post Oak Savannah vegetational areas; mainly c to w TX; mostly sw U.S. (AZ, NM, OK, and TX), also disjunct in GA. Sporulating Mar–Nov. [*Acrostichum sinuatum* Lag. ex Sw., *Cheilanthes sinuata* (Lag. ex Sw.) Domin, *Notholaena sinuata* (Lag. ex Sw.) Kaulf.] Burlage (1968) reported this species as toxic to livestock. An unidentified poison causes incoordination, arched back, rapid pulse, gasping, trembling (known as "the jimmies"), and prostration; death can result from respiratory paralysis. Sheep are apparently most susceptible, followed by goats and cattle (Weathers 1998). However, Burrows and Tyrl (2001) indicated that *A. sinuata* does not produce adverse effects, and that the toxic species is the related *A. cochisensis* (Goodd.) D.M. Benham & Windham (sometimes in the past referred to as *Notholaena sinuata* var. *cochisensis* (Goodd.) Weatherby), which is found in TX only in the extreme w part of the state. ☠

CERATOPTERIS Brongn. ANTLER FERN, WATER FERN, FLOATING FERN

A taxonomically difficult genus of 3–4 species of morphologically variable aquatics or semiaquatics widespread in the tropics to warm temperate areas (Lloyd 1993); some are grown as aquarium plants (Hoshizaki & Moran 2001). The genus is said to have the fastest life cycle of any fern—as little as one month to go from spore to spore-bearing plant. Because of this, they are used in laboratory genetics studies (Hoshizaki & Moran 2001). *Ceratopteris* has often been treated in the Parkeriaceae, the ANTLER FERN or WATER FERN family (e.g., Correll & Johnston 1970; Lloyd 1993). According to Lellinger (1985), "The Parkeriaceae clearly belongs to the Schizaeales [including Anemiaceae and Lygodiaceae], but its exact position is uncertain. As in some cases of flowering plants, the aquatic habitat has caused great modifications of structure in *Ceratopteris* that obscure the relationships of these plants to the other, non-aquatic families in the order." However, recent molecular studies (Gastony & Rollo 1998), which did not rely on highly modified morphological characters, indicated that the sister group of *Ceratopteris* is *Pityrogramma*, a genus traditionally placed in the Pteridaceae. We are thus following Tryon (1987), Tryon et al. (1990), Gastony and Rollo (1998), and Robbin Moran (pers. comm.) in treating *Ceratopteris* in the Pteridaceae; it is probably best placed in its own subfamily, Ceratopteridoideae, as originally suggested by Tryon (1987). *Ceratopteris* is the only group of homosporous (= with 1 spore type) aquatic ferns (heterosporous aquatic ferns include the Azollaceae, Marsileaceae, and Salviniaceae). The following treatment draws heavily on Lloyd (1993). (Greek: *cerato*, horned, and *pteris*, fern, derived from *pteron*, wing or feather, in reference to the antler-like fertile leaf)

REFERENCES: Benedict 1909; Morton 1967a; Hannan 1969; Lloyd 1974, 1993; Petrik-Ott & Ott 1976; Tryon 1987; Lemke 1994; Gastony & Rollo 1998; Carlquist & Schneider 2000b.

Ceratopteris thalictroides (L.) Brongn., (resembling *Thalictrum*, meadow-rue), WATER SPRITE, WATER FERN. Plant short-lived, aquatic or semiaquatic, usually rooting, but sometimes floating; leaves dimorphic, with adventitious buds or small plantlets in notches along margins; sterile leaves 1–3 pinnate, the blades lanceolate to ovate or deltate in outline, 2–41 cm long, 2–20 cm wide, with relatively broad ultimate segments (broader than the linear ultimate segments of the fertile leaf blades), the petioles 1–31 cm long, not inflated; fertile leaves 3–4 pinnate proximally, 2-pinnate distally, larger than the sterile leaves, 2–117 cm long, to 48 cm wide, the blades lanceolate to ovate, deltate, or cordate in outline, finely dissected with the ultimate segments linear, the petioles 1-46 cm long; margins of fertile blades revolute, covering the 1–3 rows of sporangia and forming false indusia. Cultivated in aquaria and warm-weather lily or fish ponds

and presumably escaping; usually rooted in mud in quiet or moving water of springs and adjacent rivers and lakes; Hays (TEX), Bell, and Comal (Petrik-Ott & Ott 1976) cos. along the Balcones Fault at the edge of the Blackland Prairie and the Edwards Plateau. According to D. Lemke (pers. comm. 1998), it is still present in the San Marcos River in Hays Co. Petrik-Ott and Ott (1976) suggested that the constant temperature of the springs along the Balcones Fault may allow this mainly tropical species to persist indefinitely in TX. The species was first reported from Texas by Morton (1967a) and was apparently introduced to the state in 1963 (Hannen 1969). Mar–Oct. Native to tropical areas worldwide, except Africa, it has been found escaped in the U.S. in CA, FL, LA, TX (Lloyd 1993), and MS (Kartesz 1999). [*Acrostichum thalictroides* L.] This is an extremely widespread and variable species (Lloyd 1974). It is cultivated in some areas (e.g., Japan) as a spring vegetable in flooded rice fields (Mabberley 1997). Tryon and Tryon (1982) suggested that while *Ceratopteris* is usually considered to be an annual, it "... may be more accurately described as short-lived." They indicated that many tropical habitats "... lack the seasonality necessary to provide a basis for an annual lifecycle." ☞

CHEILANTHES Sw. LIP FERN

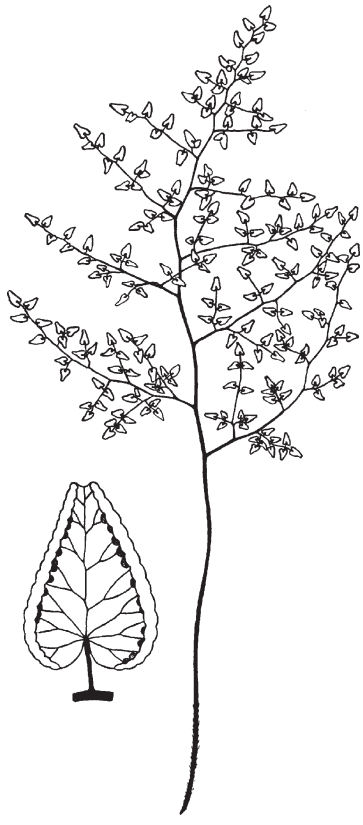
Plants xerophytic, usually growing on rocks; stems (rhizomes) compact to long-creeping; leaves monomorphic, evergreen, clustered or scattered along the rhizomes; leaf blades 2–more-pinnate-pinnatifid, usually conspicuously tomentose beneath but sometimes glabrous or nearly so; petioles dark brown to black; sporangia marginal on the abaxial (= lower) leaf surfaces; margins of ultimate leaf segments (= smallest subdivisions of leaf) recurved to form false indusia; veins of ultimate segments free or rarely anastomosing, obscure.

☙A genus of ca. 150 species found primarily in the New World, with a few in Europe, Asia, Africa, Pacific Islands, and Australia (Windham & Rabe 1993). According to Windham and Rabe (1993), *Cheilanthes* is the largest and most diverse genus of xerophytic ferns. Even after the removal of segregates including *Argyrochosma* and *Astrolepis*, it is still a heterogeneous and possibly polyphyletic genus. In fact, recent molecular evidence (Gastony & Rollo 1998) supports the hypothesis that it is polyphyletic. The scientific and common names both come from the position of the sori on the margin or "lip" of the ultimate leaf segments. Because hair-like scales as narrow as 0.1 mm wide can occur, and because scales are sometimes ciliate, magnification is often necessary for accurate determination of species. (Greek: *cheilos*, margin or lip, and *anthus*, flower, referring to the sporangia located near and protected by the recurved leaf margin) REFERENCES: Mickel 1979; Windham & Rabe 1993.

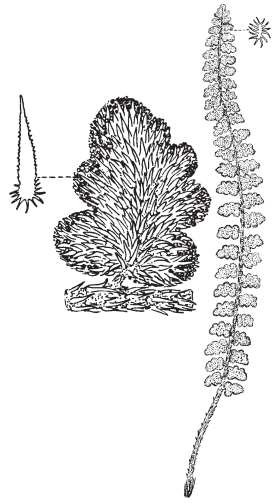
1. Midvein of leaf segments and/or rachis with scales beneath (= abaxially) (NOTE: hairs can also be present).
   2. Ultimate leaf segments (= smallest subdivisions of leaf) scabrous (= rough to the touch) on upper surface, covered with stiff hairs _____ **C. horridula**
   2. Ultimate leaf segments smooth to the touch on upper surface, lacking stiff hairs.
      3. Scales linear, inconspicuous, only slightly wider than hairs, the largest 0.1–0.4 mm wide __ **C. tomentosa**
      3. Scales linear to lanceolate to ovate, conspicuous, obviously much wider than hairs, the largest 0.4–1.0 mm wide.
         4. Scales ovate to lanceolate, long ciliate, the cilia sometimes forming an entangled mass; rhizome slender, widely creeping, with leaves scattered along the rhizome _____ **C. lindheimeri**
         4. Scales linear to lanceolate, not ciliate, rarely with 1–2 cilia at base; rhizome stout, short, with leaves in a dense clump _____ **C. eatonii**
1. Midvein of leaf segments and rachis lacking scales beneath or with extremely narrow inconspicuous hair-like scales (but can be strikingly pubescent to glabrous).
   5. Leaf blades essentially glabrous to sparsely pubescent beneath AND not at all scabrous on upper surface; ultimate leaf segments narrowly elliptic to elongate-deltate, not at all suborbicular to bead-like.



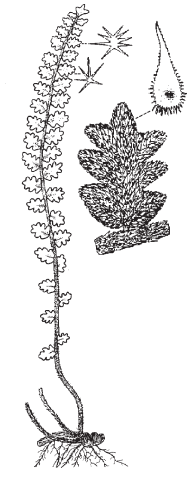
Argyrochosma dealbata [LUN]



Argyrochosma microphylla [LUN]



Astrolepis integerrima [LUN]



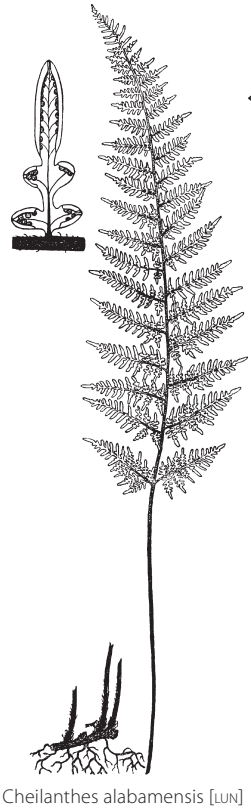
Astrolepis sinuata [LUN]



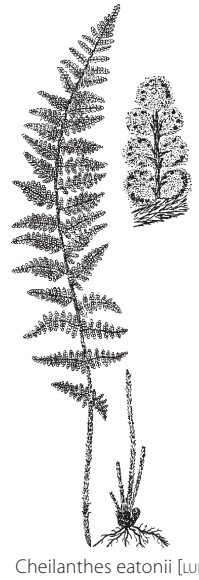
Ceratopteris thalictroides [FNA]



Cheilanthes aemula [LUN]



Cheilanthes alabamensis [LUN]



Cheilanthes eatonii [LUN]

6. Leaf blades lanceolate to oblong, 1–7 cm wide; basal pair of pinnae slightly smaller than adjacent pair; basal pair of pinnules of basal pinnae 6 equal in size _____ **C. alabamensis**
6. Leaf blades broadly triangular to ovate, 5–15 cm wide; basal pair of pinnae slightly larger than adjacent pair; basal pair of pinnules of basal pinnae conspicuously unequal in size _____ **C. aemula**

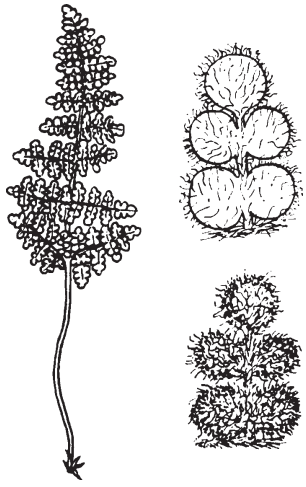
5. Leaf blades EITHER densely pubescent beneath OR scabrous (= rough to the touch) on upper surface; ultimate leaf segments suborbicular to bead-like (*C. feei* and *C. tomentosa*) OR not so (*C. horridula* and *C. lanosa*).
7. Ultimate leaf segments scabrous on upper surface, covered with stiff hairs _____ **C. horridula**
7. Ultimate leaf segments smooth to the touch on upper surface, lacking stiff hairs.
8. Ultimate fertile segments of pinnae elongate, not bead-like; leaf blades 2-pinnate-pinnatifid near base _____ **C. lanosa**
8. Ultimate fertile segments of pinnae bead-like; leaf blades 3- or 4-pinnate near base.
9. Petiole and rachis densely tomentose, particularly when young, the hairs not noticeably jointed; leaf blades usually 4-pinnate at base, 1.5–8 cm wide _____ **C. tomentosa**
9. Petiole and rachis not densely tomentose, instead very sparsely to densely hispidulose, the hairs noticeably jointed (under strong hand lens or dissecting scope); leaf blades usually 3-pinnate at base, 1–3 cm wide _____ **C. feei**

Cheilanthes aemula Maxon, (rivaling, imitating), TEXAS LIP FERN, RIVAL LIP FERN. Leaves clustered, 10–50 cm long; leaf blades broadly triangular to ovate, 5–15 cm wide, the largest ultimate segments (= the smallest subdivisions) 3–6 mm long; this is one of the two glabrous (or nearly so) East TX *Cheilanthes* species. Rocky slopes and ledges, on limestone; Austin Co. in se Blackland Prairie (Correll 1956; Turner et al. 2003) and Comal Co. (Turner et al. 2003) on the w margin of East TX; also Edwards Plateau; in the U.S. known only from TX (also n Mexico). Sporulating May–Nov. This species, which is similar to *C. alabamensis*, is apparently known from only ca. 10 localities in e, c, and w TX (Windham & Rabe 1993). While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), because of its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

Cheilanthes alabamensis (Buckley) Kunze, (of Alabama), ALABAMA LIP FERN, SMOOTH LIP FERN. Leaves clustered, 6–50 cm long; leaf blades lanceolate to oblong, 1–7 cm wide, the largest ultimate segments 3–7 mm long; this is one of the two glabrous (or nearly so) East TX *Cheilanthes* species. Limestone hillsides, crevices of limestone ledges and cliffs; scattered across TX, but most common in Edwards Plateau; mostly s 1/2 of U.S. from VA s to FL w to AZ. Sporulating nearly throughout the year, especially Mar–Nov. According to Nelson (2000), both the specific epithet and common name of this species are the result of its initial discovery in Alabama in 1843.

Cheilanthes eatonii Baker, (for its discoverer, A.A. Eaton, 1865–1908), EATON'S LIP FERN. Leaves clustered, 6–35 cm long; leaf blades 1.5–5 cm wide, the ultimate segments oval to round, bead-like, the largest 1–3 mm long; scales of leaf segment midvein and/or rachis conspicuous. Rocky slopes and ledges; Cherokee and Morris (Turner et al. 2003) cos. in the ne part of East TX and Wilson Co. (Turner et al. 2003) in the sw corner of East TX; also to the w of East TX in Brown Co. (Correll 1956; HPC); mainly Edwards Plateau and Trans-Pecos; mostly sw U.S. (AR, AZ, CO, NM, OK, TX, UT), disjunct in VA and WV. Sporulating Mar–Nov. [*C. castanea* Maxon]

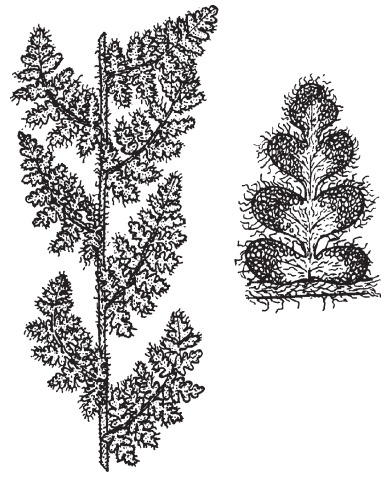
Cheilanthes feei T. Moore, (for A.L.A. Fée, 1789–1874, French botanist), SLENDER LIP FERN, WOOLLY LIP FERN, FEE'S LIP FERN. Leaves clustered, 4–20 cm long; leaf blades 1–3 cm wide, the ultimate segments 1–3 mm long; similar to *C. tomentosa* but with jointed hairs and without tomentum on the petiole and rachis. Dry, limestone or calcareous, rocky slopes and crevices; the closest citations or specimens we have found are from the Cross Timbers and Prairies—Hamilton and Palo Pinto (Correll 1956; Turner et al. 2003) cos.; included based on citation for Blackland Prairie



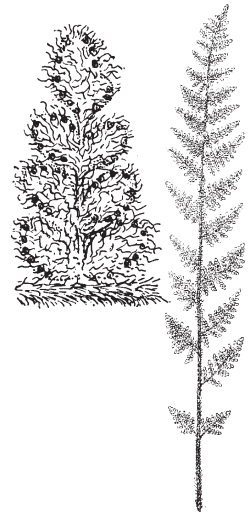
Cheilanthes feei [LUN]



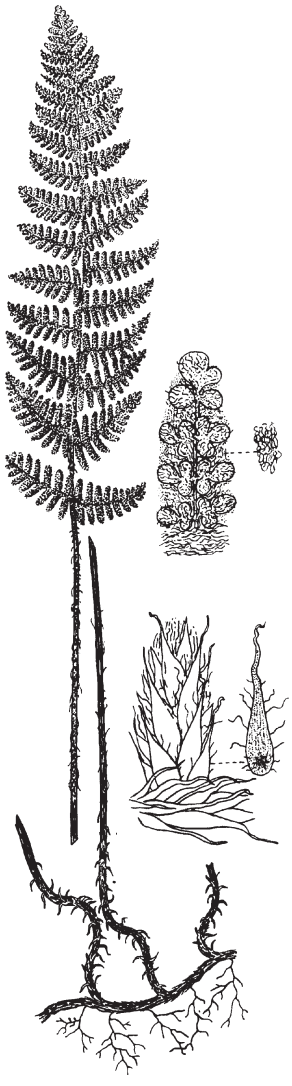
Cheilanthes horridula [LUN]



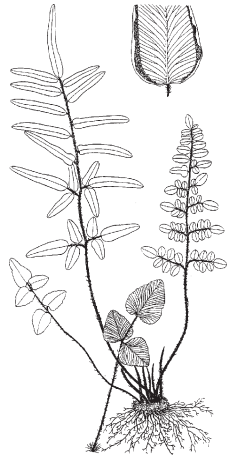
Cheilanthes lanosa [LUN]



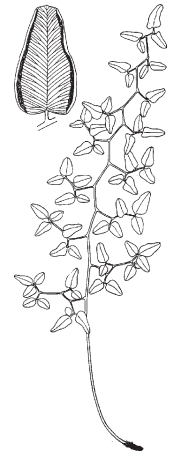
Cheilanthes tomentosa [LUN]



Cheilanthes lindheimeri [LUN]



Pellaea atropurpurea [LUN]



Pellaea ovata [LUN]

by Hatch et al. (1990). This citation may have been a misinterpretation of Correll's (1956) description of the species' range in TX as including "Hamilton and Palo Pinto counties in the northwest Blackland Prairies" (well to the w of the delineation of Blackland Prairie followed by Hatch et al. (1990) and by this book); mainly w part of Cross Timbers and Prairies s and w to w TX; sw Canada and much of w U.S. e to WI, AR, and TX, also KY and VA. Sporulating Mar–Nov. This species is a triploid that reproduces via apogamy (= a type of asexual reproduction that does not involve fertilization; the sporophyte is formed directly from the gametophyte without gamete production) (Windham & Rabe 1993, Moran 2004).

Cheilanthes horridula Maxon, (prickly), ROUGH LIP FERN. Leaves clustered, 5–30 cm long; leaf blades 1–4 cm wide, the ultimate segments narrowly elliptic to elongate-deltate, not bead-like, the largest 3–5 mm long; leaf surfaces scabrous due to distinctive stiff hairs, these often inflated basally (according to Windham & Rabe (1993), these scabrous pustulose hairs make this "one of the most distinctive species of *Cheilanthes* in North America"). Rock crevices; Bexar, Hays (BRIT), Bell, Comal, and Travis (Turner et al. 2003) cos. near border of Blackland Prairie and Edwards Plateau; mainly s and w 2/3 of TX; OK and TX. Sporulating mainly May–Nov.

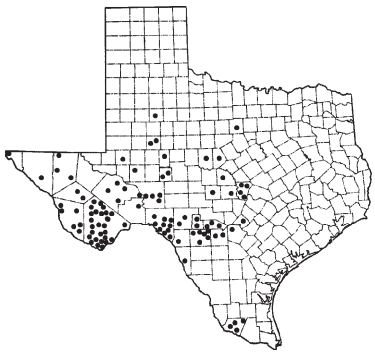
Cheilanthes lanosa (Michx.) D.C. Eaton, (woolly), HAIRY LIP FERN, WOOLLY LIP FERN. Leaves clustered, 7–50 cm long; leaf blades 1.5–5 cm wide, the ultimate segments oblong to lanceolate, not bead-like, the largest 3–5 mm long; similar in some respects to *C. tomentosa* but with hispidulous jointed hairs instead of tomentum on the petiole and rachis and with ultimate leaf segments not bead-like. Dry rocky slopes and sandstone ledges; the only TX county citation we are aware of is from McLennan Co. (Correll 1956: *Wherry s.n.*, BAYLU; Turner et al. 2003); the species is also mapped for ne TX by Windham and Rabe (1993); e U.S. from NY s to FL w to MN, KS, OK, and possibly TX. Sporulating Apr–Oct. Jack Stanford (pers. comm.), who studied the Wherry collection, questioned whether it is actually *C. lanosa*, raising the possibility that this species is not part of the TX flora.

Cheilanthes lindheimeri Hook., (for F.J. Lindheimer, 1801–1879, German-born Texas collector), LINDHEIMER'S LIP FERN, FAIRY-SWORDS. Plants with slender long-creeping rhizomes and scattered leaves (distinguishing this species from all other East TX *Cheilanthes* with compact to short-creeping rhizomes and clustered leaves); leaves 7–30 cm long; leaf blades 2–5 cm wide, the ultimate segments round to slightly oblong, bead-like, the largest 0.7–1 mm long; scales of leaf segment midvein and/or rachis conspicuous. Rocky slopes and ledges; the closest citations or specimens we have found are from the Cross Timbers and Prairies in nc TX, e.g. Palo Pinto (Correll 1956), Burnet, (Turner et al. 2003), and Parker (B. Carr, pers. comm.) cos.; included based on citation for Blackland Prairie by Hatch et al. (1990); this citation may have been a misinterpretation of Correll's (1956) description of the species' range in TX as including "Palo Pinto County in the northern Blackland Prairies" (well to the w of the delineation of Blackland Prairie followed by Hatch et al. and by this book); mainly Edwards Plateau, Cross Timbers and Prairies, and Trans-Pecos; AZ, NM, OK, and TX. Sporulating Mar–Nov. Jack Stanford (pers. comm.) indicated that this species is found primarily on granite.

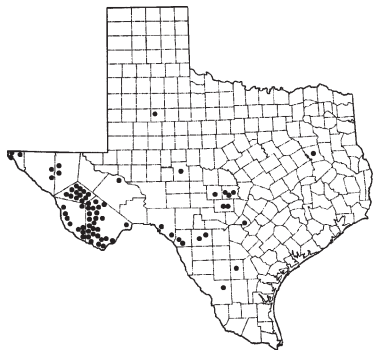
Cheilanthes tomentosa Link, (tomentose, densely woolly), WOOLLY LIP FERN. Leaves clustered, 8–45 cm long; leaf blades 1.5–8 cm wide, the ultimate segments oval (rarely oblong), bead-like, the largest 1–2 mm long; scales of leaf segment midvein and/or rachis inconspicuous. Rocky slopes and ledges; widely distributed in TX; across much of s 1/2 of U.S. from PA and WV s to GA w to AZ. Sporulating mainly May–Oct.

PELLAEA Link CLIFF-BRAKE

Xerophytic, usually on rock; stems (rhizomes) compact to creeping; leaves monomorphic or somewhat dimorphic, evergreen, clustered to scattered, 1–3 pinnate, in East TX species glabrous



Astrolepis integerrima



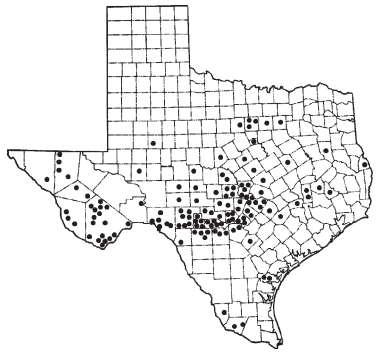
Astrolepis sinuata



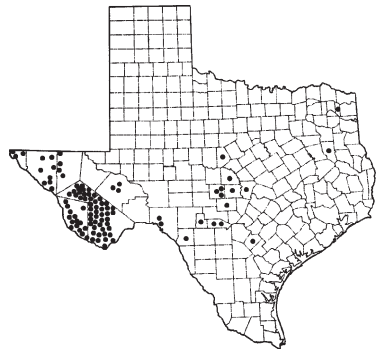
Ceratopteris thalictroides



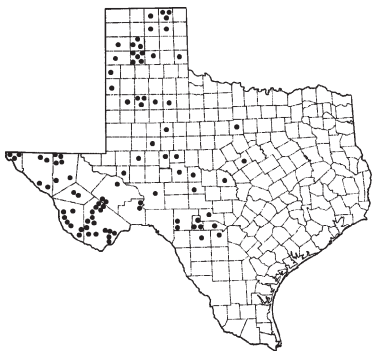
Cheilanthes aemula



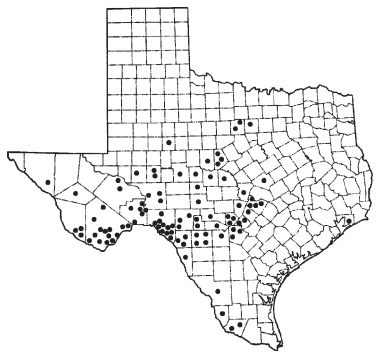
Cheilanthes alabamensis



Cheilanthes eatonii



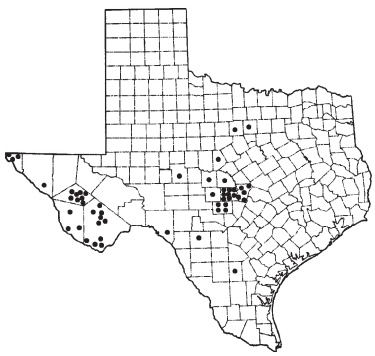
Cheilanthes feei



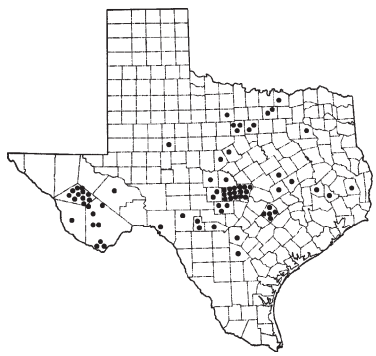
Cheilanthes horridula



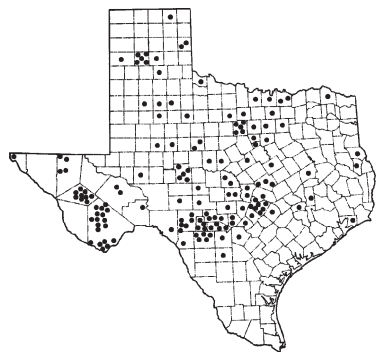
Cheilanthes lanosa



Cheilanthes lindheimeri



Cheilanthes tomentosa



Pellaea atropurpurea

or nearly so, thick-herbaceous to coriaceous; sporangia near margins of ultimate leaf segments (= smallest subdivisions of leaf) on the abaxial (= beneath) leaf surfaces; margins of ultimate leaf segments recurved to form false indusia.

A genus of ca. 40 species distributed mainly in the New World with a few in Asia, Africa, the Pacific Islands, and Australia (Windham 1993c). The genus has often been circumscribed more broadly, but as such it is probably polyphyletic. In fact, molecular evidence (Gastony & Rollo 1998) supports the hypothesis of a polyphyletic *Pellaea*. Some species previously placed in *Pellaea* are now recognized in *Argyrochosma*. (Greek: *pellos*, dark or dusky, possibly referring to bluish gray leaves)

REFERENCES: Tryon 1957; Knobloch & Britton 1963; Windham 1993c.

1. Petiole and rachis straw-colored or tan, not shiny, usually glabrous; rachis uniformly zigzag throughout _____ **P. ovata**
1. Petiole and rachis reddish purple to dark brown or blackish, shiny, glabrous or pubescent adaxially (= above) with curly hairs; rachis not uniformly zigzag, at most slightly flexuous.
   2. Pinnules mucronate (= with a small tip); some scales of the stem (look near attachment of petioles) bicolored with a dark, blackish, linear central region and a lighter brown margin; rachis usually glabrous _____ **P. wrightiana**
   2. Pinnules not mucronate; stem scales uniformly reddish brown or tan; rachis pubescent adaxially _____ **P. atropurpurea**

Pellaea atropurpurea (L.) Link, (dark purple, in reference to the color of the petiole), PURPLE CLIFF-BRAKE, PURPLE-STEM CLIFF-BRAKE, CLIFF-BRAKE, BLUE FERN. Plant to 45 cm tall; stem (rhizome) scales uniformly reddish brown or tan; leaf blades 1-pinnate or 2-pinnate below, 10–30 cm long, 5–20 cm wide, the sterile ones shorter and less divided; $2n = 87$ (Windham 1993c). Rocky slopes and woods, cliffs, usually limestone or calcareous rocks; nearly throughout TX; se Canada and most of the U.S. from VT s to FL w to MN and NV. Sporulating Mar–Nov. This species is a triploid that reproduces via apogamy (= a type of asexual reproduction that does not involve gamete formation or fertilization; this type of reproduction allows triploids, which would otherwise produce sterile spores and be sterile, to make fertile spores and thus reproduce). /293

Pellaea ovata (Desv.) Weath., (ovate). Plant usually large, to 1 m or more tall; stem (rhizome) scales bicolored, black centrally, brown marginally; leaf blades 2–3-pinnate, 15–70 cm long, 5–25 cm wide; $2n = 58$ (Windham 1993c). Rocky slopes and ledges, including limestone; Bexar (BAYLU) and Travis (Turner et al. 2003) cos.; mainly Trans-Pecos and Edwards Plateau, also Cross Timbers and Prairies; in the U.S. known only from TX (also Mexico and Guatemala). Sporulating Mar–Nov.

Pellaea wrightiana Hook., (for Charles Wright, 1811–1885, Texas collector), WRIGHT'S CLIFF-BRAKE. Plant 15–30(–50) cm tall; stem (rhizome) scales bicolored, black centrally, brown marginally; leaf blades 1-pinnate-pinnatifid to 2-pinnate below, usually 8–25 cm long, 1–5 cm wide; $2n = 116$ (Windham 1993c). Angelina (Upland Island Wilderness Area—J. Singhurst, pers. comm.), Austin, Hays, Travis, Tyler, and Washington (Turner et al. 2003) cos. in the s part of East TX; primarily Trans-Pecos, Edwards Plateau, and w Cross Timbers and Prairies; mainly sw U.S. (AZ, CO, NM, OK, TX, and UT), also disjunct in NC and SC. Sporulating Mar–Nov. [*P. ternifolia* (Cav.) Link var. *wrightiana* (Hook.) A.F. Tryon]

PTERIS L. BRAKE

A genus of ca. 300 species found worldwide in warm and tropical areas (Nauman 1993b). The young fronds of some species are reported to be edible or useful medicinally. (Greek: *pteris*,

fern, derived from *pteron*, wing or feather, in reference to the closely spaced pinnae which give the leaves a somewhat feather-like appearance—Nauman 1993b).
REFERENCES: Nauman 1993b; Stanford & Diggs 1998.

Pteris multifida Poir., (much divided, in reference to the leaves), HUGUENOT FERN, SPIDER BRAKE, SPIDER FERN, CHINESE BRAKE, SAW-LEAVED BRACKEN. Stems (rhizomes) short-creeping, densely scaly; leaves evergreen, monomorphic, clustered, (10–)25–60 cm long; leaf blades 10–35 cm long, 10–25 cm wide, essentially glabrous, at least partially 2-pinnatifid; pinnae opposite, 3–7 pairs, lanceolate to linear, those in at least distal 1/2 of mature leaves decurrent on the conspicuously winged rachis (rachis wing constricted distal to each pair of pinnae); basal and sometimes the medial pinnae with 1–2 lobes or pinnules (at least some pinnae are deeply palmately 3-divided, except on the leaves of young plants, which can have palmately compound leaves with three unlobed pinnae), the distal pinnae simple; sterile pinnae wider than fertile pinnae, with margins serrulate to serrate; fertile pinnae entire to serrate near apex; sori near margins of fertile pinnae or pinnules, usually ± continuous, the pinna or pinnule margins reflexed over sori to form false indusia. Masonry of old brick buildings, calcareous sandstone talus blocks, and sandy soils of woods; Fayette (BRIT), Hardin (TAES), Jefferson, and Montgomery (Turner et al. 2003) cos.; naturalized se U.S. from MD s to FL w to AR and TX, also CA, IL, IN, KY, and NY. Sporulating Jun–Dec. Native of e Asia. [*Pycnodoria multifida* (Poir.) Small] According to Correll (1956), this species "... was cultivated on many of the older plantations in the Deep South where it still persists. It has escaped in many areas into the nearby woods and can now be found some miles from its original point of cultivation. It is so completely at home in some places in east Texas that it must be considered as naturalized." According to Nelson (2000), *P. multifida* "was first discovered in the U.S. in 1868 in a Huguenot cemetery in Charleston, South Carolina; hence, one of its common names, Huguenot fern. The common name 'spider brake' is likely in reference to the spiderlike appearance of the deeply-divided leaves."

Pteris vittata L., LADDER BRAKE, CHINESE BRAKE, CHINESE LADDER BRAKE, (longitudinally striped—in reference to the linear false indusium), an Asian native well known as an escape from cultivation in coastal areas of the southeastern United States, is commonly found on exposed limestone (e.g., pinelands) and on a variety of man-made calcareous substrates (e.g., sidewalks, buildings, old masonry) (Nauman 1993b). It is known from LA (Kartesz 1999) and and is known from the Edwards Plateau of Texas (Stanford & Diggs 1998) based on a collection from a stream-side limestone boulder in San Saba Co. (*J.W. Stanford 5308*, 1987, BRIT, HPC, SPLT). It should be watched for in East TX; naturalized in se U.S. from SC s to FL w to TX, also CA. The strictly 1-pinnate leaves (the pinnae without lobes or divisions) easily distinguish this species from *P. multifida*. Note that because of its 1-pinnate leaves, this species, presently unknown from East TX, will not key properly in the key to genera above.

SALVINIACEAE T. Lestib.
FLOATING FERN OR WATER-SPANGLE FAMILY

A very small family (1 genus, ca. 10 species) of heterosporous (= with 2 spore types) aquatic ferns found mostly in the tropics, but ranging from s U.S., Mexico, West Indies, Central America, and South America to Eurasia and Africa, including Madagascar (Nauman 1993d). The Azollaceae has often been included in the Salviniaceae, but according to Lumpkin (1993), the relationship is not close enough to warrant inclusion in the same family. However, molecular evidence does indicate that *Salvinia* and *Azolla* are each other's closest living relative (Hasebe et al. 1995), and the two families are probably appropriately treated in the same order (Schneller 1990b). Three families of heterosporous water ferns occur in East TX (Azollaceae—*Azolla*,

Marsileaceae—*Marsilea*, *Pilularia*, and Salviniaceae—*Salvinia*). These groups are quite distinct morphologically, and traditionally the marsileaceous (*Marsilea* and *Pilularia*) and salviniaceous (*Azolla* and *Salvinia*) lines were considered to have evolved independently from different homosporous fern ancestors. However, all three living heterosporous water fern families appear to comprise a monophyletic group as suggested by recent morphological, fossil, and molecular evidence (Rothwell & Stockey 1994; Hasebe et al. 1995; Pryer 1999).
FAMILY RECOGNITION IN THE FIELD: small free-floating aquatics with leaves in groups of three (two leaves floating, nearly rounded to elliptic, entire, with conspicuous branched hairs; one leaf submerged, finely dissected, root-like).
REFERENCES: Schneller 1990b; Nauman 1993d.

SALVINIA Séguier
FLOATING FERN, WATER-SPANGLES, WATER-MOSS

Free-floating aquatics (can be trapped on mud when water levels fall); roots absent; stems creeping; leaves dimorphic, in groups of three—two floating and one submerged; floating leaves green, simple, unlobed, nearly round to oblong or elliptic, entire, obtuse or notched apically, the upper surface with numerous whitish, multicellular, papillate hairs, these having a single base and four branches, the lower surface with unbranched hairs; submerged leaves finely dissected, root-like; sporangia (either microsporangia or megasporangia) in sporocarps (formed by membranous indusia surrounding the sori) on submerged leaves, indehiscent, dispersed when the sporocarps decay (but plants usually infertile and reproducing vegetatively).

A genus of ca. 10 species of floating ferns (Nauman 1993d). The hairs on the upper leaf surfaces trap air, causing the plants to right themselves if turned over in the water (Lellinger 1985). The leaves are unusual in that the upper sides of the floating leaves (the sides visible to an observer), which appear to face the stem axis, are actually morphologically the lower (= abaxial) leaf surfaces (Croxdale 1978, 1979, 1981; Nauman 1993d). Some species have become serious aquatic weeds, particularly on man-made reservoirs and in irrigation systems (Schneller 1990b). Because of their potential threat to aquatic ecosystems, all species of the genus are prohibited in Texas (Harvey 1998). While the floating leaves of the two species discussed below are often different in size, crowding or low-light conditions tend to reduce leaf size, making the character less useful in determining species (Lellinger 1985). (Named for Professor Antonio Maria Salvini, 1633–1729, Italian botanist and professor of Greek at Florence)
REFERENCES: Herzog 1935; Weatherby 1937; Morton 1967c; Mitchell & Tur 1975; Croxdale 1978, 1979, 1981; Forno 1983; Jacobsen 1983; Thomas & Room 1986; Moran 1992; Hatch 1995; Jacono 1999a, 1999b, 1999c, 2001a, 2001b; O'Kennon et al. 1999; Garbari et al. 2000; Jacono et al. 2001; Wood et al. 2001.

1. Hairs of the upper surface of floating leaves 4-branched, the branches free at their tips (use magnification; sometimes difficult to observe on herbarium specimens); floating leaves usually 6–15 mm long, usually not folded; lower surface of floating leaves 6 covered with hairs _____ **S. minima**
1. Hairs of the upper surface of floating leaves 4-branched, the branches joined at their tips (resembling a "cage" or an "egg beater"); floating leaves usually 13–30(–38) mm long, often folded; lower surface of floating leaves sparsely hairy or ± glabrous except for hairs along the midvein _____ **S. molesta**

Salvinia minima Baker, (least, smallest), COMMON SALVINIA, WATER-SPANGLES, FLOATING FERN. Stems 1–6 cm long; floating leaves usually 6–15 mm long, rounded to cordate basally, obtuse or notched apically, usually not folded. Lakes and other aquatic habitats; Jasper (BAYLU), Jefferson (TAES), Robertson (Turner et al. 2003), Orange, Tyler (R. Helton, pers. comm.), and probably Newton and Sabine (it is known from the LA side of Toledo Bend—R. Helton, pers. comm.) cos.; naturalized in scattered localities across se U.S. (AL, AR, GA, FL, LA, OK, and TX), also MA, MD,

NM, and NY. Sporulating spring and fall (Nauman 1993d). [*S. rotundifolia* of authors, not Willd.] In TX it is considered a "harmful or potentially harmful exotic plant" and it is illegal to release, import, sell, purchase, propagate, or possess this species in the state (Harvey 1998). In certain parts of East Texas, populations of this species are so large that recreational access (e.g., boating and hunting) is being impeded (H. Elder, pers. comm.). This species had been considered to be native to the se U.S. (Nauman 1993d) but is now considered to be introduced from tropical America. (Jacono et al. 2001; BONAP 2000); it was probably introduced into FL in the late 1920s or early 1930s (Jacono et al. 2001). It was introduced into TX in 1992, apparently from w LA "on a 'marsh buggy,' during geologic exploration" (Jacono et al. 2001; see also Hatch 1995). ⊘ ☜ ❁/297

Salvinia molesta D.S. Mitch., (annoying or burdensome, in reference to the rapid vegetative growth), GIANT SALVINIA, KARIBA WEED, AQUARIUM WATER-MOSS, AFRICAN PYLE. Floating leaves ca. 13–30(–38) mm long, usually cordate basally, usually notched apically, often folded and compressed into dense chains (flat when young). Lakes and other aquatic habitats, reproducing vegetatively very effectively; Robertson (BAYLU, BRIT, TAMU, TEX), Fort Bend, Harris, Houston, Liberty, Montgomery, Newton, Orange, Sabine, Shelby, and San Jacinto (H. Elder, pers. comm.; R. Helton, pers. comm.) cos.; it has also been reported from the Gulf Prairies and Marshes (Brazoria and Chambers cos.—H. Elder, pers. comm.) and as far nw as Flower Mound (Denton Co.) in North Central TX (Jacono 2001) and Wichita Co. (H. Elder, pers. comm.) in the Rolling Plains. It was first observed in TX in 1997 (Jacono 1999c), and as of summer 2000, it was known in TX from 4 reservoirs and ca. 40 private water bodies (R. Helton, pers. comm.). Since that time it has been discovered in a number of additional localities (e.g., total of 11 public water sites—reservoirs and rivers—as of February 2004) and is continuing to spread in the state (H. Elder, pers. comm.). Now known to be present in the se U.S. from AL, FL, LA, SC, and TX. Considered "one of the world's worst weeds" (Jacono 1999c), it is thought to be native to South America (se Brazil—Forno & Harley 1979; Forno 1983; U.S. Geological Survey 2000) and is possibly of hybrid origin. The sporangia abort and the somatic chromosome number of 45 suggests a pentaploid condition (Jacobsen 1983). Jacono (2001b) noted that "*Salvinia molesta* is not known to reproduce by spores. It reproduces vegetatively, that is, new plants develop as fragments break off from mature individuals." It has been introduced by humans to fresh waters of Africa, Asia, Australia, s Europe, New Zealand, and the South Pacific and has resulted in severe economic and environmental problems (Jacono 1999a, 1999b; Garbari et al. 2000). The plants can grow rapidly and under good conditions doubling can occur in ca. one week, with a range of four to ten days (Mitchell & Tur 1975); some authorites indicate that populations can double in a little more than two days (Moran 2004). GIANT SALVINIA covers the surface of lakes and streams, and the floating mats shade and crowd out native plants. Additionally, the mats (sometimes to a meter thick!) reduce oxygen content, degrade water quality, and can cause physical problems including hindering boats, clogging irrigation and drainage canals, and blocking water intakes. The mats can become so dense that they are able to support the weight of a cinder block. Plants used in aquaria or water gardens are among the likely sources for the escaped populations (Thomas & Room 1986; Jacono 1999a, 1999b, 1999c; Wood et al. 2001; Moran 2004). According to R. Helton (pers. comm.), "all reservoirs in East TX are imminently threatened" by this species. In TX, it is considered a "harmful or potentially harmful exotic plant" and it is illegal to release, import, sell, purchase, propagate, or possess this species in the state (Harvey 1998). GIANT SALVINIA is listed as a federal noxious weed (USDA Natural Resources Conservation Service 2002), and as such is prohibited in the U.S. by federal law. Jacono (1999a) indicated that, if seen, the species should be eradicated immediately and that the Texas Parks and Wildlife, Inland Fisheries Division should be contacted at (409) 384-9965. Biological control by the salvinia weevil (*Cyrtobagous* spp.) is being tested in East TX; this weevil, native to South America, has been successfully used in control programs in various places in the Old

World (Thomas & Room 1986; Moran 1992, 2004; Wood et al. 2001; R. Helton, pers. comm.; H. Elder, pers. comm.). ⊘☜

THELYPTERIDACEAE Pic. Serm.
MARSH FERN OR MAIDEN FERN FAMILY

East TX species terrestrial; stems (rhizomes) short- or long-creeping; leaves usually monomorphic or nearly so (somewhat dimorphic in *Thelypteris dentata*); leaf blades 1-pinnate-pinnatifid, 2-pinnate-pinnatifid, or 2–3-pinnatifid near base, less divided distally, usually with an indument (sometimes sparse) of transparent needle-like hairs abaxially, the ultimate segments (= smallest subdivisions) often, but not always, entire; sori usually round, abaxial on the blade surfaces (usually on veins), medial to submarginal; indusia round to kidney-shaped or obscure or absent.

☙A medium-sized (4–6 genera and ca. 900–1000 species—Mabberley 1997; Nauman et al. 2000) family of terrestrial ferns. While the group is subcosmopolitan, most members are tropical. There has been disagreement on the number of genera, with the number having ranged from 1 to ca. 30 depending on circumscription (Smith 1993a). While members of the family have traditionally been associated with *Dryopteris* (Dryopteridaceae) (e.g., Correll 1956), there is no close relationship (Smith 1993a); the similarities are apparently due to convergent evolution.

FAMILY RECOGNITION IN THE FIELD: sori usually on veins (but not marginal) on lower leaf surfaces; leaves usually all alike, 1-pinnate-pinnatifid, 2-pinnate-pinnatifid, or 2–3 pinnatifid, the lower surfaces with transparent needle-like hairs (distinguishing this family from Dryopteridaceae, which lack such hairs), the ultimate leaf segments often (but not always) entire.

References: Smith 1990, 1993a.

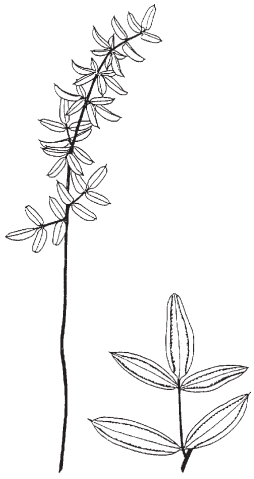
1. Rachis conspicuously and irregularly winged between pinnae (wing tissue extended as obvious lobes in some places); leaf blades ± triangular in outline, ca. as wide as long, usually 7–25(–30) cm long; indusia absent ____ **Phegopteris**
1. Rachis not winged; leaf blades much longer than wide, often > 30 cm long; indusia present, often conspicuous with a hand lens (but in *Macrothelypteris* they can be small or obscured in mature sori).
   2. Midveins of pinnae (= costae) grooved on upper (= adaxial) surface; leaf blades 1-pinnate-pinnatifid; veins of ultimate leaf segments reaching segment margins; indusia usually obvious with a hand lens ____ **Thelypteris**
   2. Midveins of pinnae not grooved on upper surface; leaf blades mostly 2-pinnate-pinnatifid; veins of ultimate leaf segments not reaching segment margins; indusia small (< 0.3 mm in diam.) or obscure ____ **Macrothelypteris**

MACROTHELYPTERIS (H. Ito) Ching FALSE MAIDEN FERN

☙A genus of ca. 10 species of tropical and subtropical regions in Asia, Africa, the Pacific Islands, and Australia (Smith 1993a). It has frequently been included in a more broadly circumscribed *Thelypteris* (e.g., Correll & Johnston 1970; Lellinger 1985; Hatch et al. 1990), but most recent authors treat it at the generic level (e.g., Smith 1993a; Peck & Taylor 1995; Kartesz 1999; Nauman et al. 2000). (Greek: *macro*, large, *thelys*, female, and *pteris*, fern)

REFERENCES: Holttum 1969; Leonard 1972.

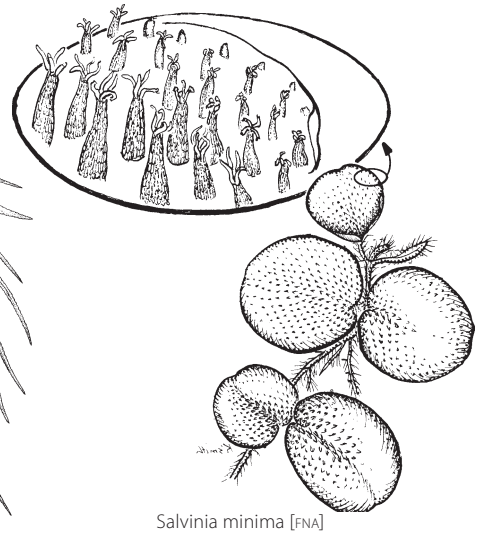
Macrothelypteris torresiana (Gaudich.) Ching, (for Luis de Torres of the Marianas Islands, governor of Guam in 1820), TORRES' FERN, MARIANA MAIDEN FERN, FALSE MAIDEN FERN. Stems (rhizomes) short-creeping; leaves monomorphic, evergreen; leaf blades mostly 2-pinnate-pinnatifid, broadest at base, much longer than wide, to ca. 85 cm long; veins of ultimate leaf segments



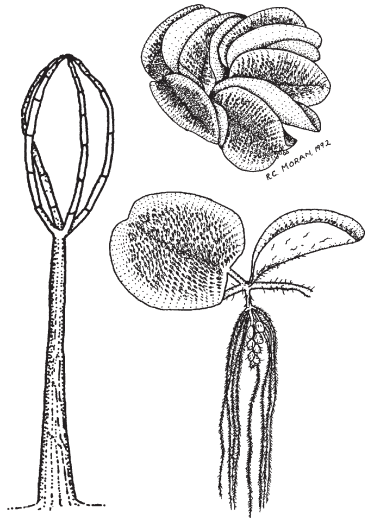
Pellaea wrightiana [LUN]



Pteris multifida [TAY]



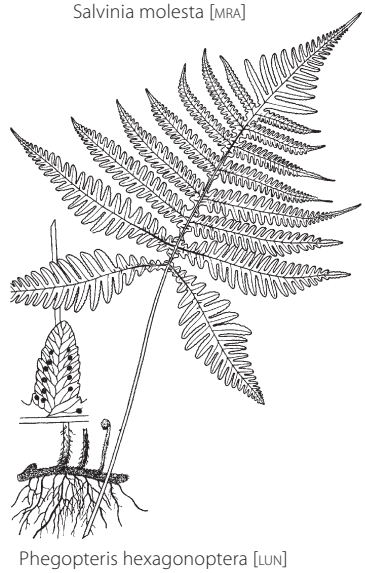
Salvinia minima [FNA]



Salvinia molesta [MRA]



Macrothelypteris torresiana [TAY]



Phegopteris hexagonoptera [LUN]

not reaching segment margins; rachis not winged; midveins of pinnae (= costae) not grooved on adaxial (= upper) surface; sori round, medial to submedial; indusia small (< 0.3 mm in diam.) or obscure. Along streams, damp woods, and moist areas; Liberty (TAMU), Newton (BRIT), and Hardin (TEX) cos. in the Pineywoods, first collected in TX by Eula Whitehouse in 1950 (Correll 1956); naturalized in se U.S. from SC s to FL w to AR and TX. Sporulating summer and fall. Native to tropical and subtropical Asia and Africa, originally described from the Marianas Islands (Thieret 1980). [*Dryopteris setigera* of authors, not (Blume) Kuntze, *Polystichum torresianum* Gaudich., *Thelypteris torresiana* (Gaudich.) Alston]

PHEGOPTERIS Fée BEECH FERN

A genus of three species with one n temperate and boreal, one in e North America, and one in e Asia (Smith 1993a). It has frequently been included in a more broadly circumscribed *Thelypteris* (e.g., Correll & Johnston 1970; Lellinger 1985; Hatch et al. 1990), but most recent authors treat it at the generic level (e.g., Smith 1993a; Peck & Taylor 1995; Kartesz 1999; Nauman et al. 2000). (Greek: *phegos*, beech, and *pteris*, fern, presumably from some species growing under *Fagus* (beech) trees)
REFERENCE: Holttum 1969.

Phegopteris hexagonoptera (Michx.) Fée, (6-angled wing, apparently in reference to the shape of the rachis wings), BROAD BEECH FERN, SOUTHERN BEECH FERN. Stems (rhizomes) long-creeping; leaves monomorphic, dying back in winter; leaf blades 2–3 pinnatifid near base, less divided distally, broadest at base, ± triangular in outline, ca. as wide as long, usually 7–25(–30) cm long; veins of ultimate leaf segments reaching segment margins or nearly so; rachis conspicuously and irregularly winged between pinnae (wing tissue extended as obvious lobes in some places); midveins of pinnae not grooved adaxially (vs. grooved in *Thelypteris*); sori round, submarginal; indusia absent. Moist wooded areas, margins of bogs, ravines along streams, often in acidic soils; Shelby (BAYLU), Marion, Rusk, Sabine (TEX), and San Augustine (Turner et al. 2003) cos. in the e Pineywoods; se Canada and throughout the e U.S. w to MN, OK, and TX. Sporulating summer and fall. [*Dryopteris hexagonoptera* (Michx.) C. Chr., *Polypodium hexagonopterum* Michx., *Thelypteris hexagonoptera* (Michx.) Nieuwl.]

THELYPTERIS Schmidel FEMALE FERN, MAIDEN FERN, MARSH FERN

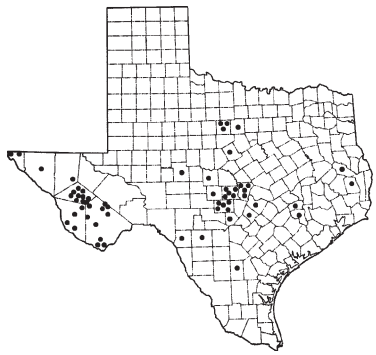
Terrestrial; stems (rhizomes) horizontal, short- or long-creeping; leaves usually ± monomorphic (somewhat dimorphic in *T. dentata*); leaf blades 1-pinnate-pinnatifid, much longer than wide; ultimate leaf segments (= smallest subdivisions of leaf) entire, with veins reaching segment margins; rachis not winged; midveins of pinnae (= costae) grooved on adaxial (= upper) surface; petioles straw-colored or purplish; sori round, in medial to submarginal position on the leaf segments on the abaxial (= lower) surfaces; indusia round to kidney-shaped, usually obvious with a hand lens, usually with pubescence.

A nearly cosmopolitan genus of ca. 875 species (Smith 1993a). Some of the species are similar and difficult to distinguish without close observation of the venation pattern of the ultimate leaf segments, particularly the basal veins. In some, the basal veins of adjacent ultimate segments join together and run united to the base of the sinus between the adjacent segments, while in others, the basal veins reach the margins of the adjacent segments at or above the sinus. (Greek: *thelys*, female, and *pteris*, fern, derived from *pteron*, wing or feather, perhaps in reference to the delicate appearance in contrast to the "male fern," *Dryopteris*—Nauman et al. 2000)
REFERENCES: Smith 1971a, 1971b.

1. Lateral veins of ultimate leaf segments (= smallest subdivisions of leaf) often forked; margins of fertile ultimate segments usually turned downward; leaf blades with all lateral veins of ultimate



Pellaea ovata



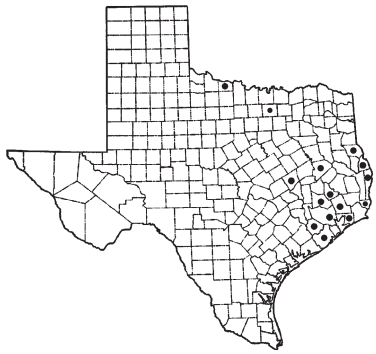
Pellaea wrightiana



Pteris multifida



Salvinia minima



Salvinia molesta



Macrothelypteris torresiana



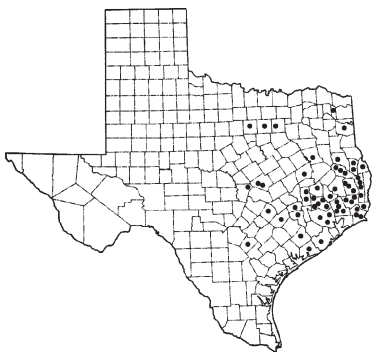
Phegopteris hexagonoptera



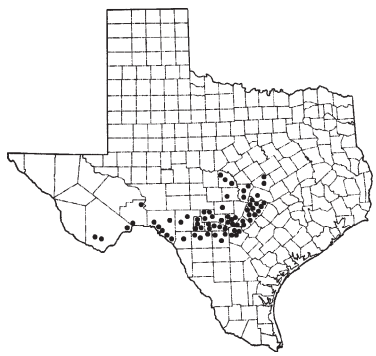
Thelypteris dentata



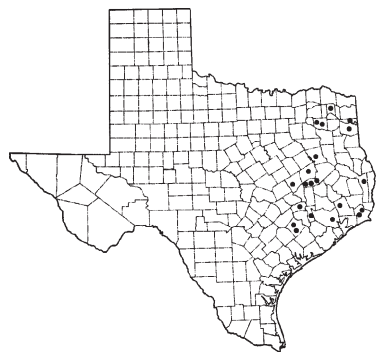
Thelypteris hispidula var. versicolor



Thelypteris kunthii



Thelypteris ovata var. lindheimeri



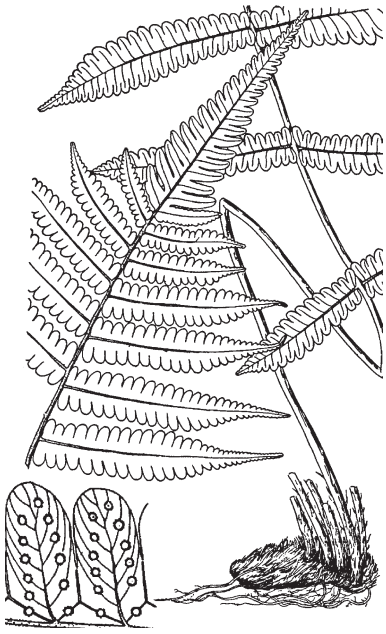
Thelypteris palustris var. pubescens

segments extending to margin of blade tissue **above** (= beyond) sinuses between adjacent ultimate segments _____ **T. palustris**

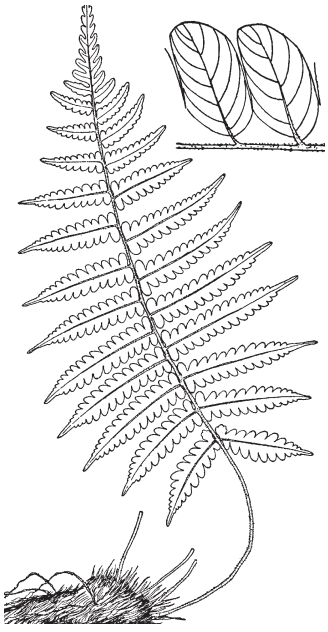
1. Lateral veins of ultimate leaf segments usually not forked; margins of fertile ultimate segments usually not turned downward; leaf blades with at least some basal lateral veins of ultimate segments extending to, joined at, or united **below** the sinuses between the adjacent ultimate segments.
   2. Basal veins of adjacent ultimate leaf segments united below the sinus between the segments, with the resulting single vein extending toward the sinus.
      3. United portion of veins below sinuses usually 2–4 mm long; midveins of pinnae with hairs mostly very short (0.3 mm or less long) on the lower surface (= abaxially); petioles often purplish; leaves usually with more than 2 pairs of greatly reduced basal pinnae _____ **T. dentata**
      3. United portion of veins below sinuses usually < 2 mm long; midveins of pinnae with hairs variable in length (0.3–0.8 mm long) on the lower surface; petioles straw-colored; leaves usually with 0–2 pairs of slightly reduced basal pinnae _____ **T. hispidula**
   2. Basal veins of adjacent ultimate leaf segments not united and thus reaching margin of segments slightly above the sinus OR meeting at the sinus.
      4. Upper surface of midveins of pinnae glabrous or with a few minute hairs, these never much longer than width of the midveins; a few scales often persistent on lower surface of rachises and midveins of pinnae of mature leaves _____ **T. ovata**
      4. Upper surface of midveins of pinnae with conspicuous (use hand lens) hairs usually longer than width of the midveins; scales absent on lower surface of rachises and midveins of pinnae of mature leaves.
         5. Basal veins of adjacent ultimate leaf segments not united, sometimes meeting at the sinus between the segments; leaf blades usually broadest at or near base, the basal pinnae as long as or only slightly shorter than more distal pinnae; leaf blades glabrous or sparsely hairy above, except along veins _____ **T. kunthii**
         5. Basal veins of adjacent ultimate leaf segments variable, some not united, some meeting at the sinus, some united below the sinus into a single vein; leaf blades broadest above base, the basal and near basal pinnae noticeably shorter than more distal pinnae; leaf blades often somewhat hairy above, on regular blade tissue as well as along the veins ___ **T. hispidula**

Thelypteris dentata (Forssk.) E.P. St. John, (toothed), DOWNY SHIELD FERN, DOWNY MAIDEN FERN. Stems short-creeping; leaves somewhat dimorphic, evergreen; leaf blades (25–)40–100 cm long, usually with more than 2 pairs of greatly reduced basal pinnae; basal veins of adjacent ultimate leaf segments (= smallest subdivisions of leaf) united below the sinus between the segments, with the resulting single vein extending toward the sinus, the united portion usually 2–4 mm long; midveins of pinnae abaxially with mostly very short (0.3 mm or less long) hairs; petioles often purplish; sori round, medial to supramedial; indusia pubescent. Wooded slopes, damp woods, swamp hummocks, and along streams; Angelina (Turner et al. 2003) and Sabine (Correll 1956) cos. in the Pineywoods; also Harris Co. (Turner et al. 2003) at the n margin of the Gulf Prairies and Marshes; naturalized in the se U.S. from SC s to FL w to TX, also KY. Sporulating summer and fall. Native to the tropics and subtropics of Asia and Africa. [*Dryopteris dentata* (Forssk.) C. Chr., *Polypodium dentatum* Forssk.]

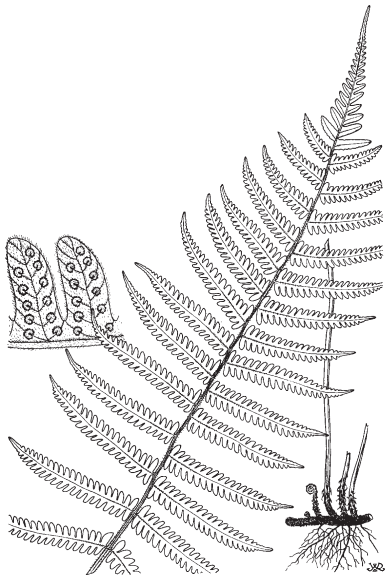
Thelypteris hispidula (Decasne) C.F. Reed var. **versicolor** (R.P. St. John) Lellinger, (sp.: diminutively hairy or bristly; var.: changing color), VARIABLE MAIDEN FERN, ST. JOHN'S SHIELD FERN, ROUGH-HAIRY MAIDEN FERN. Stems short-creeping to ascending at tip; leaves monomorphic, evergreen; leaf blades 14–55 cm long, broadest above base, the basal and near basal pinnae usually noticeably shorter than more distal pinnae; basal veins of adjacent ultimate leaf segments variable, some united below the sinus into a single vein (usually for < 2 mm) which then runs to



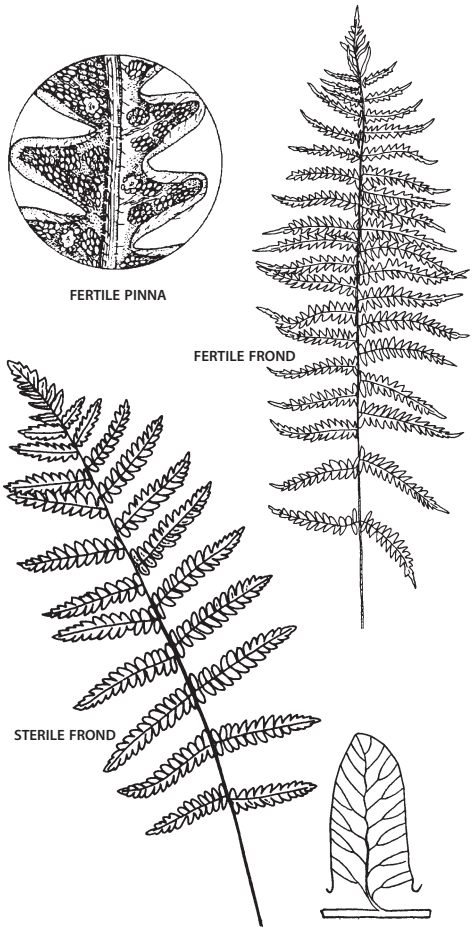
Thelypteris dentata [SM3]



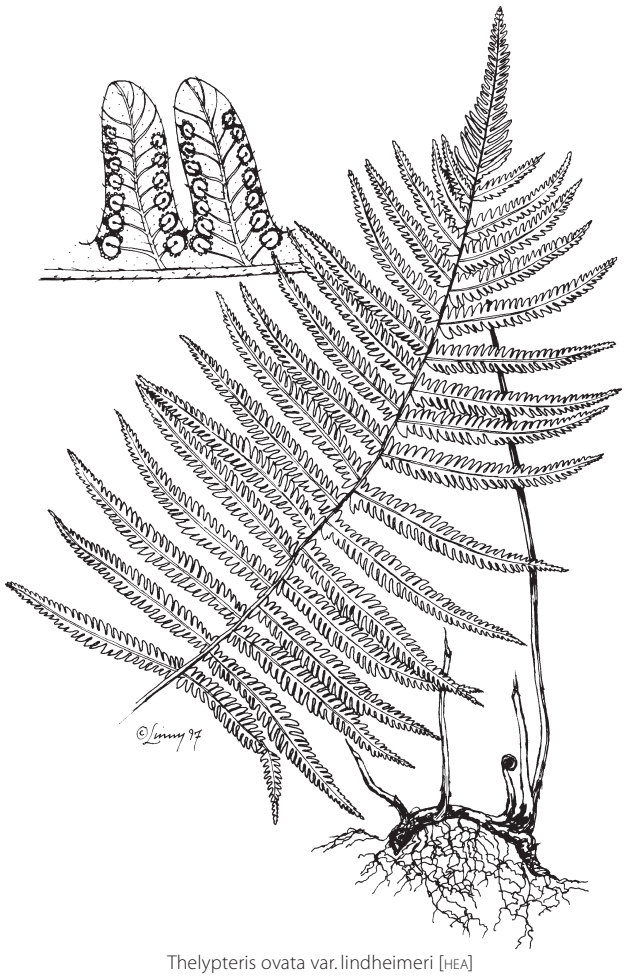
Thelypteris hispidula var. versicolor [SM3]



Thelypteris kunthii [LUN]



Thelypteris palustris var. pubescens [SM3, YAT]



Thelypteris ovata var. lindheimeri [HEA]

the sinus, some meeting at the sinus, some free; leaf blade tissue (in addition to veins) often somewhat hairy above; midveins of pinnae abaxially with hairs variable in length, 0.3–0.8 mm long; petioles straw-colored; sori medial to supramedial; indusia with pubescence. Wooded slopes and ravines, low woods, along streams; Jasper, Orange, Sabine, San Jacinto (BRIT), and Houston (BAYLU) cos. in the Pineywoods; se U.S. from SC s to FL w to TX. Sporulating summer and fall. [*Dryopteris versicolor* (R.P. St. John) M. Broun, *T. quadrangularis* (Fée) Schelpe var. *versicolor* (R.P. St. John) A.R. Sm., *T. versicolor* R.P. St. John] This species was at one time considered to be a hybrid between *T. dentata* and *T. kunthii* (e.g., Correll & Johnston 1970). However, Smith (1971a, 1971b) showed this was not possible because the supposed parents were tetraploids and this species is diploid.

Thelypteris kunthii (Desv.) C.V. Morton, (for Karl Sigismund Kunth, 1788–1850, German botanist), WIDESPREAD MAIDEN FERN, SOUTHERN SHIELD FERN, KUNTH'S MAIDEN FERN. Stems short- to long-creeping; leaves monomorphic, evergreen; leaf blades (9–)30–80 cm long, usually broadest at or near base, the basal pinnae as long as or only slightly shorter than more distal pinnae, glabrous or sparsely hairy above, except along veins, the lower surface with indument of short hairs on veins and blade tissue; basal veins of adjacent ultimate leaf segments not united, sometimes meeting at the sinus; sori medial to supramedial; indusia with pubescence. Woodlands, streambanks, swamps, ditches; widespread in East TX w to the Blackland Prairie (Bastrop, Bell, Dallas, and Wilson (Turner et al. 2003) cos.; several collections are also known from the Cross Timbers and Prairies, including a Parker Co. collection (*Jeff Quayle, s.n.*, 1997, BRIT) at the w margin of the species' range; se U.S. from NC s to FL w to AR and TX. [*Dryopteris normalis* C. Chr., *T. normalis* (C. Chr.) Moxley] This species has often been confused and lumped (e.g., Correll 1956, 1966a) with *Thelypteris ovata* var. *lindheimeri,* sometimes under the name *Dryopteris normalis. Thelypteris kunthii* has been reported to hybridize with *T. hispidula* and *T. ovata* (Smith 1993a).

Thelypteris ovata R.P. St. John var. **lindheimeri** (C. Chr.) A.R. Sm., (sp.: ovate; var.: for F.J. Lindheimer, 1801–1879, German-born Texas collector), LINDHEIMER'S MAIDEN FERN, OVATE MARSH FERN. Stems usually long-creeping; leaves monomorphic, sometimes evergreen; leaf blades usually broadest at or near base, glabrous or with minute pubescence above, with scattered hairs along veins, the lower surface with indument of short hairs on veins and blade tissue; basal veins of adjacent ultimate leaf segments not united, sometimes meeting at the sinus; sori supramedial to submarginal (sori typically closer to leaf margins than in *T. kunthii*); indusia with pubescence. Low, moist areas, wet bluffs and ledges, including limestone; Bell (BRIT), Comal, Hays, Travis, and Williamson (Turner et al. 2003) cos. near w margin of East TX; mainly Edwards Plateau and Trans-Pecos; in the U.S. known only from TX; also Latin America. Sporulating May–Nov. [*Dryopteris normalis* C. Chr. var. *lindheimeri* C. Chr.] This species has often been confused and lumped (e.g., Correll 1956, 1966a; Correll & Johnston 1970; Hatch et al. 1990) with *Thelypteris kunthii* (either as *T. kunthii* or under the name *Dryopteris normalis*). While strikingly similar in overall aspect, the two can be readily distinguished by the characters in the key.

Thelypteris palustris Schott var. **pubescens** (Lawson) Fernald, (sp.: marshy; var.: downy), SOUTHERN MARSH FERN, MARSH FERN, EASTERN MARSH FERN. Stems long-creeping, leaves monomorphic or nearly so, dying back in winter; leaf blades 10–40(–55) cm long; lateral veins of ultimate leaf segments often forked, usually extending to margin of blade tissue above sinuses between ultimate segments; margins of fertile ultimate segments usually turned downward; sori medial; indusia often with pubescence. Terrestrial in low woods, along streams, and in swamps and bogs; scattered in the Pineywoods and Post Oak Savannah; also n Gulf Prairies and Marshes; se Canada and throughout e U.S. w to ND and TX. Sporulating late summer and fall. [*Dryopteris thelypteris* (L.) A. Gray var. *pubescens* (Lawson) Weath., *Thelypteris palustris* var. *haleana* Fernald]

GYMNOSPERMS

The term gymnosperm (literally, "naked seed"), referring to those plants with ovules, and subsequently seeds, borne on the surface of an open scale, is not recognized here as a formal taxonomic category. The classification of the gymnosperms has varied considerably over time. At one point all were treated in the Class Gymnospermae, implying a close relationship. Later, the evolution of the seed was thought to have occurred independently in each gymnosperm group from different non-seed ancestors, making the gymnosperms polyphyletic and thus not worthy of formal recognition. However, recent molecular studies (e.g., Qiu et al. 1999; Mathews & Donoghue 1999; Soltis et al. 2002) suggest that all living gymnosperms form a monophyletic group. However, some questions still remain (see discussion under Gnetophyta below). As a result, and because of their distinctiveness, the four living gymnosperm groups (surviving remnants of ancient and much more diverse lineages—currently totaling 840 species in 86 genera arranged in 17 families worldwide) are treated in this flora (and by many recent authorities—e.g., Eckenwalder 1993), as separate divisions: Cycadophyta—CYCADS, Ginkgophyta—GINKGO or MAIDEN-HAIR TREE, Gnetophyta—JOINT-FIRS and relatives, and Pinophyta—CONIFERS. Only two of these (Pinophyta and Gnetophyta) are native to East TX. The other two have members widely cultivated as ornamentals and street trees in East TX. Brief accounts of the Cycadophyta and Ginkgophyta are included here for educational purposes.

REFERENCES: Hardin 1971; Kramer & Green 1990; Eckenwalder 1993; Doyle 1998; Mathews & Donoghue 1999; Qiu et al. 1999; Wunderlin & Hansen 2000b; Soltis et al. 2002.

DIVISION GNETOPHYTA

JOINT-FIRS AND RELATIVES

A small group of 3 distinctive families: Ephedraceae, Gnetaceae (1 genus, 28 species), and Welwitschiaceae (monotypic). The division is unusual among the gymnosperms in having double fertilization (in *Ephedra*—Friedman 1990, 1994) and xylem with vessels (as in most flowering plants). Molecular studies link the three families and indicate that the Gnetophyta is monophyletic (e.g., Rydin et al. 2002). At least some of these studies suggest the Gnetophyta as the sister group of the flowering plants (Hambry & Zimmer 1992; Chase et al. 1993; Qui et al. 1993; Doyle et al. 1994; Price 1996; Stefanovic et al. 1998). However, more recent molecular data, relying on a variety of different genes, seem to link the Gnetophyta with the rest of the gymnosperms and suggest the gymnosperms as a whole are monophyletic (e.g., Hasebe et al. 1999; Mathews & Donoghue 1999; Qiu et al. 1999; Soltis et al. 2002). According to Mathews and Donoghue (1999), while "Analyses of morphological characters consistently suggest that Gnetales are the closest living relatives of angiosperms, ... analyses of molecular data often unite Gnetales with conifers and support a clade of all extant seed plants except angiosperms." Nonetheless, some recent molecular studies (e.g., Rydin et al. 2002) question previous results and suggest that the phylogenetic position of the Gnetales is still ambiguous. Extensive information on the evolution, relationships, and morphology of the Gnetophyta can be found in Friedman (1996).

REFERENCES: Arber & Parkin 1908; Bell & Woodcock 1983; Bold et al. 1987; Doyle 1996; Friedman 1996; Price 1996; Hasebe et al. 1999; Mathews & Donoghue 1999; Qiu et al. 1999; Rydin et al. 2002; Soltis et al. 2002.

EPHEDRACEAE Dumort.

MORMON-TEA OR JOINT-FIR FAMILY

A monogeneric family of ca. 60 xerophytic (= dry-adapted) species (Stevenson 1993) found mainly in the n hemisphere and South America, with one species at the sw margin of East TX.

FAMILY RECOGNITION IN THE FIELD: plants shrubby, with *jointed photosynthetic* stems and leaves *reduced to minute scales*; seeds borne in *small cones* at the nodes.
REFERENCES: Correll 1966b; Kubitzki 1990; Stevenson 1993.

EPHEDRA L. MORMON-TEA, JOINT-FIR, MEXICAN-TEA

Double fertilization has been discovered in *Ephedra* (Friedman 1990, 1994). This is an unusual characteristic among the gymnosperms, having previously been thought to occur only in flowering plants. A number of species, especially in the Old World, have been used medicinally. Ephedrine, an amphetamine-like alkaloid, is derived from Asian species (e.g., *Ephedra sinica* Stapf—MA HUANG) and has been used medicinally in China for 5,000 years. Ephedrine or its derivatives have been ingredients in a large number of over-the-counter medications and dietary supplements and have been used for a number of purposes—as a decongestant, a stimulant, for weight loss, and in the treatment of asthma, sinusitis, and bronchial disorders. However, "multiple cases of psychotic reactions linked to the use of ephedrine have been described" (Bruneton 1999), and numerous other symptoms have been reported. These include dizziness, headache, gastrointestinal distress, increased blood pressure, cardiac arrhythmias, heart attacks, seizures, strokes, and death (U.S. Food and Drug Administration 2001, 2004). Also, because of its molecular structure, ephedrine can be converted to amphetamine-type compounds. As a result of these problems "certain states in the U.S. have adopted legislation to restrict the sale of plant products and ephedrine-containing products" (Bruneton 1999), and in April 2004 federal regulatons prohibiting the sale of dietary supplements containing *Ephedra* took effect (U.S. Food and Drug Administration 2004). Ephedrine is still allowed in traditional Chinese herbal remedies, and in synthetic form ephedrine is regulated as a drug under the Federal Food, Drug and Cosmetic Act, and is still permitted as an ingredient in over-the-counter drugs to treat asthma, nasal congestion, and minor eye irritation (U.S. Food and Drug Administration 2004). Native Americans in the w U.S. used several species as a source of tea (hence INDIAN-TEA), and the common name MORMON-TEA comes from the use of various sw U.S. species as a beverage by early Mormon settlers (Woodland 1997; Burrows & Tyrl 2001). (Greek: *ep-*, upon, and *hédra*, seat or sitting upon a place; from the ancient name used by Pliny for *Equisetum*, since the stems resemble the jointed stems of *Equisetum*, the segments of which appear to sit one upon the other)
REFERENCES: Cutler 1939; Steeves & Barghoorn 1959; Friedman 1990, 1994; Ickert-Bond & Wojciechowski 2004.

Ephedra antisyphilitica Berland. ex C.A. Mey., (against syphilis), JOINT-FIR, CLAPWEED, POPOTE, TEPOPOTE, CAÑATILLA. Dioecious (pollen- and seed-producing cones on separate plants), erect to spreading shrub to ca. 1 m tall; bark gray; branches jointed, alternate to whorled, stiff, to ca. 4 mm thick; twigs green to yellow-green, photosynthetic, glaucous, the internodes ca. 2–5 cm long; leaves opposite, scale-like, minute, 1–3 mm long, connate 2/3–7/8 their length, mostly non-photosynthetic; cones 1–2 per node on the twigs; staminate (= pollen-producing) cones lance-ellipsoid, 5–8 mm long, compound (made up of smaller cones), with 5–8 pairs of pale green to red bracts, the proximal bracts empty, the distal bracts each subtending a small cone composed of 2 basally fused bracteoles and a stalk-like sporangiophore; sporangiophores 4–5 mm long, exserted to 1/2 their length, each bearing 4–6 pollen-producing microsporangia; microsporangia sessile or on stalks < 1 mm long; ovulate (= seed-producing) cones ellipsoid, 6–12 mm long, sessile or nearly so, compound, with 4–6 pairs of bracts (the inner ones becoming fleshy and red, the cones thus fruit-like), with 1(–2) seeds per cone; seeds 6–9 mm long, 2–4 mm wide. Gravelly or rocky soils; Bexar, Travis (TEX), Comal, and Hays (Turner et al. 2003) cos. near the extreme w margin of East TX; mainly South TX Plains and w 1/2 of state; OK and TX. With cones late winter–early spring. According to Correll (1966b), this taxon can be distinguished from all other TX *Ephedra* species by the very narrow, pale orange-yellow or tannish bands that encircle the stem at the base of each group of connate leaves. It was reportedly used as a treatment for syphilis by the Pima Indians (Moerman 1998), but we know of no modern evidence supporting its continued use in this context.

DIVISION **PINOPHYTA**
CONIFERS

☙This is the gymnosperm division with the largest number of living representatives (68 genera and 629 species arranged in 8 families—Farjon 1998). The seeds are typically borne in cones, hence the common name, CONIFERS, from Latin *conus*, cone, and *-fero*, bearing. The Pinophyta is sometimes referred to as the Coniferophyta (Raven et al. 1986). Recent molecular evidence (Stefanovic et al. 1998) supports the theory that the conifers are a monophyletic group. The fossil history of the conifers extends to late in the Carboniferous Period (360–286 million years ago). Vast forests of Pinophyta (PINE, SPRUCE, FIR, DOUGLAS-FIR, CEDAR, etc.) are present across the northern part of the world between areas of tundra and deciduous forest; they dominate the biome known as taiga. These mostly evergreen species have xerophytically adapted, desiccation resistant foliage that allows them to maintain photosynthesis through the long winter and make immediate and maximum use of the short growing season available in the taiga. The leaves last for several years, which means that the high nutrient demand associated with making a new set of leaves each spring is avoided—this is considered a significant advantage on the generally nutrient-poor soils of the taiga (Pielou 1988). The result is that this is one of the few gymnosperm groups that has maintained dominance over flowering plants across vast areas. Though not native to TX, the small conifer family Taxaceae (YEWS) is important because the bark of *Taxus brevifolia* Nutt. (PACIFIC YEW, CALIFORNIA YEW) is the source of the terpenoid taxol, a mitotic (= cell division) inhibitor, which is an anti-cancer drug used in the treatment of ovarian, breast, and other types of cancer. As a result of this use, PACIFIC YEW populations in some areas have been greatly reduced. While not important as a direct source of taxol, the leaves of the European and Mediterranean *Taxus baccata* L. (EUROPEAN YEW, ENGLISH YEW) contain a compound that is now being used in taxol synthesis. It is interesting to note that like many medically valuable plants "discovered" by modern medicine, *Taxus* has a long history of medicinal use; e.g., early Europeans used it in treating hydrophobia (=rabies) and heart ailments, and Native Americans used it against such conditions as rheumatism, bronchitis, fever, scurvy, and skin cancer. ☠ Also like many medicinal plants, YEWS can be fatally poisonous to humans and animals. *Taxus* species have long been used in various ways such as in arrow poisons, to kill fish, and in murder and suicide. Death from YEW can be sudden, with animals sometimes being found close to the plant with foliage still in their mouths (Kingsbury 1964; Hartzell 1991, 1995; USDA Forest Service 1993; Cragg et al. 1995; Suffness & Wall 1995; Burrows & Tyrl 2001).

REFERENCES: Hardin 1971; Bell & Woodcock 1983; Raven et al. 1986; Bold et al. 1987; Hart 1987; Eckenwalder 1993; Woodland 1997; Farjon 1998; Stefanovic et al. 1998.

CUPRESSACEAE Rich. ex Bartl.
CYPRESS OR REDWOOD FAMILY

Evergreen or deciduous trees or shrubs; monoecious or in *Juniperus* usually dioecious; leaves variously opposite, whorled, or alternate and spirally arranged, sometimes appearing 2-ranked due to twisting, sometimes dimorphic, sometimes with an abaxial resin gland; pollen cones usually solitary, terminal; pollen not winged; seed cones with scales fleshy or woody.

☙This family has often been divided into Cupressaceae (in the strict sense), for those genera having opposite or whorled leaves (including *Juniperus*), and Taxodiaceae or REDWOOD FAMILY, for those genera having leaves mostly alternate. We follow Eckenwalder (1976), Hart and Price (1990), and Watson and Eckenwalder (1993) in treating them as a single family. Molecular evidence (Brunsfeld et al. 1994) shows Cupressaceae (in the strict sense) derived from within Taxodiaceae, supporting the single family treatment. The family is widespread in temperate areas

and has ca. 25–30 genera and ca. 110–130 species (Watson & Eckenwalder 1993). It is an ancient family, with a fossil record extending to the Jurassic Period (213–145 million years ago) (Miller 1988); a number of the genera are monotypic and exhibit disjunct or relictual distributions (Burrows & Tyrl 2001). Cupressaceae includes many interesting and important genera such as *Metasequoia*, *Sequoia*, *Sequoiadendron* (GIANT REDWOOD), and *Thuja* (ARBORVITAE). *Metasequoia glyptostroboides* Hu & W.C. Cheng (DAWN REDWOOD), known from only one remote area of China, was discovered in 1945. It has an extensive fossil record—it was the most abundant conifer in w and arctic North America from the late Cretaceous to the Miocene—and is thus often referred to as a living fossil. *Sequoia sempervirens* (D. Don) Endl. (COAST REDWOOD) of the Pacific coast of the U.S. is the world's tallest tree, with heights of over 117 m (Raven et al. 1986) having been reported; the tallest living tree currently known is 112.3 m (368.4 feet) (Gary Jennings, pers. comm.). It has been greatly overexploited and old growth trees are now restricted to a few reserves. *Platycladus orientalis* (L.) Franco [*Thuja orientalis* L.], (ORIENTAL-ARBORVITAE or BIOTA), an Asian native, is cultivated and can long persist in East TX—while this species has scale-like leaves resembling those of *Juniperus*, it can be easily distinguished from native Cupressaceae by its vertically aligned sprays of branchlets; foliage lacking odor when crushed, and cones with conspicuous recurved "horns" (actually bract tips). Family name from *Cupressus*, CYPRESS, a genus of 10–26 species of warm north temperate areas. (Latin name for the Italian cypress, *C. sempervirens* L.)

FAMILY RECOGNITION IN THE FIELD: EITHER evergreen trees or shrubs of dry habitats with opposite or whorled, *scale-like* leaves and *small, berry-like,* fleshy cones OR trees of wet habitats with alternate, linear to linear-lanceolate, *flat* leaves, deciduous twiglets (and thus leaves which are borne on the twiglets), nearly *globose, plum-sized,* woody cones, and often "*knees*" (erect woody projections) from the roots.

REFERENCES: Dallimore & Jackson 1931; Correll 1966b; Eckenwalder 1976; Hart 1987; Price & Lowenstein 1989; Hart & Price 1990; Page 1990b, 1990d; Watson & Eckenwalder 1993; Brunsfeld et al. 1994.

1. Leaves (adult) scale-like, closely appressed to stem, to 2.5 mm long, opposite or whorled, evergreen; cones globose to ovoid, to ca. 10 mm long, berry-like, fleshy; plants typically of dry habitats _____ **Juniperus**
1. Leaves linear to linear-lanceolate, conspicuously flat, not appressed, 5–17 mm long, alternate, deciduous (actually the leafy twiglets are deciduous, carrying the leaves with them); cones usually nearly globose, 15–25(–40) mm in diam., woody; plants of wet habitats _____ **Taxodium**

JUNIPERUS L. JUNIPER

Dioecious (pollen cones and seed cones on separate trees) or rarely monoecious (pollen cones and seed cones on same tree), evergreen, aromatic, resinous trees or shrubs; bark (in East TX species) reddish brown to brown or ashy gray, with long, thin, shreddy scales; adult leaves usually scale-like, opposite or in whorls, with an abaxial (= on side away from twig) resin gland (these elongate to elliptic to roundish); juvenile leaves needle-like; staminate cones small, cylindric, shedding pollen in late winter or early spring; mature ovulate cones fleshy, berry-like, variously colored, often glaucous, globose to ovoid, to ca. 10 mm long, reaching maturity in fall; seeds (in East TX species) 1–several, wingless.

A genus of ca. 60 species, primarily n hemisphere in distribution with 1 species in e Africa (Adams 1993). The decay-resistant wood of *Juniperus* species is often used for fence posts, the cones are an important food for birds, and gin is flavored by the cones of *Juniperus communis* L. of n North America. Numerous cultivars are used in landscaping, particularly those with unusual habits or foliage. JUNIPERS are wind-pollinated and shed large amounts of pollen (e.g., the "MOUNTAIN-CEDAR" pollen of local TV weather); this pollen is one of the most serious hay fever-causing

allergens in East TX. JUNIPERS are troublesome near apple trees and native hawthorns (*Crataegus* species) since they serve as an alternate host for cedar apple rusts (*Gymnosporangium* spp.). The sweet seed cones of some species were used as a food by Native Americans, including in the making of pemmican, a jerky-like product; however, large amounts may have toxic effects (Burrows & Tyrl 2001). Due to fire suppression and other human-induced changes, a number of native species of *Juniperus* have become troublesome invaders of native rangelands, currently affecting millions of acres (Adams et al. 1998). (Latin: *juniperus*, name for JUNIPER)

REFERENCES: Hall 1952; Adams 1972, 1975, 1977, 1986, 1993, 2000a, 2000b; Flake et al. 1978; Owens 1996; Adams et al. 1998; McLemore 2001; McLemore et. al 2004.

1. Mature ovulate cones (seed cones) reddish or copper-colored; leaf gland often with white crystalline exudate; hilum (= attachment scar) covering seed ca. 1/2 its length _____ **J. pinchotii**
1. Mature ovulate cones blue to bluish black or bluish purple; leaf gland without exudate; hilum covering seed ca. 1/3 or less it length.
   2. Plant usually with one main trunk from base; abaxial (= on side away from twig) leaf glands usually elliptic to elongate, usually not conspicuously raised (use a 10X hand lens); leaf margins entire, smooth (under a dissecting scope); species widespread and abundant in East TX _____ **J. virginiana**
   2. Plant usually with several trunks from near base; abaxial leaf glands usually roundish in outline, often conspicuously raised (use a 10X hand lens); leaf margins irregularly very minutely cellular-serrulate or cellular-denticulate (under a dissecting scope), not smooth; species known in East TX only from w margin of area _____ **J. ashei**

Juniperus ashei J. Buchholz, (for its discoverer, William Willard Ashe, 1872–1932), MOUNTAIN-CEDAR, ASHE'S JUNIPER, ROCK-CEDAR, POST-CEDAR, MEXICAN JUNIPER. Large shrub or small tree to ca. 6 m tall, usually with several trunks from near base, not resprouting after cutting or burning; bark ashy-gray to brown; ovulate cones mostly 7–8.5 mm long when mature, dark blue, glaucous, sweet, resinous; seeds 1(–3), covered by hilum for 1/3 their length. Rocky soils; often forming thickets or "cedar brakes" (further s and w in TX), Travis, Williamson (TEX), Dallas (BRIT), Bexar, Bell, Hays, McLennan (BAYLU), and Comal (Turner et al. 2003) cos. on the w margin of East TX; primarily Cross Timbers and Prairies and Edwards Plateau; AR, MO, OK, and TX. Due to fire supression, this species currently covers much more area (e.g., in the Cross Timbers and Prairies) than previously (Hall 1952; Fuhlendorf & Smeins 1997). In fact, Owens (1996) indicated that in central Texas *J. ashei* was previously confined to steep slopes, rocky outcrops, and waterways. This human-induced expansion of *J. ashei* has significant negative impacts on other native plants and is problematic for ranchers. *Juniperus ashei* is sometimes distinguished with difficulty from *J. virginiana*; in addition to the characters in the key, *J. ashei* usually has stiffer twigs and more odoriferous herbage. Hybridization and introgression have been reported where the 2 occur together (Correll 1966b; Hall 1952); Hall (1952) also noted that *J. ashei* can hybridize with *J. pinchotii*. However, Adams and Turner (1970) and Adams (1977) indicated that they refuted these reports of hybridization "using numerous chemical and morphological characters" (Adams 1993)—they found no evidence of hybridization between *J. ashei* and either *J. pinchotii* or *J. virginiana*. Nonetheless, Caren McLemore and Bob O'Kennon (pers. comm.) have observed several colonies of junipers in North Central TX that have morphological characteristics indicative of hybridization between *J. ashei* and *J. virginiana*.

Juniperus pinchotii Sudw., (for botanist Giffard Pinchot, 1865–1946), RED-BERRY JUNIPER, PINCHOT'S JUNIPER. Large shrub or shrub-like small tree to ca. 6 m tall, usually with several trunks from near base, resprouting after cutting or burning; bark ashy-gray to brown; ovulate cones 6–10 mm long, reddish or copper-colored, usually not glaucous or only slightly so, sweet, not resinous; seeds 1–2, covered by hilum for ca. 1/2 their length. Gravelly or rocky soils, com-

monly limestone or gypsum; Bell and Hill (Turner et al. 2003) cos. near extreme w margin of East TX, mainly in w 1/2 of TX; NM, OK, and TX. This species is similar to *J. ashei*, but according to Correll (1966b), the branchlets of *J. pinchotii* tend to be more slender and erect than the usually stiffish, recurved branchlets of *J. ashei*.

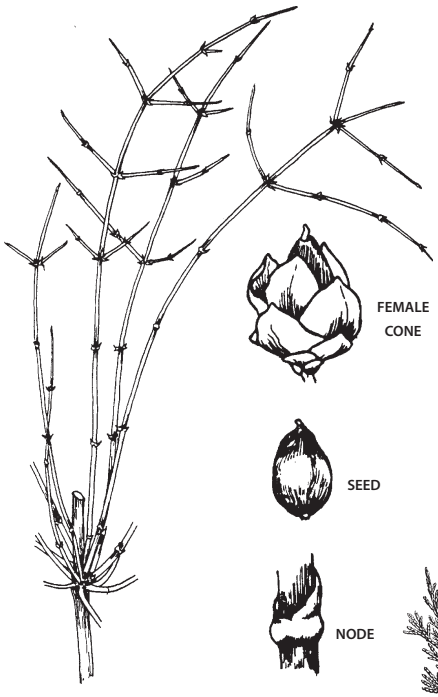
Juniperus virginiana L. var. **virginiana**, (of Virginia), EASTERN RED-CEDAR, RED-CEDAR, VIRGINIA RED-CEDAR, RED SAVIN, PENCIL-CEDAR, RED JUNIPER. Medium to large tree to 30 m tall, typically much smaller, usually with one main trunk; not resprouting after cutting or burning; bark reddish brown; ovulate cones 5–8 mm long, blue to bluish black or bluish purple, glaucous, resinous; seeds 1–2(–3), the hilum small, inconspicuous. Dry sandy and rocky soils, old fields, fencerows, forest margins; Pineywoods and Gulf Prairies and Marshes w to West Cross Timbers and Edwards Plateau; Little (1971) mapped the species in TX as far w as Wichita Co. in the Rolling Plains; Turner et al. (2003) mapped localities in the Panhandle; se Canada and e US w to ND and TX. This is a problematic invader of native prairies under conditions of fire suppression. The aromatic, moth-repelling heartwood is used for cedar chests and closets. RED-CEDAR symbolized the tree of life for a number of Native American tribes and was burned in sweat lodges and in purification rituals (Kindscher 1992). *Juniperus virginiana* var. *silicicola* (Small) E. Murray [*J. silicicola* (Small) L.H. Bailey], SOUTHERN or COASTAL RED-CEDAR, has been erroneously reported from TX (e.g., Little 1971); it is now known to occur only in FL, GA, NC, and SC (Adams 1986, 1993).

TAXODIUM Rich. BALD-CYPRESS

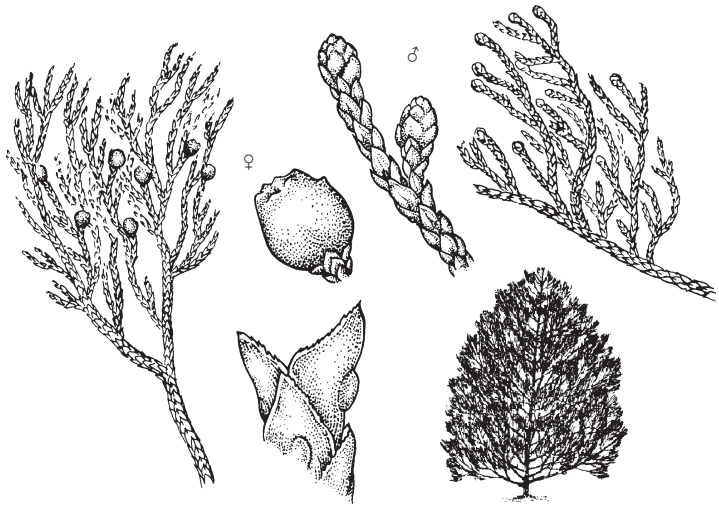
A genus of a single species (sometimes divided into 3) ranging from the United States through Mexico to Guatemala (Watson 1993); this is one of only 11 tree genera endemic to e North America (and adjacent tropical areas) (Little 1983). It is frequently segregated with related taxa into the Taxodiaceae (REDWOOD FAMILY). (*Taxus*, generic name of yew, and Greek, *oides*, like)

REFERENCES: Watson 1985, 1993; Keeland & Young 1997; Tsumura et al. 1999.

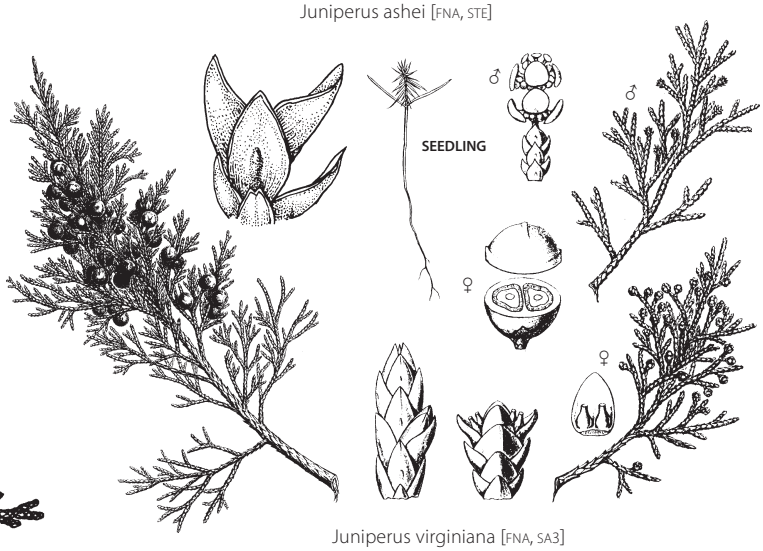
Taxodium distichum (L.) Rich. var. **distichum**, (in two ranks), BALD-CYPRESS, SOUTHERN-CYPRESS, SOUTHERN BALD-CYPRESS. **State tree of Louisiana.** Monoecious (pollen cones and seed cones on the same tree), deciduous trees to 50 m tall with a swollen, often buttressed base; in frequently flooded areas often with "knees" (erect woody projections from the roots); shoots dimorphic; long shoots indeterminate; short shoots (slender leafy twiglets) deciduous with the leaves in fall, pendent to horizontally spreading; leaves 2-ranked, linear to linear-lanceolate, flat, 5–17 mm long, laterally divergent, the free portion contracted and twisted basally, without an abaxial resin gland; staminate (pollen) cones ca. 2 mm in diam., in drooping panicles 10–12 cm long; ovulate (seed) cones usually nearly globose, to ca. 25(–40) mm in diam., the scales somewhat peltate. Swamps and along water courses and lake margins; Pineywoods and Post Oak Savannah w to Red River, Upshur (BRIT), Brazos (possibly native, M. Reed, pers. obs.) and Robertson (Turner et al. 2003) cos. and sw portion of East TX in Bexar (BAYLU), Bastrop, Bell, Comal, Hays, and Travis (Turner et al. 2003) cos.; also Gulf Prairies and Marshes and e Edwards Plateau; e U.S. from NY s to FL w to TX and MO. Pollen shed in spring; seeds in fall. This species dominates the landscape in some swampy situations, and huge populations can be found (e.g., Caddo Lake, Big Thicket). BALD-CYPRESS is an important timber tree known for its decay-resistant wood, even when in contact with soil; the heartwood is so durable that it has been referred to as "the wood eternal" (Hart & Price 1990). At one time there were large numbers of huge BALD-CYPRESSES in East TX, but because of the value of the wood, most were cut for timber. A very few impressive, extremely old individuals escaped destruction and can still be seen in the Big Thicket National Preserve in the s part of the Pineywoods. This species is extremely long lived and individuals up to ca. 1,700 years old have have been discovered in North Carolina



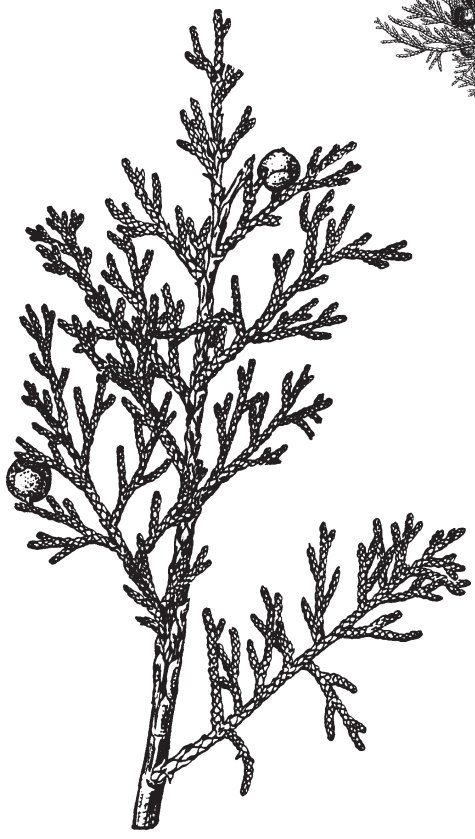
Ephedra antisyphilitica [LUN]



Juniperus ashei [FNA, STE]



Juniperus virginiana [FNA, SA3]



Juniperus pinchotii [BR1]



Taxodium distichum var. distichum [BT3, LUN]

(Stahle et al. 1988; Stahle 1996). According to Briand and Soros (2001), the "function of cypress knees has long intrigued botanists. In 1819, Michaux stated – 'No cause can be assigned for their existence.', to which in 1882 Asa Gray concurred. Since the late 19th century a number of theories have been put forward to explain their function, including aeration of the root system, vegetative reproduction, mechanical support, nutrient accumulation and carbohydrate storage. After nearly two hundred years of speculation and research, the function or functions of the knees of the cypresses still remains unclear." This species will grow in a variety of situations, while wild plants are virtually always in wet areas, BALD-CYPRESS does extremely well as a street tree and in lawns. It is currently being widely planted in East TX. Though often seen growing in relatively shallow water considerable distances from the shore of lakes, the species is reported to germinate only on moist but unflooded soil (Stalter 1981).

Two other varieties deserve mention:

Taxodium distichum var. *imbricatum* (Nutt.) Croom, (overlapping in regular order like tiles), [*T. ascendens* Brongniart, *T. distichum* var. *nutans* of authors, not (Aiton) Sweet—Watson 1985], POND-CYPRESS, is native in the se U.S. from NC s to FL and w as far as e LA (Watson 1993). It can be distinguished from var. *distichum* as follows: short shoots mostly ascending vertically; leaves not 2-ranked, mostly narrowly lanceolate, ca. 3–10 mm long, appressed and overlapping, the free portion neither contracted nor twisted basally (Watson 1993). While some authorities treat this taxon as a separate species (e.g., Nauman 2000), we are following Watson (1993) who treated it as a variety. Recent molecular evidence (Tsumura et al. 1999) supports recognition of POND-CYPRESS at the varietal level.

Taxodium distichum var. *mexicanum* Gordon, (of Mexico), [*T. mucronatum* Ten.], MEXICAN or MONTEZUMA BALD-CYPRESS, includes the famous "Tule Tree" of Oaxaca, one of the world's largest trees (in circumference) (Hall et al. 1990; Dorado et al. 1996; Debreczy & Rácz 1998). This ± evergreen variety extends as far n as s TX. According to Watson (1993), var. *mexicanum* exhibits continuous morphologic intergradation with var. *distichum* and there is some question as to whether it should be treated as a separate variety.

PINACEAE Spreng. ex F. Rudolphi
PINE FAMILY

A primarily n hemisphere family of 10 genera and ca. 200 species (Thieret 1993). It is of great economic importance as a source of softwood timber, pulpwood, naval stores (e.g., turpentine), Christmas trees, and ornamentals. In addition to *Pinus* (PINE), important genera include *Abies* (FIR), *Picea* (SPRUCE), *Pseudotsuga* (DOUGLAS FIR), and *Tsuga* (HEMLOCK). *Pseudotsuga menziesii* (Mirbel) Franco, of w North America, with trunks 3–4 m in diam. and over 90 m tall, is one of the most important lumber trees in the world (Lipscomb 1993; Woodland 1997); an individual 133 m tall was reported to have been felled in British Columbia in 1895 (Mabberley 1987). It is frequently sold as a Christmas tree in East TX and can be recognized by the pointed buds.
FAMILY RECOGNITION IN THE FIELD: trees with long, *needle-like leaves in bundles* of 2 or 3 (East TX species) and large woody *cones*; tissues resinous and aromatic.
REFERENCES: Dallimore & Jackson 1931; Correll 1966b; Little 1971; Price 1989; Farjon 1990a, 1990b; Page 1990c; Thieret 1993.

PINUS L. PINE

Monoecious (pollen cones and seed cones on the same tree), evergreen, resinous, aromatic trees to 30 m or more tall; leaves of 2 kinds: *scale-like* leaves subtending minute branchlets, each branchlet bearing a fascicle of 2–3 (in East TX species) elongate, *needle-like foliage* leaves (= needles) surrounded at the base by a membranous sheath; staminate (pollen) cones small, in

clusters at the base of the current year's growth, shedding pollen late winter to spring; pollen winged (each pollen grain having 2 air-bladders); ovulate (seed) cones becoming large and woody, in East TX species taking 2 years to mature; each scale of seed cone with a thickened, exposed, apical portion (= apophysis) terminated by a protuberance (= umbo); seeds winged (in East TX species), 2 per cone scale, shed in the fall.

A genus of ca. 110 species widely distributed in the n temperate zone and in mountainous areas of the n tropics (Kral 1993); nearly one half of the species occur in Mexico, Central America, and the Caribbean (Farjon & Styles 1997). *Pinus* has more species than any conifer genus (Millar 1993) and has the most widespread distribution of any genus of trees in the Northern Hemisphere (Price et al. 1998). According to Liston et al. (1999), "Modern classifications of *Pinus* recognize two major lineages: subgenus *Pinus* (diploxylon or hard pines, with two fibrovascular bundles in the needles) and subgenus *Strobus* (haploxylon or soft pines, with one fibrovascular bundle in the needle)." All species in East TX are in subgenus *Pinus*. *Pinus longaeva* D.K. Bailey (BRISTLE-CONE PINE of far w North America) is among the longest-living trees, with individuals approaching 5,000 years old. This species has been important in the development of dendrochronology (= tree-ring dating), and when dead specimens (which can last thousands of years before decaying) are also used, a tree ring record of 8,200 years is available. The genus has been used and known by humans for thousands of years—Theophrastus (370–285 B.C.) wrote extensively on pines and their usefulness, the genus was mentioned in ancient Greek mythology, and pine incense was used in religious ceremonies by the Romans, Mayans, and Aztecs (Mirov 1967). Many species are cultivated for timber, pulp, and resinous products (pitch, rosin, turpentine); others are used for their edible seeds (pignons, piñon, pignolia, or pine nuts) or as ornamentals. In East TX, the genus is widely cultivated as a source of wood products and is quite important economically. While the sandy acidic soils of the Pineywoods, and to some extent those of the Post Oak Savannah, are ideal for PINES, the calcium-rich, basic soils of the Blackland Prairie are not well-suited for members of this genus. Although PINES in general thus do not occur naturally w of the Post Oak Savannah-Blackland Prairie boundary, they are native as far w as Lamar Co. (Fannin Co.[?] (Correll & Johnston 1970)) in the Red River drainage where they occur on sandy, more acidic alluvium associated with that river. Mycorrhizal fungi, associated with the roots, allow pines to more effectively obtain nutrients and are apparently critical in allowing pines to utilize low-nutrient, acidic soils (Read 1998). Pines in the southeastern U.S., including East TX, are susceptible to damage by *Dendroctonus frontalis* Zimmermann (southern pine beetle), a type of bark beetle which tunnels in the inner bark and introduces blue-stain fungi, which hasten the death of the tree by plugging the water-conducting tissues (Bugwood 2001). From the ecological standpoint, human-induced changes in species composition within forests have created conditions conducive for bark beetle outbreaks (Clarke et al. 2000). In particular, under some circumstances, monoculture forestry contributes to bark beetle outbreaks (de Groot & Turgeon 1998). Substantial areas of East TX pine forest have been killed by such bark beetles. Ironically, under presettlement conditions, bark beetles were, along with fire, integral disturbance agents critical in the development of the economically important coniferous forests of the southeastern U.S. (Schowalter et al. 1981; Clarke et al. 2000). Because of the high resin content, pieces of pine heartwood resist decay for years and, when split, are quite flammable, burning with a bright light. As a result, they have been widely used for generations across the southern U.S. as kindling. In the Big Thicket before the era of flashlights, a flaming "light'd knot" had many uses, including night hunting for deer by shining the light in their eyes (Owens 1973). The following treatment relies heavily on Kral (1993). The "pine tree" is the State Tree of Arkansas (Geobop 2003). (Latin: *pinus*, name for pine)

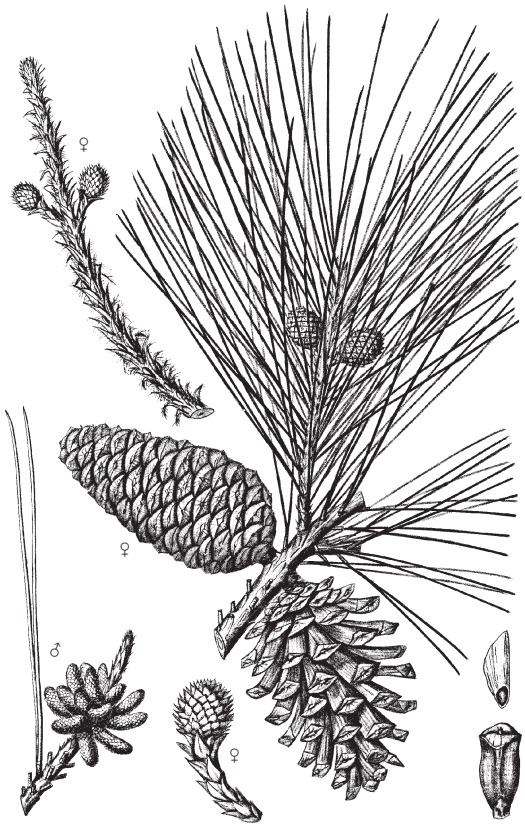
REFERENCES: Shaw 1914; Mirov 1967; Ward 1974; Perry 1991; Kral 1993; Millar 1993; Krupkin et al. 1996; Farjon & Styles 1997; Price et al. 1998; Richardson 1998; Liston et al. 1999; Whang et al. 2004; Gernandt et al. 2005.

1. Needles (20–)25–45 cm long, 3 per bundle; terminal buds silvery white, 3–4 cm long; bundle sheaths of new needles on young twigs 25 mm or more long; seed with body ca. 10 mm long and wing 30–40 mm long _____ **P. palustris**
1. Needles 5–23(–29) cm long, 2–3 per bundle; terminal buds brownish, 0.5–2 cm long; bundle sheaths of new needles on young twigs 20 mm or less long; seed with body 5–7 mm long and wing 12–20 mm long.
   2. Needles (5–)7–11(–12) cm long, usually 2(–3) per bundle; bundle sheaths 5–10(–15) mm long; terminal buds 0.5–0.7(–1) cm long; mature seed cones 4–6(–7) cm long; pollen cones 15–20 mm long at time of pollen release; bark with evident resin pockets _____ **P. echinata**
   2. Needles 12–23(–29) cm long, 2–3 per bundle; bundle sheaths (10–)12–20 mm long; terminal buds 1–2 cm long; mature seed cones 6–18(–20) cm long; pollen cones 20–40 mm long at time of pollen release; bark without resin pockets.
      3. Needles almost always 3 per bundle (very rarely 2), yellowish green to grayish green, not glossy; seed cones sessile or nearly so, mostly dull yellow-brown; surface of the exposed, thickened, apical portion of each seed cone scale (= apophysis) dull; pollen cones yellow to yellow-brown; terminal buds 1–1.2(–2) cm long _____ **P. taeda**
      3. Needles 2–3 per bundle, at least some bundles with 2, usually dark green, glossy; seed cones short-stalked, light chocolate brown; surface of exposed, thickened, apical portion of each seed cone scale lustrous as if varnished; pollen cones purplish; terminal buds 1.5–2 cm long _____ **P. elliottii**

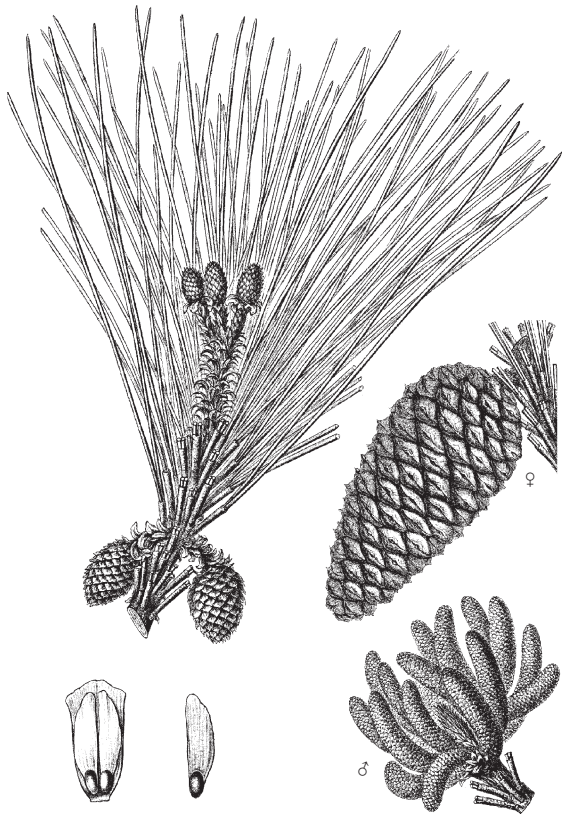
Pinus echinata Mill., (spiny), SHORTLEAF PINE, SHORTLEAF YELLOW PINE, LONGTAG PINE. Bark on older stems red-brown and separated into irregular, flat, scaly plates, with evident resin pockets; new twigs greenish brown to red-brown, red-brown to gray with age, slender (ca. 5 mm or less thick); terminal buds 0.5–0.7(–1) cm long; pollen cones 15–20 mm long at time of pollen release, yellow- to pale purple-green; seed cones 4–6(–7) cm long, red-brown, becoming gray with age, the scales with an elongate to short, stout, sharp prickle. Uplands, dry forests; native to Pineywoods and Post Oak Savannah as far w as Brazos, Leon (Turner 2003), Henderson (Correll 1966b), Red River (Little 1971), and Lamar (Wilson & Hacker 1986; Wilson 1990) cos.; spreading from cultivation in Fannin Co. (BRIT) in Red River drainage; e U.S. from NY s to FL w to MO and TX. According to Kral (1993), although this species is valuable for timber and pulpwood, it is susceptible to root rot.

Pinus elliottii Engelm., (for Stephen Elliott, 1771–1831, American botanist), SLASH PINE, PITCH PINE, YELLOW SLASH PINE. Bark on older stems orange- to purple-brown, broken up into rather large flat flakes, without resin pockets; twigs orange-brown, darker brown with age, relatively slender (to 10 mm thick); terminal buds 1.5–2 cm long; pollen cones 30–40 mm long at time of pollen release, purplish; seed cones (7–)9–18(–20) cm long, light chocolate brown, the scales with a short stout prickle. Cultivated and used in reforestation, naturalized in TX mainly in the Pineywoods and Post Oak Savannah; also n Gulf Prairies and Marshes and spreading from cultivation on sandy soils in Hood Co. in West Cross Timbers and in Denton and Tarrant cos. (R. O'Kennon, pers. obs.) in the East Cross Timbers; native to the se U.S. from SC s to FL w to e LA. This species is fast growing but is susceptible to ice damage. It is used for naval stores (e.g., turpentine) and for lumber and pulpwood and is "much planted in subtropical and warm temperate climates worldwide, particularly in Brazil" (Kral 1993).

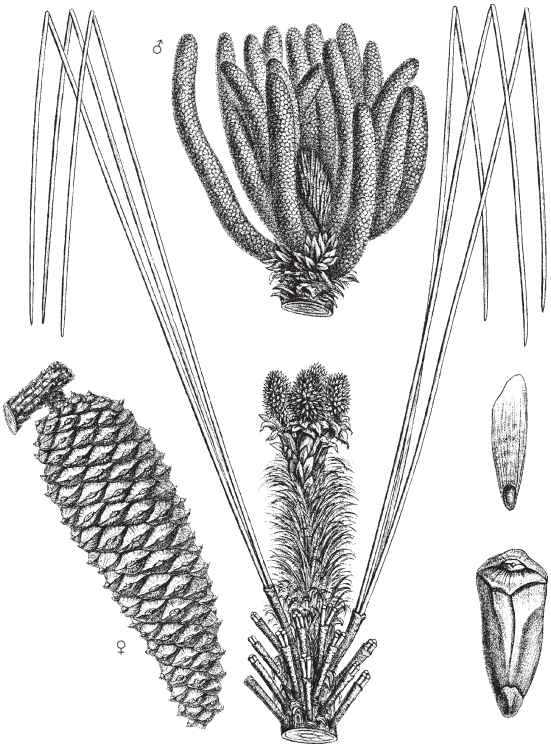
Pinus palustris Mill., (of marshes), LONGLEAF PINE, LONGLEAF YELLOW PINE, LONGSTRAW PINE. Bark on older stems orange-brown, of thin papery scales, usually thickly plated on large trees, without resin pockets; twigs orange-brown, darker with age, stout (to 20 mm thick); pollen cones 30–80 mm long at time of pollen release, purplish; seed cones 15–25 cm long, dull brown, the scales with a short reflexed prickle. Sandy soils; primarily s part of the Pineywoods; se U.S. from VA s to FL w to AR and TX. Recurrent low-intensity fire is critical for the maintenance of



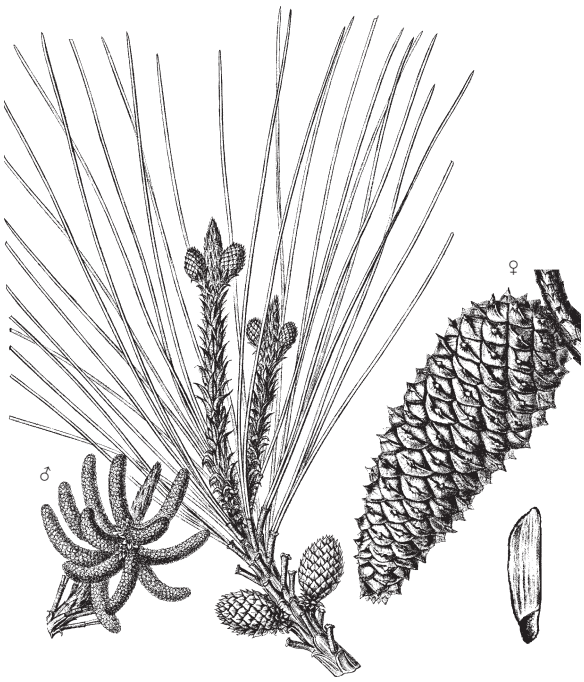
Pinus echinata [SA3]



Pinus elliottii [SA3]



Pinus palustris [SA3]



Pinus taeda [SA3]

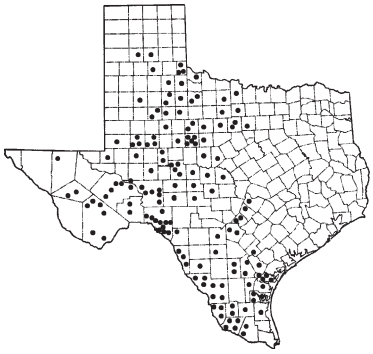
forests dominated by this deep-rooted, thick-barked, fire-tolerant species. Even very young individuals can withstand fire. They pass through a "grass" stage—called this because of the resemblance to a densely tufted perennial bunchgrass. During this stage, the taproot develops rapidly, the unbranched stem grows in diameter rather than height, and a thick tuft of needle-like leaves protects the meristem, located near ground level, from fire. At the end of the grass stage, the plant grows rapidly (several feet per year) until the meristem is above the typical scorch height of low-intensity fires (Little 1980; Agee 1998). LONGLEAF PINES are also quite resistant to attack by bark beetles (Clarke 2000). The occurrence of LONGLEAF PINE has been greatly reduced by deforestation and modern forestry practices favoring LOBLOLLY PINE. Though much less common than previously, this is a valuable timber species, and it has been important as a source of naval stores (e.g., turpentine and other resinous products used in the past for waterproofing wooded sailing ships). Nauman et al. (2000), based on Fernald (1948) and Fernald and Schubert (1948), discussed problems with the scientific name of this species, resulting from ambiguities in typification. Ward (1974) presented arguments in favor of using the name *P. palustris*, but as Nauman et al. (2000) indicated, "the problem remains." We are following Nauman et al. (2000) in "preserving contemporary usage until the typification can be resolved." ♟♣

Pinus taeda L., (ancient name for resinous pines), LOBLOLLY PINE, OLD-FIELD PINE. Bark on older stems dark red-brown and divided into irregular scaly blocks, without resin pockets; twigs orangish to yellow-brown, darker brown with age, relatively slender (to 10 mm thick); terminal buds 1–1.2(–2) cm long; pollen cones 20–40 mm long at time of pollen release, yellow to yellow-brown; seed cones 6–12 cm long, mostly dull yellow-brown, the scales with a stout-based, sharp prickle. Lowlands to dry uplands, extensively cultivated because of its value for pulpwood and timber; native to East TX as far w as Bastrop Co. ("Lost Pines"—an area of ca. 70 square miles of pine-oak woodland isolated from the main body of East TX pines by approximately 100 miles—Texas Parks and Wildlife 2002b) in sw East TX and Lamar Co. in Red River drainage (Little 1971); cultivated and escaped further w on sandy soils in Fannin (Lake Fannin) and Grayson (Buckner Preserve and Preston Peninsula) cos. (G. Diggs, pers. obs.); e U.S. from VA s to FL w to MO and TX. Extensive plantations of fast growing forms of this species can be found throughout the Pineywoods and Post Oak Savannah. Monocultures of this species have replaced vast areas of high diversity forest throughout East TX. In contrast, prior to the coming of Europeans, LOBLOLLY PINE is thought to have rarely occurred in pure stands anywhere in the West Gulf Coastal Plain (LONGLEAF and SHORTLEAF PINE were much more abundant); rather loblolly was usually associated with a variety of mixed hardwood species (Clarke 2000). The common name LOBLOLLY comes from one of the meanings of that word, "mud puddle," in reference to the sometimes wet habitat of this species (Little 1980). Hybrids have been reported with *P. echinata* and *P. palustris* (Kral 1993; Nauman et al. 2000). Rainfall in the "Lost Pines" area is considerably less than that received over most of the loblolly's natural range, and the "superior drought resistance of Lost Pines' loblolly pine is well documented" (McWilliams & Lord 1988). Such xeric-adapted plants are being propagated and sold. ♟♣

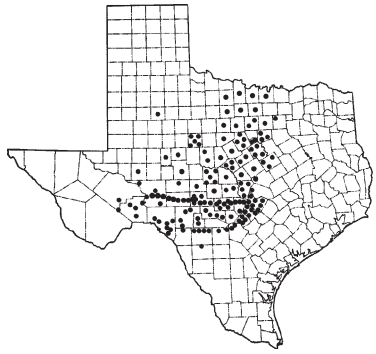
DIVISION **CYCADOPHYTA**

CYCADS

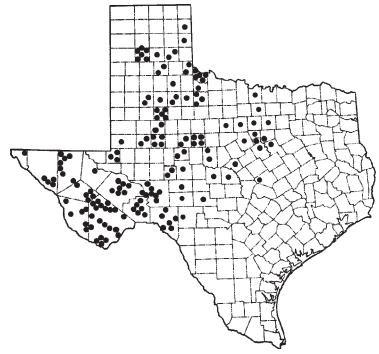
A division of 11 genera and 145 (Mabberley 1997) to 289 (Whitelock 2002) species (depending on species concepts) scattered mainly in the tropics and subtropics. Many are cultivated as ornamentals, and a number have become endangered through overcollecting. In fact, all cycad species "are now listed in Appendix II of the CITES list of rare and endangered species" (Whiting 1989). The Cycadophyta is an ancient lineage (dating from the Triassic Period onwards) whose widely scattered and restricted modern day distribution is a relict of the group's previous



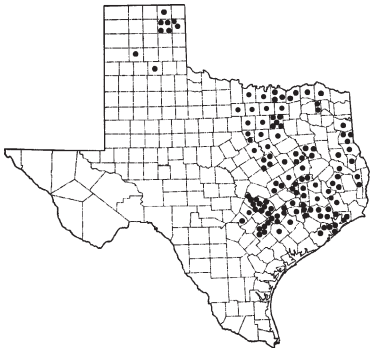
Ephedra antisyphilitica



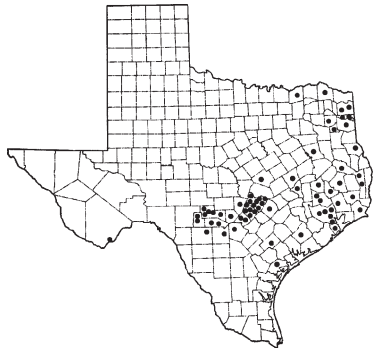
Juniperus ashei



Juniperus pinchotii



Juniperus virginiana



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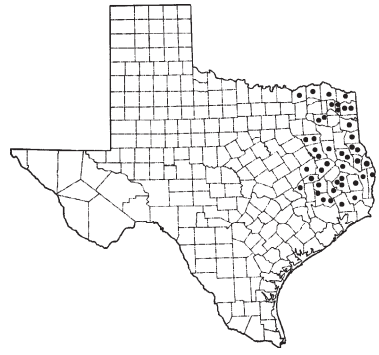
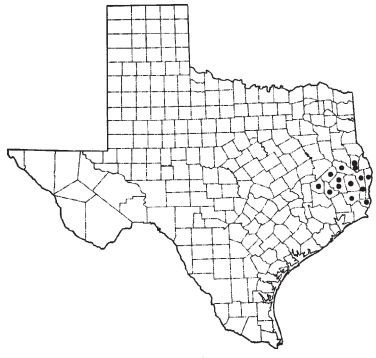


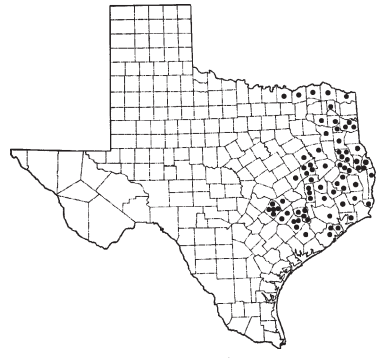
Pinus echinata



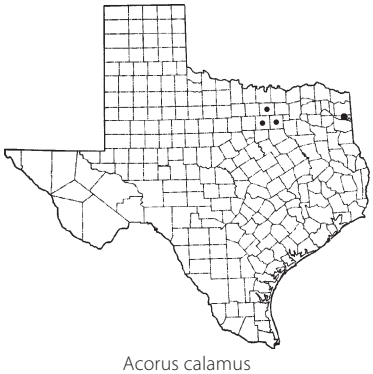
Pinus elliottii



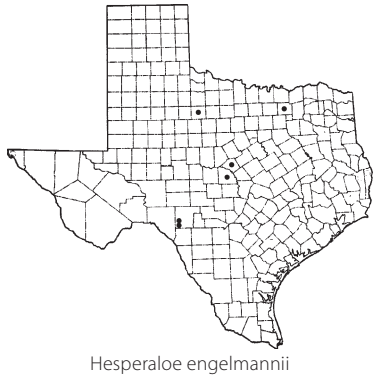
Pinus palustris



Pinus taeda



Acorus calamus



Hesperaloe engelmannii



Hesperaloe parviflora

abundance. Cycads were so numerous during the Mesozoic that this geologic period is sometimes called the "Age of Cycads and Dinosaurs" (Raven et al. 1999). Cycads superficially resemble palms (unbranched trunks, large pinnate leaves) and are sometimes referred to as "sago palms" or "Easter palms," but they are clearly unrelated to palms, as evidenced by numerous characteristics. These include naked seeds borne in cones, multi-flagellated swimming sperm, and separate sexes (plants dioecious). While we have no reports of them naturalizing in East TX, they are cultivated, and this brief write up on the Cycadophyta is included for taxonomic interest and for use in college botany classes. A number of cycads have been used as a source of human food—e.g., sago starch from the starch-rich pith of the stems of several *Cycas* species. ☠ The seeds of *Cycas* species (Cycadaceae) have been used as a dietary source of polysaccharides for humans in various western Pacific Islands. However, because they are known to be toxic, the seeds are cut and soaked for an extended period with several changes of water. The toxicity of unprocessed seeds is due to cycasin and macrozamin (glycosides which are water soluble and therefore removed by soaking), which yield toxic molecules when hydrolyzed in the human intestine. These molecules and their derivatives are reported to be hepatotoxic, carcinogenic, mutagenic, and teratogenic. On two Pacific islands (Guam and New Guinea), a fatal degenerative neurological disease (symptoms: lateral amyotrophic sclerosis, parkinsonism, dementia) has been attributed by some authorities to other toxins in the flour made from *Cycas* seeds. These other toxins may include a neurotoxic amino acid (L-BMAA). Further, ingestion of a variety of cycads is known to cause various symptoms of poisoning (e.g., severe gastrointestinal tract disturbances, liver necrosis, neurologic symptoms—hind limb paralysis in cattle, depression in dogs) in a variety of animal species as well as in humans; one or two seeds have been reported to be sufficient to kill a dog (Whiting 1989; Albretsen et al. 1998; Bruneton 1999; Burrows & Tyrl 2001). Since cycads are widely used as ornamentals, care should be taken to limit access to the plants by children and animals.

REFERENCES: Read & Solt 1986; Whiting 1989; Stevenson 1990a, 1990b, 1992; Stevenson et al. 1990; Jones 2002; Whitelock 2002.

DIVISION **GINKGOPHYTA**

MAIDEN-HAIR TREES

A division represented by a single surviving species, *Ginkgo biloba* L., GINKGO or MAIDEN-HAIR TREE (Ginkgoaceae), native of China. Fossils almost identical to modern GINKGOS are known from nearly 200 million years ago (Whetstone 1993), and the group was widespread and abundant during the middle Mesozoic Era (Scagel et al. 1984; Mauseth 1998). *Ginkgo* is "often referred to as a 'living fossil' because of its position as the sole surviving member of an ancient lineage" (Scagel et al. 1984). This relict species is widely cultivated because of its resistance to disease and pollution and its beautiful deciduous leaves which turn yellow in fall, but it is "either extinct in the wild or drastically restricted in range" (Whetstone 1993). Page (1990a) reported natural occurrence in remote valleys in China, but cultivated plants are descendants of individuals grown in temple gardens of China and Japan (Moore et al. 1998). *Ginkgo* is distinctive morphologically, having fan-shaped leaves (usually apically notched and hence the epithet *biloba*) with open dichotomous venation. Individual trees can live to 1000 years old and reach 30 m in height, with trunks to 9 m in circumference (Scagel et al. 1984; Raven et al. 1999). It is used as a street, yard, and ornamental tree in East TX. The species is dioecious, and care should be taken to use staminate trees if possible, since ovulate trees produce abundant, stalked, naked seeds the size of a small plum, which have a fleshy outer coat notorious for its rancid butter-like foul-smell (due to butanoic and hexanoic acids—Raven et al. 1999). The edible seeds or ginkgo nuts (minus the outer coat) are canned and sold in ethnic markets as "sal-nuts," "silver almonds," or "white nuts" (Scagel et al. 1984; Whetstone 1993), and the scientific name is derived from two Chinese words meaning "silver apricot" (Moore et al. 1998). ☠ However, when

consumed in large amounts, a neurotoxin in the seeds can cause "gin-nan food poisoning," including seizures, loss of consciousness, and death. The outer coat of the seeds can also cause contact dermatitis in some individuals (Burrows & Tyrl 2001). *Ginkgo* is variously used medicinally in many parts of the world, typically in the form of standardized extracts of the leaves (which do not contain the neurotoxin). Many benefits are attributed to the extracts, with uses including as a non-prescription herbal treatment for Alzheimer's disease, to relieve cerebral insufficiency, to enhance blood flow, and to increase memory and concentration. However, large doses have been reported to cause mild digestive upset (Burrows & Tyrl 2001). While we have no reports of GINKGO naturalizing in East TX, this brief write up on the Ginkgophyta is included for taxonomic interest and for use in college botany classes.
REFERENCES: Franklin 1959; Page 1990a; Whetstone 1993.

DIVISION **MAGNOLIOPHYTA**
ANGIOSPERMS OR FLOWERING PLANTS

Worldwide, the Magnoliophyta is typically considered to be composed of ca. 249,500 species in 13,185 genera arranged into 405 families (Mabberley 1997). Depending on a variety of factors, including taxonomic philosophy (e.g., lumping versus splitting, application of cladistic methodology), the number of flowering plant families recognized ranges from 387 to 685. These rather different numbers reflect differences in the rank at which groups are recognized, as well as philosophical differences in how evolutionary relationships should be reflected in classification and nomenclature (Cronquist 1988; Reveal 1993a, 1993b; APG 1998; Chase et al. 2000; APG II 2003). We are recognizing 202 of the angiosperm families as occurring in East Texas. The total number of angiosperm species is also uncertain, with recent estimates of seed plants (angiosperms plus ca. 840 species of gymnosperms) ranging from as low as 223,300 (Scotland & Wortley 2003) to as high as 422,000 species (Govaerts 2001) or ca. 423,000 species (Bramwell 2002). The Magnoliophyta is the world's dominant and most diverse group of plants; it is also the primary group upon which human civilization relies. For example, just three plants, RICE, WHEAT, and CORN, provide ca. 45% of total human caloric intake (Chrispeels & Sadava 1977). The angiosperms are seed plants with flowers, seeds which develop inside closed carpels, and double fertilization, a process by which cells in addition to the egg unite with a sperm during fertilization to form a triploid endosperm (Mabberley 1997; Stuessy 2004). The word angiosperm is derived from roots meaning "vessel seed," reflecting the development of the seeds inside a protective carpel. Recently, large scale molecular analyses (e.g., Hamby & Zimmer 1992; Chase et al. 1993; Doyle et al. 1994) have indicated that the angiosperms are a monophyletic group, supporting the same conclusion based on morphological and anatomical characters. While there is agreement, based on both molecular and morphological evidence, that the angiosperms evolved from gymnosperms, the exact ancestral gymnosperm group is as yet unknown with certainty. Current evidence does not support any living gymnosperm group as ancestral to the angiosperms, and it has been suggested that the ancestor of the flowering plants should be sought among the extinct seed ferns (= pteridophytes) (Stuessy 2004). Recent molecular studies (based on DNA sequences from several genes) have given new insights into evolutionary relationships within the flowering plants, with the oldest surviving branch of the angiosperm tree now considered by many to be *Amborella* (a dicot shrub, the only member of its family, endemic to New Caledonia, with unsealed carpels and laminar stamens). The next branch is represented by water-lilies (Nymphaeaceae and Cabombaceae) and the next the Austrobaileyales (e.g., Illiciaceae, Schisandraceae) (Mathews & Donoghue 1999; Qiu et al. 1999, 2000; Soltis et al. 1999, 2000; Zanis et al. 2002, 2003; but note criticism from Scotland 2000 and

Goremykin et al. 2003). However, other analyses (e.g., Nandi et al. 1998; Savolainen et al. 2000), while giving a very similar overall picture of flowering plant evolution, differ in some details—for example, *Ceratophyllum* (extremely reduced—e.g., no roots—and highly specialized aquatic dicot with inaperturate pollen) is found in some analyses to be the sister group to the rest of the flowering plants. Thus, while such molecular studies represent major conceptual breakthroughs, additional research is needed before there is concensus on the details of flowering plant evolution. In particular, more information is needed to give a clear picture of the relationships of ancient lineages such as *Ceratophyllum*, *Amborella*, water-lilies, and Austrobaileyales. While the earliest history of the flowering plants is poorly documented, recent paleobotanical studies (Sun et al. 2002), have provided fossil evidence of some of the oldest known flowering plants—the genus *Archaefructus* in the extinct family Archaefructaceae is now known from at least 124.6 million years ago. The flowers lack petals and sepals, bear stamens in pairs below conduplicate carpels, and have monosulcate pollen. Phylogenetically, this family is best considered a sister group to the rest of the flowering plants. Such finds, as well as slightly older microfossil (pollen) evidence, places the origin of the angiosperms in the early Cretaceous approximately 130 million years ago.

The historical division of flowering plants into Class Monocotyledonae (monocots) and Class Dicotyledonae (dicots) is not supported by recent molecular studies. Rather, the monocots appear to be a well-supported monophyletic group derived from *within* the dicots (e.g., Chase et al. 1993; Duvall et al. 1993b; Qiu et al. 1993, 1999; Soltis et al. 2000; Savolainen et al. 2000; Zanis et al. 2003) (see Fig. 174 in Appendix 3). The dicots are therefore paraphyletic and thus, from the cladistic standpoint, inappropriate for formal recognition. However, for practical reasons we are continuing to recognize the two traditional classes—monocots and dicots (see Appendices 5 and 6). The monocots (along with ferns and similar plants and gymnosperms) are included in this volume, while the dicots will be treated in a second volume. The dicots are an extremely diverse group including a wide variety of different plants (ancient to modern lineages, herbs to trees, terrestrial to aquatic, 1-pored and 3-pored pollen, etc.). Within the dicots, the vast majority of species are in the monophyletic group known as the "eudicots" (these have triaperturate or 3-pored pollen, in contrast to the monocots and a few ancient dicot lineages which have uniaperturate or 1-pored pollen) (see Fig. 174 in Appendix 3). According to Herendeen and Crane (1995), "A useful model of angiosperm classification therefore recognises the monocots and eudicots as two monophyletic clades (which together account for about 97% of extant angiosperm diversity) that are embedded in a systematically depauperate but morphologically diverse grade of magnoliid dicotyledons." At this time, however, the exact relationship among the remaining 3% of angiosperms (non-monocots and non-eudicots—a group of ancient surviving lineages with 1-pored pollen sometimes referred to as the woody magnoliids and paleoherbs) is not definitively known. Depending on the particular molecular marker(s) used, the non-eudicots (with the exception of *Ceratophyllum*) are thought by some to be monophyletic and by others to represent a grade (= level of adaptation, without implying evolutionary relationship) (Savolainen et al. 2000). Additional research in the next few years should resolve some of the remaining questions about angiosperm evolution. While our current understanding is imperfect, the accomplishments and increased understanding of the past few years are astonishing.

REFERENCES: Cronquist 1981, 1988, 1993; Wolf et al. 1989; Loconte & Stevenson 1991; Hamby & Zimmer 1992; Thorne 1992a, 1992b; Chase et al. 1993; Duvall et al. 1993b; Qiu et al. 1993, 1999, 2000; Reveal 1993a, 1993b; Doyle et al. 1994; Takhtajan 1997; Angiosperm Phylogeny Group 1998; Nandi et al. 1998; Soltis et al. 1999, 2000; Savolainen et al. 2000; Leitch & Hanson 2002; Reveal & Pires 2002; Zanis et al. 2002, 2003; Stuessy 2004

CLASS MONOCOTYLEDONAE

Plants usually herbaceous—in other words, lacking regular secondary thickening (though stems wood-like in Palmae, Smilacaceae, most Agavaceae, and a few Poaceae); seedlings usually with 1 seed leaf or cotyledon; stems or branches elongating by apical growth and also by growth of basal portion of internodes; leaves when present alternate, whorled, basal, or rarely opposite, elongating by basal growth (readily seen on spring-flowering bulbs whose leaf-tips have been frozen back); leaf blades usually with parallel or concentrically curved veins, these unbranched or with inconspicuous, short, transverse connectives (leaves net-veined or with prominent midrib and spreading side-veins parallel with each other in Alismataceae, Araceae, Cannaceae, Marantaceae, some Orchidaceae, and Smilacaceae); perianth with dissimilar inner and outer whorls (petals and sepals) or all parts ± alike (tepals); perianth parts separate or united, commonly in 3s, less often in 2s, rarely in 5s, or perianth of scales or bristles, or entirely absent.

Worldwide, the Monocotyledonae is a group composed of ca. 55,800 species (ca. 22% of the flowering plants) in 2,652 genera arranged in 84 families (Mabberley 1997); 46 of these families occur in East TX. The monocots appear to be a well-supported monophyletic group (e.g., Chase et al. 1993; Duvall et al. 1993b; Qiu et al. 1993, 1999; Soltis et al. 1997, 1999, 2000; Savolainen et al. 2000) derived from non-eudicots (the non-eudicots, including the monocots and many Magnoliidae, have pollen grains with a single aperture, while the eudicots have pollen grains with three apertures). More specifically, recent analyses indicate that the monocots are part of a "eumagnoliid" clade containing a number of Magnoliidae orders (Winterales, Piperales, Laurales, Magnoliales, and Chloranthales) (Chase et al. 2000; Soltis et al. 2000) including plants often referred to as woody magnoliids (e.g, Magnoliaceae) and paleoherbs (e.g, Aristolochiaceae). From the cladistic standpoint, since monocots are derived from within the dicots, the dicots are paraphyletic and thus inappropriate for formal recognition (see explantion and Fig. 174 in Appendix 3 and also Appendices 5 and 6). Within the monocots, *Acorus* appears to be the sister group to all other monocots, with the Alismatales (including Araceae and Hydrocharitaceae) being the next most basal group (Duvall et al. 1993b; Chase et al. 2000; Fuse & Tamura 2000; Soltis et al. 2000; Duvall 2001). However, numerous unresolved questions still exist, as emphasized by differences in the system of Reveal and Pires (2002) (e.g., recognition of Arales as a lineage separate from Alismatales, which are possibly paraphyletic). Recent advances in the understanding of monocot phylogeny (e.g., Dahlgren et al. 1985; Goldblatt 1995; Chase et al. 2000; Soltis et al. 2000) have resulted in considerable rearrangement of the monocots at the family and order levels. One of the most striking examples is that the Liliaceae in the traditional broad sense is now known to be a group of superficially similar species in four different orders: Liliales, Asparagales, Alismatales (Tofieldiaceae), and Dioscoreales (Nartheciaceae) (Chase et al. 2000). As such, this polyphyletic assembladge must be split into a number of smaller, taxonomically defensible families (see further discussion under Liliaceae and in Appendix 6). This said, there is currently no concensus on the exact number of families that should be recognized in the Liliaceae (broad sense) or in the monocots as a whole, with differences due to both taxonomic philosophy (e.g., the allowability of paraphyletic families) and lack of conclusive data. The name "monocotyledon" is derived from the presence of a single cotyledon (= seed leaf), in contrast to the two seed leaves found in the dicotyledons.

REFERENCES: Cronquist 1981, 1988, 1993; Dahlgren et al. 1985; Conran 1989; Thorne 1992a, 1992b; Chase et al. 1993; Clark et al. 1993; Duvall et al. 1993b; Qiu et al. 1993, 1999; Reveal 1993a, 1993b; Bharathan & Zimmer 1995; Chase et al. 1995a, 1995b, 2000; Goldblatt 1995; Herendeen & Crane 1995; Les & Haynes 1995; Les & Schneider 1995; Rudall & Cutler 1995; Rudall et al. 1995, 1997; Stevenson & Loconte 1995; Soltis et al. 1997, 2000; Takhtajan 1997; Angiosperm Phylogeny Group 1998; Kubitzki et al. 1998; Bremer 2000; Duvall 2000; Fuse & Tamura 2000; Savolainen et

al. 2000; Stevenson et al. 2000; Duvall 2001; Vinnersten & Bremer 2001; Reveal & Pires 2002; Davis et al. 2004.

ACORACEAE Martinov
SWEETFLAG OR CALAMUS FAMILY

☙*Acorus* has traditionally been placed in the Araceae (e.g., Dahlgren et al. 1985) despite having many characters unusual for an aroid. Grayum (1987) gave extensive reasons why the genus should be placed in its own family. The Acoraceae, thus circumscribed, is a very small, Old World and North American family of 6 or fewer species (1 more if the somewhat similar, monotypic, Australian genus *Gymnostachys* is included). Thompson (2000a) considered the family to have 1 genus and 3–6 species, a viewpoint supported by molecular data which distinguish *Acorus* from the Araceae but link *Gymnostachys* with that family (Chase et al. 2000; Soltis et al. 2000). An anaylsis by Duvall et al. (1993b) pointed to *Acorus* as the most basal living lineage of monocotyledons, and more recent molecular studies (Soltis et al. 1997, 2000; Chase et al. 2000; Fuse & Tamura 2000; Savolainen et al. 2000) support this hypothesis. *Acorus* thus appears to be the sister group to the rest of the monocots (this is referred to as the Acoranan hypothesis—Duvall 2001). These results all argue for the recognition of the Acoraceae as separate from the Araceae. A recent study of developmental and morphological similarities (Buzgo & Endress 2000) suggested a linkage between *Acorus* and the Piperales (e.g., Saururaceae), a dicot group referred to as paleoherbs and considered relatively close to the base of the flowering plant tree. A study combining molecular and fossil data (Bremer 2000) has estimated the split between *Acorus* and the remaining monocots to have occurred more than 134 million years ago (mya), near the boundary of the Jurassic and Cretaceous periods (145 mya). (subclass Arecidae—Cronquist; order Acorales—APG II)

FAMILY RECOGNITION IN THE FIELD: the only member of this family in East TX is an aromatic herb with sword-like leaves roughly 1 m long and a cylindrical, finger-like inflorescence (called a spadix) diverging from the side of an elongate, spathe-like scape.

REFERENCES: Wilson 1960; Grayum 1987; Duvall et al. 1993b; Davis 1995; Thompson 1995, 2000a; Soltis et al. 1997, 2000; Bogner & Mayo 1998; Bown 2000; Buzgo & Endress 2000; Chase et al. 2000; Savolainen et al. 2000; Duvall 2001.

ACORUS L. SWEETFLAG, CALAMUS

☙A genus of 3–6 species (Thompson 2000a) with iris-like or grass-like leaves. *Acorus* is clearly distinguished from the Araceae (with which it was previously treated) not only at the molecular level (e.g, Chase et al. 2000—see discussion above), but also in anatomical characters: ethereal oils in specialized spherical cells, the absence of raphides (bundles of microscopic, needle-like calcium oxalate crystals), and very different anther development (Judd et al. 1999). Some *Acorus* species have been cultivated for fragrant oils in the rhizomes, and the genus was of religious significance to the North American Plains Indians (Yatskievych 1999). (Latin name for an aromatic plant or possibly Latin: *acorus*, without pupil, the name used by Dioscorides for an iris used in treating cataracts)

REFERENCES: Buell 1935; Harper 1936; Packer & Ringius 1984; Motley 1994.

Acorus calamus L., (ancient name for a reed). DRUG SWEETFLAG, SWEETFLAG, CALAMUS, SEVERAL-VEIN SWEETFLAG. Sweetly aromatic (somewhat citrus-like), perennial herb with thick rhizomes and erect, linear, sword-shaped, parallel-veined leaves 0.9–1.2+ m long and 5–25 mm wide; inflorescence an exposed cylindrical spadix, 4–9 cm long, diverging laterally from an elongate, leaf-like, spathe-like scape (not a true spathe—Ray 1987); flowers perfect, covering the spadix; perianth of 6 short equal segments; stamens 6; ovary 1, superior; mature fruits not known to be

produced in North America (North American plants sterile triploids) (Thompson 2000a). Wet ground or shallow water; Dallas (BAYLU, BRIT) and Marion (Correll & Johnston 1970) cos. in n part of East TX; also in the Cross Timbers and Prairies in Denton and Tarrant (Mahler 1988) cos.; se Canada and e U.S. w to SD and TX, also CA, OR, and WA. May–Jun. The geographic origin of TX *Acorus* has been somewhat confused. The genus is apparently introduced in TX but was described as native in 1833 (Mahler 1988). Harper (1936) questioned whether *Acorus* is native to the U.S. Buell (1935), however, concluded that the genus is native to the interior of North America. According to J. Kartesz (pers. comm.), TX plants are introduced from the Old World, with *A. americanus* (Raf.) Raf. extending no further s in the Great Plains than Nebraska and Iowa. Jones et al. (1997) treated all TX material as *A. americanus*. Recent research by Thompson (1995, 2000a) has clarified the situation, showing that *A. americanus* (a diploid) is a native species occurring from the ne U.S. across s Canada and the n plains, while *A. calamus* (a sterile triploid) is an introduced Old World species occurring primarily in the e and c U.S. (including TX, AR, LA, and OK). *Acorus calamus* has a rich ethnobotanical history dating back to the ancient Egyptians, Greeks, and Romans, having been used medicinally since the time of Hippocrates. It was also known from Tutankhamun's tomb. It has been used as a fragrant essence in perfumes and oils, in alcoholic beverages, and as an apparently effective insecticide, and it is being investigated for antibacterial and antifungal properties. It is used religiously as "oil of holy ointment" for anointing sacred items, and was referred to in Exodus as SWEET CALAMUS. In Sumatra it is hung up at night to keep evil spirits from children (Plowman 1969; Motley 1994; Mabberley 1997). According to Motley (1994), "Sweet flag is poisonous under certain conditions. ..." and can cause gastrointestinal problems. Duke (1985) referenced sources indicating that oil of calamus is carcinogenic, probably due to the presence of asarone (an allylbenzene) or safrole. McGuffin et al. (1997) indicated asarone is potentially hepatocarcinogenic and can cause chromosome damage in human lymphocytes. Use of sweet flag is prohibited in the U.S. and Canada, though it is still used to flavor food, beverages, and spices in Europe (Motley 1994). /273

AGAVACEAE Endl.

YUCCA, CENTURY-PLANT, SISAL, OR AGAVE FAMILY

Herbaceous or woody, usually xerophytic perennials; stems variously subterranean and not evident to trunk-like and obvious; leaves evergreen, usually basal or bunched, proportionally narrow, flat to concave or thickened, ± fleshy or leathery, with widened, clasping bases; flowering stems with alternate leafy bracts; flowers in racemes or panicles; tepals 6, in 1 or 2 whorls, sometimes fused basally; stamens 6; pistil 1, of three carpels; ovary superior or inferior; fruit a capsule or fleshy and berry-like; seeds numerous, flattened.

A small family (ca. 300 species in 8 genera—Verhoek 1998) of tropical and temperate areas of the New World. The family is centered in the sw U.S. and Mexico but ranges from the c U.S. to Panama, the Caribbean Islands, and n South America (García-Mendoza & Galván 1995; Verhoek 1998). About 200 of the species are in the diverse genus *Agave*. Members of the family have been variously treated in the past, e.g., as part of the Amaryllidaceae or Liliaceae. Alternatively the Agavaceae has been considered in a broader sense (e.g., 550 species in 17 or 18 genera—Verhoek & Hess 2002) to include taxa now treated in such families as the Dracaenaceae and Nolinaceae. However, molecular studies (e.g., Eguiarte et al. 1994; Bogler & Simpson 1995, 1996; Fay et al. 2000) support recognition of a narrower, monophyletic Agavaceae in the order Asparagales. The superficially similar Nolinaceae, previously treated as part of the Agavaceae, is here recognized as a separate family (see note in key to genera and discussion under Nolinaceae). Recently, the Angiosperm Phylogeny Group (APG II 2003) suggested either submerging the Agavaceae into a very broadly defined Asparagaceae or alternatively recognizing

them as a separate family. A number of species of Agavaceae (e.g., *Agave* and *Yucca* species) have been used as a source of food and drink both by native peoples and commercially (e.g., tequila production). Species of *Agave*, *Hesperaloe*, and *Yucca* are used as ornamentals. *Agave*, *Furcraea*, and *Yucca* are sources of fiber for cordage and other purposes, and steroidal sapogenins from *Agave* and *Yucca* have been used as soap, in folk medicine, and in making oral contraceptives (Gentry 1982; Judd et al. 1999; Verhoek & Hess 2002). Family name from *Agave*, AGAVE, MAGUEY, or CENTURY-PLANT, a genus of ca. 200 species (Reveal & Hodgson 2002) native from the s United States to tropical South America. *Agave* species are the source of fiber (sisal hemp and henequen), pulque (a Mexican "beer"), and the distilled liquors mescal and tequila. Based on archaeological records, it is known that *Agave* species have been used for food and fiber for at least 9,000 years (Callen 1965; Gentry 1982; Irish & Irish 2000). The common name, CENTURY PLANT, results from the monocarpic (= flowering only once and then dying) habit of some species. Such a plant may grow vegetatively for many years or even decades (but probably not a century) before putting all its energy into a massive burst of flowering—the parent plant then dies as its seeds mature (Burrows & Tyrl 2001). *Agave americana* L., (of America), the CENTURY-PLANT or AMERICAN CENTURY-PLANT, native to the sw U.S. and Mexico, is cultivated in East TX and can long persist (but apparently does not escape); it has large glaucous-gray leaves with a long (2.5–5 cm) terminal spine and a paniculate inflorescence 5–7 m tall. (Greek: *agave*, noble or admirable, in reference to the handsome appearance when in flower) (subclass Liliidae—Cronquist; order Asparagales—APG II)

FAMILY RECOGNITION IN THE FIELD: usually xerophytic, typically robust perennials, often with leaves basal or crowded near base of stem (or at stem apex in large tree-like yuccas) and sometimes sharp-pointed; inflorescence a raceme or panicle; fruit a capsule or fleshy and berry-like.

REFERENCES: Dahlgren et al. 1985; Eguiarte et al. 1994, 2000; Bogler & Simpson 1995, 1996; Eguiarte 1995; García-Mendoza & Galván 1995; Sandoval 1995; Irish & Irish 2000; Verhoek & Hess 2002.

1. Flowers rosy red or salmon-colored (yellow-flowered forms known in cultivation); leaves conspicuously involute (= with margins rolled inward or toward the upper surface) upon drying, with the marginsnearly touching _____ **Hesperaloe**
1. Flowers white to greenish or yellowish (can be reddish brown toward tips); leaves not involute (can be v-shaped in *Manfreda*).
   2. Ovary inferior; leaves 10–39 cm long, without a hard spiny tip, succulent or semisucculent _____ **Manfreda**
   2. Ovary superior; leaves usually 40 cm long or more OR if shorter, then with a hard spiny tip, not succulent (but can be thick).
      3. Flowers 13–70 mm long or broad; leaves 8–80 mm wide; capsules large (much > 1 cm long), the seeds numerous in each cell _____ **Yucca**
      3. Flowers small, 2.5–7 mm long or broad; leaves 2–12 mm wide; capsules small (< 1 cm long), the seeds solitary in each cell _____ **Nolina** & **Dasylirion** (see Nolinaceae)

HESPERALOE Engelm. FALSE YUCCA

Xerophytic, ± scapose, rhizomatous perennials; leaves numerous, crowded at base of plant, linear, to 1.3 m long, succulent, conspicuously involute upon drying; flowering stem usually few-branched; pedicels to 35 mm long; flowers tubular to oblong-campanulate, rosy red or salmon-colored (yellow-flowered forms are known in cultivation); stamens shorter than the tepals; style varying from much shorter than tepals to slightly exserted; ovary superior; capsules to 3 cm or more long; seeds black.

A genus of 5–7 species native to sw North America from c TX to n Mexico (Starr 1997; Verhoek 1998; Robbins 2002; Turner & Turner 2002). It is most closely related to *Hesperoyucca* (AZ, CA, and nw Mexico) and *Yucca*, the other members of the family with superior ovaries. The following treatment is based heavily on Turner and Turner (2002). Some are widely cultivated

for their showy flowers; in addition, they are drought, heat, and cold tolerant. (Greek: *hesperos*, western or evening, and the genus name *Aloe*)
REFERENCES: Trelease 1902; Starr 1995, 1997; Pellmyr & Augenstein 1997; Robbins 2002; Smith & Steyn 2002; Turner & Turner 2002.

1. Style relatively short, 1–2(–3) times as long as ovary, much shorter than tepals, thickened at base; anthers nearly as long as ovary; inner tepals with white flaring apices; leaf margins with little tendency to form markedly arcuate frilly fibers; well-developed leaves usually 1–1.3 m long; cultivated species apparently persisting/escaped in Collin Co. _____ **H. engelmannii**
1. Style longer, 3–5 times as long as ovary, nearly as long as tepals, to 1–3 mm longer, filiform or nearly so; anthers much shorter than ovary; inner tepals only weakly flaring and only marginally white, if at all; leaf margins with many frilly arcuate fibers; well-developed leaves usually 0.1–0.7 m long; cultivated species reported as persisting/escaped in Travis Co. _____ **H. parviflora**

Hesperaloe engelmannii Krauskopf, (for George Engelmann, 1809–1884, German-born botanist and physician of St. Louis), (no common name known, but could reasonably be called ENGELMANN'S RED-FLOWERED YUCCA). Plant (in comparison with *H. parviflora)* much larger, the flowering stem to 2.5 m tall to tip of inflorescence, "with longer, relatively narrower, somewhat flatter, darker green leaves" (Turner & Turner 2002) that are not markedly fibrous marginally; pedicels to 35 mm long; flowers to 25–35 mm long. Sandy, silty, or rocky, usually calcareous soils; widely cultivated in East TX and rarely persisting/escaping? from cultivation; reported by Starr (1997) [as *H. parviflora*] and Turner and Turner (2002) from Collin Co. in the Blackland Prairie; also spreading from cultivation in Haskell Co. (Starr 1997, as *H. parviflora*; Turner & Turner 2002). Native to Mills Co. in Cross Timbers and Prairies, across the Colorado River in San Saba Co. (e Edwards Plateau), and disjunct further w in Edwards Co. (w Edwards Plateau); in the U.S. known only from TX; because of past confusion with *H. parviflora*, the occurrence of *H. engelmannii* in Mexico is unclear; therefore possibly endemic to TX. Apr–May–fall. [*H. parviflora* (Torr.) J.M. Coult. var. *engelmannii* (Krauskopf) Trel.] While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ?⚠

Hesperaloe parviflora (Torr.) J.M. Coult., (small-flowered), RED-FLOWERED-YUCCA, RED-YUCCA, RED HESPERALOE, RED-FLOWER FALSE YUCCA. Plant (in natural populations) rather small in comparison with *H. engelmannii* but generally similar to that species—distinguished as in the key; leaves usually shorter, "pale-green, sulcate, broader" (Turner & Turner 2002), strikingly fibrous marginally. Cultivated in East TX and possibly escaping/persisting; in its native habitat *H. parviflora* is found in areas of Chihuahuan Desert vegetation (e.g., *Larrea*, *Agave lechuguilla*, etc.); included here based on a Travis Co. citation by Turner et al. (2003); however, we have not seen the specimen and the only other East TX collection (Collin Co.) cited by Turner et al. (2003) keys to *H. engelmannii* according to Turner and Turner (2002); also reported as spreading from cultivation in Brown Co. (Stanford 1976) in the Cross Timbers and Prairies; native much further w in sw TX (Val Verde Co.—Turner & Turner 2002); in the U.S. occurring only in TX; endemic to TX and n Coahuila. Mar–Sep. [*Aloe yuccafolia* A. Gray; *Yucca parviflora* Torr.] Individuals of the similar *H. engelmannii* have long gone under the name *H. parviflora*, and as treated by Robbins (2002), *H. parviflora* is a variable species (including *H. engelmannii*) occurring in several disjunct localities. However, Turner and Turner (2002), based on detailed field work, separated *H. engelmannii* as a distinct species. The striking rosy red or salmon-colored flowers immediately distinguish these two species from all other East TX Agavaceae; both are widely used as ornamentals. Pollination is reported to be by hummingbirds as well as bees (Starr 1995); experiments by Pellmyr and Augenstein (1997) showed *H. parviflora* to be self-incompatible and pollinated by black-chinned hummingbirds (*Archilochus alexandri*). (RARE 2001, 2002b: G3S3) ⚠ /288

MANFREDA Salisb. FALSE ALOE, AMERICAN-ALOE, TUBE-ROSE

Glabrous ± scapose perennials with rhizomes; leaves mostly in a basal rosette, soft, thick-herbaceous, somewhat fleshy (semisucculent to succulent), entire to serrulate, and spotted, blotched, or mottled with darker green, brown, or reddish brown or not so; flowers in a spike-like raceme, nocturnal; perianth tubular-funnelform, 6-parted, greenish to greenish white or yellowish, sometimes streaked or dotted with pink or brown, sometimes aging to deep rose, purple, or nearly brown; stamens 6; filaments inserted on perianth tube, exserted; anthers linear, versatile (= attached near middle); styles exserted; capsules 3-celled; seeds numerous, flattened.

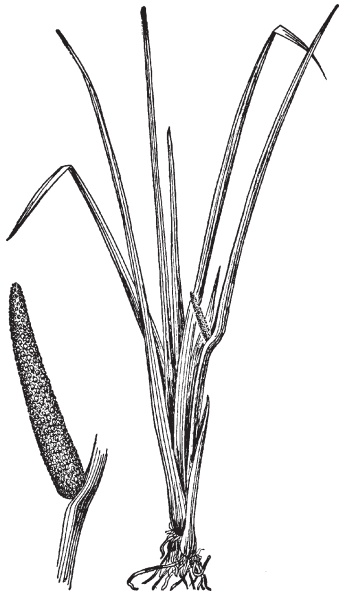
A genus of 26 species occurring principally in Mexico but ranging from the se United States to Honduras and El Salvador (Verhoek 1998, 2002; Eguiarte et al. 2000). The species have been variously recognized in *Agave*, *Manfreda*, and *Polianthes*, and these three genera are all closely related (Eguiarte et al. 2000). The rhizomes of a number of species apparently contain suds-producing sapogenins and have long been used as a source of soap (Verhoek 1978b). Even well into the 20th century (e.g., 1928), the soap, known as "amole soap," was available in TX stores, and small Mexican settlements still used *Manfreda* species to produce liquid soap in a traditional manner (Schulz 1928; Verhoek 1978b). Other species have been used medicinally (see below) or cultivated as ornamentals. "At anther maturity, the style is shorter than the filaments, or bent downward away from the anthers. By stigma maturity on the third day, the style has elongated (and straightened)" (Verhoek 2002). This is presumably a mechanism to prevent self-fertilization. (Named for Manfredus de Monte Imperiale, fourteenth-century Italian writer on medical simples—Verhoek 2002)

REFERENCES: Shinners 1951c, 1966; Verhoek-Williams 1975; Verhoek 1978a, 1978b, 2002; Diggs et al. 1999.

1. Filaments exceeding perianth tube by 4–6.6(–9.7) cm; style slightly longer than stamens; rhizome globose; tip of inflorescence usually reaching ca. 2.5 m in height; capsules cylindrical, 2.3–3.1 cm long; flowers with cooked onion odor; stigma pale green, merely 3-angled, clavate, the lobes not reflexed; species known in East TX only from Bexar Co. near extreme sw margin of area _____ **M. sileri**
1. Filaments exceeding perianth tube by 0.8–3.1 cm; style usually shorter than stamens; rhizome cylindrical; tip of inflorescence usually reaching only ca. 2 m or less in height; capsules globose to ellipsoid, 1–2.4 cm long; flowers with sweet odor; stigma white, 3-lobed, the lobes reflexed; including species widespread in East TX.
   2. Perianth lobes 9–19 mm long, recurved; perianth (including ovary) nearly 5 cm long; leaves narrowly lanceolate; mature capsules usually 20–25 mm long, usually ± ellipsoid _____ **M. maculosa**
   2. Perianth lobes 3–8 mm long, erect; perianth (including ovary) 2–3.5 cm long; leaves lanceolate to broadly lanceolate, oblong-spatulate, or elliptic; mature capsules 10–20 mm long, globose _____ **M. virginica**

Manfreda maculosa (Hook.) Rose, (spotted), TEXAS TUBE-ROSE, WILD TUBE-ROSE, SPICE-LILY, AMOLE PLANT, SOAP PLANT. Basal leaves 6–10, succulent, often blotched with brown or maroon, 2.5 cm or less wide; inflorescence (not including scape) to ca. 40 cm long; perianth greenish white or yellowish, sometimes streaked with pink, aging to deep rose, purple, or nearly brown; capsules usually ± ellipsoid, slightly pointed. Thickets, sandy clay or clay soils; Bexar, Gonzales, and Wilson (Turner et al. 2003) cos. on extreme sw margin of East TX; mainly Gulf Prairies and Marshes and South TX Plains; in the U.S. known only from TX; also Mexico. Mid-Apr–mid-Jul(–early fall). [*Agave maculosa* Hook., *Polianthes maculosa* (Hook.) Shinners] Historically, the chopped rhizomes were used for producing a shampoo and soap, and plants of this species are sometimes sold as ornamentals (Verhoek 1978b, 2002). The flowers are reported to produce a strong, spicy (Verhoek 1978b) or sweet (Verhoek 2002) odor after sundown.

Manfreda sileri Verhoek, (for Major A.M. Siler, d. 1971, of Corpus Christi, TX, who collected the type specimen), SILER'S TUBE-ROSE, MAJOR SILER'S HUACO, HUACO. Basal leaves succulent, with



Acorus calamus [GLE]



Hesperaloe engelmannii [HEB]



Hesperaloe parviflora [CUR]



Manfreda maculosa [BA1]



Manfreda sileri [HEB]

brownish markings, broadly lanceolate, 2.2–4.8 cm wide; inflorescence (not including scape) to ca. 40 cm long; flowers with cooked onion odor; perianth golden green inside, glaucous and green outside; capsules cylindrical. Open grasslands and shrublands, clay soils; Bexar Co. (Carr 2002d; Turner et al. 2003) near extreme sw margin of East TX; mainly Rio Grande valley of far s TX (Cameron, Starr, and Webb cos.—Carr 2002d); in the U.S. known only from TX; also Mexico. Spring–mid-summer. (RARE 2002a: G3S3) ⚠

Manfreda virginica (L.) Rose, (of Virginia). Basal leaves 4–10, semisucculent, often blotched; perianth greenish or yellowish, sometimes flecked or suffused with red-brown; inflorescence (not including scape) to ca. 70 cm long; flower with sweet, fruity odor; capsules globose or nearly so. According to Verhoek (2002), "Leaf shape and size in *Manfreda virginica* vary with soil type, amount of shade, length of cold period, and position of leaf in the rosette. Speckles and spots occur frequently on some leaves in most populations, and some authors have used the informal designation 'forma tigrina' for such variants." Sphinx moths are reported to be the primary pollinators in this species (Verhoek 1978; Verhoek & Hess 2002). The following key is modified from Shinners (1951c).

1. Leaves 3–6 times as long as wide, 4–10 per plant, 12–18 cm long, (2–)3–8(–10) cm wide; scape 6–10 mm thick near base, 3–5 mm thick at base of inflorescence; perianth (including ovary) 2.6–3.5 cm long, the lobes 2.5–3 mm wide at base; anthers 13–17(–20) mm long; plants flowering mid-Jun–mid-Jul, in East TX mainly in the Blackland Prairie _____ subsp. **lata**
1. Leaves 7–15 times as long as wide, ca. 10 per plant, (12–)15–30 cm long, 1–4.5 cm wide; scape 4–7 mm thick near base, 1.5–3.5 mm thick at base of inflorescence; perianth (including ovary) 2–2.3 cm long, the lobes 1.5 mm wide at base; anthers 8–10 mm long; flowering mid-Jul–mid-Aug, typically of open wooded areas _____ subsp. **virginica**

subsp. **lata** (Shinners) O'Kennon, Diggs, and Lipscomb, (broad), WIDE-LEAF FALSE ALOE. Plant 0.6–1.7 m tall (to tip of inflorescence); corm pithy; leaves 4–10, noticeably fleshy, green to bluish gray-green, occasionally with reddish splotches near base, elliptic or broadly lanceolate, deeply concave, glabrous, the margins scabrous; pedicels shorter than subtending bracts; perianth greenish or yellowish with dots or tinge of red-brown toward tips, the lobes 5–8 mm long; filaments green with reddish pigmentation; anthers exserted, cream-colored. Mainly Blackland Prairie, clay soils; s Grayson (population at type locality apparently now extinct locally), Hunt, and Kaufman (BRIT) cos.; also Parker Co. (R. O'Kennon pers. obs.) to the w in the Cross Timbers and Prairies; otherwise apparently known only from s Oklahoma. Jun–Jul. [*Agave lata* Shinners, *Polianthes lata* (Shinners) Shinners] This taxon was named as a species of *Agave* by Shinners (1951c) and subsequently transferred to *Polianthes* (Shinners 1966). Verhoek-Williams (1975) placed it in the genus *Manfreda* but synonymized it with the more widespread *M. virginica* (L.) Rose. By the time of Verhoek-Williams' 1975 study, the Grayson Co. site was apparently no longer in existence and no other TX sites were known. Since that time, several new Blackland Prairie populations with hundreds or even thousands of individuals have been discovered. While there is undoubtedly overlap in most of the characters distinguishing this subspecies from subsp. *virginica*, we agree with Shinners (1951c) that it is a geographically distinct entity; subspecific status appears most appropriate. Detailed taxonomic work on the large Blackland Prairie populations is needed. (RARE 2001, 2002b: G5T2QS2) ⚠ ⊠/292

subsp. **virginica**, (of Virginia), FALSE ALOE, RATTLESNAKE-MASTER, VIRGINIA AGAVE, AMERICAN ALOE, HUACO, AMOLE. Leaves lanceolate to somewhat oblong-spatulate, nearly flat. Pineywoods and Post Oak Savannah w to Lamar Co. (Carr 1994) in the Red River drainage; also Tarrant Co. (Fort Worth Nature Center; it is not completely certain that this population is native) in the Cross Timbers and Prairies, and in the Gulf Prairies and Marshes; e U.S. from MD s to FL w to IL and TX. Used by Native Americans as an antidote for snakebite, giving rise to the common name RATTLESNAKE-MASTER; in addition, HUACO is a Mexican name for plants used against

snakebite (Verhoek 1978b). It has been speculated that the treatment "may have had some merit since cardiac-stimulant glycosides are often found in association with saponins (Fruton & Simmonds 1958)" (Verhoek 1978b).

YUCCA L.

YUCCA, BEAR-GRASS, SPANISH-BAYONET, SOAPWEED

Plants coarse, with one to many crowns of elongate, proportionally narrow, sessile, flaccid to stiff and spear-like leaves, in East TX species these usually in a basal cluster or at ends of very short to elongate trunk-like stems; flowers in terminal racemes or panicles; inflorescence bracts wide-based, acute or acuminate, somewhat papery; flowers rather large; perianth drooping, of 6 thick, white to cream-colored, greenish, or purple-tinged segments; stamens 6; fruit a capsule or fleshy and berry-like, either erect and dehiscent, or else drooping and indehiscent; seeds many.

A genus of 35 to 40 species (Hess & Robbins 2002) of warm areas of North America (s Canada to Mexico and Guatemala and some Caribbean islands—Irish & Irish 2000), particularly the Sonoran and Chihuahuan deserts. Texas is one of two centers of diversity in the genus (Clary & Simpson 1995). While most are dry area plants that vary from trunkless forms to those having immense trunks, one species in the tropical forests of Chiapas in s Mexico is an epiphyte (Irish & Irish 2000). YUCCAS were used by Native Americans as a source of food, fiber, soap, and medicine. The spiny leaf tip was apparently used as a needle, often with the still-attached fibers serving as thread (Churchill 1986c); 2,000 year old fiber and twine from YUCCA have been found in Native American ruins in AZ. According to Bell and Castetter (in Webber 1953), "... yucca ranked foremost among the wild plants utilized by the inhabitants of the Southwest. It holds this place because of the great variety of uses to which it could be put and to the wide accessibility of this genus within the Southwest." Fleshy fruited species such as *Y. baccata* Torr., BANANA YUCCA, were used extensively as food by Native American groups including the Navajo and Hopi of the sw U.S. (Irish & Irish 2000). During World Wars I and II, large amounts of YUCCA were harvested in TX and NM for fiber (Webber 1953). All species are dependent on yucca moths for pollination. If the moths are not present the plants reproduce vegetatively, and as a result, large clonal populations are often encountered in the field (K. Clary, pers. comm.). According to Powell (1988), "The Yucca Moth (*Tegeticula* = *Pronuba*) flies at dusk to a flower where she climbs stamens to collect pollen and pack the pollen in a large ball-like mass under her neck. She then visits another flower where she inserts her ovipositer [ovipositor] directly through the ovary wall and deposits 20–30 eggs, one at a time, each directly into an ovule. She then climbs to the stigma of the same flower and spreads the pollen, thus ensuring pollination, subsequent fertilization, and developing seeds that provide nourishment for the moth larvae. Each larva ultimately destroys the seed in which it grows, but there are many undamaged seeds left in the yucca capsule." These yucca moth–yucca pollination mutualisms are "considered to be among the most apparent cases of coevolution between plants and animals" (Pellmyr et al. 1996). Baker (1986), Bogler et al. (1995), Pellmyr et al. (1996, 1997), Huth and Pellmyr (2000), and Marr et al. (2000) described some of the complexities and evolutionary implications of pollination in *Yucca*. In contrast to passive pollination, this "active pollination" (defined as "cases where specific morphological structures and behavior components exist in the pollinator for the purpose of picking up and transporting pollen, and depositing it on stigmas"), in which a pollinator purposely carries out pollination, is known only in yucca moths and fig wasps (Pellmyr 1997). Morphological features in *Yucca* associated with moth pollination include "white bowl-shaped flowers, thickened filaments, pollen as the primary floral reward, [and] odor cues for oviposition in the ovaries" (Bogler et al. 1995). Joshua Tree National Park in s CA protects *Y. brevifolia* Engelm., JOSHUA TREE, one of the large-trunked species (individuals can reach 15 m tall). (Name derived from *yuca*, a native Haitian or Caribbean Indian name for *Manihot esculenta* Crantz (Euphorbiaceae), manihot or cassava, whose roots are used for food.

"The Indian name was applied erroneously to *Yucca* because of confusion in early reports of the plants"—Irish & Irish 2000. This confusion still occurs at grocery stores where manihot/cassava/yuca is often erroneously labeled "yucca")

In addition to the species discussed below, several other YUCCAS are cultivated in East TX. Two of these (both native to w TX) resemble *Y. aloifolia*, *Y. gloriosa*, *Y. torreyi*, and *Y. treculeana* in having trunk-like stems. These are *Y. rostrata* Engelm. ex Trel. (leaves glaucous, smooth, flexible, the margins denticulate, fruits dehiscent) and *Y. thompsoniana* Trel. [now sometimes treated as a synonym of *Y. rostrata*] (leaves glaucous, ± scabrous, flexible, much shorter than in *Y. rostrata*, the margins denticulate, fruits dehiscent). *Yucca filamentosa* L. and *Y. flaccida* Haw., both with ± drooping leaves and usually without trunk-like stems or trunk-like stems very short, are also widely used in landscaping in East TX. These related species, somewhat similar to *Y. louisianensis* and *Y. necopina*, are native to the e U.S. to the e of TX. They can be distinguished as follows: *Y. filamentosa* (tepals 5–7 cm long, inflorescences glabrous, and leaves relatively stiffer, with curly marginal fibers); *Y. flaccida* (tepals 3–5 cm long, inflorescences usually pubescent, and leaves relatively limper, with ± straight marginal fibers)—see discussion under *Y. louisianensis* for more details.

REFERENCES: Trelease 1902; McKelvey & Sax 1933; McKelvey 1938, 1947; Fernald 1944; Webber 1953; Luján 1980; Baker 1986; Bogler et al. 1995; Clary & Simpson 1995; Pellmyr et al. 1996; Clary 1997; Pellmyr 1997; Pellmyr et al. 1997; Hochstätter 2000; Huth & Pellmyr 2000; Maragni et al. 2000; Marr et al. 2000; Hess & Robbins 2002; Keith 2003.

1. Leaves in crowns at ends of 1–4(–8) trunk-like stems usually 1–4.3 m tall (often relatively short in *Y. gloriosa*); leaves broad, 2.5–8 cm wide, stiff and spear-like, thickish (except flexible and thin in *Y. gloriosa*); fruits indehiscent, eventually drooping (except erect in *Y. gloriosa*).
   2. Leaves 12–40(–50) cm long; plants flowering Jun–Aug(–fall); fruits at maturity 3.5–5 cm long _____ **Y. aloifolia**
   2. Leaves 30–110 cm long; plants flowering in spring (Feb–May); fruits at maturity 5–14 cm long (except 2.5–4.5 cm long in *Y. gloriosa*).
      3. Leaves flexible, mostly recurved; fruits 2.5–4.5 cm long, leathery, erect; plants persisting and escaping in ne part of East TX _____ **Y. gloriosa**
      3. Leaves stiff, spear-like; fruits 5–14 cm long, succulent, eventually drooping; plants of s part of East TX
         4. Leaves with marginal fibers, the apical portion of leaves usually rolled inward so that margins nearly touch; ovary slender for its length, not over 7 mm in diam. at flowering time _____ **Y. torreyi**
         4. Leaves without marginal fibers, apical portion of leaves not inrolled; ovary stout for its length, 7–12 mm in diam. at flowering time _____ **Y. treculeana**
1. Leaves in a basal cluster (without visible stems) or at ends of very short trunk-like stems 0.4 m or less tall; leaves usually narrower, 0.8–4 cm wide (to 6.5 cm in the rare *Y. cernua*), not stiff and spear-like (but can be either straight or drooping); fruits dehiscent at maturity, not drooping.
   5. Leaf margins yellowish to dark orangish red or reddish brown, smooth or minutely toothed, not shredding into fibers; pistils usually 2–4.5 cm long.
      6. Panicle moderately to densely floccose, the branches recurved and drooping with age; tepals 0.75–1.7 cm wide; stamens 1.2–1.9(–2.2) cm long; species known only from Jasper and Newton counties in the eastern Pineywoods _____ **Y. cernua**
      6. Panicle glabrous or slightly pubescent, the branches wide-spreading to erect-spreading; tepals (1.4–)2–3.2 cm wide; stamens 1.8–3.2 cm long; species of western Blackland Prairie, Cross Timbers and Prairies, and Edwards Plateau.
         7. Leaves twisted, with margins inrolled most of their length, dark green, not glaucous, ± scabrous on both surfaces; leaf margins usually dark orangish red or reddish brown or occasionally yellowish, wavy _____ **Y. rupicola**

7. Leaves straight or nearly so, lacking strongly inrolled margins, usually pale bluish to sage green, conspicuously glaucous, ± smooth on both surfaces; leaf margins yellowish, flat _____ **Y. pallida**

5. Leaf margins whitish, usually shredding into prominent white fibers (these often disappearing late in year); pistils usually 2–3.2 cm long.
   8. Inflorescence usually unbranched and raceme-like or with 1 or 2 short, spreading branches near base (these often soon deciduous), borne below to just above leaf tips (separated from them by less than its own length of naked scape) _____ **Y. arkansana**
   8. Inflorescence a much branched panicle, borne well above tips of leaves (separated from them by nearly its own length or more of naked scape).
      9. Leaves very slender, 8–15 mm wide, 100–200 per strikingly globose rosette; fruit usually constricted near middle; plants of limestone substrates _____ **Y. constricta**
      9. Leaves usually (6–)15–40 mm wide, ca. 50–85 per rosette (rosette not globose in appearance); fruit constricted or not so; plants of sandy substrates.
         10. Inflorescences pubescent (rarely glabrous); fruits usually constricted near the middle; plants of Pineywoods and Post Oak Savannah _____ **Y. louisianensis**
         10. Inflorescences glabrous; fruits usually not conspicuously constricted; plants of w edge of Blackland Prairie (Dallas Co.) and westward _____ **Y. necopina**

Yucca aloifolia L., (with leaves like *Aloe*, Asphodelaceae), DAGGER PLANT, ALOE YUCCA, SPANISH-BAYONET. Plant large, to 3(–7) m tall, very variable morphologically; stems 1–3, unbranched or sparingly branched, often growing parallel to the ground for part of their length; leaves 12–40(–50) cm long, 2.5–6 cm wide, dark green, rigid, marginally denticulate, rarely with straight fibers; inflorescences paniculate, glabrous or slightly pubescent; perianth globose, creamy white (can be tinged with green or purple basally); fruits 3.5–5 cm long, indehiscent, pulpy. Widely cultivated in East TX, escaping or persisting for decades; old homesteads, dump sites, along railroads, usually sandy soils but sometimes black clayey soils; Jasper, Liberty, Newton, Tyler, and Walker (Eric Keith, pers. comm.) cos.; native to the se U.S. from VA s to FL w to coastal TX (but only naturalized in East TX). Jun–Aug(–fall). [*Y. serrulata* Haw.] "*Yucca aloifolia* has been widely cultivated, and horticultural forms (or varieties, depending upon the source) differ in the striping of yellow and white on the leaves" (Hess & Robbins 2002). This species is sometimes mistaken for *Y. gloriosa* var. *recurvifolia*, another species of the se U.S. that is also cultivated, persists, and escapes in east Texas; however, that species has longer (40–100 cm long) mostly recurved, flexible, usually entire leaves and ± leathery fruits.

Yucca arkansana Trel., (of Arkansas), ARKANSAS YUCCA, SOAPWEED. Leaves 20–60(–70) cm long, 10–25 mm wide, the margins at first white, papery with curly fibers; inflorescence glabrous; perianth 32–65 mm long, greenish white, globose; capsules ca. 4–7 cm long. Rocky limestone or sandy soils, prairies and hillsides; Pineywoods and Gulf Prairies and Marshes w to Rolling Plains and e Edwards Plateau; AR, KS, MO, OK, and TX. Mar–mid-May (this is the earliest bloomer of the dry-fruited Yuccas in Texas—K. Clary, pers. comm.). [*Y. angustissima* Engelm. ex Trel. var. *mollis* Engelm.] The roots, containing saponins, were used as a soap by both Native Americans and pioneers and the seeds were eaten raw, roasted, or ground into a flour (Yatskievych 1999). DNA evidence (Clary 1997) suggests that this species is related to *Y. louisianensis*. ⚅/307

Hybrids of *Y. arkansana* and *Y. pallida* have been found on limestone in Dallas (McKelvey 1947), to the w of East TX at Glen Rose in Somervell Co. (Shinners 1958), and recently in Tarrant County at Tandy Hills Park (BRIT). This latter population of hundreds of individuals over a number of acres is quite variable, with individuals ranging from much like typical *Y. arkansana* to those much like *Y. pallida* as well as a full spectrum of intermediates. The plants vary from having leaves with curly fibers on the margins to not so, from having leaf margins

white to yellowish, and from having inflorescences branched to sparsely branched or unbranched. In general, the plants are from 1–1.5 m tall.

Yucca cernua Keith, (drooping or nodding, in reference to the inflorescence branches), WEEPING YUCCA. Plant acaulescent, forming large solitary clumps, 1.5–4 m tall to tip of inflorescence; rhizomes 1–2 cm wide; most leaves flat, except lowermost (these usually undulate and twisted), the young leaves glaucous, becoming olive or yellowish green with age; mature leaves (30–)40–70(–80) cm long, (3–)3.5–6.5 cm wide at widest point, the margins corneous (= horn-like texture); perianth 3.4–5(–5.8) cm long, campanulate; fruits 3.2–4.5 cm long, with beaks 0.5–1 cm long. Open or slightly shaded areas, in brownish, acidic, clayey soils of the Redco Soil Series, apparently tolerant of soil disturbance (Keith 2003); known only from Jasper and Newton (BRIT, Keith 2003) cos. in the e Pineywoods; endemic to East TX. May–Jun. This species was discovered in May 2001 and described in 2003 (Keith 2003); it is the most recently described new species in the East TX flora. In series Rupicolae, it is apparently most closely related to *Y. pallida* and *Y. rupicola*, but it is quite distinct morphologically and disjunct geographically (> 300 km) from those species (Keith 2003). According to Keith (2003), the tendency of the inflorescence branches to recurve and droop is "an apparently distinctive feature separating it from all other *Yucca* species." While not officially designated as being of conservation concern (because of the recentness of its discovery), we consider this species to be so. It is currenty known from only 7 populations (Keith 2003; E. Keith, pers. comm.). The discovery of such a distinctive new species in the Pineywoods of East TX emphasizes the need for additional collecting and habitat conservation in that area. ⚠ /307

Yucca constricta Buckley, (constricted), BUCKLEY'S YUCCA. Usually stemless, rarely with trunk-like stems to 40 cm tall; overall aspect of basal leafy portion almost ball-like in outline; leaves 100–200 per rosette, 30–65 cm long, very slender (15 mm or less wide), very straight but flexible, the margins white or green with fibers that soon erode away; perianth pale greenish white; panicle branches glabrous. Limestone outcrops or rocky prairies; Limestone (BRIT), Bexar, Gonzales, Travis (McKelvey 1947), and Williamson (Turner et al. 2003) cos.; mainly Edwards Plateau and s Lampasas Cut Plain, scattered to the s; endemic to TX (Kartesz 1999) or nearly so (recently reported for ne Mexico—Hess & Robbins 2002). Apr–Jun. McKelvey (1947) included both *Y. louisianensis* and *Y. tenuistyla* in this species. According to Hess and Robbins (2002), "The major differences among these entities involve vestiture in the inflorescences." ? /307

Yucca gloriosa L. var. **recurvifolia** (Salisb.) Engelm., (sp.: glorious; var.: with recurved leaves), CURVE-LEAF YUCCA, PENDULOUS YUCCA, WEEPING YUCCA. Plant to 2 m tall; stems unbranched or branched; leaves 50–100 cm long, 3.5–5 cm wide, mostly recurved, flexible, usually entire; inflorescences paniculate; perianth white to greenish white; fruits 2.5–4.5 cm long, erect. Sandy soils; cultivated (an heirloom plant) and escaped in Hunt Co. (Matt White, pers. comm.) and persisting around old homesites in ne part of East TX in Delta, Fannin, Franklin, Lamar, Rains, and Van Zandt (Matt White, pers. comm.) cos.; East TX collections were brought to our attention by Matt White after map pages were finalized; therefore no county distribution map is provided; native to the se U.S. from FL w to LA, escaped in TX. Spring. [*Y. pendula* Groenl.; *Y. recurvifolia* Salisb.] According to Hess and Robbins (2002) this variety is poorly known, is in need of study, and is possibly not distinct from var. *glorisa* (MOUND-LILY) which occurs in GA, NC, and SC.

Yucca louisianensis Trel., (of Louisiana), LOUISIANA YUCCA, GULF COAST YUCCA. Similar to *Y. arkansana* and *Y. necopina* but panicle much-branched and usually pubescent (rarely glabrous); leaves 10–30(–40) mm wide, flexible but often rather firm (often more so than in *Y. flaccida*), the older ones sometimes drooping, the margins white, sometimes with curly fibers; perianth segments greenish to white, 5 cm or less long. Sandy soils; widespread in Pineywoods and Post Oak Savannah and an outlying population on a sandy loam terrace in the Blackland Prairie in Hunt Co. (collected in 2003 by *M. White, s.n.*, BRIT). Apr–May. [*Y. arkansana* Trel.



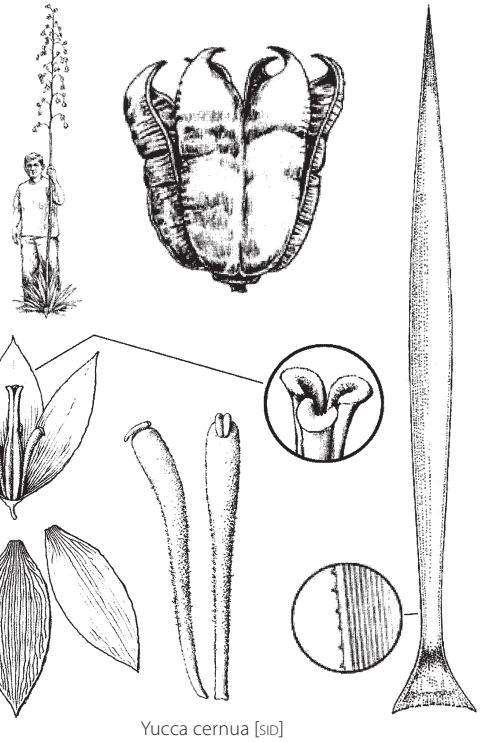
Manfreda virginica subsp. lata [HEA]



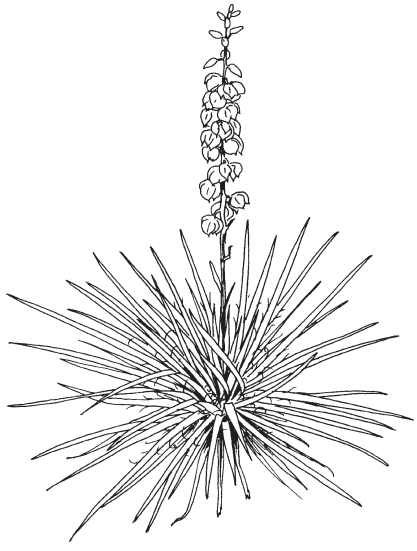
Manfreda virginica subsp. virginica [LAM]



Yucca aloifolia [SA2]



Yucca cernua [SID]

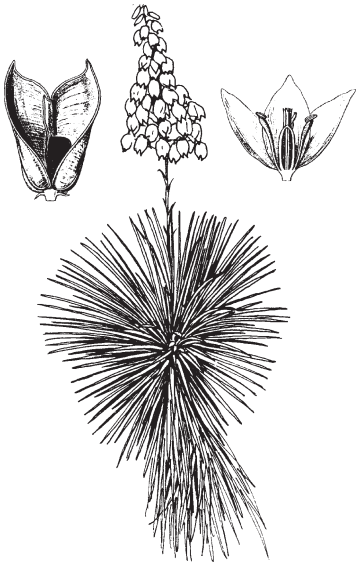


Yucca arkansana [LYN]

subsp. *freemanii* (Shinners) Hochstätter, *Y. arkansana* Trel. subsp. *louisianensis* Hochstätter, *Y. arkansana* Trel. var. *paniculata* McKelvey, *Y. freemanii* Shinners] This species is the common YUCCA in sandy areas throughout the Pineywoods and Post Oak Savannah. While the plant is well known, the appropriate epithet to use for it is not clear. It has long gone under the name *Y. louisianensis*, but Hess and Robbins (2002) recently treated it within *Y. flaccida* Haworth, a species widespread in e North America. However, they note that DNA studies by Clary (1997) are incongruent with their treatment, and that, "DNA variation indicates that *Y. louisianensis* is genetically distinct and more closely related to *Y. filamentosa* than to *Y. flaccida*." They further suggest that, "Perhaps *Yucca flaccida* should be considered a variety of *Y. filamentosa*." Alternatively, Yatskievych (1999) synonymized *Y. filamentosa* and *Y. flaccida* under *Y. smalliana* Fernald, while Kartesz (1999) submerged *Y. flaccida* and *Y. smalliana* into *Y. filamentosa* and recognized *Y. louisianensis* as a distinct species. *Yucca louisianensis* is similar to and apparently related to *Y. necopina*, and occasionally individuals with glabrous inflorescences (as in *Y. necopina*) are found. These were named *Y. freemanii* by Shinners (1951b) based on this and other differences. Until a thorough field, laboratory, and nomenclatural study of this complex (including *Y. arkansana, Y. constricta*, *Y. freemanii*, *Y. filamentosa*, *Y. flaccida*, *Y. louisianensis*, *Y. necopina*, and *Y. tenuistyla*) is carried out, we are following various recent authorities (e.g., Jones et al. 1997; Kartesz 1999) in continuing to use the long accepted and well known name *Y. louisianensis* for the common species in East TX and are including *Y. freemanii* within this species. ⊞/307

Yucca necopina Shinners, (unexpected), GLEN ROSE YUCCA, BRAZOS RIVER YUCCA. Similar to *Y. arkansana* vegetatively, but taller (1–3 m tall) and with large, much-branched inflorescences held well above the leaves; leaves ca. 50–85 per rosette; 50–80 cm long, typically 15–40 mm wide, flexible but firm and not drooping, the margins white, with curly fibers; inflorescences completely glabrous; perianth segments greenish white, 4–4.5 cm long; fruits usually not conspicuously constricted. Dallas Co. at w edge of Blackland Prairie [?] (see note below); this species was previously known only from a sandy fencerow on a Brazos River terrace near Glen Rose, Somervell Co. (Shinners 1958). It was recently rediscovered by R. O'Kennon along Brazos River terraces in Hood and Somervell cos. and in deep sand in Palo Pinto, Parker, Tarrant, and Wise (BRIT) cos. (Cross Timbers and Prairies); in total these populations number several hundreds of individuals. This is the common YUCCA of sandy soils in the n Cross Timbers and Prairies; it is apparently endemic to TX (Kartesz 1999; Carr 2002b, 2002c) but should be looked for in s OK. May–Jun. Shinners thought this to be a possible hybrid between *Y. pallida* and *Y. arkansana* but one differing from an evident hybrid of these 2 species observed nearby (Shinners 1958). Recent field observations of large numbers of relatively uniform individuals in widely separated populations—in sandy areas where neither *Y. arkansana* or *Y. pallida* typically occur—support the recognition of this entity at the specific level. Molecular evidence (K. Clary 1997) also supports specific recognition. The closest relative of *Y. necopina* seems to be *Y. louisianensis* Trel., which is distinguished by its often narrower leaves and usually pubescent inflorescences. Vines (1960) cited *Y. louisianensis* for Dallas and Fort Worth; these records are likely to be of *Y. necopina*. The relationship of *Y. necopina* and *Y. louisianensis* is in need of detailed field and lab studies. (TOES 1993: V; RARE 2002a, 20002b: G1G2S1S2; however, a lower rank may be appropriate since the species is apparently more common than previously known—Carr 2001) ⚠ ⊞/308

Yucca pallida McKelvey, (pale, in reference to the leaf coloration), PALE YUCCA, PALE-LEAF YUCCA. Colonies typically with 10–30 rosettes each; plant 1.3–2.5 m tall to tip of inflorescence; leaves < 100 per rosette, 18–35(–50) cm long, ca. 20–40 mm wide, conspicuously glaucous, the margins corneous (= horn-like texture), flat; panicle narrowly to widely branched, glabrous and glaucous; perianth segments with pale greenish center and white edges; stigma lobes erect, scarcely spreading. Limestone outcrops or rocky prairies; w Blackland Prairie (e.g., Dallas Co., on the



Yucca constricta [LYN, SA3]



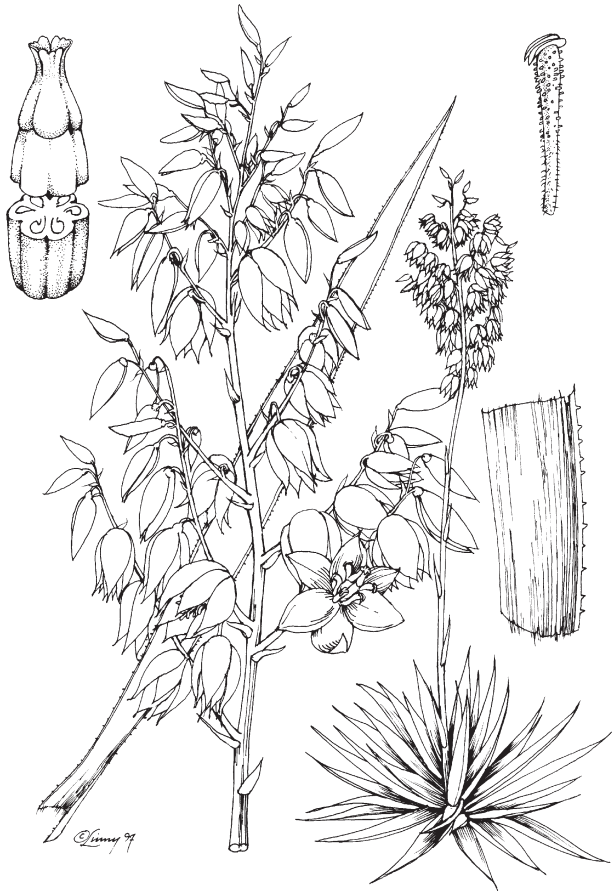
Yuccal gloriosa var. recurvifolia [NIC]



Yucca louisianensis [BRU]



Yucca necopina [HEA]



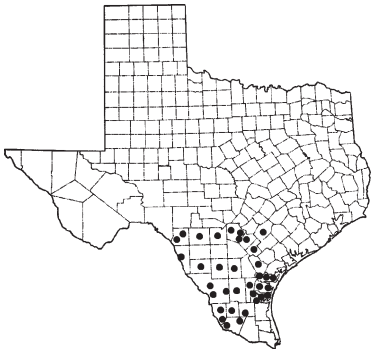
Yucca pallida [HEA]

Austin Chalk, Hill, McLennan (BRIT), Bell, Williamson, and Travis (Turner et al. 2003) cos.); mainly Cross Timbers and Prairies; endemic to TX (Kartesz 1999; Carr 2002b, 2002c). May–Jun. According to Clary (1997), DNA evidence suggests a close relationship of this species with *Y. rupicola*. Plants apparently intermediate between *Y. pallida* and *Y. rupicola* are found in several localities (McKelvey 1947), including the area n of Austin (E. Keith, pers. comm.). They usually have blue-green glaucous leaves (like *Y. pallida*), but the leaves are twisted and have wavy margins. /308

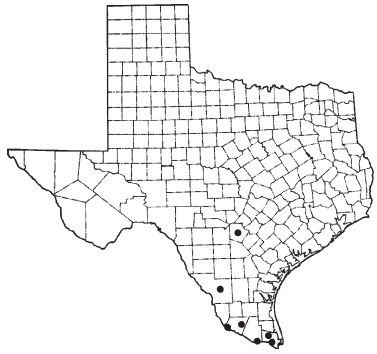
Yucca rupicola Scheele, (growing on cliffs or ledges), TEXAS YUCCA, TWIST-LEAF YUCCA. Similar to *Y. pallida*; colonies typically with 2–15 rosettes; leaves < 100 per rosette, 20–60 cm long, to 40 mm wide, flaccid, twisted, the margins wavy; panicle glabrous to slightly pubescent; perianth segments whitish or greenish white; stigma lobes widely spreading. Limestone ledges, plains; Bexar, Comal, Hays, McLennan, Travis, and Williamson (Turner et al. 2003) cos. near w margin of the Blackland Prairie; mainly Edwards Plateau; endemic to TX (Kartesz 1999; Carr 2002b, 2002c). Apr–Jun. /308

Yucca torreyi Shafer, (for John Torrey, 1796–1873, American botanist, physician, and collector of many w North American plants), TORREY'S YUCCA, SPANISH-DAGGER. Plant large, to ca. 7 m tall; stems unbranched or rarely with 2–3 branches; dead leaves reflexed on trunk below leaf crown; leaves 30–110 cm long, light green, stiff, spear-like, entire, with marginal fibers, the apical portion of the leaves usually rolled inward so that the margins nearly touch; panicle with 0.1–0.5 of its total length extending beyond the leaves or rarely entirely within the leaves; perianth subglobose or campanulate, sometimes fully expanding, cream (can be tinged with purple); fruits 7–14 cm long, indehiscent, fleshy. Gravelly soils, grassy and chaparral mesas and slopes; Bexar (Turner et al. 2003) and Travis (Carr 2002a) cos. near the sw margin of East TX; also Brown and Burnet (HPC) cos. on sw margin of the Cross Timbers and Prairies; however, K. Clary (pers. comm.) questions whether the species is native as far e as Burnet and Travis cos.; mainly Edwards Plateau and Trans-Pecos. Late Mar–May. [*Y. baccata* Torr. var. *macrocarpa* Torr., *Y. crassifolia* Engelm., *Y. macrocarpa* (Torr.) Coville] This species is sometimes treated as a synonym of the related *Y. treculeana* (e.g., Powell 1988; Hess & Robbins 2002); according to Webber (1953) and Correll and Johnston (1970), the two sometimes hybridize. Since they can usually be readily distinguished in the field, we are following McKelvey (1938), Jones et al. (1997), and Kartesz (1999) in recognizing them at the specific level.

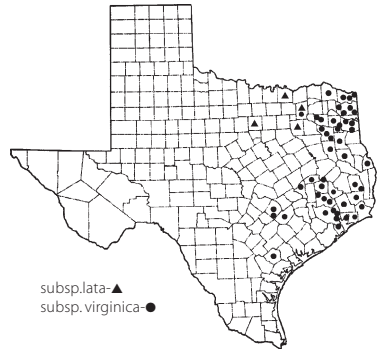
Yucca treculeana Carr., (for A.A.L. Trécul, 1818–1896, who took plants of this species to France in 1850—Vines 1960), SPANISH-DAGGER, SPANISH-BAYONET, TRECUL'S YUCCA, DON QUIXOTE'S-LANCE, PITA, PALMA PITA, PALMA DE DÁTILES, PALMA LOCA, TEXAS-BAYONET. Plant large, to ca. 7 m tall; stems few-branched, with leaf crown at apex; dead leaves reflexed on trunk below leaf crown (trunks bare of dead leaves on old plants); leaves 50–100 cm long, green, entire (sometimes denticulate at base of leaf), without marginal fibers, the apical portions of the leaves not inrolled; panicle with ca. 0.5–0.75 of its total length extending beyond the leaves; perianth broadly globose or hemispherical, greenish cream to cream (can be lightly tinged with purple); fruits 5–11.5 cm long, indehiscent, the flesh sweetish and succulent. Brushland; Bexar (TAES), Goliad (TAMU), Hays (TAMU), Travis (Tharp letter quoted in McKelvey 1938; R. O'Kennon, pers. obs.), and Comal (Turner et al. 2003) cos. near extreme sw margin of East TX, also Brazos Co. (K. Clary, pers. comm.); s TX n to s part of Cross Timbers and Prairies (Burnet Co.—Buckley in McKelvey 1938; R. O'Kennon, pers. obs.) and s part of East TX; in the U.S. known only from TX. Feb–Apr. [*Y. treculeana* var. *succulenta* McKelvey] Carr (2002a) considered Travis Co. collections previously thought to be of this species to be *Y. torreyi*; however, K. Clary (pers. comm.) observes that *Y. treculeana* does come as far e as Travis Co. and also up from s TX to Brazos Co. The spines were used historically to jab a snake bite and induce bleeding in order to flush away the poison (Vines 1960). Pioneers cooked and prepared the flowers like cabbage and also pickled them (Schulz 1922; McKelvey 1938; Crosswhite 1980). According to Havard (1896), the fleshy,



Manfreda maculosa



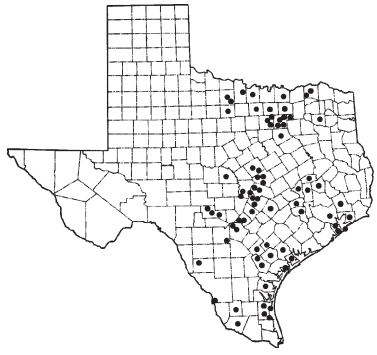
Manfreda sileri



Manfreda virginica



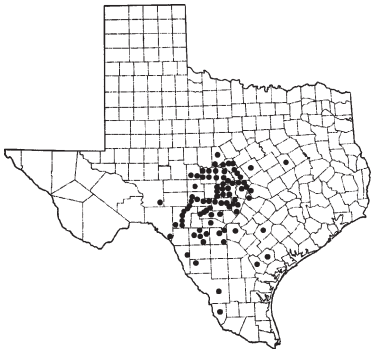
Yucca aloifolia



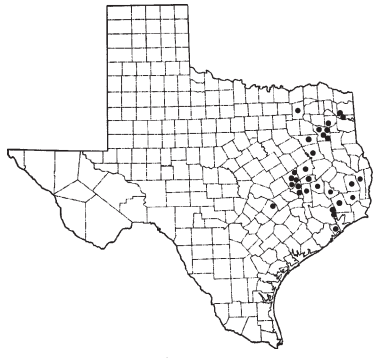
Yucca arkansana



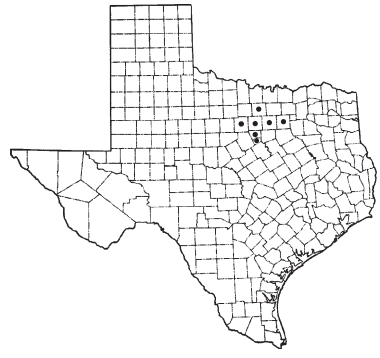
Yucca cernua



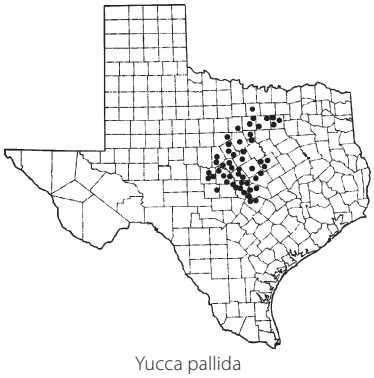
Yucca constricta



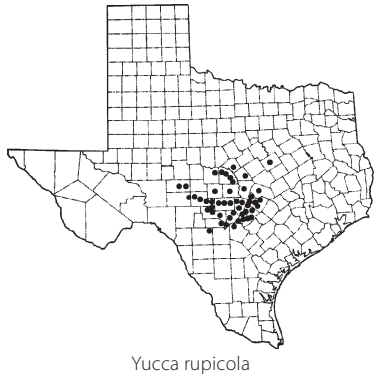
Yucca louisianensis



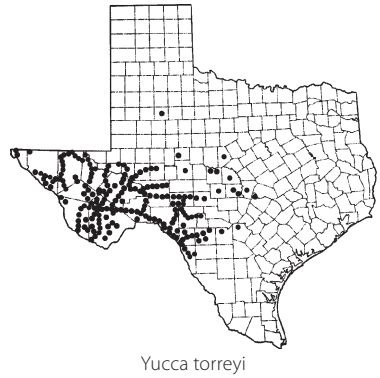
Yucca necopina



Yucca pallida



Yucca rupicola



Yucca torreyi

banana-like fruits are delicious, contain considerable sugar, and were converted by Chihuahua Indians into a fermented beverage. Long fibers obtained by macerating the leaves were used in the past to make ropes (Crosswhite 1980). ⚅/308

Yucca tenuistyla Trel., (slender-styled), WHITE-RIM YUCCA. This very poorly known *Yucca* species is found on brushlands on the Edwards Plateau and the South TX Plains and could possibly be found on the s margin of East TX—an Austin Co. Trelease specimen cited in McKelvey (1947) may be *Y. tenuistyla*, but in the words of McKelvey (1947), "the material is immature and inadequately labelled." The species is endemic to TX (Kartesz 1999; Carr 2002b, 2002c; Hess & Robbins 2002). The plants are acaulescent and diminutive (to ca. 1 m tall, but usually much less), resembling *Y. arkansana* but with a branched inflorescence; leaf blades 10–20 mm wide, mostly recurving; capsules not constricted. Flowering spring. According to Hess and Robbins (2002), the characters separating this species from *Y. constricta* are tenuous, and McKelvey (1947) included it within *Y. constricta* "with a question." However, these two species are usually easily distinguished in the field. *Yucca constricta* is typically a much taller plant with very numerous, straight, narrower leaves (3–)7–15 mm wide and constricted capsules. Detailed field work is needed to determine the range and appropriate status of *Y. tenuistyla*. (RARE 2001, 2002b: G3S3) 🌵

ALISMATACEAE Vent.
ARROWHEAD OR WATER-PLANTAIN FAMILY

Annual or perennial, aquatic or wet area herbs, largely glabrous, with milky sap; leaves basal, sometimes dimorphic with different submersed (linear and bladeless) and emergent (generally with distinct blades) forms; leaf blades entire, linear to ovate-elliptic, or triangular and with basal lobes (= sagittate), longitudinally ribbed (midrib more prominent than others) and with cross veins; inflorescences scapose, racemose, paniculate, or rarely umbellate, bracteate, with flowers or branches in whorls; flowers perfect or imperfect; sepals 3, green; petals 3, white or rarely pink, equal; stamens 6–many; pistils 15–many, of a single carpel each, on a swollen or elongating receptacle; ovary superior with basal placentation; fruits achenes in our species, often with stylar beaks.

A small (ca. 80 species in 12 genera) family of aquatic or wet area plants, nearly cosmopolitan in distribution (Haynes & Hellquist 2000a) but primarily n temperate and neotropical with most species found in the New World. A number of species are valuable as food for wildlife or as aquarium plants or aquatic ornamentals. Molecular analyses (e.g., Duvall et al. 1993b; Chase et al. 2000; Fuse & Tamura 2000; Soltis et al. 2000) indicate that Alismataceae are phylogenetically near the base of the monocotyledons—Acoraceae are the sister group to all other monocots, with Alismataceae in the next most basal clade. The presence of unsealed carpels (during flowering) (Kaul 1976) may be indicative of this basal position. The Limnocharitaceae appears to be the family most closely related to Alismataceae (Haynes & Holm-Nielsen 1992; Les & Haynes 1995; Haynes et al. 1998a) and has sometimes been submerged in the Alismataceae (Judd et al. 1999). However, most modern treatments (e.g., Cronquist 1981; Takhtajan 1997; Haynes 2000a; Haynes & Hellquist 2000a) separate the two families. (subclass Alismatidae—Cronquist; order Alismatales—APG II)

FAMILY RECOGNITION IN THE FIELD: wet area or aquatic herbs with milky sap and basal, often broad, usually distinctly petiolate leaves; flowers whorled, usually in scapose racemes or panicles, with 3 green sepals, 3 white or rarely pink petals, and usually numerous separate pistils (later, achenes).

REFERENCES: Small 1909; Beal 1960a; Charlton 1973; Argue 1974, 1976; Rogers 1983; Haynes 1984; Dahlgren et al. 1985; Kaul 1985; Haynes & Holm-Nielsen 1994; Haynes et al. 1998a; Haynes & Hellquist 2000a.

1. Pistils (later, achenes) in a single ring around the margin of a flattened receptacle; stamens 6; leaf blades never sagittate (instead, cuneate to cordate at base); petals 1–3 mm long _____ **Alisma**
1. Pistils (later, achenes) densely crowded over entire surface of a convex receptacle, forming a head-like mass; stamens usually > 6 (often numerous); leaf blades variable in shape, sometimes sagittate; petals (1–)3–20(–25) mm long.
   2. Fruiting "heads" (actually aggregate of achenes from a single flower) rough in appearance, resembling a bur due to the conspicuous persistent styles on the achenes; achenes turgid, ribbed or ridged, not winged; flowers perfect; leaf blades never sagittate _____ **Echinodorus**
   2. Fruiting "heads" not bur-like (except somewhat so in *S. brevirostra*); achenes flattened, with a membranous lateral wing; flowers perfect or imperfect, at least the lower imperfect; leaf blades sagittate OR not so _____ **Sagittaria**

ALISMA L. WATER-PLANTAIN

A widely distributed but primarily n temperate and Australian genus of 9 species (Haynes & Hellquist 2000a). (Greek: *alisma*, water-plantain)
REFERENCES: Fernald 1946a; Hendricks 1957[1958]; Voss 1958; Pogan 1963; Rubtzoff 1964; Björkqvist 1967, 1968.

Alisma subcordatum Raf., (slightly cordate), SOUTHERN WATER-PLANTAIN, AMERICAN WATER-PLANTAIN, WATER-PLANTAIN, SMALL-FLOWER WATER-PLANTAIN, MUD-PLANTAIN, SUBCORDATE WATER-PLANTAIN. Emergent perennial herb with numerous fibrous roots; stems erect; leaves basal, emersed, rarely floating; leaf blades ovate to elliptic, to 12(–15) cm long and 8(–10) cm wide, basally broadly cuneate to subcordate, long-petioled; inflorescences to 60(–100) cm tall, paniculate, with whorled branches; flowers perfect; petals white or pinkish, 1–3 mm long, suborbicular; receptacle flattened, 4 mm wide or less including achenes; style 1/4 the length of the ovary; achenes 1.5–2.2 mm long, wingless, smooth, with a single dorsal groove. Shallow water; Lamar (Carr 1994) and Red River (Turner et al. 2003) cos. in the Red River drainage; also Hemphill Co. in the Panhandle (BRIT); Hatch et al. (1990) also cited the Blackland Prairie; se Canada and throughout e U.S. (except FL and LA) w to ND and TX, also AZ, CA, NM, and OR. Jun–Sep. [*A. parviflorum* Pursh, *A. plantago-aquatica* L. var. *parviflorum* (Pursh) Torr., *A. plantago-aquatica* subsp. *subcordatum* (Raf.) Hultén] While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

ECHINODORUS Rich. ex Engelm. BURHEAD

Ours emergent annual or perennial herbs; emersed leaves long-petioled, the leaf blades with arcuate veins prominent below; submersed leaves also sometimes present, usually sessile; inflorescences usually much exceeding the leaves, racemose or umbellate, with flowers in whorls; flowers perfect; petals white; stamens ca. 9–22; pistils 15–250, spirally arranged on a convex receptacle forming a head-like mass; fruiting "heads" rough in appearance, resembling a bur due to the conspicuous persistent styles on the achenes; achenes turgid, ribbed or ridged, beaked, without a wing.

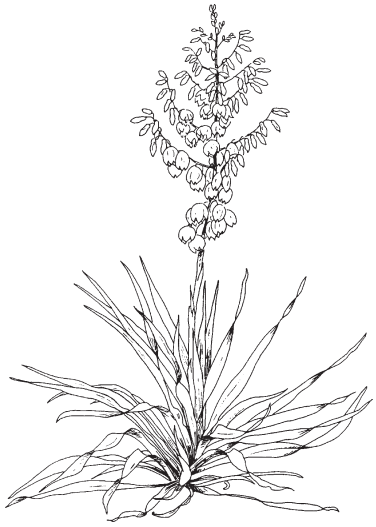
A genus of 26 species extending from the n U.S. to Argentina and Chile (Haynes & Holm-Nielsen 1994; Haynes & Hellquist 2000a). A narrowly endemic species, *E. floridanus* R.R. Haynes & J.R. Burkhalter, was recently described from the Florida Panhandle (Haynes & Burkhalter 1998). Some are cultivated as ornamental aquarium plants or aquatic ornamentals. Bees were found to be the main pollinators of a South American species (Vieira & de Souza Lima 1997), and given the showy flowers of East TX species, insect pollination is expected. (Greek: *echinus*, rough husk, and *doros*, a leather bottle, applied to the ovary, which in most species is armed with the persistent style (= beak), these giving the fruiting "heads" a bur-like appearance)
REFERENCES: Fassett 1955; Rataj 1975; Haynes & Holm-Nielsen 1986; Haynes & Burkhalter 1998.

1. Plants ± delicate, diminutive, to only 25 cm tall; blades of emersed leaves 0.2–0.6 cm wide, narrowly lanceolate to ovate; submersed leaves typically present, sessile; pistils 15–20 per flower; flowers ca. 3–6(–8) mm across _____ **E. tenellus**
1. Plants usually relatively larger, stout, to ca. 100 cm tall; blades of emersed leaves 0.5–20 cm wide, lanceolate to elliptic to ovate; submersed leaves typically absent (petiolate when present); pistils 45–250 per flower; flowers 6–25 mm across.
   2. Inflorescences erect when young but later arching and becoming prostrate, rooting at nodes and sometimes vegetatively proliferating to form plantlets; veins of sepals usually with papillose or roughened ridges; stamens usually 20–22; flowers 10–25 mm across _____ **E. cordifolius**
   2. Inflorescences rigidly erect at maturity, not proliferating; veins of sepals smooth (note that tissue between veins can have granulations); stamens usually 9–15; flowers 6–11 mm across _____ **E. berteroi**

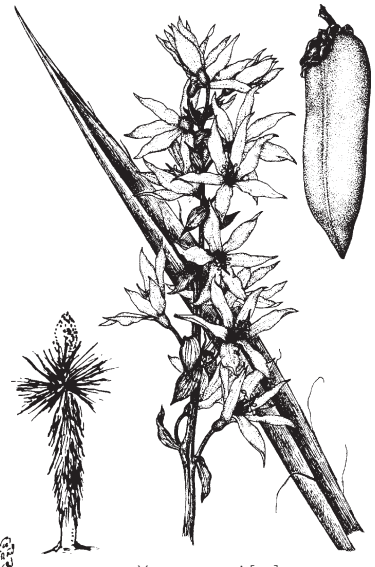
Echinodorus berteroi (Spreng.) Fassett, (for C.G.L. Bertero, 1789–1831, Italian physician who botanized in West Indies), BURHEAD, ERECT BURHEAD, UPRIGHT BURHEAD. Coarse annual or short-lived perennial with scapes to 80 cm tall; rhizomes present; leaves mostly emersed, variable, those of mature plants with blades broadly ovate, 2.6–18 cm long, 0.5–20 cm wide, subcordate to truncate or broadly cuneate at base; secretory tissue visible as pellucid (= clearish, somewhat transparent) line-like markings conspicuous in dried leaves when backlit with strong light; petioles 5–6 ridged or, on large leaves, terete; inflorescences racemose or sometimes branched and paniculate, 1.5–40 cm long, rigidly erect at maturity, not producing plantlets at tips, with flowers in 1–9 whorls of 1–3(–4) flowers each; flowers 6–14 mm across; sepal veins not papillose; petals clawed, the claw to ca. 0.5 mm long; stamens (9–)12(–15); anthers versatile (= filament attached near middle of anther); pistils 45–200; achenes 0.9–3.2 mm long. Mud and shallow water, clay soils; widespread in TX; throughout much of the U.S. from OH s to FL w to CA. May–Oct. [*E. berteroi* var. *lanceolatus* (Engelm. ex S. Watson & J.M. Coult.) Fassett, *E. rostratus* (Nutt.) Engelm. ex A. Gray, *E. rostratus* var. *lanceolatus* Engelm. ex S. Watson & J.M. Coult.]

Echinodorus cordifolius (L.) Griseb. var. **cordifolius**, (with heart-shaped leaves), CREEPING BURHEAD. Stout perennial to ca. 1.2 m tall; rhizomes absent or to 6 cm long; leaves emersed; leaf blades ovate to elliptic, 6.5–18(–32) cm long, 2.5–15(–19.1) cm wide; secretory tissue visible as pellucid line-like markings (in dried leaves when backlit); petioles terete to triangular; inflorescences racemose, to 60+ cm long, erect when young but later arching and becoming prostrate and rooting at nodes, often producing plantlets at tips (proliferating), with flowers in 3–9 whorls of 3–15 flowers each; flowers 10–25 mm across; sepals with papillate veins; petals not clawed; stamens ca. 20–22; anthers versatile; pistils 200–250; achenes ca. 2–3.5 mm long. Mud and shallow water, clay soils; widespread in e 1/2 of TX; e U.S. from VA s to FL w to IA and TX. Apr–Nov. Following Haynes and Holm-Nielsen (1994) and Jones et al. (1997), Diggs et al. (1999) treated the TX material of this taxon as *E. cordifolius* subsp. *fluitans* (Fassett) R.R. Haynes & Holm-Niels. However, based on further study, we are now following Haynes and Hellquist (2000a) who treated all North American material of the species as var. *cordifolius*. [*E. radicans* (Nutt.) Engelm.] This is the only species in the genus with arching to prostrate inflorescences, and also the only species with papillose veins on the sepals (Haynes & Hellquist 2000a). /285

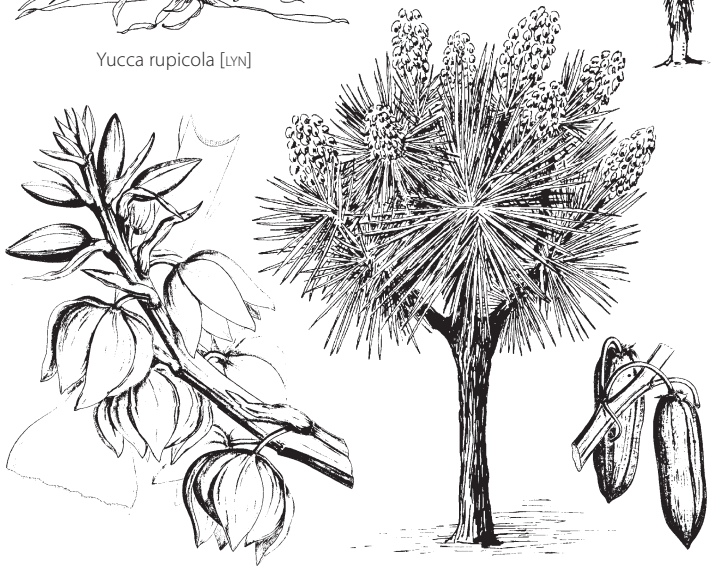
Echinodorus tenellus (Martius) Buchenau (tender, delicate), DWARF BURHEAD, LANCE-LEAF BURHEAD. Slender stoloniferous annual to 20(–25) cm tall; rhizomes absent; submersed sessile leaves typically present; emersed leaves petiolate; blades of emersed leaves linear, 1–6(–7.4) cm long, 0.2–0.6 mm wide, without pellucid line-like markings; inflorescences usually umbellate, rarely racemose, to 6 cm long, erect, not producing plantlets at tips (not proliferating), of 1–2 whorls of 4–6 flowers each; flowers ca. 3–6(–8) mm across; sepal veins not papillose; petals clawed, the claw ca. 1 mm long; stamens usually 9; anthers basifixed (= filament attached at anther base); pistils 15–20; achenes 0.8–1.5 mm long. Stream or lake margins, sandy soils; Houston Co.



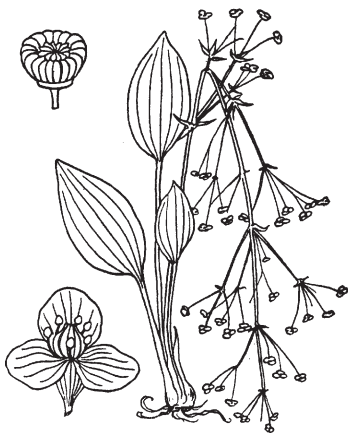
Yucca rupicola [LYN]



Yucca torreyi [VIN]



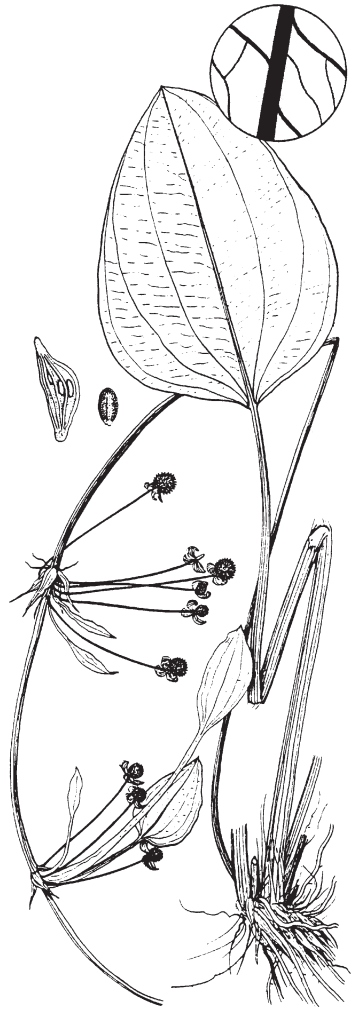
Yucca treculeana [PES, SA2]



Alisma subcordatum [BB2]



Echinodorus berteroi [BEA]



Echinodorus cordifolius [FLN]

(BRIT) in the Pineywoods and Bastrop Co. (Turner et al. 2003) in the Post Oak Savannah; also, the range map in Haynes and Hellquist (2000a) indicated a substantial area in the s and w parts of East TX (counties not specified); scattered in TX; widespread in e U.S. from NY s to FL w to KS and TX. Summer–fall. [*E. parvulus* Engelm., *E. tenellus* var. *latifolius* (Seub.) Fassett, *E. tenellus* var. *parvulus* (Engelm.) Fassett, *Helianthium parvulum* (Engelm.) Britton, *Helianthium tenellum* Britton] This species has long been treated in TX as *E. parvulus*. However, Haynes and Hellquist (2000a) indicated that while *E. tenellus* has often been separated into two species, one in North America and one in the tropics, a continuum exists and *E. parvulus* (the North American form) should therefore be included in the older *E. tenellus*.

SAGITTARIA L. ARROWHEAD, WAPATO

Mostly perennial, aquatic or semi-aquatic, rhizomatous herbs, usually emergent when flowering; rhizomes sometimes terminated by tubers; leaves varying with environmental conditions (particularly depth of water) and season, usually with distinct blades but sometimes phyllodial (= petiole and blade indistinct; actual phyllodes are bladeless petioles); leaf blades unlobed or sagittate; petioles long and spongy; submersed leaves typically bladeless; inflorescences usually erect or sometimes procumbent, branched or unbranched; flowers in whorls of (2–)3, pedicelled, bracteate, mostly imperfect or sometimes perfect; petals white; stamens numerous; pistils numerous, forming a head-like mass (referred to as a fruiting "head" or fruiting aggregate); achenes flattened, with a membranous lateral wing, beaked.

A predominantly New World genus of ca. 30 species, ranging from Canada s to Argentina and Chile; 3–4 species also occur in Eurasia (Haynes & Holm-Nielsen 1994; Haynes & Hellquist 2000a). The starchy tubers are edible in a number of species and may be variously cooked, roasted, or candied (Yatskievych 1999). Some species are cultivated as ornamental aquarium plants or aquatic ornamentals. Some ARROWHEADS exhibit leaf polymorphism—the submersed leaves ribbon-shaped, the floating ones with ovate blades, the emergent ones with sagittate blades. Because of this and the similar leaves of a number of taxa, reproductive structures are critical in separating some species. Further, additional extensive morphological variation within species can make species identification difficult (Hauber & Legé 1999). (Latin: *sagitta*, an arrow, from the leaf shape of some species)

REFERENCES: Smith 1895; Bogin 1955; Rataj 1972; Wooten 1973; Bloedel & Hirsch 1979; Beal et al. 1982; Kortright 1998; Hauber & Legé 1999.

1. Leaf blades not sagittate, without basal lobes (note: *S. platyphylla* occasionally has a projection(s) from the base of the blade, but not well formed lobes); filaments usually pubescent OR glabrous in 1 species (*S. papillosa*).
   2. Stalks (pedicels) of fruiting "heads" recurved; achene beaks 0.3–0.6 mm long; bracts of inflorescence smooth, thinly membranous; filaments pubescent _____ **S. platyphylla**
   2. Stalks (pedicels) of fruiting "heads" ascending or spreading, not recurved, or if so, then achene beaks < 0.3 mm long; bracts of inflorescence papillose and thickened OR smooth and membranous; filaments pubescent OR glabrous (in *S. papillosa*).
      3. Bracts of inflorescence smooth and membranous; filaments dilated at base, pubescent ____ **S. graminea**
      3. Bracts of inflorescence papillose and sometimes ridged, thickened; filaments linear or only slightly dilated at base, pubescent OR glabrous.
         4. Bracts of inflorescence 3–10 mm long, ovate, free, papillose; filaments glabrous, slightly dilated at base, shorter than anthers; leaves ± phyllodial (= petiole and blade ± indistinct), the petioles triangular in cross section, enlarged-spongy at base, tapering to linear or narrowly lanceolate blade portion; achenes 1–1.5 mm long _____ **S. papillosa**
         4. Bracts of inflorescence 3–35 mm long, lanceolate, basally connate, papillose and sometimes ridged; filaments pubescent, cylindric (not dilated), longer than anthers; leaves with

long terete petioles and definite blades (lanceolate to broadly ovate); achenes 1.6–2.5 mm long ____ **S. lancifolia**

1. Leaf blades usually sagittate, with conspicuous, projecting, basal lobes; filaments glabrous.
   5. Sepals of pistillate flowers in fruit 5–14 mm long, appressed, enclosing the achenes; stalks (pedicels) of fruiting "heads" usually recurved and noticeably thickened (usually ca. 1–2 mm wide); petioles terete; most flowers perfect (the predominantly pistillate flowers have a ring of sterile stamens) ____ **S. montevidensis**
   5. Sepals of pistillate flowers in fruit 4–7 mm long, reflexed or spreading, not enclosing the achenes; stalks (pedicels) of fruiting "heads" ascending or if recurved then not noticeably thickened (< 1 mm wide); petioles angular; few or no flowers perfect (pistillate flowers without a ring of sterile stamens).
      6. Basal lobes of leaf blade significantly longer than (commonly twice as long as) blade body ____ **S. longiloba**
      6. Basal lobes of leaf blade usually ± equal to or shorter than blade body.
         7. Lower floral bracts triangular-ovate, obtuse or acute, 3–12 mm long, connate 1/4 or more total length; achene beak projecting ± horizontally or slightly downcurved, the wing of the achene extending ± smoothly to upper surface of the beak ____ **S. latifolia**
         7. Lower floral bracts lanceolate to narrowly triangular, acuminate, 12–30(–50) mm long, distinct or connate < 1/4 total length; achene beak projecting upward at an angle, the wing of the achene not extending smoothly to upper surface of the beak, with a definite interruption ("saddle"-like) ____ **S. brevirostra**

Sagittaria brevirostra Mack. & Bush, (short-beaked), SHORT-BEAK ARROWHEAD, MIDWESTERN ARROWHEAD. Leaves to 0.6 m long; leaf blades to 25(–30) cm long and 11(–20) cm wide (usually smaller), usually sagittate; bracts of inflorescence not papillose; sepals reflexed or spreading, not enclosing mature achenes; petals 8–15 mm long; filaments cylindric, usually longer than anthers, glabrous; achenes 2.1–3.1 mm long; achene beak inserted laterally, ascending apically, broad-based, 0.4–1.7 mm long. Rivers, ditches, other wet areas; Dallas, Ellis, Grayson (BRIT), and Collin (Turner et al. 2003) cos. in Blackland Prairie and Polk Co. (Turner et al. 2003) in the Pineywoods; also Rolling Plains; sc Canada (Sask.) and mostly c U.S. from MI s to AL and w to ND and NM, also CA. Jun–Aug. [*S. engelmanniana* J.G. Smith subsp. *brevirostra* (Mack. & Bush) Bogin]

Sagittaria graminea Michx., (resembling grass), GRASS-LEAF ARROWHEAD, GRASSY ARROWHEAD. Leaves phyllodial (= petiole and blade indistinct) or with blades; juvenile leaves and early season leaves phyllodial, the later leaves often with blades; phyllodial leaves variable in length and width, to ca. 2.5(–4) cm wide; leaf blades variable in shape, ranging from linear to linear-lanceolate to elliptic; inflorescences racemose; bracts of inflorescence not papillose; sepals reflexed or spreading, not enclosing fruiting aggregate; petals 6–15 mm long; filaments broadly dilated, shorter than anthers, pubescent; achenes 1.5–2.8 mm long; achene beak laterally inserted just below summit, ascending, subulate, to 0.3 mm long or obsolete. In mud or shallow water, ditches, marshes, other wet areas; widespread in East TX; also Gulf Prairies and Marshes; se Canada and widespread in e 1/2 of the U.S., also WA. Apr–Nov. [*S. cycloptera* (J.G. Sm.) C. Mohr, *S. lancifolia* L. var. *angustifolia* (Lindl.) Griseb., *S. stolonifera* Engelm. & A. Gray]

Sagittaria lancifolia L. subsp. **media** (P. Micheli) Bogin, (sp.: lance-leaved; subsp.: intermediate, the middle), SCYTHE-FRUIT ARROWHEAD, BULL-TONGUE ARROWHEAD. Leaf blades lanceolate to broadly ovate, to 40 cm long and 10(–16) cm wide; petioles terete; bracts of inflorescence papillose and sometimes also ridged, to 35 mm long, basally connate; sepals reflexed to spreading, not enclosing fruiting aggregate, papillose; petals ca. 8–20 mm long; filaments cylindric, longer than anthers, pubescent; beak of achene inserted laterally near apex of achene, ascending, to 0.8 mm long. Swamps, marshes, or other wet areas; s Pineywoods and s Post Oak Savannah, also Hatch et al. (1990) indicated occurrence in the Blackland Prairie (however, we have seen no confirming specimens from the Blackland Prairie); also Gulf Prairies and Marshes and South TX

Plains; se U.S. from VA s to FL w to TX. According to R. Haynes (pers. comm.), this is a mainly coastal species. May–Nov. [*S. falcata* Pursh, *S. lancifolia* var. *media* P. Micheli, *S. plantaginifolia* Martens & Galeotti] Subspecies *media* is distinguished by its papillose bracts and sepals and lanceolate to broadly ovate leaf blades. Subspecies *lancifolia* (known from FL, GA, and SC) has striate to ribbed bracts and sepals and linear to ovate leaf blades (Haynes & Hellquist 2000a).

Sagittaria latifolia Willd., (broad-leaved), COMMON ARROWHEAD, DUCK-POTATO, WAPATO, DOWNY ARROWHEAD. Leaves to 1.5 m long; leaf blades to 50 cm long, usually sagittate, the lobes varying from narrow to deltoid, usually ± equal to or shorter than blade body; bracts of inflorescence 3–12 mm long, cupped, obtuse or acute, connate 1/4 or more total length, smooth; sepals reflexed from fruiting aggregate, to 10 mm long; petals to ca. 10–20(–25) mm long; filaments cylindric, usually longer than anthers, glabrous; achenes 2.5–4 mm long; achene beak inserted laterally, horizontal or slightly downcurved, broad-based, 1–2 mm long. Lakes, ponds, or other wet areas; scattered in e 1/2 of TX; also Panhandle; s Canada and widespread nearly throughout the U.S. May–Aug. [*S. latifolia* var. *obtusa* (Muhl. ex Willd.) Wiegand, *S. latifolia* var. *pubescens* (Muhl.) J.G. Sm., *S. obtusa* Muhl. ex. Willd., *S. pubescens* Muhl.] In the past, two varieties were often recognized (var. *latifolia* with inflorescence bracts and sepals glabrous and var. *pubescens* (Muhl. ex Nutt.) J.G. Sm. with inflorescence bracts and sepals densely pubescent). However, Haynes and Hellquist (2000a) indicated that pubescence "... alone is insufficient for recognition of the varieties." The tubers were used as food by Native Americans (Erichsen-Brown 1979). ⊠/297

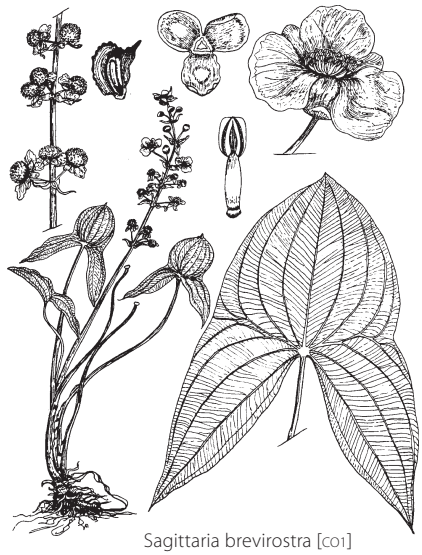
Sagittaria longiloba Engelm. ex J.G. Sm., (long-lobed), LONG-LOBE ARROWHEAD, LONG-BARB ARROWHEAD, FLECHA DE AGUA. Leaves to 0.8 m long; leaf blades to 26.5 cm long, 0.8–15 cm wide, usually sagittate, the basal lobes significantly longer than (commonly twice as long as) blade body, usually 2 cm or less wide; bracts of inflorescence usually < 15 mm long, ± flat, acuminate to attenuate, connate 1/4 or more total length, smooth; sepals 4–7 mm long, reflexed from fruiting aggregate; petals to ca. 14 mm long; filaments cylindric, often longer than anthers, glabrous; achenes 1.2–2.5 mm long; achene beak inserted laterally, ascending, triangular, tiny, to only 0.15(–0.6) mm long or obsolete. Ponds, swamps, ditches, or other wet areas; Bastrop (BRIT), Caldwell, Dallas, DeWitt, and Gonzales (Turner et al. 2003) cos., primarily in the sw part of East TX; mainly s and w TX; sc U.S. from NE s to TX and w to AZ, also CA. Apr–Nov. This species can be distinguished from *S. latifolia* (bracts cupped, obtuse to merely acute; leaf blades with lobe usually ± equal to or shorter than blade body; achene beak horizontal or slightly downcurved) by the ± flat, acuminate to attenuate bracts, longer leaf blade lobes, and the ascending achene beak. Native Americans and early settlers used the tubers as food, calling them duck-potatoes or swan-potatoes (Kirkpatrick 1992).

Sagittaria montevidensis Cham. & Schltdl. subsp. **calycina** (Engelm.) Bogin, (sp:. presumably of Montevideo, Uruguay; subsp.: calyx-like), HOODED ARROWHEAD; GIANT ARROWHEAD. Annual (Kaul 1985) or perennial; leaves to 1 m long; leaf blades 3–40 cm long, 2–25 cm wide, usually sagittate; bracts of inflorescence ca. 10 mm long, smooth; sepals appressed around fruiting aggregate; stalks (pedicels) of fruiting "heads" usually recurved and noticeably thickened (usually ca. 1–2 mm wide); petals with a green or purplish spot at base; filaments cylindric, longer than anthers, glabrous; achenes 2–3(–4.3) mm long; achene beak inserted laterally, horizontal or oblique, narrowly winged, 0.4–0.8 mm long. Lakes, ponds, other wet areas; Lee, Harris (BRIT), Brazos, Robertson (TAMU), Cass, Dallas, Grayson, Hardin, Jefferson, Liberty, Travis (Turner et al. 2003), and Walker (E. Keith, pers. comm.) cos.; widely scattered in TX; widespread through much of the e U.S. w to SD and AZ, also CA and OR. Jun–Oct. While this taxon is sometimes (e.g., Kartesz 1994, 1999) recognized as a separate species [*S. calycina* Engelm.], we are following Haynes and Holm-Nielsen (1994), Jones et al. (1997), and Haynes and Hellquist (2000a) in treating it as a subspecies of *S. montevidensis*.

Sagittaria papillosa Buchenau, (with papillae or nipple-like structures), NIPPLE-BRACT ARROWHEAD. Leaves ± phyllodial (= petiole and blade indistinct), ± enlarged-spongy at base, tapering



Echinodorus tenellus [FLN, RHO]



Sagittaria brevirostra [CO1]



Sagittaria graminea [CO1]



Sagittaria longiloba [CO1]



Sagittaria lancifolia subsp. media [FLN, GLE]



Sagittaria latifolia [MAS]

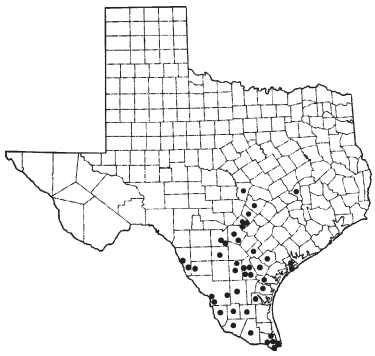
to linear or narrowly lanceolate blade portion or blade absent; petioles triangular in cross section; bracts of inflorescence densely papillose, 3–10 mm long; sepals papillose, appressed to spreading from fruiting aggregate; petals to ca. 12 mm long; filaments linear to slightly dilated, ascending, shorter than anthers, glabrous; achenes 1–1.5 mm long; achene beak inserted laterally above middle of achene, ca. 0.1–0.3 mm long. Swamps, marshes, lake margins, or other wet areas; Pineywoods and Post Oak Savannah; also Gulf Prairies and Marshes and e Edwards Plateau; Hatch et al. (1990) also indicated occurrence in the Blackland Prairie (however, we have seen no confirming specimens from the Blackland Prairie); AR, LA, MS, OK, and TX. Mar–Nov. Wooten and Brown (1983) studied the reproductive biology of this monoecious species.

Sagittaria platyphylla (Engelm.) J.G. Sm., (broad-leaved), DELTA ARROWHEAD. Leaf blades lanceolate to elliptic or ovate, 8–20 cm long, 2–8 cm wide, rarely with a lateral projection(s) from the base, but never truly sagittate; bracts of inflorescence smooth, basally connate, 3–8 mm long; stalks (pedicels) of fruiting "heads" spreading to recurved; sepals 4–6 mm long, usually reflexed from fruiting aggregate; filaments dilated, as long as or longer than anthers, pubescent; achenes 1.2–2 mm long; beak of achene inserted laterally, 0.3–0.6 mm long, horizontal to ascending, subulate. Swamps, marshes, ponds, or other wet areas; Pineywoods and Gulf Prairies and Marshes w to Rolling Plains and Edwards Plateau; e U.S. from VA s to FL w to KS and TX. Apr–Oct. [*S. graminea* Michx. var. *platyphylla* Engelm.] This is one of the most common *Sagittaria* species in East TX. While not problematic in its native North America, this species has recently (Sage et al. 2000) been discovered as an introduced weed in w Australia, where it has been described as an aquatic weed threat and has been designated a "Declared Plant" of the highest priority for control. ⊠/297

ALLIACEAE Batsch ex Borkh.
ONION FAMILY

Ours perennial, scapose herbs from a bulb, usually but not always with an onion or garlic odor; leaves usually all basal or subbasal (or nearly to the middle of the stem in some introduced species), with closed, tubular, basal sheaths and slender blades; inflorescence terminating a scape, with a basal involucre of one or more sheathing bracts; flowers in umbellate or head-like clusters or solitary, radially symmetrical; tepals 6, separate or partly connate, all petal-like; stamens 6; ovary superior; style 1; fruit a loculicidal capsule.

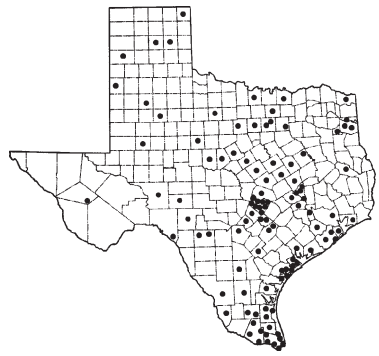
☙–A medium-sized family of 13 genera (all small except *Allium,* the other 12 genera totaling ca. 75–82 species) and ca. 600 species (Rahn 1998a)—but see note under *Allium*. They are perennial herbs usually with a bulb (some species in other areas have a rhizome or corm). Most of the genera are found in South America, but the largest genus, *Allium*, is widespread in the n hemisphere (Rahn 1998a). A number are used as ornamentals (e.g., *Allium*, *Ipheion*) or as food plants (e.g., *Allium*). Raphides or allylic sulphides (which account for the onion smell) are often present in Alliaceae. Alkaloids are absent but are regularly found in the Amaryllidaceae (Rahn 1998a), within which this family has sometimes been placed. The genera have been variously treated in terms of family affiliation. Many authorities have put them in a broadly defined and clearly polyphyletic (but practical) Liliaceae (e.g., Correll & Johnston 1970; Cronquist 1988; Diggs et al. 1999) based on superficial similarities of the flower structure to that of the genus *Lilium*, while others (e.g., Hutchinson 1934; Traub 1963a) treated them in the Amaryllidaceae based on such characters as the umbellate inflorescence subtended by bracts. However, based on phylogenetic analyses (e.g., Fay & Chase 1996; Fay et al. 2000), we are following many recent authors (e.g., Rahn 1998a) in recognizing the Alliaceae as a distinct family; it is apparently a monophyletic group in the order Asparagales, closely related to the Amaryllidaceae. As such, it is more closely related to other Asparagales families such as Hypoxidaceae, Iridaceae, and Orchidaceae than it is to other taxa often put in a broadly defined Liliaceae (Chase et al. 1995a,



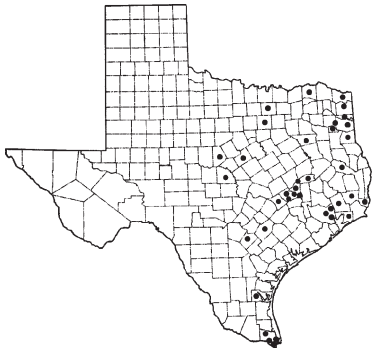
Yucca treculeana



Alisma subcordatum



Echinodorus berteroi



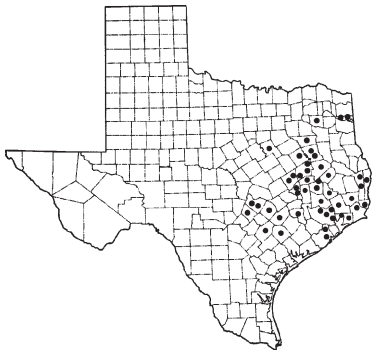
Echinodorus cordifolius



Echinodorus tenellus



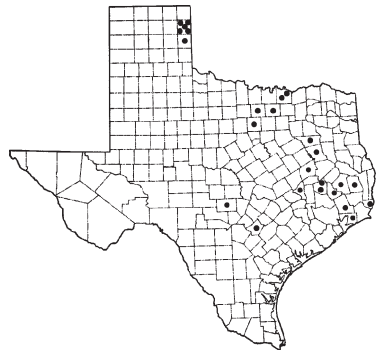
Sagittaria brevirostra



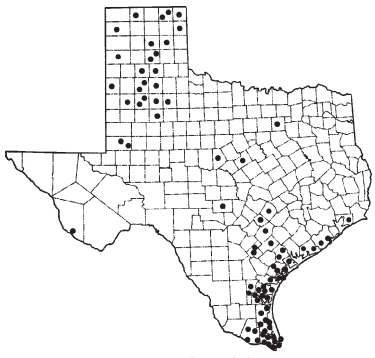
Sagittaria graminea



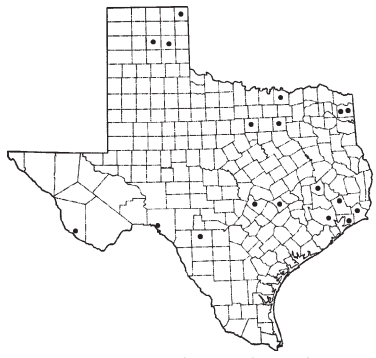
Sagittaria lancifolia subsp. media



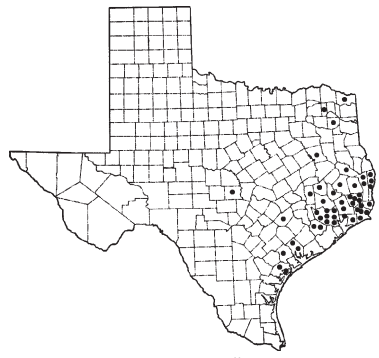
Sagittaria latifolia



Sagittaria longiloba



Sagittaria montevidensis subsp. calycina



Sagittaria papillosa

1995b, 1996, 2000; Fay et al. 2000). Genera (e.g., *Brodiaea*) now recognized in the Themidaceae (Rahn 1998b) have sometimes been included in the Alliaceae (e.g., Dahlgren et al. 1985) based on superficial similarities. However, phylogenetic analyses (e.g., Fay et al. 2000) show that these genera are not closely related to Alliaceae. Recently, the Angiosperm Phylogeny Group (APG II 2003) proposed optionally treating the Alliaceae broadly to include the Agapanthaceae and Amaryllidaceae. For a detailed discussion of the groups formerly treated as Liliaceae in the broad sense, see the family synopsis of the Liliaceae (here treated in a restricted sense) on page 726. (subclass Liliidae—Cronquist; order Asparagales—APG II)

FAMILY RECOGNITION IN THE FIELD: scapose bulbose herbs with superior ovaries, often with umbellate or head-like, showy inflorescences subtended by an involucre of sheathing bract(s); flowers usually numerous, small, and white, pink, reddish pink, or purplish (but flowers 1(-2) and blue to lavender or whitish in *Ipheion*); most species with onion or garlic odor.

REFERENCES: Dahlgren et al. 1985; Fay & Chase 1996; Rahn 1998a, 1998b; Fay et al. 2000.

1. Flower 1(–2) at end of a scape; perianth pale blue to lavender or white with pale blue tinge, the lobes with a darker central line and brownish tinge on back, 20–28 mm long; filaments united _____ **Ipheion**
1. Flowers in an umbel with 3–many flowers (these sometimes replaced by bulbils); perianth white to yellowish, pink, reddish pink, red, or purplish, 12 mm or less long; filaments separate.
   2. Umbels with few to very numerous flowers (ca. 5–500, but often more than 15), bulbils sometimes present replacing some or all flowers; pedicels (= flower stalks) within an umbel all ± same length; anthers oblong, ca 1 mm long; plants with onion or garlic odor when bruised _____ **Allium**
   2. Umbels with 3–15(–20) flowers, without bulbils; pedicels within an umbel of different lengths; anthers linear, ca. 1.5–2 mm long; plants without onion or garlic odor when bruised _____ **Nothoscordum**

ALLIUM L. ONION, GARLIC, LEEK

Bulbose perennials typically with odor of onion or garlic, our species glabrous; stems unbranched; leaves all subbasal (in native and introduced species) or with leaves nearly to the middle of the stem (in introduced species); leaves with closed, tubular, basal sheath and slender blade, the blades flat to cylindrical; inflorescence a solitary, terminal umbel subtended by a spathe that divides into 1–3 bracts; flowers white to pink, reddish pink, red, or purplish, or replaced by bulbils; perianth of 6 similar, ± free segments (= tepals).

A mainly n hemisphere genus of 550–700 species (McNeal & Jacobsen 2002) ranging from Eurasia and North America to n Africa, Sri Lanka, and Mexico, and especially abundant in c Asia (Rahn 1998a). However, species limits within the genus are unsettled, and Rahn (1998a) indicated that the genus is estimated to have "260–550–690" species. The genus exhibits great variation in genome size (Ohri et al. 1998). It includes many species used as ornamentals and for herbs and vegetables. *Allium* has long been cultivated, including ONION, GARLIC, SHALLOT, LEEK, RAMPS, and CHIVES. There are inscriptions on Egyptian pyramids and tombs built ca. 2500 BC mentioning onions and leeks (Davies 1992). *Allium* species contain sulfur-containing (e.g., N-propyl disulfide) compounds similar to those found in the unrelated mustard family (Blackwell 1990); cows grazing on wild onions are known to give onion-flavored milk and butter (Cheatham & Johnston 1995). While Alliums are generally edible, gastroenteritis or other problems can result from excessive consumption of some species. Livestock can also develop toxic symptoms if large quantities are eaten, and dogs and cats can have reactions to onions in table scraps (Lampe & McCann 1985; Cheatham & Johnston 1995; Weathers 1998; Bruneton 1999; Burrows & Tyrl 2001; Hart et al. 2001). According to Block (1985) and Rahn (1998a), when an ONION or GARLIC bulb is cut, low-molecular-weight organic molecules that incorporate sulfur atoms are released (e.g., allicin). These compounds, which are released only from wounded or decaying tissue, have a number of biological effects: they are tear-inducing (= lacrimatory), and the tear-inducing substance can undergo hydrolysis to form sulfuric acid. Certain of the com-

pounds are antibacterial or antifungal; others inhibit blood clotting. The sulfur-containing compounds are effective as feeding deterrents to animals (Rahn 1998a). Alliums are being researched for medicinal uses (e.g., antibacterial, antifungal, anti-inflammatory, antiseptic, anticoagulant, etc.), and some (e.g, garlic, onions) have been shown to be effective against the buildup of cholesterol in the blood (Cheatham & Johnston 1995). The following key relies in part on characteristics of the bulbs, including the bulb coats. Specimens should therefore include the entire bulb and should not be "cleaned up" prior to pressing. Garlic has many cloves, while onions have an undivided bulb—hence the derivation of the word onion—the single bulb was probably referred to as unio (Latin: *uni*, one), later union, and eventually onion (in English) and oignon in French (Davies 1992). (The ancient Latin name for garlic, from Celtic: *all*, hot or pungent; this classic usage is still reflected in the words used for garlic in several modern languages—Italian, *aglio*, and Spanish, *ajo*—Davies 1992)

REFERENCES: Fraser 1939; Ownbey 1951; Moore 1954–1955; Ownbey & Aase 1955; Di Fulvio 1973; Howard 1990; Davies 1992; Hanelt 1996; Linne von Berg et al. 1996; Mathew 1996; Mes et al. 1997 [1998]; Ronsheim 1997; Gregory et al. 1998; Ohri et al. 1998; Stevenson et al. 1999; McNeal & Jacobsen 2002.

1. Leaf blades hollow, circular in cross section or nearly so; flowering stems to more than 1 m tall; introduced species.
   2. Flowering stems inflated below the middle, 3–20(–30) mm in diam.; leaf blades 5–15(–20) mm in diam.; bulbs usually > 2 cm in diam., only 1–3 per plant; umbel usually without bulbils ____ **A. cepa**
   2. Flowering stems slender, not inflated below the middle, 4 mm or less in diam.; leaf blades 1–5 mm in diam.; bulbs 1–2 cm in diam., clustered, typically 5–20 per plant; umbel usually with at least some bulbils _____ **A. vineale**
1. Leaf blades flat, folded, or concave; flowering stems usually 0.5(–0.9) m or less tall (except taller in *A. ampeloprasum* and *A. sativum*); native and introduced species.
   3. Umbel with bulbils (= small asexual bulbs produced in an inflorescence), often with few or no flowers; the few flowers, if present, rarely producing capsules or seeds.
      4. Flowering stems naked above the subbasal leaves, usually 0.5(–0.9) m or less tall; bulb coats with fibers that persist as a conspicuous net-like structure enclosing the bulbs; leaf blades 1–5 mm wide; involucral bracts subtending umbel not narrowed to a beak; widespread native species _____ **A. canadense** var. **canadense**
      4. Flowering stems with leaves nearly to middle, often 0.5–2 m or more tall; bulb coats lacking a net of persistent fibers; leaf blades 5–24(–40) mm wide; involucral bract(s) subtending umbel narrowed to an elongate beak; persisting or escaped introduced species.
         5. Underground bulb usually with ca. 2–few main cloves and numerous small (ca. 1 cm long), yellowish or brownish, typically stalked bulblets from the base; bracts subtending umbel 2–5, persistent; stamens equaling or usually slightly exserted beyond the perianth segments; umbel usually large, (3–)5–10 cm in diam. _____ **A. ampeloprasum**
         5. Underground bulb without small bulblets but usually with 5–18+ similar-sized large bulblets (= cloves); bract subtending umbel solitary, falling early; stamens included or just equaling perianth segments; umbel usually 5 cm or less in diam. _____ **A. sativum**
   3. Umbel without bulbils; flowers producing capsules and seeds.
      6. Leaves 5–24(–40) mm wide; flowering stems EITHER 3-angled OR with leaves nearly to the middle; escaped introduced species.
         7. Plants 45–200 cm tall; flowering stems round, with 4–10 leaves borne nearly to middle of stem; perianth segments white to pink or reddish pink, 5.5 mm or less long ____ **A. ampeloprasum**
         7. Plants 20–50(–60) cm tall; flowering stems 3-angled, naked above the 2–3 subbasal leaves; perianth segments white, 7–12 mm long _____ **A. neapolitanum**
      6. Leaves 1–5(–7) mm wide; flowering stems round or nearly so (definitely not 3-angled) AND naked above the subbasal leaves; widespread native species.

8. Plants flowering late summer and fall; perianth segments deep pink to red; stamens exserted, longer than the perianth; species of prairies, usually in calcareous areas, in East TX known at present only from Brazos, Dallas, Lamar, Polk, and Van Zandt cos. _____ **A. stellatum**

8. Plants flowering in spring; perianth segments pink, lavender, purplish red, or white; stamens not exserted, shorter than to ca. as long as perianth segments; species of various habitats and soils, including some widespread in East TX.

9. Bulb coats lacking fibers that persist as a conspicuous net-like structure enclosing the bulbs; bulbs with a few short-stalked basal bulblets; perianth segments white or pinkish; TX endemic known only from extreme sw part of East TX and adjacent South TX Plains _____ **A. elmendorfii**

9. Bulb coats with fibers that persist as a conspicuous net-like structure enclosing the bulbs; bulbs without short-stalked basal bulblets (except in *A. runyonii*); perianth segments pink, lavender, purplish red, white, or greenish yellow; including species widespread in East TX.

10. Perianth segments remaining spreading after flowering, becoming dry, papery and rigid; spathe usually divided into 2–3 separate or partly united involucral bracts, each with 1 nerve _____ **A. drummondii**

10. Perianth segments either shriveling or, if persistent, then becoming urceolate; spathe usually divided into 2–3 separate or partly united involucral bracts, each with 3–7 nerves.

11. Perianth urceolate, permanently enclosing the capsule, the perianth segments 5–11 mm long; net-like structure enclosing bulbs usually very coarse; plants rare, if present, in East TX.

12. Bulbs at flowering time with a cluster of short-stalked basal bulblets; perianth segments white with pinkish midribs, fading pink, 5–7 mm long; pedicels ca. 2 times the length of perianth in full flower; species limited to extreme s portion of East TX if present _____ **A. runyonii**

12. Bulbs at flowering time without basal bulblets; perianth segments deep rose or rose-purple, fading purple, 7–11 mm long; pedicels ca. equal in length to perianth in full flower; species of extreme n portion of East TX if present _____ **A. perdulce**

11. Perianth campanulate or urceolate-campanulate, ultimately withering somewhat and exposing the capsule, the perianth segments 4–7 mm long; net-like structure enclosing bulbs fine or only moderately coarse-meshed; including plants widespread in East TX.

13. Perianth usually white (rarely pink); plants of the Post Oak Savannah and westward _____ **A. canadense** var. **fraseri**

13. Perianth usually pinkish or lilac; plants with distributions various.

14. Pedicels filiform (= thread-like) or nearly so; leaf blades narrower than flowering stem, 0.3–2 mm wide; plants of Pineywoods and n Gulf Prairies and Marshes w to East Cross Timbers and e Edwards Plateau _____ **A. canadense** var. **mobilense**

14. Pedicels stouter; leaf blades narrower to broader than flowering stem, 0.5–7 mm wide; plants of n part of Blackland Prairie w to Rolling Plains OR extreme s part of East TX and to the s.

15. Umbel with 25–60 flowers; flowers with sweet hyacinth scent; n part of Blackland Prairie w to Rolling Plains _____ **A. canadense** var. **hyacinthoides**

15. Umbel with 5–25 flowers; flowers ± scentless or slightly fragrant; extreme s part of East TX and to the s _____ **A. canadense** var. **ecristatum**

Allium ampeloprasum L., (leek or onion of the vineyard), WILD LEEK, GREAT-HEADED GARLIC, WILD ELEPHANT GARLIC. Bulb usually with ca. 2–few main cloves and producing numerous bulblets from the base, the bulblets small (ca. 1 cm long), yellowish or brownish; leaves borne nearly to the middle of the stem, withering by flowering time, flat, 30–60 cm long, 15–24(–40) mm wide, sheathing the stem; flowering stem stout, 45–200 cm tall; umbel (3–)5–10 cm wide; flowers often more than 100 to 500 per umbel, sometimes replaced by bulbils (then flowers relatively few); perianth segments 4–5.5 mm long, white to pink or reddish pink. Weedy areas; Grayson (extensive roadside colony, BRIT), Bowie (TAMU), and Walker (E. Keith, pers. comm.) cos., also the map in Cheatham and Johnston (1995) showed 3 other East TX localities without indicating specific counties (in Blackland Prairie, Post Oak Savannah, and Pineywoods); apparently scattered in e 1/2 of TX; se U.S. from VA s to FL w to OK and TX, also NY and OH. Summer. Native of Europe, n Africa, and Asia. *Allium porrum* L., LEEK, GREAT GARLIC, probably derived from *A. ampeloprasum*, is also cultivated and probably persists locally. It differs in having the bulb but poorly developed and bulblets few. It is cultivated for the edible fleshy leaf sheaths. Stanford (1971) reported *A. porrum* from Hamilton Co. in the Cross Timbers and Prairies. *Allium ampeloprasum* is considered a noxious weed in OK (Kartesz 1999).

Allium canadense L., (of Canada), WILD ONION. Leaves 1–5(–7) mm wide, green at flowering time; flowering stem 10–50 cm tall; flowers 0–50(–60) per umbel, replaced by or intermixed with bulbils and green sprouts, or flowers many and the umbel without bulbils or sprouts; perianth segments usually 4–7 mm long, white to pink or lavender, withering after flowering and exposing the capsule. The key to varieties of *A. canadense* is included in the key to *Allium* species. In large amounts, this plant has caused death in cattle (Kingsbury 1964); gastroenteritis has been reported in children (Lampe & McCann 1985). Yatskievych (1999) reported that the plants "can impart an onion flavor to milk produced by cows that feed on them."

var. **canadense**. CANADA GARLIC, WILD GARLIC, WILD ONION, CANADA WILD ONION. Leaf blades 1–5 mm wide; flowering stem 15–50 cm tall, naked above the flat, solid, subbasal leaves (this character is important in distinguishing this taxon from *A. vineale*, which has ± cylindrical hollow leaves up to or near middle of the flowering stem); flowers all or mostly replaced by bulbils; perianth segments when present 4–7 mm long, white to pink. Open woods, fields, roadsides, other open areas; widespread from East TX and Gulf Prairies and Marshes w to East Cross Timbers; se Canada and e U.S. w to SD and TX. Mar–May. [*Allium acetabulum* (Raf.) Shinners] The presence of bulbils in the inflorescence is of prime importance in recognizing this variety. /274

var. **ecristatum** (M.E. Jones) Ownbey, (without a crest), CRESTLESS WILD ONION. Leaf blades 1–5 mm wide; flowering stem 10–30 cm tall; perianth segments 5–7 mm long, deep pink. Prairies, poorly drained sites on sandy substrates (Carr 2001); included based on citation by Hatch et al. (1990) for vegetational area 4 (Blackland Prairie); mainly Gulf Prairies and Marshes and South TX Plains; Ownbey (1951) and Ownbey and Aase (1955) cited only Bee (possibly San Patricio due to an error), Goliad, Victoria, and Wilson cos.; Carr (2001) also cited Matagorda (?), Nueces (?), Refugio, and San Patricio cos.; Turner et al. (2003) also mapped Jim Hogg Co.; endemic to TX (Kartesz 1999; Carr 2002b, 2002c; McNeal & Jacobsen 2002). Mar–early April. [*A. canadense* subsp. *ecristatum* (M.E. Jones) Traub & Ownbey] This variety can be distinguished from the similar var. *hyacinthoides* by its few (5–25)-flowered umbel and thickish perianth segments. According to Carr (2001), "This is a poorly-understood taxon which either doesn't exist in a discrete fashion or, if so, may well be more common than collections indicate." McNeal and Jacobsen (2002), however, recognized it as a distinct variety. This variety is of conservation concern. (RARE 2001, 2002b: G5T3S3)

var. **fraseri** Ownbey, (for John Fraser, 1750–1811, Scottish collector in North America), FRASER'S WILD ONION. Leaf blades 1–7 mm wide; flowering stem 20–50 cm tall; flowers without hyacinth

scent; perianth segments 4–7 mm long, white (rarely pink). Rocky, often calcareous soils, woods or open areas; Post Oak Savannah w to Rolling Plains and Edwards Plateau; KS, NE, OK, SD, and TX. Apr–May. [*A. fraseri* (Ownbey) Shinners] The typically white flowers are important in recognizing this variety. Intergradation with var. *mobilense* is known where the two varieties overlap (Ownbey & Aase 1955).

var. **hyacinthoides** (Bush) Ownbey & Aase, (hyacinth-like), FRAGRANT WILD ONION. Leaf blades 0.5–7 mm wide; flowering stem 15–30(–40) cm tall; umbel many-flowered; flowers fragrant with sweet hyacinth scent; perianth segments 5–7 mm long, pink, thin. Calcareous prairies or infrequently in sandy soils, in sun or shade; Blackland Prairie w to edge of Rolling Plains, mostly to the w of var. *mobilense*; endemic to TX and s OK. Late Mar–Apr. [*A. hyacinthoides* Bush] Turner et al. (2003) treated this taxon as a distinct species, while McNeal et al. (2002) considered it a variety of *A. canadense*.

var. **mobilense** (Regel) Ownbey, (of Mobile, Alabama), MOBILE ONION, PINK WILD ONION. Flowering stem 10–30(–50) cm tall; bulb at base of plant sometimes with 1 or 2 bulblets (not present in other vars.); leaf blades 0.3–2 mm wide; perianth segments 4–6(–7) mm long, pink (rarely white). Sandy or rocky soils, rarely on limestone or clay, woods and prairies; Pineywoods and n Gulf Prairies and Marshes w to East Cross Timbers and e Edwards Plateau; e U.S. from SC s to FL w to OK and TX. Apr–mid-May. [*A. mobilense* Regel] Turner et al. (2003) apparently considered this the sexual form of var. *canadense*. ⚅/274

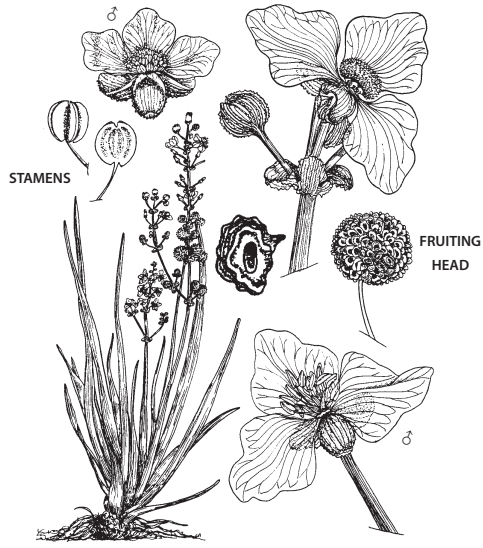
Allium cepa L., (Latin for onion), ONION, COMMON ONION. Bulb sometimes quite large; leaves cylindrical with groove on inner surface; flowering stem to ca. 1+ m tall, inflated below middle; umbel 4–9 cm in diam.; pedicels often many times longer than flowers; flowers sometimes very many; perianth segments 3–4.5(–7) mm long, green to white(–pink), with greenish midveins ; sessile bulbils occasionally replacing some or all of the flowers. Cultivated, persisting, and possibly escaped; included based on citation of vegetational area 4 (Blackland Prairie) by Hatch et al. (1990); no county distribution map is provided; also cited by Hatch et al. (1990) for South TX Plains and Cross Timbers and Prairies; scattered in e U.S. w to WI and TX, also CA, OR, MT, and WA. May–Jun. Native of w Asia. This species, the ONION of commerce, is widely grown and has numerous cultivars resulting from ca. 3,000 years of cultivation (Stearn 1980). It is often polyploid (2*n* = 16, 32, 54), is unknown in the wild, and is thought to be derived from *A. oschaninii* O. Fedtsch., native to c Asia (Davies 1992; McNeal & Jacobsen 2002). ☜

Allium drummondii Regel, (for its discoverer, Thomas Drummond, 1780–1835, Scottish botanist and collector in North America), DRUMMOND'S ONION, PRAIRIE ONION. Leaves 1–3(–5) mm wide; flowering stem 7–30 cm tall; involucral bracts usually 1-nerved; umbel with 10–25 flowers; pedicels ca. 6–18 mm long; perianth segments 6–9 mm long, white to pink, lavender, or purple-red (rarely greenish yellow), remaining spreading after flowering, becoming dry, papery and rigid. Sandy or gravelly, often limestone soils; widespread throughout TX; c U.S. from AR and TX w to NE and NM. Mar–May. ⚅/274

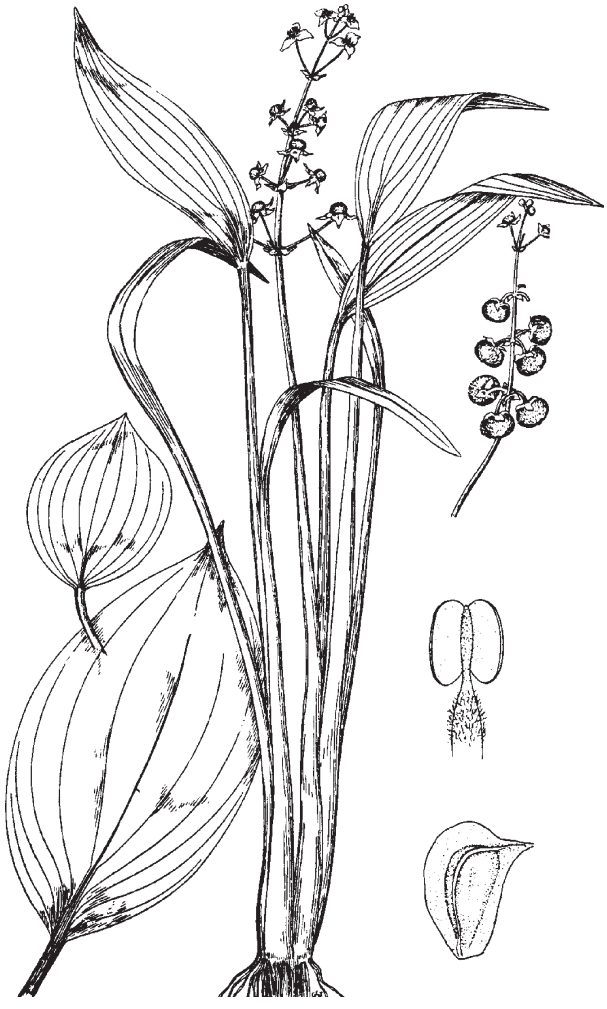
Allium elmendorfii M.E. Jones ex Ownbey, (named for Elmendorf, TX, in Bexar Co., near the type locality), ELMENDORF WILD ONION, MARION'S WILD ONION, WILD ONION. Bulbs with a few short-stalked basal bulblets, the bulb coats lacking net-like fibers; leaves 1–2 mm wide; flowering stem 15–40 cm tall; umbel with 10–30 flowers; perianth segments ca. 5 mm long, white or pinkish, withering and not permanently enclosing the capsule. Sandy soils, grassland openings in post oak woodlands; Gonzales, Guadalupe (BAYLU), Bexar, and Wilson (Carr 2001) cos. near s margin of East TX; otherwise known only from Atascosa (Ownbey 1951; Correll & Johnston 1970), Bee, Kenedy, Llano, Nueces, San Patricio (TOES 1993), Aransas (Carr 2001), Frio (McNeal & Jacobsen 2002), and Refugio (Poole et al. 2002) cos.; endemic to TX (Kartesz 1999; Carr 2002b, 2002c; McNeal & Jacobsen 2002). Mar–Apr. This species is similar to *A. runyonii*, which



Sagittaria montevidensis [CO1]



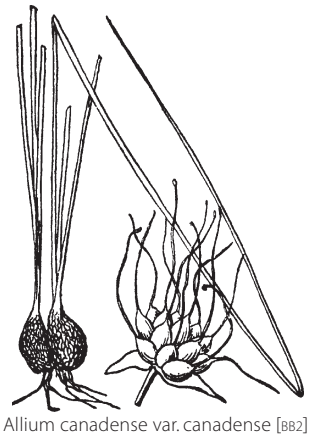
Sagittaria papillosa [CO1]



Sagittaria platyphylla [AMB]



Allium ampeloprasum [GLE]



Allium canadense var. canadense [BB2]

can be distinguished by its bulb coats which have fibers that persist as a conspicuous net-like structure enclosing the bulbs. (TOES 1993: V; RARE 2002a: G2S2) ⚠

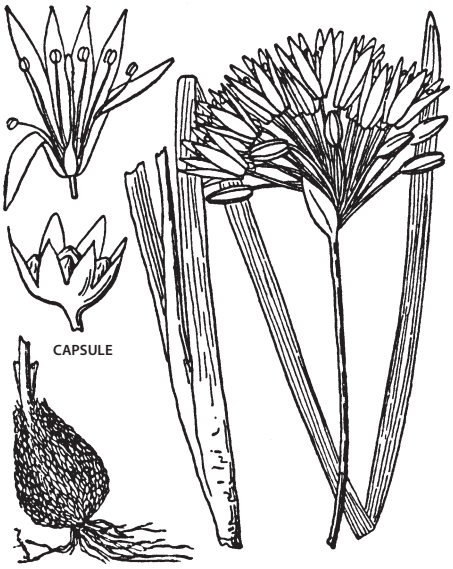
Allium neapolitanum Cirillo, (of Naples), NAPLES GARLIC, WHITE GARLIC, DAFFODIL GARLIC, FLOWERING ONION, NEOPOLITAN ONION. Leaves 5–20 mm wide; flowering stem 20–50(–60) cm tall, 3-angled; umbel 5–11 cm in diam., not forming bulbils; perianth segments 7–12 mm long, white. Naturalized in deciduous woods; Travis Co. where reported as locally abundant (Carr 2002a); Cheatham and Johnston (1995) also mapped locations (without specifying counties) in the se part of East TX and e Edwards Plateau; AL, CA, FL, LA, and TX. Mar–Apr. Native of Mediterranean region. [*A. inodorum* Aiton]

Allium perdulce S.V. Fraser, (very sweet), FRASER'S ONION, SWEET-SMELLING ONION, WILD ONION. Leaves 1–2 mm wide; flowering stem 7–25 cm tall; umbel 5–20(–25)-flowered; flowers sweet-scented; perianth segments 7–11 mm long, deep rose or rose-purple, fading purple, permanently enclosing the capsule. Sandy or gravelly prairies; included based on range map in Cheatham and Johnston (1995) indicating occurrence in Red River drainage east to ca. Grayson or Fannin cos.; mainly n part of Cross Timbers and Prairies w to Plains Country and s to Edwards Plateau; c U.S. from SD to TX, also IA and NM. Mar–early Apr. Two varieties, var. *sperryi* Ownbey and var. *perdulce,* are recognized in this species. All East TX plants are var. *perdulce*.

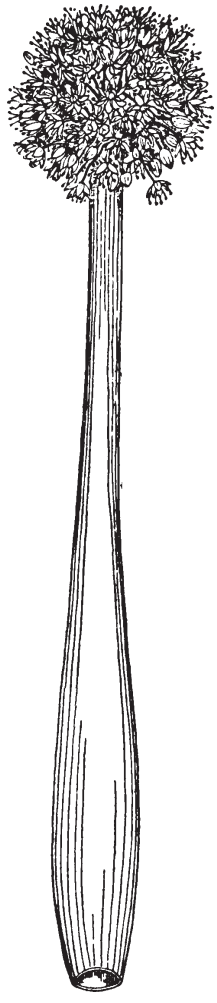
Allium runyonii Ownbey, (for Robert Runyon, 1881–1968, of Brownsville, student of the vegetation of the lower Rio Grande Valley and collector of the type specimen—see Ideker (2002) for details of Runyon's life), RUNYON'S ONION. Bulbs at flowering time with a cluster of short-stalked basal bulblets; leaves 1–4 mm wide; flowering stem 10–35(–45) cm tall; umbel with 10–25 flowers; perianth segments 5–7 mm long, white with pinkish midribs, fading pink, permanently enclosing the capsule. Sandy soils; included based on citation of vegetational area 4 (Blackland Prairie) by Hatch et al. (1990); Carr (2002b) also cited Goliad Co. near extreme s boundary of East TX; however, Ownbey (1951) and Ownbey and Aase (1955) gave the distribution as Rio Grande Plains in s TX, and Cheatham and Johnston (1995) and Turner et al. (2003) map it well to the s of East TX. This species may therefore be only on the margin of East TX; endemic to TX (Kartesz 1999; Carr 2002b, 2002c; McNeal & Jacobsen 2002). Mar. The cluster of short-stalked bulblets typically present at the base of the bulb is unusual among the East TX species of *Allium* (it otherwise occurs only in *A. elmendorfii*).

Allium sativum L., (cultivated or sown), GARLIC. Bulb of 5–18+ similar-sized bulblets (= cloves); bulb coats membranous, silky white or pink; leaves 6–12, borne to ca. the middle of the stem, flat, 5–15(–20) mm wide, sheathing the stem; flowering stem stout, to 100(–200) cm tall; umbel usually 5 cm or less in diam., with bulbils; flowers (when present) 20 or less, usually aborting before anthesis; perianth segments usually greenish white or pinkish. Cultivated in East TX and probably persisting and escaping; included because of likelihood of encountering it in abandoned garden spots; no county distribution map is provided; se Canada and widespread in e 1/2 of the U.S., also CA and CO. May–Jul. This is a cultigen derived from an Old World species, possibly *A. longicuspis* Regel of c Asia; cultivated since ancient times, probably 3,000 B.C. or earlier; bulbs were found in the tomb of Tutankhamen; used medicinally, in cooking, and worn around the neck to supposedly ward off evil spirits, trolls, and vampires (Rose & Strandtmann 1986; Mabberley 1987; Mathew 1996; McNeal & Jacobsen 2002). The word garlic comes from Anglo-Saxon: *gar*, a spear, and *leac*, plant or herb, in reference to the spear-like leaves (Shosteck 1974; Davies 1992). Though economically important, this species is considered a noxious weed in OK (Kartesz 1999). ⊘

Allium stellatum Nutt. ex Ker Gawl., (star-like), PRAIRIE ONION, WILD ONION, PINK WILD ONION. Bulb coats usually lacking fibers that persist as a conspicuous net-like structure enclosing the bulbs (this character is shared with *A. elmendorfii*); leaves 1–5 mm wide; flowering stem 20–50



Allium canadense var. mobilense [BB2]



Allium cepa [GLE]



Allium elmendorfii [HEB]



Allium drummondii [BB2]



Allium runyonii [HEA]



Allium neapolitanum [BA1]



Allium perdulce [HOL]

(–70) cm tall; umbel nodding while in bud, but becoming erect or nearly so by flowering time, with 40 or fewer flowers; perianth segments spreading, 5–8 mm long, deep pink to red, withering after flowering; stamens exserted. Prairies, usually in calcareous soils; Dallas, Van Zandt (Ownbey 1951), Lamar (Carr 1994), Brazos, and Polk (Brown & Elsik 2002) cos.; also Cooke and Tarrant cos. (BRIT) in Cross Timbers and Prairies; sc Canada and mostly c U.S. from MI and ND s to TX. Jul–Oct. This species is unusual in its late summer and fall flowering time.

Allium vineale L., (of vineyards), FIELD GARLIC, WILD GARLIC. Leaves borne up to or near the middle of the stem, ± cylindrical, hollow (at least lower half), 1–5 mm in diam., sheathing the stem; flowering stem 30–120 cm tall; umbel 2–5 cm in diam.; sessile bulbils usually replacing some or all of the flowers; perianth segments 3–5 mm long, pink to purplish pink to whitish or greenish white. Weedy and disturbed areas; included based on location mapped (without specific county indicated) in the ne part of East TX (Cheatham & Johnston 1995); no county distribution map is provided; se Canada and e U.S. w to NE and TX, also w North America in B.C., CA, and OR. May–Aug. Native of Europe, apparently introduced into N.A. in colonial times (McNeal & Jacobsen 2002). This species is considered to be an agricultural weed and in some cases a serious pest. McNeal and Jacobsen (2002) consider it a noxious weed, as do the states of CA and OK (Kartesz 1999). Cows eating it produce milk with an onion flavor, and the bulbils contaminate grain (e.g., wheat) harvests (Davies 1992; Cheatham & Johnston 1995; Yatskievych 1999). This species can be quite similar superficially to *A. canadense* (especially individuals with bulbils) but can be easily distinguished by the presence of ± cylindrical, hollow leaves up to or near the middle of the flowering stem (versus only flat, solid, subbasal leaves in *A. canadense*). There is significant variation among individuals in *A. vineale* in resource allocation to three different reproductive modes: sexual flowers, aerial bulbils, and underground bulbs—recent research has shown strong heritability in these patterns (Ronsheim & Beaver 2000). ⊘ ☜

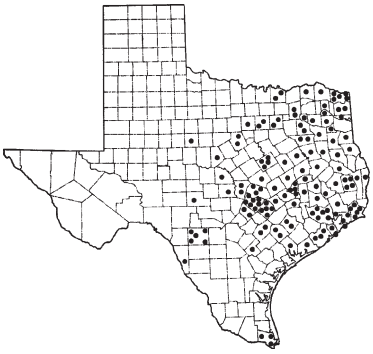
IPHEION Raf. SPRING-STAR

A South American genus of 3 species (Rahn 1998a) of both onion-scented and unscented herbs sometimes treated in the genus *Tristagma* (e.g., Traub 1963b; Mabberley 1997; Kartesz 1999). Generic concepts have been unstable in the group, with *Ipheion uniflorum* having been assigned to at least 8 different genera (Traub & Moldenke 1955; Traub 1963b). We are following Rahn (1998a) in recognizing *Ipheion* at the generic level. (Greek: origin obscure)
REFERENCES: Traub & Moldenke 1955; Traub 1963b; Crosa 1975.

Ipheion uniflorum (Lindl.) Raf., (one-flowered), SPRING-STAR, SPRING STARFLOWER. Glabrous bulbose perennial, 7–20 cm tall, with onion/garlic odor; leaves basal, each with long, closed, tubular sheath of thin, scarious texture, and slender green blade; scape with 2 partly or wholly united bracts above the middle, terminated by 1(–2) flowers; perianth 20–28 mm long, the segments partly fused, pale blue to lavender or white with pale blue tinge, the lobes with darker central line and brownish tinge on back; filaments ± united to form a tube. Cultivated and escaping; Dallas, Bowie (BRIT), and Kaufman (Diggs et al. 1999) cos. and Edwards Plateau (Hatch et al. 1990, without specific county indicated); se U.S. from VA s to FL w to OK and TX, also CA and OR. Feb–Mar. Native of Argentina and Uruguay. [*Brodiaea uniflora* (Graham) Engl., *Tristagma uniflorum* (Lindl.) Traub] ☜ ⚅/289

NOTHOSCORDUM Kunth FALSE GARLIC

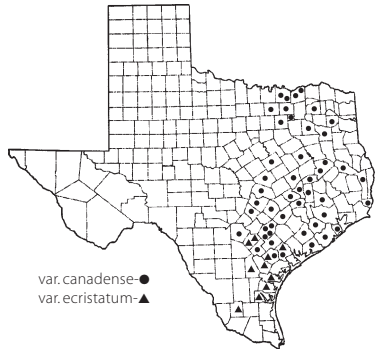
Perennial, scapose, glabrous herbs from bulbs, similar to *Allium* but without onion or garlic odor or fibrous reticulum around bulbs; leaves basal, with closed, tubular, basal sheaths and slender, filiform to linear blades; inflorescence a solitary umbel terminating the unbranched scape, subtended by a spathe of 2 scarious bracts; pedicels unequal at flowering time; flowers



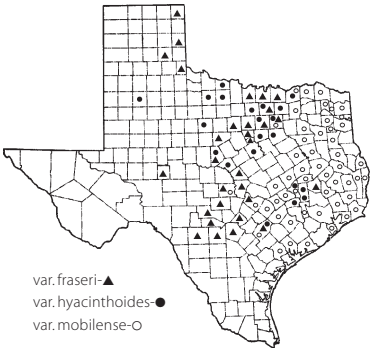
Sagittaria platyphylla



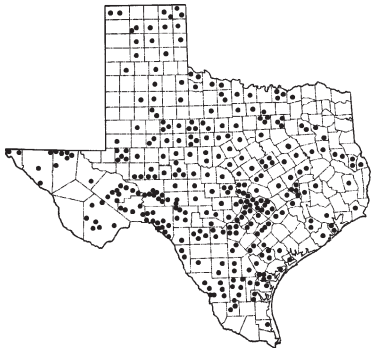
Allium ampeloprasum



Allium canadense



Allium canadense



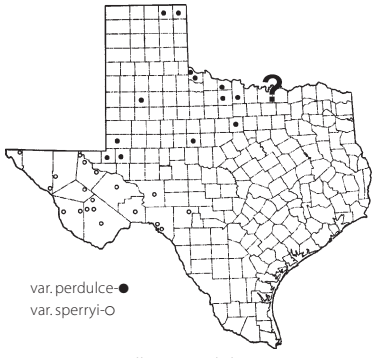
Allium drummondii



Allium elmendorfii



Allium neapolitanum



Allium perdulce



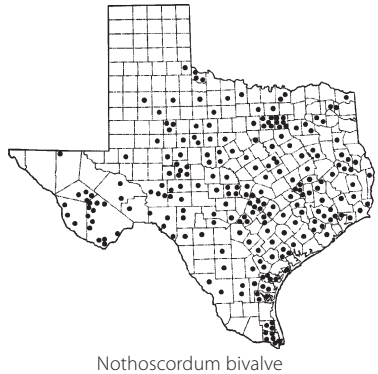
Allium runyonii



Allium stellatum



Ipheion uniflorum



Nothoscordum bivalve

whitish to cream, sometimes with yellowish base inside and/or lavender to pink or purple-red midribs; perianth of 6 similar segments (= tepals), these ± separate or connate to 1/3 their length.

A New World, mostly South American genus of ca. 19 species (Jacobsen & McNeal 2002) similar to *Allium* and sometimes treated in that genus (e.g., Radford et al. 1968); however, *Nothoscordum* species lack the characteristic odor of *Allium*. The following key is modified from Jacobsen and McNeal (2002). (Greek: *nothos*, false, and *scordon*, garlic, in reference to the resemblance to garlic but without the flavor or odor)
REFERENCES: Di Fulvio 1973; Stearn 1986; Ravenna 1991; Howard 1993; McNeal 1993; Jacobsen & McNeal 2002.

1. Flowers not fragrant; bulbs with no or few bulblets; umbels usually with 3–12 flowers; leaves 1–4(–5) mm wide; tepals separate or nearly so ____ **N. bivalve**
1. Flowers fragrant; bulbs with numerous bulblets; umbels usually with 10–15(–20) flowers; leaves 4–12 mm wide; tepals connate to 1/3 their length ____ **N. gracile**

Nothoscordum bivalve (L.) Britton, (two-valved), CROW-POISON, YELLOW FALSE GARLIC. Bulbs to 1.5 cm in diam.; plant 7–40 cm tall; inflorescences 1(–2) per plant, of 3–12 flowers; pedicels 1–3 cm long; flowers scentless; perianth usually 8–12 mm long, whitish to cream with yellowish base inside and lavender to purple-red midveins on backs of perianth segments; anthers ca. 2 mm long. Open woods, prairies, roadsides, lawns, disturbed sites; throughout most of TX; one of our most abundant and widespread native plants; widespread in e U.S. from OH s to FL w to KS and TX, also AZ and NM. Mostly Mar–early May and late Sep–Oct. [*N. texanum* M.E. Jones] Though resembling an *Allium* and placed by some in that genus [as *A. bivalve* (L.) Kuntze], this species is easily distinguished by its longer anthers (2 mm long versus ca. 1 mm in *Allium* species) and lack of odor. /292

Nothoscordum gracile (Dryander) Stearn, (slender, gracefully slight in form), HONEY-BELLS, FRAGRANT FALSE GARLIC. Bulbs ca. 1.5 cm in diam.; plant 20–40(–60) cm tall; inflorescences 1–2 per plant, of 10–15(–20) flowers; pedicels 2–6 cm long; flowers fragrant; perianth 8–15 mm long, the segments white with pinkish to reddish midveins. Roadsides, waste and disturbed areas; Hays and Jefferson (Turner et al. 2003 as *N. inodorum*) cos. at s margin of East TX; also Tarrant Co. (*Quayle 93*, BRIT) in Cross Timbers and Prairies; se U.S. from SC s to FL w to TX, also CA. Flowering throughout the growing season. Native of South America. [*Allium gracile* Dryander, *A. fragrans* Ventenat, *N. fragrans* (Ventenat) Kunth, *N. borbonicum* of authors, not Kunth, *N. inodorum* of authors, not (Ait.) Nichols] The correct epithet for this species has been controversial (e.g., Stearn 1986; Ravenna 1991). Kartesz (1999) recognized both *N. borbonicum* (with *N. inodorum* of authors as a synonym) and *N. gracile*, while Turner et al. (2003) treated the species as *N. inodorum*. We are following Jacobsen and McNeal (2002) for nomenclature of this species; they recognize only one species in this complex and consider *N. borbonicum* a misapplied name. While apparently rare in TX, this species, which spreads rapidly by seeds and bulblets, is widely naturalized in North America, Europe, Africa, Asia, and Australia (Jacobsen & McNeal 2002); it is considered a noxious weed in CA (McNeal 1993).

ALSTROEMERIACEAE Dumort.
ALSTROEMERIA OR PERUVIAN-LILY FAMILY

A small New World family of 3–5 genera and 150–160 species of erect or twining herbs ranging from c Mexico to Patagonia but found especially in the Andes (Mabberley 1997; Bayer 1998; Sanso & Xifreda 2001). The family is important horticulturally, with species cultivated for cut flowers, as pot plants, or as outdoor ornamentals. Storage roots of several species are starchy

and edible (Bayer 1998). The genera have been variously treated in terms of family affiliation. Some authorities have put them in a very broad and clearly polyphyletic (but practical) Liliaceae (Cronquist 1988), while others have treated them in the Amaryllidaceae (Pax & Hoffman 1930) or segregated them as a distinct family (e.g., Dahlgren et al. 1985; Bayer 1998). Based on phylogenetic analyses, we are following Bayer (1998) and Rudall et al. (2000b) in treating *Alstroemeria* in the Alstroemeriaceae (order Liliales). For a detailed discussion of the groups formerly treated as Liliaceae in the broad sense, see the family synopsis of the Liliaceae (here treated in a restricted sense) on page 726. The Alstroemeriaceae appears related to the Colchicaceae (Bayer 1998; Rudall et al. 2000b). (subclass Liliidae—Cronquist; order Liliales—APG II)
FAMILY RECOGNITION IN THE FIELD: lily-like, leafy-stemmed perennial herbs with 3–8 showy flowers in an umbellate inflorescence, the tepals red to wine, greenish apically, spotted purplish brown, 3.5–4.5 cm long, distinct; ovaries inferior.
REFERENCES: Bayer 1998; Aagesen & Sanso 2003.

ALSTROEMERIA L. PERUVIAN-LILY, LILY-OF-THE-INCAS, PARROT-LILY

A genus of ca. 60 species (Holmes 2002d) of South America, particularly Chile and Brazil, but ranging from Venezuela to Tierra del Fuego (Aagesen & Sanso 2003). Hybridization is common and there is significant morphological variation—the result is that there are problems in species delimitation (Aker & Healy 1990). The leaf base is twisted during development so that the morphologically "upper" leaf surface faces downward at maturity (Aker & Healy 1990; Mabberley 1997). Some species are cultivated as ornamentals—the cut flowers can be found in numerous florists and grocery stores throughout East TX. The starchy roots have been eaten since the time of the Incas (Aker & Healy 1990). The mature capsules are reported to "open under dry and warm conditions with an audible explosion, catapulting valves and seeds away" (Bayer 1998). There is temporal separation between the shedding of pollen and stigma receptivity in many species (e.g., *A. pulchella*), making outcrossing very likely (Aker & Healy 1990). Pollination by bees, flies, hummingbirds, and butterflies has been reported (Aker & Healy 1990; Bayer 1998) (Named for Clas Alströmer, 1763–1794, Swedish naturalist and friend and pupil of Linnaeus, who sent Linnaeus seeds of the genus—Stinson 1942; Holmes 2002d)
REFERENCES: Stinson 1942; Uphof 1952; Aker & Healy 1990; Sanso 1996; Sanso & Xifreda 2001; Holmes 2002d.

Alstroemeria pulchella L.f., (pretty), PARROT-LILY. Erect perennial herb to ca. 90 cm tall, from tubers; stems leafy; leaves alternate, to 11 cm long and 3 cm wide, petiolate; leaf blades narrowly lanceolate to elliptic-spatulate on fertile stems, broader on sterile stems; petioles 2–4 cm long; inflorescences terminal, umbellate, with 3–8 flowers; pedicels 1.5–3 cm long; flowers slightly bilaterally symmetrical; tepals 6, distinct, red to wine, spotted purplish brown, greenish apically, 3.5–4.5 cm long; stamens 6; ovary inferior; capsules ± globose, to 1.3 cm long, many-seeded. Roadsides ("aggressive" colony—E. Keith, pers. comm.); Newton Co. (*Keith 717*, BAYLU); se U.S. from FL w to TX; since this species was added after map pages for the flora were completed, no county distribution map is provided. Spring–early summer. Native to Brazil. [*A. brasiliensis* Sprengel, *A. psittacina* Lehmann] This species is used as an outdoor ornamental in the deep south and has become naturalized (Holmes 2002d). It has been reported to spread rapidly and proven difficult to eradicate (Turner & Wasson 1999).

AMARYLLIDACEAE Juss.
AMARYLLIS OR DAFFODIL FAMILY

Bulbose perennials; leaves basal, sometimes not present at flowering time; inflorescence terminal, scapose, umbellate (technically a pseudoumbel resulting from the reduction of helicoid

cymes—Müller-Doblies 1977; Meerow & Snijman 1998), sometimes reduced to a single flower, subtended by bracts; flowers often showy; perianth of 6 similar, usually partly connate, petal-like segments (= tepals), an additional whorl of tepal-like tissue, the crown or corona, sometimes present within the tepals; stamens 6; filaments separate or connate; ovary inferior, of 3 carpels; style 1; placentation axile; fruit usually a capsule.

A medium-sized family (59 genera and ca. 850 species) of mostly bulbose, scapose perennial herbs (Meerow & Snijman 1998), often with showy flowers. While primarily tropical, the species are widely distributed, with centers of diversity in South America (28 genera, especially the Andes), Africa (19 genera), and the Mediterranean (8 genera); only *Crinum* (with water dispersed seeds) is found in both the Old and New worlds. Such a distribution supports a Gondwanan origin for the family, dating from a time when the southern continents were in close proximity (Raven & Axelrod 1974; Meerow & Snijman 1998). Ito et al. (1999), based on molecular evidence, found that the earliest branch of the family is African. They therefore suggested that the Amaryllidaceae originated in Africa, with South America as a secondary center of diversification. The family is rich in distinctive alkaloids, with at least one, pancratistatin, showing promise as an anticancer drug (Pettit et al. 1993, 1995). The Amaryllidaceae is economically most important for its ornamentals—*Narcissus*, *Leucojum*, and *Galanthus* are reported to be "among the most important temperate-zone spring-flowering bulbs in commerce" (Meerow & Snijman 1998), and *Amaryllis*, *Crinum*, *Cyrtanthus* (KAFFIR-LILY), *Eucharis* (AMAZON-LILY), *Haemanthus* (BLOOD-LILY), *Hippeastrum*, *Hymenocallis*, *Nerine* (GUERNSEY-LILY), and *Zephyranthes* are among the many other ornamentals (Judd et al. 1999). The genera have been variously treated in terms of family affiliation. Many authorities have put them in a very broadly defined and clearly polyphyletic (but practical) Liliaceae (e.g., Cronquist 1988; Diggs et al. 1999) based on superficial similarities of the flower structure to that of the genus *Lilium*, while others have treated them as a separate Amaryllidaceae variously delimited based on particular characters such as an inferior ovary (e.g., Correll & Johnston 1970) or an umbellate inflorescence subtended by bracts (e.g., Hutchinson 1934; Traub 1957a). Based on phylogenetic analyses (e.g., Fay & Chase 1996; Meerow et al. 1999 [2000], 2000b; Chase et al. 2000; Fay et al. 2000), we are following many recent authors (e.g., Mabberley 1997; Meerow & Snijman 1998) in recognizing the Amaryllidaceae as distinct and excluding such groups as the Alliaceae, Hemerocallidaceae, or portions of the Agavaceae, which have sometimes been included based on such characters as inflorescence similarities (e.g., Traub 1963a) or ovary position (Correll & Johnston 1970) (see further discussion under Alliaceae). As recognized here in a fairly narrowly defined sense, the Amaryllidaceae is a well-defined monophyletic group in the order Asparagales and most closely related to the Agapanthaceae, Alliaceae, and Hyacinthaceae (Fay & Chase 1996; Ito et al. 1999; Meerow et al. 1999, 2000b). As a member of this order, the Amaryllidaceae is more closely related to families such as the Agavaceae, Iridaceae, and Orchidaceae than it is to other taxa often put in a broadly defined Liliaceae (Chase et al. 1995a, 1995b, 1996, 2000; Fay et al. 2000). Unfortunately, family circumscription of the Amaryllidaceae is not yet settled—recently, the Angiosperm Phylogeny Group (APG II 2003) suggested either submerging the Amaryllidaceae into a very broadly defined Alliaceae or alternatively recognizing them as a separate family. It is now clear that the Amaryllidaceae and other members of order Asparagales have evolved many characteristics in parallel with families in order Liliales (Dahlgren et al. 1985). For a detailed discussion of the groups formerly treated as Liliaceae in the broad sense, see the family synopsis of the Liliaceae (here treated in a restricted sense) on page 726. Family name from *Amaryllis*, BELLADONNA-LILY, a genus now considered to be represented by a single South African species. (Greek: *Amaryllis*, a shepherdess, possibly from a root word meaning sparkling, in reference to the attractiveness of the flowers—Shosteck 1974) (subclass Liliidae—Cronquist; order Asparagales—APG II)

FAMILY RECOGNITION IN THE FIELD: scapose bulbose herbs with inferior ovaries, 6 stamens, usually showy flowers, and umbellate inflorescences subtended by bracts.

REFERENCES: Traub & Moldenke 1949; Traub 1957a, 1963a; Dahlgren et al. 1985; Meerow 1995; Fay & Chase 1996; Müller-Doblies & Müller-Doblies 1996; Meerow & Snijman 1998; Ito et al. 1999; Meerow et al. 1999, 1999 [2000], 2000a, 2000b.

1. Perianth bright red to salmon; introduced ornamental species rarely escaping.
   2. Leaves present or absent at flowering time; perianth lobes spreading but not strongly reflexed, ± broadly lanceolate to almost ovate; stamens not much exserted beyond perianth, ca. as long as perianth or less _____ **Hippeastrum**
   2. Leaves not present at flowering time (appearing after flowers have withered); perianth lobes strongly reflexed, noticeably narrow, almost linear; stamens much exserted beyond perianth, ca. 2 times as long as perianth _____ **Lycoris**
1. Perianth white to pink, yellow, or orange-yellow, sometimes the different flower parts of different colors; including common native species.
   3. Perianth with a corona (= an additional whorl of tepal-like tissue inside the tepals).
      4. Corona united with the filaments; perianth white, the lobes 6–11.5 cm long, many times (ca. 10) longer than wide; native species _____ **Hymenocallis**
      4. Corona not united with the filaments; all or part of perianth usually yellow (all white in 1 species), the lobes 1–4(–5.5) cm long, at most a few times longer than wide; introduced species _____ **Narcissus**
   3. Perianth without a corona.
      5. Perianth < 3 cm long, the segments white with yellowish green spot near tips, nearly free to base (tube absent); flowers nodding, 2–10 in an umbel _____ **Leucojum**
      5. Perianth 2–30.5 cm long (including tube), white to pink, yellow, or orange-yellow, the segments usually fused into an elongate tube 0.2–15.5 cm long (without a tube or essentially so in 1 species of *Zephyranthes*); flowers usually erect (outward curved to drooping in 1 species of *Crinum*), either solitary OR 2–12 in an umbel.
         6. Flowers (1–)2–12 in an umbel, the umbel subtended by 2 bracts; perianth very long, the free lobes 5–11 cm long; leaves present at flowering time, 1–7 cm wide _____ **Crinum**
         6. Flower solitary, subtended by a single bract; perianth lobes often (but not always) 4.5 cm or less long; leaves absent at flowering time OR if present, 0.1–1 cm wide.
            7. Perianth orange-yellow, 25–30 mm long (tube and lobes combined), with tube only ca. 2 mm long; stamens of four lengths _____ **Habranthus**
            7. Perianth white to pink, yellow, or orange-yellow (if yellow or orange-yellow, then perianth tube 5 mm or more long), the perianth length variable, but in most species more than 30 mm long (tube and lobes combined); stamens of two lengths.
               8. Flower white, sometimes with pink tinge or veins pink (a pale yellow-flowered species occurs just s of East TX); perianth tube elongate, (1.5–)3–18 cm long; stamens fasciculate (= in bundles or clusters); leaves often absent at flowering time _____ **Cooperia**
               8. Flower white to pink, yellow, or orange-yellow; perianth tube usually short, 0.1–2.4 cm long; stamens not fasciculate; leaves usually present at flowering time _____ **Zephyranthes**

COOPERIA Herb. RAIN-LILY

Bulbose, scapose, glabrous herbs, often flowering without leaves, 8–35 cm tall; scapes appearing quickly after rains (hence the common name); inflorescence a solitary terminal flower subtended by a conspicuous bract; flower erect, sessile or short-pedicelled, "night-blooming, opening in the afternoon or evening" (Correll & Johnston 1970) (but see note below under *C. pedunculata*); perianth white, sometimes pink-tinted outside or on veins (but can be yellow in species to the s of East TX), salverform to somewhat funnelform, with a conspicuously elongate tube and a spreading limb of similar sepal and petal lobes; stamens fasciculate, of two lengths; ovary inferior; capsule trilocular; seeds flat, black, D-shaped.

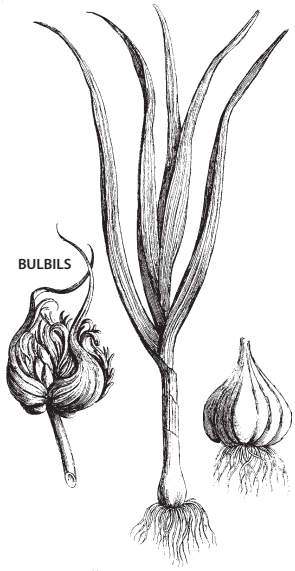
A small American genus of ca. 6–7 species (Correll & Johnston 1970) sometimes recognized as a subgenus of *Zephyranthes* (Traub 1963a) and recently submerged into that genus by some authors (e.g., Mabberley 1997; Meerow & Snijman 1998; Meerow et al. 2000b; Ward 2000; Flagg et al. 2002b). *Cooperia* can be distinguished by its fasciculate stamens and elongate perianth tube. Hybrids with *Zephyranthes* are known (Flagg & Flory 1976; Flagg et al. 2002b). However, molecular evidence (Meerow et al. 1999 [2000], 2000b) indicated that *Zephyranthes* is polyphyletic, with possibly three origins. Given this and the uncertainty of the future generic placement of *Cooperia* species, we are following Correll and Johnston (1970), Kartesz (1994, 1999) and Jones et al. (1997) in maintaining *Cooperia* as a distinct genus pending further study and clarification of nomenclature. ☠ Ingestion of *Cooperia* is thought to be a cause of photosensitization (= increased sensitivity to light, thus easily sunburned) observed in cattle in s TX; the specific toxin is unknown. Symptoms include reddening, swelling, edema, and sloughing and peeling of the skin (Burrows & Tyrl 2001). (Named for Daniel Cooper, ?1817–1842, an English botanist and gardener)
REFERENCES: Cory 1950a; Ward 2000; Flagg et al. 2002b.

1. Flower sessile, the ovary borne just above attachment of subtending bract; perianth tube (from base to where perianth begins to widen) greatly elongate, (3.4–)6–18 cm long; style > 40 mm long, longer than perianth tube.
   2. Style typically exceeded by the anthers or nearly so; species widespread in East TX _____ **C. drummondii**
   2. Style usually exceeding the anthers; species in East TX known only from Colorado Co. at s margin of area _____ **C. traubii**
1. Flower pedicelled, the ovary borne well above attachment of subtending bract (base of ovary usually 5–25 mm above bract attachment); perianth tube usually shorter, 2.2–4(–4.7) cm long; style < 35 mm long, shorter than perianth tube _____ **C. pedunculata**

Cooperia drummondii Herb., (for its discoverer, Thomas Drummond, 1780–1835, Scottish botanist and collector in North America), CEBOLLETA, RAIN-LILY, BRAZOS RAIN-LILY. Spring leaves 1–3(–5) mm wide; flowers white, sometimes with pink tinge or pink veins; perianth salverform, the limb nearly flat, ca. 1/4 as long as the long, slender, pedicel-like basal tube, the lobes 12–20 mm long, obtuse, rarely reflexed; stamens appearing equal in length. Prairies, lawns, roadsides, often on thin soils over limestone; widespread in TX except Panhandle; AL, AR, KS, LA, MS, OK, and TX. Jun–Oct, typically after a rain. [*Zephyranthes brazosensis* (Herb.) Traub, *Zephyranthes chlorosolen* (Herb.) D. Dietr., *Zephyranthes herbertiana* D. Dietr.] The flowers open in the late afternoon or evening (Kirkpatrick 1992). This species possibly causes photosensitization (= increased sensitivity to light, thus easily sunburned) in cattle (Burrows & Tyrl 2001). ☠ ⚅/283

Cooperia pedunculata Herb., (peduncled, stalked, or footed), GIANT RAIN-LILY, PRAIRIE RAIN-LILY, WHITE RAIN-LILY, WIDE-LEAF RAIN-LILY, EVENING STAR RAIN-LILY. Spring leaves 4–10 mm wide; flowers white, sometimes with pink beneath; perianth broadly funnelform, the limb about 1/2 or more as long as the narrowly cylindric basal tube, the lobes 25–30 mm long, each with an abrupt small point, rarely reflexed; stamens subequal. Rocky or sandy soils, prairies, roadsides, open woods; scattered in s part of East TX; scattered in s 1/2 of TX; FL, LA, and TX. Apr–Jul, typically a few days after heavy rains. [*Zephyranthes drummondii* D. Don.] According to Wills and Irwin (1961), the flowers "... open slowly around dusk or earlier on cloudy days, the lobes gradually spreading during the night, and appearing fully expanded the next morning. Ordinarily each flower lasts only one day, turning pale pink before withering, but in dull weather withering may not occur until the second day." Individuals "with rare biflowered inflorescences were collected by B.C. Tharp in 1930 and 1946 in Austin, Texas" (Flagg et al. 2002b). Dead leaves of this species (when wet after rains) are thought to cause photosensitization in cattle; microbiological activity may be involved (Burrows & Tyrl 2001; Hart et al. 2001). ☠ ⚅/283

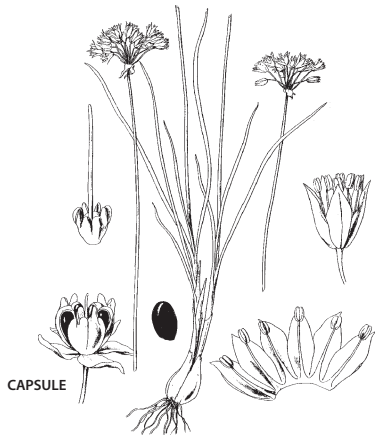
Cooperia traubii Hayw., (for H.P. Traub, 1890–1983, horticulturist and specialist in the Amaryllidaceae), TRAUB'S RAIN-LILY. Similar to *C. drummondii*, but more delicate in appearance; leaves only ca. 1 mm wide; flowers white, sometimes with pink tinge or pink veins; perianth



Allium sativum [ANO]



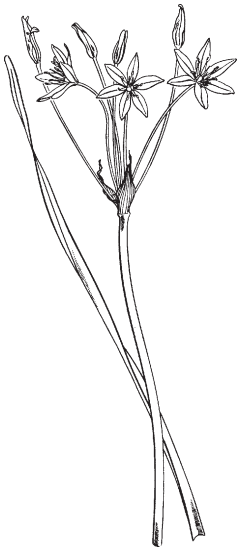
Allium vineale [GEO]



Allium stellatum [HO1]



Ipheion uniflorum [CHT]



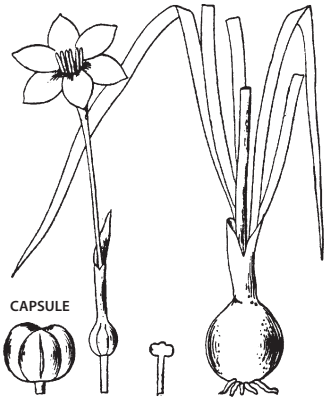
Nothoscordum bivalve [YAT]



Nothoscordum gracile [NIC]



Alstroemeria pulchella [BA3]



Cooperia drummondii [BB2]



Cooperia pedunculata [CUR]



Cooperia traubii [HEB]

salverform, the lobes often reflexed; stamens appearing equal in length. Low but well-drained grasslands; Colorado Co. (Carr 2001, 2002d) at extreme s margin of East TX; also Aransas, Brazoria, Colorado, Galveston and Refugio (Carr 2001, 2002d) cos. in the Gulf Prairies and Marshes; endemic to TX (Kartesz 1999; Carr 2002b, 2002c) or nearly so (also ne Mexico—Flagg et al. 2002b). Early summer–mid-fall. Flowers opening in the evening. This "poorly known" taxon "needs additional study" (Carr 2002b). (RARE 2001, 2002b: G3QS3)

Cooperia jonesii Cory, (for F.B. Jones, 1909–1995, author of *Flora of the Texas Coastal Bend*), JONES' RAIN-LILY. This species, known from just s of East TX, can be distinguished by its yellow perianth (vs. white in East TX *Cooperia* species); its fasciculate stamens and elongate perianth tube ((1.5–)3–12.6(–13) cm long) can distinghish it from similar yellow-flowered *Zephyranthes* species. Bee, Cameron, Goliad, Nueces, Refugio, San Patricio and Victoria (Correll & Johnston 1970) cos. in the Gulf Prairies and Marshes; endemic to TX (Kartesz 1999; Carr 2002b, 2002c; Flagg et al. 2002b). Mainly Jul–Oct. [*Zephyranthes jonesii* (Cory) Traub] Correll and Johnston (1970) speculated, and Flagg and Flory (1976) obtained evidence, that *C. jonesii* is a hybrid between *Zephyranthes pulchella* and *Cooperia drummondii*. Flagg et al. (2002b) indicated that this species is of conservation concern. (RARE 2001, 2002b: G3QS3)

CRINUM L. CRINUM-LILY, SPIDER-LILY

Scapose, glabrous, perennial herbs from a bulb; leaves basal, deciduous, broadly strap-shaped, sheathing each other basally and together forming a short stalk-like structure just above the bulb; scape slightly longer to slightly shorter than the leaves, solid, terminated by an umbel of usually (1–)2–12 flowers, the umbel subtended by 2 membranous bracts; perianth funnelform to salverform, with an elongate tube and 6 essentially equal perianth lobes, the tube ca. equal to or longer than the lobes; stamens 6; ovary inferior; fruit a capsule.

A genus of ca. 100 species (Holmes 2002a) of bulbiferous perennial herbs of tropical and warm areas (but with a center of diversity in sub-Saharan Africa) (Fangan & Nordal 1993; Meerow & Snijman 1998; Meerow et al. 2003). It is the only genus in the family found in both the Old and New Worlds (Meerow & Snijman 1998). A number of species are cultivated as ornamentals and some are used medicinally. (Greek: *crinon*, a lily, possibly from *crinos*, a comet or trailing hair, from the trailing (reflexed) perianth lobes—Hannibal 2002)
REFERENCES: Uphof 1942; Traub 1957b, 1962a; Moldenke 1962; Shirley 1963; Hannibal 1972; Verdoorn 1973; Holmes 1992, 2002a; Lehmiller 1987, 1993; Fangan & Nordal 1993; Meerow et al. 2003.

1. Flowers usually white, sessile or nearly so (pedicels 5 mm or less long), (1–)2–6(–7) per scape, erect or nearly so (floral tube straight); plant with elongate stolons _____ **C. americanum**
1. Flowers white to pink or reddish, with pink to red stripes, on pedicels (20–)40–60(–90) mm long, (5–)6–12(–rarely more) per scape, outward curved to drooping (the floral tube curved); plant not stoloniferous _____ **C. bulbispermum**

Crinum americanum L., (of America), FLORIDA CRINUM, SOUTHERN SWAMP-LILY, STRING-LILY, SEVEN-SISTERS. Bulbs to 7 cm wide; stolons delicate, to 85 cm long, allowing vegetative spread; leaves 3–14 per plant, deciduous with late winter frost, new leaves appearing in late Feb–early Mar; leaf blades broadly strap-shaped, to 120(–150) cm long, 1–7 cm wide; scapes to ca. 1 m tall, ranging from green to grayish green or (in late fall) with reddish pigmentation; flowers delicately fragrant, opening in early evening; perianth salverform, usually white, but the segments sometimes light pink on the outer surface, the tube 6–15.5 cm long, slender, greenish, the lobes (5–)7–15 cm long, 0.9–2.4 cm wide, reflexed at maturity; anthers linear, 1.7–2.4 cm long; capsules 2.5–4.5 cm long excluding the often prominent beak, buoyant; seeds 1–8 per fruit. Native *Crinum* species have been among the most confused of all East TX plants. For example, three taxa have been identified from exactly the same population by previous workers who had not

observed the plants in the field (Lehmiller 1987). Correll and Johnston (1970) listed 3 taxa of *Crinum* for TX. Likewise, Kartesz (1994) recognized *C. americanum* and 2 varieties of *C. strictum*. However, Lehmiller (1987, 1993) argued that all American *Crinum* are nearly homogeneous and proposed that "... all American *Crinum* be designated as *C. americanum* L. with geographic variations addressed under subspecies classification." Holmes (1992) also concluded that *C. strictum* "should be merged into *C. americanum*." While further research is needed, based on Lehmiller's extensive field observations and Holmes' (1992) analyses, it is probable that only a single variable species influenced by seasonal weather factors and local environmental conditions is involved. Two varieties of *C. americanum* are currently recognized by Holmes (2002a); they are not distinguished on the county distribution map.

1. Umbel with 2–5 flowers; leaves slightly shorter than scape; leaf blades pale green _____ var. **americanum**
1. Umbel with 6–7 flowers; leaves longer than scape; leaf blades dark green _____ var. **traubii**

var. **americanum**. Swamps, marshes, ditches, lake margins, in acidic clay muck, often beneath a dense canopy of cypress and gums; Hardin, Jefferson, and Liberty cos. (Lehmiller 1987) at margin of the Pineywoods and Gulf Prairies and Marshes; Lehmiller (1987) also reported *C. americanum* from the Sabine River at the TX-LA border (without specific county indicated, but probably Orange Co.); se U.S. from SC s to FL w to TX. (Mar–)Jun–Nov(–Dec). [*C. herbertianum* Schult. f., *C. strictum* Herb., *C. texanum* L.S. Hannibal] Lehmiller (1987) reported large populations of this species in the swamps along the Neches River within the Beaumont Unit of the Big Thicket National Preserve, extending s of Beaumont, and from the Trinity River 80 km w of Beaumont. Hummingbirds, bumble bees, and black moths have been reported as pollinators (Lehmiller 1987). /283

var. **traubii** (Moldenke) L.S. Hannibal, (for H.P. Traub, 1890–1983, horticulturist and specialist in the Amaryllidaceae). Swamps, marshes; known only from specimens grown from bulbs collected in Jefferson and Hardin cos. (Holmes 2002a); endemic to East TX. According to Holmes (2002a), this variety flowers from summer to autumn. [*C. strictum* Herb. var. *traubii* Moldenke] Based on extensive field studies of *Crinum* in the Neches River bottoms of the Big Thicket near Beaumont, Lehmiller (1987) concluded that only one taxon of *Crinum* grows there and noted that "both seasonal weather factors and local environment can induce marked variations in morphology." He further noted that the "degree of ecological sensitivity observed in native *C. americanum* makes any endeavor to differentiate individual varieties very suspect." Therefore, while we are tentatively recognizing var. *traubii* following Holmes (2002a), it is quite possible that this variety, known only from cultivated plants, is nothing more than a different morphological expression resulting from cultivation. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution, until additional information is available we consider this variety to be of conservation concern. ⚠

Crinum bulbispermum (Burm. f.) Milne-Redh. & Schweick., (with bulb-like seeds), HARDY SWAMP LILY, ORANGE RIVER LILY. Bulbs 7–13 cm wide; leaves to 80 cm long, 3–5(–rarely more) cm wide; scapes 40–90 cm tall; pedicels of different lengths; flowers sweetly fragrant; perianth funnelform, white to pink or reddish, with pink to red stripes, the tube 5–11 cm long, the lobes to 11 cm long. Cultivated, persisting and escaping in disturbed, often wet areas; Cherokee, Fayette, Houston, Leon, McLennan, Milam (BAYLU), Madison (TAMU), Brazos, Harris, Walker (Turner et al. 2003), and Grimes (M. Reed pers. obs.) cos.; also Gulf Prairies and Marshes, and Tarrant and Gillespie (Turner et al. 2003) cos. further w; FL, LA, NC, and TX. Spring–summer. Native of s Africa. [*Amaryllis bulbisperma* Burm. f., *C. longifolium* of authors, not (L.) Thunb.] /283

HABRANTHUS Herb. COPPER-LILY

A genus of ca. 30 species (Flagg et al. 2002a) of s South America, Mexico, and the s U.S. (Meerow & Snijman 1998), including some cultivated as ornamentals. It is related to *Zephyranthes*

(Meerow et al. 1999 [2000]), and *Habranthus* species have sometimes been included in that genus. However, *Habranthus* has somewhat bilaterally symmetrical flowers with fasciculate to semifasciculate filaments of 4 different lengths, while *Zephyranthes* has radially symmetrical flowers with nonfasciculate filaments of two lengths (Flagg et al. 2002a). Even when *Habranthus* is considered in a narrower sense (10 species of temperate South America—Mabberley 1997), our species (*H. tubispathus*) is still in the genus. (Greek: *habros*, graceful, delicate, or splendid, and *anthos*, a flower)

REFERENCES: Sealy 1937; Uphof 1946; Holmes & Wells 1980; Howard 1996; Diamond et al. 1998; Flagg et al. 2002a.

Habranthus tubispathus (L'Hér.) Traub, (tube-spathed), COPPER-LILY, RIO GRANDE COPPER-LILY, ATAMOSCO-LILY, STAGGER-GRASS,. Leaves basal, to 25 cm long, 3–4(–5) mm wide, appearing in autumn and withering by early spring; scape to ca. 30 cm tall, with 1 flower; pedicel about twice as long as the subtending involucral bract; flower bent forward to suberect; perianth usually 25–30 mm long, orange-yellow, sometimes with reddish tinge on outer surface, spreading-funnelform, with short (ca. 2 mm) basal tube; stamens of four lengths; filaments curving distally; ovary inferior; stigma trifid, with linear lobes; capsule subglobose, ca. 15 mm wide; seeds numerous, flat, black, D-shaped. Moist open areas, grasslands, lawns, roadsides; widespread in s part of East TX; also Gulf Prairies and Marshes and South TX Plains; also yard weed in Tarrant Co. (BRIT) in Cross Timbers and Prairies; AL, FL, LA, and TX. Jul–Oct, after rains. [*Amaryllis tubispatha* L'Hér., *H. texanus* (Herb.) Herb. ex Steud., *Zephyranthes texana* Hook.] Nearly identical forms of this species occur in Argentina, Chile, and Uruguay (Howard 1996). Sealy (1937) and Holmes and Wells (1980) suggested that *H. tubispathus* is native to South America and was introduced into TX in the late 1600s or early 1700s, possibly by Spanish missionaries. Howard (1996) disagreed and indicated that several other species share this disjunct distribution. Flagg et al. (2002a) stated that its origin is not clear, but he cited Diamond et al. (1998) who gave evidence for its introduction into AL in the late 1800s by seeds sent from TX. Based on its widespread occurrence in South America, we are tentatively considering the species to be introduced to the U.S., possibly in a manner similar to the AL introduction. ?☜ ⚙/287

HIPPEASTRUM Herb.

BARBADOS-LILY, NAKED-LADY, RED SPIDER-LILY, AMARYLLIS

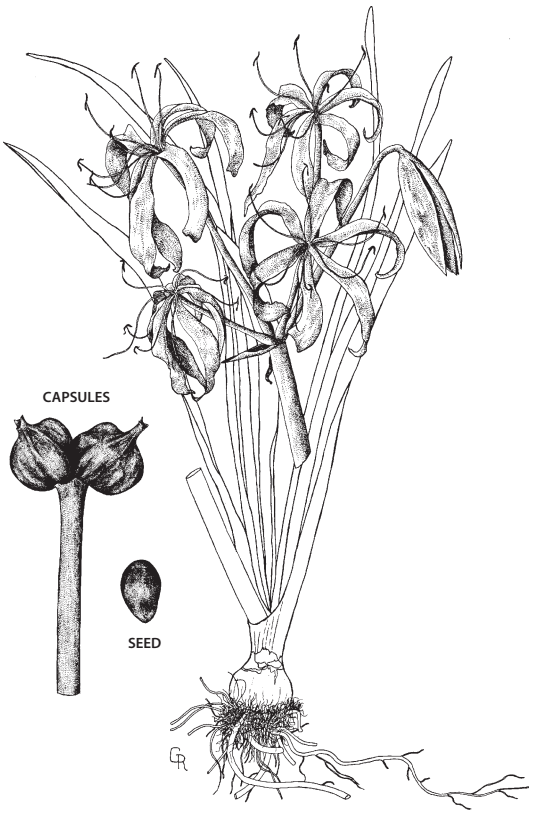
Glabrous scapose perennials from bulbs; leaves all basal; inflorescence umbellate, few-flowered; flowers showy; perianth of 6 tepals in 2 whorls, funnelform to campanulate, with a basal tube; stamens inserted on perianth tube; ovary inferior; fruit a capsule.

A genus of ca. 75 species (Holmes 2002b) of bulbose plants of West Indies, Central America, South America, and (1 species) w Africa, including narrow-leaved species sometimes separated as the genus *Rhodophiala*. A number are widely cultivated as ornamentals and numerous hybrids are known. Nomenclature in this group has been controversial—many species were originally named in the genus *Amaryllis*, but that genus is now treated as containing only the BELLADONNA-LILY, *A. belladonna* L., of South Africa (Goldblatt 1984; Meerow et al. 1997). (Greek *hippeus*, rider, and *astron*, star, the allusion obscure—Holmes 2002b)

REFERENCES: Sealy 1937; Traub & Moldenke 1949; Goldblatt 1984; Tjaden 1985; Brandham & Bhandol 1997; Meerow et al. 1997; Holmes 2002b.

1. Perianth ca. 5 cm or less long; plant flowering in Aug–Sep _____ **H. bifidum**
1. Perianth 12 cm or more long; plant flowering in spring to early summer _____ **H. puniceum**

Hippeastrum bifidum (Herb.) Baker, (divided into 2 parts), OXBLOOD-LILY, HURRICANE-LILY, SCHOOLHOUSE-LILY, FALL AMARYLLIS. Plant to ca. 30–40 cm tall; foliage present during fall, winter, and spring, absent in summer, appearing after the flowers; leaves linear, somewhat glaucous; flowers 2–4(–6) per naked stalk; perianth bright red, to ca. 5 cm long, the tube very short. Cultivated



Crinum americanum [GWO]



Crinum bulbispermum [HEB]



Habranthus tubispathus [CUR]



Hippeastrum bifidum [CAB]



Hippeastrum puniceum [LAM]

and persisting, possibly naturalizing; we are aware of non-cultivated East TX specimens only from Madison (Neill & Wilson 2001) and Walker (*Keith 599*, SBSC) cos.; this "German-Texas heirloom plant" is also reported to have naturalized in the German settled areas of central TX (SFASU Mast Arboretum 2001; Great Outdoors 2001) but no specific county records are available; in the U.S. reported only for TX. Aug–Sep. Native of Argentina and Uruguay. [*Amaryllis bifida* (Herb.) Spreng., *Habranthus bifidus* Herb., *Rhodophiala bifida* (Herb.) Traub] The common name HURRICANE-LILY is apparently derived from the tendency to flower suddenly in late summer or early fall following rains.

Hippeastrum puniceum (Lam.) Voss, (reddish purple), BARBADOS-LILY, AMARYLLIS. Bulb to 5–10 cm in diam.; plant to ca. 0.6(–1) m tall; foliage appearing after the flowers; leaves strap-like, (3–) 3.5–5 cm wide; flowers 2–4 per naked stalk; perianth reddish to salmon colored, lighter and/or yellowish green toward base, with whitish midstripe on adaxial surface of each outer tepal, large and showy, 12 cm or more long, the tube 2.5–3 cm long. Old home sites, disturbed areas, persisting and spreading; included based on mapped locality in the se corner of East TX (without specific county indicated) by Holmes (2002b); no county distribution map is provided; LA and TX. Spring–early summer. [*Amaryllis belladona* of authors, not L., *Amaryllis punicea* Lam.] This species is "the 'amaryllis' of commerce that is extensively cultivated outdoors in the southern United States and indoors elsewhere" (Holmes 2002b).

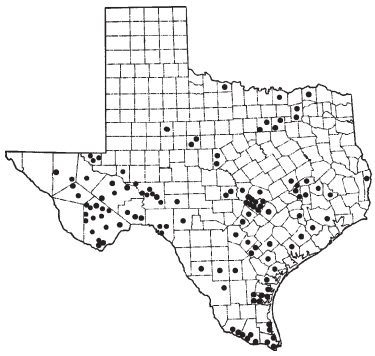
HYMENOCALLIS Salisb. WHITE SPIDER-LILY, SPIDER-LILY

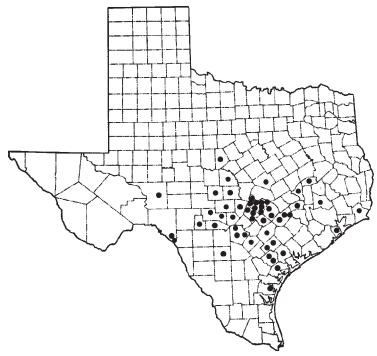
Glabrous perennials from a large bulb; leaves basal, strap-like, deciduous or persistent, distichous; inflorescence an umbel with 3–12 flowers, terminating a naked scape, subtended by 2 or more usually scarious bracts; flowers white, extremely large and showy, sweet scented, opening sequentially; perianth with a long slender tube and linear to narrowly lanceolate, spreading lobes (tepals); large, conspicuous, membranous, cup-like crown (= corona) present and connecting the bases of the filaments (the corona is actually a staminal cup created by the fusion and expansion of the proximal portion of the filaments—Smith & Garland 2003); distal portions of filaments free, "spidery"; fruit a few-seeded capsule.

A genus of ca. 50 species ranging from the se U.S. to ne South America, particularly in Mesoamerica (Meerow & Snijman 1998; Smith & Flory 2002); a number are cultivated as ornamentals. The bulbs of some species are poisonous due to the presence of alkaloids such as lycorine and tazettine (Lampe & McCann 1985; Spoerke & Smolinske 1990). *Hymenocallis* was used in early European medicine for treating tumors, and a number of species contain the alkaloid pancratistatin, which is now showing promise as an anticancer drug (Pettit et al. 1993, 1995). Smith and Flory (2002) and Smith and Garland (2003) emphasize that *Hymenocallis* species are particularly difficult to identify from herbarium specimens since many of the critical characters are lost upon drying. There has long been confusion surrounding SPIDER-LILY species in TX (e.g., Howard 1995; Smith & Flory 2001), and Smith and Flory (2002) "recommend a thorough investigation of *Hymenocallis* in Texas and adjacent states to achieve a clearer understanding of the southwestern spider-lily species." Shinners (1951a) indicated that there were only 2 *Hymenocallis* taxa in TX (one spring-flowering and one summer–fall-flowering), and his early analysis may have been correct. The following treatment is modified from Smith and Flory (2002). (Greek: *hymen*, a membrane, and *callos*, beauty, in reference to the corona)
REFERENCES: Small 1933; Morton 1935; Shinners 1951a; Sealy 1954; Traub 1962b; Howard 1995; Smith & Flory 2001, 2002; Smith & Garland 2003.

1. Plants flowering early–mid-spring (Mar–May); leaves fresh at flowering time, not distinctly wider above middle, narrowly elongate tongue-shaped, 1.7–3.6(–4) cm wide, coriaceous; perianth tube 4.5–8(–10.5) cm long; corona (= cup-like whorl of tepal-like tissue connecting filament bases) 2–3.5 cm long; free portion of filaments 1.5–3 cm long; plants of wet habitats _____ **H. liriosme**

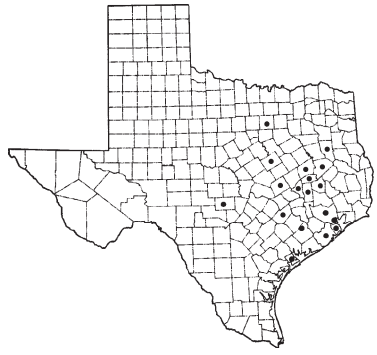

Nothoscordum gracile

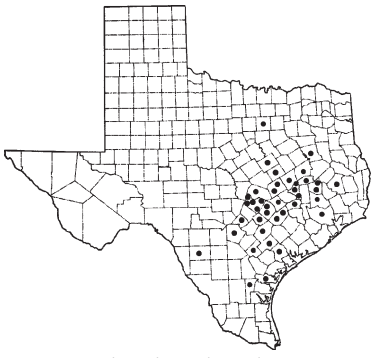

Cooperia drummondii


Cooperia pedunculata

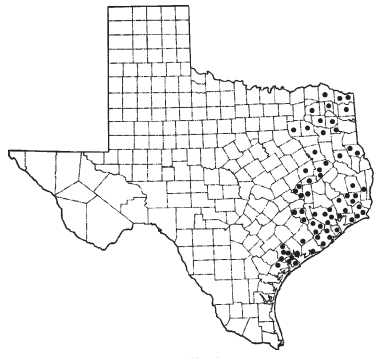

Cooperia traubii

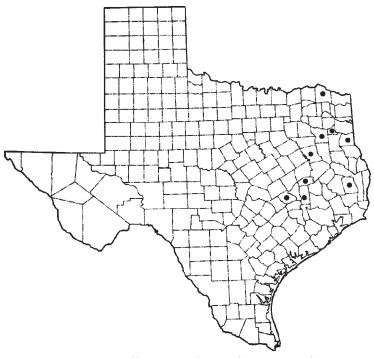

Crinum americanum


Crinum bulbispermum


Habranthus tubispathus


Hippeastrum bifidum


Hymenocallis liriosme


Hymenocallis occidentalis var. eulae


Leucojum aestivum


Lycoris radiata

1. Plants flowering summer–early fall (Jul–Sep); leaves withering before flowering time OR leaves fresh at flowering time, distinctly wider above middle before tapering toward end, narrowly oblanceolate in overall shape, 2–6 cm wide, ± not coriaceous; perianth tube 7–13.5 cm long; corona (2.5–)3.3–4(–4.5) cm long; free portion of filaments 2.5–4 cm long; plants of variable, but sometimes mesic habitats _____ **H. occidentalis**

Hymenocallis liriosme (Raf.) Shinners, (lily-smell or fragrant lily), SPRING SPIDER-LILY, WESTERN SPIDER-LILY, FRAGRANT SPIDER-LILY, WESTERN MARSH SPIDER-LILY, LOUISIANA MARSH SPIDER-LILY. Plant to 68(–88) cm tall; leaves shiny green; flowers (3–)5–12; perianth similar to that of *H. occidentalis* but slightly smaller, the tepals 6–9 cm long, 8 mm or less wide. Stream bottoms, ditches, pond margins, other wet areas, sometimes in shallow water; widespread in Pineywoods and e Post Oak Savannah; also n Gulf Prairies and Marshes; AL, AR, LA, MS, OK, and TX. Mar–May. [*H. caroliniana* of TX authors, not (L.) Herb., *H. galvestonensis* (Herb.) Baker, *H. galvestonensis* subsp. *angustifolia* Traub, *Pancratium liriosme* Raf.] Shinners (1951a) correctly recognized there was only one spring-flowering SPIDER-LILY in TX; unfortunately, later authors (e.g., Correll & Johnston 1970; Jones et al. 1997; Diggs et al. 1999; Turner et al. 2003) thought there were two species and called one of them *H. caroliniana*, a species whose type specimen is actually of a different species and even genus, *Pancratium maritimum* L. (Smith & Flory 2002). 🏵/289

Hymenocallis occidentalis (J. Le Conte) Kunth, (western), WOODLAND SPIDER-LILY, HAMMOCK SPIDER-LILY, NORTHERN SPIDER-LILY, SUMMER SPIDER-LILY. Plant similar to *H. liriosme*, (40–)50–75 cm tall; leaves glaucous when young; flowers 3–9; perianth extremely large and showy, the tepals white, green-striped on keel, (7–)8.5–11.5 cm long, 10 mm or less wide, the corona white with small yellowish green eye.

1. Leaves withering before flowering time _____ var. **eulae**
1. Leaves fresh at flowering time _____ var. **occidentalis**

var. **eulae** (Shinners) Ger. L. Sm. & Flory, (for Eula Whitehouse, 1892–1974, herbarium botanist and collector at Southern Methodist University, and author/artist of *Texas Flowers in Natural Colors* (1936), the first color-illustrated guide to TX wildflowers). Leaves appearing in late winter, withering in late spring before flowering, suberect; scape bracts 4–5 cm long. Sandy pine or mixed hardwood forests, in heavy soils near streams, seepage slopes; Shelby, Smith, Tyler (BRIT), Burleson (TAMU), Madison (Neill & Wilson 2001), Anderson, Gregg, Grimes, Panola, and Red River (Turner et al. 2003) cos.; OK and TX. Summer–early fall. [*H. eulae* Shinners] Smith and Flory (2002) indicated that this taxon is in need of additional study. 🏵/289

var. **occidentalis**. Leaves appearing in late winter, fresh at flowering and subsequently withering, arching outward; scape bracts 4.5–7 cm long. Floodplain forests, wooded hillsides, sometimes in upland mesic forests; according to Smith and Flory (2002) and Smith and Garland (2003), this taxon occurs widely in the e U.S. from NC s to FL w to IL, AR, and LA but not in TX. Turner et al. (2003) mapped *H. caroliniana* (a misapplied name) widely in East TX and the Gulf Prairies and Marshes. It is unclear whether they were referring to *H. liriosome* or possibly to *H. occidentalis* var. *occidentalis*. However, we have not seen any specimens that are unambiguously var. *occidentalis* and are thus only provisionally including this species for East TX; no distribution map is provided. Summer–early fall. [*H. caroliniana* of authors, not (L.) Herb.] This taxon has long been cultivated in southern gardens, and specimens "often have been identified as *H. caroliniana* (Linnaeus) Herbert on herbarium sheets and in floras" (Smith & Flory 2002). However, that name is now known to be a synonym of a different species (Smith & Flory 2002).

LEUCOJUM L. SNOWFLAKE

A genus of ca. 10 species (Straley & Utech 2002c) ranging from Europe to nw Africa and sw Asia; related to and sometimes confused with *Galanthus* (Meerow et al. 1999 [2000], 2000b). However, *Leucojum* has "perianth segments that are all equal in size, and hollow stems that are

usually taller and bear 2–5 [usually] flowers" (versus in *Galanthus* outer perianth segments larger than inner, and solid stems that bear 1 flower) (Straley & Utech 2002c). Several species are cultivated as ornamentals. ☠ The leaves and bulbs of *Leucojum* are reported to contain the alkaloids lycorine and galanthamine and to be poisonous (Straley & Utech 2002c). (Greek: *leucos*, white, and *ion*, a violet, in reference to the color and delicate fragrance of the flowers)
REFERENCES: Stern 1956; Webb 1980; Elliott 1992; Crespo et al. 1996; Straley & Utech 2002c.

Leucojum aestivum L., (summer), GIANT SNOWFLAKE, SUMMER SNOWFLAKE. Bulbose perennial; leaves broadly linear, to ca. 50(–70) cm long and 5–20 mm wide, surrounded at base by tubular sheaths, well-developed at flowering time; scapes (20–)35–60 cm tall, hollow, somewhat flattened and with 2 membranous wings; umbel with 2–7 nodding flowers, subtended by an apparently solitary, membranous bract 3–5 cm long; pedicels (1–)2.5–6(–7) cm long; perianth campanulate, without elongate perianth tube; corona absent; perianth segments 6, free nearly to base, all about equal, each white with yellowish green spot near the tip, (10–)1.5–2(–2.2) cm long; anthers longer than filaments; seeds 5–7 mm long, black, with testa (= seed coat) loose, forming air pockets. Cultivated and escaping; Dallas (BRIT) and Panola (ASTC) cos.; se Canada and widespread in e U.S. w to IL and TX. Mar. Native of Europe. Two other similar European species are cultivated and may persist in East TX: ☜

Leucojum vernum L., (spring), SPRING SNOWFLAKE, native of Europe, has the perianth segments all equal, flowers usually solitary, and whitish seeds. ☜

Galanthus nivalis L., (genus: Greek: *gala*, milk, and *anthos*, flower; sp.: of snow), SNOWDROP, COMMON SNOWDROP, has the inner perianth segments much shorter than outer, only the inner green-tipped, and flowers solitary. This European native is considered to be "one of the most popular of all cultivated bulbose plants" for cool temperate climates (Davis 1999). ☜

LYCORIS Herb. RED SPIDER-LILY

☁ A genus of ca. 20 species (Meerow & Snijman 1998), primarily e Asian, ranging from China, Korea, and Japan to Burma; cultivated as ornamentals. ☠ The bulbs of *Lycoris* species are poisonous due to the presence of the alkaloid lycorine (Lampe & McCann 1985). (Named after Lycoris, a beautiful Roman actress and mistress of Marc Antony)
REFERENCES: Traub & Moldenke 1949; Hsu et al. 1994; Tae & Ko 1996.

Lycoris radiata (L'Hér.) Herb., (with rays), SPIDER-LILY, RED SPIDER-LILY, HURRICANE-LILY. Bulbose perennial to ca. 50 cm tall; leaves 30–60 mm long, to ca. 8 mm wide, glaucous, not present with the flowers, appearing only after the flowers have withered; inflorescence a few-flowered umbel at end of a solid scape; flowers bright red, lacking fragrance; perianth ca. 4–5 cm long, the lobes reflexed and with wavy margins; stamens much-exserted, twice as long as perianth; ovary inferior; fruit a few-seeded capsule. Cultivated and long persisting or possibly escaping; Liberty Co. (Brown et al. 2002a), also known from a roadside ditch in Grayson Co. (G. Diggs, pers. obs.); scattered in the e U.S. in FL, IL, LA, MS, NC, SC, and TX. Fall (Oct). Native of China, Japan, and Korea. Poisonous (Lampe & McCann 1985). ☠ ☜ ⚅/291

NARCISSUS L. DAFFODIL, NARCISSUS

Bulbose, glabrous, scapose perennials with linear, flat or terete leaves exserted from closed tubular sheaths; inflorescence terminal, umbellate or the flower solitary, subtended by a membranous sheathing bract splitting along 1 side; flowers often sweet-scented, yellow and/or white; perianth united into a tube, this terminating in a central tubular or cup-shaped crown (= corona), the perianth lobes spreading to reflexed from the base of the corona; corona often ruffled at apex, often differently colored from perianth lobes; stamens often of 2 different lengths; fruit a many-seeded capsule.

A genus of ca. 26 species (Straley & Utech 2002d). A number of species (and their hybrids) of this Old World (Europe to n Africa and w Asia) genus are cultivated for their early spring flowers, and they are among the most popular garden plants (Huxley et al. 1992). The genus is difficult taxonomically because of the ease of hybridization (Hanks 2002) and the presence of numerous aneuploids and polyploids (Meerow & Snijman 1998). Several of the most frequently cultivated species and their hybrids, which long persist around old homesites or escape, are treated here. In the cut-flower trade, cultivars with long coronas are traditionally called DAFFODILS, while those with short coronas are referred to as NARCISSUSES (Burrows & Tyrl 2001). The leaves and bulbs have been known to cause toxic symptoms (e.g., nausea, vomiting, dizziness) or even death in humans, and even small amounts cause vomiting; livestock have also been poisoned when *Narcissus* bulbs were used as emergency food; toxins include a number of alkaloids (e.g., narcissine, lycorine) and possibly a glycoside. The bulbs and leaves can cause dermatitis in susceptible individuals. Raphides (= bundles of microscopic, needle-like calcium oxalate crystals) are also present in the bulbs and can cause mechanical injury to the mouth, throat, or hands by puncturing cell membranes (Kingsbury 1964; Schmutz & Hamilton 1979; Spoerke & Smolinske 1990; Turner & Szczawinski 1991; Foster & Caras 1994; Bruneton 1999; Burrows & Tyrl 2001; Julian & Bowers 2002). Narcissus oil (probably from *N. poeticus*) was used by the Greek Hippocrates as early as the 4th century B.C. for treating tumors, a use that was subsequently repeated in many cultures (Pettit et al. 1993). Interestingly, compounds (e.g., the alkaloid pancratistatin) from other members of the Amaryllidaceae are now showing promise as anticancer agents (Pettit et al. 1993, 1995). (Greek plant name derived from *narke*, numbness or torpor, from its narcotic properties; in Greek mythology the youth Narcissus fell in love with his own reflection in a pool and was turned into this plant by the gods.)

REFERENCES: Jefferson-Brown 1951; Meyer 1966; Brandham & Kirton 1987; Blanchard 1990; Hanks 2002; Straley & Utech 2002d.

1. Corona nearly as long as or slightly longer than lobes of perianth; perianth tube (below attachment of perianth lobes) broadly conical, about as long as lobes; flower 1 per flowering stalk _____ **N. pseudonarcissus**

1. Corona ca. 3/4 as long as lobes of perianth or shorter (often much shorter); perianth tube nearly cylindrical, slightly to much shorter than lobes; flowers 1–15(–20) per flowering stalk.
   2. Corona ca. 1/2–3/4 as long as perianth lobes; flowers usually yellow (but the corona can be a deeper yellow), 1-4 per flowering stalk.
      3. Leaves thick (subterete), grooved; flowers (1–)2–4 per flowering stalk, fragrant, usually uniformly bright yellow _____ **N. ×odorus**
      3. Leaves flat; flower 1 per flowering stalk, not fragrant, with the perianth lobes pale yellow and the corona orange-yellow _____ **N. ×incomparabilis**
   2. Corona 1/3 as long as perianth lobes or less; flowers white to yellow (but corona can be differently colored), 1–15(–20) per flowering stalk.
      4. Leaves thick, terete (= cylindrical) or nearly so and grooved on upper surfaces, green, 2–4 mm wide; flowers ± uniformly golden yellow _____ **N. jonquilla**
      4. Leaves flat or nearly so, mostly ± glaucous, 6–15(–20) mm wide; flowers EITHER with the perianth lobes conspicuously differently colored than the corona OR the perianth entirely white.
         5. Perianth entirely white; flowers (2–)5–15(–20) per flowering stalk _____ **N. papyraceus**
         5. Perianth lobes conspicuously differently colored than the corona; flowers 1–8(–15) per flowering stalk.
            6. Perianth lobes white; corona yellow with red rim; flowers usually 1 per flowering stalk _____ **N. poeticus**
            6. Perianth lobes white to cream; corona yellow to deep yellow, without red rim; flowers 2–8(–15) per flowering stalk _____ **N. tazetta**



Hymenocallis liriosme [HEA]



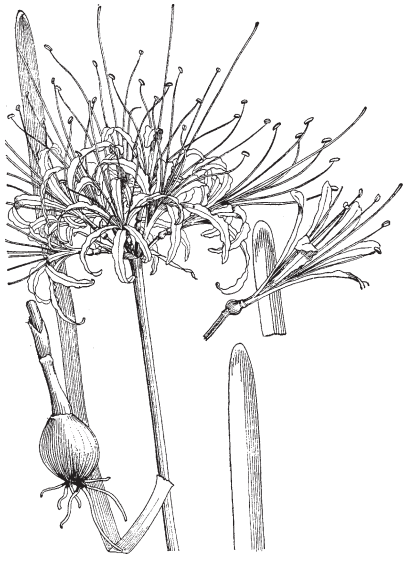
Hymenocallis occidentalis var. eulae [HEB]



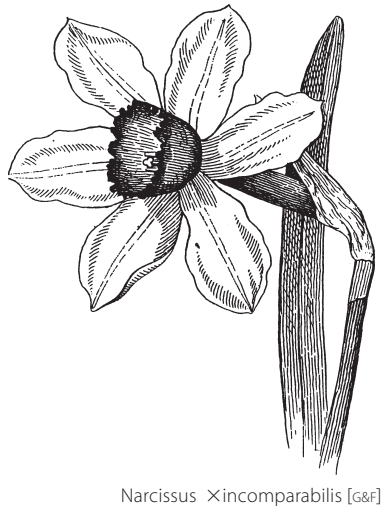
Leucojum aestivum [GLE]



Hymenocallis occidentalis var. occidentalis [NOV]



Lycoris radiata [SIN]



Narcissus ×incomparabilis [G&F]

Narcissus ×**incomparabilis** Mill. [*N. poeticus* × *N. pseudonarcissus*], (incomparable). Hybrid similar to *N. pseudonarcissus*; leaves 8–12 mm wide; perianth lobes 25–35 mm long; perianth tube 20–25 mm long; corona 13–22 mm long. Cultivated; no escaped specimens from East TX seen; included because it has been reported by Straley and Utech (2002d) as persisting in TX (location in TX not specified, but presumably in e part of the state) and because it is expected to be found persisting; no county distribution map provided; scattered in the e U.S. in KY, LA, MS, NC, NJ, NY, PA, TX, and VA, also OR. Mar. There are numerous forms, including many of the modern "fancy" types (Shinners 1958).

Narcissus jonquilla L., (from Spanish: *junquillo*, rush, for the slender leaves), JONQUIL. Leaves thick, terete (= cylindrical) or nearly so and grooved on upper surfaces, 2–4 mm wide; inflorescences (1–)2–5-flowered; pedicels unequal; flowers strongly fragrant; perianth usually uniformly colored or corona slightly deeper; perianth lobes 10–15 mm long; perianth tube slender, (17–)20–30 mm long; corona 2–5 mm long. Cultivated and long persisting; Grayson and Hunt (BRIT) cos.; se U.S. from NC s to GA w to AR and TX, also B.C. (Canada), IL, MD, OH, and UT. Feb–Mar. Native of sw Europe. This species is known to hybridize with *N. tazetta* to form *N.* ×*intermedius* Louisel, which has leaves intermediate in width, 3–6-flowered inflorescences, and flowers uniformly bright yellow or with the corona darker (Straley & Utech 2002d).

Narcissus ×**odorus** L. [*N. jonquilla* × *N. pseudonarcissus*], (fragrant), CAMPERNELLE JONQUIL. Hybrid resembling *N. jonquilla* (e.g., thick, grooved leaves) but with slightly larger flowers (perianth lobes to 25 mm long) and the corona ca. 1/2–3/4 as long as the perianth lobes; inflorescences (1–)2–4-flowered; flowers very fragrant. Occasionally cultivated; no escaped specimens from East TX seen; included because it has been reported by Straley and Utech (2002d) as persisting in TX (location in TX not specified, but presumably in e part of the state) and because it is expected to be found persisting; scattered in the se U.S. in LA, SC, TX, and VA; no county distribution map provided. The leaves and inflorescence distinguish it from another hybrid *N.* ×*incomparabilis* (flat leaves, inflorescence of 1 flower), which also has a corona 1/2–3/4 as long as the perianth lobes.

Narcissus papyraceus Ker Gawl., (papery or white as paper), PAPER-WHITE NARCISSUS. Leaves 6–15(–20) mm wide; flowers very fragrant; perianth lobes (8–)10–18(–25) mm long, white; perianth tube slender, 15–25 mm long; corona 2–4 mm long, white. Cultivated and long persisting; Brazos Co. (included based on personal observation by M. Reed of persistence; no county distribution map provided); CA, LA, and TX. Late winter–early spring or in fall if wet weather follows a dry summer. Native of w Europe, the Mediterranean region, and n Africa. While easily distinguished from *N. tazetta* when fresh, this species is difficult to separate based on herbarium specimens and was considered synonymous with *N. tazetta* by many early authors (Straley & Utech 2002d); it differs in having slightly larger, entirely white flowers.

Narcissus poeticus L., (pertaining to the poets), PHEASANT'S-EYE, POET'S NARCISSUS. Leaves 5–13 mm wide; flowers very fragrant; perianth lobes 15–30 mm long, white; perianth tube slender, 20–30 mm long; corona 1–2.5 mm long, yellow with a red, wavy margin. Cultivated; no escaped specimens from East TX seen; included because it is expected to be found persisting; no county distribution map provided; se Canada and widespread in the e U.S., also in w N.A. in B.C., UT, and WA. Mar–May. Native from France to Greece. The flowers are used in making perfume. This species is known to hybridize with *N. tazetta* to form *N.* ×*medioluteus* Mill. [*N. biflorus* Curtis], which is ± intermediate between the parents and has 2-flowered inflorescences, white to pale yellow perianth lobes, and a darker yellow, short corona (Straley & Utech 2002d).

Narcissus pseudonarcissus L., (false *Narcissus*), DAFFODIL, TRUMPET NARCISSUS. Leaves 5–15 mm wide, flat; flowers fragrant; perianth yellow (rarely white) with corona usually deeper yellow (rarely white); perianth lobes 18–40(–55) mm long; perianth tube broad, gradually flared, about



Narcissus jonquilla [NIC]



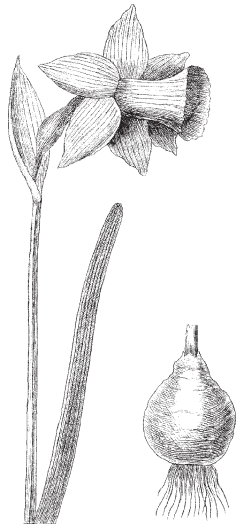
Narcissus ×odorus [CUR]



Narcissus papyraceus [CUR]



Narcissus poeticus [NIC]



Narcissus pseudonarcissus [LAM]



Narcissus tazetta [LAM]



Zephyranthes candida [BA1]



Zephyranthes grandiflora [CUR]



Zephyranthes pulchella [ARM]

12–20 mm long; corona (15–)30–35(–50) mm long. Cultivated and long persisting; Grayson and Hunt (BRIT) cos.; se Canada and widespread in the e U.S. w to IL and TX, also in w N.A. in B.C. and WA. Feb–Mar. Native of w Europe. This species is reported to be the most variable in the genus (Straley & Utech 2002d), with doubles, various color forms, and some with twisted flower parts (Bailey 1949).

Narcissus tazetta L., (small cup, from Italian word), POLYANTHUS NARCISSUS, BUNCH-FLOWERED NARCISSUS. Leaves flat, 6–15(–20) mm wide; flowers fragrant, perianth lobes 8–22 mm long, white to cream; perianth tube slender, 12–20 mm long; corona 3–6 mm long, yellow to deep yellow. Cultivated and long persisting, old homesites; according to Shinners (1958), this species and its hybrids frequently escape; Angelina, Brazos, Fannin, and Harrison (Turner et al. 2003) cos.; se U.S. from VA s to FL w to AR and TX, also CA and OR. Late Feb–Mar. Native of Mediterranean area. It is reported to have been cultivated since 1557 (Meyer 1966). This species is quite similar to *N. papyraceus* except for the color of the corona.

ZEPHYRANTHES Herb. ZEPHYR-LILY, RAIN-LILY

Bulbose, scapose, glabrous perennials, leaves linear, usually present at flowering time; inflorescence a solitary terminal flower subtended by a membranous sheathing bract; pedicel shorter than the subtending bract; flower erect to inclined, typically opening in the morning (Jones 1982); perianth with or without a tube, the tube, if present, usually short; stamens not fasciculate, of two lengths; stigma capitate or trifid; ovary inferior; fruit a many-seeded capsule.

A genus of ca. 50 species (in the narrow sense) ranging from the se U.S. to Argentina (Meerow & Snijman 1998); a number are cultivated as ornamentals. The related genus *Cooperia* is sometimes submerged into *Zephyranthes* and hybrids with that genus are known (Flagg & Flory 1976; Flagg et al. 2002b) (see further discussion under *Cooperia*). However, molecular evidence (Meerow et al. 1999 [2000], 2000b) suggests that *Zephyranthes* is polyphyletic, with possibly three origins. Given this and uncertainty about the future generic assignment of *Cooperia* species, we are following Correll and Johnston (1970), Kartesz (1994, 1999), and Jones et al. (1997) in maintaining *Cooperia* as a distinct genus, pending further study and clarification of taxonomy and nomenclature. When treated in the broad sense according to Flagg et al. (2002b), the genus has ca. 70 species. According to Correll and Johnston (1970) and Jones (1982), *Zephyranthes* species open their flowers in the morning, while *Cooperia* species open theirs in the afternoon or evening. The common name RAIN-LILY reflects the fact that flowering typically follows heavy rains (often within a week). (Greek: *zephyros*, the west wind, and *anthos*, flower, in reference to the origin of the genus in the western hemisphere—Huxley et al. 1992)
REFERENCES: Sealy 1937; Flagg 1961; Jones 1961; Spencer 1973; Flagg & Flory 1976; Arroyo 1986; Ward 2000; Flagg et al. 2002b.

1. Tepals buttercup yellow to orange-yellow ____ **Z. pulchella**
1. Tepals white to pink.
   2. Tepals white or white with a tinge of pink externally; perianth 4.5 cm or less long (tube and lobes); perianth tube absent or essentially so, 0.4 mm or less long; anthers 5–8 mm long ____ **Z. candida**
   2. Tepals pink; perianth 5.6–9 cm long (tubes and lobe); perianth tube (12–)18–23 mm long; anthers 13–22 mm long ____ **Z. grandiflora**

Zephyranthes candida (Lindl.) Herb., (shining or pure white), AUTUMN ZEPHYR-LILY, FAIRY-LILY, AUTUMN RAIN-LILY, PERUVIAN SWAMP-LILY. Bulbs ca. 2.5 cm in diam.; leaves to 20 cm long, 2–3 mm wide, persisting through winter (Flagg et al. 2002b); scape 10–30 cm tall; flower erect; perianth tube absent or essentially so (0.1–0.4 mm long); tepals white or white with a tinge of pink externally; stigma borne among or only slightly (< 2 mm) beyond the anthers. Weedy areas, sandy soils with humus; Angelina (*Holmes & Singhurst 12023*, BAYLU), Montgomery (Brown

2000), Anderson, Bexar, Jefferson, Liberty, and Van Zandt (Turner et al. 2003) cos.; also n Gulf Prairies and Marshes; se U.S. from NC s to FL w to TX. Sep–Oct. Native of Argentina and Uruguay. [*Amaryllis candida* Lindl., *Argyropsis candida* (Lindl.) M. Roemer, *Atamosco candida* (Lindl.) Sasaki, *Plectronema candida* (Lindl.) Raf.] In comparison with other *Zephyranthes* species, this taxon has thicker leaves that persist through winter and a different chromosome number—it has thus sometimes been separated into a segregate genus (i.e., *Plectronema*) (Flagg et al. 2002b).

Zephyranthes grandiflora Lindl., (large-flowered), ROSE-PINK ZEPHYR-LILY, PINK RAIN-LILY. Bulbs to 2 cm in diam.; leaves to 30 cm long and 7 mm wide; scape to 30 cm tall; flower ± erect to inclined at an upward angle; perianth tube (12–)18–23 mm long; tepals pink; stigma exserted beyond the anthers. In or near woods, moist open areas; included based on mapped location in Flagg et al. (2002b) near extreme s margin of East TX (without specific county); no county distribution map provided; AL, FL, LA, MS, and TX. Spring–early summer. Apparently native from Mexico to Guatemala and the West Indies. While Kartesz (1999) treated this species as a native, Flagg et al. (2002b) considered it introduced from Latin America. It is widely used as an ornamental and "frequently displays flowers with extra parts" (Flagg et al. 2002b).

Zephyranthes pulchella J.G. Sm., (pretty), SHOWY ZEPHYR-LILY, CEBOLLETA. Bulbs ca. 1–2 cm in diam.; leaves to 25 cm long and 3.5 mm wide; scape 10–35 cm tall; flower erect, unscented; perianth ca. 2–3 cm long, the tube usually 5–10 mm long; tepals buttercup yellow to orange-yellow; anthers 3–7 mm long; stigma usually borne among the anthers. Swales, ditches, or other low areas, sandy or clay soils; Bexar, Gonzales, Jefferson, and Wilson (Turner et al. 2003) cos. at s margin of East TX; also Gulf Prairies and Marshes and South TX Plains; endemic to TX (Carr 2002b, Carr 2002c) or nearly so (ne Mexico—Flagg et al. 2002b). May–Nov, usually after heavy rains.

Zephyranthes refugiensis F.B. Jones, (for Refugio Co., TX, where originally discovered), REFUGIO ZEPHYR-LILY, REFUGIO RAIN-LILY. This species, known from just s of East TX, can be distinguished by the combination of its elongate perianth tube (usually 12–24 mm long), light yellow tepals, and distinctly fragrant flowers. Perianth 2.5–5 cm long; stamens separate or semifasciculate; stigma usually among the anthers. Open swales or brushy pastures on tight sandy loam; s Goliad, Refugio, and San Patricio (Carr 2001, 2002d) cos.; endemic to TX (Kartesz 1999; Flagg et al. 2002b; Carr 2002b, Carr 2002c). Jul–Nov, usually after heavy rains. This species is reported to be the result of hybridization involving *Cooperia jonesii* and *Z. pulchella* (Flagg & Flory 1976, Flagg et al. 2002b). Flagg et al. (2002b) indicated that this species is of conservation concern. (RARE 2001, 2002b: G2G3S2S3)

ANTHERICACEAE J. Agardh
ST. BERNARD'S-LILY FAMILY

A medium sized family of 9 genera and ca. 215 species (Conran 1998; Cruden 1999), subcosmopolitan in distribution. Many authorities (e.g., Correll & Johnston 1970; Cronquist 1988; Kartesz 1999) have placed these plants in a broadly defined and clearly polyphyletic (but practical) Liliaceae based on superficial similarities of the flower structure to that of the genus *Lilium* (e.g., 6 perianth segments, 6 stamens, superior ovary). However, we are following Dahlghren et al. (1985), Conran (1998), Fay et al. (2000), and Reveal and Pires (2002) in recognizing the Anthericaceae in the order Asparagales and reasonably closely related to the Agavaceae, based on phylogenetic analyses. As such, it is more closely related to other Asparagales families including the Iridaceae and Orchidaceae than it is to many other taxa often put in a broadly defined Liliaceae (Chase et al. 1995a, 1995b, 1996, 2000; Fay et al. 2000). For a detailed discussion of the groups formerly treated as Liliaceae in the broad sense, see the family

synopsis of the Liliaceae (here treated in a restricted sense) on page 726. Recently, the Angiosperm Phylogeny Group (APG II 2003) recommended either including the Anthericaceae in the Agavaceae or in a very broadly defined Asparagaceae. Family name from *Anthericum*, ST. BERNARD'S-LILY, an Old World genus of ca. 65 species; a number of New World species previously included in *Anthericum* (see e.g., Correll & Johnston 1970) have now been put in *Echeandia*. (Greek: *anthos*, a flower, and *kerkos*, a hedge, in reference to the tall flower stems of some species) (subclass Liliidae—Cronquist; order Asparagales—APG II)
FAMILY RECOGNITION IN THE FIELD: the only species occurring in East TX (only on extreme w margin) is a lily-like subscapose herb from a corm and has yellow or yellow-orange flowers.
REFERENCES: López-Ferrari & Espejo Serna 1995; Chase et al. 1996; Conran 1998.

ECHEANDIA Ortega CRAG-LILY

A genus of ca. 80 species of sw North America to South America (Cruden 1999, 2002), particularly Mexico and Central America; a number were previously included in *Anthericum* (Cruden 1981). There are many narrow endemics (Cruden 1999). Some species have anthers in a cone and a number are reported to have the "vibrator" or "buzz" pollination syndrome, and to be pollinated by bumblebees (Bernhardt & Montalvo 1977, 1979; Conran 1998; Cruden 1999); for a discussion of this syndrome see the generic synopsis of *Polygonatum* in the Convallariaceae. (Named for Pedro Gregorio Echeandía, 1746–1817, Spanish botanist in Zaragoza—Cruden 2002)
REFERENCES: Cruden 1981, 1994, 1999, 2002; Cruden & McVaugh 1989.

Echeandia flavescens (Schult. & Schult.f.) Cruden, (yellowish), TORREY'S CRAG-LILY. Perennial subscapose herb from a corm; roots (modified for storage) fascicled, fleshy-fibrous, with thickened areas; leaves all basal or nearly so, grass-like, linear, to 30(–40) cm long, 0.5–4(–9) mm wide, the bases of old leaves persistent; scape glabrous or scabrescent only near base, with 0–3 bracts, these soon scarious; inflorescence simple and racemose or else paniculate and with 1–3 branches; flowers oriented upward or away from inflorescence axis; perianth yellow to yellow-orange, of 6 segments (7.5–)10–15(–17) mm long, these spreading to strongly reflexed; stamens 6; filaments scaled, the scales at right angles to filament axis; anthers free, 1.5–3(–3.5) mm long; ovary superior; style 1; fruit a dehiscent capsule 7–16 mm long. One small disjunct population of this typically more western species was discovered in 1998 by Chuck Sexton within the Balcones Canyonlands National Wildlife Refuge (Carr 2002a); the plants were in a grassy opening in juniper woodland; Travis Co. (*C. Sexton s.n.*, BCNWR; Carr 2002a); mainly Trans-Pecos; AZ, NM, TX. (May–)Jul–Oct. [*Anthericum flavescens* Schult. & Schult.f., *Anthericum torreyi* Baker, in part] This species "is a highly variable polyploid complex" ($2n = 16, 32, 48$) (Cruden 2002).

ARACEAE Juss.
CALLA, ARUM, OR AROID FAMILY

East TX species herbaceous, glabrous, rooted perennials with basal, simple or (in *Arisaema*) compound, entire leaves, or one species a free-floating, velvety hairy aquatic; inflorescence a fleshy spike (= spadix) with a highly modified leafy bract (= spathe) subtending or enclosing it (spathe very small at insertion of peduncle to rhizome in *Orontium*); spadix with staminate flowers in upper part and pistillate flowers in basal part, typically protogynous (= female flowers maturing first), or less commonly staminate and pistillate flowers on different plants; flowers very small, usually imperfect (perfect in *Orontium*); perianth lacking, of a few minute scales, or present but inconspicuous; staminate flowers with 1–10 stamens, their filaments very short or absent; pistillate flowers with superior ovary; fruit a berry.

A large (more than 3,300 species in 101 genera—Thompson 2000b; T. Croat, pers. comm.), nearly cosmopolitan but mainly tropical and subtropical family of perennial herbs, vines, epiphytes,

hemiepiphytes, and aquatics (Croat 1988 [1990], pers. comm.). A number are used as food crops and many species are valued as ornamentals. Food crops include the edible starchy corms of *Colocasia* (TARO), *Xanthosoma* (TANIER), and *Alocasia macrorrhiza* (L.) G. Don (UPRIGHT ELEPHANT-EARS). Ornamentals include *Anthurium* (PAINTER'S PALETTE), *Caladium*, *Dieffenbachia* (DUMB-CANE), *Monstera*, *Philodendron*, *Pothos*, *Spathiphyllum* (PEACE-LILY or WHITE-SAILS), and *Zantedeschia* (CALLA-LILY). According to Croat (1994), the Araceae is the most important family for indoor foliage plants in North America. ☠ Many Araceae have tissues containing raphides (= bundles of microscopic, needle-like calcium oxalate crystals) which are sometimes barbed and grooved and which reportedly cause injury to the mouth, throat, or hands by puncturing cell membranes (Prychid & Rudall 2000; Burrows & Tyrl 2001). However, properly cooked plants which still contain the crystals generally do not cause irritation—therefore, the reaction is apparently caused at least in part by other compounds (Thompson 2000b). The plants are also often cyanogenic or contain alkaloids, free oxalic acid, proteolytic enzymes, or other toxins; some are potentially fatally poisonous (McIntire et al. 1992; Woodland 1997). *Philodendron*, one of the most popular house plants in the U.S., has raphides and questionable unidentified proteins and can cause painful burning to the mouth and throat, as well as contact dermatitis. Some reports suggest the leaves, if ingested, are highly toxic to cats; the plants should not be left within reach of children or pets (Lampe & McCann 1985; Spoerke & Smolinske 1990; Burrows & Tyrl 2001). *Dieffenbachia* (DUMB-CANE), another common house plant, contains raphides and the alkaloid protoanemonine. Ingestion causes burning, hypersalivation, and swelling of the tongue, pharynx, and larynx, and can result in death through suffocation. The common name is derived from its ability to cause speech to become slurred and unintelligible, or even to paralyze the vocal cords and render speech impossible. It is believed that the stems and leaves of DUMB-CANE were used in the Caribbean to punish and silence rebellious slaves (Morton 1982; Foster & Caras 1994; Bruneton 1999). Members of Araceae are pollinated by insects, some by flies attracted by the odor of carrion (e.g., in *Amorphophallus* with huge inflorescences). In some genera (e.g., *Arisaema, Arum*) there is a "kettle trap" pollination mechanism (Mayo et al. 1998) by which pollinators are trapped for some period of time in the kettle-like spathe (thus increasing the probability of pollen transfer). Some species of Araceae can produce heat in the inflorescences (thermogenesis), which volatilizes odors to attract pollinators (Proctor et al. 1996; Bown 2000). The genus *Acorus*, traditionally placed in the Araceae, is here recognized in the Acoraceae. The Lemnaceae (DUCKWEED family) is considered by many authorities to have evolved from within the Araceae by neotenous reduction (= retention of juvenile characteristics in a mature organism), and it has been suggested that Lemnaceae be reduced to a subgroup within a more inclusive, monophyletic Araceae. As currently treated, the Araceae may thus be paraphyletic and from the cladistic viewpoint inappropriate for formal recognition (French et al. 1995; Mayo et al. 1995, 1997, 1998; Stockey et al. 1997). For more information see discussion under the genus *Pistia*. Molecular analyses (e.g., Fuse & Tamura 2000; Chase et al. 2000; Soltis et al. 2000) indicate that Araceae are phylogenetically near the base of the monocotyledons—Acoraceae are the sister group to all other monocots, with Araceae (and Alismataceae and other Alismatales) in the next most basal clade. Family name from *Arum*, a genus of 26 species of Europe and the Mediterranean area. (Greek: *aron*, the classical name of these plants, possibly derived from Arabic: *ar*, fire (Bown 2000), in reference to the burning caused by ingestion of some species) (subclass Arecidae—Cronquist; order Alismatales—APG II)

FAMILY RECOGNITION IN THE FIELD: herbaceous perennials (also 1 floating aquatic) with numerous very small flowers on an often finger-like *spadix* subtended by a sheath-like *spathe*; leaves usually basal, with expanded blades, often with net venation.

REFERENCES: Birdsey 1951; Wilson 1960; Plowman 1969; Jacobsen 1985; Nicolson 1987b; Ray 1987, 1988; Bown 1988, 2000; Croat 1988 [1990], 1994; Grayum 1990, 1992; Bogner & Nicolson 1991; French et al. 1995; Mayo et. al. 1995, 1997, 1998; Thompson 1995, 2000b; Bogner 1997[1998]; Croat 1998.

1. Plants free-floating aquatics; leaves 3–15 cm long, velvety hairy, sessile; spathes ca. 15 mm long; pistillate flower solitary at base of inflorescence _____ **Pistia**
1. Plants rooted in soil (even when in water); leaves often much longer than 15 cm, not velvety hairy, usually petioled (sessile in *Acorus*); spathes much longer than 15 mm (apparently absent in *Orontium*); pistillate or perfect flowers several to many per inflorescence.
   2. Leaves compound with 3–15(–21) leaflets _____ **Arisaema**
   2. Leaves simple.
      3. Leaves sessile, the blades narrow (0.5–2.5 cm wide), broadly grass-like and parallel-veined; spadix diverging laterally from an elongate leaf-like structure _____ **Acorus** (see Acoraceae)
      3. Leaves petioled, the blades broad (usually much greater than 2.5 cm wide—sometimes less in *Cryptocoryne*), not at all grass-like, either parallel-veined or net-veined; spadix subtended by or enclosed by a spathe OR spadix terminal.
         4. Leaf blades relatively small, 3–9(–15) cm long, (1–)1.5–3.5(–4) cm wide, usually with brownish, reddish, or purplish coloration at least on the veins, neither bluish green nor with a velvety sheen; introduced aquatic known in East TX only from the San Marcos River in Hays Co. at the extreme w margin of the area _____ **Cryptocoryne**
         4. Leaf blades usually relatively large, 6–90 cm long, 3–ca. 90 cm wide, with various coloration, but if at the small end of this size range then bluish green with velvety sheen; including species widespread in East TX.
            5. Spathe apparently absent (spathe very small at insertion of peduncle to rhizome); leaf blades cuneate (= wedge-shaped) at base, not at all cordate, sagittate, nor hastate ___ **Orontium**
            5. Spathe well-formed, subtending or enclosing the spadix; leaf blades either cordate, sagittate, or hastate at base.
               6. Leaf blades peltate (the notch at base of blade not as deep as attachment of petiole), usually with a red or purplish spot on the upper surface distal to where the petiole attaches to the blade; spathes yellow to orange _____ **Colocasia**
               6. Leaf blades not peltate, without a purplish spot; spathes cream white to peach OR green with pale to white or yellow-green margins.
                  7. Plants with a tuberous corm at base and with well-developed, horizontal, elongate rhizomes; spathes cream white to peach; leaf blades (larger ones) to 120 cm long and 90 cm wide; longer petioles 1.8–2 m long; introduced species ___ **Xanthosoma**
                  7. Plants with only thick fibrous roots, without a tuberous corm or horizontal rhizomes; spathes green with pale to white or yellow-green margins; leaf blades to only ca. 50(–59) cm long and 15(–30 cm) wide; longer petioles to only ca. 0.6(–1) m long; native species _____ **Peltandra**

ARISAEMA Mart. JACK-IN-THE-PULPIT, GREEN-DRAGON

Herbaceous, monoecious or dioecious perennials from a corm; leaves 1–2(–3), with sheathing bases and 3–15(–21) leaflets, ± net-veined; inflorescence a spadix at the end of a scape; scape usually shorter than petioles; spathe sheath-like or with a tube and limb; spadix long-exserted or included, the distal portion not flower-bearing; flowers without perianth; staminate flowers above the pistillate on the spadix or staminate and pistillate flowers on different plants; fruits 1–few-seeded, red or orangish red berries, 10–13 mm in diam.

A genus of ca. 170 species (Thompson 2000b) of e Africa, Arabia, tropical and e Asia, and North America. All parts of *Arisaema* plants contain microscopic crystals of calcium oxalate (and possibly also toxins), which if eaten are reported to disrupt cells and cause extreme burning and swelling of the mouth and throat (Stephens 1980; Cheatham & Johnston 1995). Native Americans used the properly prepared (cooked, dried, etc.) ground corms of both East TX species as flour (Yatskievych 1999). Individuals of *Arisaema* species demonstrate significant morphological variability (e.g., some plants are many times larger than others); the result

has been disagreement over the taxonomy of the group. The ability of plants to change sexual expression is well known in the genus (e.g., *A. dracontium* and *A. triphyllum*), with changes correlated with plant size and environmental conditions (e.g., Schaffner 1922; Lovett-Doust & Cavers 1982a, 1982b; Bierzychudek 1984; Clay 1993; Dieringer & Cabrera R. 2000; Ruhren & Handel 2000; Richardson & Clay 2001). Smaller individuals are typically staminate, while larger ones have both staminate and pistillate flowers or pistillate only (Thompson 2000b). In addition, a change in sexual expression can be induced experimentally by changing the amount of leaf area or by modifying environmental factors such as soil nutrient levels (Thompson 2000b). The common name JACK-IN-THE-PULPIT is derived from the spadix (= "jack") being enclosed in the "pulpit"-like spathe. (Greek: *aris*, a kind of arum, and *haima*, blood, from the red-spotted leaves of some species)

REFERENCES: Schaffner 1922; Huttleston 1949, 1981, 1984; Treiber 1980; Lovett-Doust & Cavers 1982a, 1982b; Murata 1990; Clay 1993; Boles et al. 1999 [2000]; Dieringer & Cabrera R. 2000; Richardson & Clay 2001; Guzman & Guzman 2002; Diggs & O'Kennon 2003.

1. Primary leaf of mature plants divided into (5–)7–15(–21) unequal leaflets (sometimes some of the divisions not completely separated into leaflets); summit of spathe with inrolled margins; spadix long-exserted beyond the spathe, tapering to a long slender point; fruit cluster conical _____ **A. dracontium**

1. Primary leaf of mature plants divided into 3 or 5 leaflets; summit of spathe flat, the margins not inrolled; spadix included, not exserted beyond the spathe, apically blunt; fruit cluster ovoid or subglobose _____ **A. triphyllum**

Arisaema dracontium (L.) Schott, (Greek name for a kind of arum, presumably from *draco*, dragon), GREEN-DRAGON, DRAGON-ROOT, GREEN-JACK. Leaf usually solitary, divided into (5–)7–15(–21) unequal and sometimes asymmetrical leaflets (sometimes some of the divisions are not completely separated into leaflets), these in a ± semi-circular arrangement (very young plants can have the primary or only leaf with only 3 leaflets); spathe sheath-like, the summit with margins inrolled, tapering to a slender point; spadix 8–15+ cm long, the sterile portion long-exserted; fruits orangish red. Low woods, moist slopes; Pineywoods and Gulf Prairies and Marshes w to Cross Timbers and Prairies and e Edwards Plateau; se Canada and throughout e U.S. w to MN and TX. Late Apr–May. Both diploids ($2n = 28$) and tetraploids ($2n = 56$) are known, and reproduction is reported to occur both clonally (offsets from the corm) and sexually (Boles et al. 1999 [2000]; Yang et al. 1999). The rust fungus *Uromyces ari-triphylli* (Schwein.) Seeler sometimes causes conspicuous lesions on GREEN-DRAGON in East TX (J. Hennen, pers. comm.). The tissues contain injurious calcium oxalate raphides (Lampe & McCann 1985). ☠ ⚄/276

Arisaema triphyllum (L.) Schott, (three-leaved), JACK-IN-THE-PULPIT, INDIAN-TURNIP, INDIAN CHERRIES. Leaves 1 or 2, often 2 on flowering individuals, with 3 or 5 leaflets; spathe with a tube and a limb, the summit arching over the spadix, the margins not inrolled; spadix 3.5–8(–9) cm long, not exserted; fruits red. Moist to wet woods, moist slopes, swampy areas, and bogs. Mar–May. Detailed study of these extremely variable plants led Huttleston (1949, 1981, 1984) to conclude that the variation seen in the JACK-IN-THE-PULPITS was best represented taxonomically by recognizing a single species with 4 subspecies (2 of which are treated here). He indicated that "...plants of the four subspecies are very distinctive and readily identified, at least in living condition. Since many of the key characteristics...are obscured or lost during drying, it is not always possible to identify herbarium specimens to subspecies." Treiber (1980) recognized 3 subspecies (2 in TX) and synonymized the 5-leaved form [subsp. *quinatum*] with subsp. *pusillum* (Peck) Huttl. Because "much overlap occurs in expression of the characteristics supposedly defining infraspecific taxa," because numerous intermediate forms exist, and because the ranges of the subspecies overlap, Thompson (2000b) recently recognized a single variable species without subspecies. Still more recently, Guzman and Guzman (2002) followed Treiber (1980) in submerging

subsp. *quinatum* into subsp. *pusillum*, but they noted that they had not seen living material of plants with 5 leaflets. Geraldine Watson (pers. comm.) noted that in the Big Thicket the two local forms are recognizable both morphologically and by habitat (subsp. *quinatum* in drier situations) and are distinct enough to be separate species. While the taxonomy of this complex is not settled, because two kinds are recognizable in East TX, we are following the in-depth treatments by Huttleston (1981, 1984) in recognizing two subspecies in East TX (not distinguished on the county distribution map). However, hybridization between the subspecies (Huttleston 1984), morphological intergradation, and sympatry of the subspecies over a large portion of their ranges (Treiber 1980) do make the recognition of a single variable species without varieties or subspecies (Thompson 2000b) an attractive option. Individual plants are long-lived, with a life span of 15–25 years (Bierzychudek 1982). Vegetative reproduction by means of stolons is apparently common (Treiber 1980; Guzman & Guzman 2002). The fleshy fruits are eaten and dispersed by birds and probably also mammals (Bierzychudek 1982). Pollination by fungus gnats (order Diptera; family Mycetophilidae) (Treiber 1980) and thrips (small insects in the order Thysanoptera) (Rust 1980) has been reported in this species. The corms were used as food and medicine by Native Americans but can be eaten only after special preparation (Guzman & Guzman 2002). The tissues contain injurious calcium oxalate raphides (Lampe & McCann 1985).

1. Primary leaf divided into 5 leaflets (the lateral lobes sometimes not completely separated into leaflets); spathe blade ovate with apiculate tip, unmarked green or yellow-green; distal portion of spadix 2 mm or less in diam., bent, cylindric _____ subsp. **quinatum**
1. Primary leaf divided into 3 leaflets; spathe blade broadly lanceolate to broadly ovate with acute to acuminate tip, usually marked with purple or red-brown; distal portion of spadix > 3 mm in diam., straight, cylindric or usually somewhat clavate (= club-shaped) _____ subsp. **triphyllum**

subsp. **quinatum** (Buckley) Huttl., (in fives). While the primary leaf is divided into 5 leaflets, the typically smaller secondary leaf often has 3 leaflets. Moist woods, in similar, but often somewhat drier habitats than subsp. *triphyllum*; Cherokee, Jasper, Liberty (BRIT), Hardin (TAMU), San Jacinto (TAES), Angelina, Nacogdoches, Sabine, and San Augustine (ASTC) cos., Pineywoods; se U.S. from NC s to FL w to TX. [*A. quinatum* (Buckley) Schott]

subsp. **triphyllum**. Lateral leaflets occasionally lobed on the outer margins. Moist woods, widespread in the Pineywoods; also n Gulf Prairies and Marshes; recently a large disjunct population was discovered in Parker Co. in the Cross Timbers and Prairies (*O'Kennon 16024*, BRIT); se Canada and throughout e U.S. w to ND and TX. [*A. atrorubens* (Aiton) Blume] This is by far the most common subspecies in TX; large variable populations are sometimes observed (e.g., in Cass Co.). The Parker Co. population, disjunct from East TX by 140 miles (225 kilometers), occurs in a "rockhouse" microhabitat between sandstone/conglomerate rock walls. Few inflorescences were observed in this population, which is apparently reproducing primarily by vegetative means. This occurrence probably represents an "Ice Age holdover" (MacRoberts & MacRoberts 1997a) from a colder and wetter period of the Pleistocene when vegetational areas were shifted considerably to the south and west (Diggs & O'Kennon 2003; also see Kral 1966c, Delcourt & Delcourt 1993, and the introduction in this volume (page 209) for a discussion of glacial influences on plant distribution). Interestingly, another species known from this same Parker Co. location, *Carya ovata* (SHAG-BARK HICKORY), is also disjunct from the e part of East TX. Such persistence in climatically moderated "rockhouse" environments has been documented for a variety of plant species in the e U.S., including some endemics (e.g., Walck et al. 1996; Farrar 1998). /276

COLOCASIA Schott TARO, DASHEEN, COCO-YAM, ELEPHANT'S-EAR

A tropical Asian genus of 7 species (Thompson 2000b) of tuberous herbs with peltate leaves; some species are used as ornamentals and for food. All parts of *Colocasia* species, except the



Narcissus jonquilla



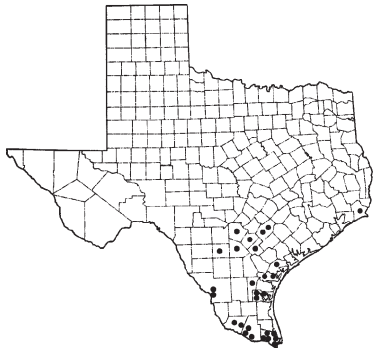
Narcissus pseudonarcissus



Narcissus tazetta



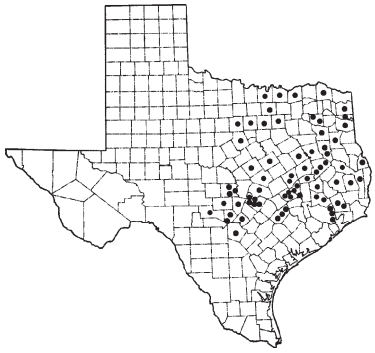
Zephyranthes candida



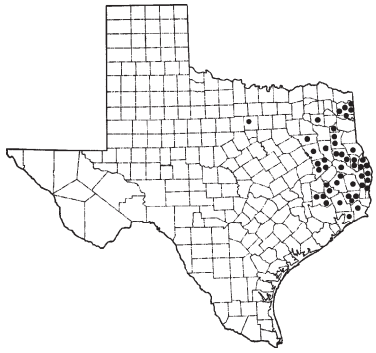
Zephyranthes pulchella



Echeandia flavescens



Arisaema dracontium



Arisaema triphyllum
(both subsp.)



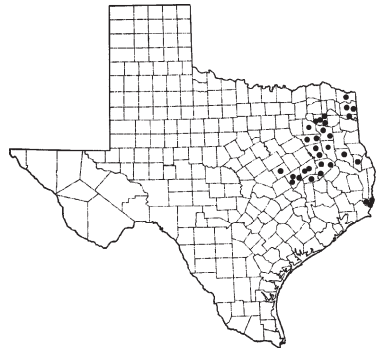
Colocasia esculenta



Cryptocoryne beckettii



Orontium aquaticum



Peltandra virginica

corm (when properly prepared) and leaves (again, with proper preparation), contain calcium oxalate crystals (and possibly also toxins) which can cause burning and swelling of the mouth and throat and even death (Schmutz & Hamilton 1979). The common name DASHEEN is "said to be a corruption of the French *du Chine*, 'from China' " (Shosteck 1974). (Greek: *kolokasia*, derived from Arabic: *colcas* or *culcas*, the terms originally used for the edible roots of *Nelumbo nucifera* Gaertn.—water lotus, and "thus applied to *Colocasia* because of its edible tubers"—Serviss et al. 2000)

REFERENCES: Greenwell 1947; Arridge & Fonteyn 1981; Wang 1983; Tahara et al. 1999a, 1999b; Ochiai et al. 2000; Serviss et al. 2000.

Colocasia esculenta (L.) Schott, (edible), TARO, WILD TARO, ELEPHANT'S-EAR, KALO, DASHEEN, EDDO, COCO-YAM, MALANGA. Large perennial with large tuber-like corm and scale-covered, well-developed, elongate, sometimes tuberous rhizomes (often emergent from the soil and becoming stoloniferous); leaves all basal; leaf blades to 70 cm long and 40 cm wide, ± ovate, cordate to sagittate or hastate at base, peltate—the notch at base not as deep as attachment of petiole, the upper blade surface usually with a red or purplish spot above where the petiole attaches and often with a velvety sheen, with midvein and lateral veins even with or minutely raised above adjacent blade tissue; petioles usually longer than leaf blades; spathe convolute, (10–)20–35 (–40) cm long, constricted between the inflated tube and expanded blade, yellow to orange; spadix terminated by a short or long sterile appendage; fruits and seeds not observed in TX material, the fruits reported to be orange; both diploid ($2n = 2x = 28$) and triploid ($2n = 3x = 42$) forms are known (Tahara et al. 1999a). Cultivated as an ornamental and apparently spreading in wet areas; Bell (specimens collected in 1997 from a large population along Salado Creek, including a flowering individual), Dallas, Liberty, Polk, Travis (Town Lake; huge population—G. Diggs, pers. obs.) (BRIT), Henderson (BAYLU), Hays (San Marcos River—Arridge & Fonteyn 1981), and Guadalupe (Turner et al. 2003) cos., extensively naturalized along Turtle Creek in Dallas (R. O'Kennon, pers. obs.); according to Serviss et al. (2000), this species occurs throughout "most of eastern Texas"; also Edwards Plateau; se U.S. from NC s to FL w to TX. Summer–Sep. Native of tropical Asia. An important foodstuff for more than 2,000 years (Plowman 1969), this widely cultivated species has numerous varieties and hundreds of forms or land races (Serviss et al. 2000). Three of the varieties are reported (Serviss et al. 2000) as occurring in East TX: var. *aquatilis* Hassk., var. *antiquorum* (Schott) Hubb. & Rehd., and var. *nymphaeifolia* (Vent.) A.F. Hill. However, these "three varieties intergrade appreciably in form and ecology and probably encompass only a single, highly variable taxon" (Serviss et al. 2000). We are therefore not recognizing varieties in this treatment. Worldwide, in terms of food production, this species is the most important member of the Araceae (Serviss et al. 2000); approximately 400 million people include TARO in their diets (Bown 2000). It is widely grown in the tropics for the starchy, edible (when appropriately cooked), tuberous corm and young leaves, and it was apparently first brought into the U.S. as a food for slaves. It was subsequently cultivated by the Dept. of Agriculture throughout the southeast, including East TX. In Hawaii it is eaten as "poi," a fermented paste made from crushed cooked corms (Greenwell 1947; Arridge & Fonteyn 1981; Ivancic & Lebot 1999; Thompson 2000b). Taro chips, made from the corms, are now available in many East TX grocery stores as a snack food. However, all parts of the plant except the corms (when properly prepared) contain calcium oxalate crystals and possibly also toxins (Schmutz & Hamilton 1979). ☠ ☞ ⚅/282

CRYPTOCORYNE Fisch. ex Wydl. WATER-TRUMPET

A genus of ca. 50–60 species of rhizomatous, often stoloniferous marsh and water plants found throughout most of tropical Asia from India and China to the Philippines and New Guinea (Reumer 1984; Mayo et al. 1997, 1998; Ørgaard & Jacobsen 1998; Bastmeijer 2003). The inflorescences are reported to "give off a dung-like scent; this attracts insects, which crawl

down the inside of the [tubular] spathe, where they become trapped and pollinate the female flowers" (Brickell & Zuk 1997). Ørgaard and Jacobsen (1998) have studied pollination in the group and determined that the pollinators (flies) are attracted by a carrion-like odor. A further elaboration of this "trap-escape mechanism" are down-pointing hairs inside the spathe which prevent insects from climbing out before they have collected pollen from the later-maturing male flowers. After the male flowers mature and the pollen is released, the hairs collapse, permitting the insects to escape and thus carry out the pollen. Additionally, a thin layer of mucilage on the inner surface of the lower part of the spathe ("kettle") has been suggested as a food source/reward for pollinators. Many species are cultivated as ornamental aquarium plants, some are grown on a large scale for this purpose, and *Cryptocoryne* is one of the best known aroid genera from an aquarist's viewpoint (Bown 2000). The following description is slightly modified from Nicolson (1987a) and Rosen (2000). (Greek: *kryptos*, hidden, and *korynê*, club, the spadix being hidden from view inside the spathe—Mayo et al. 1997)
REFERENCES: Jacobsen 1976, 1977; Reumer 1984; Graaf & Arends 1986; Nicolson 1987a; Ørgaard & Jacobsen 1998; Rosen 2000; Doyle 2001; Bastmeijer 2003.

Cryptocoryne beckettii Thwaites ex Trimen, (for T.W. Beckett, 1839–1906, a coffee planter who collected plants in Sri Lanka), WATER-TRUMPET. Perennial, rhizomatous, emergent-submerged, evergreen herb; leaves basal, with elongate sheathing petioles to 15 cm long; leaf blades glabrous, ovate to narrowly ovate, 3–10(–15) cm long, (1–)1.5–3.5(–4) cm wide, the upper surface green to dark green to brown and marbled to red-brown, the lower surface red-tinged to more or less brownish or green, the veins usually conspicuously red or purplish, the apex acute to acuminate, the base obtuse to cordate, the margins entire, sometimes undulate; submerged specimens mostly with larger, thinner leaves, often brownish marbled; inflorescence (not seen in TX material) short peduncled; spathe 4–13(–20) cm long, the limb greenish brown, narrowly ovate, 0.5–1.2 cm wide, 1.5–3 cm long, upright to somewhat recurved and twisted; spadix 1 cm long; $2n = 28, 42$ (Reumer 1984). Exposed bottom in open shallow riffles and shaded deep pools of the San Marcos River in the city of San Marcos; in TX known only from Hays Co. at extreme w edge of East TX; reported as first collected in TX in 1996 (Rosen 2000); no other North American records were reported by either Kartesz (1999) or Thompson 2000b—except for this TX locality, the species is apparently unknown from North America. Data not available on flowering in TX. Native of Sri Lanka (Jacobsen 1976). Rosen (2000) suggested that the occurrence in the San Marcos River is probably the result of escape from cultivation or the dumping of aquaria. This species has the potential to spread rapidly, and it poses a threat to *Zizania texana* (TEXAS WILD RICE) (Doyle 2001), an endangered species which is known only from the upper San Marcos River. *Cryptocoryne beckettii* should be designated as a noxious weed and is symbolized as such here; Doyle (2001) recommends eradication while it is still possible.

ORONTIUM L. GOLDEN-CLUB

A monotypic genus endemic to e North America. The common name derives from the golden yellow spadix borne at the end of a scape. (Classical name for a water plant growing in the Syrian river Orontes)
REFERENCES: Wilson 1960; Grear 1966; Klotz 1992.

Orontium aquaticum L., (growing in or under water), GOLDEN-CLUB. Aquatic perennial herb with thick rhizomes buried in mud; leaves all basal, long-petioled (petioles to 40+ cm long); leaf blades simple, oblong-elliptic, 6–30(–45) cm long, 3–16 cm wide, bluish green with distinctive velvety sheen, cuneate at base, prominently parallel-veined, entire, emergent or often floating (waxy and readily shedding water and with large intercellular air spaces); spadix on an elongated scape, bright golden yellow, oblong, 2–5(–10) cm long, with a band of white below the flowers; spathe apparently absent (actually a very small spathe is present at the insertion of

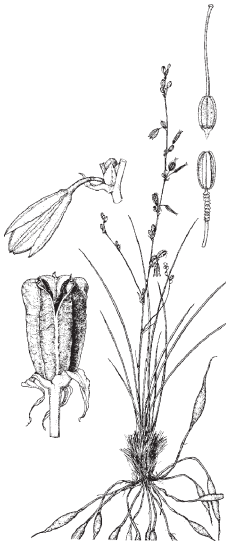
peduncle to rhizome; flowers usually perfect, variable; perianth segments 2–6; stamens 1–6 (1–2 staminodes sometimes present); pistil usually 1; fruit a blue-green, 1-seeded berry ca. 10–20 mm in diam. Shallow water, moist banks; Polk Co. (BRIT) in the Pineywoods; e U.S. from NY s to FL w to TX. Apr–Jun. When properly prepared (boiled repeatedly, etc.), the rhizome and seeds are reported to be edible (Mabberley 1997), and the seeds were eaten by Native Americans (Thompson 2000b). Feb–Jun. Thompson (2000b) suggested that this is probably the most distinctive species of Araceae in North America, citing the absence of a spathe and the characteristic blue-green velvety leaves. The presence/absence of a spathe in this species is controversial. According to Ray (1988), the sheath at the base of the peduncle, with only a bract-like blade, is not morphologically equivalent to the spathe of other members of the family; T. Croat (pers. comm.), however, considers this structure to be a spathe. This species is sometimes cultivated as an ornamental (Thompson 2000b). While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠ ▩/293

PELTANDRA Raf. ARROW ARUM

A genus of 2 species endemic to e North America (Thompson 2000b); some authorities (e.g., Blackwell & Blackwell 1974 [1975]) believe there is only a single variable species. (Greek: *pelta*, shield, and *andr*, man, in reference to the shield-shaped tops of the staminate flowers—Thompson 2000b)

REFERENCES: Blake 1912; Goldberg 1941; Wilson 1960; Blackwell & Blackwell 1974 [1975]; Patt et al. 1995.

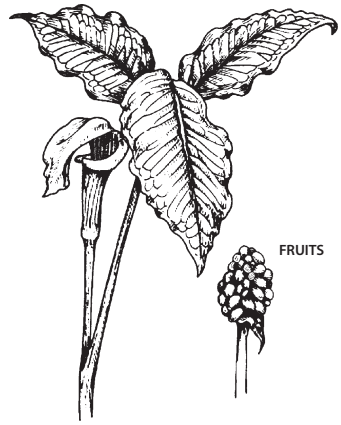
Peltandra virginica (L.) Schott, (of Virginia), VIRGINIA ARUM, TUCKAHOE, GREEN ARUM, ARROW ARUM, GREEN ARROW ARUM. Perennial monoecious herb from thick fibrous roots; leaves clustered on short stems; petioles to ca. 0.6(–1) m long; leaf blades highly variable in shape and size, to 50(–59) cm long and ca. 15(–30) cm wide (usually small in comparison to those of *Xanthosoma*), with 3 main veins, entire, somewhat glaucous beneath or not glaucous, ± sagittate or hastate, with basal lobes varying from short and rounded to long and pointed; scape nearly equaling the petioles in length at flowering time; spathe green with pale to white or yellow-green margins, ca. 10–20 cm long, open distally or almost throughout, the lower part persistent and enclosing the spadix in fruit; spadix white to cream, yellow, or orangish, from shorter than to nearly as long as spathe, completely covered by flowers or only the apex naked, the lower portion pistillate, the upper portion staminate, with sterile flowers between; perianths absent; staminate flowers with 4–5 connate stamens forming a flat-topped synandrium; berries ca. 6–18 mm in diam., green to brownish or dark purple-green, with 1–2(–4) seeds surrounded by gelatinous material. Bogs, swamps, and other wet areas; Cherokee, Henderson, Houston, Leon, Robertson, San Augustine, Smith (BRIT), Anderson, Marion, Wood (TAES), Nacogdoches (ASTC), Bowie (BAYLU), Van Zandt (Kral 1955), Cass, Falls, Madison, and Orange (Turner et al. 2003) cos., Pineywoods and Post Oak Savannah; also n Gulf Prairies and Marshes; se Canada and throughout e U.S. w to MN and TX, also naturalized in CA and OR. Apr–May. [*P. tharpii* F.A. Barkley] Pollination is by a chloropid fly; the flies use VIRGINIA ARUM inflorescences as mating and brood sites, with both adults and developing larvae feeding on pollen (but not damaging ovules or seeds); this type of pollination system has been referred to as the "androecial brood-site pollination syndrome" (Patt et al. 1995; Thompson 2000b). Fruits and seeds of this species are eaten by wildlife, especially waterfowl. Migratory birds are thought to be an important factor in dispersal (Thompson 2000b). The roasted starchy roots were formerly used as food by Native Americans (Mabberley 1997); they are reportedly poisonous until properly prepared by cooking (Yatskievych 1999). The common name TUCKAHOE is one of the few Native American plant names still widely used; it was written about by Captain John Smith (Durant 1976).



Echeandia flavescens [MCV]



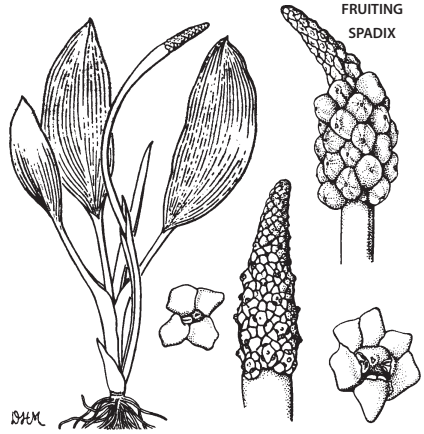
Arisaema dracontium [YAT]



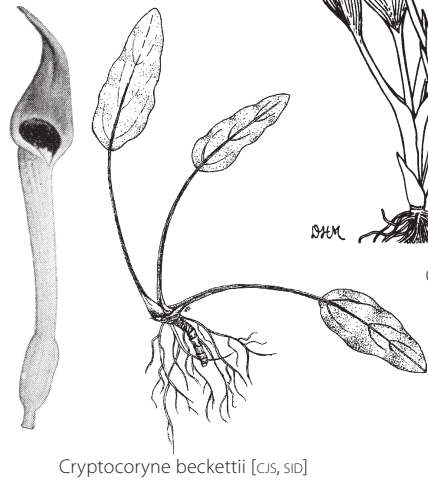
Arisaema triphyllum subsp. triphyllum [YAT]



Colocasia esculenta [NIC]



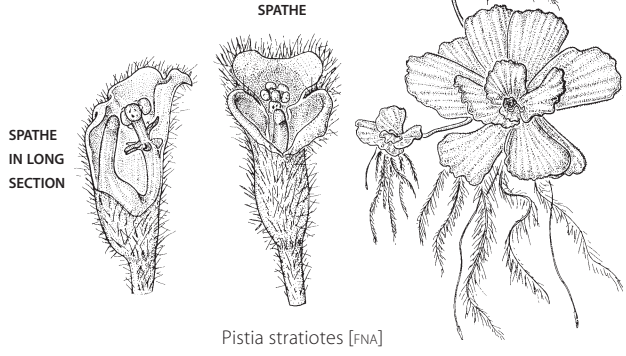
Orontium aquaticum [JAA]



Cryptocoryne beckettii [CJS, SID]



Peltandra virginica [CO1, YAT]



Pistia stratiotes [FNA]

PISTIA L. WATER-LETTUCE, SHELLFLOWER, WATER-BONNET

A monotypic genus of tropical and subtropical regions worldwide. The leaves are nearly horizontal during the day, but move to a more vertical position at night. The leaf hairs create a water-repellent surface. This aquatic genus seems to be an evolutionary link between the Araceae and the Lemnaceae (DUCKWEED family). Kvacek (1995) suggested that the fossil genus *Limnobiophyllum* is a fossil link between Araceae and Lemnaceae, and Stockey et al. (1997), using a cladistic approach and material of *Limnobiophyllum,* concluded that *Pistia* plus *Limnobiophylum* and Lemnaceae form a monophyletic group, and that the Lemnaceae "is a monophyletic group imbedded within the Araceae." The Araceae thus appears paraphyletic when the Lemnaceae is removed. Stockey et al. (1997) suggested that if Lemnaceae is recognized as a distinct family, *Pistia* should be "regarded as the basal genus in the family Lemnaceae, rather than a genus of the Araceae." *Pistia* is cultivated as an aquatic ornamental. (Greek: *pistos*, water or liquid, or *pistra*, water trough, referring to its aquatic habitat)

REFERENCES: Kvacek 1995; Stoddard 1989; Stockey et al. 1997; Lemon & Posluszny 2000a.

Pistia stratiotes L., (soldier), WATER-LETTUCE, SHELLFLOWER, WATER-BONNET. Monoecious free-floating herb; roots long, feathery, hanging; leaves clustered in rosettes, entire, gray-green, velvety hairy, strongly ribbed lengthwise, cuneate to obovate-cuneate, to ca. 3–15(–20) cm long, truncate to emarginate at apex; spathes axillary, inconspicuous, ca. 15 mm long; spadix with staminate flowers in a whorl above, the solitary pistillate flower below; perianth absent; fruits brownish. Streams, lakes, and ponds; San Jacinto (BRIT), Jefferson (TAES), Colorado, Comal, and Hays (Turner et al. 2003) cos. near s margin of East TX; also apparently spreading from cultivation in creeks in Tarrant Co. (at the Fort Worth Botanic Garden) in the Cross Timbers and Prairies and in the Gulf Prairies and Marshes and Edwards Plateau; sporadically scattered across s 1/3 of the U.S. from NC s to FL w to CA, also NY (Kartesz 1999). The species does not tolerate salinity or frost (Stoddard 1989), and Thompson (2000b) indicated that the populations in FL, LA, and TX are probably the only ones that persist. The species is widespread in the tropics and subtropics, and while there is disagreement as to whether *Pistia* is native to the U.S., "available evidence suggests it is indigenous" (Thompson 2000b). Spring. This species can become a pest in some regions by occupying areas of open water, and in TX it is considered a "harmful or potentially harmful exotic plant"; it is illegal to release, import, sell, purchase, propagate, or possess this species in TX (Harvey 1998). In some areas (e.g., the Nile River system in Africa) the species is responsible for sudd formation ("sudd" is Arabic for obstruction); this term refers to large mats of floating vegetation which impede river navigation (Bown 2000). Since its nativity is in question and it is illegal to possess it in TX, we are denoting it symbolically as a potentially harmful exotic. Despite being called WATER-LETTUCE, this species contains oxalates and possibly other toxins; intense irritation of the mouth, throat, and upper digestive tract from eating even small amounts has been reported (Morton 1982). ⊘ ☠ ▣/293

XANTHOSOMA Schott YAUTIA, ELEPHANT'S-EAR, TAHITIAN-SPINACH

A tropical American genus of 57 species of herbs with milky sap and sagittate or hastate leaf blades; some are cultivated as ornamentals and for food. ☠ Nearly all parts of a number of species are injurious due to the presence of calcium oxalate crystals and possibly a toxic alkaloid; ingestion can cause burning, swelling, and blistering of the mouth, throat, and digestive tract. Fatalities have been reported; even tasting small amounts can cause serious reactions (Morton 1982; Lampe & McCann 1985). (Greek: *xanthos,* yellow, and *soma,* body, alluding to the yellow inner tissues of some species)

REFERENCES: Lemke & Schneider 1988; Loh et al. 2000; Serviss et al. 2000.

Xanthosoma sagittifolium (L.) Schott, (arrow-leaved), ELEPHANT'S-EAR, ARROW-LEAF ELEPHANT'S-EAR, YAUTIA, TANNIA, TANIA, COCO-YAM. Large perennial herb from a tuberous corm; well-devel-

oped rhizomes present, without a scaly covering (in contrast to *Colocasia*), the rhizomes often tuberous at various places; aerial stems developing with age (in tropical areas); foliage similar to that of *Colocasia* but leaves not peltate; leaf blades to 120 cm long and 90 cm wide, sagittate at base, with 3–9 pairs of main lateral veins, the upper blade surface with midvein and lateral veins sunken below adjacent blade tissue; petioles longer than blades, to ca. 2 m long; spathe 18–22 cm long, convolute, constricted between the inflated tube and expanded blade, pale green to glaucescent, becoming cream white to peach with age; spadix 6–13 cm long, without a sterile tip. Apparently spreading from cultivation, in wet areas, those in water surviving the winter (the species has only minimal cold tolerance—Serviss et al. 2000); included based on citations for Blackland Prairie by Hatch et al. (1990) and Bell Co. (Fort Hood—Sanchez 1997) near margin of Blackland Prairie and Cross Timbers and Prairies; also on the Edwards Plateau; FL and TX. Oct. Native to West Indies. Grown there and in the tropics as an ornamental and for its edible (after cooking) corms and specially prepared young leaves—in some areas it is a staple source of carbohydrates (Huxley et al. 1992). Serviss et al. (2000) cite a source (Vaughn & Geissler 1997) noting that the species has been cultivated in the neotropics since pre-Colombian times. However, the sap is reported to be an irritant, and as with other *Xanthosoma* species, the plant should be considered toxic unless one has thorough knowledge of proper preparation techniques (Kingsbury 1964; Morton 1982).

ARECACEAE Juss.
(PALMAE Juss.) PALM FAMILY

A large (ca. 2,500 species in 191 genera—Zona 2000), nearly cosmopolitan but mainly tropical, often conspicuous family of usually unbranched, evergreen trees, shrubs, or lianas. The Arecaceae contains a number of economically important plants including *Areca catechu* L. (BETEL NUT), *Bactris gasipaes* Kunth (PEACH PALM or PEJIBAYE), *Calamus* species (RATTAN), *Cocos nucifera* L. (COCONUT PALM), *Copernicia prunifera* (Mill.) H.E. Moore (CARNAUBA WAX PALM), *Elaeis guineensis* Jacq. (OIL PALM), *Phoenix dactylifera* L. (DATE PALM), *Phytelephas macrocarpa* Ruíz & Pav. (VEGETABLE-IVORY or TAGUA), *Roystonea regia* (Kunth) O.R. Cook (ROYAL PALM), and *Washingtonia filifera* (L. Linden) H. Wendl. (CALIFORNIA FAN PALM). The world's largest seeds (to 50 cm long) are produced by *Lodoicea maldivica* (J.F. Gmel.) Pers. (SEYCHELLES PALM, DOUBLE-COCONUT, COCO-DE-MER). "Palms are the universal symbol of the tropics in the popular imagination" (Meerow 2000), and because of the variety of species useful for food, fiber, and shelter, the PALM family is considered to be the third most important family to humans, following only the GRASS and BEAN families. The family is unusual in typically having an unbranched trunk with a single apical bud and a terminal rosette of leaves. The woody stems are completely different in structure and manner of growth from those of dicots, having no permanent cambium or enlargement in diam. King's-cabbage or heart-of-palm is a food obtained from the apical bud (= apical meristem) of several species (e.g., *Bactris gasipaes*). The family is considered to be the most morphologically diverse among the monocots and perhaps even among the angiosperms (Uhl et al. 1995; Anzizar et al. 1998). Even though this monophyletic family is quite distinctive morphologically, cladistic analyses indicate that the palms are the sister group to the Commelinanae clade (e.g., Chase et al. 1993, 2000). While some palms are wind-pollinated, it is now known that many are pollinated by insects (Uhl & Moore 1977; Dransfield & Uhl 1998). Family name from *Areca*, a genus of 60 species native from India and China through Indomalesia to New Guinea and the Solomon Islands. (Name derived from a vernacular name used in Malabar) (subclass Arecidae—Cronquist; order Arecales—APG II)

FAMILY RECOGNITION IN THE FIELD: trunkless or trunked plants with a single rosette of large, evergreen leaves, the leaf blades *fan-like*, pleated toward the base, palmately divided into numerous segments; flowers small, numerous, in a panicle.

REFERENCES: Bailey 1961; Moore 1973; Moore & Uhl 1982; Dahlgren et al. 1985; Dransfield 1986; Dransfield & Uhl 1986, 1998; Henderson 1986; Uhl & Dransfield 1987, 1999; Zona & Henderson 1989; Tomlinson 1990; Lockett 1991; Henderson et al. 1995; Uhl et al. 1995; Zona 1997, 2000; Anzizar et al. 1998; Baker et al. 1999; Henderson & Borchsenius 1999; Asmussen et al. 2000.

SABAL Adans. PALMETTO

Perennials with subterranean or aerial, woody or pithy, unbranched spineless stems and a single apical meristem; leaves long-petioled, the blades stiff, evergreen, glabrous, fan-like, longitudinally pleated toward base, palmately divided over half way (sometimes becoming split to base) into many narrowly lanceolate segments; hastula (= flap of tissue from petiole where petiole meets blade) well-developed, adaxial; inflorescence a long panicle with 2 or 3 orders of branching, its stalk with leafy bracts consisting of a closed, tubular basal sheath and grass-like short blade; flowers numerous, bisexual, subsessile, small (3.5–6.5 mm long); calyx 3-lobed; petals 3, whitish or greenish, longer than the calyx; stamens 6; pistil 1; ovary superior; fruits drupe-like, but with membranous endocarps, black or brownish black.

A genus of 16 species (Zona 2000) of trunkless or trunked, unarmed palms ranging from the se United States to South America. Some are used as a source of thatch. Pollination in the genus is mostly by native bees, introduced honeybees, and wasps (Zona 1987, 1990, 2000; Ramp 1989). Bears are reported to disperse the seeds of *Sabal* species in Florida (Zona & Henderson 1989). (Derivation unknown, the name possibly derived from an American vernacular name)
REFERENCES: Small 1922; Nixon et al. 1973; Zona 1987, 1990; Lockett & Read 1990; Lockett 1991, 1995, 2003; Ramp & Thien 1995; Goldman 1999.

1. Stems (trunk) aerial; leaves 10–30 per plant, the segments 60–115(–145) per leaf, marginally filiferous (= thread-bearing); hastula 9.5–15.5 cm long, acute to acuminate; inflorescences with 3 orders of branching (not counting main inflorescence axis); fruits > 13 mm long; species rare in East TX _____ **S. mexicana**
1. Stems usually subterranean, the plants thus usually appearing to be without a stem (aerial stems rarely present); leaves 4–10 per plant, the segments 15–65(–84) per leaf, marginally not filiferous; hastula 0.8–4.7 cm long, obtuse; inflorescences usually with 2 orders of branching (not counting main inflorescence axis); fruits < 9 mm long; species widespread and abundant in East TX _____ **S. minor**

Sabal mexicana Mart., (of Mexico), MEXICAN PALMETTO, RIO GRANDE PALMETTO, TEXAS PALMETTO, PALMA DE MICHAROS. Plant to 15 m tall (Lockett [2003] measured a fallen stem ca. 11 m long); stems (trunk) aerial, 20–35 cm DBH (= diam. breast height). Evergreen subtropical woodlands on deep alluvial soils (TOES 1993), floodplains, riverbanks, and swamps; included based on research and collections by Lockett (1991, 2003), who worked with the diary of Fray Isidro Felix de Espinosa, a priest who accompanied a 1716 Spanish expedition into the area that is now San Antonio. Espinosa "reported seeing 'palmitos legítimos' at San Antonio Springs, source of the San Antonio River, in what is today the city of San Antonio" (Lockett 1991). Lockett subsequently found *S. mexicana* in remnant forests near San Antonio springs (Bexar Co.). According to Lockett, "Since *S. mexicana* is commonly cultivated in the area there appears to be no way of knowing, without intensive historical research, whether the wild specimens are the progeny of imported transplants, or are descendants of a native population, which itself may have been relocated for landscaping. What we do know is that *S. mexicana* thrives in the area, while *S. minor* is lacking." Zona (2000) also mapped a locality for *S. mexicana* (county not specified) in the sw part of East TX. Lockett and Read (1990) cited plants from Jackson and Victoria cos. (along Garcitas Creek), and Turner et al. (2003) also mapped Brazos (presumably introduced), Cameron (native), and Harris (s portion—native status unknown) cos.; probably extreme s portion of East TX, but mainly Rio Grande Valley in the South TX Plains and central Gulf Coast in Gulf Prairies and Marshes (Lockett & Read 1990); Lockett (2003) also noted that the species is

spreading from cultivation in Austin (Travis Co.) and has escaped in Bandera Co. (Edwards Plateau); in the U.S. known only from TX, but widespread from Mexico to Central America. Spring–Fall. [*S. exul* (O.F. Cook) L.H. Bailey, *S. texana* (O.F. Cook) Becc.] While rare in TX, *S. mexicana* is "one of the most common palms of lowland tropical Mexico" (Zona 1990). The species is often cultivated in the s part of TX (but can survive winters much further north—e.g., Austin and even Dallas—Lockett 2003). Because the wood was useful in wharf building (resistant to the shipworm, which destroys wood in warm salt water) and the plants prized as ornamentals (Lockett & Read 1990; Lockett 2003), it is likely that most native populations have been harvested, and that this species was much more common in presettlement times. (TOES 1993: IV) ⚠

Sabal minor (Jacq.) Pers., (smaller), DWARF PALMETTO, BUSH PALMETTO, DWARF PALM, BLUE PALM, BLUE STEM, SWAMP PALM, BLUE PALMETTO, SWAMP PALMETTO, LATANIA, LATANIER. Plant to ca. 2 m tall (rarely taller—to nearly 5 m), usually acaulescent with a pithy crown or rarely with a short trunk (10–20 cm in diam.); leaf blades ± suborbicular in outline, to ca. 1.6 m wide. Usually in stream bottoms, floodplains, riverbanks, and swamps (but curiously also known from dry, open, upland habitats in parts of the Edwards Plateau—e.g., Lockett 1991); Pineywoods and Gulf Prairies and Marshes w along larger rivers to Dallas, Kaufman (BRIT), and McLennan (BAYLU) cos. in the Blackland Prairie and Gonzales (Turner et al. 2003; Palmetto State Park), Van Zandt, and Wood (BRIT) cos. in the Post Oak Savannah, also Hays and Travis cos. on w margin of East TX w to Gillespie Co. (BRIT) on the Edwards Plateau and naturalized in Tarrant Co. (R. O'Kennon, pers. obs.); se U.S. from NC s to FL w to OK and TX; recently a population was discovered in n Mexico, ca. 225 miles sw of the nearest known population (Goldman 1999); this area of Mexico is known to share a number of floristic components with the e U.S. (Dressler 1954; Martin & Harrell 1957). Mainly spring–summer, but nearly year round in lower Rio Grande Valley (Davis in Lockett & Read 1990). [*S. louisiana* (Darby) Bomhard] While *S. minor* is typically acaulescent, populations of trunked individuals are known, especially in the w portion of the species range (particularly in LA and TX); stems of 1–1.5 m in height are not uncommon (Ramp & Thien 1995). Such populations have long caused taxonomic confusion (e.g., the name *S. louisiana*). Bailey (1961) indicated that "There appear to be no botanical characters separating the two extremes except such dimensions of parts as are associated with stature." Recent electrophoretic studies support the inclusion of the trunked populations in *S. minor* (Ramp & Thien 1995). A Brazoria Co. population (of larger trunked individuals up to 27 feet tall) may be hybids between *S. minor* and *S. mexicana* (Lockett 1991, 2003). According to Zona (2000), "Further research is needed to test this hypothesis." Part of the hybrid population is now protected in a satellite unit of the San Bernard National Wildlife Refuge (Lockett 2003). ⚅/296

ASPARAGACEAE Juss.
ASPARAGUS FAMILY

A small family of 2 genera and ca. 305 species (Judd 2001). In addition to *Asparagus*, the family includes only *Hemiphylacus*, a small Mexican group of 5 species (Hernández 1995). While previously often placed in the Asphodelaceae or Hyacinthaceae, recent evidence (primarily molecular data) suggests that *Hemiphylacus* be included in the Asparagaceae (e.g., Rudall et al. 1997, 1998b; Judd 2001). Members of the Asparagaceae are typically adapted to dry conditions. According to Kubitzki and Rudall (1998), "Most species are found in regions with semiarid to arid and Mediterranean-type climate, and extreme xeromorphic adaptations are common." Many authorities have put the taxa here treated as Asparagaceae in a broadly defined and clearly polyphyletic (but practical) Liliaceae (e.g., Correll & Johnston 1970; Cronquist 1988; Diggs et al. 1999), based on superficial similarities in flower structure to the genus *Lilium*. Others (e.g., Mabberley 1997) have recognized the Asparagaceae but have treated it in a broad sense (6 genera). However, based on phylogenetic analyses, we are following Judd (2001) in recognizing the Asparagaceae as a mono-

phyletic family of two genera in the order Asparagales, closely related to the Convallariaceae (Rudall et al. 1997; Fay et al. 2000). As such, it is more closely related to other Asparagales families such as the Iridaceae and Orchidaceae than it is to many other taxa often put in a broadly defined Liliaceae (Chase et al. 1995a, 1995b, 1996, 2000; Fay et al. 2000). For a detailed discussion of the groups formerly treated as Liliaceae in the broad sense, see the family synopsis of the Liliaceae (here treated in a restricted sense) on page 726. In contrast to the narrow treatment here, the Angiosperm Phylogeny Group (APG II 2003), based largely on molecular data, recently suggested treating the Asparagaceae extremely broadly to include a number of diverse families, including the Agavaceae, Hyacinthaceae, Ruscaceae (including Convallariaceae, Dracaenaceae, and Nolinaceae), and Themidaceae, among others. As such, the Asparagaceae is extremely broadly defined morphologically. Because of this lack of morphological coherence, and until nomenclature in the petaloid monocots is more settled, we are following Judd (2001) in recognizing the family in the narrow sense. (subclass Liliidae—Cronquist; order Asparagales—APG II)

FAMILY RECOGNITION IN THE FIELD: the only species occurring in East TX is an introduced perennial 1–2(–3) m tall with leaves reduced to scales and numerous very finely dissected leaf-like branches; flowers are small and axillary and fruits are red berries.

REFERENCES: El-Gazzar & Badawi 1974; Malcomber & Demissew 1993; Hernández 1995; Kubitzki & Rudall 1998; Rudall et al. 1998b; Judd 2001.

ASPARAGUS L. ASPARAGUS, ASPARAGUS-FERN

A widely distributed Old World genus of ca. 300 species characteristic of regions with arid to Mediterranean climates (Judd 2001); some authorities (e.g., Straley & Utech 2002a) are less sure of the number of species, estimating 170–300. Segregates (e.g., *Myrsiphyllum*, *Protasparagus*) have sometimes been proposed, but these are now generally not accepted (Malcomber & Demissew 1993; Judd 2001). Based on embryological and molecular evidence, the genus appears monophyletic (Straley & Utech 2002a). Adaptations to dry conditions are common, including underground organs to store water and nutrients, leaves reduced to scales, and the presence of phylloclades (Kubitzki & Rudall 1998). While there is controversy over their exact anatomical origin (Cooney-Sovetts & Sattler 1986; Kubitzki & Rudall 1998; Judd 2001), the phylloclades (also called cladodes or cladophylls) of *Asparagus* are generally considered to be portions of a stem highly modified to have the general form and function of a leaf. The true nature of these structures can apparently be surmised since flowers are sometimes borne on the phylloclades. Several species are cultivated as vegetables, for example, the strong spring shoots of the commonly eaten ASPARAGUS. Others are used as ornamentals (e.g., ASPARAGUS-FERN, *A. setaceus* (Kunth) Jessop, and SPRENGER ASPARAGUS, *A. aethiopicus* L.), some have molluscicidal steroid saponins (Mabberley 1997), and a number are used medicinally (Judd 2001). *Asparagus aethiopicus*, also known as ASPARAGUS-FERN, EMERALD-FERN, or EMERALD-FEATHER, is a native of c and s Africa. This species, which has gone under various names (e.g., *A. densiflorus* (Kunth) Jessop, misapplied) (Judd 2001), is the most commonly cultivated member of the genus and is well known for "its graceful, airy masses of 'foliage' in pots, urns, hanging baskets, and window boxes" (Bailey & Bailey 1976). The berries of *Asparagus* species are dispersed by birds (Judd et al. 2002). (Greek: *asparasso*, to rip, in reference to the spiny leaves of some species—Straley & Utech 2002a, or alternatively, the ancient Greek name from, *asparagos*, a sprout or shoot, in reference to the food use of the tender sprouts—Shosteck 1974)

REFERENCES: Nichols 1990; Straley & Utech 2002a.

Asparagus officinalis L., (sold in shops, applies to medicinal, edible, and otherwise useful plants), GARDEN ASPARAGUS, COMMON ASPARAGUS. Rhizomatous, dioecious, glabrous perennial usually 1–2(–3) m tall, unarmed; stems annual, with many very finely dissected, photosynthetic branches (phylloclades/cladophylls) functioning like leaves; phylloclades needle-like, usually 0.6–2 cm long; leaves reduced to scales ca. 3–4 mm long; flowers axillary, 1–2(–3) per axil, on

jointed pedicels; perianth campanulate, greenish yellow or yellowish, the 6 tepals ca. 4–6(–8) mm long, connate basally; ovary superior; fruit a red berry to ca. 1 cm in diam. Widely cultivated and escaping to sandy areas; Cooke, Grayson, McLennan (BRIT), Bexar, Brazos, Cass, Navarro, Travis (Turner et al. 2003), and Walker (E. Keith, pers. comm.) cos.; scattered in TX; s Canada and throughout the U.S. May–Jul. Native of the coasts of Europe, n Africa, and Asia. This species has been grown since the time of the ancient Greeks for the edible young spring shoots (Mabberley 1997); it is widely used as a vegetable and is now naturalized in temperate regions nearly worldwide. Two types are commonly grown, "white asparagus" (shoots cut below ground just as they reach the surface and before chlorophyll production has begun) and "green asparagus" (shoots cut at ground level when they reach ca. 18–22 cm above the soil surface) (Judd 2001). Mature ASPARAGUS has been reported to cause poisoning in cattle (Kingsbury 1964). The young plants can cause dermatitis, and the fruits have been suspected of causing problems in humans (Schmutz & Hamilton 1979). However, there is apparently "very little risk of intoxication" from *Asparagus* species (Burrows & Tyrl 2001). While the plants are dioecious, flowers of both male and female plants have sterile rudiments of the other sex present (e.g., sterile anthers in female flowers) (Judd 2001). Pollination is thought to be by bees (e.g., honeybees) and beetles, and the fruit is dispersed by birds (Judd 2001). ☠ ☞ ⚅/276

BROMELIACEAE Juss.

PINEAPPLE, BROMELIAD, OR AIRPLANT FAMILY

A relatively large family (2,600+ species in 56 genera—Luther & Brown 2000) of epiphytic or terrestrial, xerophytic herbs. The Bromeliaceae is mainly limited to tropical to warm temperate areas of the New World, "except for a single, probably recent dispersal to west Africa" (Benzing 2000). This geographic restriction of the family is possibly due to its relatively recent (probably not before the Tertiary Period) evolution (Benzing 2000). The Bromeliaceae is the largest family of flowering plants limited almost exclusively to the Americas (Benzing 1994). Bromeliads can be distinguished from other monocots by their unique stellate or scale-like, multicellular hairs, and many species have distinctive stigmas (e.g., conduplicate, spiral) (Benzing et al. 1978; Brown & Gilmartin 1984; Gilmartin & Brown 1987). In the field, many species can be recognized by their tough, thickened, often spiny leaves, often conspicuous inflorescences with colored bracts, and typically epiphytic or xerophytic habit. The most economically important species is *Ananas comosus* (L.) Merr. (PINEAPPLE), which was probably native to South America but which was already cultivated by indigenous peoples throughout the New World tropics by the time of Columbus (Benzing 2000). Many other species are cultivated as ornamentals, and there are many enthusiasts (e.g., the Bromeliad Society International which publishes the J. Bromeliad Soc.). A number of the epiphytic species are tank epiphytes (Zotz & Thomas 1999). These have tightly clasping leaf bases and are thus able to act as well-like "tanks" to store water that can be absorbed by specialized roots or hairs. These epiphytes form a "hanging ecosystem" in New World tropical forests and provide aquatic habitats for an assortment of animals including frogs and insects. Many tropical epiphytic bromeliads also exhibit mutualistic relationships with ants (e.g., "ant-house bromeliads"). The ants benefit by using special living cavities in the plant and the plant obtains critically needed nutrients from its ant colony (Benzing 2000). Based on molecular data, the family is monophyletic (Ranker et al. 1990; Chase et al. 1993, 1995a; Crayn et al. 2000) and is in the commelinoid group in the order Poales, related to such families as Poaceae, Sparganiaceae, and Xyridaceae (Chase et al. 2000). Family name from *Bromelia*, a tropical American genus of 48 species. (Named for Olaf Bromel, 1639–1705, Swedish botanist) (subclass Zingiberidae—Cronquist; order Poales—APG II)

FAMILY RECOGNITION IN THE FIELD: gray or gray-green, xerophytic *epiphytes*; leaves with distinctive peltate scales.

REFERENCES: Smith 1938; 1961; Smith & Wood 1975; Benzing 1976, 1994, 2000; Smith & Downs 1977; Benzing et al. 1978; Brown & Gilmartin 1984, 1989; Dahlgren et al. 1985; Gilmartin & Brown 1987; Ranker et al. 1990; Martin 1994; Terry et al. 1997a, 1997b; Smith & Till 1998; Butcher 2000; Crayn et al. 2000; Horres et al. 2000; Luther & Brown 2000.

TILLANDSIA L. BALL-MOSS, AIRPLANT, NEEDLE-LEAF

Xerophytic epiphytes largely covered with multicellular peltate scales or trichomes that collect water and nutrients, the plants gray when dry, gray-green when wet; leaves entire; flowers perfect; stamens 6; ovary superior; fruit a septicidal capsule; seeds with a basal plumose appendage.

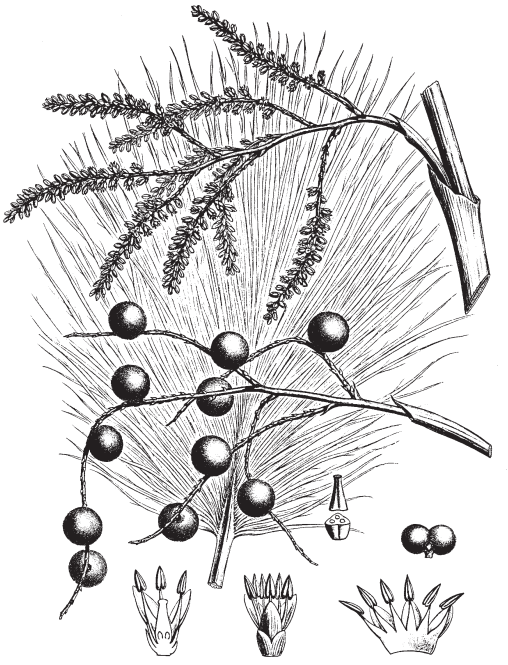
A tropical American genus of ca. 550 species (Luther & Brown 2000) of epiphytes (less often lithophytes and terrestrials), typically with leaves in a rosette; some are cultivated as ornamentals. Because of their grayish color, seedlings are sometimes confused with lichens (E. McWilliams, pers. comm.). Since the epiphytic habit often results in water stress, many epiphytic bromeliads, including *Tillandsia* species, use their extremely specialized stellate or scale-like, multicellular hairs to reflect sunlight, reduce water loss, and serve as the primary organ for absorption of water and nutrients. The two East TX species can be described as "atmospheric epiphytic" or "atmospheric" type epiphytes (Benzing et al. 1978; Crayn 2000) which are adapted for water absorption from the air, in contrast to "tank" species which impound/store water. In addition, ca. two-thirds of bromeliads, including both species of *Tillandsia* found in East TX, exhibit CAM photosynthesis which allows night absorption and storage of CO_2, thereby reducing water loss through transpiration during the day (Benzing 1976, 2000; Martin 1994). Unlike parasitic plants such as *Phoradendron* (mistletoe in the Loranthaceae), epiphytes, including those in the Bromeliaceae, do not harm trees; rather, they use them only for support. (Named for Elias Tillands, 1640–1693, professor at Abo, Finland, who as a student crossing directly from Stockholm, Sweden, was so seasick that he returned to Stockholm by walking more than 1,000 miles around the head of the Gulf of Bothnia and hence assumed his surname ("by land"); the genus was erroneously supposed by Linnaeus to dislike water)
REFERENCES: Birge 1911; McWilliams 1992, 1995; White et al. 1998a.

1. Plants typically in dense ball-like clumps; stems short, 10 cm or less long, completely concealed by the overlapping leaf sheaths; flowers at the end of a scape, conspicuously exserted above the leaves; petals violet or bluish _____ **T. recurvata**
1. Plants slender, wiry, usually curled, forming elongate hanging strands, not ball-like; stems elongate, often several meters long, visible between the leaves; flowers apparently sessile among the leaves; petals greenish or yellow-green _____ **T. usneoides**

Tillandsia recurvata (L.) L., (recurved), BALL-MOSS, BUNCH-MOSS, SMALL BALL-MOSS, GALLITOS. Plant rarely > 15 cm tall; roots present; leaves arising close together, recurving, elongate (2–17 cm long), very narrow (to ca. 3 mm wide), covered with scales; scape slender, with 1–2(–5) flowers; petals violet or bluish; seeds comose with bristles in two series separated by several mm. In East TX, usually epiphytic or further s and w also on rocks, tombstones, and utility wires; sw margin of East TX (Bexar Co.) n and e to Harris, Hill, Henderson, Madison, and Walker cos. (McWilliams 1992, 1995; White et al. 1998a) in the Blackland Prairie, Post Oak Savannah, and Pineywoods; primarily s 1/2 of TX; apparently spreading e and ne (several populations are now known from LA—E. McWilliams, pers. comm.); an introduced population on a single tree was observed in Dallas (McWilliams 1992); AZ, FL, GA, LA, NM, and TX and s to Central and South America. Flowering throughout the year. This species has expanded its geographic range in TX over the past 80 years, perhaps in response to changing climate; such climate-sensitive species may be able to serve as early indicators of projected regional climatic change (McWilliams 1995). White et al. (1998a), however, questioned this interpretation. /303



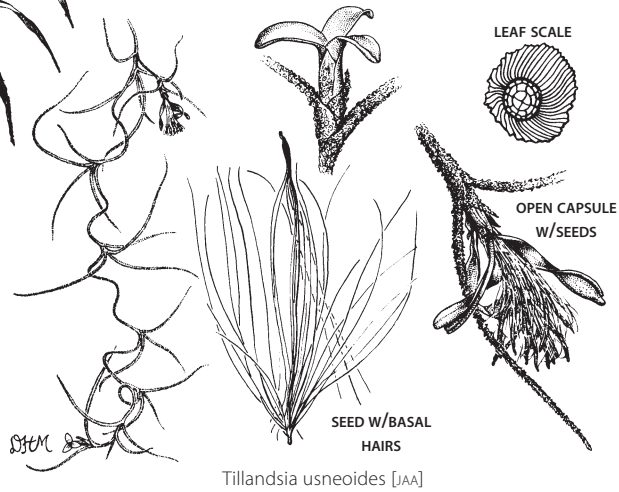
Xanthosoma sagittifolium [BA1]



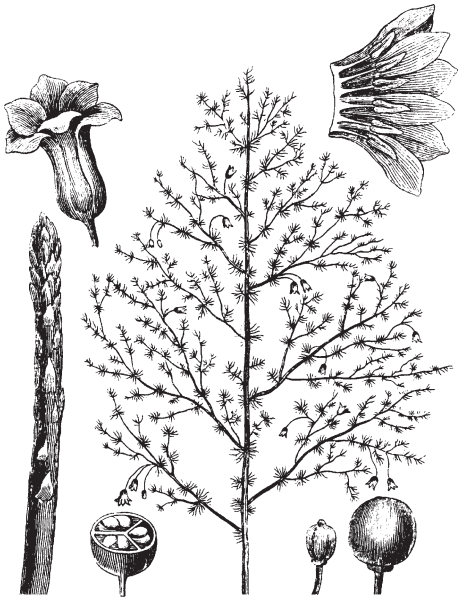
Sabal mexicana [SA3]



Sabal minor [BA1]



Tillandsia usneoides [JAA]



Asparagus officinalis [LAM]



Tillandsia recurvata [JAA]

Tillandsia usneoides (L.) L., (like *Usnea*, old-man's-beard, a lichen that hangs from trees) SPANISH-MOSS, OLD-MAN'S-BEARD, LONG-MOSS, BLACK-MOSS, PASTLE, FLORIDA-MOSS. Hanging strands to 3–4(–8) m long; roots nearly always absent; leaves ± thread-like, 2–3(–6) cm long, ca. 1–2 mm wide, densely scaly; inflorescence of a single flower; petals greenish or yellow-green. Epiphytic or on wires or other supports; e and s parts of East TX; also Gulf Prairies and Marshes and South TX Plains; se U.S. from VA s to FL w to TX. Feb–Jun. In moist areas in East TX, this species often hangs in large, extremely conspicuous festoons from trees. It occurs from the s U.S. s to Argentina, an incredible distribution stretching across 5,000 miles (8,047 km) of latitude. It is distributed by the wind and by birds using it as nest material. The dried plants have long been used in upholstery, as packing material (Kennedy 1841; Mabberley 1987), and in crafts and floral designs. This superficially lichen-like species is strikingly different morphologically from other members of the genus. However, mature plants of *T. usneoides* retain many characteristics commonly found in the seedling stage of other members of the genus, and *T. usneoides* is thus clearly linked to these other species (Tomlinson 1995). 🏵/303

BURMANNIACEAE Blume
BURMANNIA FAMILY

Very small, delicate, apparently annual or possibly perennial herbs; leaves minute, bract-like; flowers perfect, in small, head-like, racemose, or cymose clusters (can be solitary); perianth segments 6, united, usually with free lobes; stamens 3; ovary inferior; fruit a capsule; seeds numerous, small.

A small (125–130 species in 13 or 14 genera, including Thismiaceae—Maas-van de Kamer 1998; Caddick et al. 2002b; Lewis 2002) primarily pantropical and warm temperate family that occurs n to Japan and the e U.S. and s to New Zealand and Tasmania. The species are typically small forest herbs. Based on molecular studies, it is now generally agreed that the family is related to Thismiaceae (e.g., Caddick et al. 2002b; Neyland 2002), with some authorities combining the families (e.g., Caddick et al. 2002b) and others recognizing two related families (e.g., Neyland 2002). While traditionally often described as saprophytic, Burmanniaceae are mycophytic (= living symbiotically with fungi), and their manner of obtaining nutrition is more accurately described as mycotrophic or myco-heterotrophic (= obtaining nutrition via fungi) (Leake 1994). The family includes many mycotrophic species without chlorophyll, while green-leaved species are hemimycotrophic, constituting a transitional stage between autotrophy and heterotrophy. Fungi are located in special layers of cells in the roots (Maas-van de Kamer 1998). Relationships of this family have long been controversial. It was previously considered to be closely related to the Orchidaceae, based on the following shared characteristics: epigynous, bilaterally symmetrical flowers, numerous small seeds, and mycotrophy (Rasmussen 1985). Subsequently, molecular and cladistic research suggests that the families are not related and the similarities are due to convergence (Rasmussen 1995; Chase et al. 2000; Soltis et al. 2000). A number of molecular studies have suggested that Burmanniaceae is in the Dioscoreales and thus more closely related to such families as Dioscoreaceae and Nartheciaceae than to Orchidaceae (which is in order Asparagales) (Chase et al. 1995b; Caddick et al. 2000, 2002b; Chase et al. 2000). In contrast, other recent molecular research including more genera than previously sampled indicates that the family (minus the superficially similar but unrelated genus *Corsia* now in the Corsiaceae) plus Thismiaceae is in a relatively isolated position "not closely aligned with either the Dioscoreales or the Orchidaceae" (Neyland 2002). Additional research will be needed to clarify the relationships of this family. It has been suggested that the numerous tiny seeds are dispersed by water (Maas et al. 1986). (subclass Liliidae—Cronquist; order Dioscoreales—APG II)

FAMILY RECOGNITION IN THE FIELD: very small herbs of bogs or wet areas, with a thread-like stem, scale-like leaves, and 1–few small terminal flowers ± in a cluster or few-flowered racemose inflorescence.

REFERENCES: Jonker 1938; Wood 1983; Dahlgren et al. 1985; Maas et al. 1986; Rasmussen 1995; Maas-van de Kamer 1998; Caddick et al. 2000, 2002a, 2002b; Lewis 2002; Neyland 2002.

1. Hypanthium (= structure surrounding the inferior ovary) terete (= rounded in cross section); flowers purple or whitish with purple markings, sometimes nodding, 10–15 mm long (including hypanthium), funnel-shaped to campanulate, the mouth of corolla rather open; pedicels conspicuous, ca. 6–12 mm long (from base of flower to small bract); anthers borne on filaments 0.5–1 mm long (filaments winged); capsules 3-valved from base, the valves curling upward; ovary with a single cell _____ **Apteria**

1. Hypanthium 3-angled or 3-winged; flowers greenish white to white, cream, or blue to violet, erect, ca. 5 mm long (including hypanthium), tubular, the mouth of corolla rather closed; pedicels absent or short, ca. 2 mm or less long; anthers sessile or essentially so; capsules opening by irregular horizontal slits; ovary 3-celled _____ **Burmannia**

APTERIA Nutt. NODDING-NIXIE

A genus extending from the s U.S. and West Indies to c South America; it is variously treated as having 3 species (Mabberley 1997) or 1 variable species (Mass-van de Kamer 1998; Lewis 2002). (Greek: *a*, without, and *pteron*, wing, in reference to the wingless floral tube)

Apteria aphylla (Nutt.) Barnhart ex Small (without leaves), NODDING-NIXIE. Delicate, erect, achlorophyllous, mycotrophic herb (annual or possibly perennial) to 21(–27) cm tall; rhizome cylindric, slightly tuberous, scaly; stems thread-like, simple or branched above, purplish; leaves scale-like, to 3(–4) mm long; inflorescence racemose, usually with 1–5(–6) pedicelled, sometimes nodding flowers; flowers purple or whitish with purplish stripes and lobes, 8–15 mm long (including hypanthium), funnel-shaped to campanulate, persistent, the perianth lobes 1.5–3(–4) mm long, the 3 outer lobes much wider than the 3 inner; stamens attached to perianth; filaments 0.5–1 mm long, 2-winged, basally decurrent; ovary 1-celled; capsules 3–4(–6) mm long, nodding, dehiscing from base, the valves curling upward. In decaying leaves of low woods, on margins of bogs, baygalls, and deeply shaded stream margins, often with mosses (*Sphagnum* spp.); Hardin, Jasper, Tyler (BRIT), Angelina, Newton, Nacogdoches (ASTC), Sabine (MacRoberts & MacRoberts 1998a), Jefferson, and Polk (Turner et al. 2003) cos. in the s part of the Pineywoods; se U.S. from GA and FL w to TX. Jul–Oct. [*A. aphylla* var. *hymenanthera* (Miq.) Jonker, *A. hymenanthera* Miq., *A. setacea* Nutt.] ⚅/276

BURMANNIA L. BLUE-THREAD

Very small, apparently annual herbs with usually unbranched, thread-like stems; leaves alternate, reduced to scales, few, widely spaced along the stem; flowers erect in head-like, racemose, or cymose clusters (can be solitary), greenish white to white, cream, or blue to violet, erect; perianth segments fused into a tube, free at tips, the lobes minute to obsolescent; hypanthium 3-angled or 3-winged; anthers sessile or essentially so, attached to perianth; capsules with persistent perianth.

A genus of ca. 60 species (Lewis 2002) of tropical and subtropical areas of the world. Species range from leafy, green, and at least partially autotrophic to achlorophyllous mycotrophs (Wood 1983). (Named for Johannes Burman, 1706–1779, a Dutch medical doctor, botanist, and professor at the Botanical Garden of Amsterdam)

1. Hypanthium conspicuously 3-winged, ca. 3–4 mm wide (including wings); flowers in a racemose or cymose cluster (can be solitary), not all originating from the same point, blue to violet (rarely white) _____ **B. biflora**

1. Hypanthium 3-angled, but not conspicuously winged, ca. 0.5–1.5 mm wide; flowers in a head-like cluster (can be solitary), all originating from ca. the same point, greenish white or cream, sometimes tinged with blue _____ **B. capitata**

Burmannia biflora L., (two-flowered), TWO-FLOWER BURMANNIA, NORTHERN BLUE-THREAD, NORTHERN BURMANNIA. Plant 3–16(–18) cm tall; leaves tiny and scale-like, 1–3(–4) mm long; flowers 1–ca. 15, in a racemose or cymose cluster, small, 3–6 mm long (including hypanthium), blue to violet (rarely white), the lobes sometimes cream; inner perianth lobes 2/3 to nearly as long as outer perianth lobes; capsules 2–3.5 mm long, 3-winged. Moist woods, bogs; Cass, Hardin, Harrison, Smith (BRIT), Houston (Wood 1983), Angelina, Jasper (MacRoberts & MacRoberts 1998a), Sabine, and Tyler (Turner et al. 2003) cos. in the Pineywoods; se U.S. from VA s to FL w to TX. Aug–Oct. ⚅/279

Burmannia capitata (J.F. Gmel.) Mart., (headed), CAP BURMANNIA, SOUTHERN BLUE-THREAD. Plant 5–20(–33) cm tall; leaves tiny and scale-like, to 5(–8+) mm long; flowers 1–several(–25) in a head-like cluster at tip of stem, small, 2–6 mm long (including hypanthium), greenish white or cream, sometimes tinged with blue; inner perianth lobes usually < 2/3 as long as outer perianth lobes; capsules 1.3–3 mm long, 3-angled, but not winged. Moist woods, bogs; Pineywoods and Post Oak Savannah w to near e margin of Blackland Prairie; se U.S. from NC s to FL w to OK and TX. Aug–Nov. The flowers are apparently self-pollinated (Wood 1983).

CANNACEAE Juss.
CANNA FAMILY

A very small family (a single genus and 10 species) of glabrous erect herbs with large showy flowers and starchy rhizomes. It is native to tropical and subtropical areas of the Americas (Kress & Prince 2000). Grootjen and Bouman (1988) considered the group to have 30–35 species, while Tanaka (2001) recognized 20 species (including sterile triploids); such treatments are not widely accepted. Various cultivars are grown as ornamentals worldwide (Grootjen & Bouman 1988), and some are naturalized in the Old World (Judd et al. 2002). The Cannaceae appears monophyletic and is most closely related to the Marantaceae (PRAYER PLANT family) (Kress & Prince 2000), and more distantly to the Zingiberaceae (GINGER family) and Costaceae (SPIRAL-FLAG family), and more distantly still to other Zingiberales families, including the Heliconiaceae (HELICONIA family), Musaceae (BANANA family), and Strelitziaceae (BIRD-OF-PARADISE family) (Smith et al. 1993; Chase et al. 2000; Kress et al. 2001). As in Marantaceae, there is secondary pollen presentation and "reduction in the number of pollen-bearing stamens to a single bisporangiate anther" (Kennedy 2000b). (subclass Zingiberidae—Cronquist; order Zingiberales—APG II)

FAMILY RECOGNITION IN THE FIELD: large, erect, rhizomatous herbs with broad, banana leaf-like leaves and large showy flowers—the main showy parts are the staminodes; fruits warty.

REFERENCES: Kirchoff 1983, 1991; Rogers 1984; Maas 1985; Kress 1990; Smith et al. 1993; Kubitzki 1998a; Kress & Prince 2000; Tanaka 2001; Kress et al. 2001.

CANNA L. CANNA, INDIAN-SHOT

Erect, perennial, rhizomatous herbs 1 m or more tall, the aerial stems unbranched, dying back to the ground in winter in East TX; leaves 2-ranked along the stem, with sheathing petioles; leaf blades large, banana leaf-like, simple, entire, with prominent midvein and pinnately arranged, parallel lateral veins; inflorescence terminal, bracteate; flowers bisexual, asymmetric, variously colored and showy; sepals 3; petals 3, united at base; fertile stamen 1, petal-like; staminodes 3, petal-like and forming the primary showy parts of the flower, unequal, 2 large and 1 smaller; ovary inferior, of 3 carpels; fruit a warty capsule.



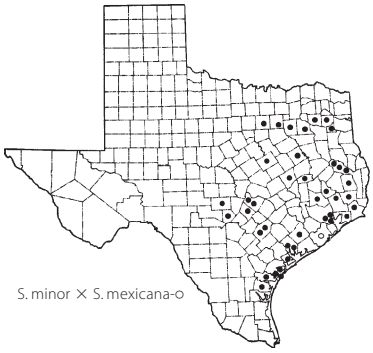
Pistia stratiotes



Xanthosoma sagittifolium



Sabal mexicana

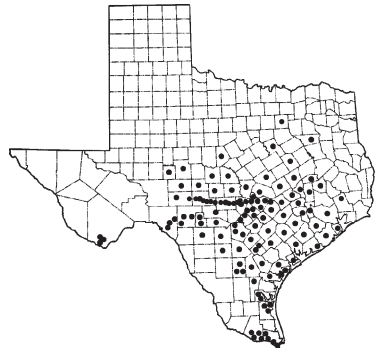


S. minor × S. mexicana-o

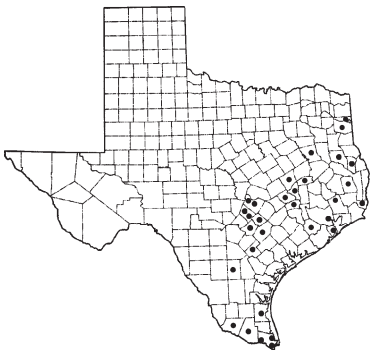
Sabal minor



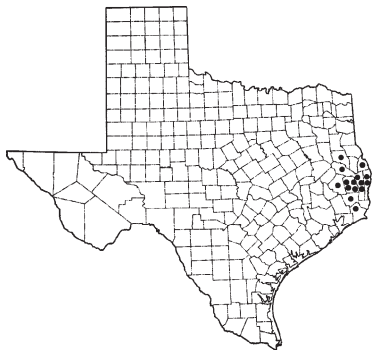
Asparagus officinalis



Tillandsia recurvata



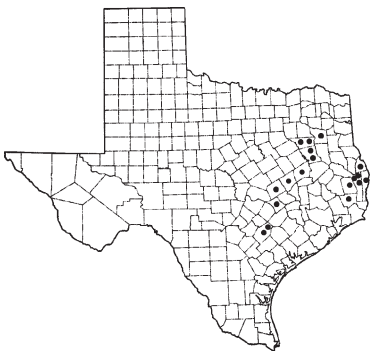
Tillandsia usneoides



Apteria aphylla



Burmannia biflora



Burmannia capitata



Canna ×generalis



Canna indica

A genus of 10 species with a number cultivated as ornamentals (mainly hybrids) for their striking leaves (banana leaf-like in shape and sometimes bronze or magenta) and large, brightly colored flowers. The flowers are unusual in having staminodes (= modified sterile stamens) as the largest and showiest floral organs (instead of petals). It was previously thought to have ca. 50–60 species (e.g., Bailey 1949; Correll & Johnston 1970; Bailey & Bailey 1976), but recent studies have clarified variation and hybridity in the genus (Kress & Prince 2000). It is horticulturally important, with over 1,000 cultivated forms known (Kubitzki 1998a). *Canna edulis* Ker Gawl., QUEENSLAND ARROWROOT, ACHIRA, (based on DNA data, now considered to be a hybrid—Prince, Kress, Maas, and Mass, unpublished data—L. Prince, pers. comm.) is cultivated for its starchy edible rhizome, which has easily digestible starch grains used for infants and invalids. This species, which was originally domesticated in the Peruvian Andes ca. 2500 B.C., is now cultivated mainly in India and Australia (Gade 1966; Kubitzki 1998a). *Canna* seeds are able to survive long periods of dormancy—a viable *Canna* seed 600 years old was found in a South American tomb (Sivori et al. 1968; Lerman & Cigliano 1971). Cannas shed pollen before the flowers open. In some species (e.g., *C. indica*) while in bud, pollen from the single anther is reported to be deposited onto the style (away from the stigma thus avoiding self-pollination) where it is presented to pollinators. This phenomenon is a type of secondary pollen presentation (Kubitzki 1998a). Alternatively, the early shedding of pollen may be to promote self-pollination—L. Prince (pers. comm.) reports high seed set in seven species even when the pollinator is excluded. Pollination of the yellow-flowered species, *C. flaccida* and *C. glauca* (which flower at dusk) may be by hawkmoths, while several red- or orange-flowered species of the New World tropics are pollinated by hummingbirds (Kress & Prince 2000). In addition to the two species treated below, two other *Canna* species are reported from coastal TX by Hatch et al. (1990): *C. flaccida* Salisb. (BANDANNA-OF-THE-EVERGLADES, GOLDEN CANNA, native of the se U.S.) and *C. glauca* L. (LOUISIANA CANNA, BRAZILIAN ARROW-WOOD, native of LA, TX, and Latin America). The four species occurring in TX can be separated by the following key modified from Bailey (1949) and Kress and Prince (2000). However, it should be noted that hybridization can cause confusion when attempting to identify Cannas. (Greek: *kanna*, a reed-like plant)
REFERENCES: Tomlinson 1961; Gade 1966; Segeren & Mass 1971; Grootjen & Bouman 1988.

1. Petals strongly reflexed; corolla tube ca. 4 cm long; sepals 2.5–3.5 cm long; flowers yellow, fewer than 5 per inflorescence _____ *C. flaccida*
1. Petals erect or strongly ascending; corolla tube 2 cm or less long; sepals 0.9–2 cm long; flowers variously colored, including yellow, often more than 5 per inflorescence.
   2. Plants not glaucous; flowers red to yellow-orange, but not pure yellow (except in some hybrid cultivars), 4.5–7.5 cm long; staminodes relatively narrow, 0.3–0.5 cm wide _____ **C. indica**
   2. Plants glaucous throughout (less so in *C.* ×*generalis*); flowers variously colored (*C.* ×*generalis*) OR pure yellow (*C. glauca*), to 10 cm long; staminodes wider, 0.5 to more than 2.5 cm wide.
      3. Flowers pure yellow; staminodes 0.5–2.3 cm wide _____ *C. glauca*
      3. Flowers variously colored; staminodes usually 2.5 cm or more wide _____ **C.** ×**generalis**

Canna ×**generalis** L.H. Bailey [*C. glauca* × *C. indica*], (normal, usual, prevailing), COMMON GARDEN CANNA. Plants similar to *C. indica*, 1–nearly 2 m tall, somewhat glaucous; flowers variously colored and showy; petals not reflexed; corolla tube not or only slightly exceeding calyx. This cultivar can persist and spread and is capable of taking over a stock tank (M. Reed, pers. obs.); Hardin Co. (BRIT) in the s Pineywoods and Madison Co. (Neill & Wilson 2001) in the Post Oak Savannah; Turner et al. (2003) also mapped a hybrid cultivar from Hays Co.; in much of the e U.S. from NY s to FL w to TX. Summer. The parental species are native to the New World tropics. This "species" represents a highly variable hybrid complex of garden origin. Subsequent hybridization with *C. flaccida* has yielded *C.* ×*orchioides* Bailey (petals reflexed, flowers bright yellow to red, often striped and splashed, corolla tube much exceeding the calyx). Continued breeding has caused the distinction between *C.* ×*generalis* and *C.* ×*orchioides* to become

blurred, further confusing the situation (Huxley et al. 1992; Kubitzki 1998a). Some authorities (e.g., Huxley et al. 1992; Kartesz 1999) treat *C.* ×*orchioides* as a synonym of *C.* ×*generalis*.

Canna indica L., (of India), INDIAN-SHOT, PLATANILLO. Plant to 1 or even 2 m tall, glabrous but not glaucous; leaves to 60 cm long and 30 cm wide, apically short acuminate to acute; flowers red to yellow-orange, but not pure yellow (except in some hybrid cultivars), 4.5–7.5 cm long; corolla tube 5–20 mm long; capsules 1.5–3 cm long; seeds black, globose or nearly so, 4-8 mm in diam. Weedy areas, waste places; Liberty Co. (Trinity River National Wildlife Refuge—Brown et al. 2002a) on se margin of East TX; also mapped for sw TX by Kress and Prince (2000) and cited by Hatch et al. (1990) for the Gulf Prairies and Marshes; FL, LA, SC, and TX. Spring–summer. [*C. coccinea* Mill., *C. edulis* Ker Gawl.] Probably native of the New World tropics (despite the epithet and common name), but now widespread in tropical and subtropical areas worldwide (Kress & Prince 2000). According to Bailey (1924), this is "One of the old-fashioned garden cannas, grown mostly for its foliage effects." The black, round, shiny seeds of *C. indica* L., INDIA-SHOT, are very hard and durable and resemble bullets—hence the derivation of the common name (Durant 1976). They have been used as beads (e.g. for rosaries), and in South America the natives "put the seeds in nutshells, strung them like a necklace and used them as rattles" (Durant 1976). /279

COLCHICACEAE DC.
AUTUMN CROCUS FAMILY

A small family of 19 genera and ca. 225 species of perennial herbs with corms or rhizomes, distributed in temperate to tropical regions mostly of the Old World, particularly the s hemisphere. A single genus, *Uvularia*, is native to North America (Nordenstam 1998). Many are cultivated as ornamentals. The genera have been variously treated in terms of family affiliation. Some authorities have put them in a very broad and clearly polyphyletic (but practical) Liliaceae (e.g., Correll & Johnston 1970; Cronquist 1988), while others have segregated some as the Uvulariaceae (e.g., Dahlgren et al. 1985; Takhtajan 1997). However, based on phylogenetic analyses, we are following Nordenstam (1998), Rudall et al. (2000b), and Vinnersten and Bremer (2001) in treating *Uvularia* in the Colchicaceae (order Liliales). For a detailed discussion of the groups formerly treated as Liliaceae in the broad sense, see the family synopsis of the Liliaceae (here treated in a restricted sense) on page 726. Some members of the Colchicaceae (e.g., *Colchicum* and *Gloriosa* species) produce colchicine-type alkaloids which are very poisonous and cause severe damage to livestock in certain regions (e.g., Africa); these alkaloids are also used medicinally (Nordenstam 1998; Burrows & Tyrl 2001). Family name from *Colchicum*, AUTUMN CROCUS, NAKED LADIES, a karyologically complicated genus (high frequency of polyploidy) of ca. 90 species found in Europe, Asia, and Africa (Nordenstam 1998). *Colchicum* is also the source of the medicine colchicum (formerly used as a pain-killer and in treating gout) and of the toxic alkaloid colchicine, used in plant research to cause a doubling of chromosomes by disorganizing the spindle mechanism at mitosis (Mabberley 1997). (Name from the northeast Black Sea shores of Georgia, once called Colchis, the autumn crocus supposedly having originated there) (subclass Liliidae—Cronquist; order Liliales—APG II)

FAMILY RECOGNITION IN THE FIELD: perennial herbs with erect-arching, unbranched or 1-branched leafy stems, sessile or perfoliate leaves, and solitary, apparently axillary, stalked and drooping flowers with free, pale yellow perianth parts.

REFERENCES: Shinwari et al. 1994; Nordenstam 1998; Rudall et al. 2000b.

UVULARIA L. BELLWORT, MERRY-BELLS

Glabrous perennial herbs from rhizomes; stems erect, arching, unbranched or typically once-branched; leaves alternate, sessile or perfoliate, acute, entire, glaucous; flower solitary, appearing axillary, nodding on a stalk; perianth narrowly bell-shaped; sepals and petals 3 each, similar,

free, pale yellow, promptly deciduous; stamens 6, ca. 1/3–1/2 the length of the perianth; filaments shorter than anthers; ovary superior, 3-locular; style 1; stigmas 3; fruit a 3-angled dehiscent capsule; seeds 1–3 per locule.

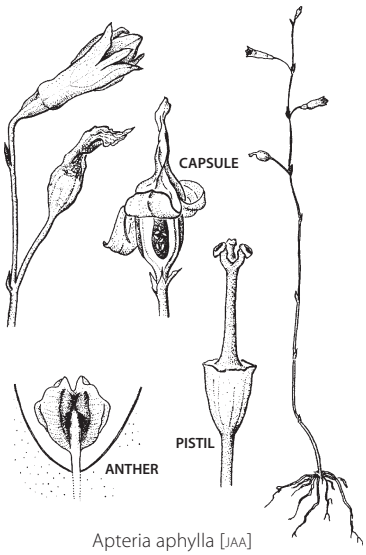
A genus of 5 species (Nordenstam 1998; Utech & Kawano 2002) endemic to e North America. They are rhizomatous spring-flowering herbs with arching stems, 2-ranked leaves, and pendulous flowers. The plants vegetatively superficially resemble *Polygonatum,* SOLOMON'S-SEAL (Convallariaceae, order Asparagales), but can be easily distinguished by the free perianth parts (vs. perianth parts fused nearly to the tips in *Polygonatum*). Some are cultivated as ornamentals. According to Yatskievych (1999), "Young shoots of *Uvularia* species have been cooked and eaten like asparagus, and the starchy rootstocks of some species have also been boiled and eaten." The roots were also used as a salve for wounds and sores (Bush 2001). Elaiosomes/arils (= external food bodies) are present on the seeds, and the seeds of at least some species are dispersed by ants (Handel et al. 1981). The common name, BELLWORT, is probably derived from the bell-shaped nodding flowers and the Anglo-Saxon, *wyrt*, a plant or herb. (Latin: *uvula*, the soft anatomical structure hanging in the human throat, diminutive of *uva*, grape, apparently in reference to the pendulous flowers; the plant was once thought to be a remedy for diseases of the uvula—Shosteck 1974)

REFERENCES: Anderson & Whitaker 1934; Dietz 1952; Wilbur 1963; Kawano & Iltis 1964; Whigham 1974; Seibert & Savidge 1991; Reveal 1992; Hawashi et al. 1998; Kudoh et al. 1999; Bush 2001; Wijesinghe & Whigham 2001; Utech & Kawano 2002; Singhurst et al. 2003a.

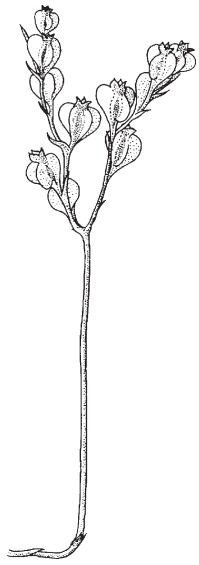
1. Leaves perfoliate (= with leaf base completely surrounding the stem); flower borne on a flower stalk (resembling a side branch) bearing a single perfoliate leaf-like bract; capsules obtusely 3-angled, ± truncate (= cut off squarely) at tip, with 2 attenuate beaks on each of the 3 lobes _____ **U. perfoliata**
1. Leaves sessile; flower borne on a bractless flower stalk from axil of a leaf along main stem; capsules sharply 3-angled, ellipsoid and ± pointed at tip, not beaked _____ **U. sessilifolia**

Uvularia perfoliata L., (perfoliate, with the leaf surrounding or embracing the stem), PERFOLIATE BELLWORT, MEALY BELLWORT, LARGE BELLWORT. Plant with slender stolons in addition to short rhizome; stems 15–40(–60) cm tall at flowering time, terete; leaves elliptic to ovate-lanceolate, 3.5–12.5 cm long, 1.5–5(–6) cm wide, perfoliate, the margins smooth; flower 1 per leafy perfoliate bract (commonly 1 but sometimes up to several flowers per stem); perianth (10–)17–30(–37) mm long, granular-papillose on inner surface; anthers 6–10 mm long; connectives of filaments exserted more than 0.8 mm beyond anthers; ovary sessile; capsule 7–13(–15) mm long, truncate apically; seeds arillate. Moist woods, hardwood bottoms and lower slopes, often in ravines or in or near hillside seeps, acidic sandy soils or calcareous substrates; Sabine (BRIT), San Augustine (TAMU), Shelby (TOES 1993), and Nacogdoches (Singhurst et al. 2003a) cos. in the Pineywoods; first documented for TX by Nixon et al. (1987); se Canada and widespread in the e U.S. w to OH and TX. Spring. A life history study of this species in North Carolina (Whigham 1974) found that the primary pollinator was a flightless staphylinid beetle, ants dispersed the seeds, asexual reproduction was much more important than sexual reproduction, the species was largely self-incompatible, and growth and reproduction occurred during the "very short period of time between the onset of favorable growing conditions and closure of the overhead canopy." Seibert and Savidge (1991) found that the principle pollinators of a similar species, *U. grandiflora* Sm., were queen bumblebees; they questioned Whigham's (1974) finding concerning pollination because "the two *Uvularia* species are morphologically and phenologically very similar." The life-history strategy of this species has been described as a "waiting strategy," with predominantly vegetative reproduction under suboptimal closed canopy conditions and both vegetative and sexual reproduction under optimal conditions in canopy gaps (Kudoh et al. 1999). (TOES 1993: V) ⚠ /306

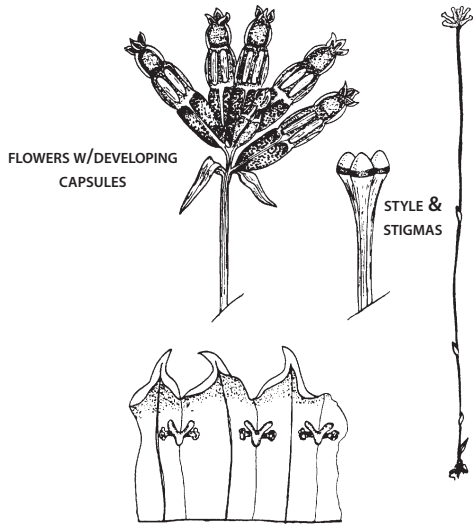
Uvularia sessilifolia L., (sessile-leaved), SESSILE-LEAF BELLWORT, SMALL BELLWORT, WILD-OATS, STRAW-LILY. Plant with long slender rhizomes; stems 15–40(–45) cm tall at flowering time,



Apteria aphylla [JAA]



Burmannia biflora [FLN]



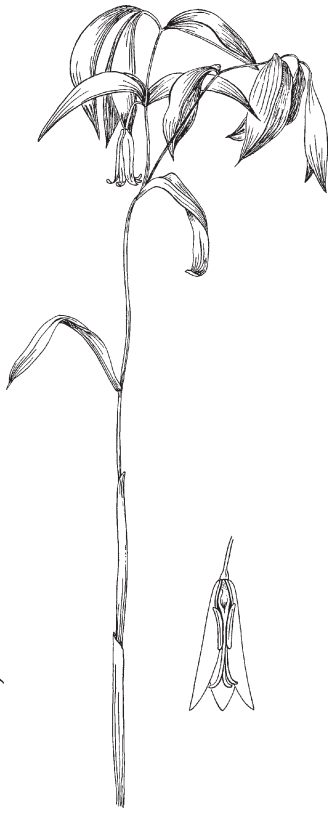
Burmannia capitata [CO1]



Canna indica [NIC]



Uvularia perfoliata [LAM]



Uvularia sessilifolia [GLE]



Canna ×generalis [BA2]

angled distally; leaves narrowly to broadly elliptic, tapering to broadly rounded at base, (3.5–)4.5–8 cm long, 1.2–3(–4) cm wide, the margins minutely denticulate; flower 1 per stem; perianth 12–28 mm long, smooth on inner surface; anthers 5–10(–13) mm long; connectives of filaments barely exserted beyond anthers; ovary stipitate; capsule 8–24 mm long, ellipsoid; seeds arillate. Deep ravines, mesic forests; Cass (*Singhurst 11724*, BAYLU), Jasper (*Singhurst 11213*, BAYLU; Singhurst et al. 2003a), and Newton (*Carr & Wolf 15983*, TEX) cos.; se Canada and widespread in the e U.S. w to ND and TX. Apr–May. [*Oakesia sessilifolia* S. Wats.; *Oakesiella sessilifolia* (L.) Small] The Cass Co. location is disjunct by approximately 280 km from the Newton and Jasper localities (Singhurst et al. 2003a). The species was first collected in TX by Carr and Wolf in 1997. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

COMMELINACEAE R. Br.
SPIDERWORT FAMILY

Annual or perennial herbs; leaves alternate or basal, with closed, tubular basal sheaths and broad or narrow, grass-like, entire blades; flowers in small cymose clusters subtended by reduced upper leaves or leafy bracts (if the bracts enclose the flowers they are referred to as spathes); sepals 3; petals 3, thin and delicate, usually lasting half a day or less (flowers open during morning, later in cloudy weather); stamens usually (5–)6, all fertile or some modified into staminodes (= sterile stamens) or lacking; filaments often long-hairy; pistil 1; ovary superior; fruit a capsule.

A medium-sized (ca. 630 species in 40 genera—Faden 2000b) family of tropical, subtropical, and warm temperate herbs, with greatest diversity in Africa (Faden 1983). It is a well-defined family characterized by a "closed leaf sheath, a succulent leaf blade, and three-merous flowers with distinct petals and sepals" (Evans et al. 2000a). A number are widely used as ornamentals, including species of *Tradescantia* (SPIDERWORT), *Rhoeo* (BOATFLOWER, OYSTERPLANT), and *Zebrina* (WANDERING-JEW); the latter 2 genera are now typically included in *Tradescantia* (Hunt 1986a). The flowers are unusual in lacking nectar and being ephemeral (lasting only a few hours); the only reward for pollinators is pollen, and a number of specialized pollination adaptations have evolved (Faden 1998, 2000b, 2000c). These include such attractants as yellow antherodes (= sterile "anthers" on staminodes), colorful showy hairs on stamens, and broad yellow connectives, all of which give the impression of more pollen than is actually present (and thus serve to deceptively attract pollinators) (Faden 1992; Evans et al. 2000b). "Floral deception is common and is often associated with heteranthery in flowers, which directs bees to the set of stamens that offers the lesser reward" (Faden 2000c). Pollen dimorphism (= 2 kinds of pollen) is often associated with heteranthery (= the differentiation of stamens into two sets; e.g., feeding stamens and pollination stamens). Stamens are sometimes modified into staminodes (which can be showy), and these in some cases produce sterile pollen (Faden 2000c). Classification within the Commelinaceae has been confused due to convergent evolution associated with similar selective pressures relating to the pollination biology of nectarless flowers (Evans et al. 2000a), and there is a high level of incongruence between morphology-based and molecular-based phylogenies of the family (Evans et al. 2003). Recent molecular evidence indicates that the family is monophyletic and in general supports the classification of the family developed by Faden and Hunt (1991), based heavily on anatomical (instead of floral) characters (Evans et al. 2000b, 2003). According to Faden (1998), there are also differing ideas about the family-level evolutionary relationships of the Commelinaceae, depending on the types of data used. A variety of data (except DNA sequence information) suggests a relationship with families such as Mayacaceae, Xyridaceae, or Eriocaulaceae. However, DNA sequence data place such families as

the Haemodoraceae and Pontederiaceae closer to Commelinaceae (Faden 1998). Recent molecular studies (e.g., Chase et al. 2000) indicate the family is most closely related to Pontederiaceae. (subclass Commelinidae—Cronquist; order Commelinales—APG II)

FAMILY RECOGNITION IN THE FIELD: herbs with succulent, mucilaginous stems with knotted nodes and usually alternate, ± basally sheathing leaves with strongly parallel veins; petals 3 (1 sometimes smaller), delicate, often blue.

REFERENCES: Woodson 1942; Brenan 1966; Tomlinson 1966; Poole & Hunt 1980; Faden 1983, 1985, 1992, 1998, 2000b, 2000c; Hunt 1986a; Tucker 1989; Faden & Hunt 1991; Evans 1995; Evans et al. 2000a, 2000b, 2003.

1. Leaf blades 4 cm or less long (often much less); plant mat-forming, creeping; the three petals all ± similar, translucent white, 3–6 mm long, inconspicuous, lanceolate to narrowly oblong, without an expanded blade; stigma bushy; filaments glabrous; introduced species rare in East TX, known only from Walker Co. _____ **Callisia**

1. Leaf blades usually > 4 cm long, often much longer; plant habit various; the three petals all ± similar OR not all alike, variously colored, with expanded blade, the larger ones 6–25 mm long OR if smaller, then not translucent white; stigma not bushy; filaments glabrous OR pubescent; including native and introduced species widespread and common in East TX.
   2. Inflorescences immediately subtended only by an involucre of small bracteoles that fall off early (but the elongate peduncles can arise from the axils of leaves); the three petals all ± similar, 3–3.5(–6) mm long; fertile stamens 2 (4 staminodes also present); introduced species known in East TX only from the s margin of the Pineywoods _____ **Murdannia**
   2. Inflorescences immediately subtended or enclosed by a single leafy bract (the bract sometimes conspicuously folded) OR by 2(–3) leaf-like bracts with reduced sheaths but conspicuous long blades; the three petals all ± similar OR not all alike, the larger ones 6–25 mm long; fertile stamens 3 or 6; native and introduced species widespread in East TX.
      3. Inflorescences each subtended by 2(–3) leaf-like bracts with reduced sheaths but conspicuous long blades; the 3 petals all ± similar; fertile stamens 6, equal _____ **Tradescantia**
      3. Inflorescences each subtended or enclosed by a single leafy bract (the bract sometimes conspicuously folded); the 3 petals not all alike, EITHER 2 larger and bluish and 1 one much smaller and white (at least paler than the others) OR one petal slightly smaller than the others; fertile stamens 3 (2–3 staminodes also present) OR 6 and unequal.
         4. Bract enclosing inflorescence (spathe) folded, the two sides ± parallel, 1.0–3.5 cm long, conspicuously different in shape from stem leaves; fertile stamens 3 (2–3 staminodes also present); filaments glabrous; petals (upper 2) clawed; foliage not glaucous; including species widespread in East TX _____ **Commelina**
         4. Bract subtending inflorescence flat, not folded, 4–8 cm long, similar to upper stem leaves but shorter and wider; fertile stamens 6; filaments (5 of the 6) bearded; petals not clawed; foliage glaucous; species restricted to the sw portion of East TX _____ **Tinantia**

CALLISIA Loefl. ROSELING

A mainly tropical American genus of 20 species, with the species quite variable vegetatively (some with elongate grass-like leaves). Some are cultivated as ornamental ground covers or hanging basket plants. (Greek: *kallos*, beauty or pretty, in reference to the attractive leaves)

REFERENCES: Hunt 1986b, 1994.

Callisia repens (Jacq.) L., (creeping), CREEPING INCHPLANT, BASKET PLANT, BOLIVIAN-JEW. Mat-forming, creeping perennial rooting at the nodes, with flowering stems ascending; leaves 2-ranked; leaf blades 1–4 cm long, 1(–2) cm or less wide, sessile, glabrous except for ciliate margins, somewhat fleshy; inflorescences sessile in axils of upper leaves, usually of pairs of sessile cymes; bract solitary, inconspicuous; flowers both bisexual and pistillate, unscented, subsessile,

the pedicels 0.5–1.5 mm long; petals all ± similar, translucent white, lanceolate to narrowly oblong, without an expanded blade, 3–5(–6) mm long, inconspicuous; stamens 0–6, sometimes 1 or more staminodial, exserted; filaments glabrous; stigma bushy; capsules 2-locular. Disturbed places; Walker Co. (Nesom & Brown 1998); also far s TX; FL, LA, and TX. Spring–fall. Native of Latin America. [*Hapalanthus repens* Jacq.] While some authorities indicate this species is native to the U.S. (e.g., Kartesz 1999), we are following Wunderlin (1998) and Faden (2000b) in considering it introduced. The species is reported to be self-compatible (Tucker 1989). It has been suggested that the ± bladeless petals and bushy stigmas are possibly adaptations to wind pollination (Tucker 1989).

COMMELINA L. WIDOW'S-TEARS, DAYFLOWER

Annuals or perennials; inflorescences enclosed in spathes; bract enclosing inflorescence (spathe) folded, the two sides ± parallel, conspicuously different in shape from stem leaves; flowers bilaterally symmetrical; petals greatly or slightly unequal, blue or blue and white, the upper 2 larger and clawed; stamens quite unequal, 3 fertile (1 of these different in size and form from others), 3 slightly shorter and sterile (actually staminodia); filaments glabrous.

A genus of ca. 170 species (Faden 2000b) of tropical and warm areas of the world. While flowers of this family generally lack nectar (pollen is the only reward—Faden 1998, 2000b), bees are reported to pierce the juicy lobes of the upper 3 sterile anthers of *Commelina* to obtain "nectar" (Mabberley 1997). The common name DAYFLOWER comes from the extremely delicate flowers which open in the morning but are gone by noon on sunny days (Kirkpatrick 1992). (Named for the early Dutch botanists, Commelijn, on account of the 2 showy petals and 1 less conspicuous petal. Linnaeus was referring to the three botanists of that name, two of whom, Johannes, 1629–1692, and Caspar, 1667–1731 (nephew of Johannes), were conspicuous botanists, while the third "... died before accomplishing anything in Botany"—Zimdahl 1989)
REFERENCES: Pennell 1916a, 1937, 1938; Brashier 1966; Faden 1989, 1993; Krings et al. 2002.

1. Leaf-like spathe enclosing flowers open on the top margin but with edges fused together along the back margin; perennials with thickened roots.
   2. Corolla with 2 uppermost petals blue and the lowermost (3rd petal) much smaller and white; spathes often both scattered along the stem (located opposite the leaves) and near the stem apex, usually 1 per node; leaf sheath margins inconspicuously ciliate with whitish hairs; leaves with auricles at summits of sheaths; leaf blades 14–35 mm wide _____ **C. erecta**
   2. Corolla with all 3 petals blue, the lowermost slightly smaller; spathes usually in clusters near the stem apex; leaf sheath margins conspicuously ciliate with reddish hairs; leaves without auricles; leaf blades 20–65 mm wide _____ **C. virginica**
1. Leaf-like spathe enclosing flowers open both on the top margin and also down the back margin to where it attaches to its stalk; annuals with fibrous roots.
   3. Corolla with 2 uppermost petals blue and the lowermost (3rd petal) much smaller and white or paler than the others; leaf blades (10–)15–40 mm wide; leaf sheaths usually 10–20 mm long; bottom edge of spathes (actually midvein) ± straight; spathes usually pale with contrasting dark green veins; capsules with 2 locules; seeds rugose pitted-reticulate _____ **C. communis**
   3. All 3 petals blue, the 3rd only slightly smaller; leaf blades 7–15(–24) mm wide; leaf sheaths usually 5–10 mm long; bottom edge of spathes usually curved (spathes falcate) OR ± straight; spathes without contrasting veins; capsules with 3 locules; seeds smooth to faintly alveolate to reticulate.
      4. Spathes usually distinctly falcate, the open margin usually ciliolate to glabrous; false anthers of staminodes entirely yellow; upper cyme in larger spathes usually well-developed and 1–several-flowered, exserted; capsules 4–6.3 mm long; seeds of ventral locule 2–2.8 (–3.2) mm long, deeply reticulate; only 2 of the 3 staminodes with well-developed false anthers _____ **C. diffusa**

4. Spathes not at all to slightly falcate, the margin usually ciliate near attachment to stalk; false anthers of staminodes usually yellow with a central maroon/reddish brown spot; upper cyme in spathes usually vestigial, not exserted (rarely well-developed, 1-flowered, and exserted); capsules (5–)6–8 mm long; seeds of ventral locule 2.4–4.3(–4.6) mm long, smooth to faintly alveolate; all 3 staminodes with well-developed false anthers _____ **C. caroliniana**

Commelina caroliniana Walter, (of Carolina), CAROLINA DAYFLOWER. Stems decumbent to scandent; leaf blades 7–15(–24) mm wide; leaf-like spathe enclosing flowers open both on the top margin and also down the back margin to where it attaches to its stalk; petals all blue, one slightly smaller and whitish medially; all 3 staminodes with well-developed false anthers, these yellow, often with a central maroon spot. Fields, roadsides, and weedy areas; Colorado, Harris, Orange, and Travis (Faden 1993) cos. on the s edge of East TX; also Gulf Prairies and Marshes; se U.S. from NC s to FL w to AR, MO, and TX. Summer–fall. The species is apparently native to India and Bangladesh (despite the specific epithet and common name) and was probably introduced into the U.S. in South Carolina with rice seed in the late 17th century (Faden 1989). The characters used in the key to separate *C. caroliniana* from the similar *C. diffusa* are modified from Faden (1989, 1993). ☜

Commelina communis L., (common), COMMON DAYFLOWER, ASIATIC DAYFLOWER. Stems erect, later decumbent, to 4 mm in diam., to 50 cm tall; leaf blades (10–)15–40 mm wide; leaf-like spathe enclosing flowers open both on the top margin and also down the back margin to where it attaches to its stalk; all 3 staminodes with well-developed false anthers, these yellow, sometimes with a central maroon spot. Stream banks and low thickets, sometimes a garden weed; Dallas (BRIT), Brazos (TAMU), Gonzales, and San Jacinto (Turner et al. 2003) cos.; Faden (2000b) mapped the species (without specific counties) as occurring in TX only in the n and ne parts of East TX; Turner et al. (2003) also mapped two localities in the Gulf Prairies and Marshes; se Canada and throughout e U.S. w to SD and TX, also OR. May–Oct. Native of e Asia. ☜

Commelina diffusa Burm. f., (diffuse, spreading), SPREADING DAYFLOWER, CREEPING DAYFLOWER, CLIMBING DAYFLOWER. Stems erect initially, later decumbent, usually not more than 1.5 mm in diam.; leaf blades 5–33 mm wide; leaf-like spathe enclosing flowers open both on the top margin and also down the back margin to where it attaches to its stalk; only 2 of the 3 staminodes with well-developed false anthers (1 staminode often lacking), these yellow, without a central spot. Low woods; widespread in e 1/3 of TX w to Fannin (Talbot property), Rockwall (BRIT), Gonzales, and Travis (Turner et al. 2003) cos.; e U.S. from VT s to FL w to KS and TX. Apr–Nov. There is disagreement over the geographic origin of this species (Yatskievych 1999), which occurs in tropical America, Asia, Africa, and the Pacific Islands; however, Faden (2000b) considers it introduced to the U.S. This species is believed by some sources to be among the world's worst weeds (Holm et al. 1977). ⊘ ☜

Commelina erecta L., (erect), ERECT DAYFLOWER, HIERBA DE POLLO, WHITE-MOUTH DAYFLOWER. Stems erect to decumbent, 10–70(–100+) cm long; leaf-like spathe enclosing flowers open on the top margin but with edges fused together along the back margin; all 3 staminodes with well-developed false anthers, these yellow, without a central spot. Native in various soils, often a weed. May–Jun and Sep–Oct, occasionally Jul–Aug. While varieties are often distinguishable, there is considerable variation (Brashier 1966) and overlap between them. Faden (2000b) indicated the three varieties freely intergrade and are of questionable significance. ⚅/282

1. Blades of middle and upper leaves broadly oblong-lanceolate, less than 5 times longer than wide, 1.4–3.2 cm wide _____ var. **erecta**
1. Blades of middle and upper leaves narrowly oblong-lanceolate or linear-lanceolate, more than 5 times longer than wide, 0.5–1.2(–2.0) cm wide.
   2. Spathes (1.3–)1.5–2.0(–2.3) cm long _____ var. **angustifolia**
   2. Spathes (2.2–)2.5–2.8(–3.3) cm long _____ var. **deamiana**

var. **angustifolia** (Michx.) Fernald, (narrow-leaved), NARROW-LEAF DAYFLOWER. In habitats as diverse as sandy woods and rocky limestone slopes; throughout TX; throughout much of the U.S. from PA s to FL w to WY and AZ.

var. **deamiana** Fernald, (for Charles C. Deam, 1865–1953, American botanist). Usually in sandy soils; East TX w to Cross Timbers and Prairies (e.g., Hill Co.—BRIT); MI s to LA w to MN and AZ.

var. **erecta**. Thickets, stream banks or a weedy invader elsewhere; Madison (TAMU) and Dallas (TAES) cos.; while we are aware of only a few TX sheets of this variety, it was reported from vegetational areas 2, 4, 5, 6, 7, 8, and 9 by Hatch et al. (1990); e U.S. from NY s to FL w to AZ.

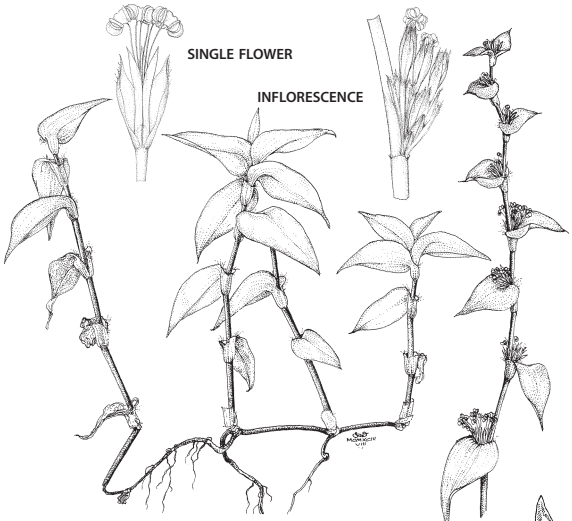
Commelina virginica L., (of Virginia), VIRGINIA DAYFLOWER. Plant spreading by elongate rhizomes; stems coarse, 3–6 mm in diam. at base, usually strictly erect (rarely decumbent), to 90 (-100) cm tall; leaf blades scabrous when rubbed toward base; leaf-like spathe enclosing flowers open on the top margin but with edges fused together along the back margin; all 3 staminodes with well-developed false anthers, these yellow, without a central spot. Low woods, wet places; Pineywoods and n Gulf Prairies and Marshes w to Blackland Prairie; the range map in Faden (2000b) shows the species extending further w into the Cross Timbers and Prairies and Edwards Plateau; e U.S. from N.J. s to FL w to KS and TX. May–Oct.

Commelina benghalensis L., (of Bengal), TROPICAL SPIDERWORT, BENGHAL DAYFLOWER, JIO, a common paleotropical weed, has been discovered in several southeastern states (FL, GA, LA, NC) as well as CA (Faden 1993; Thomas & Allen 1993; Faden 2000b; Krings et al. 2002). This species is considered a noxious weed in FL, a U.S. federal noxious weed (Kartesz 1999; USDA Natural Resources Conservation Service 2002), and according to sources to be among the world's worst weeds (Holm et al. 1977). It should be looked for in the moister parts of East TX adjacent to LA and reported if found. It can be distinguished as follows: annual with relatively broad unauricled leaves often with reddish hairs at sheath apex; leaf-like spathes with edges fused together along the back margin, often clustered; corolla of three blue (–lilac) petals, one of these smaller but still conspicuous; basal, sometimes subterranean cleistogamous flowers usually present in addition to chasmogamous flowers (Krings et al. 2002). ⊘ ☜

MURDANNIA Royle DEWFLOWER

A genus of ca. 50 species of pantropical and temperate areas (Faden 2000b). (Named for Murdan Aly, plant collector and keeper of the herbarium at Saharunpore, India—Faden 2000b) REFERENCES: Shinners 1962c; Faden 1978.

Murdannia nudiflora (L.) Brenan, (naked-flowered), NAKED-STEM DEWFLOWER. Annual herb to 35 cm tall; stems and branches often creeping and rooting at lower nodes; leaves sessile; leaf blades linear to linear-lanceolate or lanceolate-oblong, 1.5–11(–18) cm long, 2–7(–8) mm wide; inflorescences few-flowered cymes subtended by involucres of bracteoles that fall early, the cymes terminating long peduncles (to 9+ cm long); spathaceous bracts absent; pedicels ca. 3 mm long, elongating to 4–5 mm in fruit; flowers bisexual, slightly bilaterally symmetrical; petals 3–3.5(–6) mm long, pinkish purple to purplish or violet, with expanded blades; fertile stamens 2, the filaments bearded; staminodes usually 4; capsules 3-locular, 2.5–5 mm long, with 2 seeds per locule. Roadsides and other weedy sites; Jefferson (BRIT) and Montgomery (TAES) cos. near s margin of Pineywoods; also Gulf Prairies and Marshes; e U.S. from NC s to FL w to TX. Summer–fall. Native of Asia. [*Aneilema nudicaule* (Burm. f.) G. Don, *Aneilema nudiflorum* (L.) Sweet, *Commelina nudiflora* L.] A note on the Jefferson Co. sheet (*Cory 49974*, BRIT) said, "...a pest and hard to eradicate from gardens." This species is considered by some sources to be among the world's worst weeds (Holm et al. 1977). ⊘ ☜



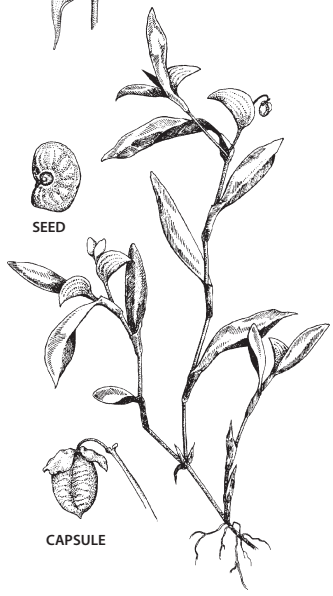
Callisia repens [MCV]



Commelina caroliniana [GLE]



Commelia communis [DIL]



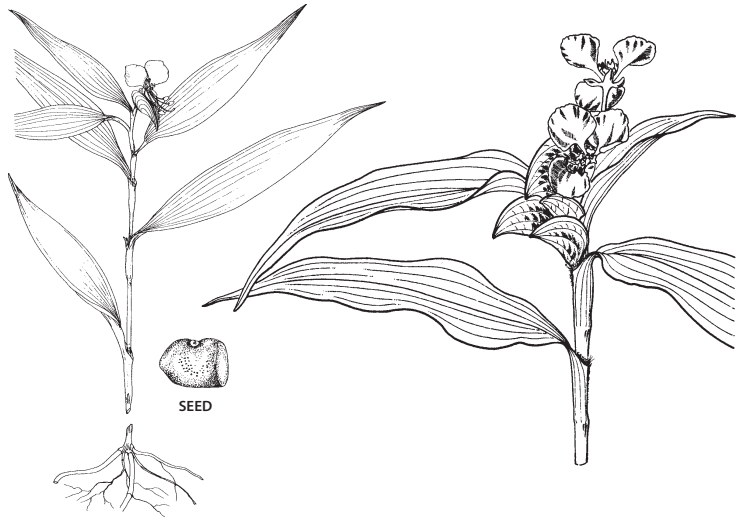
Commelina diffusa [MO1]



Commelina erecta var. angustifolia [JON]



Commelina erecta var. erecta [DIL, SHI]



Commelina virginica [FNA, YAT]

TINANTIA Scheidw. FALSE DAYFLOWER, WIDOW'S-TEARS

A genus of ca. 14 species (Faden 2000b) from TX to the American tropics; some are cultivated as ornamentals. Two of the species (including *T. anomala*) were previously treated as *Commelinantia*. Faden (2000b) suggested that "...although some attributes, including pollen and chromosome number, can still be used to separate *Commelinantia* from *Tinantia*, these characters are not of sufficient import to merit separate generic status." (Named for François A. Tinant, 1808–1858, a forester in Luxembourg—Faden 2000b)
REFERENCES: Tharp 1922, 1956; Woodson 1942; Castro 1978; Simpson et al. 1986.

Tinantia anomala (Torr.) C.B. Clarke, (anomalous), FALSE DAYFLOWER, WIDOW'S-TEARS. Tufted glabrous annual with erect or spreading stems 2–80 cm long, becoming freely branched, the branches emerging through the back of the leaf sheaths just above the nodes; basal leaves tapered to a long petiole; upper stem leaves sessile or short petioled, the blades ± lanceolate, often somewhat cordate and clasping basally; flowers in elongate cymes; bract subtending inflorescence flat, not folded, 4–8 cm long, similar to upper stem leaves but shorter and wider; petals not clawed, the 2 upper and larger ones 15–18 mm long, lavender-blue, the much smaller lower 1 white; stamens 6, all fertile, very polymorphic; upper 3 stamens with filaments conspicuously bearded with yellow-tipped hairs and with small anthers, the 2 lateral upper stamens upright, the middle upper stamen less upright; lower 3 stamens curved downward, with larger anthers, the filaments of lateral 2 lower stamens with purple hairs, the filament of middle lower stamen glabrous; capsules 6–8 mm long. Limestone gravel or rocky crevices, often in some shade; Edwards Plateau and Gulf Prairies and Marshes n to s part of Cross Timbers and Prairies and e to Burleson Co. (along Koontz Bayou, near the Brazos River—TAMU); endemic to TX or nearly so (1 record from Durango, Mexico—R. Faden, pers. comm.). Apr–Jun, rarely later. [*Commelinantia anomala* (Torr.) Tharp] Simpson et al. (1986) gave detailed information on the reproductive biology of this apparently largely self-pollinating species. Nonetheless, Faden (2000c) reported that the pollen sacs and hairs of the upper stamens absorb UV light, in contrast to the rest of the flower. The anthers of these stamens have only half as much pollen as those of the other stamens (Simpson et al. 1986). Pollinators (bees) are thus potentially deceived—they would obtain less reward from the more attractive stamens (Faden 2000c). ? /303

TRADESCANTIA L. SPIDERWORT, WANDERING-JEW

Perennial subsucculent herbs; leaf blades linear to oblong-elliptic; inflorescences subtended by a usually leaf-like bract; petals equal, usually not clawed, blue to rose, magenta, purple, or white; stamens 6, all fertile and equal; filaments long-pilose with colored hairs (glabrous in 1 species); anthers dumbbell or bow-tie shaped.

An American genus of ca. 70 species (Faden 2000b). A number are cultivated as ornamentals, including species previously treated in *Rhoeo* (BOATFLOWER, OYSTERPLANT), *Setcreasea*, and *Zebrina* (WANDERING-JEW). The staminal filaments of most species have long moniliform (= made up of a row of single cells, like the beads of a necklace) hairs and were used by Robert Brown in 1828 to observe and describe protoplasmic streaming (= the active flowing of cytoplasm in the cell), which is easily observed under a microscope (Cochrane & Iltis 2000). Hybridization and introgression are well known in *Tradescantia* and complicate the taxonomy of the genus (Anderson & Woodson 1935; Anderson & Hubricht 1938; Faden 2000b). We are in general following the traditional delimitation of species formulated by Anderson and Woodson (1935) and followed by most authors since that time. Faden (2000b) indicated that, "The species described by E. Anderson and R.E. Woodson Jr. (1935) are narrowly defined and typological. Nevertheless, they are recognizable entities even if some of them may prove eventually unworthy of specific rank." The common name is possibly derived from the long slender leaves which clasp the stem and dangle like spider legs or from the mucilaginous sap stringing out of a broken stem to resemble a spider's web, and "wort," from Anglo-Saxon, *wyrt*, a plant or herb (Tveten

& Tveten 1993). (Named for John Tradescant, 1608–1662, gardener to King Charles I of England)
REFERENCES: Bush 1904; Tharp 1932; Anderson & Woodson 1935; Anderson & Sax 1936; Anderson & Hubricht 1938; Anderson 1954; MacRoberts 1977a, 1977b, 1980; Hunt 1975; 1980.

1. Flowers subsessile; petals clawed, the claws fused basally, forming a tube; stamens arising from the petals; filaments glabrous OR with long hairs; corollas either purplish red or pale pink to whitish; species rare in East TX (known only from Gonzales and Travis cos.).
   2. Petals pale pink or whitish; filaments hairy; leaf blades elliptic; bracts similar to leaf blades but smaller; plants flowering Feb–May _____ **T. buckleyi**
   2. Petals purplish red; filaments glabrous; leaf blades narrowly lanceolate; bracts ovate, very different in shape from leaf blades; plants flowering Jul–Oct _____ **T. leiandra**
1. Flowers on distinct pedicels; petals neither clawed nor fused basally; stamens free from petals; filaments with long hairs; corollas variously colored; including species widespread and abundant in East TX.
   3. Petals white; plants decumbent, rooting at the nodes; leaf blades lanceolate-elliptic to narrowly ovate _____ **T. fluminensis**
   3. Petals variously colored, but only rarely white; plants erect or ascending, only rarely rooting at the nodes; leaf blades usually linear-lanceolate to lanceolate-oblong.
      4. Leaf blades (at least the upper ones) broader than their opened flattened sheaths; species limited to w part of East TX and further w _____ **T. edwardsiana**
      4. Leaf blades narrower than to ca. as broad as their opened flattened sheaths; including species widespread in East TX.
         5. Upper internodes glabrous.
            6. Sepals glabrous or with only a small tuft of hairs at the tip (these are the only two East TX species like this; all others have pubescent sepals).
               7. Foliage glaucous; leaves 5–45 cm long, arcuate, forming an acute angle with the stem _____ **T. ohiensis**
               7. Foliage not to only slightly glaucous; leaves 4–11 cm long, straight, forming a nearly right angle with the stem _____ **T. paludosa**
            6. Sepals sparsely to densely pubescent on the back, the hairs glandular or eglandular.
               8. Sepals either completely eglandular-pubescent or with both glandular and eglandular hairs (use magnification); bracts pilose to glabrous; leaf blades usually pilose, occasionally lacking hairs _____ **T. hirsutiflora**
               8. Sepals usually with glandular pubescence only (sometimes with a tuft of eglandular hairs at the tip); bracts glabrous; leaf blades glabrous _____ **T. occidentalis**
         5. Upper internodes variously hairy (puberulent, pilose, or with matted hairs).
            9. Hairs on internodes long and matted or tangled, spider-web-like in appearance, ± appressed.
               10. Stems erect or ascending, unbranched or infrequently branched, 30–105 cm tall; roots conspicuously felty with red-brown hairs easily visible to the naked eye _____ **T. reverchonii**
               10. Stems spreading and ± diffuse, much branched, 10–35 cm long; roots (tuberous thickened) tomentose but not conspicuously felty to the naked eye _____ **T. subacaulis**
            9. Hairs on internodes minute or long and ± straight, wide-spreading.
               11. Sepals with only eglandular pubescence (use magnification).
                  12. Leaf sheaths glabrous or minutely pubescent; bracts conspicuously saccate at base, their blades reduced, densely and minutely velutinous _____ **T. gigantea**
                  12. Leaf sheaths long pilose or with long matted or tangled hairs; bracts not conspicuously saccate at base, their blades well-developed, glabrous to ± pilose.
                     13. Stems 12–50 cm tall, with 2–5 nodes; sepals relatively firm, dull-green to suffused or edged with rose; pedicels 1–3 cm long _____ **T. hirsutiflora**

13. Stems 2–7 cm tall in flower, to 20(–30) cm in fruit, usually with 1–2 nodes; sepals somewhat petal-like, usually strikingly purple or rose-colored, occasionally pale green; pedicels usually 4–6 cm long _____ **T. tharpii**

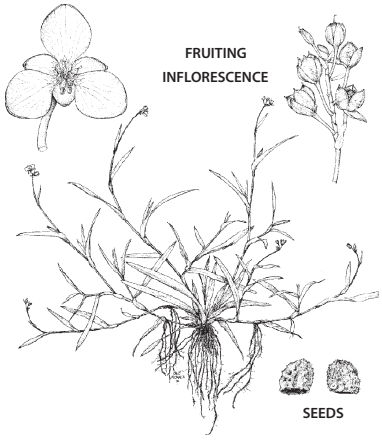
11. Sepals with glandular pubescence and often eglandular pubescence as well (use magnification).
    14. Leaf sheaths long pilose, at least toward their summits _____ **T. hirsutiflora**
    14. Leaf sheaths glabrous or short pubescent.
        15. Petals ovate, bright blue, occasionally pink; plants 10–30(–45) cm tall; blades of leaves and bracts 20 cm or less long; bracts not conspicuously saccate at base _____ **T. humilis**
        15. Petals obovate, magenta-pink to blue; plants 20–75(–100) cm tall; blades of leaves and bracts 10–40 cm long; bracts conspicuously saccate at base _____ **T. gigantea**

Tradescantia buckleyi (I.M. Johnston) D.R. Hunt, (for Samuel Botsford Buckley, 1809–1884, state geologist of TX and plant collector), BUCKLEY'S SPIDERWORT. Plant to 50 cm tall; flowers subsessile; sepals densely pilose at base, sparsely so above; petals pale pink or whitish, clawed, the claws fused basally, forming a tube; stamens epipetalous; ovary and fruit pubescent. Clay soils; Gonzales Co. (Carr 2001, 2002d; Turner et al. 2003) at extreme s boundary of East TX; also Gulf Prairies and Marshes and South TX Plains; in the U.S. known only from TX (also Tamaulipas in Mexico). Mainly Feb–May. This species has sometimes (e.g., Correll & Johnston 1970) been recognized in the segregate genus *Setcreasea* as [*S. buckleyi* I.M. Johnston]. (RARE 2001, 2002b: G3S3) ⚠

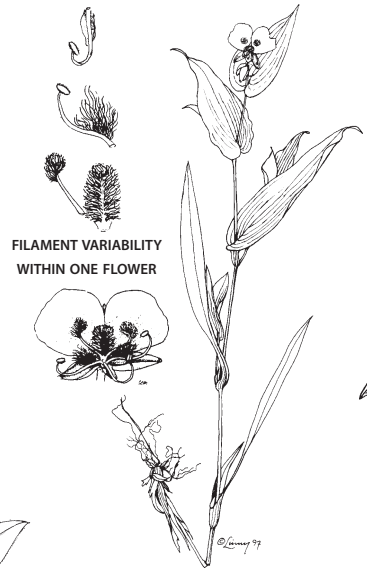
Tradescantia edwardsiana Tharp, (of Edwards Plateau), PLATEAU SPIDERWORT. Plant 25–70 cm tall; stems erect or ascending, puberulent to glabrate; leaf blades elliptic-lanceolate, 7–30 cm long, 15–65 mm wide, gradually constricted to the sheath, acuminate, minutely puberulent to essentially glabrate; leaf sheaths 7–20 mm wide, nearly glabrous except for the ciliate margins; pedicels minutely and densely puberulent, the hairs sometimes glandular when flowers are in bud stage; sepals glandular-puberulent, sometimes also with eglandular pubescence; petals white to pale blue or lavender, rarely bright pink, broadly ovate. Rich woods, moist alluvial terraces, and ravines; Bell, Collin, Dallas, Fannin (BRIT), Hays, Travis (Anderson & Woodson 1935), Bexar, Comal, and Grayson (Turner et al. 2003) cos.; endemic to TX (Kartesz 1999; Carr 2002b, 2002c)—Edwards Plateau, Cross Timbers and Prairies, and w part of East TX. Feb–May.

Tradescantia fluminensis Vellozo, (growing in running water), WANDERING WILLY, WHITE WANDERING-JEW. Stems decumbent, rooting at the nodes; leaf blades lanceolate-elliptic to narrowly ovate, 2.5–6 cm long, 1–2 cm wide, glabrous; pedicels conspicuous, 10–15 mm long; sepals with midribs bearing eglandular hairs; petals white. Weedy areas; known in TX only from Dallas (*Lehto 25584*, BRIT), San Jacinto (*E. Keith*, SBSC), Nacogdoches (R. George, pers. comm.), Brazos, and Smith (TAES—sheets reported on Digital Flora of Texas Herbarium Specimen Browser (2002), but not seen) cos.; AL, CA, FL, LA, and TX. Spring–fall. Native of South America. /304

Tradescantia gigantea Rose, (gigantic), GIANT SPIDERWORT. Plant to 100 cm tall; stems erect or ascending, branching infrequently, glabrous below, minutely pubescent above; leaf blades glabrous or the upper minutely pubescent; bracts conspicuously saccate at base; sepals usually with only eglandular pubescence; petals magenta-pink to blue. Limestone soils; e Edwards Plateau and sw part of East TX, scattered further n and e in Dallas, Hunt (BRIT), Brazos, Upshur, and Van Zandt (Turner et al. 2003) cos.; probably endemic to TX. Faden (2000b) mapped the species as occurring in LA but noted that "Plants of *Tradescantia gigantea* growing around Ruston, Louisiana, may have originated from cultivated plants." Mar–May. Reported to hybridize with *T. ohiensis* (Anderson & Woodson 1935, who were referring to individuals of *T. ohiensis* as *T. canaliculata* Raf.). /304



Murdannia nudiflora [MCV]



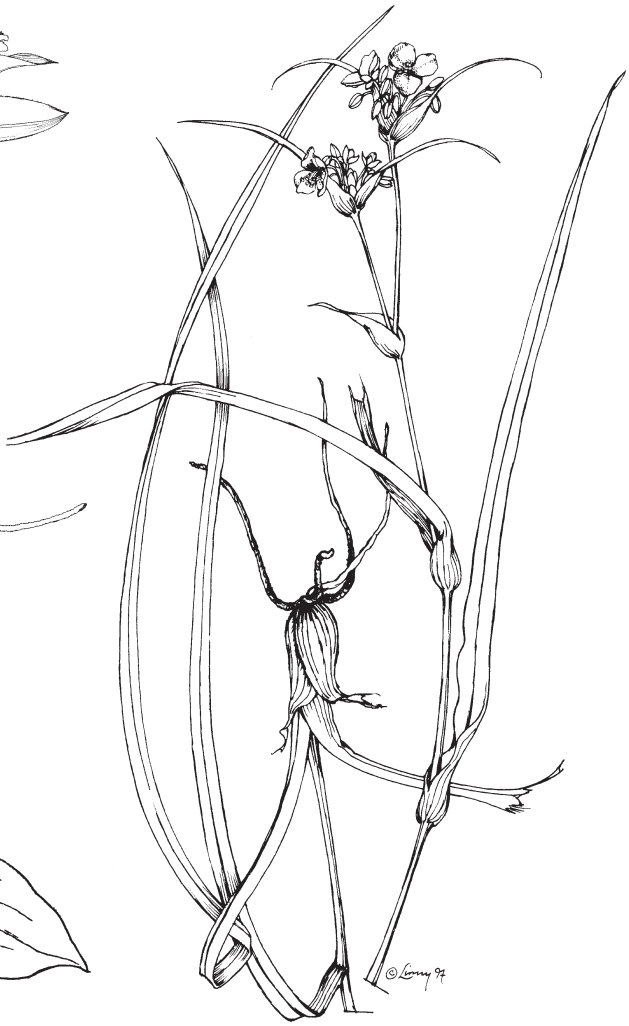
Tinantia anomala [HEA, TOR]



Tradescantia edwardsiana [RHO]



Tradescantia buckleyi [HEB]



Tradescantia gigantea [HEA]



Tradescantia fluminensis [BA3]

Tradescantia hirsutiflora Bush, (hairy-flowered), HAIRY-FLOWER SPIDERWORT. Plant 12–50 cm tall; stems ± spreading pilose to hirsute or glabrate; sepals with only eglandular pubescence or with both glandular and eglandular hairs; petals bright blue to purplish, rarely pink. Sandy soils; widespread in e 1/3 of TX; se U.S. from GA and FL w to OK and TX. Mar–Jun. The flowers can be quite fragrant (M. Reed, pers. obs.). Hybrids have been reported in other states with *T. occidentalis*, *T. ohiensis*, and *T. paludosa* (Faden 2000b). Short individuals of *T. hirsutiflora* may be confused with tall individuals of *T. subacaulis*; however, *T. hirsutiflora* has long, fleshy but not tuberous roots, while *T. subacaulis* has tuberous-thickened roots. ⚅/304

Tradescantia humilis Rose, (low-growing, dwarf), TEXAS SPIDERWORT, GRASS-VIOLET. Plant 10–30(–45) cm tall, minutely pubescent to slightly pilose or largely glabrous; sepals with both glandular and eglandular hairs; petals bright blue, occasionally pink. Sandy or rocky ground and disturbed sites; widespread in s part of East TX, scattered to the n; also Gulf Prairies and Marshes, South TX Plains, and e Edwards Plateau.; endemic to TX (Kartesz 1999; Carr 2002b, 2002c; Faden 2002b). Mar–Jun. 🤠

Tradescantia leiandra Torr., (with smooth stamens, presumably in reference to the glabrous filaments), CANYON SPIDERWORT, SETCREASEA. Plant 30–50 cm tall; flowers subsessile; sepals usually with both glandular and eglandular hairs; petals purplish red, clawed, the claws fused basally forming a tube; stamens epipetalous; fruit glabrous. Escaped from cultivation in Travis Co. on the campus of Saint Edward's University (Lynch 1974), but not widely naturalized (Carr 2002a); native to the mountains of the Trans-Pecos and adjacent Mexico. Jul–Oct. This species has sometimes (e.g., Correll & Johnston 1970) been recognized in the segregate genus *Setcreasea* as [*S. leiandra* (Torr.) Pilg.]. Plants from Presidio Co. (region of Capote Falls) have been recognized as a separate variety (var. *glandulosa* Correll) based on the presence of glandular versus eglandular pedicel hairs (Correll 1968; Faden 2000b). (RARE 2001, 2002b: G3S2) ⚠

Tradescantia occidentalis (Britton) Smyth, (western), PRAIRIE SPIDERWORT. Plant 10–90 cm tall; similar to *T. ohiensis* but with glandular hairs on sepals; leaf blades averaging narrower (to 20 mm wide); petals bright blue to rose or magenta. Sandy, gravelly, or less often clayey soils, prairies, thickets, and woods; widespread throughout TX but less common in e 1/3; sc Canada and e U.S. from WI s to LA w to MT and AZ. Mar–Jul. [*T. occidentalis* var. *melanthera* MacRoberts] Variety *melanthera* was named by MacRoberts (1977a) based on dark anther connectives. We are following Faden (2000b) in not recognizing this variety. ⚅/304

Tradescantia ohiensis Raf., (of Ohio), OHIO SPIDERWORT, BLUE-JACKET. Plant 20–75 cm tall, glabrous and glaucous; leaf blades 5–45 cm long, 3–32(–45) mm wide; sepals glabrous or with a tuft of eglandular hairs at the tip; petals blue to rose, magenta, or rarely white. Sandy or clayey soils, prairies, meadows, thickets and roadsides, now also commonly cultivated in native wildflower gardens; widespread and common in the e 1/2 of TX, scattered further w; se Canada (Ont.) and throughout e U.S. w to MN and TX. [*T. canaliculata* Raf., *T. ohiensis* var. *foliosa* (Small) MacRoberts] This is one of the most common spiderworts in East TX. According to Faden (2000b), it is the most common and widespread *Tradescantia* species in the U.S. It hybridizes with a number of other species (e.g., *T. gigantea*). Feb–Jun. The roots are reported to contain a poisonous saponin (Ajilvsgi 1984). ☠ ⚅/304

Tradescantia paludosa E.S. Anderson & Woodson, (growing in marshy places), CONFEDERATE SPIDERWORT. Plant 15–60 cm tall; stems glabrous, not at all to only slighly glaucous; leaf blades 4–11(–20) cm long, 4–12 mm wide, often constricted at base; sepals glabrous or with a tuft of eglandular hairs at the tip; petals pale blue. Bottomlands, forests, roadsides, and weedy areas; in TX known only from the extreme ne part of the Pineywoods (mapped without specific county—Faden 2000b); thus no county distribution map is provided; AL, AR, LA, MS, and TX. Mar–May. [*T. ohiensis* Raf. var. *paludosa* (E.S. Anderson & Woodson) MacRoberts] This species is similar to *T. ohiensis* but has smaller leaves and other distinguishing characteristics as indicated in the



Uvularia perfoliata



Uvularia sessilifolia



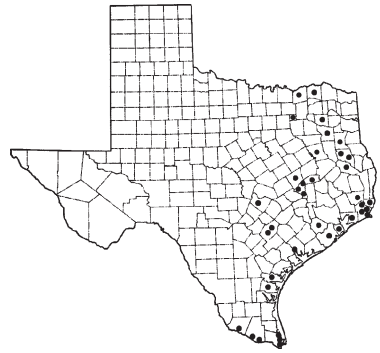
Callisia repens



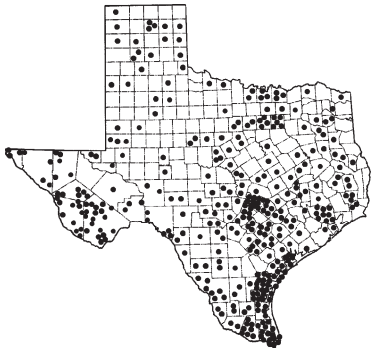
Commelina caroliniana



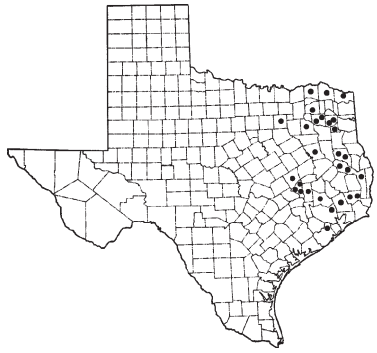
Commelina communis



Commelina diffusa



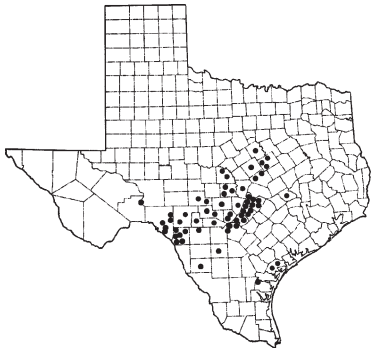
Commelina erecta
(all three vars.)



Commelina virginica



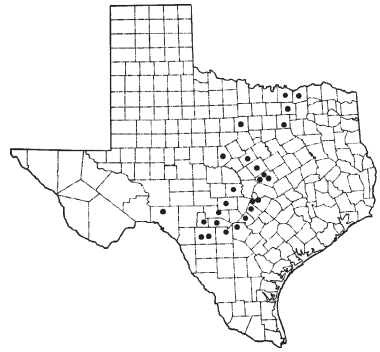
Murdannia nudiflora



Tinantia anomala



Tradescantia buckleyi



Tradescantia edwardsiana

key. While recognizing it as a distinct species, Faden (2000b) indicated that this is "... clearly Anderson and Woodson's weakest species, and D.T. MacRoberts (1979) may be correct in treating it as a variety of *Tradescantia ohiensis*." This species can be cultivated year-round in greenhouses, since the plants apparently do not require a winter dormancy (Faden 2000b).

Tradescantia reverchonii Bush, (for Julien Reverchon, 1837–1905, a French-American immigrant to Dallas and important botanical collector of early TX), REVERCHON'S SPIDERWORT, GRASS-VIOLET. Roots thick, fleshy, conspicuously felty with red-brown hairs easily visible to the naked eye; stems 30–105 cm tall, erect or ascending, simple or infrequently branched, usually rather densely pilose with somewhat matted or tangled hairs; sepals with eglandular or both eglandular and glandular hairs; petals bright blue (rarely rose or white). Sandy soils, open woods; widespread in the s and e parts of East TX, also collected at Dallas by Reverchon (Mahler 1988) but not found there since; also Gulf Prairies and Marshes, South TX Plains, and e Edwards Plateau; AR, LA, and TX. Mar–Jul.

Tradescantia subacaulis Bush, (almost without a stem), STEMLESS SPIDERWORT. Roots tuberous-thickened; stems spreading, 10–35 cm long, densely matted-pilose throughout; sepals with glandular and eglandular hairs; petals usually bright blue, occasionally pink. Loose sandy soils, open woods or open ground; widespread in e 1/2 of TX; endemic to TX (Faden 2000b; Carr 2002b, 2002c). Late Mar–Jun.

Tradescantia tharpii E.S. Anderson & Woodson, (for Benjamin Carroll Tharp, 1885–1964, botanist at Univ. of TX and author of *Structure of Texas Vegetation East of the 98th Meridian*), THARP'S SPIDERWORT. Plant long-pilose throughout, usually densely so; stems 2–7 cm tall in flower, to 20(–30) cm in fruit; stems rarely branching, often initially acaulescent; sepals with only eglandular pubescence; petals deep rose or purple, sometimes blue. Sandy clay or rarely silty clay soils, rocky prairies, open woods, or open ground; Collin, Denton, and Dallas (BRIT) cos. in the Blackland Prairie; while we have seen specimens from only a few counties, Hatch et al. (1990) cited vegetational areas 4, 5, 7, and 8, and the range map in Faden (2000b) shows the species occurring throughout East TX; KS, MO, OK, and TX. Late Mar–Apr.

CONVALLARIACEAE Horan.
LILY-OF-THE-VALLEY FAMILY

Rhizomatous perennial herbs, acaulescent or with arching to erect-arching stems; leaves all basal or cauline; inflorescences terminal or axillary; flowers perfect, 3-merous; perianth of distinct or fused segments; stamens 6; ovary superior or partly inferior; fruit a berry.

A small family (17 genera and 130 species) found in North and Central America, Europe, and Asia (Conran & Tamura 1998). The family placement of the genera treated here as Convallariaceae has been extremely variable. Many authorities in the past have put them in a broadly defined and clearly polyphyletic (but practical) Liliaceae (e.g., Correll & Johnston 1970; Cronquist 1988; Diggs et al. 1999) based on superficial similarities in flower structure to that of the genus *Lilium*. However, molecular analyses (Chase et al. 1995a, 2000; Fay et al. 2000) leave little doubt that the group belongs in order Asparagales. Judd et al. (1999) and Yamashita and Tamura (2000) placed the genera in the Convallariaceae, while Rudall et al. (2000a), Judd et al. (2002), and Judd (2003) treated them in a broadly interpreted Ruscaceae. More recently, the Angiosperm Phylogeny Group (APG II 2003) suggested placing them either in Ruscaceae or in a very broadly defined Asparagaceae (along with such families as Agavaceae). While placement in Asparagales now seems clear, there has been disagreement in molecular analyses of the complex that could possibly affect family circumscription (e.g., Rudall et al. 2000a; Yamashita & Tamura 2000). Until taxonomy of the group is more settled, we are following Conran and Tamura (1998) and Yamashita and Tamura (2000) in recognizing the Convallariaceae at the



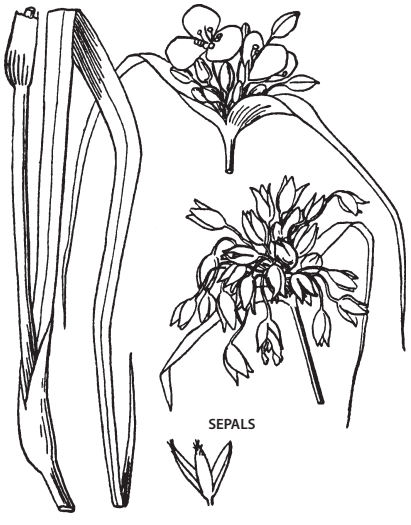
Tradescantia hirsutiflora [HEA]



Tradescantia humilis [HEA]



Tradescantia leiandra [HEB]



Tradescantia ohiensis [BB2]



Tradescantia occidentalis [FNA]

family level. It is more closely related to other Asparagales families such as the Agavaceae, Iridaceae and Orchidaceae than it is to many other taxa often put in a broadly defined Liliaceae (Chase et al. 1995a, 1995b, 1996, 2000; Fay et al. 2000). For a detailed discussion of the groups formerly treated as Liliaceae in the broad sense, see the family synopsis of the Liliaceae (here treated in a restricted sense) on page 726. Molecular evidence indicates that the Convallariaceae as treated here is closely related to Asparagaceae, Dracaenaceae, and Nolinaceae, and some studies (e.g., Chase et al. 1995a; Chase et al. 2000; Fay et al. 2000) have suggested that Dracaenaceae and Nolinaceae should be included in the Convallariaceae (which would otherwise be paraphyletic). However, since Nolinaceae appears to be a morphologically well-defined monophyletic group (Bogler & Simpson 1995, 1996), and until the nomenclature of this complex is settled, we are maintaining the Nolinaceae as a distinct family. Many Convallariaceae are cultivated as ornamentals, including *Clintonia* (WOOD-LILIES), *Convallaria*, *Disporum* (FAIRY-BELLS), *Liriope* (LILY-TURF), *Maianthemum* (MAY-LILIES), *Ophiopogon* (LILY-TURF, MONDO-GRASS), and *Streptopus* (TWISTED-STALK). Family name from *Convallaria*, LILY-OF-THE-VALLEY, a circumboreal genus of three closely related species often treated as a single species (Conran & Tamura 1998). LILY-OF-THE-VALLEY is a popular ornamental, but ☠ it contains cardiotoxic glycosides (Burrows & Tyrl 2001). (Latin: *convallis*, valley, in reference to a favored habitat of one of the species—Shosteck 1974) (subclass Liliidae—Cronquist; order Asparagales—APG II)

FAMILY RECOGNITION IN THE FIELD: of the three species occurring in East TX two are perennial herbs with arching to erect-arching, unbranched leafy stems and either axillary inflorescences of a few drooping flowers or many-flowered terminal panicles; the third is an introduced, cultivated, acaulescent herb with white or pale purple flowers in a raceme.

REFERENCES: Dahlgren et al. 1985; Shinwari et al. 1994; Conran & Tamura 1998; Rudall et al. 2000a; Yamashita & Tamura 2000; Judd 2003.

1. Plants acaulescent, all leaves basal; leaf blades 1.5 cm or less wide _____ **Ophiopogon**
1. Plants with an erect to erect-arching stem, the leaves cauline; leaf blades 3–8(–13) cm wide.
   2. Perianth 0.5–1 mm long, the segments distinct; inflorescences terminal panicles, with 50 or more flowers; fruits ruby red at maturity; leaves petiolate, the petioles 1–6 mm long _____ **Maianthemum**
   2. Perianth 13–20(–22) mm long, the segments fused nearly to their tips; inflorescences axillary, with 15 or fewer flowers; fruits blue-black at maturity; leaves sessile to clasping _____ **Polygonatum**

MAIANTHEMUM F.H. Wigg.

FALSE SOLOMON'S-SEAL, MAYFLOWER, MAY-LILY

A genus of 30–33 species (LaFrankie 2002; Judd 2003) of North and Central America, Europe, Siberia, the Himalayas, China, and Japan. Species are variously terrestrial or epiphytic, with most being understory herbs in cool moist forests (Judd 2003). The flowers are either dimerous with four tepals or trimerous with six tepals. Since dimerous flowers are quite unusual among monocots, the three species exhibiting this characteristic were in the past recognized as the genus *Maianthemum* (in the strict sense), while those species with trimerous flowers were placed in *Smilacina*. However, we are following LaFrankie (1986a, 1986b, 2002) and Judd (2003), who consider all the species closely related and treat them in a single genus (which because of nomenclatural priority must be *Maianthemum*). According to LaFrankie (2002) and Judd (2003), the monophyly of a broadly considered *Maianthemum* is supported by morphological, chromosomal, and molecular analyses, and the four-tepaled (2-merous) condition is apparently "the result of anatomical reduction from the 3-merous state." Some species are cultivated as ornamentals. According to Yatskievych (1999), the young shoots of some taxa can be cooked like asparagus, and "the starchy rhizomes of some species were soaked in lye and then parboiled by Native Americans." Pollination is apparently by various insects and fruit dispersal is by birds (Judd 2003). (Latin: *Maius*, May, and Greek: *anthemon*, flower—LaFrankie 2002)

REFERENCES: Kawano & Iltis 1966; LaFrankie 1984, 1986a, 1986b, 2002.



Tradescantia paludosa [AND]



Tradescantia subacaulis [HEA]



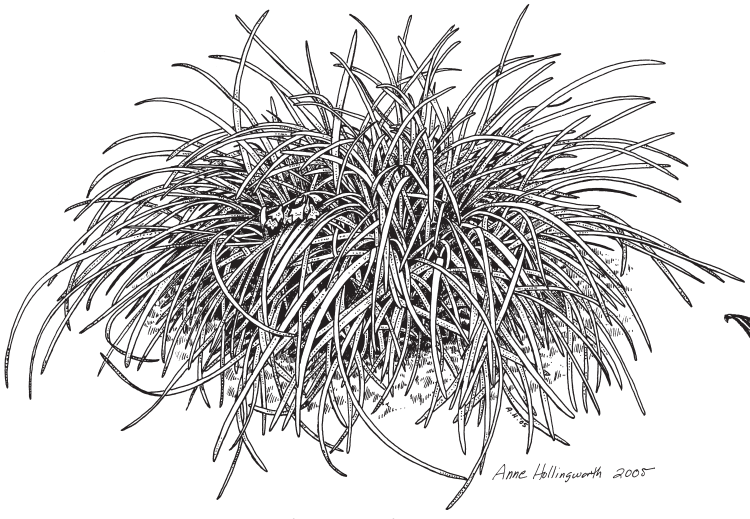
Tradescantia tharpii [AND]



Tradescantia reverchonii [HEA]



Maianthemum racemosum [YAT]



Ophiopogon jaburan [ann]



Polygonatum biflorum [BA1]

Maianthemum racemosum (L.) Link, (with a raceme type inflorescence), LARGE FALSE SOLOMON'S-SEAL, FALSE SPIKENARD, SOLOMON'S-PLUME. Herb with thick (8–14 mm wide), knotty, creeping rhizomes; stems arching, unbranched, to ca. 1(–1.2) m long; leaves 5–13 per stem, in 2 ranks, short petiolate, usually 7–18 cm long, 3–8 cm wide; inflorescence a panicle of ca. 50–250 small flowers; pedicels 0.5–1 mm long; flowers with 6 distinct tepals; tepals 0.5–1 mm long, white to yellowish white, inconspicuous; fruit a globose berry 4–6 mm in diam., when immature greenish or yellowish white with copper to reddish-brown speckles, maturing to translucent ruby red; seeds usually 1–2(–4). Deciduous woods; included based on mapped location in extreme ne part of East TX by LaFrankie (2002)—but without county specified (possibly Bowie Co.); we have seen no East TX specimens and only tentatively consider this species to be a member of the East TX flora; also Trans-Pecos; nearly throughout Canada and the U.S. Mid-spring. [*Convallaria racemosa* L., *Smilacina racemosa* (L.) Desf.] The species is sometimes cultivated (LaFrankie 2002). This taxon is apparently apomictic—seeds are produced without fertilization (LaFrankie 1986b; Yatskievych 1999). If present in East TX, the species is extremely rare and of conservation concern. ⚠

OPHIOPOGON Ker Gawl.
LILY-TURF, MONDO-GRASS, SNAKE-BEARD, JAPANESE-HYACINTH

A genus of ca. 20–54 species (Mabberley 1997; Conran & Tamura 1998) native from Indomalesia to the Himalayas and Japan. Some are cultivated as evergreen turf-formers. *Liriope muscari* (Decne.) L.H. Bailey, (BIG BLUE LILY-TURF; leaves 8–20 mm wide, usually exceeded by the scape; flowers dark violet to white) and *L. spicata* Lour. (CREEPING LILY-TURF; leaves 5 mm or less wide, longer than the scape; flowers pale violet to white) resemble *Ophiopogon* species and are cultivated, persist, and spread vegetatively in flower beds in East TX. They can be distinguished from *Ophiopogon* by having filaments about as long as the anthers and the tepals free from the ovary. (Greek: *ophis*, a snake, and *pogon*, beard)
REFERENCE: Walters et al. 1986.

Ophiopogon jaburan (Siebold) Lodd., (an oriental vernacular name), JABURAN LILY-TURF, WHITE LILY-TURF, GIANT LILY-TURF, SNAKE-BEARD. Scapose, tufted, evergreen, perennial herb; roots not tuberous; leaves linear, 10–15 mm wide, with 9–13 veins; inflorescence a terminal raceme; scape 30–60 cm long, shorter than to equaling the leaves in length; pedicels 10–15 mm long; flowers nodding, with 6 distinct tepals; tepals white or pale purple, 7–8 mm long, adnate in their lower portions to the ovary; filaments shorter than anthers; ovary partly inferior; stigma 1; fruit berry-like, oblong, 1-seeded; seed blue. Cultivated and presumably escaped; included based on report for the Big Thicket National Preserve (Harcombe 2004); no county distribution map is provided. AR and TX. Summer. Native of Japan. A number of variegated cultivars are known. This species is not very cold hardy, being used more in frost-free areas (Huxley et al. 1992). ☜

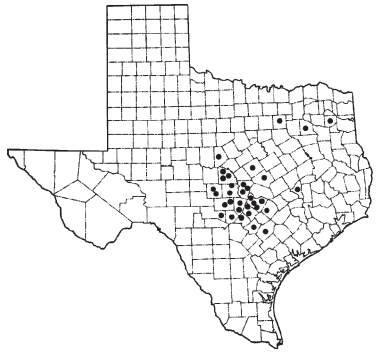
Ophiopogon japonicus (Thunb.) Ker Gawl., (of Japan), MONDO-GRASS, MONKEY-GRASS, DWARF LILY-TURF, DWARF MONDO, is widely cultivated in East TX. This native of China, Japan, and Korea is somewhat similar to *O. jaburan* but less robust. It can be distinguished by its tuberous roots, narrower, grass-like leaves (2–4 mm wide) with 3–5 veins, shorter scape (5–12 cm long), pedicels (2–6 mm long), and tepals (4–5 mm long). Variegated forms are known. This species is hardier than *O. jaburan* and can survive temperatures as low as -4° F(-20° C) or even lower (Huxley et al. 1992). ☜

POLYGONATUM Mill. SOLOMON'S-SEAL

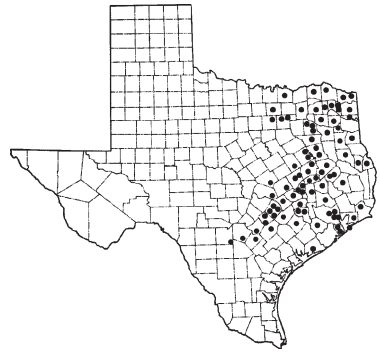
A genus of 57 species of herbs with robust horizontal rhizomes. It is distributed in the warm-temperate to boreal zones of the n hemisphere (especially sw China and Japan) (Tamura et al. 1997; Conran & Tamura 1998; Utech 2002c). The plants superficially resemble *Uvularia*,



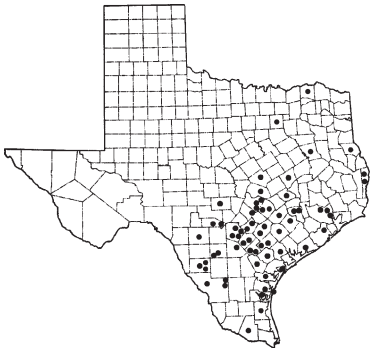
Tradescantia fluminensis



Tradescantia gigantea



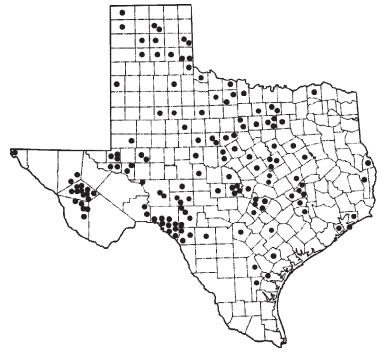
Tradescantia hirsutiflora



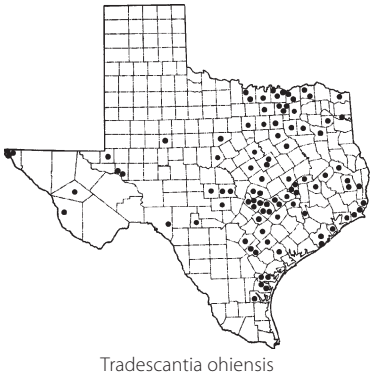
Tradescantia humilis



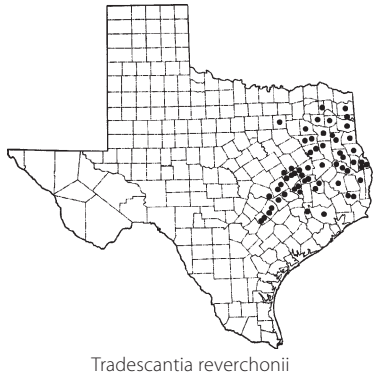
Tradescantia leiandra



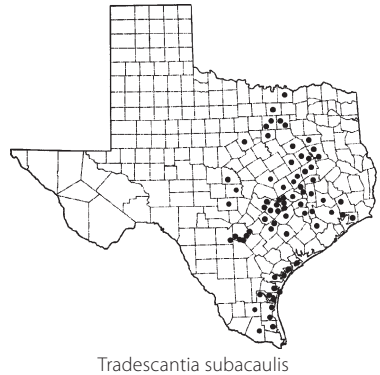
Tradescantia occidentalis



Tradescantia ohiensis



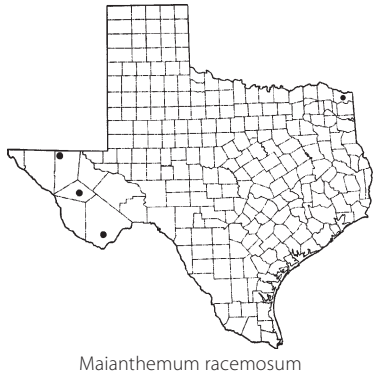
Tradescantia reverchonii



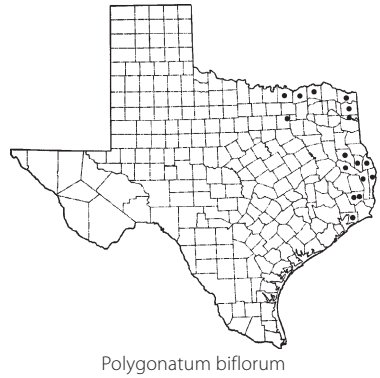
Tradescantia subacaulis



Tradescantia tharpii



Maianthemum racemosum



Polygonatum biflorum

BELLWORT, (Colchicaceae, order Liliales) but can be easily distinguished by the perianth parts fused nearly to their tips (vs. free in *Uvularia*). SOLOMON'S-SEAL can be told from FALSE SOLOMON'S-SEAL as follows: SOLOMON'S-SEAL has axillary flowers, while FALSE has them terminal. Soloman, being wise and diligent, sealed his documents as he wrote them. Impostors were lazy, saved them all up, and sealed them all at once. Recent molecular analysis suggests the genus is monophyletic (Tamura et al. 1997). At least some *Polygonatum* species are reported to have the "vibrator," "vibrational," or "buzz" pollination syndrome and to be pollinated by bumblebees (Corbet et al. 1988). In this syndrome (known in at least 72 families of plants), pollinators (which seek pollen as a reward but inadvertently carry some pollen to other flowers) shake the anthers by vibrating/shivering their thoracic flight muscles at a certain frequency; this audible "buzz" sets up a resonance in the anthers or the space they enclose and the otherwise inaccessible pollen is released from the vibrating anthers and collected by the insect (Buchmann 1983; Erickson & Buchmann 1983; Barth 1985; Proenca 1992; Harder & Barclay 1994; King & Buchmann 1996; Proctor et al. 1996; Judd 2003). Dispersal of the colorful berries is probably by birds (Judd 2003). Some species are variously used as ornamentals, for food, or medicinally. Native Americans used a number of species medicinally (Moerman 1998). However, the fruits contain an anthraquinone that causes vomiting and diarrhea (Utech 2002c). One possible derivation of the common name is that the scar formed on the rhizome when the stem breaks off at the end of the growing season supposedly resembles the official seal of King Solomon (Ajilvsgi 1984). Another possibility is that the name derives from "the plant's age-old use as a balm to seal, or close, fresh wounds" (Durant 1976). Yet another is that the plant has six-petaled flowers, resembling the six points of the Star of David, which was previously known as Solomon's seal (Durant 1976). (Greek, *polys*, many, and *gonu*, knee, in reference to the many joints of the rhizome) REFERENCES: Gates 1917; Bush 1927; Ownbey 1944; Tamura et al. 1997; Utech 2002c.

Polygonatum biflorum (Walter) Elliott, (two-flowered), GREAT SOLOMON'S-SEAL, GIANT SOLOMON'S-SEAL. Glabrous perennial from knotty rhizomes; stem erect-arching, to ca. 1 m tall (rarely taller); leaves borne along the stem, elliptic-lanceolate to broadly elliptic, to ca. 15(–25) cm long and 7(–13) cm wide, glabrous on both surfaces; inflorescences axillary, (1–)2–9(–15)-flowered; peduncles to ca. 6 cm long, elongating in fruit, flattened; pedicels to 2 cm long, sometimes longer in fruit; flowers perfect, pendulous; perianth 13–20(–22) mm long, whitish to greenish white or greenish yellow, the segments fused nearly to their tips; stamens 6; filaments inserted near middle of perianth tube; style 1; fruit a blue-black berry to ca. 12 mm in diam. Rich, moist, wooded slopes, mesic forests; Dallas (Spring Creek Preserve in Garland), Grayson (BRIT), Fannin, Red River (BAYLU), Bowie, Harrison, Nacogdoches, Rusk, San Augustine (ASTC), Angelina, Cass, Hardin, Lamar (TOES 1993), Jasper, Newton, and Sabine (Turner et al. 2003) cos.; mainly e Pineywoods and Red River drainage; se Canada and widespread in the e 2/3 of the U.S. Mar–May. [*Convallaria biflora* Walter, *P. biflorum* var. *commutatum* (Schult. f.) Morong, *P. commutatum* (Schult. f.) A. Dietr.] Native Americans boiled the young shoots and leaves and ate them as greens or like asparagus; the rhizomes were also eaten after being boiled or dried and beaten into flour (Moerman 1998; Utech 2002c). While some authorities (e.g., Kartesz 1999) recognize varieties in this species, it is a variable polyploid complex ($2n$ = 20, 40) that is problematic to divide (Utech 2002c; Judd 2003). Until further study clarifies the variation present, we are following Utech (2002c) and Judd (2003) in not recognizing infraspecific taxa. (TOES 1993: V) ⚠ ֍/295

CYPERACEAE Juss. SEDGE FAMILY

Annual or perennial herbs; culms (= stems) triangular (most commonly), flat, round, square, or multi-angular, with smooth nodes and usually pithy or spongy internodes; leaves with tubular basal sheath (often reduced or absent from upper leaves) closed except at summit (but apt to

become split by growth of culm), with or without a scaly ring or fringe of hair (ligule) at junction of sheath and blade on upper (inner) side, and a usually elongate blade (leaves all reduced to inconspicuous sheaths in *Eleocharis* and some *Cyperus* and *Scirpus*); inflorescences various (umbellate in *Cyperus* and *Fimbristylis* and less distinctly so in some other genera); flowers (often referred to as florets) perfect or unisexual (in *Carex* and *Scleria*), each subtended by a single (rarely 2) scale-like bract (these bracts often referred to as floral scales or in this treatment as scales of spikelets or simply scales), without perianth or perianth reduced to bristles or small perianth scales, solitary or in spikelets (= basic unit of inflorescence, consisting of a shortened axis and 1–numerous scale-like bracts, the lowermost of which are often empty); stamens 1–3, with anther attached by one end; pistil 1; fruit an achene, usually trigonous or biconvex.

A large, cosmopolitan (greatest diversity in the tropics but often dominant in cold regions), taxonomically difficult family of herbs, with over 5,000 species in 104 genera (Goetghebeur 1998); ca. 2,000 of the species are in the huge genus *Carex*. As such, it is the third largest monocot family, following the Orchidaceae and Poaceae. The Cyperaceae, with 248 species (7.3% of the total number of species), is the third largest family in the East TX flora (after Poaceae and Asteraceae). Floral structures are quite reduced in association with wind pollination, resulting in a lack of useful taxonomic characters (Yen & Olmstead 2000). Because of the often similar vegetative parts and reduced reproductive structures, technical characters requiring at least a hand lens frequently have to be used to distinguish species. Cyperaceae species superficially resemble both grasses and rushes, and recent evidence suggests a close relationship between Cyperaceae and Juncaceae (e.g., Simpson 1995; Goetghebeur 1998; Chase et al. 2000; Muasya 2000a; Ball et al. 2002). Phylogenetic analysis indicates that the family is monophyletic (Muasya et al. 2000a). Some molecular data suggest that Juncaceae and Cyperaceae are sister taxa (Chase et al. 1995b; Linder & Kellogg 1995) or even that Cyperaceae may be derived from within Juncaceae, possibly making Juncaceae paraphyletic (Plunkett et al. 1995; Munro & Linder 1998). According to Plunkett et al. (1995), the "progenitor-derivative relationship of Juncaceae and Cyperaceae ... reveals an additional example of paraphyletic families which presents a series of taxonomic dilemmas." A number of similar situations exist (e.g., Brassicaceae and Capparaceae), and if paraphyletic families are disallowed (as favored by many cladists), taxonomists are thus faced with wholesale rearrangement of many long established and easily recognized families—see Appendix 6 for further discussion of these issues. The family is of economic importance as wildlife food, for woodland grazing, or for erosion control; in n temperate parts of the world the plants sometimes replace grasses as forage; in TX in the Hill Country and w part of the state, *Carex emoryi* L. becomes important for livestock during summer months (S.D. Jones, pers. comm.); also some are problematic weeds. The sedge family (with ca. 32% of its species having C_4 photosynthesis) is one of only two monocot families (the other is the Poaceae) with the typical C_4 photosynthetic pathway (Soros & Bruhl 2000); this pathway is an adaptation to prevent water loss and is an advantage in arid environments. Phylogenetic analysis indicates that the C_4 pathway has arisen independently four times in the Cyperaceae (Soros & Bruhl 2000). (subclass Commelinidae—Cronquist; order Poales—APG II)

FAMILY RECOGNITION IN THE FIELD: grass-like or rush-like herbs with solid internodes, round or often *3-angled* culms ("sedges have edges"), and often 3-ranked leaves; many (but not all) species grow in wet habitats; flowers small, inconspicuous, without perianth or perianth reduced to bristles or small scales, subtended by 1 scale-like bract each (or in *Carex* the female flower enclosed in a sac-like perigynium), and arranged in very reduced spikes/spikelets. The ± similar Poaceae (GRASSES) have hollow or solid internodes, round culms, 2-ranked leaves usually with a ligule, and flowers subtended by 2 scale-like bracts each (lemma and palea); the ± similar Juncaceae (RUSHES) have flowers with a small 6-parted perianth.

REFERENCES: Svenson 1957; Dahlgren et al. 1985; Goetghebeur 1987, 1998; Tucker 1987; Bruhl et al. 1992; Bruhl 1995; Rolfsmeier 1995; Muasya et al. 2000a, 2000b; Simpson & Inglis 2001; Ball et al. 2002.

1. Pistil (and later achene) enclosed in a pouch or sac (= perigynium) from which the style is exserted during flowering; flowers imperfect _____ **Carex**
1. Pistil (and later achene) not enclosed in a perigynium (but subtended by a flat or concave scale); flowers perfect (imperfect in *Scleria*).
   2. Scales of spikelets (= scale-like bracts also referred to as floral scales or simply scales) 2-ranked (= in two distinct rows), the spikelets ± flattened or square in cross section.
      3. Culms without any leaf blades or leafy bracts (leaves reduced to basal sheaths); spikelets with 2–4(–9) scales; inflorescences without any branching whatsoever, of a solitary terminal spikelet; achenes with a tubercle (= cap-like persistent style base differing in appearance from achene) (in East TX only 1 species of *Eleocharis* (*E. baldwinii*) has the scales of spikelets 2-ranked) _____ **Eleocharis baldwinii**
      3. Culms (= stems) with leaf blades or leafy bracts at least below the inflorescence; spikelets with 1-many scales; inflorescences often conspicuously branched, of few–many spikelets; achenes without a tubercle; including species extremely abundant in East TX.
         4. Inflorescences widely spaced in the axils of leaves/bracts with well-developed sheaths; perianth bristles present, 6–9 per flower _____ **Dulichium**
         4. Inflorescence branches apically clustered and subtended by sheathless bracts; perianth bristles absent.
            5. Plants small (culms 40(–55) cm or less tall); inflorescence a single unlobed or 3-lobed (but unbranched) terminal structure; spikelets with only 2 well-developed scales (also with 2 minute, brownish, basal scales) and only 1 bisexual fertile flower; each spikelet with only 1 achene; achenes lenticular (= lens-shaped); styles 2-branched _____ **Kyllinga**
            5. Plants variable in size, but often much larger than 40 cm tall; inflorescence often obviously branched; spikelets usually with 4–many scales and 3–many bisexual flowers; each spikelet with > 1 achene; achenes usually trigonous (= 3-sided) OR in a few species lenticular; styles usually 3-branched OR in a few species 2-branched _____ **Cyperus**
   2. Scales of spikelets spirally arranged, not 2-ranked, the spikelets round OR scales only 2 per spikelet.
      6. Scales of spikelets white; spikelets in a terminal, leafy-bracted head-like cluster, the bracts with white bases; style branches 2 _____ **Rhynchospora**
      6. Scales of spikelets variously colored (may rarely be partly white); inflorescences various, but not with white-based bracts; style branches 2 or 3.
         7. Inflorescences with a single spikelet, this terminal, the inflorescences thus without any branching whatsoever; culms without leaf blades or leafy bracts; achenes with a tubercle (= cap-like persistent style base at apex of achenes, differing in appearance from actual achene) _____ **Eleocharis**
         7. Inflorescences with 1–many spikelets, these terminal or lateral, the inflorescences thus unbranched OR often conspicuously branched; culms with leaf blades (at least basal ones) or leafy bracts; achenes with or without a tubercle.
            8. Achenes with whitish or light grayish, bony or crustaceous, outer layer (pericarp), usually sitting on a distinct hardened ring-like or disk-like pad (= hypogynium); flowers unisexual _____ **Scleria**
            8. Achenes with neither whitish, light grayish, bony, nor crustaceous outer layer, nor sitting on a distinct, hardened, ring-like or disk-like pad; flowers bisexual.
               9. Achenes with a prominent tubercle; spikelets usually 1–few-flowered, the uppermost 1–2 florets usually without pistil; lower (1–)2–3 scales of spikelets usually sterile _____ **Rhynchospora**
               9. Achenes without tubercle (except in *Bulbostylis*, which has thread-like leaves); spikelets 1–many-flowered, all florets with pistil; only lowest scale of spikelet usually sterile (except in *Cladium* which usually has more than 1 sterile lower scale).
                  10. Scales of spikelets with prominent bristle-tip longer than width of scale base; perianth of 3 stalked-bladed perianth scales, these sometimes alternating with 3 bristles _____ **Fuirena**

10. Scales of spikelets with short bristle-tip or bristle-tip absent; perianth of 1 thin perianth scale, or of bristles, or perianth absent.
    11. Spikelets (actually small spikelet-like spikes or heads of spirally arranged single-flowered spikelets) 1–5(–8) mm long, sessile; each scale enclosing a single, thin, inconspicuous perianth-like bracteole; plants very small, to only 15(–20) cm tall; scales with 2 or 3 prominent veins (use strong hand lens) _____ **Lipocarpha**
    11. Spikelets 2.5–20 mm long, sessile or on distinct pedicels; each scale enclosing a perianth of bristles or perianth absent; plants small to very large; scales with only 1 prominent vein (the midrib).
        12. Spikelets with a single fertile (= achene-producing) floret subtended by ca. 2–5 empty scales (these lack achenes but can have an aborted pistil or stamens); leaf margins scaberulous (= only slightly roughened, almost smooth to the touch) to dangerously spinulose-serrulate (= saw-toothed); inflorescences with numerous spikelets, these usually in groups of 2–10 at the ends of short branches; perianth absent; species rare in East TX _____ **Cladium**
        12. Spikelets not as above, with 1–many fertile florets, each spikelet subtended by at most 1 empty scale; leaf margins various; inflorescences not as above; perianth absent or of bristles; including species common and widespread in East TX.
            13. Inflorescences usually either 1-sided or widely spreading or drooping; perianth of bristles (except in *Isolepis* and *Schoenoplectus saximontanus*); plants small to very large (to 5 m tall) (segregates of *Scirpus* in the broad sense).
                14. Inflorescences with 1(–2) spreading to erect modified leaf (involucral bract) appearing like a continuation of the culm, the inflorescences thus appearing lateral; culms with 1–3 leaves near base OR without blade-bearing leaves.
                    15. Plants rhizomatous perennials 30–300(–500) cm tall; culms 2–20 mm thick near base; achenes smooth; perianth bristles present; inflorescences with 1–150 or more spikelets _____ **Schoenoplectus**
                    15. Plants tufted annuals or perennials 2–65 cm tall; culms 0.2–1.5 mm thick near base; achenes minutely papillose (sometimes obscurely so) or with prominent, transverse, wavy ridges; perianth bristles absent.
                        16. Achenes minutely papillose (this can sometimes be obscured by a whitish wax-like layer); spikelets 2–10 mm long; inflorescences with 1–3 spikelets; plants 2–25(–40) cm tall _____ **Isolepis**
                        16. Achenes with prominent, transverse, wavy ridges; spikelets 5–20 mm long; inflorescences with 1–10(–20) spikelets; plants 9–65 cm tall _____ **Schoenoplectus**
                14. Inflorescences with 2 or more well-developed leaf-like involucral bracts, the inflorescences appearing terminal; culms with well-developed leaves.
                    17. Spikelets small, 3–10 mm long, 2–4 mm wide, very numerous; scales of spikelets glabrous, not apically notched, awnless or nearly so; achenes < 1.5 mm long; culms mostly obscurely triangular _____ **Scirpus**

17. Spikelets larger, 10–30(–40) mm long, (4–)6–10 mm wide, often relatively few in number; scales of spikelets puberulent, often glabrescent, apically notched and with an awn 1–3 mm long; achenes usually 2.3–4.1 mm long; culms sharply triangular _____ **Bolboschoenus**

13. Inflorescences neither distinctly 1-sided, widely spreading, nor drooping; perianth absent; plants 1 m or less tall, often much less.
    18. Leaf blades thread-like, 0.1–0.6 mm wide; achenes with tubercle (= cap-like persistent style base differing in appearance from actual achene); inflorescences often with only 1 prominent bract _____ **Bulbostylis**
    18. Leaf blades flat, some or all over 0.8 mm wide; achenes without tubercle; inflorescences with 2 or more leafy bracts.
        19. Spikelets 1-flowered (with only 2 well-formed scales per spikelet), sessile in head-like, almost spikelet-like clusters closely subtended by bracts much longer than the heads; style base neither dilated nor fimbriate _____ **Kyllinga**
        19. Spikelets several–many-flowered (scales numerous), on distinct pedicels, or if clustered then spikelets conspicuously many-scaled; style base often dilated and fimbriate _____ **Fimbristylis**

BOLBOSCHOENUS (Asch.) Palla BULRUSH, TUBEROUS BULRUSH

Rhizomatous perennials to ca. 1.5 m tall, often forming dense stands; rhizomes 1–5 mm thick; corms ("tubers") developing at base of culms, to ca. 20 mm thick; culms sharply triangular, with nodes, usually 3–8 mm in diam.; leaves basal and cauline, several; leaf sheaths reaching ca. to middle of culm or beyond; ligules absent; leaf blades well-developed, to 12 mm wide; inflorescence terminal, with 2 or more well-developed, leaf-like, involucral bracts (1–4 of them longer than the inflorescence); spikelets large, 10–30(–40) mm long, usually few in number, (1–)2–15(–40), either all sessile or some single or clustered on peduncles, round in cross section; scales of spikelets 25 or more per spikelet, spirally arranged, apically notched, awned; perianth bristles 3–6, not persistent on fallen achenes or a few persistent; stamens 3; styles bifid or trifid; achenes biconvex to compressed trigonous, without a tubercle.

A genus of 6–15 species (Smith 2002a) known from North America, Eurasia, Central and South America, Africa, Australia, and some Pacific Islands. Four species are native to North America n of Mexico, and 1 naturalized. Previously included in *Scirpus* (e.g., Kartesz 1994) and sometimes treated as a section or subgenus in *Scirpus* in the broad sense. Strong (1993, 1994) and Kartesz (1999) included *Bolboschoenus* in *Schoenoplectus*. Smith (2002a), however, pointed out several differences between the genera (e.g., *Bolboschoenus* with leaves basal and cauline, without ligules vs. *Schoenoplectus* with leaves usually all basal, with ligules). We are thus following Browning et al. (1995b), Smith (1995, 2002a), and Jones et al. (1997) in recognizing this segregate of *Scirpus* at the generic level. This approach is supported by phylogenetic studies (e.g., Bruhl 1995; Muasya et al. 2000b) which suggest that *Scirpus* sensu lato is polyphyletic. Some species are dominants in wetlands and can be valuable to wildlife (Kantrud 1996; Smith 2002a). The following key to species is modified from that in Smith (2002a). (Greek: *bulbus*, bulb, and *schoeno*, reed or rush-like, in reference to the corms)

REFERENCES: Beetle 1942, 1947; Koyama 1962; Tucker 1987; Strong 1993, 1994; Browning et al. 1995b; Bruhl 1995; Smith 1995, 2002a; Smith & Yatskievych 1996; Smith & Kukkonen 1999; Muasya et al. 2000b.

1. Spikelet scales translucent, membranous, with awns ca. 0.25 mm wide at base; achenes usually biconvex; styles 2-branched, rarely a few 3-branched; anthers yellow, rarely orange _____ **B. maritimus**
1. Spikelet scales nearly opaque, usually papery, with awns ca. 0.4–0.5 mm wide at base; achenes mostly compressed trigonous; styles mostly 3-branched, a few 2-branched; anthers brownish orange _____ **B. robustus**

Bolboschoenus maritimus (L.) Palla subsp. **paludosus** (A. Nelson) T. Koyama, (sp.: of the sea; subsp.: growing in marshy places), ALKALI BULRUSH, BAYONET-GRASS, PRAIRIE BULRUSH, SALTMARSH BULRUSH, SALTMARSH CLUB-RUSH. Plant (40–)60–150 cm tall; leaf sheath fronts (=ventral surface) usually membranous at mouth, the veins diverging below summit leaving a triangular veinless area; spikelets 10–30(–40) mm long, (4–)6–10 mm in diam.; scales of spikelets medium brown to nearly colorless, rarely darker, with midnerve prolonged into a 1–3 mm long awn; achenes 2.3–4.1 mm long, biconvex. Wet lands, in alkaline or brackish to saline soils; Grayson (Hagerman National Wildlife Refuge—BRIT) and Kaufman (Turner et al. 2003) cos.; scattered inland mainly in the w 2/3 of TX; widespread in coastal and w interior Canada and the U.S. (except the se). Jul–Aug. [*B. paludosus* (A. Nelson) Soó, *Schoenoplectus maritimus* (L.) Lye, *Scirpus maritimus* L., *Scirpus maritimus* L. var. *paludosus* (A. Nelson) Kük., *Scirpus paludosus* A. Nelson, *Scirpus pacificus* Britton] All TX material is subsp. *paludosus*; subspecies *maritimus* is a primarily European taxon known in North America only from the North Atlantic coast (Smith 2002a). The corms were used as food by Native Americans in w North America (Beetle 1950).

Bolboschoenus robustus (Pursh) Soják, (stout, strong in growth), SEASIDE BULRUSH, SEASIDE CLUBRUSH, SALT-MARSH BULRUSH. Plant 50–150 cm tall; leaf sheath fronts often papery at mouth, the veins reaching nearly to the summit (in some parts of the range of the species) or in the Gulf region (including TX) sometimes with a triangular, membranous, veinless area as in *B. maritimus*; spikelets 10–30 mm long, 6–10 mm in diam.; scales of spikelets medium to dark orange-brown, with a 2–3 mm long awn; achenes 2.7–3.5 mm long, usually compressed trigonous. Brackish to saline shores and marshes; Van Zandt Co. (inland salt marsh, due to a salt dome, near Grand Saline, BRIT—identification confirmed by G. Smith); mainly coastal (the only noncoastal localities known are in AR, LA, and TX (Smith 2002a); Atlantic and Gulf coasts from ME s to FL w to TX, also CA. Spring–fall. [*Schoenoplectus robustus* (Pursh) M.T. Strong, *Scirpus maritimus* (L.) Palla var. *macrostachyus* Michx., *Scirpus robustus* Pursh] This species has not been recognized in TX by some authors (e.g., Turner et al. 2003); Smith (2002a) noted that *B. maritimus* and *B. robustus* "have long been widely confused in the southwest." Probable hybrids with *B. maritimus* are known (Smith 2002a). ⊞/277

BULBOSTYLIS Kunth HAIR SEDGE

Ours small tufted annuals or short-lived perennials with fibrous roots; leaves basal, filiform or setaceous; inflorescence a small, simple or compound, umbel-like cyme (sometimes referred to as an anthela) at end of flowering culm, short-bracted, only 1 bract prominent; spikelets several-flowered; scales of spikelets spirally imbricate, keeled; perianth bristles absent; achenes trigonous-obovoid, ca. 1 mm long; style base persistent as a minute tubercle.

A genus of ca. 100 species (Kral 2002c) of tropical and warm areas, with the center of diversity in tropical Africa (Tucker 1987); previously included in *Fimbristylis*. The tubercle (= caplike persistent style base differing in appearance from actual achene) of *Bulbostylis* distinguishes it from *Fimbristylis* (which lacks a tubercle). Kral (1971) and Tucker (1987) discussed separation of the two genera. The diminutive members of this genus have been described as "wispy" and "easily overlooked in the field" (Yatskievych 1999); they are often found in dry sandy habitats. The 4 East TX species differ in chromosome number (Tucker 1987). (Greek: *bolbos*, swelling or bulb, and *stylos*, pillar, column, or style)

REFERENCES: Gordon-Gray 1971; Lye 1971b; Kral 1971, 2002c; Tucker 1987; Jones & Wipff 1992a.

1. All spikelets sessile or essentially so (mature spikelets can drop the lower scales and appear stalked); inflorescence a solitary, dense, hemispherical to globose cluster of spikelets; achenes 0.5–0.6 mm long; scales of spikelet glabrous and lustrous ____ **B. barbata**
1. Most spikelets distinctly stalked; inflorescence a simple or compound, open or compact, umbellate cyme; achenes longer than 0.6 mm; scales of spikelet usually puberulent, rarely glabrous, dull not lustrous.
   2. Umbel-like cymes simple; scales of spikelets truncate to broadly obtuse at apex, often notched, the tip of the keel barely reaching base of notch; achenes finely transversely ridged, not papillate; plants annual ____ **B. capillaris**
   2. Umbel-like cymes sometimes compound (the cyme branches themselves bearing small cymes); scales of spikelets broadly obtuse to acute at apex, the tip of the keel reaching the apex of the scale or slightly exceeding it; achenes papillate (= with fine pebbling; use hand lens or dissecting scope), evenly so or the papillae sometimes in lines; plants annual OR perennial, sometimes with culm bases hard and swollen.
      3. Scales of spikelet 1–1.5 mm long; achenes when mature gray, the faces evenly papillate; plants annual or perennial; species widespread in East TX ____ **B. ciliatifolia**
      3. Scales of spikelet 2–2.7 mm long; achenes when mature gray to yellow-brown or dark brown, papillate, but the papillae arranged in lines; plants perennial, the culm bases often hard and swollen; species in TX primarily of the w part of the state, known in East TX only from Washington Co. ____ **B. juncoides**

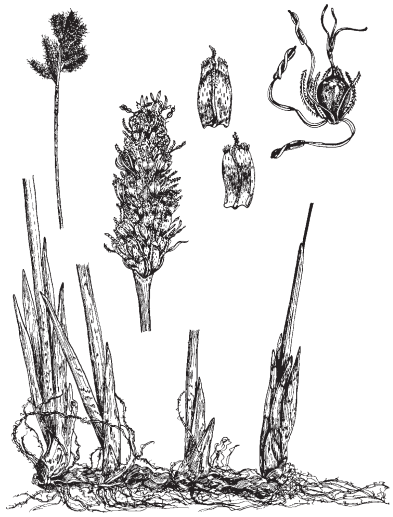
Bulbostylis barbata (Rottb.) C.B. Clarke, (barbed), WATER-GRASS. Slender annual to 20(–30) cm tall; spikelets narrowly lance-ovoid to linear or oblong, 3–7 mm long, the scales 1.2–2.2 mm long; achenes finely reticulate; $n = 5$ (Kral 1971). The lone TX locality was a disturbed area along a ditch with running water, on strongly acid sand; in general "moist to dry sands of roadbanks, fields, natural and artificial clearings" (Kral 1971); known in TX only from Newton Co. (Jones & Wipff 1992; Turner et al. 2003); se U.S. from NC s to FL w to TX. Jul–Sep(–Oct). [*Scirpus barbatus* Rottb.] Native of the Old World tropics. First reported for TX in 1992 (Jones & Wipff 1992). Kral (1971) indicated that this is a weedy species expanding its range in the se U.S., and that it is a "frequent invader of cultivated ground and common enough on sandy fields in late summer to form a reddish-brown carpet of inflorescences."

Bulbostylis capillaris (L.) Kunth ex C.B. Clarke, (hair-like), HAIR SEDGE, DENSE-TUFT HAIR SEDGE. Slender annual 5–35 cm tall; spikelets narrowly ovoid, (2–)3–5 mm long, rarely longer, the scales 1.5–2 mm long; $n = 36$ (Tucker 1987); however, Kral (2002c) has $2n = 84$. In loose sand; e 1/2 of TX and Trans-Pecos; se Canada and widespread in e 1/2 of the U.S., also AZ, CA, and NM. Jun–Sep. [*B. capillaris* var. *crebra* Fernald, *Fimbristylis capillaris* (L.) A. Gray, *Scirpus capillaris* L.] Clusters of spikelets are reported to be occasionally found at the plant base in this species (Kral 1971, 2002c).

Bulbostylis ciliatifolia (Elliott) Fernald, (ciliate-leaved), CAPILLARY HAIR SEDGE. Annual or short-lived perennial to 40 cm tall; spikelets narrowly ovoid to lance-ovoid or oblong, 2–6 mm long. Sandy areas. Summer–Fall. Kral (1971) separated 2 varieties as follows:

1. Annuals usually 20 cm or less tall; inflorescence a simple to rarely compound umbel of few, lance-ovoid spikelets; longest bract of inflorescence seldom exceeding inflorescence; edges of leaves usually hispidulous ____ var. **ciliatifolia**
1. Perennials 15–40 cm tall; inflorescence usually of many, oblong or lance-linear spikelets and commonly compound; longest bract of inflorescence commonly longer than inflorescence; edges of leaves usually distinctly tuberculate-scabrid ____ var. **coarctata**

var. **ciliatifolia**. Annual. Bastrop Co. (BRIT) in s part of East TX, also Parker Co. (BRIT) in the Cross Timbers and Prairies. [*Scirpus ciliatifolius* Elliott] We have seen specimens of this variety



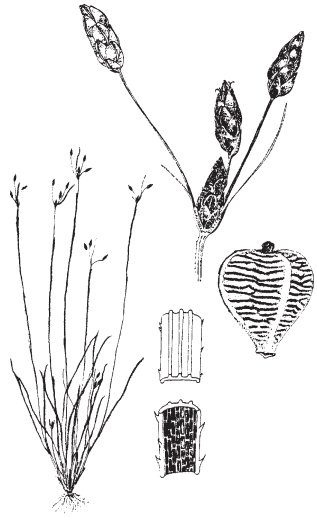
Bolboschoenus maritimus subsp. paludosus [CO1]



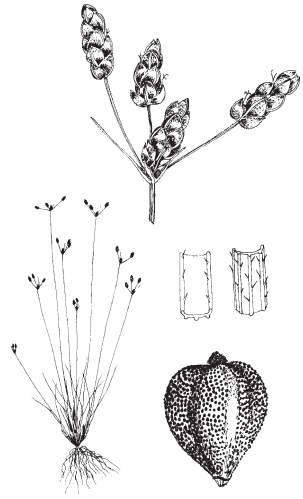
Bolboschoenus robustus [MAS]



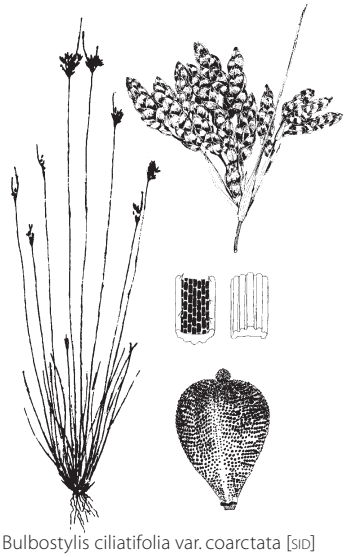
Bulbostylis barbata [SID]



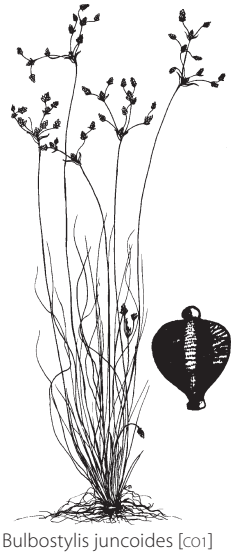
Bulbostylis capillaris [SID]



Bulbostylis ciliatifolia var. ciliatifolia [SID]



Bulbostylis ciliatifolia var. coarctata [SID]



Bulbostylis juncoides [CO1]

from only 2 TX counties (both annotated by R. Kral); it is apparently much less abundant in TX than is var. *coarctata*; se U.S. from VA s to FL w to TX. While not officially designated as such (e.g., TOES 1993; Carr 2002b; Poole et al. 2002), given its limited known occurance in the state, we consider this variety to be of conservation concern in TX. ⚠

var. **coarctata** (Elliott) Kral, (crowded together). Perennial; *n* = 30 (Kral 1971). Widespread in e 1/2 of TX; se U.S. from VA s to FL w to TX. [*B. coarctata* (Elliott) Fernald, *Scirpus coarctatus* Elliott]

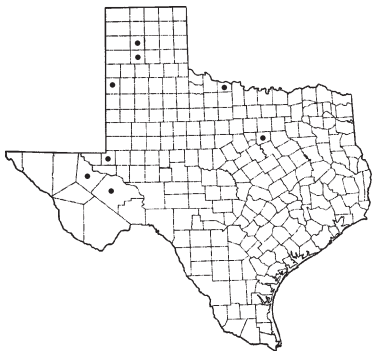
Bulbostylis juncoides (Vahl) Kük., (barbed), RUSH HAIR SEDGE. Perennial, to 30(—40) cm tall, densely cespitose, often with hard, swollen culm bases; spikelets lanceoloid to cylindric, 4—6 mm long; *n* = 60 (Kral 1971). "Rolling upland" (from Carr label), prairies, savannahs, often in rock crevices, typically at high elevations; disjunct from w TX e to Washington Co. (Turner et al. 2003, based on *Carr 17189*, TEX); mainly Edwards Plateau and Trans-Pecos; AZ, NM, and TX. Flowering throughout the growing season. [*B. fendleri* C.B. Clarke, *B. juncoides* var. *ampliceps* Kük., *Fimbristylis juncoides* (Vahl) Alain] Kral (2002c, pers. comm.) indicates that this species is extremely polymorphic.

CAREX L. CARIC SEDGE

Treatment and maps prepared by Stanley D. Jones (BRCH)

Cespitose or rhizomatous grass-like perennial herbs; culms trigonous or infrequently hexagonal or rarely terete, mostly solid, rarely hollow, fertile or both vegetative (including pseudoculms) and fertile culms present; leaves 3-ranked (this helps distinguish the vegetative stage of *Carex* and other Cyperaceae from grasses); leaf sheaths closed, ligulate; ligule hyaline; leaf blades mostly narrowly linear or sometimes broadly linear (grass-like), rarely otherwise, usually with antrorsely serrulate margins; basal leaves usually more numerous and longer than cauline leaves; inflorescences simple, compound, or decompound, of terminal spikes, terminal and lateral spikes, racemes, spicate-racemes, or open or contracted panicles of spicate or racemose branches; spikes ("spike" is frequently applied to most if not all of these broad ranging inflorescence types in *Carex*) either unisexual or bisexual, sessile, separate and distinct or crowded into a compact head in which the individual spikes are obscured, or spikes peduncled and distinct, the peduncles either short or long (Braun 1967); bisexual spikes androgynous (= having the staminate flowers distal to the pistillate) or gynecandrous (= having the pistillate flowers distal to the staminate); unisexual spikes arranged so that the staminate spike is terminal, with lateral spikes pistillate or sometimes androgynous; flowers incomplete and imperfect, either pistillate or staminate (all East TX plants monoecious), each solitary in the axil of a single subtending, 1—3-veined pistillate or staminate scale-like bract, without a perianth; staminate flowers with (2–)3 stamens, the filaments in ours filiform and distinct; pistillate flowers enclosed by an indehiscent sac-like scale (the **perigynium**, the most distinctive feature of the genus) with an apical orifice from which the style and/or stigmas protrude at anthesis; perigynium chartaceous, coriaceous, or membranous in texture, pubescent or glabrous, granular, verrucose, or without any noticeable surface ornamentation, veinless or with several to numerous raised or impressed veins, beaked or beakless, closely enveloping the achene and not at all inflated to strongly inflated, with corky tissue at base or not so, winged or not so; carpels 2 or 3; style withering and deciduous or persistant on the achene, if persistent then the lower portion being of the same color and texture as the achene; stigmas 2—3(–4); ovary 1, with a single ovule; fruit an achene, lenticular, trigonous or subterete (obscurely trigonous), without perianth bristles; chromosome number: *n* = 6—56 (Tucker 1987).

A huge cosmopolitan genus of significant taxonomic difficulty, comprising ca. 2,000 species (Ball & Reznicek 2002), mostly in n temperate and arctic regions, of moist to wet habitats but with many dry site species; when tropical mostly montane. In many wetlands, *Carex* is one of the most prolific and obvious constituents. The polarization of character states is very uncertain and a difficult endeavor in a genus so large and whose phylogeny is so poorly understood



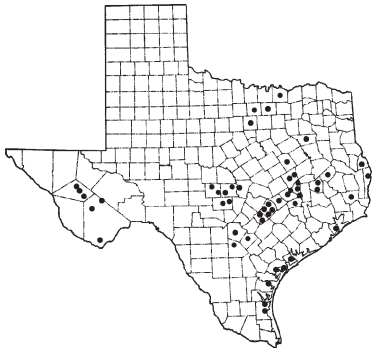
Bolboschoenus maritimus subsp. paludosus



Bolboschoenus robustus



Bulbostylis barbata



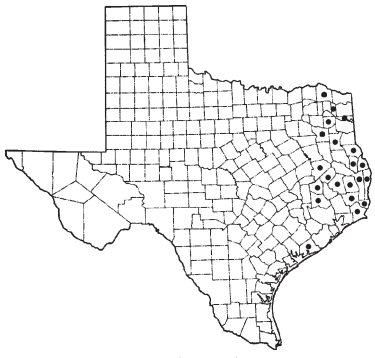
Bulbostylis capillaris



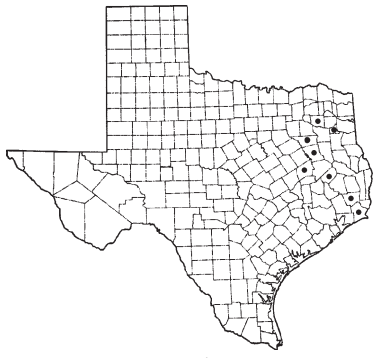
Bulbostylis ciliatifolia



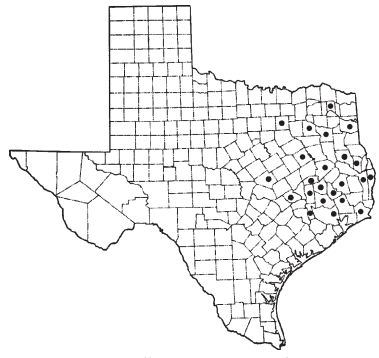
Bulbostylis juncoides



Carex abscondita



Carex alata



Carex albicans var. australis



Carex albolutescens

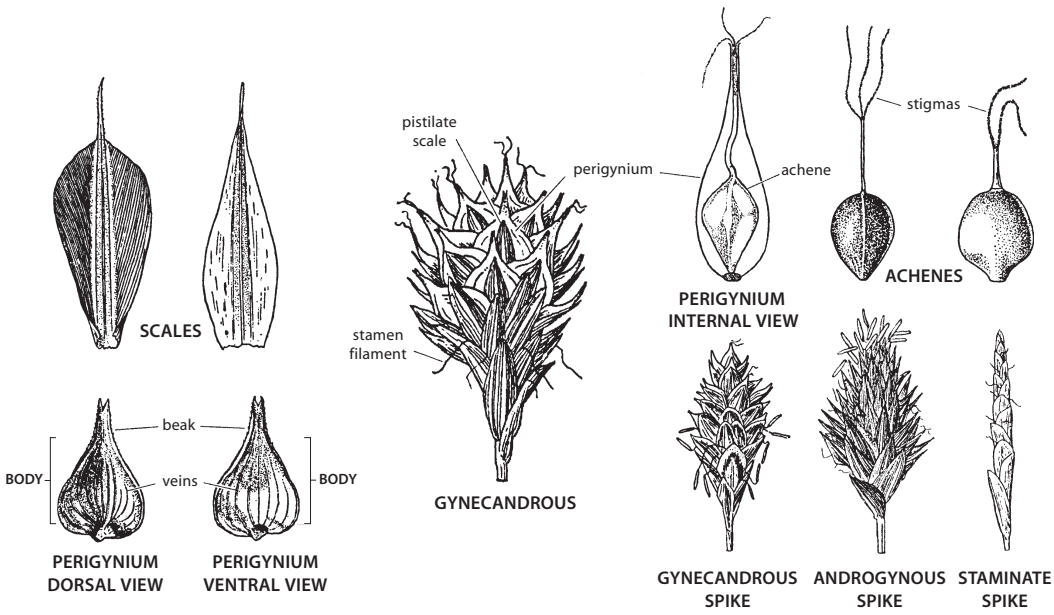


Carex amphibola

(Crins 1990; Reznicek 1990; Naczi et al. 1998). Recent molecular analysis suggests that *Carex* is paraphyletic, with three smaller genera, *Cymophyllus*, *Kobresia*, and *Uncinia*, derived from within it (Yen & Olmstead 2000); further work is needed to clarify such relationships. It is the largest genus of vascular plants in North America, with 480 species being documented in the recent Flora of North America treatment (Ball & Reznicek 2002). It is also the largest genus in the TX flora, with ca. 95 taxa plus 6 introduced cultivated species that may persist. Further, it is the largest genus in the East TX flora, with 80 species. The genus *Carex* is divided into taxonomic subdivisions known as sections. Of the 70 sections occurring in North America, 28 can be found in East TX. The appropriate section name is given following each species description. The nursery industry has caught on to the aesthetic beauty of *Carex,* and almost every nursery has several to many species for sale. The number of cultivated *Carex* species in TX is surely going to increase. Forage value of *Carex* for livestock in TX is generally low, but the genus is of use to wildlife, especially rabbits, rodents, deer, and birds, including turkey and bobwhite quail. Martin et al. (1951) listed 77 species of fur or game mammals that feed on *Carex*. A few of the northern and western United States species (*C. geyeri* Boott, *C. filifolia* Nutt., etc.) have high nutritional content and have been used as forage for cattle. Kreczetovicz (1935) stated that up to 5% of hay and pasture production in the USSR was comprised of *Carex*. In western TX, *Carex emoryi* Dewey (WILLIAM EMORY'S CARIC SEDGE) is frequently foraged on by cattle while visiting rivers and streams to drink. The genus is also important in preventing soil erosion. Some species are especially important as sand binders in dune areas. Many are pioneer species or species found around ponds and swamps, where they collect alluvium and help in the gradual filling of depressions. In some arctic and alpine regions they are the dominant meadow vegetation. *Carex* can also be a good ecological indicator, as many species are specific in their habitat requirements (Jermy et al. 1982). Regarding dispersal, "It has been assumed that inflated perigynia are dispersed by floating on water, but experimental verification is lacking" (Tucker 1987). The genus is primarily wind-pollinated, though no species of *Carex* is known to cause hayfever. *Carex albula* Allan, *C. buchananii* Berggr., *C. conica* Boott ex L.M. Perry, *C. flacca* Schreb., and *C. morrowii* Boott var. *morrowii* and *C. muskingumensis* Schwein. are cultivars that are widely sold in TX nurseries and may persist depending on local environmental conditions.

County records cited in the text are based on the records of S.D. Jones.

Floral Characteristics of Carex [mac]



The following key to species is based on mature perigynia (= sac-like structure enclosing the pistillate flower and later the fruit) and fruits (achene); fruiting material is essential for proper identification. The following specialized terminology may be helpful: infructescence = a mature inflorescence, in other words, an inflorescence in fruit; incomplete veins = veins that do not extend the entire length of the perigynium body; septate-nodulose = with conspicuous cross venation; androgynous = condition where the staminate flowers are distal to the pistillate flowers; gynecandrous = condition where the pistillate flowers are distal to the staminate flowers; abaxial side = side away from the axis or dorsal side; adaxial side = side toward the axis or ventral side. Digital images (line drawings) of most East TX *Carex* species are available on-line (TAMU 1997). (The classical Latin name, of obscure origin; possibly from the Greek: *keirein*, to cut, on account of the sharp leaves—as indicated in the English name SHEAR-GRASS)

REFERENCES: Kükenthal 1909; Mackenzie 1931—35, 1940; Hermann 1954, 1970; Bryson 1980; Reznicek & Ball 1980; Menapace et al. 1986; Tucker 1987; Standley 1989, 1990, 2002a, 2002b, 2002c; Ball 1990; Bernard 1990; Crins 1990; Jones & Hatch 1990; Manhart 1990; Naczi 1990, 1992, 2000, 2002; Naczi & Bryson 1990; Reznicek 1990, 2002a, 2002b, 2002c; Jones & Reznicek 1991, 1995; Jones et al. 1991a, 1991b; Rothrock 1991; Cayouette & Catling 1992; Jones & Jones 1993; Reznicek & Naczi 1993; Jones 1994a, 1994b; Rothrock & Reznicek 1996a, 1996b, 2001, 2002; Ford et al. 1998; Hyatt 1998; Naczi et al. 1998, 2002; Miller et al. 1999; Mohlenbrock 1999; Starr et al. 1999; Yen & Olmstead 2000a, 2000b; Roalson et al. 2001; Rosen 2001; Ball 2002a, 2002b, 2002c; Ball & Reznicek 2002; Bryson & Naczi 2002a, 2002b; Cochrane 2002a, 2002b; Cochrane & Naczi 2002; Crins & Rettig 2002; Crins et al. 2002; Ford & Reznicek 2002; Mastrogiuseppe et al. 2002; Naczi & Bryson 2002; Reznicek & Catling 2002; Reznicek & Ford 2002; Standley et al. 2002; Waterway 2002; Downer & Hyatt 2003; MacRoberts et al. 2004; Starr et al. 2004.

1. Achenes 2–sided, plano-convex or unequally biconvex in transverse-section; stigmas 2.
   2. Infructescence (= inflorescence in fruit) 2–5 cm wide, usually an open or contracted panicle of spicate branches.
      3. Perigynia with beak as long as or longer than the body; dorsal surface of leaf sheaths green without white dots; ventral leaf sheath margins with orange-red dots; achenes ovate-
      3. Perigynia with beak shorter than the body; dorsal surface of leaf sheath dark blue-green with conspicuous white dots; ventral leaf sheath margins without orange-red dots; achenes broadly ovate; perigynial wall little to not at all adhering to achene _____ **C. oklahomensis**
   2. Infructescence less than 1.5 cm wide, a contracted panicle of spicate branches, spicate racemes, or composed of terminal, lateral, or terminal and lateral spikes.
      4. Terminal spike solely staminate, or sometimes partly pistillate as in some specimens of *C. crinita*.
         5. Lateral spikes conspicuously peduncled, drooping or not _____ **C. crinita** var. **brevicrinis**
         5. Lateral spikes, at least the lower, sessile or nearly so, ascending.
            6. At maturity leaf sheaths becoming fimbriate filiferous, hyaline material between veins fugacious, leaving only a reticulate network of veins; lower lateral spikes usually remote; perigynia granular-papillate in upper half _____ **C. stricta**
            6. At maturity leaf sheath not becoming fimbriate filiferous, hyaline material between veins not fugacious, not leaving a reticulate network of veins, instead leaving leaf sheath intact; lower lateral spikes overlapping; perigynia granular-papillate only apically _____ **C. emoryi**
      4. Terminal spike either androgynous or gynecandrous.
         7. Terminal or all spikes androgynous (in some species the staminate flowers often fugacious, making spikes appear solely pistillate); spikes not appearing clavate.
            8. Primary spicate branches usually less than 10, most frequently the primary branches comprised of a single spike, infrequently rebranching giving rise to secondary spikes.

9. Leaf sheaths baggy (loose) around the culm _____ **C. gravida**
9. Leaf sheaths tight (not loose) around the culm.
    10. Lowest inflorescence bract 5.5–25 cm long, greatly exceeding the inflorescence, two to many times as long as the inflorescence.
        11. Culms smooth below inflorescence; plants of open or semi-open bottomlands or floodplain habitats _____ **C. arkansana**
        11. Culms antrorsely scaberulous below inflorescence; plants of open mesic to submesic woodlands _____ **C. perdentata**
    10. Lowest inflorescence bract less than 5.5 cm long, not exceeding the inflorescence, or less than two times as long as the inflorescence.
        12. Beaks of perigynia smooth, not serrated.
            13. Perigynia ovate-deltoid, veinless ventrally, spongy at base but without a swollen spongy area at base on ventral surface _____ **C. leavenworthii**
            13. Perigynia ovate-lanceoid, with veins present or absent on ventral surface, with an enlarged spongy area at base of perigynia.
                14. Perigynia 1.3–1.8 mm wide; widest leaf blade 1.5–3 mm wide; veins present on ventral surface over enlarged spongy area at base of perigynia. _____ **C. retroflexa**
                14. Perigynia 1–1.3 mm wide; widest leaf blade 1–1.5 mm wide; veins absent on ventral surface over enlarged spongy area at base of perigynia _____ **C. texensis**
        12. Beaks of perigynia serrated, not smooth.
            15. Perigynia spongy at base (especially ventrally), with or without a swollen area at base.
                16. Perigynia (1.4–)1.5–2.7(–2.8) mm wide, ovate-deltoid or conspicuously ovate, without a swollen spongy area at base on ventral surface.
                    17. Perigynia 2.2–3.2(–3.3) mm long, veinless ventrally, with 0(–3) veins dorsally _____ **C. leavenworthii**
                    17. Perigynia (3.3–)3.4–5.2(–5.6) mm long, with 0–5(–8) narrow veins (ca. 0.1–0.2 mm wide) ventrally, with 0–10(–11) narrow veins dorsally _____ **C. perdentata**
                16. Perigynia 0.9–1.8 mm wide, ovate-lanceoid or slightly ovate-oblong, with a swollen spongy area at base of ventral surface.
                    18. Perigynia (3–)4–5 times as long as wide, 3.6–4.1 mm long, 0.7–1.2 mm wide; plants with ± elongate rhizomes _____ **C. socialis**
                    18. Perigynia 3 or less times as long as wide, 3–3.5 mm long, 1.4–1.6 mm wide; plants without elongate rhizomes _____ **C. rosea**
            15. Perigynia not spongy at base.
                19. Adaxial and abaxial leaf surfaces smooth, not minutely papillose (sandpaper-like), except sometimes sparingly so along major veins.
                    20. Perigynia (3.4–)3.5–4.7 mm long, (2–)2.1–2.7(–3.1) mm wide.
                        21. Apex of the ventral surface of leaf sheath straight or slightly concave, not callused or only slightly thickened, friable (= easily crumbled); frequently with scattered reddish dots; dorsal surface of leaf sheaths white or pale green with darker green longitudinal veins, with darker green septate-nodules, but not green mottled with white; widest leaf blade (3–)4–8 mm wide; most culms forming greater than 70° angle with the ground _____ **C. gravida**
                        21. Apex of ventral surface of leaf sheath concave, callused, not friable; without scattered reddish dots; dorsal surface

of leaf sheaths green, with darker green septate-nodules, some sheaths green mottled with white; widest leaf blade 2.5–4.5 mm wide; most culms forming less than a 50°angle with the ground, usually much less _____ **C. austrina**

20. Perigynia 2–3.5 mm long, 1.3–2.3(–2.4) mm wide.
    22. Perigynia bodies ovate-deltoid; perigynia beaks 0.3–0.7(–0.8) mm long, with a single row of serrations, the beak abruptly arising from the apex of the perigynium; widest leaf blade 1.1–3(–4) mm wide; leaves per fertile culm 2–6(–7); culm width ca. 2 cm above rootstock 1–2.4(–3.5) mm wide; pistillate scale (1.3–)1.5–2.2(–2.5) mm long, with awn 0–0.8(–1) mm long; dorsal surface of leaf sheath frequently green mottled with white dots _____ **C. leavenworthii**
    22. Perigynia bodies ovate or suborbicular; perigynia beaks 0.8–1.1 mm long with a double row of serrations, the beaks gradually tapering from the shoulder of the perigynium; widest leaf blade (1.9–)2.5–4.4 mm wide; leaves per fertile culm (4–)5–8; culm width ca. 2 cm above rootstock 1.7–3.2(–3.3) mm wide; pistillate scale 1.1–1.7(–1.9) mm long, with awn 0–3.2 mm long; dorsal surface of leaf sheath mostly green, infrequently green mottled with white dots _____ **C. cephalophora**

19. Adaxial or both adaxial and abaxial leaf surfaces minutely papillose (sandpaper-like), at least near distal end.
    23. Ventral surface of perigynia with (5–)6–15 conspicuous broad veins (ca. 0.05 mm wide), the dorsal surface with (0–)1–12 broad veins _____ **C. muehlenbergii** var. **muehlenbergii**
    23. Ventral surface of perigynia with 0–6(–8) narrow veins (ca. 0.01–0.02 mm wide), the dorsal surface with 0–11(–14) narrow veins.
        24. Pistillate scales 3–4.2(–4.3) mm long, (1–)1.6–2.6(–3) mm wide, with mid-stripe 3–veined, rarely 1–veined; culms usually forming an angle of 50° or less with the ground _____ **C. austrina**
        24. Pistillate scales (1.5–)1.8–3.1 mm long, (1–)1.2–1.8(–2.2) mm wide, with mid-stripe 1-veined, occasionally 3-veined; culms usually forming an angle of 70° or more with the ground.
            25. Beaks of perigynia 0.2–0.6(–1) mm long, abruptly arising from apex of perigynium; perigynia broadly ovate, (1.5–)2.5–3.8 mm long; dorsal surface of leaf sheaths frequently green with mottled white dots _____ **C. muehlenbergii** var. **enervis**
            25. Beaks of perigynia (1–)1.4–1.7(–1.8) mm long, tapering from shoulders or occasionally abruptly arising from apex of perigynia; perigynia ovate or ovate-deltoid, 3.2–5.2(–5.6) mm long; dorsal surface of leaf sheaths only infrequently mottled with white dots _____ **C. perdentata**

8. Primary spicate branches more than 10, often these primary branches rebranching into secondary branches.
    26. Perigynia spongy or corky at base; leaf sheaths loose around culm.

27. Perigynia beaks as long as or longer than the bodies; dorsal surface of leaf sheaths green without white dots; ventral leaf sheath margins with orange-red dots; achenes ovate-lanceolate; perigynial wall adhering to achene _____ **C. crus-corvi**

27. Perigynia beaks shorter than the bodies; dorsal surface of leaf sheath dark blue-green with conspicuous white dots; ventral leaf sheath margins without orange-red dots; achenes broadly ovate; perigynial wall little to not at all adhering to achene _____ **C. oklahomensis**

26. Perigynia not spongy or corky at base; leaf sheaths tight around culm.

28. Perigynia dark brown or brown to olivaceous, shiny, conspicuously biconvex; ventral surface of leaf sheaths veinless and not transversely rugose; plants normally growing on *Taxodium* stumps in cypress swamps _____ **C. decomposita**

28. Perigynia green, stramineous, or brownish, if brownish not shiny, lenticular; ventral surface of leaf sheaths with longitudinal veins and transversely rugose, at least at maturity; plants not normally growing on *Taxodium* stumps.

29. Most leaf blades equal to or exceeding the flowering culms _____ **C. vulpinoidea**

29. Most leaf blades shorter than the flowering culms.

30. Perigynia with red glandular dots; perigynia broader than long or less frequently as broad as long, reniform or infrequently more or less orbicular; pistillate scales inconspicuous _____ **C. triangularis**

30. Perigynia without red glandular dots; perigynia narrowly ovate to ovate-orbicular, usually narrower than long or equal in width and length; pistillate scales usually conspicuous.

31. Achene 1.2–1.5 mm long; perigynia 1.6–2.4 mm broad, 2.6–3.2 mm long; apex of the ventral surface of leaf sheaths of the upper leaves somewhat thickened; base of culms 2.5–3(–4.5) mm thick; rhizomes not elongate _____ **C. annectens**

31. Achenes 1.7–2 mm long; perigynia (2–)2.5–2.8 mm broad, 3–4.5 mm long; apex of the ventral surface of leaf sheaths of the upper leaves friable (= easily crumbled), not thickened; base of culms (3–)3.5–6 mm thick; rhizomes elongate _____ **C. fissa**

7. Terminal or all spikes gynecandrous; spikes frequently appearing clavate.

32. Base of perigynia bodies with spongy tissue; achene seated above the spongy tissue, not at the base; margins of perigynia not winged, or if so, not conspicuously so.

33. Perigynia lanceolate, 4.5–5.5 mm long, 0.7–1 mm wide, ascending; spikes overlapping, all but the lowest _____ **C. bromoides**

33. Perigynia ovate, suborbicular or reniform, 1.9–3.8 mm long, 1.5–3 mm wide, divergent to reflexed; spikes interrupted, not overlapping _____ **C. atlantica**

34. Widest leaf blades 1.6–4 mm wide; infructescence mostly 18–50 mm long; perigynia 2.3–3.8 mm long _____ **C. atlantica** subsp. **atlantica**

34. Widest leaf blades 0.7–1.6 mm wide; infructescence mostly 8–20 mm long; perigynia 1.9–3 mm long _____ **C. atlantica** subsp. **capillacea**

32. Base of perigynia bodies without spongy tissue; achene seated at or near the base; margins of perigynia conspicuously winged.

35. Pistillate scales (at least the upper) scabrously awned, aristate; perigynia widest well above the middle; inner bands (adaxial surface) of leaf sheaths green _____ **C. alata**

35. Pistillate scales obtuse to more or less acuminate, but never scabrously awned; perigynia and leaf sheaths various.

36. Perigynium wing restricted to upper half of body; perigynia bodies oblanceolate, mostly less than 1.5 mm wide _____ **C. tribuloides** var. **sangamonensis**

36. Perigynium wing not restricted to upper half of body; perigynia bodies ovate, obovate, orbicular, or reniform, 1.5–6 mm wide.

37. Perigynia with several obvious veins over the achene on the adaxial (= ventral) surface.
    38. Perigynia beaks 1.5–2.5 mm long; perigynia 5–20(–30) per spike; spikes 2–4 per culm _____ **C. hyalina**
    38. Perigynia beaks less than 1.5(–1.8) mm long; perigynia 25–80 per spike; spikes 3–8 per culm.
        39. Perigynium body widest above the middle, the body more or less obovate.
            40. Styles abruptly contorted just above the achene; perigynium beak abruptly tapered to a long tip, spreading away from the spike _____ **C. albolutescens**
            40. Styles straight to somewhat sinuous but not abruptly contorted; perigynium beak abruptly or gradually tapering, spreading from the spike at maturity or appressed to the resst of the spike.
                41. Larger achenes 0.8–1.2 mm wide; larger perigynia 1.6–2.8 mm wide, 4–6(–7) veined over achene adaxially.
                    42. Pistillate scales reddish-brown and acute; inflorescences of robust culms arched or nodding, 2.3–8.4 cm long, the spikes strongly separated; spikes clavate, the staminate portion of well-developed spikes 2–11 mm long; leaf sheaths glabrous or rarely sparsely papillose; achenes 0.9–1.2 mm wide, with apiculum 0.4–0.8 mm long _____ **C. ozarkana**
                    42. Pistillate scales white-hyaline and obtuse; inflorescences of robust culms erect, 1–4.5 cm long, the spikes slightly separated to congested; spikes rounded to acute at base, the staminate portion of the spikes < 2 mm long; leaf sheaths sparsely to densely papillose (at 30× magnification); achenes 0.75–1 mm wide, with apiculum < 0.4 mm long _____ **C. longii**
                41. Larger achenes (1.3–)1.4–1.8 mm wide; larger perigynia 2.5–3.3(–3.6) mm wide, veinless or few-veined adaxially.
                    43. Larger perigynia 3.2–4.7(–5) mm long; pistillate scales acute, the larger scales 3.3–3.4(—4.3) mm long, 2.3–3 times longer than wide; achenes 1–1.2 (—1.4) times longer than wide _____ **C. brevior**
                    43. Larger perigynia (4.7–)5–5.5 mm long; pistillate scales acuminate, the larger scales (3.8–)4–4.9 mm long, 3.3–4.2 times longer than wide; achenes (1.2–)1.3–1.6 times longer than wide _____ **C. shinnersii**
        39. Perigynium body widest at or below the middle, the body more or less orbicular.
            44. Larger achenes 1–1.35 mm wide, 1.2–1.7 mm long; larger perigynia 2.5–4(–4.2) mm long, 1.5–2.4(–2.6) mm wide ____ **C. festucacea**
            44. Larger achenes (1.3–)1.4–1.8 mm wide, (1.6–)1.7–2.2 mm long; larger perigynia 3.2–5.5 mm long, 2.5–3.3(—3.6) mm wide.
                45. Larger perigynia 3.2–4.7(—5) mm long; pistillate scales acute, 3.3–4(–4.3) mm long, 2.3–3.1 times longer than wide; achenes 1–1.2(–1.4) times longer than wide _____ **C. brevior**

45. Larger perigynia (4.7–)5–5.5 mm long; larger pistillate scales acuminate, (3.8–)4–4.9 mm long, 3.3–4.2 times longer than wide; achenes (1.2–)1.3–1.6 times longer than wide _____ **C. shinnersii**

37. Perigynia veinless or rarely with 1–3 faint veins over the achene on the adaxial (= ventral) surface.
46. Perigynia bodies reniform, 0.6–0.9 times as long as wide, (2.6–)3.2–5 mm wide, the ventral surface finely granular-papillose (at 30–40× magnification) _____ **C. reniformis**
46. Perigynia bodies more or less orbicular or rarely obovate, 0.9–1.6 times as long as wide, 1.5–6.1 mm wide, if slightly reniform then less than 2.6 mm wide, the ventral surface smooth (at 30–40×).
47. Perigynia obovate _____ **C. brevior**
47. Perigynia more or less orbicular.
48. Larger perigynia 4–6 mm wide _____ **C. tetrastachya**
48. Larger perigynia 1.5–3.4 mm wide.
49. Larger achenes 1.4–1.8 mm wide, 1.7–2 mm long; larger perigynia 3.4–4.5 mm long, 2.5–3.3(–3.4) mm wide _____ **C. brevior**
49. Larger achenes (1–)1.1–1.35 mm wide, 1.3–1.7 mm long; larger perigynia 2.5–3.9(–4.2) mm long, 1.5–2.5 mm wide _____ **C. festucacea**

1. Achenes 3-sided, trigonous or obscurely terete in transverse-section; stigmas 3.
50. Style continuous with the achene, and of the same color and texture as the achene, persisting.
51. Spike solitary and terminating the flowering culm.
52. Spike androgynous or solely pistillate, 5–18 mm long × 2–3 mm thick; leaf blades 0.5–1.3 mm wide _____ **C. leptalea** subsp. **harperi**
52. Spike gynecandrous, 30–40 mm long × 12–15 mm thick; leaf blades 3.5–10 mm wide _____ **C. typhina**
51. Spikes two or more per flowering culm, terminal, lateral, or terminal and lateral.
53. Larger perigynia 1 cm long or longer, including beaks.
54. Perigynia with body lanceolate, 2.5 mm wide or less; style straight _____ **C. lonchocarpa**
54. Perigynia with body narrowly or broadly ovoid, (2.5–)3.5–7 mm wide; style bent and usually contorted.
55. Pistillate spike outline tending to be globose; perigynia loosely arranged, spreading, drying dark olive-drab green _____ **C. intumescens**
55. Pistillate spike outline oblong to cylindric; perigynia either loosely arranged or not, drying stramineous, green or light olive-drab green.
56. Peduncles of staminate spikes greatly exceeding the uppermost pistillate spike; perigynia loosely arranged, ascending-spreading _____ **C. louisianica**
56. Peduncles of staminate spikes shorter than to only slightly exceeding the uppermost pistillate spike; perigynia either loosely arranged or tightly arranged.
57. Achenes distinctly wider than long, widest above the middle, subtruncate to truncate apically; perigynia loose to tightly arranged, usually squarrose at maturity (± 90° to the rachis) _____ **C. gigantea**
57. Achenes as wide as long or longer, widest near the middle, not subtruncate or truncate apically, perigynia tightly arranged, ascending or slightly spreading but usually not squarrose.
58. Achene shoulders (area from widest part of the achene to apex) convex or plane, the angles of achene smooth curved, not knobbed, the faces flat to slightly concave _____ **C. lupulina**

58. Achene shoulders concave, the angles of achene more or less pointed, with nipple-like knobs, the faces strongly concave _____ **C. lupuliformis**

53. Larger perigynia 1 cm long or longer, including beaks.
    59. Larger perigynia 7–9(–9.5) mm long, including beaks, the beaks 3–4 mm long _____ **C. lurida**
    59. Larger perigynia 4–6.5(–7) mm long, including beaks, the beaks 2.8 mm long or less.
        60. Perigynia mostly squarrose at maturity (± 90° to the rachis); beaks of perigynia abruptly arising from perigynia bodies _____ **C. frankii**
        60. Perigynia ascending or descending along the rachis; beaks of perigynia abruptly arising from perigynia bodies OR tapering.
            61. Perigynia descending along the rachis; teeth of perigynium beak long and widely divergent _____ **C. comosa**
            61. Perigynia ascending along the rachis; teeth of perigynium beak more or less straight, not widely divergent, or if divergent, then relatively short.
                62. Spikes gynecandrous, two per flowering culm _____ **C. typhina**
                62. Spikes usually solely staminate and solely pistillate, or some lateral spikes may be androgynous, while the terminal is solely staminate, the spikes three or more per flowering culm _____ **C. hyalinolepis**

50. Style not continuous with the achene, and usually not of the same color and/or texture as the achene, not persistent, withering, however, an apiculus may remain.
    63. Perigynia pubescent, at least apically, often minutely so (use 25× magnification).
        64. Perigynia mostly concealed by pistillate scales.
            65. Staminate and pistillate spikes widely separate on elongate peduncles; plants without elongate creeping rhizomes _____ **C. microrhyncha**
            65. Staminate and pistillate spikes at most moderately separate; plants with elongate creeping rhizomes.
                66. Perigynia 2.5–3 mm long; flowering culms conspicuous, not hidden among the leaves _____ **C. albicans** var. **australis**
                66. Perigynia 3.2–3.4 mm long; flowering culms inconspicuous, hidden among the leaves _____ **C. nigromarginata** var. **floridana**
        64. Perigynia conspicuous, not concealed by pistillate scales.
            67. Flowering culms without basal spikes; spikes 15–20 flowered _____ **C. tenax**
            67. Flowering culms with basal spikes; spikes 3–6 flowered _____ **C. planostachys**
    63. Perigynia glabrous or at most granular.
        68. Spikes, at least some, arising from or near the base of a flowering culm (at least some spikes arising at or near the base of the plant).
            69. Perigynia distichously arranged along the rachis _____ **C. planispicata**
            69. Perigynia spirally imbricate along the rachis, not distichous.
                70. Beaks of perigynia conspicuous, 3–3.5 mm long; spikes on long, winged, capillary peduncles to 15 cm long; shoot bases reddish _____ **C. basiantha**
                70. Beaks of perigynia not conspicuous, less than 0.5 mm long; spikes either not on capillary peduncles or, if capillary, then the peduncles less than 5 cm long, in any case peduncles not winged; shoot bases either reddish OR white.
                    71. Staminate spikes sessile; shoot bases white; prophylls pale brown _____ **C. abscondita**
                    71. Staminate spikes pedunculate; shoot bases reddish; prophylls reddish _____ **C. edwardsiana**
        68. Spikes not arising from the base or near the base of a flowering culm (no spikes arising from or near the base of the plant).
            72. Spikes, predominantly gynecandrous.
                73. Spikes arising laterally on flexuous peduncles, the spikes drooping.
                    74. Longest pistillate scales with awns 1.2–5 mm long, the awns more than

half as long as pistillate scale body; perigynia 4.5–6 mm long, ovate-lanceolate, inflated and loose around the achene _____ **C. davisii**

74. Longest pistillate scales acuminate or with short awns 0–0.5(–2) mm long, the awns less than half as long as pistillate scale body; perigynia 3.5–4.6 mm long, rhomboid or narrowly elliptic, broadest near the middle and tapering to both ends, not inflated, close to the achene _____ **C. oxylepis**

73. Spikes terminal on flowering culm, the spikes stiff, ascending.

75. Mature perigynia ascending along the rachis, appearing flattened on the side next to the rachis, the perigynia not appearing inflated _____ **C. complanata**

75. Mature perigynia squarrose to (ca. 90º), or at least spreading along the rachis, not flattened on the side next to the rachis, the perigynia inflated.

76. Pistillate scales 3–6 mm long, including awn; achenes 2.1–2.6 mm long; plants of dry upland prairies and open grassy areas _____ **C. bushii**

76. Pistillate scales (2–)2.5–3 mm long, including awn; achenes 1.5–2 mm long; plants most frequently in low wet woods, wooded swamps, river flood plain forest, or less frequent in open grassy areas _____ **C. caroliniana**

72. Spikes, at least some, usually the terminal, solely staminate.

77. Lateral spikes arising on flexuous peduncles, drooping, at least the lower ones.

78. Lateral spikes 2–6 mm wide, solely pistillate; plants tufted _____ **C. debilis**

78. Lateral spikes 7–9 mm wide, solely pistillate or at least some androgynous; plants rhizomatous.

79. Perigynia 5–7 mm long, stramineous, not granular; beak of perigynia hyaline _____ **C. cherokeensis**

79. Perigynia 3–5(–6) mm long, dark brown to reddish-brown, minutely granular; beak of perigynia not hyaline.

80. Perigynia 4–5(–6) mm long, with 11–14 conspicuous veins, at least apically; pistillate scale apex acute to acuminate, tapering into an awn _____ **C. joorii**

80. Perigynia 3–4.5 mm long, appearing veinless or with 4–5(–8) inconspicuous veins, except for the conspicuous veins marking the angles; pistillate scale apex usually emarginate, with an abruptly arising awn.

81. Lowest pistillate spike drooping; peduncle usually more than 1 cm long; lateral spikes frequently androgynous; plants maturing summer to early fall (rarely spring) _____ **C. glaucescens**

81. Lowest pistillate spike erect; peduncle 1 cm long or less; lateral spikes frequently solely pistillate; plants maturing spring, some individual plants maturing in summer or rarely early fall _____ **C. verrucosa**

77. Lateral spikes absent or present, peduncled or not, if present and peduncled, the peduncles not flexuous, the spikes not drooping.

82. Most of the beaks of perigynia conspicuously bent.

83. Pistillate scales brown, reddish-brown, or reddish-purple on both sides of the mid-vein; plants with elongate rhizomes _____ **C. meadii**

83. Pistillate scales green or hyaline on both sides of the mid-vein; plants without elongate rhizomes.

84. Veins impressed on faces of the perigynia, not appearing raised.

85. Larger perigynia (4–)4.2–5.5(–6) mm long; style base straight or slightly bent _____ **C. flaccosperma**

85. Larger perigynia 3.2–4.1(–4.5) mm long; style base usually conspicuously bent or reflexed _____ **C. glaucodea**

84. Veins raised on faces of the perigynia.

86. Perigynia 1.6–2.5 mm wide, with about 12 veins, the perigynia bodies rounded at base, loosely enveloping achene at maturity _____ **C. granularis**

86. Perigynia 1–1.7(–1.8) mm wide, with 14 or more veins, the perigynia bodies tapered at base, closely enveloping achene at maturity.

87. Perigynia faces concave, plane, or slightly convex; lowest pistillate spike near base of plant _____ **C. digitalis**

88. Staminate spike overtopped by first pistillate bract; tallest flowering culm equal to or shorter than foliage; perigynia with 10–14 veins per face _____ **C. digitalis** var. **floridana**

88. Staminate spike overtopping first pistillate bract; tallest flowering culm usually overtopping foliage; perigynia with 6–12 veins per face _____ **C. digitalis** var. **macropoda**

87. Perigynia faces convex, especially proximally; lowest pistillate spike not near base of plant.

89. Distal lateral spikes narrower than their subtending bracts and concealed by them when viewed from below _____ **C. kraliana**

89. Distal lateral spikes wider than their subtending bracts and not concealed by them when viewed from below.

90. Perigynia obovoid, 2.4–2.6 mm long, 1–1.7 times longer than wide, with a short, abruptly bent beak _____ **C. blanda**

90. Perigynia fusiform, 3.4–5 mm long, 2–3 times longer than wide, tapering into a curved, more or less elongate beak.

91. Perigynia yellowish at maturity and pale greenish when young; 1–2 pistillate spikes overtopping the peduncle of the staminate spike _____ **C. crebriflora**

91. Perigynia green or greenish; peduncles of the staminate spike overtopping pistillate spikes (at least most do).

92. Perigynia loosely overlapping, ca. 6–7 in a 1 cm span; leaf blades of flowering culms 2–7 mm wide; lowest spike with an erect or ascending peduncle _____ **C. striatula**

92. Perigynia closely overlapping, ca. 10–12 in a 1 cm span; leaf blades of flowering culms 2.5–3.5 mm wide; lowest spike on a long, drooping, capillary peduncle _____ **C. styloflexa**

82. Most of the beaks of perigynia straight, not bent.

93. Plants with elongate creeping rhizomes _____ **C. microdonta**

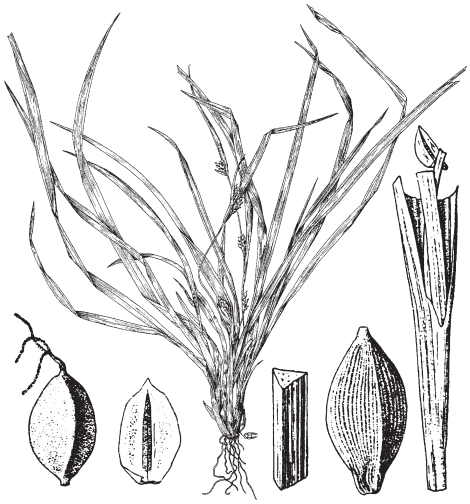
93. Plants cespitose, without elongate rhizomes.
    94. Perigynia distichously arranged along the rachis.
        95. Perigynia obovate to subglobose, rarely ovate-oblong, 1.6-2.1 times as long as wide _____ **C. bulbostylis**
        95. Perigynia oblong-lanceolate, (2–)2.5–2.9 times as long as wide _____ **C. planispicata**
    94. Perigynia spirally arranged along the rachis.
        96. Shoot bases brown, often white above the brown.
            97. Perigynia (4–)4.2–6 mm long; style base straight or slightly bent; anthers 1.6–2 mm long _____ **C. flaccosperma**
            97. Perigynia 3.2–4.1 mm long; style base usually conspicuously bent or reflexed; anthers 1.8–3.6 mm long _____ **C. glaucodea**
        96. Shoot bases purplish-red.
            98. Perigynia (1.8–)2–2.6 mm wide, orbicular to suborbicular in transverse-section; achene bodies (excluding stipe) 2.2–3 mm long _____ **C. grisea**
            98. Perigynia 1.5–2.4 mm wide, obtusely triangular in transverse-section; achene bodies (excluding stipe) 1.8–2.3(–2.4) mm long.
                99. Apex of perigynia obtuse, blunt; perigynia 3.5–4.5 mm long, 1.8–2.3(–2.5) times longer than wide _____ **C. corrugata**
                99. Apex of perigynia more or less pointed; perigynia 4.2–5.2 mm long, (2.2–)2.5–3.1 times longer than wide _____ **C. amphibola**

Carex abscondita Mack., (concealed), HIDDEN-FRUIT CARIC SEDGE, THICKET CARIC SEDGE. A sciophyte (= a plant adapted to grow in or tolerate heavy shade) of wet to mesic, shaded deciduous hardwood forests, pine forests, or swamps; e part of the Red River drainage, extreme ne parts of the Post Oak Savannah, and throughout the Pineywoods; also in the ne part of the Gulf Prairies and Marshes; widespread in the e U.S. w to OK and TX. Fruiting Apr–Jun. Section *Careyanae*

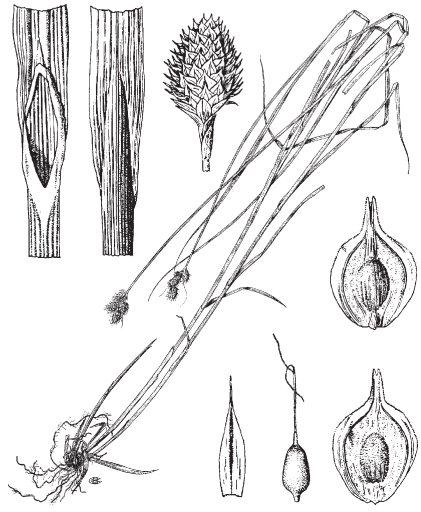
Carex alata Torr., (winged), WINGED CARIC SEDGE, BROAD-WING CARIC SEDGE. Wet, open to partially open sites with sandy soils, marshy and wooded pond margins, low open wet woods, and less frequently along open wet roadside ditches; infrequent throughout the Pineywoods in Anderson, Gregg, Hardin, Henderson, Jefferson, Leon, Trinity, and Wood cos.; also ne part of the Gulf Prairies and Marshes; se Canada (Ont.) and widespread in the e U.S. w to OK and TX. Fruiting Apr–Jun(–Sep). Section *Ovales*

Carex albicans Willd. ex Spreng. var. **australis** (L.H. Bailey) Rettig, (sp.: whitish; var.: southern), SOUTHERN BELLOWS-BEAK CARIC SEDGE. Rhizomes long, horizontally spreading. Sandy or rocky woods, frequently on slopes in mixed pine-hardwood forests; throughout the Pineywoods, infrequent in the Post Oak Savannah from Freestone, Grimes, Walker, and Van Zandt cos., and infrequent in the Blackland Prairie from Bell and Dallas cos.; also ne part of the Gulf Prairies and Marshes; se U.S. from VA s to FL w to AR and TX. Fruiting Apr–Jun. [*C. physorhyncha* Liebm. ex Steud.] Crins and Rettig (2002) reported *Carex albicans* var. *albicans* for TX. However, TX material of Section *Acrocystis* does not bear this out. Variety *albicans* differs by having short, ascending to erect rhizomes. Section *Acrocystis*

Carex albolutescens Schwein., (whitish yellow), WHITISH YELLOW CARIC SEDGE, GREEN-WHITE CARIC SEDGE. Wet woods, thickets, and peats; infrequent in the n Post Oak Savannah and scattered throughout the Pineywoods; also ne part of the Gulf Prairies and Marshes; widespread in the e U.S. w to OK and TX. Fruiting Apr–Jun(–Aug). Section *Ovales*



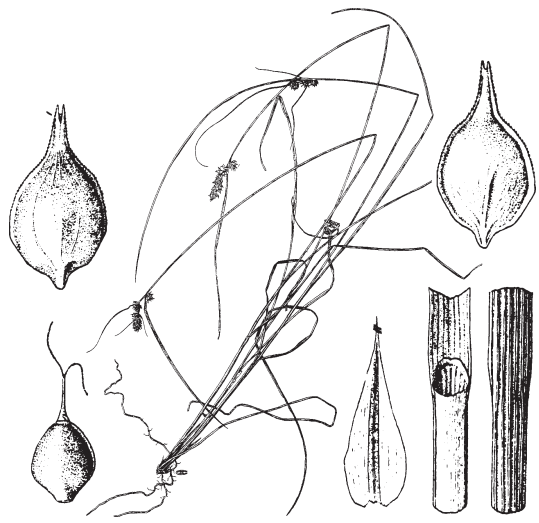
Carex abscondita [MAC]



Carex alata [MAC]



Carex albicans var. australis [MAC]



Carex arkansana [MAC]



Carex amphibola [MAC]



Carex annectens [MAC]



Carex albolutescens [BB2]

Carex amphibola Steud. (ambiguous, doubtful), NARROW-LEAF CARIC SEDGE, EASTERN NARROW-LEAF SEDGE. A facultative sciophyte along lower slopes of mixed pine/hardwood forests or hardwood forests and in floodplains; rare in TX, being known only from Polk and Hunt cos.; se Canada (Ont.) and widespread in e U.S. w to OK and TX. Fruiting Apr–May. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. Section *Griseae* ⚠

Carex annectens (E.P. Bicknell) E.P. Bicknell, (connecting), CONNECTING CARIC SEDGE, YELLOW-FRUIT CARIC SEDGE. A facultative heliophyte (= a plant adapted to grown in or tolerate full sun) of open wet roadside ditches, prairie swales, wet prairies, marshy areas, and low deciduous woods. This species was mapped for numerous TX counties by Turner et al. (2003). However, the taxonomic placement of TX specimens keying here is dubious, and the species may not be a member of the East TX flora; because no definitive East TX specimens of this species have been found, no county distribution map is provided. Southeastern Canada and widespread in the e U.S. Fruiting (late Mar–)Apr–May. *Carex triangularis* is reported to always have red glandular dots on the perigynia. A small number of TX specimens, whether fresh or from herbarium specimens, lack these red dots and will key to *C. annectens*. However, these specimens do not appear different from *C. triangularis* in any other respect. Section *Multiflorae*

Carex arkansana L.H. Bailey, (of Arkansas), ARKANSAS CARIC SEDGE. A facultative sciophyte in openings in low, seasonally wet woods, open bottomlands, and damp prairies associated with creeks and river floodplains. Post Oak Savannah, e Red River drainage, n Blackland Prairie, and n Pineywoods; AR, IL, KS, MO, OK, and TX. Fruiting May–Jun. Section *Phaestoglochin*

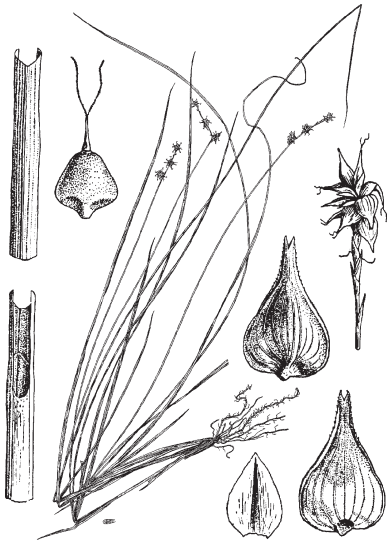
Carex atlantica Schkuhr ex Willd., (of the Atlantic), ATLANTIC CARIC SEDGE. Plants of this species tolerate direct sun or partial to moderate shade and are found in *Sphagnum* bogs, acid creek bottoms with *Sphagnum*, and low, acid, deciduous woods. The following two varieties are distinguished in the key to species. Section *Stellulatae*

var. **atlantica**, ATLANTIC CARIC SEDGE. Known in East TX only from Tyler Co.; se Canada and widespread in e U.S. w to MO and TX. Fruiting Apr–May. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this taxon to be of conservation concern in TX. ⚠

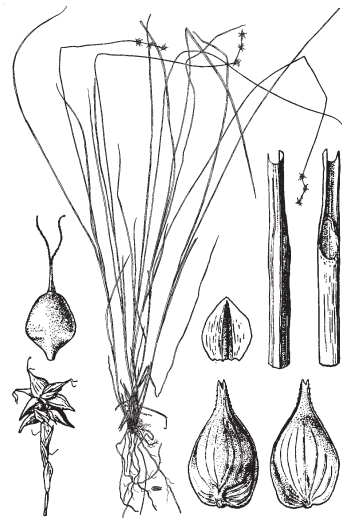
var. **capillacea** (L.H. Bailey) Reznicek, (hair-like), NARROW-LEAF ATLANTIC CARIC SEDGE, PRICKLY BOG CARIC SEDGE. Central part of the Pineywoods s to the ne Gulf Prairies and Marshes, much more frequent in occurrence than var. *atlantica*; se Canada and widespread in e U.S. w to IL and TX. Fruiting Apr–May.

Carex austrina (Small) Mack., (southern), SOUTHERN CARIC SEDGE. Obligate heliophyte in open prairies on Alfisols, but occasional on Mollisols and Vertisols and encroaching on Histosols; throughout East TX; also Cross Timbers and Prairies, Rolling Plains, Edwards Plateau, and Gulf Prairies and Marshes from the Coastal Bend area ne; sc U.S. Fruiting Mar–early Jul. [*C. muehlenbergii* Schkuhr ex Willd. var. *australis* Olney, *C. muehlenbergii* var. *austrina* Small] Section *Phaestoglochin*

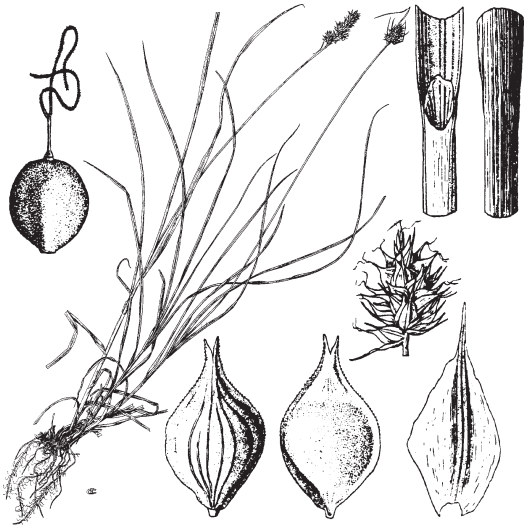
Carex basiantha Steud., (basal-flowered), BASAL-FRUIT CARIC SEDGE, WIDOW CARIC SEDGE. A facultative sciophyte along ravine slopes of mixed pine-hardwood forests and deciduous woods, usually in rocky or sandy soils, most often a mesic-slope species of rich woods but can occur in bottoms; e edge of the Red River drainage; the e edge of the Post Oak Savannah and frequent throughout most of the Pineywoods; also extending s into the ne part of the Gulf Prairies and Marshes; se U.S. from NC s to FL w to OK and TX. Fruiting late Mar–Jul. [*C. willdenowii* var. *pauciflora* Olney ex Hall, *nomen nudum*; *C. willdenowii* var. *pauciflora* Olney ex L.H. Bailey; *C. willdenowii* of American authors, not Schkuhr ex Willd.] Section *Phyllostachyae*.



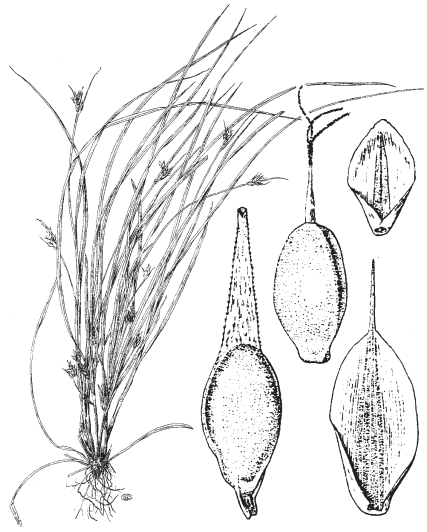
Carex atlantica var. atlantica [MAC]



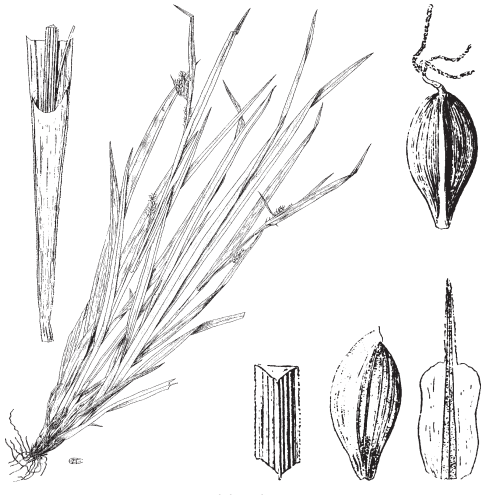
Carex atlantica var. capillacea [MAC]



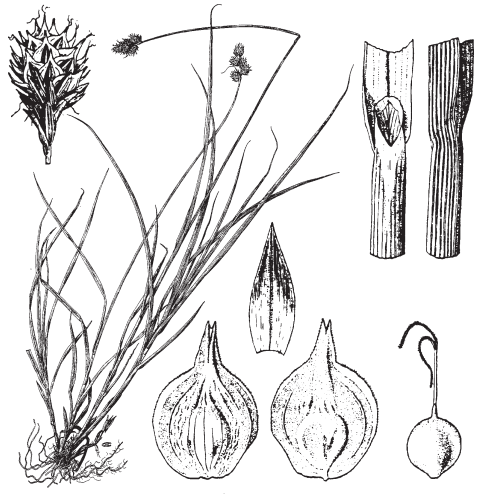
Carex austrina [MAC]



Carex basiantha [MAC]



Carex blanda [MAC]



Carex brevior [MAC]

Carex blanda Dewey, (mild), CHARMING CARIC SEDGE, EASTERN WOODLAND CARIC SEDGE. Dry to mesic woods, bottomlands, slopes, forest edges, and meadows, mostly sciophytic; throughout East TX; also in the Cross Timber and Prairies, Edwards Plateau, and the n half of the Gulf Prairies and Marshes; se Canada (Ont.) and e 2/3 of the U.S. Fruiting Apr–May(–Jun). Section *Laxiflorae*

Carex brevior (Dewey) Mack. ex Lunell, (short), SHORT CARIC SEDGE, SHORT-BEAK CARIC SEDGE. A facultative heliophyte found in submesic to mesic open meadows, prairies, and roadsides, avoiding acidic soils; throughout East TX except the sw part; also e Cross Timbers and Prairies, ne Gulf Prairies and Marshes, and Hemphill Co. in the n Rolling Plains; s Canada and nearly throughout the U.S. Palatability is rated as medium for all livestock throughout the summer, but the species is usually not sufficiently plentiful to be of much importance (Hermann 1970). Fruiting late Apr–Jun. Section *Ovales*

Carex bromoides Schkuhr ex Willd., (brome-like), BROMUS-LIKE CARIC SEDGE, BROME-LIKE CARIC SEDGE. A facultative sciophyte in low, wet, deciduous woods, swamps, and rarely along marsh edges and wet meadows; Jasper, Newton, San Augustine, and Tyler cos. in the se Pineywoods; se Canada and e U.S. w to MN and TX. Fruiting Apr–May. This species was first reported for TX by Bridges and Orzell (1989); the TX locations are the westernmost known in the U.S. (Bridges & Orzell 1989). Section *Deweyanae*

Carex bulbostylis Mack., (bulb-styled), GLOBOSE CARIC SEDGE, FALSE HAIR CARIC SEDGE. A facultative sciophyte of variable habitats in mesic deciduous forests, flood plains, and adjacent slopes, usually in neutral soils or slightly acidic or slightly alkaline loams, sandy loams, sandy clay loams, or clay loams; widespread in East TX; also Cross Timbers and Prairies, Edwards Plateau, and Gulf Prairies and Marshes from the Coastal Bend area northeastward; AR, LA, MS, OK, TN, and TX. Fruiting Mar–May. [*C. amphibola* Steud. var. *globosa* (L.H. Bailey) L.H. Bailey] Section *Griseae*

Carex bushii Mack., (for its discoverer, Benjamin Franklin Bush, 1858–1937, postmaster in MO and amateur botanist), BENJAMIN BUSH'S CARIC SEDGE. Obligate to facultative heliophyte in open mesic to submesic prairies, open roadsides, and forest edges with sandy soils; throughout most of East TX except for the sw part; also e edge of the Cross Timbers and Prairies and ne part of the Gulf Prairies and Marshes; e U.S. w to NE and TX. Fruiting Mar–Jun. [*C. caroliniana* Schwein. var. *cuspidata* (Dewey) Shinners] Section *Porocystis*

Carex caroliniana Schwein., (of Carolina), CAROLINA CARIC SEDGE. A facultative sciophyte in low deciduous woods, usually on lower slopes and in bottoms, near wooded streams, on sandy soils; frequent in the right habitat in the Pineywoods, the Post Oak Savannah, e part of the Red River drainage, and e part of the Blackland Prairie; also in the Gulf Prairies and Marshes from the Coastal Bend area northeastward; scattered in the e U.S. w to KS and TX. Fruiting Apr–May. Section *Porocystis*

Carex cephalophora Muhl. ex Willd., (head-bearing), HEAD-BEARING CARIC SEDGE, OVAL-LEAF CARIC SEDGE. A facultative sciophyte, primarily on Alfisols with sandy or sandy loam soils, slopes in mesic to submesic hardwood forests, mixed hardwood-pine forest, or occasionally at wetter sites on Entisols along river courses, etc., occasionally remaining as remnants in openings, pastures, or roadsides; a widespread but infrequent species from the e edge of the Post Oak Savannah throughout the Pineywoods, with a historical record from Dallas Co.; also in the ne part of the Gulf Prairies and Marshes; se Canada and e U.S. w to NE and TX. Fruiting (late Mar–) late Apr–late Jul(–early Oct). Section *Phaestoglochin*

Carex cherokeensis Schwein., (for Cherokee Co., TX, from which the type specimen was collected), CHEROKEE CARIC SEDGE, WOLF-TAIL SEDGE. A strongly rhizomatous facultative heliophyte but

persists in light shade; open roadsides, pastures, and openings in low, damp, deciduous woods with sandy or sandy loam soils, frequently in calcareous conditions, sometimes forming nearly monospecific stands in low woods in the Post Oak Savannah; throughout East TX; also in the Cross Timbers and Prairies and Gulf Prairies and Marshes; se U.S. from VA s to FL w to MO, OK, and TX. Fruiting Apr–May(–early Jun). Section *Hymenochlaenae* ⚙/280

Carex comosa Boott, (bearded) BEARDED CARIC SEDGE. A facultative heliophyte of swamps, lake margins, and other shallow waters; Bowie, Smith, Walker, and Wood cos.; se Canada and widespread in the e U.S., also CA and ID. Fruiting late Apr–early Jun. Section *Vesicariae* ⚙/280

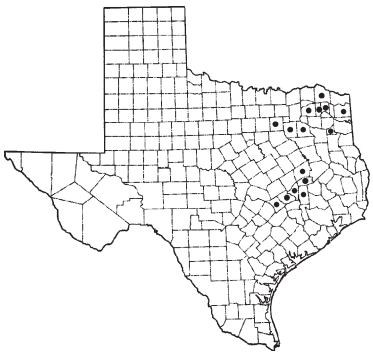
Carex complanata Torr. & Hook., (flattened), FLAT-FRUIT CARIC SEDGE, HIRSUTE CARIC SEDGE. Leaf blades glabrescent or often persistently pilose proximally. In shade or full sun, usually in open mesic deciduous forests with sandy soils, or forest edges or clear-cuts; throughout most of East TX except the sw part; also Gulf Prairies and Marshes from the Coastal Bend area ne; scattered in the e U.S. w to IA and TX. Fruiting Apr–May(–Jun). A closely related species, *C. hirsutella* Mack., is mapped by Ball and Reznicek (2002) as occurring in TX. However, its occurrence in the state is not supported by herbarium specimens from either TX herbaria or MICH. *Carex hirsutella* can be separated from *C. complanata* by having its leaf blades with both surfaces pilose. Section *Porocystis* ⚙/280

Carex corrugata Fernald, (corrugated or wrinkled), WRINKLE-FRUIT CARIC SEDGE, PRUNE-FRUIT CARIC SEDGE. A facultative sciophyte along floodplains of mesic deciduous forests, on alluvia, in acidic to alkaline clays to silt loams; throughout East TX except the most sw part; also in the Cross Timbers and Prairies and the Gulf Prairies and Marshes from the Coastal Bend area northeastward; e U.S. from WV s to FL w to KS and TX. Fruiting Apr–May. Section *Griseae* ⚙/280

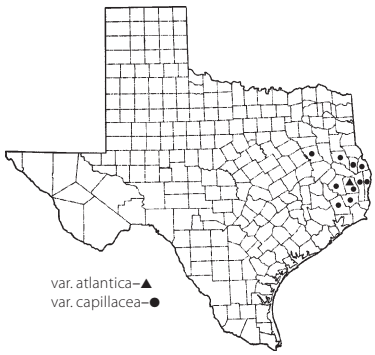
Carex crebriflora Wiegand, (closely-flowered) CLOSE-FLOWERED CARIC SEDGE, COASTAL PLAIN CARIC SEDGE. A facultative sciophyte along lower slopes to bottoms of mesic deciduous forests or mixed pine hardwood forests, mostly on alluvial deposits; throughout most of the Pineywoods and Waller and Washington cos. in the Post Oak Savannah; also sparingly in the Gulf Prairies and Marshes from the Coastal Bend area northeastward; se U.S. from VA s to FL w to AR and TX. Fruiting Mar–May. Section *Laxiflorae*

Carex crinita Lam. var. **brevicrinis** Fernald, (sp.: provided with long hair; var.: short-haired), SHORT-HAIR CARIC SEDGE. A facultative heliophyte in open areas of wooded swamps, bottoms, ditches, and shorelines; from the c area of the Pineywoods northward and the ne part of the Post Oak Savannah; widespread in the e U.S. w to NE and TX. Fruiting May–Jun. Section *Phacocystis* ⚙/280

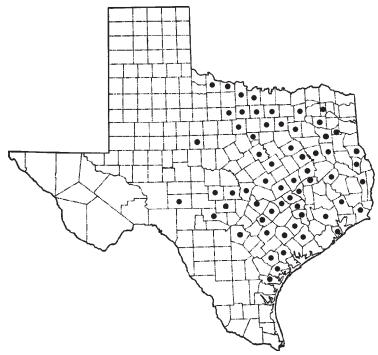
Carex crus-corvi Shuttlew. ex Kunze, (crow-spur), CROW-FOOT CARIC SEDGE, RAVEN-FOOT CARIC SEDGE. A facultative heliophyte in wet prairies, depressions, roadside ditches, marshes, and open swamps; throughout East TX; also in Cross Timbers and Prairies, Gulf Prairies and Marshes, and one record from Hidalgo Co. at the s tip of the South TX Plains; se Canada (Ont.) and e U.S. from VA to FL w to MN and TX. Fruiting (late Feb–)Apr–Jun(–early Jul). Standley (2002a) listed *C. stipata* Muhl. ex Willd. var. *stipata*, a somewhat similar species, for TX. However, Jones et al. (1991) deleted this taxon from the TX flora after examining all TX material, including specimens from MO (Missouri Bot. Garden), NA (U.S. Natl. Arboretum), NLU (Univ. of Louisiana at Monroe), and US (Smithsonian Inst.). All TX material labeled *C. stipata* was referable to *C. crus-corvi* or *C. oklahomensis*. *Carex crus-corvi* can readily be separated from *C. stipata* and *C. oklahomensis* by its ventral leaf sheath margins with orange-red dots, the achenes ovate-lanceolate, and the perigynial walls adhering to the achenes; in contrast, in *C. stipata* and *C. oklahomensis* the ventral leaf sheath margins lack orange-red dots, the achenes are broadly ovate, and the perigynial walls adhere little or not at all to the achenes. Section *Vulpinae* ⚙/280



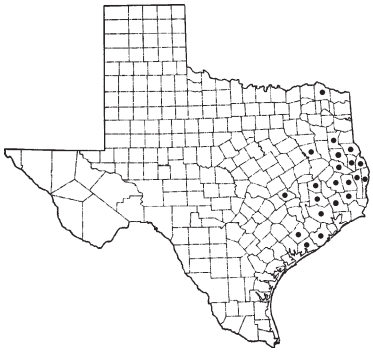
Carex arkansana



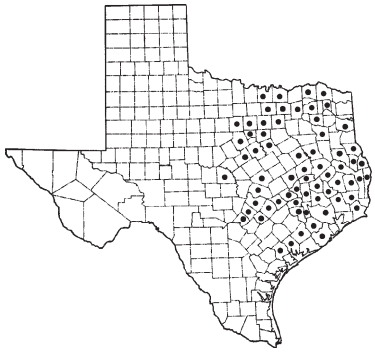
Carex atlantica



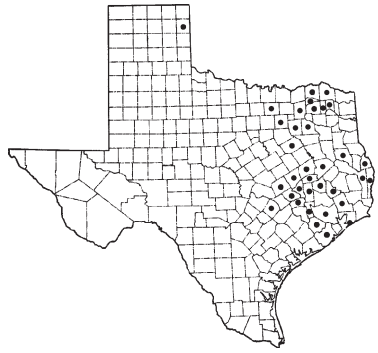
Carex austrina



Carex basiantha



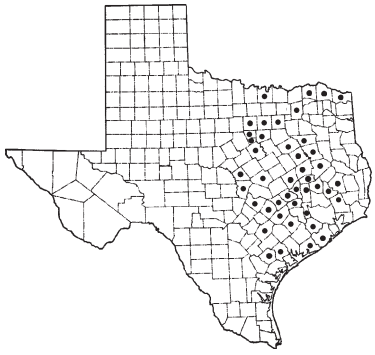
Carex blanda



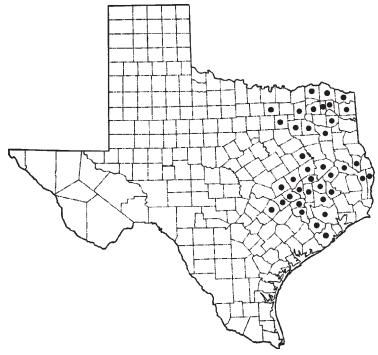
Carex brevior



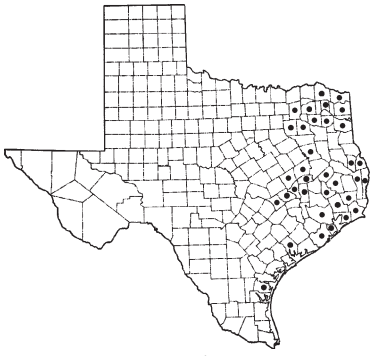
Carex bromoides



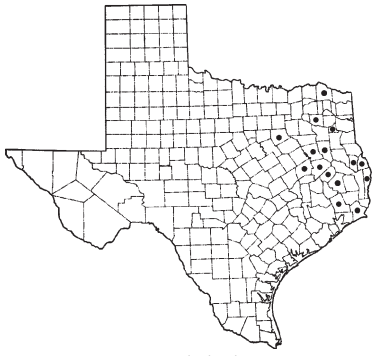
Carex bulbostylis



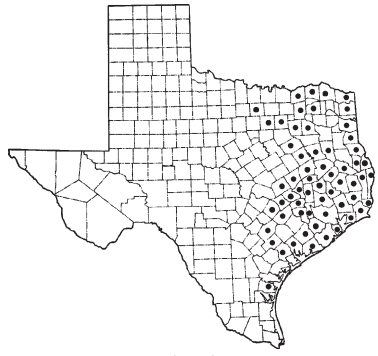
Carex bushii



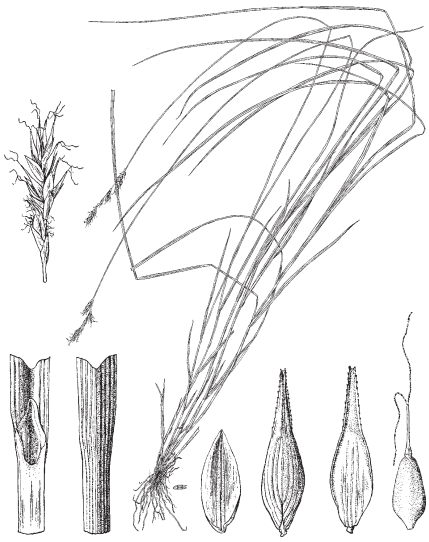
Carex caroliniana



Carex cephalophora



Carex cherokeensis



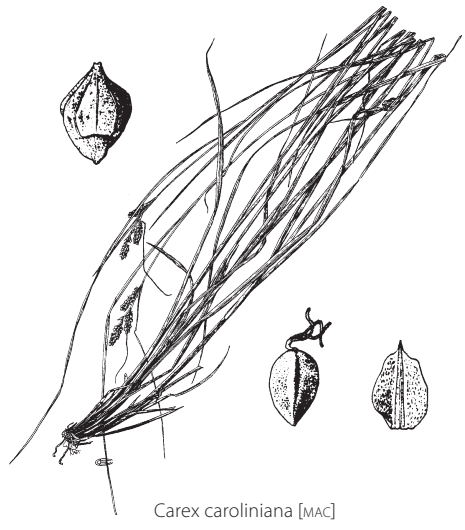
Carex bromoides [MAC]



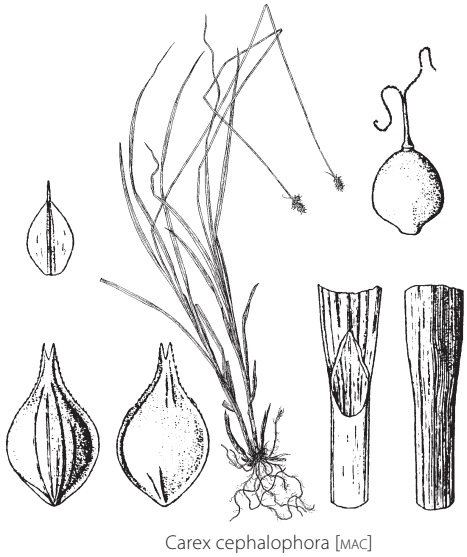
Carex bulbostylis [MAC]



Carex bushii [MAC]



Carex caroliniana [MAC]



Carex cephalophora [MAC]



Carex cherokeensis [MAC]

Carex davisii Schwein. & Torr. (for Emerson Davis, 1798–1866, amateur student of *Carex*), EMERSON DAVIS' CARIC SEDGE. A facultative sciophyte in rich, deciduous, calcareous woods, forest edges, meadows, and shores; known from the n parts of the Blackland Prairie and Post Oak Savannah; also e Cross Timbers and Prairies; se Canada and e U.S. except far se. Fruiting Apr–May(–mid-Jun). Section *Hymenochlaenae*

Carex debilis Michx., (frail), WEAK CARIC SEDGE, WHITE-EDGE CARIC SEDGE. A facultative sciophyte in low woods, low meadows, swamps, bogs, forest edges, and especially along creek edges in forests; throughout the Pineywoods and in Leon and Wood cos. of the Post Oak Savannah; also the extreme ne counties of the Gulf Prairies and Marshes; e U.S. from PA s to FL w to MO, OK, and TX. Fruiting Apr–May(–Jul). Section *Hymenochlaenae*

Carex decomposita Muhl., (decompound), CYPRESS-KNEE CARIC SEDGE,. A facultative heliophyte growing on decaying stumps in swamps, most often on *Taxodium* stumps; rare in ne part of East TX in Marion and Wood cos. and in Liberty, Jasper, and San Jacinto cos. in the s part of the Pineywoods; se U.S. from NY s to FL w to MO, OK, and TX. Fruiting late Apr–early Jun. (RARE 2001, 2002b: G3S1). Section *Heleoglochin* ⚠

Carex digitalis Schkuhr ex Willd., (of a finger), SLENDER WOODLAND CARIC SEDGE. The following two varieties are distinguished in the key to species. Section *Careyanae*

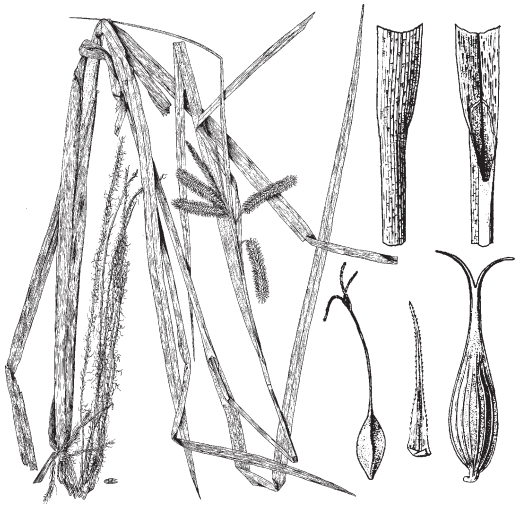
var. **floridana** (L.H. Bailey) Naczi & Bryson, (of Florida) ASYMMETRIC-FRUITED FINGER CARIC SEDGE. A facultative sciophyte along mesic and submesic slopes, both lower and upper, of mixed pine/hardwood forests and hardwood forests; e Pineywoods; se U.S. from NC s to FL w to AR and TX. Fruiting late Mar–early Jun. [*C. digitalis* var. *asymmetrica* Fernald]

var. **macropoda** Fernald, (long-stalked), LONG-STALKED FINGER CARIC SEDGE. A facultative sciophyte along mesic and submesic slopes, both lower and upper, of mixed pine/hardwood forests and hardwood forests; throughout the Pineywoods; also ne part of the Gulf Prairies and Marshes; se U.S. from PA s to FL w to MO and TX. Fruiting late Mar–early Jun.

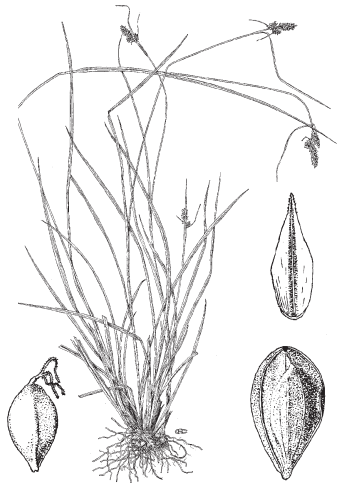
Carex edwardsiana E.L. Bridges & Orzell, (of the Edwards Plateau), EDWARDS PLATEAU CARIC SEDGE. A facultative sciophyte growing in the shade of trees, shrubs, or taller herbaceous plants; mesic to submesic mixed juniper-hardwood forests and ravine slopes, in alkaline clay loams and sandy clay loams; w edge of the Blackland Prairie in Bell, Bexar, Comal, Hays, and Travis cos.; also the e edge of the Edwards Plateau contiguous with the Blackland Prairie; endemic to TX (Carr 2002b, 2002c; Naczi & Bryson 2002). Fruiting Apr–May. [*C. oligocarpa* of TX authors in part, not Schkuhr ex Willd.] This species is reported to occupy the driest habitats of any species of Section *Griseae* and to range the farthest sw of any member of the section (Naczi & Bryson 2002). Section *Griseae* 

Carex emoryi Dewey, (for Major William Hemsley Emory, 1811–1887, American solider who worked on US/Mexican Boundary Survey), WILLIAM EMORY'S CARIC SEDGE. A facultative heliophyte along margins of streams, rivers, lakes, ponds, marshes, and open swamps 250–4,000 ft in elevation; in East TX mostly in the Blackland Prairie, but in the Post Oak Savannah, and Montgomery and Walker cos. of the Pineywoods; also Cross Timbers and Prairies, Edwards Plateau, Rolling Plains, ne corner of the South TX Plains, and El Paso Co. of the Trans-Pecos; sc Canada and ne and c U.S. from NY s to VA w to WY and NM. Fruiting Mar–May. This species provides some forage value to cattle. Section *Phacocystis*

Carex festucacea Schkuhr ex Willd., (fescue-like), FESCUE CARIC SEDGE. A plant that does well in shade or full sun, in damp or wet low areas in woods or in open wet creek bottoms that fan out into rush meadows; throughout most of East TX except for the sw part; also ne Gulf Prairies and Marshes; se Canada (Ont.) and e U.S. w to MN and TX. Fruiting Apr–May(–early Jun). Section *Ovales*



Carex comosa [MAC]



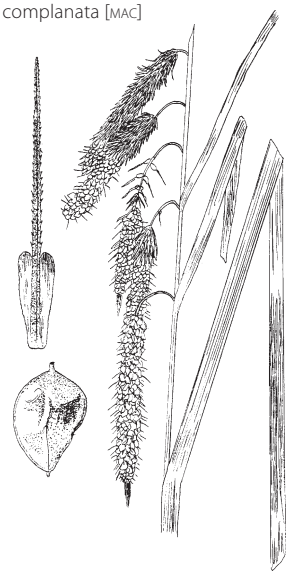
Carex complanata [MAC]



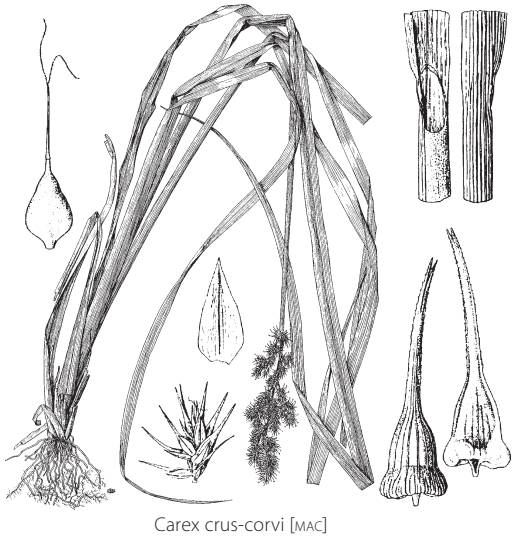
Carex corrugata [HEA]



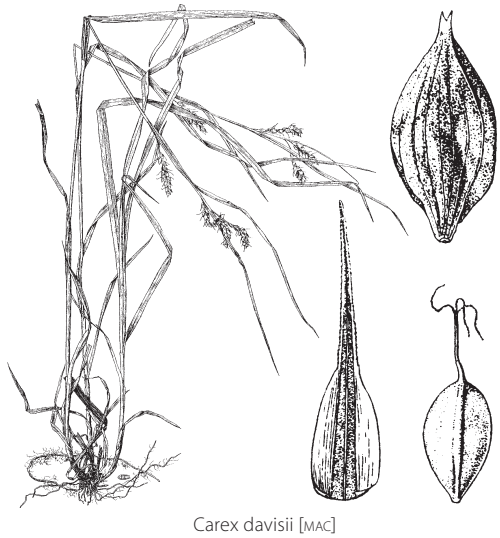
Carex crebriflora [MAC]



Carex crinata var. brevicrinis [STE]



Carex crus-corvi [MAC]



Carex davisii [MAC]

Carex fissa Mack. (split) SHARP-MARGIN CARIC SEDGE, HAMMOCK CARIC SEDGE. A facultative heliophyte in open wet roadside ditches and in open wet areas in floodplains, usually in alluvial clay soils; mostly in the Post Oak Savannah and Blackland Prairie, e part of the Red River drainage, and w edge of the Pineywoods; also ne Gulf Prairie and Marshes; KS, MO, OK, and TX. Fruiting May–Jun. This species was reported new for TX by Jones et al. in 1990. Section *Multiflorae*

Carex flaccosperma Dewey, (flaccid, weak, or soft-seeded or -fruited), FLACCID-FRUIT CARIC SEDGE, THIN-FRUIT CARIC SEDGE. A facultative sciophyte found in floodplains in mesic deciduous forests or even in submesic forests, in acidic silt loams, sandy loams, sandy clay loams, clays, and loams; throughout East TX; also the ne corner of the South TX Plains, the Gulf Prairies and Marshes from the Coastal Bend area northeastward, and one record from Taylor Co., in a disjunct area of the Edwards Plateau; se U.S. from VA s to FL w to KS and TX. Fruiting late Mar–May(–Sep). Section *Griseae*

Carex frankii Kunth, (for its discoverer, Joseph Frank, 1782–1835, German botanist, physician, and traveler in US), JOSEPH FRANK'S CARIC SEDGE. A plant that tolerates full sun or partial to moderately heavy shade, in low alluvial deciduous woods, usually forest edges, bottomlands, and wet meadows, most frequently in calcareous or neutral soils; throughout East TX except the sw part; also Cross Timbers and Prairies, Edwards Plateau, Trans-Pecos, and the Gulf Prairies and Marshes from the Coastal Bend area northeastward; se Canada (Ont.) and e U.S. w to NE and TX. Fruiting May–Sep(–early Nov). [*C. aureolensis* Steud.] Ford and Reznicek (2002) designated all TX material of this species as *C. aureolensis* Steud., while previous modern floras have treated *C. aureolensis* as a synonym of *C. frankii*. Ford and Reznicek (2002) stated that *C. aureolensis* "has been recognized as a distinct species based on its staminate and pistillate scale morphology, growth habit, and distribution." However, TX material possibly consists of two distinct taxa. Until more detailed study of this complex in TX is carried out and to avoid confusion, for the present we are continuing to use the name *C. frankii* for TX material. Section *Squarrosae*

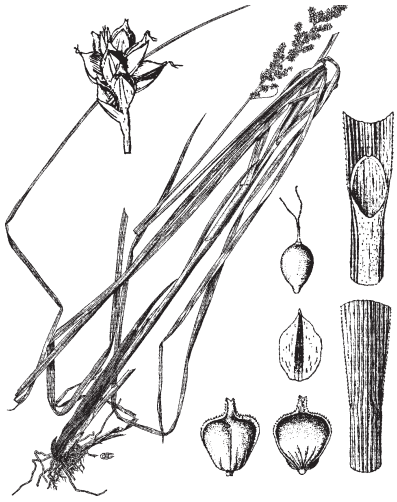
Carex gigantea Rudge, (gigantic), GIANT CARIC SEDGE. A facultative heliophyte which can also exist in shady conditions, in open acidic forest depressions and open hydric roadside ditches through forests; Hardin, Harris, Liberty, Newton, Polk, and San Jacinto cos. in the s Pineywoods; se U.S. from VA s to FL w to MO, OK, and TX. Fruiting May–Sep. Section *Lupulinae*

Carex glaucescens Elliott, (rather glaucous, whitened with a coating or bloom), GLAUCESCENT CARIC SEDGE, SOUTHERN WAXY CARIC SEDGE. A sciophyte or heliophyte in mixed pine/hardwood or hardwood forest depressions, low woods, pinelands, savannahs, and marshes; s Pineywoods; also extreme n Gulf Prairies and Marshes; se U.S. from VA s to FL w to TX. Fruiting (late Apr–) Jul–Oct. Section *Pendulinae* ⚅/281

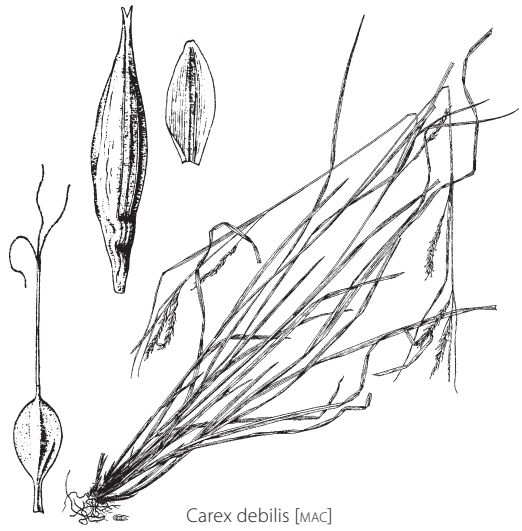
Carex glaucodea Tuck. ex Olney, (gray-green), GRAY-GREEN FRUIT CARIC SEDGE, BLUE CARIC SEDGE. A plant that does well in sun or shade along edges and in openings of mesic deciduous forests or in ephemeral wet prairies, in acidic to alkaline loams or clays; Angelina, Franklin, Hardin, Hopkins, Jasper, Lamar, Red River, Tyler, Walker, and Wood cos; se Canada (Ont.) and e U.S. (except extreme se) w to MO, OK, and TX. Fruiting May–Jun(–early Jul). [*C. flaccosperma* Dewey var. *glaucodea* (Tuck. ex Olney) Kük.] Section *Griseae*

Carex granularis Muhl. ex Willd., (granular, covered with minute grains), GRANULAR CARIC SEDGE, LIMESTONE-MEADOW CARIC SEDGE. A plant that grows either in sun or shade in rich alluvial woods, meadows, bottomlands, and on shores, usually in calcareous soils; Bowie, Lamar, Red River cos. in the Red River drainage, Hunt and Hopkins cos. just to the s, and San Augustine Co. in the Pineywoods; s Canada and widespread in e 1/2 of U.S. Fruiting May–Jun. [*C. granularis* var. *haleana* (Olney) Porter] Section *Granulares*

Carex gravida L.H. Bailey, (heavy with fruit), HEAVY-FRUIT CARIC SEDGE. A facultative heliophyte in open swales, seepy areas, damp or mesic prairies with calcareous soils; Dallas, Hunt and



Carex decomposita [MAC]



Carex debilis [MAC]



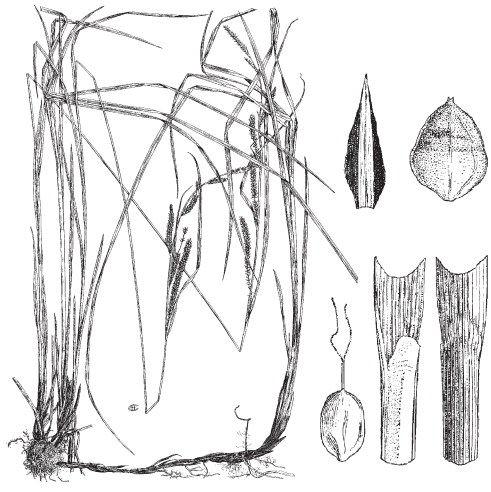
Carex digitalis var. floridana [HEB]



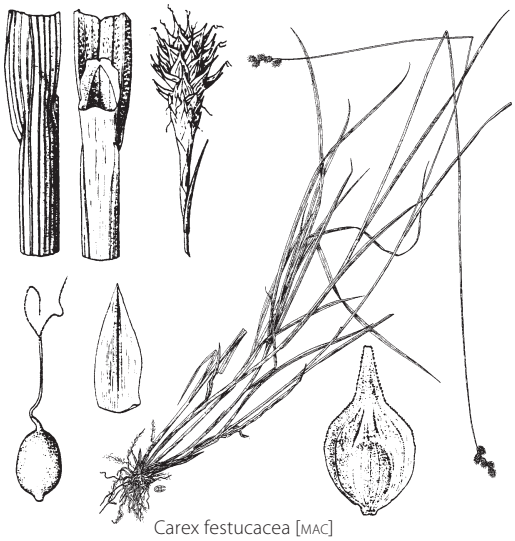
Carex digitalis var. macropoda [HEB]



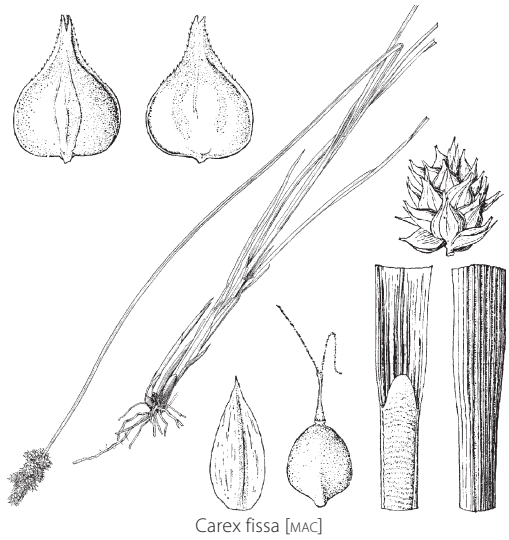
Carex edwardsiana [PHY]



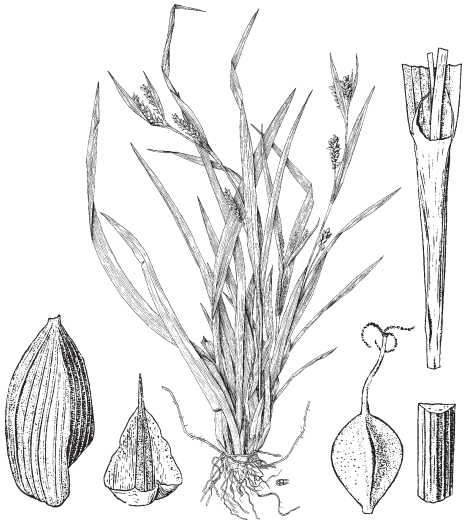
Carex emoryi [MAC]



Carex festucacea [MAC]



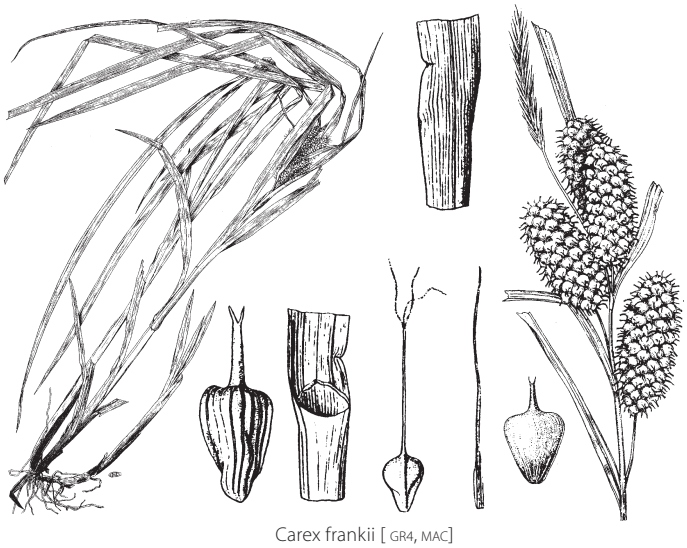
Carex fissa [MAC]



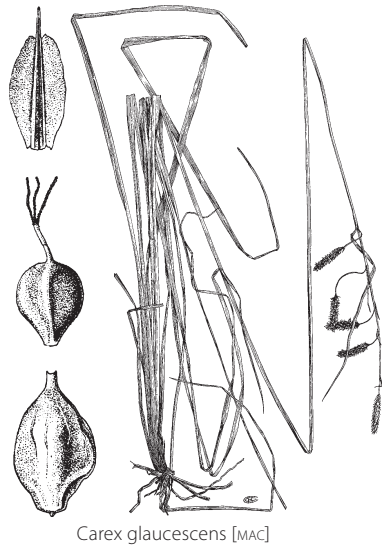
Carex flaccosperma [MAC]



Carex gigantea [MAC]



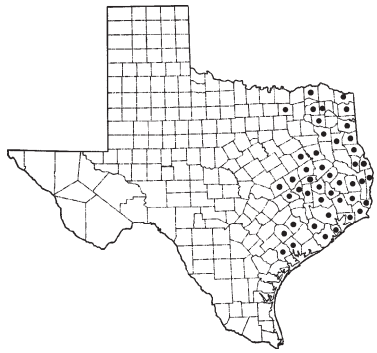
Carex frankii [GR4, MAC]



Carex glaucescens [MAC]



Carex comosa



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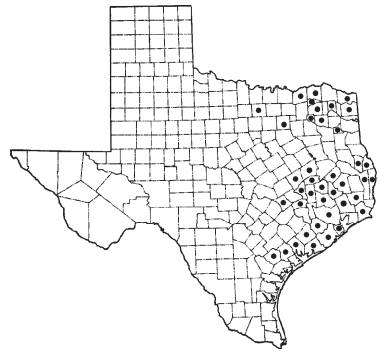
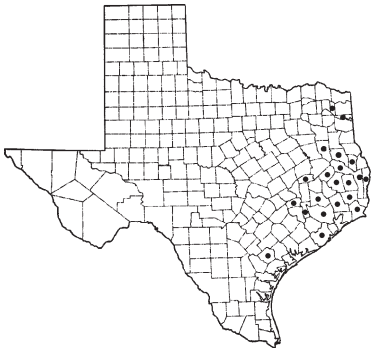
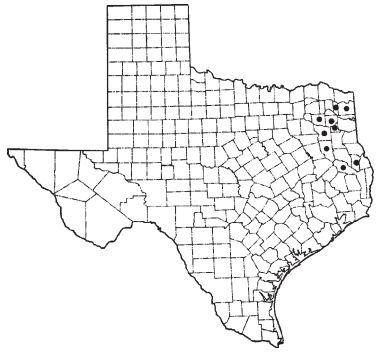


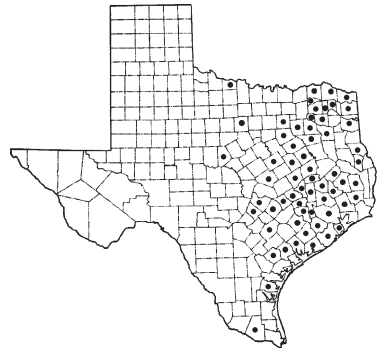
Carex corrugata



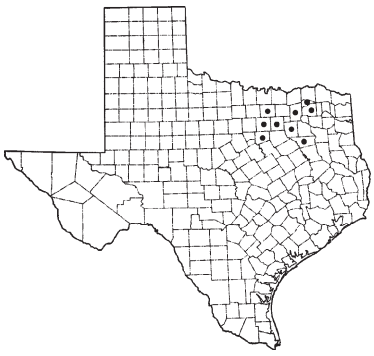
Carex crebriflora



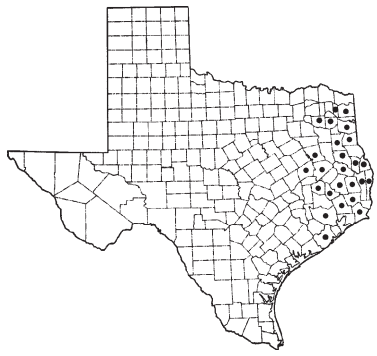
Carex crinita var. brevicrinis



Carex crus-corvi



Carex davisii



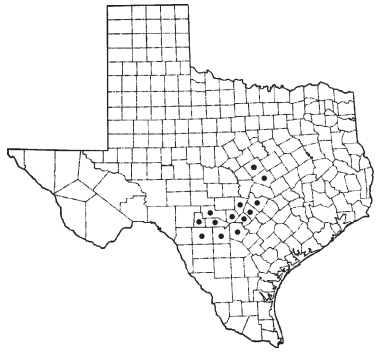
Carex debilis



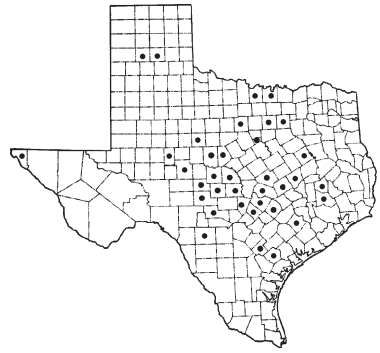
Carex decomposita



Carex digitalis
(both vars.)



Carex edwardsiana



Carex emoryi

Navarro cos. in the Blackland Prairie; also n Cross Timbers and Prairies, Rolling Plains, and High Plains; s Canada and e 2/3 of U.S. except far ne and far se. Fruiting May–Jun. [*C. gravida* var. *lunelliana* (Mack.) F.J. Herm., *C. lunelliana* Mack.]. Variety *lunelliana* is here treated as a synonym because characteristics of both var. *gravida* and var. *lunelliana* can be found in most specimens examined across their range. Section *Phaestoglochin*

Carex grisea Wahlenb., (gray), INFLATED CARIC SEDGE, INFLATED NARROW-LEAF CARIC SEDGE. A facultative sciophyte of floodplains in mesic deciduous forests, on acidic to alkaline sandy loams, loams, sandy clay loams, and clay loams; Dallas and Kaufman cos. in the n part of the Blackland Prairie and Madison and Walker cos. in the Post Oak Savannah; also e Cross Timbers and Prairies; se Canada and e 1/2 of U.S. except far se. Fruiting Apr–Jun(–early Jul). [*C. amphibola* Steud. var. *turgida* Fernald] Section *Griseae*

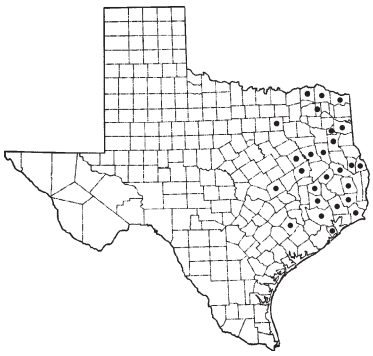
Carex hyalina Boott, (transparent, translucent), FEW-FLOWERED CARIC SEDGE, TISSUE CARIC SEDGE. A facultative sciophyte of bottomland hardwood forests, usually on secondary flood terraces in wet neutral clay soils but sometimes on soils that are slightly acid or slightly alkaline; in East TX frequent along the Trinity and Sulphur rivers and their tributaries and along the lower Brazos River and its tributaries; also n Gulf Prairies and Marshes; AR, LA, MS, OK, TN, and TX. Fruiting mid-Mar–mid-May(–mid-Jun). Though rated by TOES (1993), as can be seen from the county distribution map, this species is now known from a significant number of counties. (TOES 1993: V). Section *Ovales* ⚠

Carex hyalinolepis Steud., (with transparent or translucent scales), HYALINE-SCALE CARIC SEDGE, SHORELINE CARIC SEDGE. An obligate heliophyte forming massive colonies, found in open roadside ditches, swales, shores, marshes, open swamps, and creeksides, frequently in black calcareous or neutral clay; throughout much of the Blackland Prairie and the Post Oak Savannah, the e part of the Red River drainage, and the n part of the Pineywoods; also the Gulf Prairies and Marshes from just n of the Coastal Bend area northeastward; se Canada (Ont.) and e U.S. w to NE and TX. Fruiting Apr–May(–early Jul). Section *Paludosae*

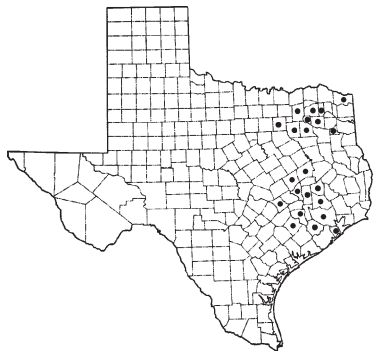
Carex intumescens Rudge, (swollen, puffed up), BLADDERY CARIC SEDGE, GREATER BLADDER CARIC SEDGE. A facultative to obligate sciophyte in swampy woods, bottomland hardwood forests, and bogs, in acidic soils; throughout the Pineywoods, ne part of the Post Oak Savannah, and e part of the Red River drainage; also the Gulf Prairies and Marshes from the Coastal Bend area northeastward; e Canada and e U.S. w to MN, OK, and TX. Fruiting Mar–Sep. Section *Lupulinae* ⚅/281

Carex joorii L.H. Bailey, (for its discoverer, Joseph F. Joor, 1848–1892), JOSEPH JOOR'S CARIC SEDGE, CYPRESS-SWAMP CARIC SEDGE. A facultative sciophyte in mixed pine/hardwood or hardwood forest depressions, low woods, and marshes; throughout the Pineywoods and ne part of Post Oak Savannah; also Gulf Prairies and Marshes from Brazoria Co. northeastward; se U.S. from VA s to FL w to MO and TX. Fruiting (late Apr–)Jul–Oct. Section *Pendulinae*

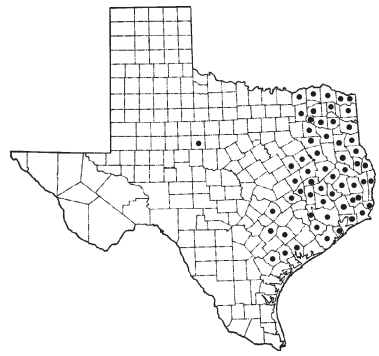
Carex kraliana Naczi & Bryson, (for Robert Kral, 1926–, Director and Curator of Vanderbilt Herbarium, renowned se United States botanist and expert in Xyridaceae and Cyperaceae, currently at the Botanical Research Institute of TX), ROBERT KRAL'S CARIC SEDGE. A sciophyte in mesic deciduous woods; Marion, Sabine, and Tyler cos., but undoubtedly in other East TX counties; se U.S. from VA s to FL w to IN, AR, and TX. Fruiting Mar–Jun. This is one of the most recently described species in the East TX flora (Naczi et al. 2002). *Carex kraliana* is most similar to *C. laxiflora* Lam., but in East TX it is most like *C. blanda*. In addition to characters in the key, it differs in having the terminal spike exceeded by or subequal to the most distal lateral spike (Naczi et al. 2002). Even though this recently described species will probably be found in other counties, given its limited currently known distribution in the state, we consider it to be of conservation concern in TX. Section *Laxiflorae* ⚠



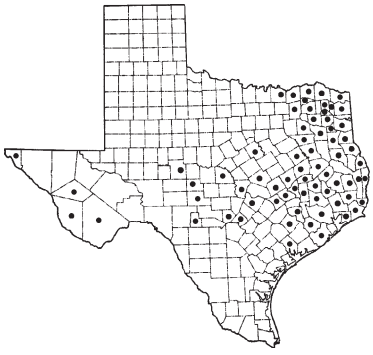
Carex festucacea



Carex fissa



Carex flaccosperma



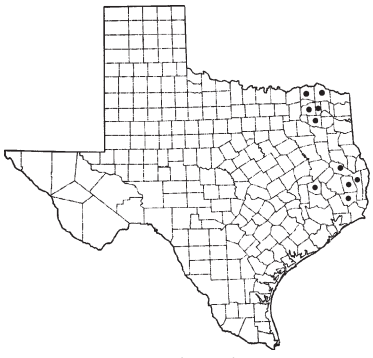
Carex frankii



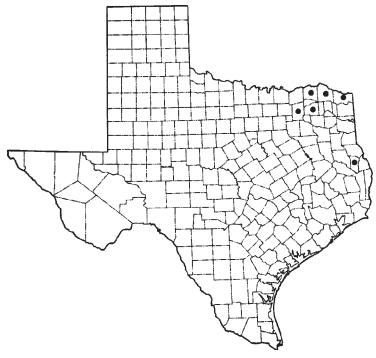
Carex gigantea



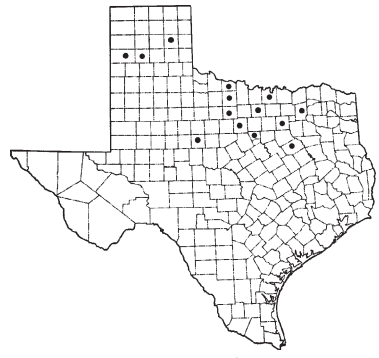
Carex glaucescens



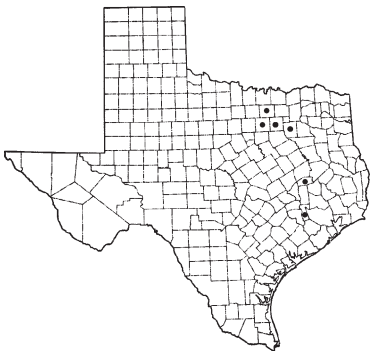
Carex glaucodea



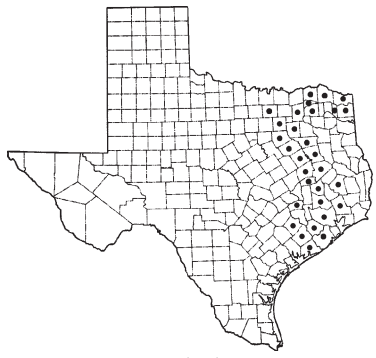
Carex granularis



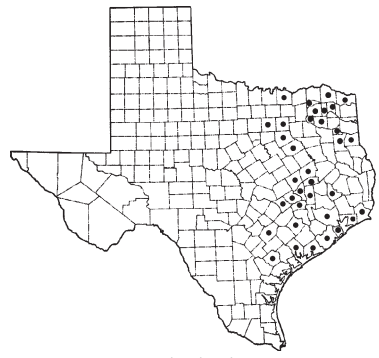
Carex gravida



Carex grisea



Carex hyalina



Carex hyalinolepis

Carex leavenworthii Dewey, (for its discoverer, Melies Conklin Leavenworth, 1796–1862, s US botanist, explorer, and army surgeon), LEAVENWORTH'S CARIC SEDGE. Primarily a facultative heliophyte but grows more robust in shade, primarily on Alfisols with sand or sandy loam, occasionally on Entisols, Histosols, or Mollisols, in open mesic to submesic sites, occasionally in wetter sites, forest edges and openings, pastures, roadsides, and lawns, appearing to do better in recently disturbed sites as a successional species but capable of persisting; throughout East TX; also e part of the Cross Timbers and Prairies, e part of the Edwards Plateau, ne part of the South TX Plains and Jim Hogg Co. further s, and the Gulf Prairies and Marshes from the Coastal Bend area northeastward; se Canada (Ont.) and e U.S. w to NE and TX also CA. Fruiting (mid-Feb–)mid-Mar–early Jul(–late Oct). [*C. cephalophora* Muhl. ex Willd. var. *angustifolia* Boott, *C. cephalophora* var. *leavenworthii* (Dewey) Kük.] Section *Phaestoglochin*

Carex leptalea Wahlenb. subsp. **harperi** (Fernald) W. Stone, (sp.: delicate; subsp.: for its discoverer, Roland MacMillan Harper, 1878–1966), ROLAND HARPER'S BRISTLE-STALK CARIC SEDGE. A facultative sciophyte found in acid seep heads, seeps, and bogs of mixed pine hardwood or hardwood forests; probably throughout the Pineywoods, though recorded from Shelby and Nacogdoches cos. southward, and in Wood Co. of the Post Oak Savannah; also Harris Co. in the n Gulf Prairies and Marshes; se U.S. from PA s to FL w to MO and TX. Fruiting Apr–Jun(–Oct). [*C. harperi* Fernald] Cochrane (2002b) did not recognize infraspecific taxa in this species, stating that "because they intergrade to some degree, the modern tendency is to treat them as only extreme phases in a wide-ranging, complex species." Cochrane does go on to provide salient characters for all the variants and states the most distinct variant is *Carex leptalea* subsp. *harperi*. Given the variation pattern present, recognition at the subspecies level seems most appropriate and is thus being done here. Section *Polytrichoideae*

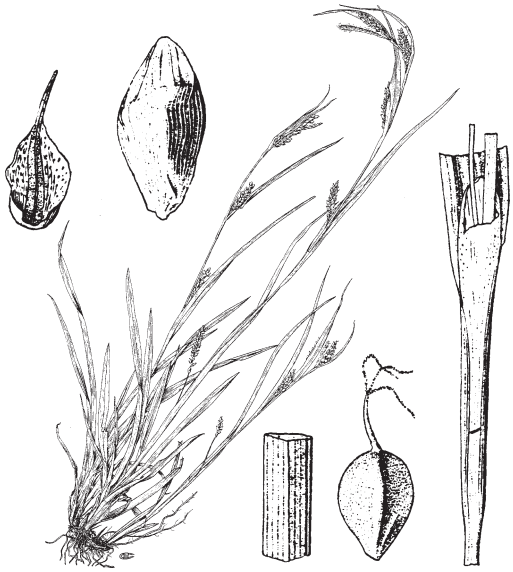
Carex lonchocarpa Willd., (spear-fruit), SPEAR-FRUIT CARIC SEDGE, SOUTHERN LONG CARIC SEDGE. A facultative sciophyte found in acid seep heads, seeps, bogs, wet creek bottoms, wet bottomland hardwoods, and cypress swamp margins; Hardin, Jasper, Newton, Sabine, Shelby, and Tyler cos. in the e Pineywoods; also Harris Co. in the n Gulf Prairies and Marshes; se U.S. from NJ s to FL w to MO and TX. Fruiting Apr–May(–Jun). [*C. folliculata* L. var. *australis* L.H. Bailey] Section *Folliculatae*

Carex longii Mack., (for Bayard Henry Long, 1885–1969, of Philadelphia), BAYARD LONG'S CARIC SEDGE. A facultative heliophyte in open, damp or wet acidic sites, usually in sandy, or peaty soils; throughout much of East TX except in the sw part and the extreme n; also the Gulf Prairies and Marshes from the Coastal Bend area northeastward; se Canada and e U.S. w to WI, OK, and TX. Fruiting May–Jul(–Nov). Section *Ovales*

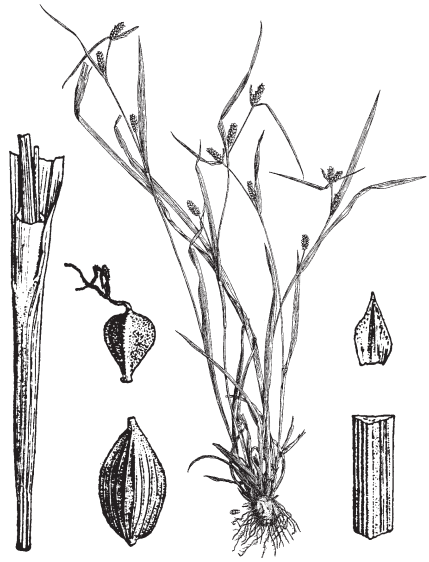
Carex louisianica L.H. Bailey, (of Louisiana), LOUISIANA CARIC SEDGE. A facultative sciophyte but able to withstand full sun, in swampy woods, bogs, bottomland hardwood forests, and pinelands in acidic soils; throughout the Pineywoods, the Red River drainage, and much of the Post Oak Savannah except for the sw part, but absent from the Blackland Prairie; also in ne part of Gulf Prairies and Marshes; e U.S. from NJ s to FL w to IL, OK, and TX. Fruiting Apr–Aug. Section *Lupulinae* ⚅/281

Carex lupuliformis Sartwell ex Dewey, (similar in form to *Carex lupulina*), HOP-LIKE CARIC SEDGE, FALSE HOP CARIC SEDGE. Primarily a heliophyte but also found in shadier conditions than *C. lupulina*, in open forest swales, open ditches, and open swamps, rare though locally abundant and forming large colonies; Bowie, Harris, Houston, Liberty, Marion, and Montgomery cos.; also Brazoria Co. in the n Gulf Prairies and Marshes; se Canada and e U.S. w to IA, OK, and TX. Fruiting Jun–Oct. (RARE 2002b: G3G4S1). Section *Lupulinae* ⚠

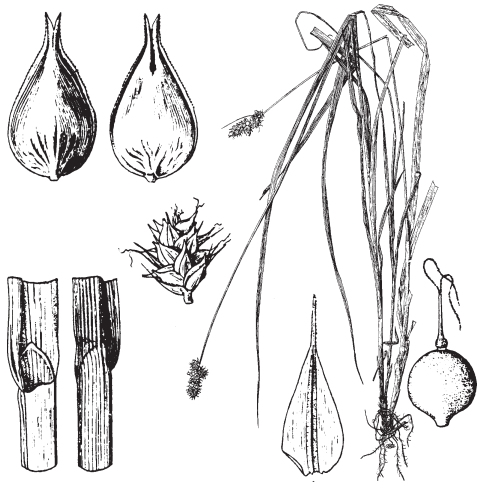
Carex lupulina Muhl. ex Willd., (resembling *Humulus lupulus*—hops), HOP CARIC SEDGE. A facultative heliophyte in open swamps, low woods, marshes, and open wet ditches in somewhat



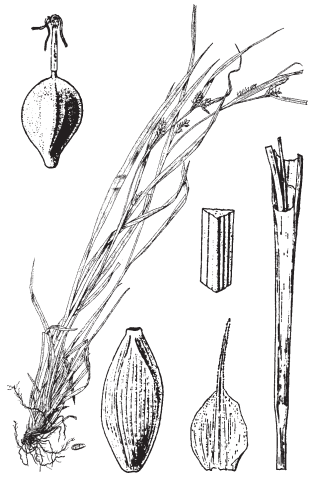
Carex glaucodea [MAC]



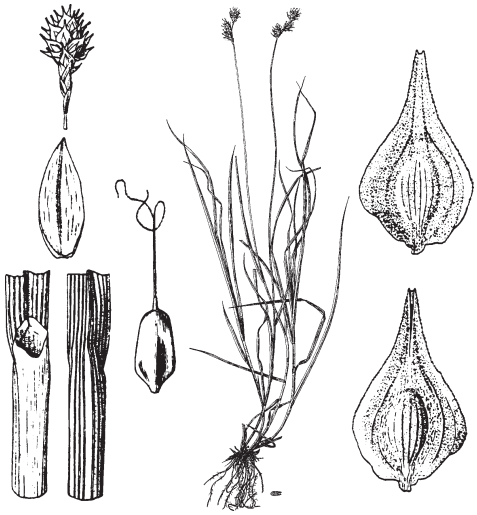
Carex granularis [MAC]



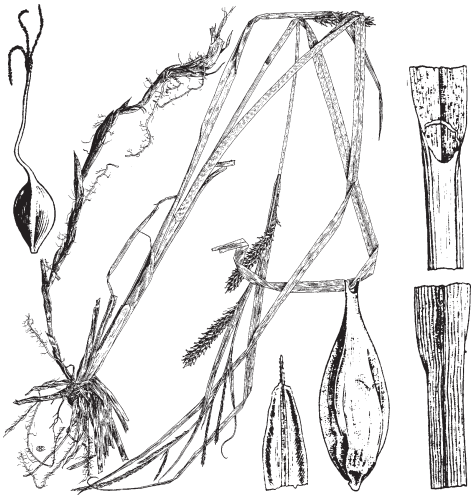
Carex gravida [MAC]



Carex grisea [MAC]



Carex hyalina [MAC]



Carex hyalinolepis [MAC]

acidic-neutral to calcareous soils; throughout most of East TX, but rare in the sw part, though reported from Gonzales and Hays cos.; also present in the ne part of the Gulf Prairies and Marshes; se Canada and e U.S. w to WI, NE, and TX. Fruiting Apr–Oct. Section *Lupulinae* ⚙/281

Carex lurida Wahlenb., (sallow, pale yellow), SALLOW CARIC SEDGE. A facultative heliophyte in open swales and open swamps; throughout the Pineywoods, most of the Red River drainage, most of the Post Oak Savannah except the sw part, rare in the Blackland Prairie, and apparently absent in the sw part of East TX; also Denton Co. of the Cross Timbers and Prairies; e Canada and e U.S. w to WI, MO, OK, and TX. Fruiting late Apr–early Jul(–Aug). Section *Vesicariae* ⚙/281

Carex meadii Dewey, (for its discoverer, Samuel Barnum Mead, 1798–1880, botanist and physician of CT and IL), SAMUEL MEAD'S CARIC SEDGE. An obligate heliophyte in open mesic to wet calcareous clay prairies and depressions, and a conspicuous plant in early spring due to its glaucous leaves; n part of East TX in Dallas, Grayson, Gregg, Kaufman, and Lamar cos., Post Oak Savannah in Austin and Leon cos., and s part of the Pineywoods in Jasper, Liberty, and San Jacinto cos.; also n Gulf Prairies and Marshes, Floyd Co. of the High Plains, and Hemphill Co. of the Rolling Plains; sc Canada and e 1/2 of U.S., also AZ. Fruiting late Mar–mid-May(–early Jun). Section *Paniceae*

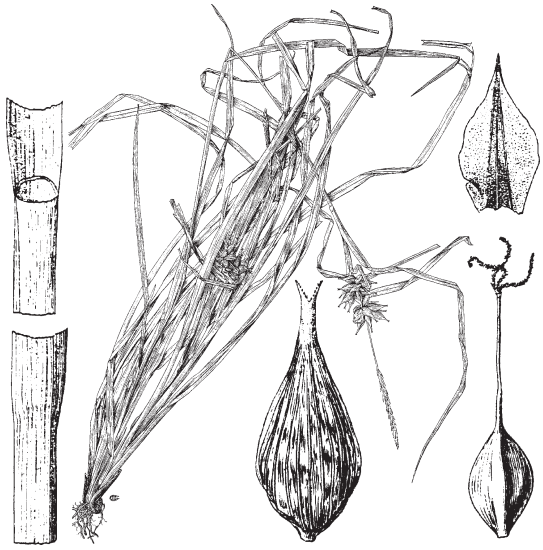
Carex microdonta Torr. & Hook., (small-toothed), SMALL-TOOTH CARIC SEDGE, LITTLE-TOOTH CARIC SEDGE. An obligate heliophyte mainly along roadsides but also where basic soils occur, including calcareous shores, gravels, meadows, prairies, and glades, also possibly in non-calcareous, neutral soils; throughout the s half of East TX, nw part of East TX, and Red River Co. in the ne; also e Cross Timbers and Prairies, Wheeler Co. in the Rolling Plains, Edwards Plateau, Trans-Pecos, and n South TX Plains; sc U.S., also FL. Fruiting late Apr–Jun. Section *Granulares*

Carex microrhyncha Mack., (small-beaked), SMALL-BEAKED CARIC SEDGE, LITTLE-SNOUT CARIC SEDGE. A facultative sciophyte that will tolerate some direct sun in submesic oak-hickory forests or oak-juniper woodlands, found at the base of trees or in semi-open areas with sandy or sandy gravel soils; throughout much of East TX sw to Bastrop and Lavaca cos., but overlooked and infrequently collected; also in the Cross Timbers and Prairies in Parker Co. and in the Gulf Prairies and Marshes in Galveston Co.; AR, KS, MO, OK, and TX. Fruiting early Feb–Apr(–May). Crins and Rettig (2002) treated this taxon as a synonym of *C. umbellata* Schkuhr ex Willd. They stated that "a revision of the *C. umbellata-C. tonsa* complex may reveal distinctions." In fact, preliminary molecular data already support recognition of *C. microrhyncha* at the species level (E. Roalson, pers. comm.). In addition, *C. umbellata* ranges from MO northward while *C. microrhyncha* ranges from MO southward. There is also a difference in achene color, and the achene apex of *C. microrhyncha* is retuse as opposed to being rounded in *C. umbellata*. Based on this information, this taxon is here being recognized at the species rank. Section *Acrocystis*

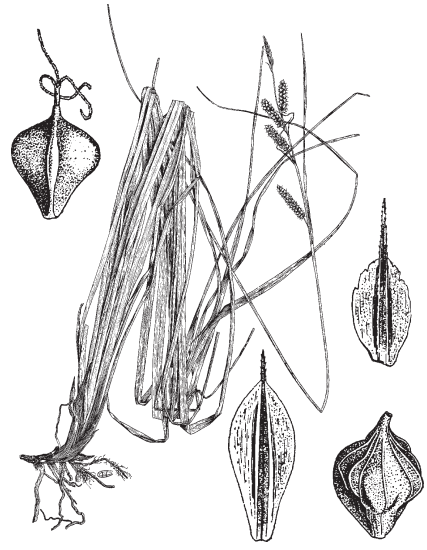
Carex muehlenbergii Schkuhr ex Willd., (for Gotthilf Henry Ernest Muhlenberg, 1753–1815, German-educated, pioneer botanist and Lutheran minister of PA), MUHLENBERG'S CARIC SEDGE. The following two varieties are distinguished in the key to species. Section *Phaestoglochin*

var. **enervis** Boott, (nerveless), GOTTHILF MUHLENBERG'S VEINLESS CARIC SEDGE. An obligate to facultative sciophyte, but in some habitats growing as a remnant in full sun, in mesic or submesic hardwood forests (frequently oak-hickory woods), on Alfisols, less frequently on Entisols, Vertisols, or Histosols, but most frequently found in sandy soils with a humus layer or in thin soils over limestone with a humus layer; throughout East TX; also Cross Timbers and Prairies, Edwards Plateau, King Co. in the Rolling Plains, n South TX Plains, and Gulf Prairies and Marshes from the Coastal Bend area northeastward; se Canada (Ont.) and e U.S. w to WI, NE, and TX. Fruiting Apr–Jul(–Oct). [*C. onusta* Mack., *C. plana* Mack.]

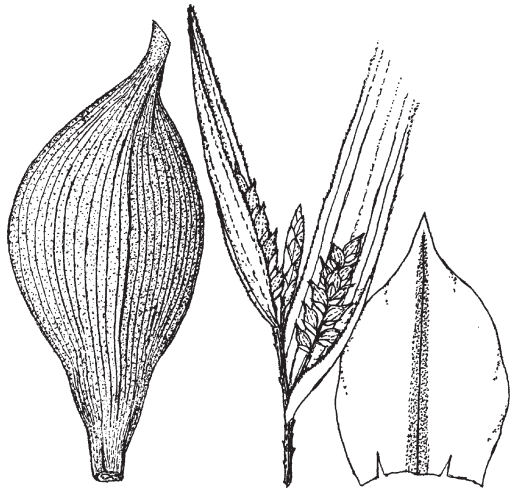
var. **muehlenbergii**, GOTTHLIF MUHLENBERG'S CARIC SEDGE. Obligate to facultative heliophyte in Entisols of open sand hills, openings in sandy oak-hickory woods, sandy forest edges, open to



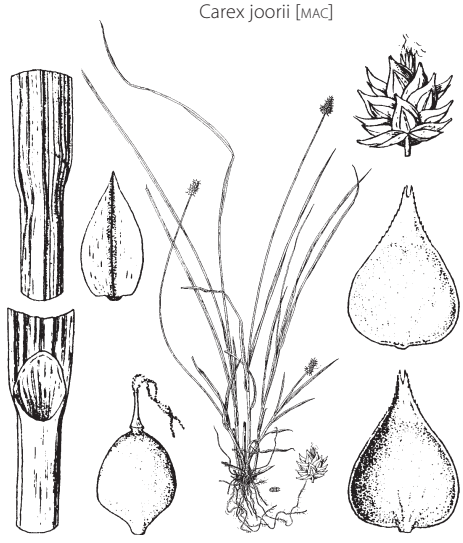
Carex intumescens [MAC]



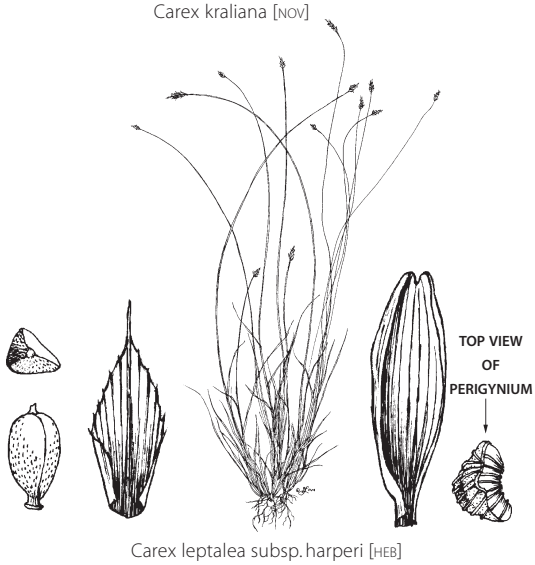
Carex joorii [MAC]



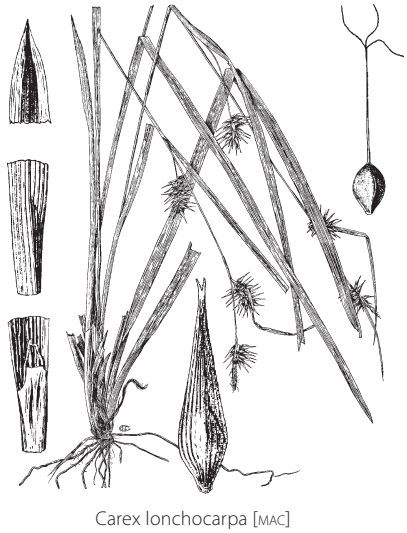
Carex kraliana [NOV]



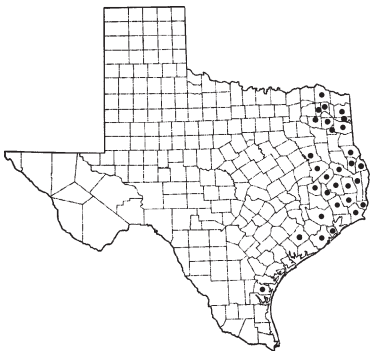
Carex leavenworthii [MAC]



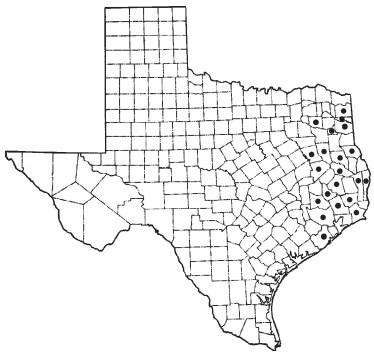
Carex leptalea subsp. harperi [HEB]



Carex lonchocarpa [MAC]



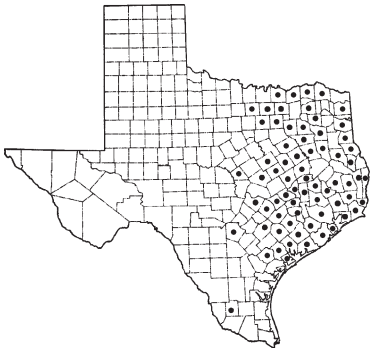
Carex intumescens



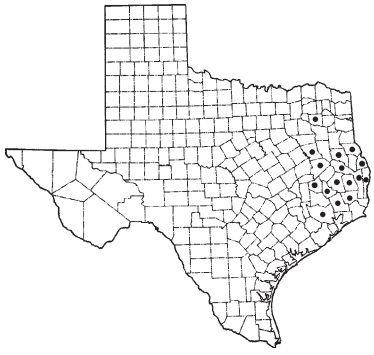
Carex joorii



Carex kraliana



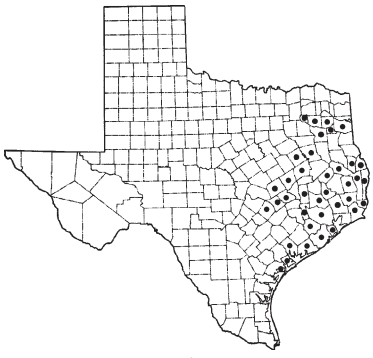
Carex leavenworthii



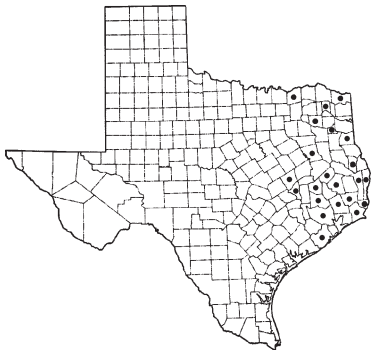
Carex leptalea subsp. harperi



Carex lonchocarpa



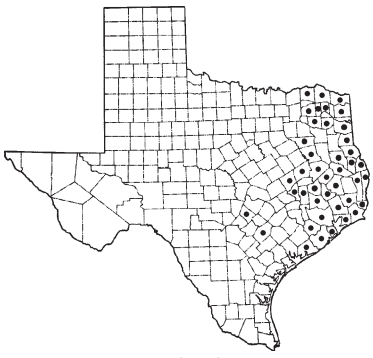
Carex longii



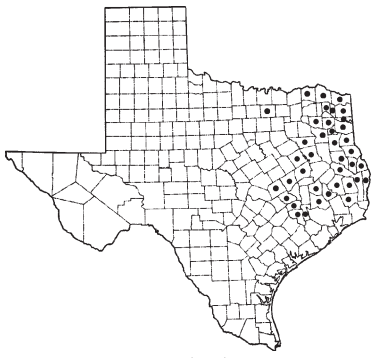
Carex louisianica



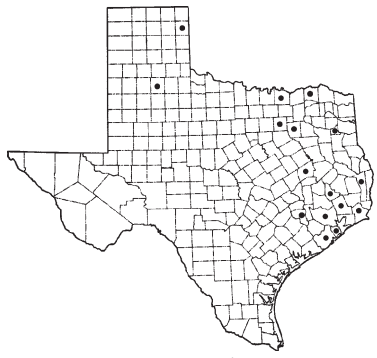
Carex lupuliformis



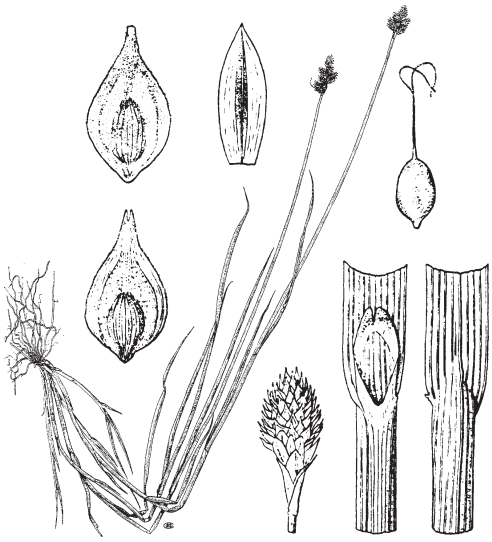
Carex lupulina



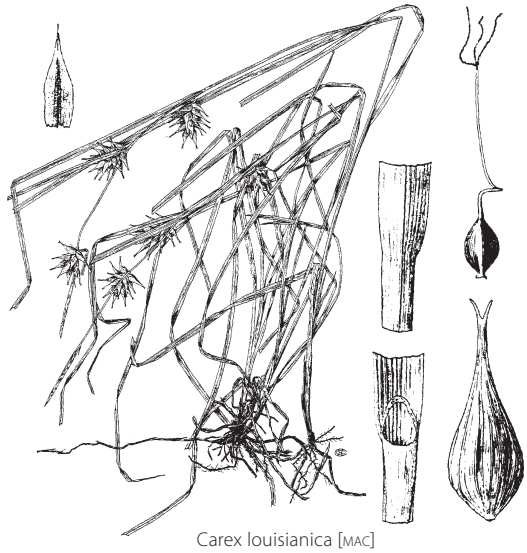
Carex lurida



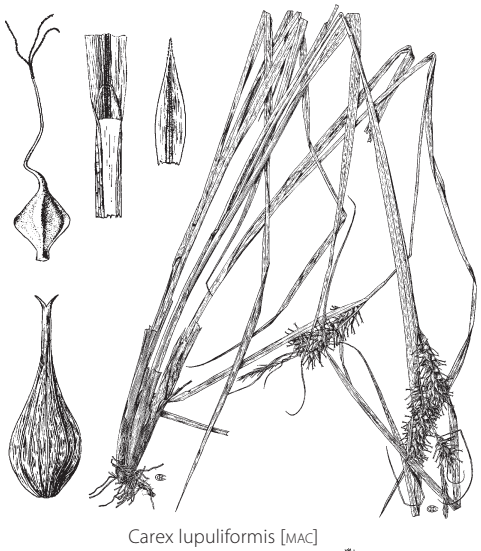
Carex meadii



Carex longii [MAC]



Carex louisianica [MAC]



Carex lupuliformis [MAC]



Carex lupulina [MAC]



Carex lurida [MAC]



Carex meadii [MAC]

semi-open sandstone outcrops, and open pine barrens, or on thin soils over limestone, occasional on Alfisols or even Histosols; throughout much of East TX sw to Caldwell and Gonzalez cos.; also a few counties in the Cross Timbers and Prairies and Harris Co. in the n Gulf Prairies and Marshes; se Canada and e U.S. w to WI, KS, and TX. Fruiting (late Mar–)late Apr–mid-Aug(–early Sep).

Carex nigromarginata Schwein. var. **floridana** (Schwein.) Kük., (sp.: black-margined; var.: of Florida), FLORIDA BLACK-MARGINED CARIC SEDGE. A facultative sciophyte in dry woods, frequently dry sandy woods; widespread in the Pineywoods and the e edge and the n part of the Post Oak Savannah, but absent from the Blackland Prairie and from the sw part of East TX; also in the extreme ne part of the Gulf Prairies and Marshes; se U.S. from NC s to FL w to TX. Fruiting late Feb–mid-Apr. [*C. floridana* Schwein.] Crins and Rettig (2002) treated this taxon as a distinct species (*C. floridana*) and separated it from *C. nigromarginata* in the narrow sense (a species of the e U.S. w to AR and MO), using the characters in the key below. The main difference is apparently the rhizomes, a character they used to separate varieties of *C. albicans*. Varietal status appears best suited to treat the variation seen in *C. nigromarginata* and is most consistent with the treatment of other taxa in this section of *Carex* (e.g., *C. albicans*). The rank of variety is thus being used here. The fruits are reportedly dispersed by ants, with a whitish swelling near the base of the perigynium acting as an elaiosome (= appendage used in dispersal by ants or other insects) (Gaddy 1986). Section *Acrocystis*

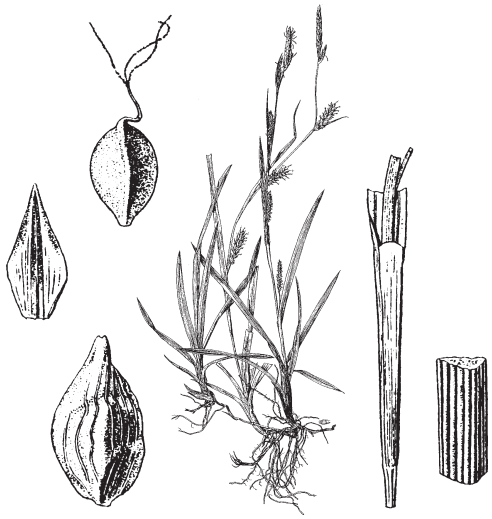
1. Rhizomes horizontally spreading to ascending, 17–75 mm long; stigmas 2 or 3; some achenes biconvex or trigonous; culm bases usually weakly fibrous _____ *C. floridana*
1. Rhizomes ascending to erect, 0–10 mm long; stigmas 3; achenes obtusely trigonous in cross section; culm bases often strongly fibrous _____ *C. nigromarginata*

Carex oklahomensis Mack., (of Oklahoma), OKLAHOMA CARIC SEDGE. A facultative to obligate heliophyte of open wet ditches, beaver ponds, and wet prairies, also sparingly in wet clearings of forested areas; n part of East TX in Anderson, Camp, Freestone, Leon, Nacogdoches, Titus, and Wood cos; sporadic in e U.S. from DE s to NC w to KS and TX. Fruiting Apr–May. Section *Vulpinae*

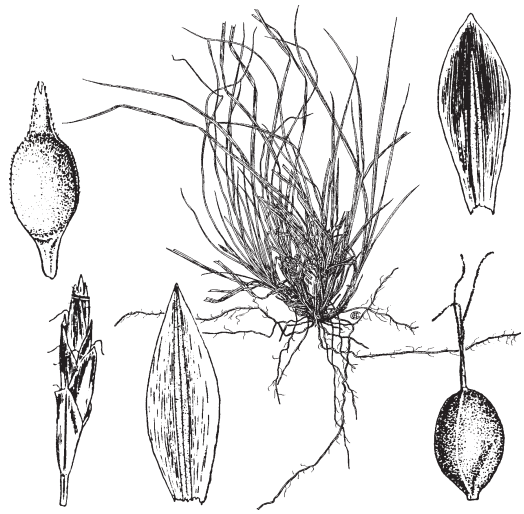
Carex oxylepis Torr. & Hook., (sharp-scaled), SHARP-SCALE CARIC SEDGE. A facultative sciophyte that will tolerate some full sun, in rich low moist hardwood forests, frequently along floodplains of forest creeks; throughout most of East TX except for the sw part; also in the Gulf Prairies and Marshes from the Coastal Bend area northeastward; se U.S. from VA s to FL w to MO, OK, and TX. Fruiting Mar–Apr(–early Jun). Section *Hymenochlaenae*

Carex ozarkana P. Rothr. & Reznicek, (of the Ozarks), OZARK CARIC SEDGE. A facultative heliophyte in early successional wetlands on mineral soils, often in association with seepages, seepy banks of streams, permanently wet ditches, pond shores, and wet depressions in meadows and pastures, in sites usually dominated by *Juncus* spp., with loamy, usually acidic soils, ranging from clay loams to silt loams; e part of the Red River drainage, the n parts of the Post Oak Savannah and Pineywoods, and Sabine Co. further s; AR, LA, OK, and TX. Fruiting late Apr–May. Section *Ovales*

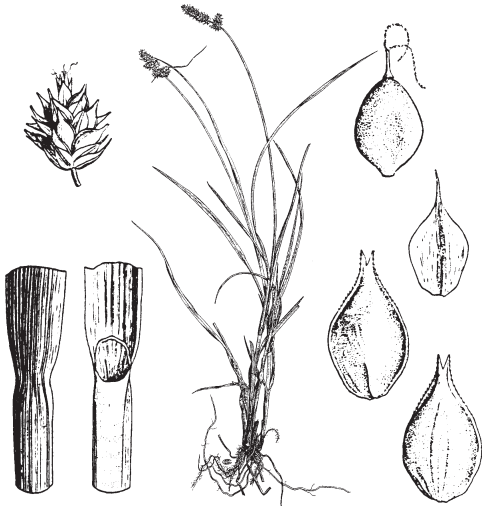
Carex perdentata S.D. Jones, (having teeth), CONSPICUOUSLY-TOOTHED CARIC SEDGE, SANDSTONE CARIC SEDGE. A plant of sun or shade conditions, primarily in sandy loam, on sandstone outcrops, and granitic outcrops, or in thin soils over limestone, open mesic to submesic hardwood forests, open hardwood-juniper forests, or woodlands in savannahs with granite outcrops; w edge of East TX, mainly w edge of the Blackland Prairie and Colorado and Fayette cos. of the Post Oak Savannah; also n part of the South TX Plains, Cross Timbers and Prairies, and Edwards Plateau; OK and TX. Fruiting mid-Mar–early Jun. This species was described relatively recently (Jones 1994b). Section *Phaestoglochin*



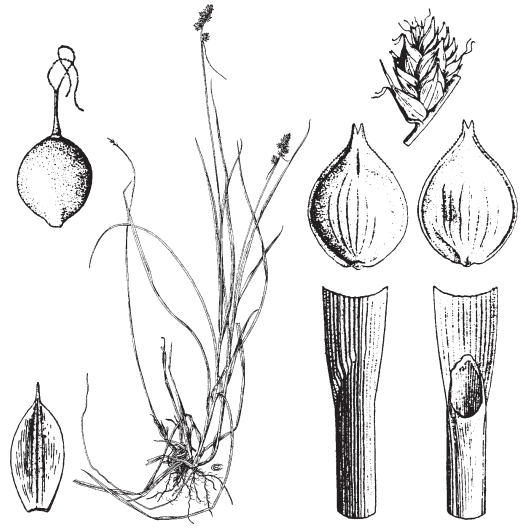
Carex microdonta [MAC]



Carex microrhyncha [MAC]



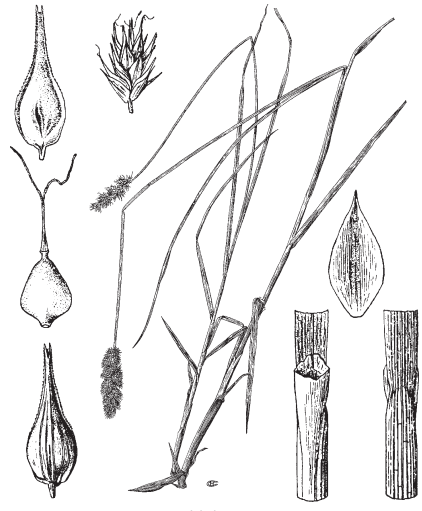
Carex muehlenbergii var. enervis [MAC]



Carex muehlenbergii var. muehlenbergii [MAC]



Carex nigromarginata var. floridana [MAC]



Carex oklahomensis [MAC]

Carex planispicata Naczi, (plane-spiked), SINGLE-PLANE CARIC SEDGE. A facultative sciophyte in mesic deciduous forests, upper parts of floodplains and adjacent slopes, on acid loams, silt loams, and sandy loams; mainly s Pineywoods and n Post Oak Savannah; e U.S. from PA s to GA w to IL, OK, and TX. Fruiting Apr–May. In our area this species frequently grows with *Carex abscondita*. Section *Griseae*

Carex planostachys Kunze, (flat-spiked), CEDAR CARIC SEDGE. A plant that grows in the shade of junipers, oaks, various shrub spp., or taller herbaceous plants but also does well when exposed to some full sun, in dry oak-juniper areas or scrub on calcareous soils; mainly on the w edge of the Blackland Prairie, and c part of the Post Oak Savannah southeastward, extending e to Grimes Co.; also Cross Timbers and Prairies, Edwards Plateau, Trans-Pecos, King Co. in the Rolling Plains, n part of the South TX Plains, and the Coastal Bend area of the Gulf Prairies and Marshes; AR, OK, and TX. Fruiting Mar–May. Section *Halleranae*

Carex reniformis (L.H. Bailey) Small, (kidney-shaped), KIDNEY-SHAPE CARIC SEDGE. A facultative sciophyte in low wet woods, sloughs, and less frequently in marshes; widespread in the Pineywoods, the c part of the Post Oak Savannah northward, and the Red River drainage; also Tarrant Co. in the e part of the Cross Timbers and Prairies and the ne part of the Gulf Prairies and Marshes; se U.S. from VA s to FL w to IL, OK, and TX. Fruiting May–Jun. Section *Ovales*

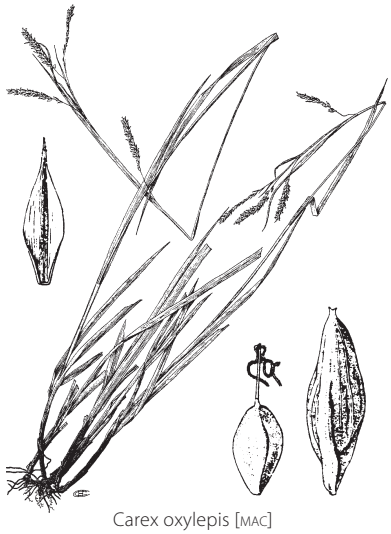
Carex retroflexa Muhl. ex Willd., (bent backward), REFLEXED-FRUIT CARIC SEDGE. A facultative sciophyte in dry rocky or sandy woods, thickets, and forest edges but sometimes persisting in openings exposed to full sun along fence rows and cleared areas; throughout most of East TX; also Cross Timbers and Prairies, e edge of the Edwards Plateau, and the ne part of the Gulf Prairies and Marshes; se Canada (Ont.) and widespread in e U.S. w to IL, KS, and TX. Fruiting late Mar–May(–Jun). Section *Phaestoglochin*

Carex rosea Schkuhr ex Willd., (rose-like), STELLATE CARIC SEDGE, ROSY SEDGE. A facultative sciophyte in rich deciduous woods, frequently associated with *Podophyllum* (may-apple); Anderson, Hardin, Harris, Rusk, Sabine, and San Augustine cos., but probably throughout the Pineywoods, the e edge of the Red River drainage, possibly the n counties of the Post Oak Savannah, and the ne Gulf Prairies and Marshes; se Canada and widespread in e 1/2 of U.S., also WY. Fruiting late Apr–Jun(–early Jul). This species is easily overlooked and infrequently collected. Section *Phaestoglochin*

Carex shinnersii P. Rothr. & Reznicek, (for Lloyd Herbert Shinners, 1918–1971, author of *Spring Flora of the Dallas-Fort Worth Area Texas* and founder of the botanical journal *Sida, Contributions to Botany*), LLOYD SHINNERS' CARIC SEDGE. A facultative heliophyte in open wet swales and bottoms, depressions, or wet roadside ditches or ones with ephemeral water, usually on sandy soils; Delta, Kaufman, Lamar, and Red River cos. in the n part of East TX and undoubtedly in many other counties of East TX; also Tarrant Co. in the Cross Timbers and Prairies; AR, KS, OK, and TX. Fruiting May–Jun. This species was only recently described (Rothrock & Reznicek 2001). Section *Ovales*

Carex socialis Mohlenbr. & Schwegman, (companionable or sociable), COMPANION CARIC SEDGE, LOW WOODLAND CARIC SEDGE. A facultative sciophyte in clay or sandy clay soils of secondary terraces of river floodplains, frequently associated with *C. hyalina*, mostly along the floodplains of the Trinity and Sulphur rivers in the Blackland Prairie, Post Oak Savannah, Red River drainage, and Pineywoods; se U.S. from NC s to GA w to IL, OK, and TX. Fruiting late Mar–May. Section *Phaestoglochin*

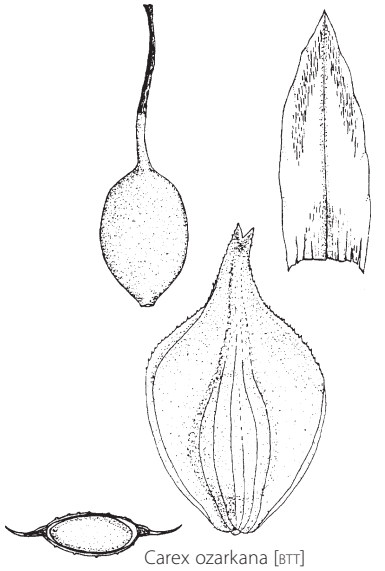
Carex striatula Michx., (with fine longitudinal lines), FINE-LINE CARIC SEDGE, LINED CARIC SEDGE. A facultative sciophyte, frequently on upper slopes of ravines in partial openings of deciduous forests; mainly in the Pineywoods and one collection from Dallas Co. in the Blackland Prairie, absent from the sw and nw parts of East TX; e U.S. from NY s to FL w to AR and TX. Fruiting



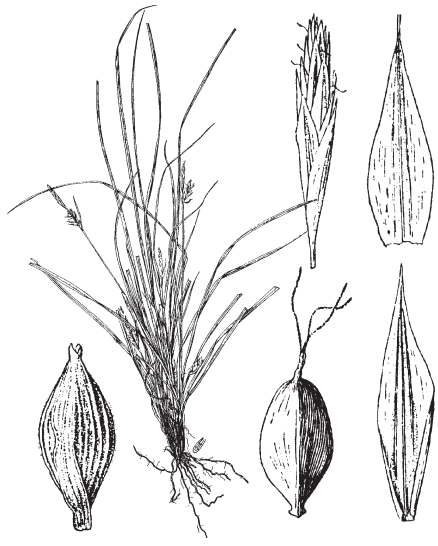
Carex oxylepis [MAC]



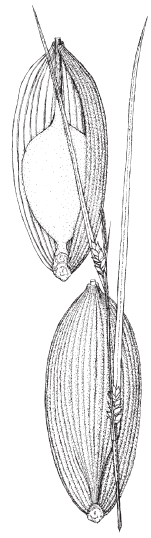
Carex perdentata [SID]



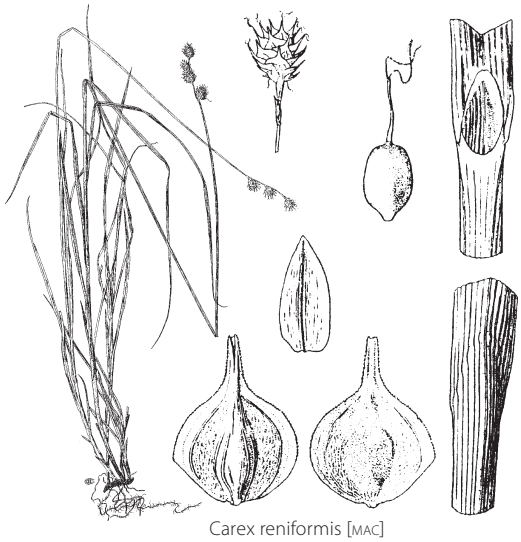
Carex ozarkana [BTT]



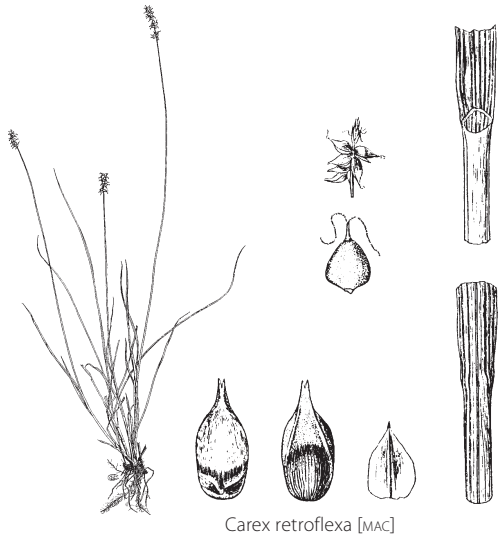
Carex planostachys [MAC]



Carex planispicata [FNA]



Carex reniformis [MAC]



Carex retroflexa [MAC]

Mar–May(–Jun). The fruits are reportedly dispersed by ants, with a whitish swelling near the base of the perigynium acting as an elaiosome (= appendage used in dispersal by ants or other insects) (Gaddy 1986). Section *Laxiflorae*

Carex stricta Lam., (erect), TUSSOCK CARIC SEDGE, UPRIGHT CARIC SEDGE. A facultative heliophyte but also does well in shady areas, marshes, wet meadows, pond margins, and most frequently in semi-open boggy *Sphagnum* creek bottoms; Anderson, Freestone, Gonzales, Henderson, Robertson, and Walker cos.; se Canada and e U.S. from ME s to NC w to KS, also MS and TX. Fruiting Mar–May. Section *Phacocystis*

Carex styloflexa Buckley, (with curved style), BENT CARIC SEDGE. A facultative sciophyte in mesic to hydric areas, edges of bogs but most frequently along margins of acid streams in mixed pine/hardwood or hardwood forests; mainly s Pineywoods; also Harris Co. in the n Gulf Prairies and Marshes; e U.S. from NY s to FL w to OH, LA, and TX. Fruiting Apr–May(–Jun). Section *Laxiflorae*

Carex tenax Chapm. ex Dewey, (holding fast), HOLD-FAST CARIC SEDGE, WIRE CARIC SEDGE. A plant of open pine or pine/oak sand barrens which grows in full sun or partial shade; Hardin, Newton, Shelby, and Tyler cos. in the se Pineywoods; se U.S. from NC s to FL w to TX. Fruiting late Apr–mid-Jun. Section *Halleranae* ⊠/281

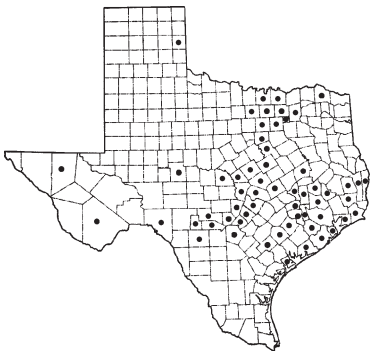
Carex tetrastachya Scheele, (four-spike), FOUR-ANGLE CARIC SEDGE, BRITTON'S CARIC SEDGE. A facultative heliophyte found in open, moist to wet sites, wet prairies, roadside ditches, open swamp and marsh edges, less in open low woods, most frequently in calcareous soils; as presently circumscribed (there is significant infraspecific variation present that is being studied): s part of the Pineywoods, most of the Post Oak Savannah, and Blackland Prairie; also Cross Timbers and Prairies, s and ne Rolling Plains, Edwards Plateau, South TX Plains, and Gulf Prairies and Marshes; LA, OK, and TX. Fruiting Mar–May(–early Jun). [*C. brittoniana* L.H. Bailey] Section *Ovales*

Carex texensis (Torr.) L.H. Bailey, (of Texas), TEXAS CARIC SEDGE. In submesic to mesic, rocky or sandy woods and fields, at home in sun or partial to moderate shade; throughout the Pineywoods and the e edge of the Post Oak Savannah; also ne part of the Gulf Prairies and Marshes; e 1/2 of U.S. except extreme midwest, also CA. Fruiting mid-Mar–mid-May(–early Jun). [*C. retroflexa* Muhl. ex Willd. var. *texensis* (Torr.) Fernald] Downer and Hyatt (2003) discussed differences between this species and the similar *C. retroflexa.* Section *Phaestoglochin*

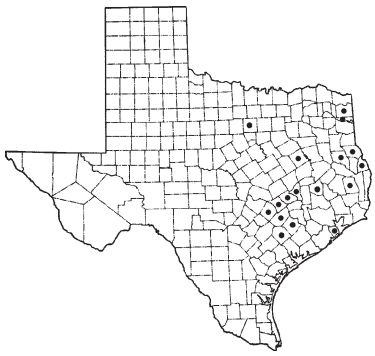
Carex triangularis Boeck., (triangular), TRIANGULAR CARIC SEDGE, EASTERN FOX CARIC SEDGE. A facultative heliophyte in open wet roadside ditches and in open wet areas in floodplains, rarely under closed canopies, usually in alluvial clay soils; throughout most of East TX sw to DeWitt Co. in the Post Oak Savannah; also the Gulf Prairies and Marshes from the Coastal Bend area northeastward; from TN and MS w to KS and TX. Fruiting (Apr–)May–Jun. Section *Multiflorae*

Carex tribuloides Wahlenb. var. **sangamonensis** Clokey, (sp.: resembling *Tribulus*—caltrop; var.: from Sangamon, IL), SANGAMON CALTROP CARIC SEDGE. A facultative sciophyte, frequently in the open in bottomlands, swales, swamp margins, low wet deciduous woods, and marshes, though designated here as a sciophyte, it appears to do well in shade or sun; throughout much of the Pineywoods, the e Post Oak Savannah, the e part of the Red River drainage, and the ne part of the Blackland Prairie; also the ne part of the Gulf Prairies and Marshes; e U.S. from OH s to AL w to KS and TX, also SC. Fruiting May–Aug. Section *Ovales*

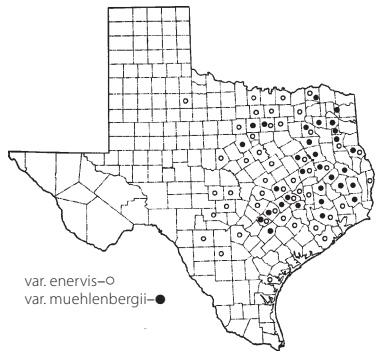
Carex typhina Michx., (resembling *Typha*—cat-tail), CAT-TAIL CARIC SEDGE. A facultative sciophyte found in rich bottomland hardwood forests; ne part of the Post Oak Savannah, e part of the Red River drainage, and the e edge of the Pineywoods from Jasper Co. northward; se Canada and widespread in e U.S. w to MN and LA, also TX. Fruiting May–Aug. Section *Squarrosae* ⊠/281



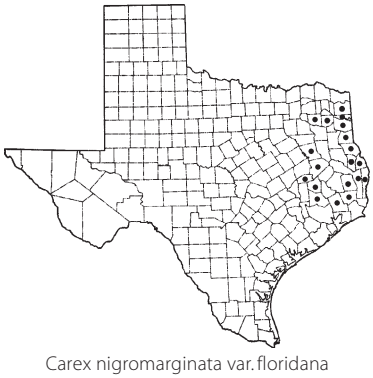
Carex microdonta



Carex microrhyncha



Carex muehlenbergii



Carex nigromarginata var. floridana



Carex oklahomensis



Carex oxylepis



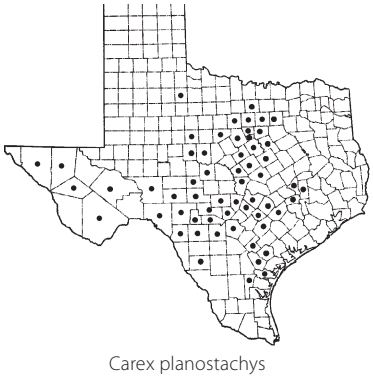
Carex ozarkana



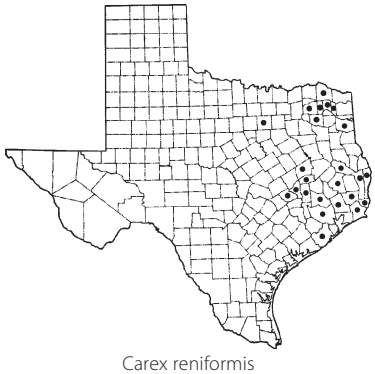
Carex perdentata



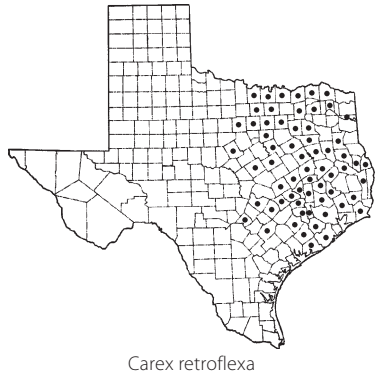
Carex planispicata



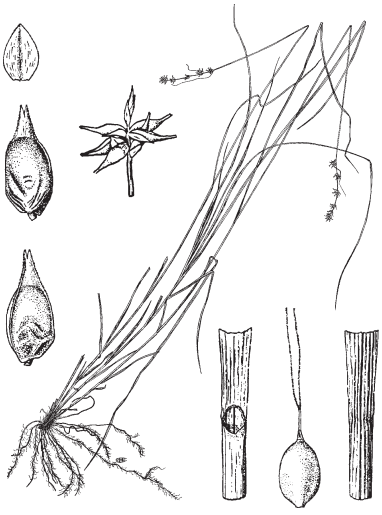
Carex planostachys



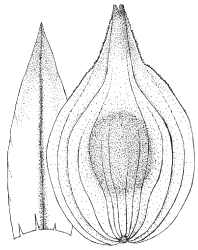
Carex reniformis



Carex retroflexa



Carex rosea [MAC]



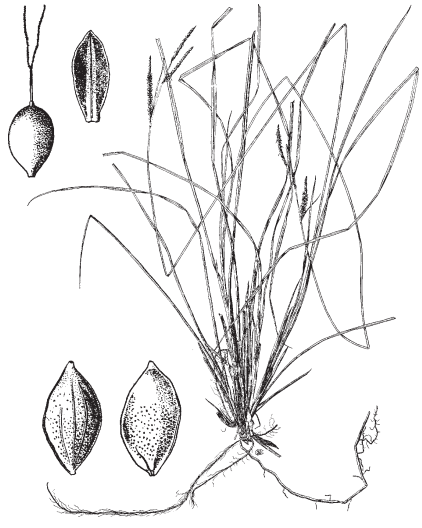
Carex shinnersii [FNA]



Carex socialis [BTT]



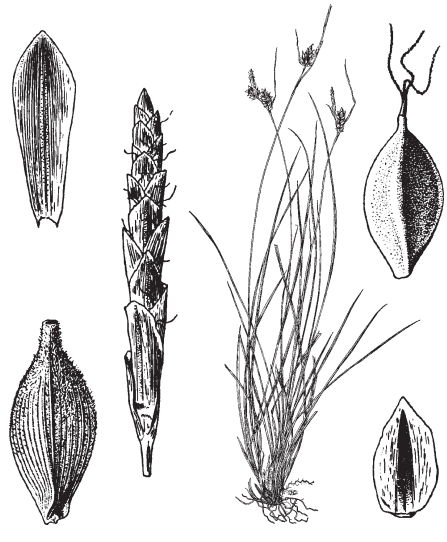
Carex striatula [MAC]



Carex stricta [MAC]



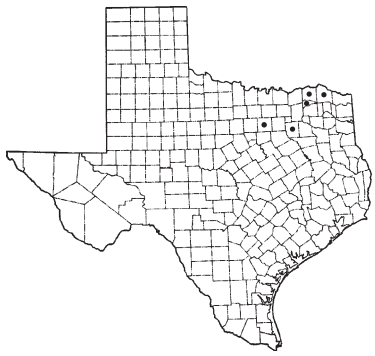
Carex styloflexa [MAC]



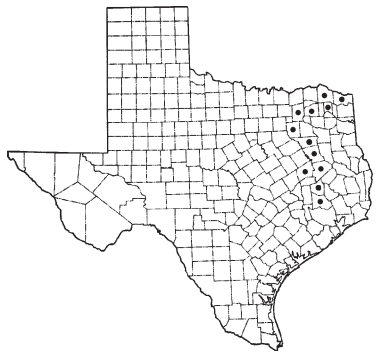
Carex tenax [MAC]



Carex rosea



Carex shinnersii



Carex socialis



Carex striatula



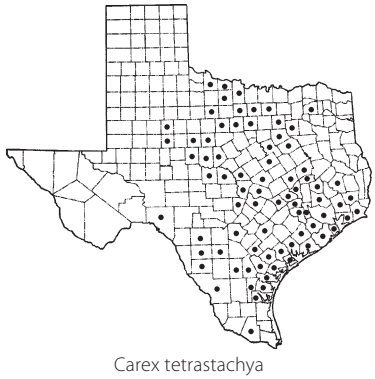
Carex stricta



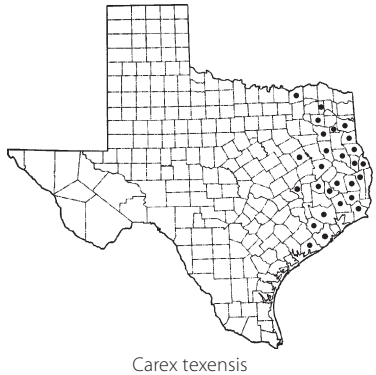
Carex styloflexa



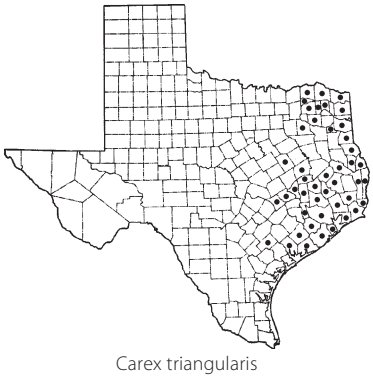
Carex tenax



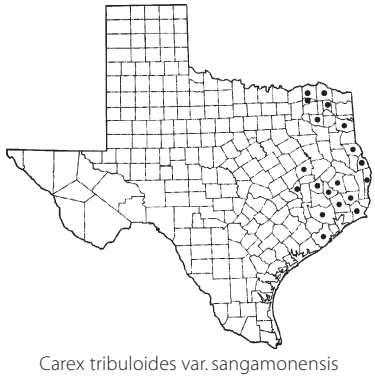
Carex tetrastachya



Carex texensis



Carex triangularis



Carex tribuloides var. sangamonensis



Carex typhina

Carex verrucosa Muhl., (with warts), WARTY CARIC SEDGE. A facultative heliophyte found in open, hydric, acidic, depressional areas and open roadside ditches, less frequently in shaded areas; Hardin, Jasper, Liberty, Montgomery, Newton, and and San Jacinto cos. in the s Pineywoods; also n Gulf Prairies and Marshes; se U.S. from NC s to FL w to TX. Fruiting Apr–mid-Jun(–Sep). Section *Pendulinae* This species was reported new for TX by Bridges and Orzell in 1989; it is similar to *C. glaucescens* but can be distinguished by the characters in the key to species.

Carex vulpinoidea Michx., (resembling *Carex vulpina*, with inflorescence like a fox tail), FOXTAIL CARIC SEDGE, COMMON FOX CARIC SEDGE. A heliophyte of wet roadside ditches, lakesides, pondsides, and open wet floodplains, usually in clayey soils; throughout much of the Pineywoods, in the Post Oak Savannah from Brazos Co. n, and in the Red River drainage; also Denton Co. in the Cross Timbers and Prairies, the Rolling Plains, the nw corner of the High Plains, and the n Gulf Prairies and Marshes; throughout s Canada and most of U.S. Fruiting Jun–Aug. Section *Multiflorae*

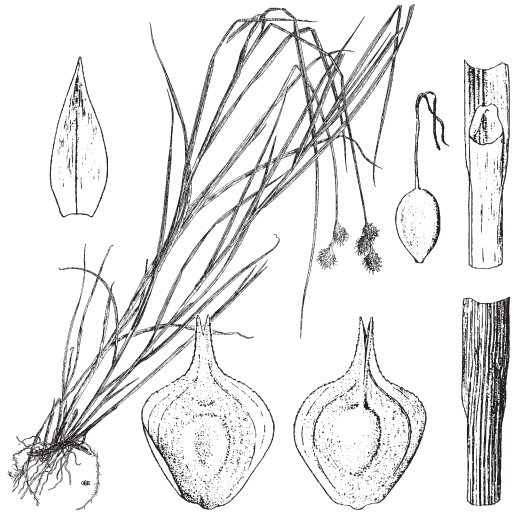
CLADIUM P. Browne
SAW-GRASS, TWIG-RUSH, SWAMP SAW-GRASS

Rhizomatous perennials; culms obtusely trigonous; leaves cauline, with well-developed blades; leaf sheaths loose; ligules absent; inflorescences cymosely branched, with numerous spikelets usually in groups of 2–10 at the ends of short branches, leafy-bracted; spikelets with a single achene-bearing fertile floret subtended by a second floret with an aborted pistil, as well as ca. 2–5 empty scales (these lacking achenes but sometimes with an aborted pistil or stamens); scales of spikelets spirally imbricate; stamens 2; stigmas 3; perianth bristles absent; achenes terete, without tubercles.

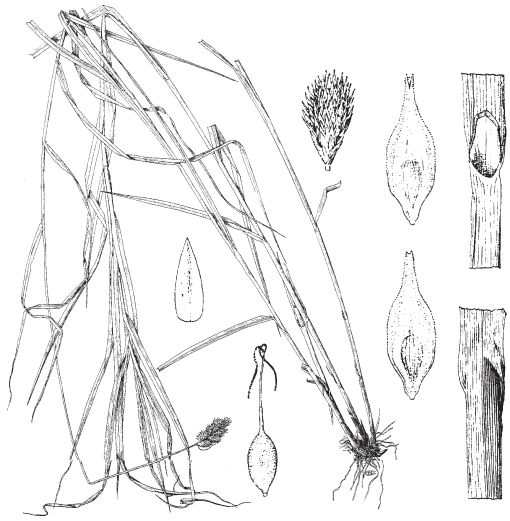
A genus of 3–4 species, in both the Old and New worlds (Mabberley 1997; Tucker 2002c). *Cladium mariscus*, sometimes called ELK SEDGE, was previously used for thatching in Great Britain (Mabberley 1997), and its culms and leaves are used in making paper products in the Danube Delta, Romania (Tucker 2002c). *Cladium* species superficially resemble some *Rhynchospora* taxa but can be easily distinguished by the lack of tubercles on the achenes. (Greek *cladion*, a branchlet, from the repeatedly branched inflorescence of the first named species) REFERENCES: Tucker 1987, 2002c; McVaugh 1993; Miao et al. 1998; Ivey & Richards 2001.

1. Leaf blades 1–3.5 mm wide, to ca. 0.3 m long, with margins scaberulous (= only slightly roughened, almost smooth to the touch); plants 1 m or less tall, the culms 1–2 mm in diam.; inflorescences with only 1st and 2nd order branches (the branches only branched once) _____ **C. mariscoides**
1. Leaf blades 5–15 mm wide, to 1 m long, with margins dangerously saw-toothed; plants to 3 m tall, the culms often 5–10 mm in diam.; inflorescences with 3rd and 4th order branches (the secondary and tertiary branches rebranched) _____ **C. jamaicense**

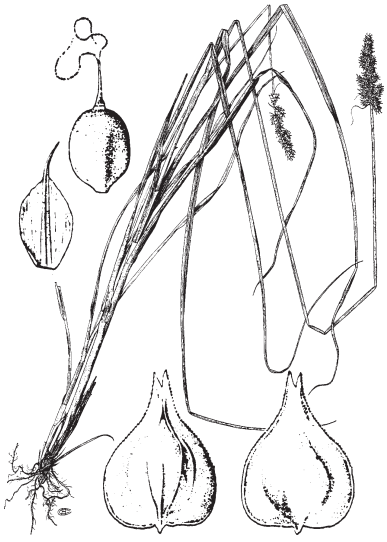
Cladium jamaicense Crantz, (of Jamaica), JAMAICAN SAW-GRASS, SAW-GRASS, SWAMP SAW-GRASS, JAMAICA SWAMP SAW-GRASS. Plant 1–3 m tall; rhizomes to ca. 10 mm in diam.; leaf blades ca. 0.3–1 m long, with dangerously spinulose-serrulate (= saw-toothed) margins and midrib (on lower surface); inflorescences 20–80 cm long, 10–30 cm wide, much-branched, sometimes droopy, with spikelets in groups of 2–6 at the ends of short branches; spikelets 3–5 mm long; achenes with surfaces roughened, obovoid to subglobose, apiculate-pointed or obtuse, contracted basally, 2–3 mm long. Stream or lake margins, wet areas, often in calcareous soils; Anderson, Wood (BRIT), Harris, Jefferson, Travis (Turner et al. 2003), and Dallas (R. O'Kennon, pers. obs.) cos.; also Gulf Prairies and Marshes, Edwards Plateau, and Trans-Pecos; se U.S. from VA s to FL w to TX. Jul–Oct. [*C. mariscus* (L.) J. Pohl subsp. *jamaicense* (Crantz) Kük., *Mariscus jamaicense* (Crantz) Britton] JAMAICAN SAW-GRASS is "the principal plant of the Everglades marshes of Fla." (Godfrey & Wooten 1979), and its ecology there has been studied in detail (Steward & Ornes 1975). Both



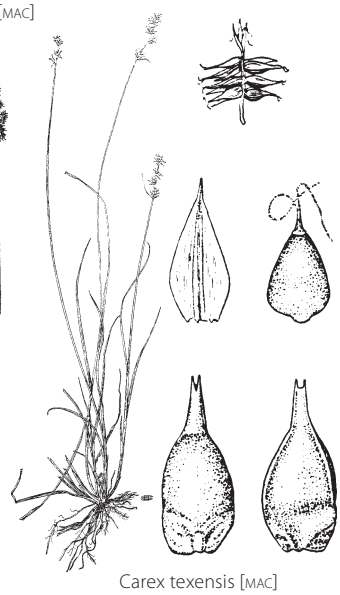
Carex tetrastachya [MAC]



Carex tribuloides [MAC]



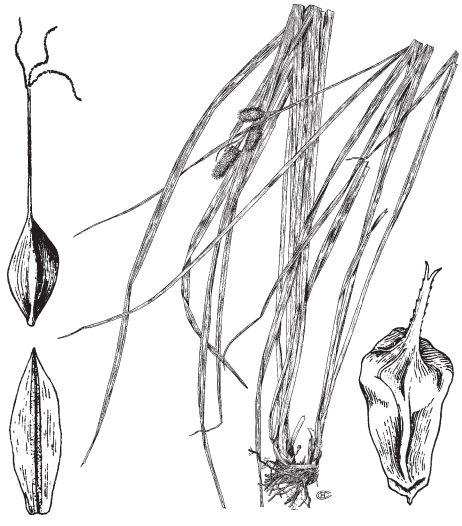
Carex triangularis [MAC]



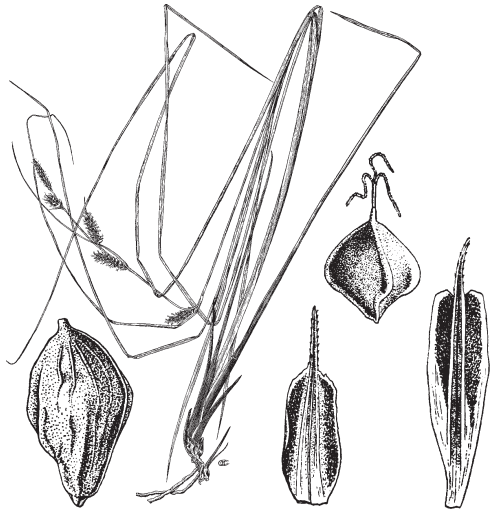
Carex texensis [MAC]



Carex vulpinoidea [MAC]



Carex typhina [MAC]



Carex verrucosa [MAC]

sexual (seed producing) and asexual (reproducing by rhizome propagation or formation of vegetative plantlets in the spikelets) reproduction is known in the species (Miao et al. 1998). This species has often been treated as a subspecies of the Old World *C. mariscus* (e.g., Kartesz 1999). However, we are following Hatch et al. (1990), Jones et al. (1997), and Tucker (2002c) in treating it as a distinct species. Tucker (2002c) recognized it as such "with some trepidation."

Cladium mariscoides (Muhl.) Torr., (resembling *Mariscus*, a segregate now included in *Cyperus*), SMOOTH SAW-GRASS, TWIG-RUSH, SWAMP SAW-GRASS. Plant 0.3–1 m tall; rhizomes ca. 2 mm in diam.; leaf blades involute, with scaberulous margins; inflorescences 5–30 cm long, slender, ca. 2–5 cm wide, usually of relatively few cymes, the inflorescences much smaller than in *C. jamaicense*, ca. 15–25 mm long, with spikelets in groups of 3–10 at the ends of short, erect branches; spikelets 3–6 mm long; achenes smooth, short-cylindric, apiculate-pointed, truncate basally, 2.5–3.5 mm long. Seepage-fed peat bogs, wet areas; Anderson (*McRoberts & McRoberts 3990*—BRIT), Smith (Bridges & Orzell 1989a), and Henderson (Turner et al. 2003) cos. in the nc part of East TX; very rare in the state; mainly se Canada and ne U.S., disjunct s to FL and TX. Jul–Sep. [*Mariscus mariscoides* (Muhl.) Kuntze] First reported for TX in 1989 (Bridges & Orzell 1989a) from bogs associated with Queen City Sand (Eocene) and an adjacent terrace. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. It is possibly a glacial age relict—surviving in a specialized microhabitat, long after the general climate of the area is no longer appropriate (Kral 1966; MacRoberts & MacRoberts 1997; Diggs 2002; Diggs & O'Kennon 2003). ⚠

CYPERUS L. FLAT SEDGE, UMBRELLA SEDGE, SEDGE-GRASS

Annuals or usually perennials; plants largely glabrous except for scabrous-margined leaves; culms (= stems) triangular in cross section; leaves basal or nearly so; inflorescences terminal, head-like or umbel-like, often conspicuously branched, leafy-bracted at base; scales of spikelets usually 4–many, usually visibly 2-ranked (= in two distinct rows), the spikelets ± flattened or square in cross section, usually with 3–many bisexual flowers; perianth bristles absent; style branches 2 or 3; achenes > 1 per spikelet, trigonous or lenticular, without a tubercle.

A genus of ca. 600 species of annual or perennial herbs of pantemperate and tropical distribution (Tucker et al. 2002); as such it is the second largest genus in the Cyperaceae following *Carex* (Tucker 1987). The spikelet scales in two vertical rows or ranks (not spirally arranged) makes *Cyperus* species easily recognized. Recent phylogenetic analyses suggest that the genus is paraphyletic with a number of genera embedded within it, including *Kyllinga* and *Lipocarpha* (Muasya et al. 2000a, 2000b, 2002). *Cyperus* is a taxonomically difficult genus with a number of taxa apparently hybridizing and intergrading morphologically. Intermediates between *C. croceus, C. echinatus, C. retroflexus,* and *C. retrorsus* are frequently seen. Similar problems occur within other species complexes. Both C_3 and C_4 photosynthesis are known in the genus (Tucker 1987; Li et al. 1999). Some species are problematic weeds while others are cultivated as ornamentals. The pith from the culms of the commonly cultivated Old World *Cyperus papyrus* L. (PAPYRUS, PAPER-REED) was used by the Egyptians to make paper at least 5,500 years ago and later by the Greeks and Romans (Tucker et al. 2002); the Greek word for the plant was *papyros* from which our word paper is derived (Hepper 1992). This species was also used to make sandals, ropes, and boats (e.g., Moses in the bulrushes). The Greek word *byblos* was the name for the white pith of PAPYRUS used in making paper (the pith was cut into strips, glued together, and then pressed and dried—Zohary 1982); the word *byblos* became modified into *biblion* and was applied to all scrolls or books and eventually to the Bible (Hepper 1992). (Greek, *kupeiros* or *cypeiros*, ancient name for the Eurasian species, *Cyperus longus* L.—Tucker et al. 2002) REFERENCES: Kükenthal 1935–1936; McGivney 1938, 1941a, 1941b; Corcoran 1941; Marcks 1972,

1974; Baijanth 1975; Denton 1978; Tucker 1983, 1987, 1994; Carter 1984; Carter & Jarvis 1986; Carr 1988; Carter & Kral 1990; Schippers et al. 1995; Jones et al. 1996; Carter & Jones 1997; Carter et al. 1999; Li et al. 1999; Muasya et al. 2000a, 2000b; Tucker et al. 2002; Rosen 2004.

1. Achenes lenticular (= lens-shaped) in cross section; styles 2-branched.
   2. Spikelets with only 2 scales (plus 2 minute, brownish, basal scales much smaller than regular scales); achene 1 per spikelet; inflorescences (3–)4–12(–17) mm long _____ see **Kyllinga**
   2. Spikelets with 6 or more scales; achenes several per spikelet; inflorescences variable, often much larger (subgenus *Pycreus*).
      3. Spikelets mostly 1–1.9 mm wide, sharp-pointed; achenes 0.4–0.5(–0.6) mm wide, narrowly oblong to oblong, ca. 2 times as long as wide, subcylindric, not much laterally compressed, usually apically truncate-apiculate _____ **C. polystachyos**
      3. Spikelets mostly 2–3.5 mm wide, usually subacute to obtuse, not sharp-pointed; achenes 0.6–1.1 mm wide, usually obovoid to ovoid, sometimes nearly as broad as long, laterally flattened or biconvex, apically rounded to subacute.
         4. Spikelets in spikes, spread out along an elongate rachis 10–30 mm long; spikelet margins appearing minutely serrate to the unaided eye (due to spreading scales); scales of spikelet with conspicuous clear border, loosely imbricate, barely overlapping next scale _____ **C. flavicomus**
         4. Spikelets in heads or glomerules, those of a head or glomerule arising at ± the same point (thus without an elongate rachis, the rachis usually 2 mm or less); spikelet margins appearing smooth to the unaided eye (scales closely appressed); scales of spikelet without clear border, closely imbricate.
            5. Surface of achenes with rectangular to linear, longitudinally elongate cells and transverse undulations; stamens 3 _____ **C. flavescens**
            5. Surface of achenes with isodiametric or square cells, without transverse undulations; stamens 2 or 3.
               6. Floral scales light to dark brown, usually with some reddish pigment; annual with culms 3–25(–30) cm tall; stamens 2 or 3 _____ **C. bipartitus**
               6. Floral scales straw-colored to yellowish brown, without reddish pigment; perennial with culms 15–75 cm tall; stamens 2 _____ **C. lanceolatus**

1. Achenes trigonous (= 3-angled) in cross section, sometimes unequally so; styles 3-branched.
   7. Spikelets borne in digitate clusters (rarely singly) or in umbellate or glomerate heads, all spikelets of a given group arising at ca. the same point, not spread out along a distinct axis (= rachis).
      8. Leaves (all or most) reduced to bladeless sheaths, the culms thus appearing nearly leafless; stamens 3.
         9. Inflorescence bracts numerous, 10–25, all ± horizontally oriented, much exceeding the inflorescence and extremely conspicuous _____ **C. involucratus**
         9. Inflorescence bracts 2(–4), at various angles, shorter than to longer than the inflorescence, but not extremely conspicuous.
            10. Culms with conspicuous septa (= internal cross partitions, but visible externally) at intervals of 5–50 mm (closer together apically), nearly round in cross section, ca. 4–12 mm in diam. at base; spikelet scales 2.9–3.7 mm long; longest inflorescence bract usually 2 cm or less long (rarely longer); achenes 1.2–1.6 mm long _____ **C. articulatus**
            10. Culms nonseptate, sharply 3-angled, 1–4 mm in diam. at base; spikelet scales 1–1.9 mm or less long; longest inflorescence bract usually 6–12(–18) cm long; achenes 0.5–0.7 mm long _____ **C. haspan**
      8. Leaves with well-developed blades; stamens 1–3.
         11. Scales of spikelets with the tips slightly to strongly recurved (= curved backwards).
            12. Achenes usually 2–2.4 mm long; spikelets usually 7–20 mm long; perennials viscid (= sticky) when fresh _____ **C. oxylepis** (in part)

12. Achenes 0.6–1.5 mm long; spikelets usually 2.5–10 mm long; annuals or perennials, not viscid.
    13. Plants coarse rhizomatous perennials; leaves usually nodulose (= with knot-like septa visible under a hand lens) owing to numerous cross veins between the main veins; achenes 1–1.5 mm long, linear to linear-oblong _____ **C. pseudovegetus**
    13. Plants small annuals; leaves not nodulose; achenes 0.6–1.1 mm long, elliptic to oblong-ovate.
        14. Scales of spikelets with 5–11 nerves, with long-acuminate, awn-like tips (visible to the naked eye); plants with a persistent spice-like odor _____ **C. squarrosus** (in part)
        14. Scales of spikelets with at most 3 nerves, with pointed but not awn-like tips; plants without a spice-like odor _____ **C. acuminatus**
11. Scales of spikelets with the tips straight to slightly incurved.
    15. Scales of spikelets minute, < 1 mm long, bead-like, rounded or broadly obtuse apically; achenes 0.5–0.8 mm long, the surfaces finely granular _____ **C. difformis**
    15. Scales of spikelets larger, 1 mm or more long, variously shaped but not as above; achenes various.
        16. Plants small tufted annuals; culms (2–)6–15(–35) cm tall; achenes obovoid, from ca. 3/4 as wide as long to nearly as wide as long _____ **C. compressus**
        16. Plants perennials, rhizomatous or with thickened and/or hardened stem bases; culms often taller; achenes variously shaped, ca. 1/2 as wide as long or narrower.
            17. Scales of spikelets with 7–13 nerves (midnerve plus 3–6 nerves visible on each side of scale), 1.8–4 mm long, not 2-keeled, with a single keel or broadly rounded on the back; achenes 1.5–2.4 mm long.
                18. Scales of spikelets with recurved to straight, awn-like or distinct, minute, narrowly pointed apex 0.4–0.8 mm long (note: the basal scales are often merely mucronulate, with apex to 0.2 mm long); plants viscid (= sticky) when fresh; leaf blades involute (= with margins rolled) _____ **C. oxylepis** (in part)
                18. Scales of spikelets without awn-like or distinct narrowly pointed apex, sometimes emarginate (= notched) apically, if mucronulate apex present, this at most 0.3 mm long; plants viscid when fresh (*C. elegans*) OR not so; leaf blades involute (*C. elegans*) OR not so.
                    19. Leaf blades involute; achenes obovoid, widest near the tip, usually black with a thin, cellular, grayish-white overlay that tends to slough off; plants viscid when fresh _____ **C. elegans** (in part)
                    19. Leaf blades flat or V-shaped; achenes narrowly oblong to oblong-ellipsoid, widest near the middle, variously colored but without a grayish-white overlay; plants not viscid.
                        20. Longest inflorescence bract ascending; inflorescences usually with 3–10 rays (= main branches); scales of spikelets only slightly overlapping the adjacent scales on the same side of the spikelet (giving margin of spikelet a distinctive serrate outline); anthers 1–1.3 mm long _____ **C. grayoides**
                        20. Longest inflorescence bract horizontal to reflexed; inflorescences unbranched or with 1–4 rays; scales of spikelets conspicuously overlapping; anthers 0.3–1 mm long.
                            21. Leaf blades 0.5–2 mm wide; achenes narrowly oblong, 0.5–0.8 mm wide; anthers 0.8–1 mm long; scales of spikelets yellowish to yellowish brown _____ **C. filiculmis**

21. Leaf blades often wider, 1–4 mm wide; achenes ± ellipsoid, 0.8–1.2 mm wide; anthers 0.3–0.7 mm long; scales of spikelets off-white to light reddish brown _____ **C. lupulinus**

17. Scales of spikelets with 1 nerve, usually 1–2 mm long, 2-keeled in basal 1/3–2/3 (use magnification; the two keels are close together, with a groove between them; this character is best seen when the scale is viewed from its back (= abaxial side)); achenes 0.7–1.5 mm long.
    22. Leaf blades, leaf sheaths, and bracts conspicuously nodulose (= with knot-like septa visible under a hand lens) owing to numerous cross veins between the main veins (especially visible on lower surface); culms sharply 3-angled, scabrous on angles only.
        23. Scales of spikelets oblanceolate, usually 1.7–2.5 mm long; inflorescences with 5–12 rays (= main branches); achenes 1.2–1.5 mm long; spikelets (1.7–)2.2–3.2 mm wide _____ **C. virens**
        23. Scales of spikelets ovate, 1.4–1.6 mm long; achenes 1–1.2 mm long; inflorescences with 3–5 rays; larger spikelets 1.5–2.2 mm wide _____ **C. drummondii**
    22. Leaf blades, leaf sheaths, and bracts not nodulose; culms 3-angled to nearly rounded, usually smooth (except retrorsely scabrous in *C. surinamensis*).
        24. Culms rough to the touch, sparsely to densely covered with microscopic retrorse (= down-pointing) teeth; achenes 0.7–0.9 mm long _____ **C. surinamensis**
        24. Culms smooth to the touch, rarely with a few horizontal knobs; achenes 0.8–1.5 mm long.
            25. Inflorescence bracts 3–4, the longest erect or nearly so, appearing as a continuation of the culm; scales of spikelets reddish laterally _____ **C. reflexus**
            25. Inflorescence bracts 4–8(–10), all horizontal to ascending, but none appearing as a continuation of the culm; scales of spikelets pale to greenish or yellowish brown or light brown laterally.
                26. Spikelets (5–)7–10(–rarely longer) mm long; anthers 0.8–1.2 mm long; achenes broadly ellipsoid _____ **C. ochraceus**
                26. Spikelets 4–6.5 mm long; anthers 0.6–0.7 mm long; achenes narrowly ellipsoid to ellipsoid _____ **C. entrerianus**

7. Spikelets in spikes (sometimes head-like), spread out along a distinct axis, not arising at the same point (the axis, however, is sometimes quite short and concealed by crowded spikelets; it is sometimes necessary to spread and/or remove the spikelets and look carefully at their attachment points).
    27. Spikelet axis (= rachilla) separating at maturity at the base of each spikelet scale, the mature spikelet disarticulating into segments consisting of a scale, internode, and achene clasped by rachilla wings (in immature spikelets, the only obvious sign of this is that the spikelet axis (= rachilla including its wings) becomes thickened, spongy or corky, and light-colored (subgenus *Diclidium*) _____ **C. odoratus**
    27. Spikelet axis remaining intact or apparently so, the florets either falling separately from the persistent axis OR the entire axis falling as a unit (OR unclear in immature *C. odoratus*).
        28. Spikelets of a spike ± perpendicular to the spike axis to markedly reflexed, enough of them reflexed to give the general appearance of the spikelets drooping around the spike axis.
            29. Spikes oblong, not wider toward apex, ca. 1/2 as wide as long; culms smooth; leaves and bracts smooth except for marginal prickles _____ **C. hystricinus** (in part)

29. Spikes usually wider toward apex, nearly 3/4 or more as wide as long; culms (at least upper portions) densely minutely scabridulous (can determine by touch or with lens); leaves and bracts harshly scabrous or hirtellous on upper surface.
    30. Spikelets with 3–6(–8) scales, the whole spikelet (6–)8–10(–17) mm long; rays (= main branches) smooth (rarely with a few antrorse hairs just below spike); leaves and bracts with pubescence confined to midvein on lower surface; inflorescence with bracts longer than longest ray _____ *C. retrofractus*
    30. Spikelets with 1(–2) scales, the whole spikelet 6–8 mm long; rays scaberulous; leaves and bracts generally puberulent over both surfaces; inflorescence with longest bract ± equal to or shorter than longest ray (bracts sometimes slightly longer) _____ **C. plukenetii**

28. Spikelets variously arranged, spreading perpendicularly to ascending, but not markedly reflexed (in dense spikes a few at the very base may be reflexed, but the general appearance is definitely not of spikelets drooping).
    31. Leaves (all or most) reduced to bladeless sheaths, the culms thus appearing nearly leafless; culms with conspicuous septa (= internal partitions, but visible externally) at intervals of 5–50 mm (closer together apically) _____ **C. articulatus**
    31. Leaves with well-developed blades; culms not as above.
        32. Scales of spikelets with recurved or straight, awn-like or distinct, minute, narrowly pointed apex 0.4–1.2 mm long (note: the basal scales are often merely mucronulate, with apex to 0.2 mm long).
            33. Scales of spikelets closely appressed, ± parallel to rachilla (= spikelet axis), persistent; spikelets 0.7–1.4(–1.8) mm wide; rachilla winged, the wings 0.3–0.7 mm wide.
                34. Spikelets (8–)12–15(–24) mm long, (0.8–)1.1–1.4(–1.8) mm wide, with (4–)5–8(–14) scales; spikes loose, the axis of each spike easily visible; terminal scale of spikelet conduplicate (= folded lengthwise); achenes 1.7–2 mm long _____ **C. lentiginosus**
                34. Spikelets (2.2–)4–12(–21) mm long, 0.7–1.2 mm wide, with 1–3(–5) scales; spikes usually dense, sometimes loose; terminal scale of spikelet involute (= with edges rolled inward); achenes 1.8–2.4 mm long.
                    35. Longest spikelets usually 2.8–9(–11) mm long, at most flexuous with curved tips, not contorted; distal scales of spikelets with smooth midvein and mucro 0.1–0.3(–0.5) mm long; longest scale of spikelet (2.1–)2.5–3.5(–4) mm long; anthers 0.3–0.6 mm long; species widespread in East TX _____ **C. retroflexus** (in part)
                    35. Longest spikelets 9–21 mm long, flexuous-contorted; distal scales of spikelets with scabrid midvein and mucro 0.6–1.9 mm long; longest scale of spikelet (3.5–)3.7–4.8 mm long; anthers 0.5–1.3 mm long; species known in East TX only from Travis Co. _____ **C. floribundus**
            33. Scales of spikelets widely spreading, sometimes nearly perpendicular to rachilla, deciduous; spikelets 1.3–4(–6) mm wide; rachilla wingless.
                36. Scales of spikelets with the tips slightly to strongly recurved (= curved backwards), 0.5–1 mm wide if flattened (each side of scale ca. 0.25–0.5 mm wide), strongly veined; plants with a persistent spice-like odor; achenes 0.5 mm or less wide; stamen 1(–2) _____ **C. squarrosus** (in part)
                36. Scales of spikelets with the tips straight or only slightly recurved, 1.5–2.4(–2.5) mm wide if flattened (each side of scale 1/2 of this), weakly veined; plants without a spice-like odor; achenes 0.5–1(–1.1) mm wide; stamens 3.
                    37. Leaf blades with involute margins; plants viscid (=sticky) when

fresh; achenes ellipsoid, 2–2.4 mm long, apically acute; scales of spikelets 3.1–4 mm long _____ **C. oxylepis** (in part)

37. Leaf blades flat to V-shaped; plants not viscid when fresh; achenes obovoid, 1.5 mm or less long, apically obtuse to notched; scales of spikelets (2.4–)2.6–3 mm long _____ **C. compressus** (in part)

32. Scales of spikelets without awn-like or distinct narrowly pointed apex, sometimes emarginate (= notched) apically, if mucronulate apex present, this at most 0.3 mm long.

38. Scales of spikelets 1.3–2.5(–3.2) mm long; achenes 0.7–1.5(–1.9) mm long; spikelets in rather loose elongate spikes or open panicles, the spike axis visible.

39. Scales of spikelets obovate to nearly orbiculate, nearly as wide as long, appearing tiny and bead-like to the naked eye; spikelets 1.5–2.1 mm wide, in spikes with a loose and open, almost panicle-like arrangement; rachilla wingless; species of the s portion of East TX _____ **C. iria**

39. Scales of spikelets elliptic to ovate or oblong-ovate, not appearing bead-like; spikelets 0.8–1.5(–1.9) mm wide, in rather loose elongate spikes, these not in a panicle-like arrangement; rachilla winged; including species widespread in East TX.

40. Spikelets (5–)8–15(–20+) mm long; scales of spikelets 1.5–3 mm long; achenes (1–)1.2–1.5(–2) mm long; spikelet axis and sometimes wings at maturity becoming thickened, spongy or corky, and light-colored _____ **C. odoratus**

40. Spikelets 3–8(–11) mm long; scales of spikelets, 1.3–1.5(–1.8) mm long; achenes 0.7–1 mm long; neither spikelet axis nor wings thickened at maturity.

41. Plants annuals, without rhizomes; roots usually reddish when fresh; culms usually 1–3 mm wide; scales of spikelets 1.3–1.5 mm long; anthers 0.2–0.3 mm long _____ **C. erythrorhizos**

41. Plants coarse perennials, with rhizomes; roots not reddish; culms often strikingly large, (2–)4–15 mm wide; scales of spikelets 1.5–2 mm long; anthers 0.4–0.5 mm long _____ **C. digitatus**

38. Scales of spikelets (2–)2.5–5.5 mm long; achenes (1.1–)1.3–3 mm long; spikelets in rather loose elongate spikes as above OR in crowded or extremely densely packed, short, compact spikes with the inflorescence axis usually not visible.

42. Spikelets 2.2–4 mm wide.

43. Spikes loose, the spikelets spread apart so that the rachis (= inflorescence axis) is usually visible at a glance; achenes (1.1–)1.3–1.5(–1.6) mm long; plants rhizomatous, the rhizomes bearing tubers (3–)6–11 mm in diam. _____ **C. esculentus**

43. Spikes dense, the rachis visible only upon close inspection; achenes (1.4–)1.7–2.4 mm long; plants rhizomatous, the rhizomes knotty, but without tubers.

44. Leaf blades involute; achenes obovoid, widest near the tip, black with a thin, cellular, grayish-white overlay that tends to slough off; plants viscid (= sticky) when fresh _____ **C. elegans** (in part)

44. Leaf blades flat or V-shaped; achenes narrowly oblong to oblong-ellipsoid, widest near the middle, variously colored but without a grayish-white overlay; plants not viscid.

45. Longest inflorescence bract ascending; inflorescences

usually with 3–10 rays (= main branches); scales of spikelets only slightly overlapping the adjacent scales on the same side of the spikelet (giving margin of spikelet a distinctive serrate outline); anthers 1–1.3 mm long _____ **C. grayoides**

45. Longest inflorescence bract horizontal to reflexed; inflorescences unbranched or with 1–4 rays; scales of spikelets conspicuously overlapping; anthers 0.3–1 mm long.
    46. Leaf blades 0.5–2 mm wide; achenes narrowly oblong, 0.5–0.8 mm wide; anthers 0.8–1 mm long; scales of spikelets yellowish to yellowish brown _____ **C. filiculmis**
    46. Leaf blades often wider, 1–4 mm wide; achenes ± ellipsoid, 0.8–1.2 mm wide; anthers 0.3–0.7 mm long; scales of spikelets off-white to light reddish brown ___ **C. lupulinus**

42. Spikelets 1–2.2 mm wide.
    47. Spikelets with 6–40 scales per spikelet; well-developed spikelets usually 10–40(–55) mm long, noticeably flattened, ca. 2 or more times wider than thick.
        48. Spikelets (1.2–)1.3–2.2 mm wide; plants rhizomatous perennials; anthers 1 mm or more in length; achenes (1.1–)1.3–1.8 (–1.9) mm long; spikelet axis persistent.
            49. Bracts 3–4(–5) per inflorescence, about equaling inflorescence in length; spikelets 3–9(–12) per spike _____ **C. rotundus**
            49. Bracts 5–13 per inflorescence, greatly exceeding inflorescence; spikelets 10–50 per spike.
                50. Spikelets usually reddish brown, with scales 3–4 mm long; culms usually 50–110 cm tall _____ **C. setigerus**
                50. Spikelets brown to golden-brown, with scales 1.8–2.7(–3.4) mm long; culms usually 15–60(–65) cm tall _____ **C. esculentus**
        48. Spikelets 0.6–0.9 mm wide; plants nonrhizomatous perennials; anthers less than 1 mm long; achenes (1.5–)1.8–2.4 mm long; spikelet axis deciduous at base _____ **C. strigosus**
    47. Spikelets with (1–)3–6(–8) scales per spikelet; well-developed spikelets usually 2.2–12 mm long, roughly quadrangular to nearly round in cross section, 1–1.5 times wider than thick.
        51. Spikelets arranged in rather loose spikes, the inflorescence axis easily visible when pressed.
            52. Achenes 2.5–2.8 mm long _____ **C. hystricinus** (in part)
            52. Achenes 1.4–2.2(–2.4) mm long.
                53. Scales of spikelets yellowish to yellowish brown at maturity, 3.2–5(–6) mm long; plants with culm base swollen, corm-like _____ **C. strigosus**
                53. Scales of spikelets usually brownish or reddish brown at maturity, 2.6–3.4 mm long; plants with culm base not thickened to somewhat thickened.
                    54. Spikelets usually 6–9 per 5 mm of rachis (relatively looser); spikes (15–)25–35 mm long; culms 0.5–1 mm wide; leaf blades 3 mm or less wide _____ **C. thyrsiflorus**
                    54. Spikelets usually 11–21 per 5 mm of rachis (rela-

tively more crowded); spikes 10–20(–25) mm long; culms 2–2.6 mm wide; leaf blades (3–)4–5.8 mm wide ____ **C. pseudothyrsiflorus**

51. Spikelets usually crowded or extemely densely packed into short compact spikes, the inflorescence axis usually not easily visible when pressed.
    55. Spikes usually all sessile or nearly so (occasionally 1(–2) on elongate rays), cylindric, usually more than 2 times as long as wide ____ **C. aggregatus**
    55. Spikes usually (at least 2 or more) on elongate rays, globose to ovoid to cylindric, 1–2 times as long as wide.
        56. Spikes cylindric or subcylindric, 6–8(–10) mm broad; spikelets so dense that outline of spike is smooth; achenes 1.2–1.7 mm long; spikelets 2.2–4(–4.5) mm long ____ **C. retrorsus**
        56. Spikes globose to subglobose or ovoid, mostly > 8 mm broad; outline of head appearing somewhat smooth OR rough; achenes 1.3–2.5 mm long; spikelets 3.5–10(–18) mm long.
            57. Spikes globose to subglobose, with (75–)100–250 spikelets per well-developed spike; spikelets arranged so densely that outline of spike is ± smooth ____ **C. echinatus**
            57. Spikes globose to subglobose or ovoid, with 10–50(–70) spikelets per spike; outline of spike appearing somewhat rough (because of less densely arranged spikelets).
                58. Achenes usually (1.8–)2–2.5 mm long, in cross section the sides concave; leaf blades usually 1–3 mm wide; scales of spikelets usually 3–5 mm long, the terminal scale involute ____ **C. retroflexus** (in part)
                58. Achenes usually 1.3–1.8 mm long, in cross section the sides ± flat to convex; leaf blades (at least larger ones) usually 3–4.5 mm wide; scales of spikelets usually 2.3–3 mm long, the terminal scale not involute ____ **C. croceus**

Cyperus acuminatus Torr. & Hook. ex Torr., (tapering at tip), TAPER-LEAF FLAT SEDGE, TAPER-TIP FLAT SEDGE. Tufted annual usually 10–40(–45) cm tall; culms slender; leaf sheaths not nodulose; leaf blades 1–4 mm wide; inflorescences with spikelets digitately arranged in compact heads; scales weakly S-shaped in longitudinal section, the tip with a slight to marked outward curve; achenes 0.8–1.1 mm long. Moist areas; nearly throughout TX; throughout much of the U.S. Mostly May–Oct.

Cyperus aggregatus (Willd.) Endl., (bunched, crowded, in dense clusters), INFLATED-SCALE FLAT SEDGE. Rhizomatous perennial to 100 cm tall; inflorescences of usually sessile, densely cylindric spikes; achenes 1.8–2.1 mm long. Roadsides, thickets, dry areas; Newton Co. (*E. Keith 603*, SBSC—identified L. Brown); also Bee, Refugio, and San Patricio (TAES) cos. to the s of East TX; since this species was added after map pages for the flora were completed, no county distribution map is provided; AZ, LA, MS, NJ, NM, OR, PA, and TX. Jul–Sep. [*C. flavus* (Vahl) Nees var. *aggregatus* (Willd.) Kük.]

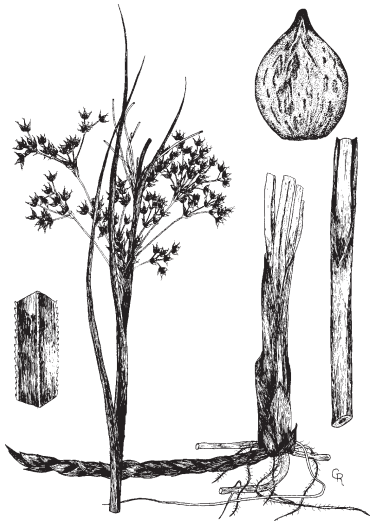
Cyperus articulatus L., (jointed), CHINTÚL, JOINTED FLAT SEDGE. Perennial 0.5–1.4(–2) m tall, with creeping rhizomes, forming colonies; culms with conspicuous septa; leaves few, basal, usually reduced to small essentially bladeless sheaths; inflorescences essentially bractless or with very small bracts, of rather loose digitate (–spicate) clusters of spikelets; spikelets 6–33(–55) mm long (rarely surprisingly long); achenes 1.2–1.6 mm long. Moist grasslands, marshes, other wet areas; widespread in s part of East TX, scattered to the n (e.g., Grayson (BRIT), Anderson, Hunt, and McLennan (Turner et al. 2003) cos.; also Gulf Prairies and Marshes and South TX Plains; se U.S. from SC s to FL w to TX. May–Oct. The rhizome has been used medicinally (Burkhill 1985), and the sweet smelling roots have been used in perfumery (Judd et al. 1999). According to Tucker et al. (2002), this species is the only North American *Cyperus* with a reed-like appearance resembling larger plants of *Juncus* or *Schoenoplectus*.

Cyperus bipartitus Torr., (divided nearly to the base into two parts), SHINING FLAT SEDGE. Annual to only 30 cm tall, very similar to *C. flavescens* and *C. lanceolatus*, distinguished by color of scales and surface of achenes as in key; inflorescences with spikelets in loosely digitate heads or glomerules; floral scales light to dark brown, usually with some reddish pigmentation; achenes lenticular, 1–1.3(–1.5) mm long. Moist areas along rivers, lakes, seeps; Bowie Co. (Turner et al. 2003); Correll and Johnston (1970) and Turner et al. (2003) cited specimens of the closely related *C. niger* Ruiz & Pavon from Austin and Washington cos—that species is known primarily from the w U.S. (AZ, CA, NM, OK, w TX), and the two East TX localities are presumably *C. bipartitus*; se Canada and widespread throughout much of the U.S. (Jul–)Aug–Oct(–Nov). [*C. rivularis* Kunth] While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

Cyperus compressus L., (flattened), POORLAND FLAT SEDGE. Small tufted annual (2–)6–15(–35) cm tall; inflorescences with relatively few spikelets (usually 12 or less) in ± digitate clusters; achenes 1–1.5 mm long, from ca. 3/4 to nearly as wide as long. Weedy and disturbed areas; Dallas, Harris, Jefferson, Newton, Sabine, Wood (BRIT), Colorado, Harris, Nacogdoches, Polk, and Tyler (Turner et al. 2003) cos.; also Gulf Prairies and Marshes; widespread in e 1/2 of the U.S. Jul–Nov.

Cyperus croceus Vahl, (saffron-colored, yellow), BALDWIN'S FLAT SEDGE. Tufted perennial usually 15–45 cm tall; inflorescences of globose to ovoid, relatively crowded to dense clusters of spikelets, the clusters 8–20 mm broad; spikelets 3–8 mm long; scales with green keel and reddish or yellow-brown sides; achenes usually 1.3–1.8 mm long. Sandy open areas; widespread in East TX; also n Gulf Prairies and Marshes and scattered to the w; e U.S. from PA s to FL w to MO and TX. May–Oct. [*C. baldwinii* Torr., *C. globulosus* of authors, not Aubl., *C. globulosus* var. *robustus* (Boeck.) Shinners, *C. retrorsus* Chapm. var. *robustus* Kük.] The name *C. globulosus* has long been mistakenly applied to this species (Tucker et al. 2002). A number of BRIT specimens have been annotated by Stanley Jones (BRCH) as *C. croceus* × *C. retroflexus* or *C. croceus* × *C. retrorsus*.

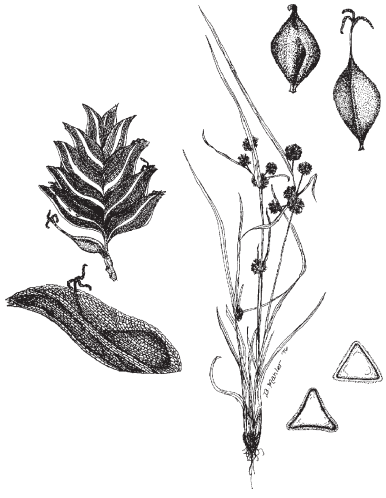
Cyperus difformis L., (of unusual or differing forms), VARIABLE FLAT SEDGE, SMALL-FLOWER UMBRELLA SEDGE. Annual 10–30(–50) cm tall; roots red; leaves 2–4(–7) per culm, 1–4 mm wide; inflorescences with spikelets digitately arranged in heads; heads globose or lobulate; spikelets 5 (–8) mm or less long; scales roundish, obtuse, very small, 0.5–0.8 mm long, green with brownish or purplish sides; achenes 0.5–0.8 mm long. Unshaded shallow creek beds in perennially wet mud over limestone or dolomite, also creek banks, lake shores, and other wet, often frequently flooded areas; Travis (BRIT), Williamson (Carr 1988), and Newton (Bryson et al. 1996; Turner et al. 2003) cos.; otherwise in TX known only from Harris Co. (Turner et al. 2003) near s margin of East TX; first collected in TX in 1981 and first reported by Carr (1988); e. U.S. from NY s to FL w to TX, also AZ, CA, ID, OR, and NM. Native of the Old World. Lipscomb (1980) discussed the distribution of *C. difformis* in North America—the earliest known North American collection



Cladium jamaicense [GWO]



Cladium mariscoides [BB2]



Cyperus acuminatus [BT2]



Cyperus aggregatus [GLE]



Cyperus articulatus [CO1]



Cyperus bipartitus [MAS]



Cyperus compressus [BT2]

was from Mexico in 1851, with the first known U.S. reports from the 1930s. Tyndall (1983) concluded that the species is transported at least partially by birds (presumably achenes on feet, etc.). According to Tucker (1987), this weedy species is able to complete its life cycle in as little as one month, with a single plant producing thousands of achenes. It is considered by some sources to be among the world's worst weeds (Holm et al. 1977). ⊘ ☜

Cyperus digitatus Roxb., (fingered, with fingers), FINGER FLAT SEDGE. Plant coarse perennial similar to *C. erythrorhizos*; culms to 150 cm tall, (2–)4–15 mm wide; inflorescences with spikelets in relatively crowded cylindrical spikes; achenes ca. 0.9 mm long. Moist areas, ditches, pond margins; Limestone, Robertson, Van Zandt (BRIT), and Trinity (Turner et al. 2003) cos.; mainly Gulf Prairies and Marshes and South TX Plains; FL and TX. Jun–Nov.

Cyperus drummondii Torr. & Hook., (for its collector, Thomas Drummond, 1780–1835, Scottish botanist and collector in North America), DRUMMOND'S FLAT SEDGE. Tufted perennial; culms 35–170 cm tall, sharply 3-angled, scabrous on angles only; leaf blades, leaf sheaths, and bracts with knot-like septa visible under a hand lens; spikelets in digitate head-like clusters; achenes 1–1.2 mm long. Pond margins, seeps, coastal prairies, typically in less disturbed areas than the related *C. virens* (Carter et al. 1999); Harris (Rosen 2004) and Orange (Carter et al. 1999) cos. near se margin of East TX; also Fort Bend Co. (BRIT) in the Gulf Prairies and Marshes and Goliad Co. (Carter et al. 1999) in the South TX Plains; e U.S. from SC s to FL w to TX. May–Oct. [*C. robustus* Kunth, *C. virens* var. *drummondii* (Torr. & Hook.) Kük., *C. virens* subsp. *drummondii* (Torr. & Hook.) T. Koyama, *C. virens* var. *robustus* (Kunth) Kük.] While some authorities (e.g., Kartesz 1999) combine this taxon with *C. virens*, we are following Carter et al. (1999) and Tucker et al. (2002) in recognizing it as a separate species. Carter et al. (1999) gave an extensive analysis and justification. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

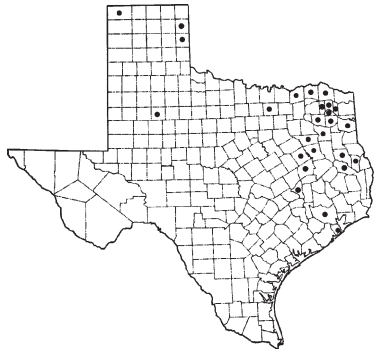
Cyperus echinatus (L.) A.W. Wood, (prickly), GLOBE FLAT SEDGE, CYLINDER FLAT SEDGE. Tufted perennial; culms 15–70(–100) cm tall, corm-like at base; heads or spikes globose or subglobose, 8–21 mm long, 8.5–18 mm broad, less than 1/4 longer than broad, the spikelets arranged so densely that outline of spike is ±smooth; achenes (1.5–)1.8–2.3 mm long. Sandy open areas, often in disturbed places; Pineywoods and n Gulf Prairies and Marshes w to West Cross Timbers and e edge of Edwards Plateau; widespread in the e 1/2 of the U.S. May–Oct. [*C. ovularis* (Michx.) Torr.] ⚅/284

Cyperus elegans L., (elegant), STICKY FLAT SEDGE, ROYAL FLAT SEDGE. Tufted viscid (= sticky) perennial 25–80 cm tall; leaf blades involute, nodulose (= with knot-like septa visible with a hand lens) basally when dried; inflorescences with longer rays branched into head-bearing secondary rays, the spikelets mostly in digitate head-like clusters; achenes 1.5–2 mm long. Damp soils, ditches, open areas; Hardin, Newton (BRIT), Bexar, Freestone, Harris, Orange, and Travis (Turner et al. 2003) cos.; scattered mainly s 1/2 of TX; FL, LA, NM, and TX. Jul–Nov.

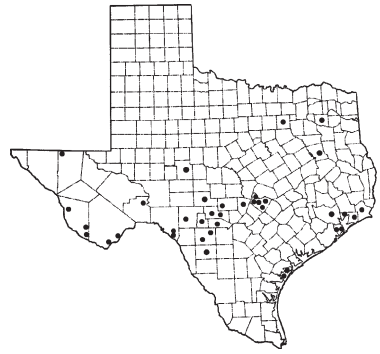
Cyperus entrerianus Boeck., (from Entre Rios, the name of an historically disputed area now in Argentina and the type locality of the species—Carter 1990), WOODRUSH FLAT SEDGE. Perennial usually 65 cm or less tall; spikelets in digitate head-like clusters; achenes ca. 1 mm long. Ditches, other moist areas; Harris, Montgomery (BRIT), Jefferson, Newton, and Waller (Turner et al. 2003) cos.; also Gulf Prairies and Marshes; se U.S. from GA s to FL w to TX. Jul–Sep. [*Cyperus luzulae* of authors, not (L.) Rottb. ex Retz., *C. luzulae* var. *entrerianus* (Boeck.) Barros] Native of Latin America. This introduced species can be locally abundant and "seems highly correlated with rice culture" (Carter 1990). According to Tucker et al. (2002), it was first collected in the U.S. in FL in 1941. It has in the past been confused with *C. luzulae*, a species that does not occur in North America (Tucker et al. 2002). ☜



Carex verrucosa



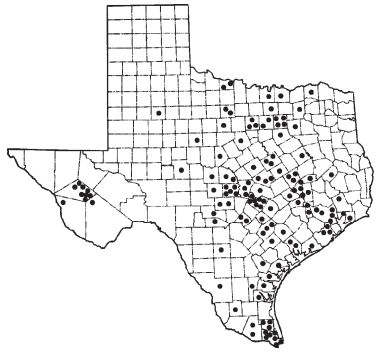
Carex vulpinoidea



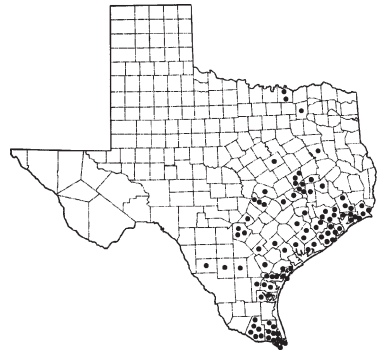
Cladium jamaicense



Cladium mariscoides



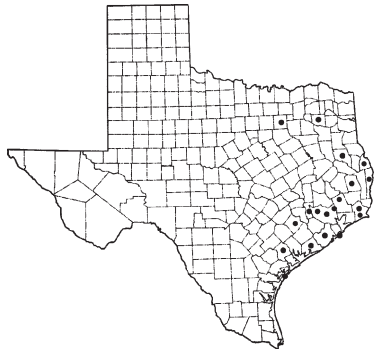
Cyperus acuminatus



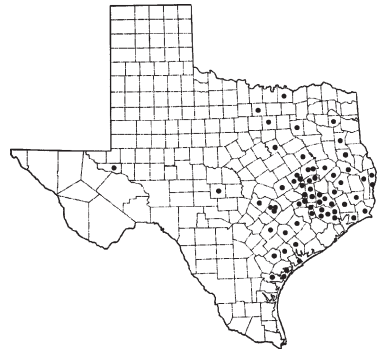
Cyperus articulatus



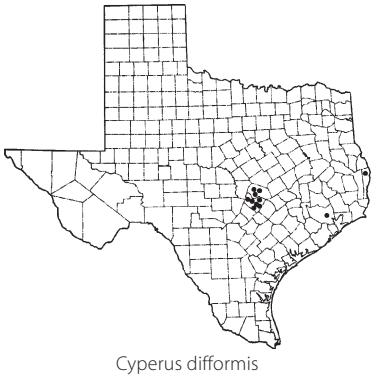
Cyperus bipartitus



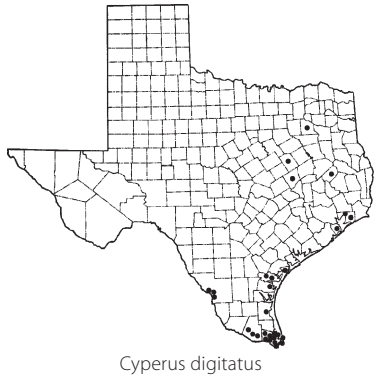
Cyperus compressus



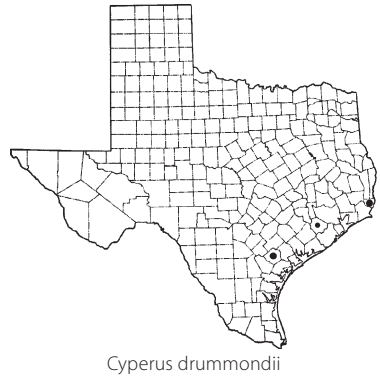
Cyperus croceus



Cyperus difformis



Cyperus digitatus



Cyperus drummondii

Cyperus erythrorhizos Muhl., (red-rooted), RED-ROOT FLAT SEDGE. Tufted annual 5–60(–120) cm tall, quite variable in size; fresh roots usually reddish; culms usually 1–3 mm wide; inflorescences umbel-like clusters of spikes; rays unequal; spikes several per peduncle, cylindrical, relatively crowded; scales relatively small, 1.3–1.5 mm long; achenes 0.7–1 mm long. Marshy areas, lake margins; widespread in the e 1/2 of TX; also El Paso Co. (Turner et al. 2003) in the Trans-Pecos; s Canada and widespread in much of the U.S. Jul–Dec. ⚅/284

Cyperus esculentus L., (edible), YELLOW NUT-GRASS, CHUFA, NORTHERN NUT-GRASS, CHUFA FLAT SEDGE. Perennial, colonial, usually 15–60 cm tall; rhizomes often with tuber-like thickenings; inflorescences with spikes loose, the spikelets spread apart so that the inflorescence axis is usually visible at a glance; anther connective prolonged into a red dot 0.05–0.1 mm long; achenes (1.1–)1.3–1.5(–1.6) mm long. Disturbed soils, ditches, swales, cultivated fields, near streams, moist areas; scattered nearly throughout TX; s Canada and throughout the U.S. Summer–fall. According to Mabberley (1987), this species is native to w Asia and Africa and widely naturalized in the New World; however, Tucker (1994) and Tucker et al. (2002) regard the species to be cosmopolitan—they divide it into varieties and consider var. *esculentus* to be restricted to the Old World, with several varieties native to North America. [*C. esculentus* var. *angustispicatus* Britton, *C. esculentus* var. *leptostachyus* Boeck., *C. esculentus* var. *lutescens* (Torr. & Hook.) Kük., *C. esculentus* var. *macrostachyus* Boeck.] Schippers et al. (1995) discussed infraspecific variation in this widespread species. It is a state noxious weed in AZ, CA, CO, NC, NV, OR, and WA (Kartesz 1999), can be a troublesome weed infesting a variety of crops, and is considered by some sources to be among the world's worst weeds (Holm et al. 1977). It is now known as a weed in all 50 U.S. states and s Canada (Tucker 1987). The nut-like, edible, tuber-like thickenings were an important food in ancient Egypt (Pascual et al. 2000) and were used during pioneer days in this country (Crosswhite 1980); the species is currently being studied for additional uses (Pascual et al. 2000). While varieties are sometimes recognized in this species (e.g., Schippers et al. 1995; Jones et al. 1997; Kartesz 1999; Tucker et al. 2002), we have been unable to consistently distinguish the taxa and are following Yatskievych (1999) in not recognizing infraspecific taxa. For those wishing to distinguish varieties, the following key (from Tucker et al. 2002) separating the two attributed to East TX may be helpful. This species is somewhat similar to *C. rotundus* (also with tuber-like thickenings on the rhizomes); see discussion under that species. ⊘

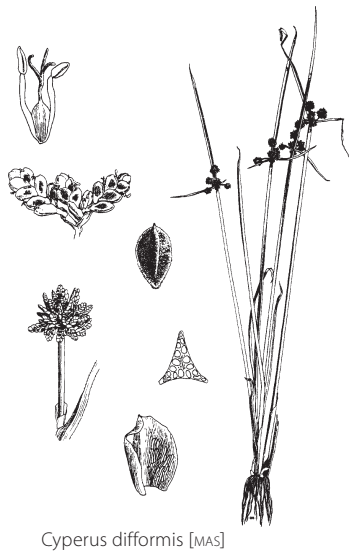
1. Spikelets (1.2–)1.5–2 mm wide; floral scales 1.8–2.7 mm; anthers (1–)1.3(–1.6) mm; styles (0.7–)1–1.2 mm; stigmas (1.2–)1.8(–2.5) mm _____ var. *leptostachyus*
1. Spikelets 2.4–3 mm wide; floral scales (2.7–)2.9–3.4(–3.6); anthers (1.2–)1.3–2(–2.1) mm; styles (0.9–)1.3–2(–2.2) mm; stigmas (2–)2.3–2.8 (–4) mm _____ var. *macrostachyus*

Cyperus filiculmis Vahl, (with thread-like culms), FERN FLAT SEDGE. Tufted perennial 15–40(–48) cm tall; inflorescences with spikelets in digitate head-like clusters; achenes 1.8–2.2 mm long. Open areas, often in well-drained soils; Waller (BRIT), Brazos, Freestone, and Robertson (Turner et al. 2003) cos. in s part of East TX; also Comal Co. (TAMU) at w margin of East TX; also Cross Timbers and Prairies and Edwards Plateau; se U.S. from MD s to FL w to TX. Jun–Sep(–Oct). [*C. martindalei* Britton] This species has often in the past been treated more broadly to include *C. lupulinus* (e.g., apparently by Correll & Johnston 1970 and Hatch et al. 1990), which is here recognized as a distinct species.

Cyperus flavescens L., (yellowish), YELLOW FLAT SEDGE. Tufted annual usually 10–30 cm tall; scales of spikelets yellow-green to yellowish brown; inflorescences with spikelets in ± head-like clusters; achenes lenticular, usually black, shiny, 1–1.2 mm long, with rectangular to linear (vertical) cells, the rows of cells marked by horizontal, wavy, usually discolored sutures (transverse undulations). Moist sand, often disturbed areas; scattered in East TX; also Gulf Prairies and Marshes, Cross Timbers and Prairies, and Edwards Plateau; se Canada and widespread in e 1/2 of the U.S, also CA. Jul–Nov. [*C. flavescens* var. *poiformis* (Pursh) Fernald, *Pycreus flavescens* (L.) Rchb.]



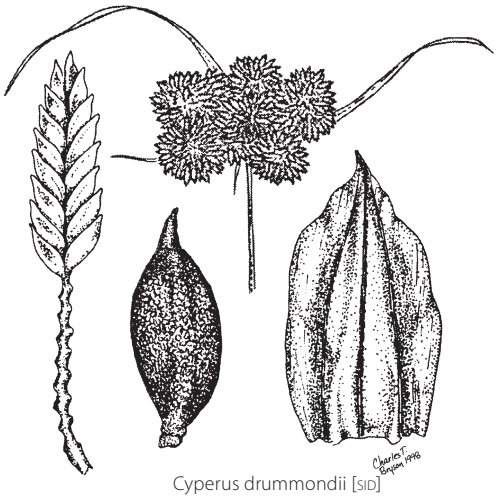
Cyperus croceus [BT2]



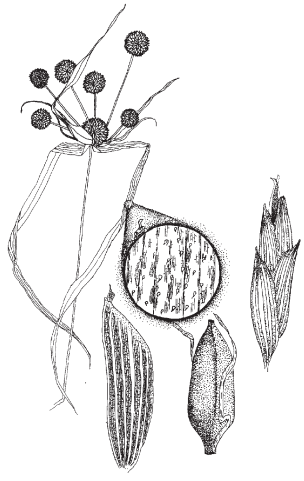
Cyperus difformis [MAS]



Cyperus digitatus [KIR]



Cyperus drummondii [SID]



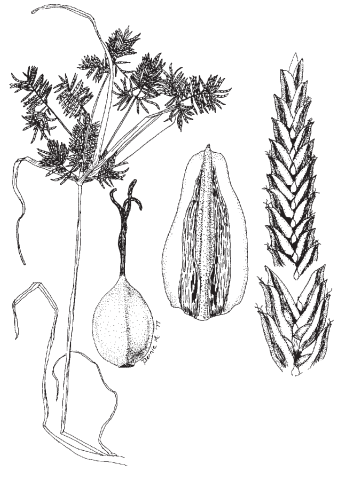
Cyperus echinatus [BT2]



Cyperus elegans [CO1]



Cyperus entrerianus [CUM]



Cyperus erythrorhizos [BT2]

Cyperus flavicomus Michx., (with yellow tuft or crest), WHITE-EDGE FLAT SEDGE. Annual; culms 20–80 cm tall; inflorescences with spikelets in spikes, spread out along an elongate rachis 10–30 mm long; achenes 0.9–1.2 mm long. Ditches, lake shores; Montgomery (E. Keith, pers. comm., SBSC), Jefferson, and Orange (Turner et al. 2003) cos. at se margin of East TX and cited for the Big Thicket National Preserve by the National Park Service (1995a, 1995b); also n Gulf Prairies and Marshes and Trans-Pecos. Aug–Oct. Native of the tropics. [*C. albomarginatus* (Mart. & Schrad. ex Nees) Steud.] This species has long gone under the name *C. albomarginatus* (e.g., Correll & Johnston 1970; Godfrey & Wooten 1979); however, the epithet *flavicomus* is older and thus has nomenclatural priority (Tucker 1985). ☜

Cyperus floribundus (Kük.) R. Carter & S.D. Jones, (producing abundant flowers). Tufted rhizomatous perennial; culms 40 cm or less tall; inflorescences with spikelets in a single, loose to dense spike; longest spikelets 9–21 mm, flexuous-contorted; achenes 1.8–2.4 mm long. Moist disturbed areas; Travis Co. (Turner et al. 2003) at w margin of East TX; mainly Gulf Prairies and Marshes and South TX Plains; this species is known only from TX and Mexico. Jun–Sep. [*C. uniflorus* Torr. & Hook., not Thunb., *C. uniflorus* Torr. & Hook. var. *floribundus* Kük.] This species has sometimes been synonymized with *C. uniflorus* or *C. retroflexus* (e.g., Tucker 1994). However, we are following Carter and Jones (1997) and Tucker et al. (2002) who argue that this taxon is worthy of recognition at the specific level.

Cyperus grayoides Mohlenbr., (resembling *Cyperus grayi*—Mohlenbrock 1959), MOHLENBROCK'S SEDGE, MIDWESTERN GRAY'S FLAT SEDGE. Tufted perennial from short rhizomatous, tuber-like base; culms to 35(–50) cm tall; inflorescences with spikelets in loose to dense head-like clusters; scales of spikelets only slightly overlapping the adjacent scales on the same side of the spikelet (giving margin of spikelet a distinctive serrate outline); achenes 2–2.4 mm long. Deep sand and sandy loam in dry, almost barren openings in upland longleaf pine savannahs, mixed pine-oak forests, and post oak woodlands (Carr 2001), typically on the Willis, Catahoula, Sparta, Queen City, and Carrizo geologic formations (Bridges & Orzell 1989a); widespread in Pineywoods and Post Oak Savannah; AR, IL, LA, MO, and TX. May–Nov, depending upon rainfall. The specific epithet was originally spelled "grayioides' (Mohlenbrock 1959) but has been corrected to *grayoides* (e.g., Kartesz 1999; Tucker et al. 2002). This species is considered to be of conservation concern by Carr (2001, 2002d) and Tucker et al. (2002), but it apparently is more widespread than previously thought (e.g., numerous counties cited by Turner et al. 2003). It has been reported to hybridize with *C. retrofractus* (Bridges & Orzell 1989a). (RARE 2001, 2002b: G3S3; Tucker et al. 2002) ?⚠

Cyperus haspan L., (the native name in Ceylon), SHEATHED FLAT SEDGE, HASPAN FLAT SEDGE. Tufted perennial; culms (10–)25–70(–100) cm tall, sharply 3-angled; most leaves reduced to bladeless sheaths or rarely with short blades; spikelets in loose to crowded, digitate, head-like clusters; achenes 0.5–0.7 mm long. Moist places; widespread in Pineywoods and Post Oak Savannah; also Gulf Prairies and Marshes, e Edwards Plateau, and Burnet Co. (S.D. Jones, pers. comm.) near s edge of Cross Timbers and Prairies; se U.S. from VA s to FL w to TX. Jun–Oct. [*C. haspan* var. *americanus* Boeck.] This pantropical to warm temperate species can be a problematic weed (e.g., in rice fields—Holm et al. 1997). ⚅/284

Cyperus hystricinus Fernald, (porcupine-like, bristly), BRISTLY FLAT SEDGE. Tufted perennial; culms to 1 m tall, glabrous; rhizomes thick, to 1.5 cm long; leaf blades 4–6 mm wide; inflorescences with spikelets in oblong spikes that are not wider toward apex, the lower spikelets markedly reflexed and appearing ± drooping around the peduncle; spikelets golden brown, with only 1–2(–3) scales; achenes 2.5–2.8 mm long. Xeric sandy soils; scattered in East TX; also Tarrant Co. (Tucker 1984b) in the Cross Timbers and Prairies and Jim Hogg Co. (Turner et al. 2003) in the South TX Plains; e U.S. from NJ s to FL w to MO and TX. Summer–fall. [*C. retrofractus* (L.) Torr. var. *hystricinus* (Fernald) Kük.]

Cyperus involucratus Rottb., (with an involucre), UMBRELLA-PLANT, UMBRELLA FLAT SEDGE, ALTERNATE LEAF FLAT SEDGE. Perennial to 1.5 m tall; leaves reduced to bladeless sheaths; inflorescence bracts very numerous (10–25) and very long (15–40 cm); inflorescences with spikelets in digitate clusters; achenes 0.6–0.8 mm long. Widely cultivated, persisting, and spreading in moist disturbed areas; Brazos, Harris, Gonzales, and Travis (Turner et al. 2003) cos.; widely scattered in TX; CA, FL, LA, and TX. Summer–fall. Native of Old World, probably Africa or Madagascar. [*C. alternifolius* of authors, not L., *C. alternifolius* L. subsp. *flabelliformis* (Rottb.) Kük., *C. flabelliformis* Rottb.] Baijnath (1975) discussed nomenclature for this species.

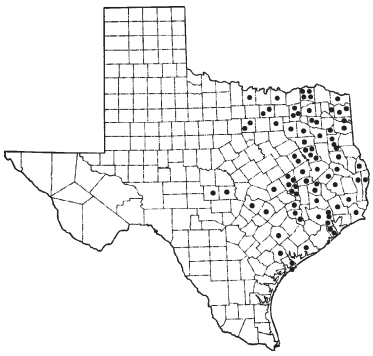
Cyperus iria L., (possibly from Greek *iridos*, rainbow or iris of the eye), RICE-FIELD FLAT SEDGE. Tufted annual 60 cm or less tall; spikelets in spikes in a loose and open, almost panicle-like arrangement; scales of spikelets obovate to nearly orbiculate, nearly as wide as long, appearing tiny and bead-like to the naked eye; achenes 1.2–1.4 mm long. Ditches, disturbed places, often moist to wet areas; Hardin, Harris, Jefferson, Newton, Travis, Waller (BRIT), Colorado, and Orange (Turner et al. 2003) cos.; also n Gulf Prairies and Marshes; widespread in e 1/2 of U.S., also CA. (Apr–)Jun–Oct. Native of Eurasia. This species was first recorded for the New World from the se U.S. in the 1840s (Tucker et al. 2002). It is principally a weed of rice and is considered by some sources to be among the world's worst weeds (Holm et al. 1977).

Cyperus lanceolatus Poir., (lanceolate, lance-shaped). Perennial with culms 15–75 cm tall; inflorescences with spikelets in ± head-like clusters; achenes 1–1.3 mm long, lenticular, the surfaces with isodiametric or square cells, without transverse undulations. Wet areas; Lavaca and Travis (Turner et al. 2003) cos. in s part of East TX; also Llano Co. (Turner et al. 2003) on the Edwards Plateau; se U.S. from GA s to FL w to TX. Summer. [*C. densus* Link, *C. lanceolatus* var. *compositus* J. Presl & C. Presl] This species is similar to *C. flavescens* in terms of habit, spikelets, and scales, but it can be distinguished by the achene surfaces.While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

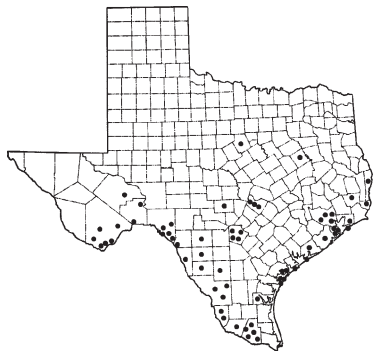
Cyperus lentiginosus Millsp. & Chase, (freckled), LATIN AMERICAN FLAT SEDGE. Tufted perennial usually 40(–70) cm or less tall; inflorescences with spikelets in loose spikes, the spike axes easily visible; achenes 1.7–2 mm long. Open woods and thickets; DeWitt and Robertson (Turner et al. 2003) cos.; also Gulf Prairies and Marshes and South TX Plains; FL and TX. Spring–summer. [*C. tenuis* Sw. var. *lentiginosus* (Millsp. & Chase) Kük.]

Cyperus lupulinus (Spreng.) Marcks, (resembling *Humulus lupulus*—hops), SLENDER FLAT SEDGE, GREAT PLAINS FLAT SEDGE. Tufted perennial 15–50 cm tall, with hard swollen culm bases, often developing short knotty rhizomes; inflorescences typically of a single nearly spherical head-like cluster of spikelets or sometimes with a few rays bearing small head-like clusters; spikelets gray-green; achenes 1.7–2.2 mm long. Sandy open woods; widely scattered mostly in the n 1/2 of TX; se Canada and e U.S. from VT s to NC w MN and TX, also CO, ID, and OR. May–Jun, occasionally to Sep. [*C. bushii* Britton, *C. filiculmis* of authors, not Vahl—Marcks 1974] We are following Marcks (1974) and Tucker et al. (2002) in recognizing this species, which has often not been cited for TX (e.g., Correll & Johnston 1970; Hatch et al. 1990); it has apparently sometimes been included in a broadly conceived *C. filiculmis*.

Cyperus ochraceus Vahl, (pale dull yellow, ochre yellow), POND FLAT SEDGE. Tufted perennial 20–80 cm tall; inflorescences with spikelets in uncrowded, digitate, head-like clusters; achenes 1–1.5 mm long. Ditches, other moist disturbed areas; Bexar (BRIT), Harris, Lavaca, Liberty, and Travis (Turner et al. 2003) cos. near s margin of East TX; mainly Gulf Prairies and Marshes and South TX Plains; se US from GA s to FL w to TX. (May–)Jun–Nov. This widespread species occurs from the se U.S. s to Mexico and Central and South America.



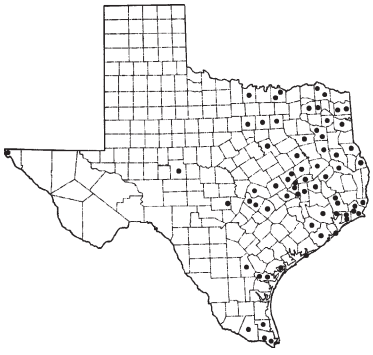
Cyperus echinatus



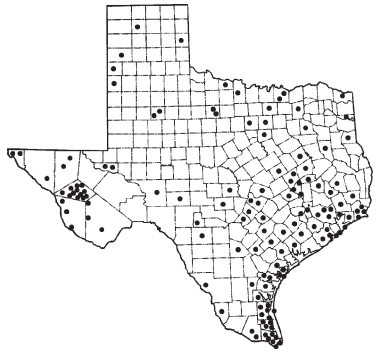
Cyperus elegans



Cyperus entrerianus



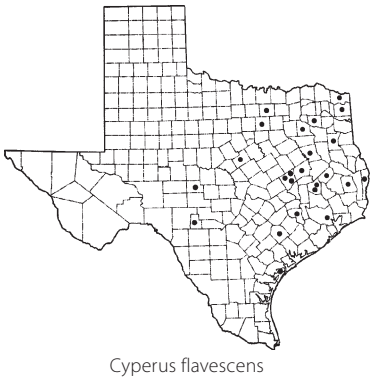
Cyperus erythrorhizos



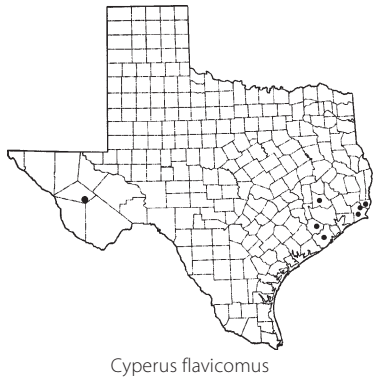
Cyperus esculentus



Cyperus filiculmis



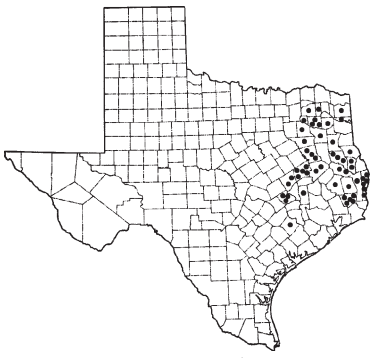
Cyperus flavescens



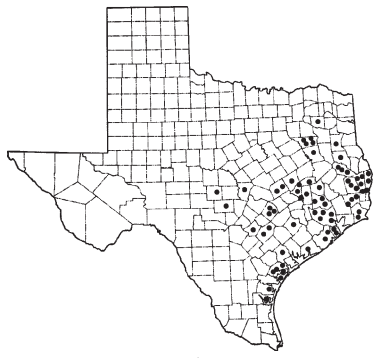
Cyperus flavicomus



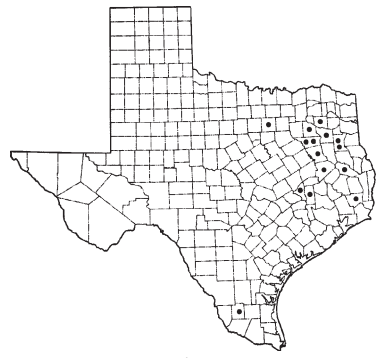
Cyperus floribundus



Cyperus grayoides



Cyperus haspan



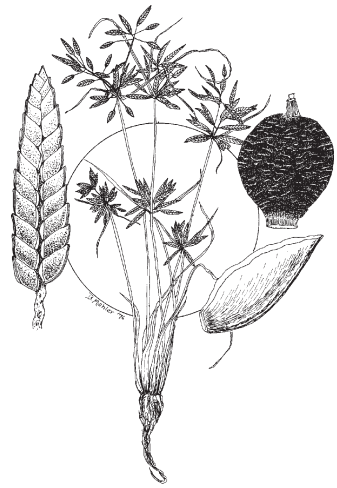
Cyperus hystricinus



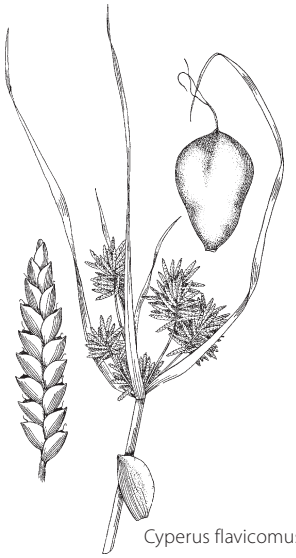
Cyperus esculentus [REE]



Cyperus filiculmis [CO1]



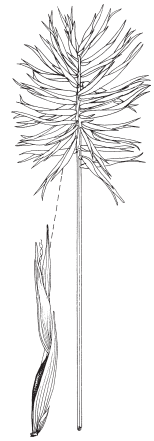
Cyperus flavescens [BT2]



Cyperus flavicomus [GLE]



Cyperus involucratus [BA1, BR2]



Cyperus floribundus [FNA]



Cyperus grayoides [YAT]



Cyperus haspan [GWO]



Cyperus hystricinus [BB2]

Cyperus odoratus L., (fragrant), FRAGRANT FLAT SEDGE, LARGE-HEAD FLAT SEDGE, RUSTY FLAT SEDGE. Tufted annual or perennial usually 5–60(–90) cm tall; inflorescences with spikelets in dense to loose, cylindric to ovoid spikes; spikelets at maturity often dull reddish to brownish; spikelet axis separating at maturity at the floret nodes (because this is not always evident in young material, *C. odoratus* can also be reached in the key without recognizing this character); scales relatively small, usually 1.5–3 mm long; achenes (1–)1.2–1.5(–2) mm long. Stream banks, lake shores, or other moist areas; abundant in all parts of TX; se Canada and throughout the e 1/2 of the U.S., scattered to the w. Jun–Oct. [*C. engelmannii* Steud., *C. ferruginescens* Boeck., *C. odoratus* var. *engelmannii* (Steud.) R. Carter, S.D. Jones, & Wipff, *C. odoratus* var. *squarrosus* (Britton) S.D. Jones, Wipff, & R. Carter] The spongy thickened rachilla internodes have been suggested as an adaptation "to make the achenes buoyant, thus contributing to dispersal by water" (Tucker 1987). This is one of the most common *Cyperus* species in East TX. We are following a variety of sources (e.g., Correll & Johnston 1970; Kartesz 1994, 1999; Tucker 1984b, 1994; Tucker et al. 2002) in treating it as a single variable species. Tucker (1983, 1987), for example, indicated that there was not a single consistent character separating *C. engelmannii* from *C. odoratus* and that the two intergrade extensively. Correll and Johnston (1970) noted concerning *C. odoratus* that "... it is impossible to distinguish segregate taxa." Given that the varieties overlap morphologically and are mostly sympatric, treatment as a variable species without infraspecific taxa is possibly best. Jones et al. (1996), however, recognized the following three varieties indicating that "We find these three taxa closely related and mostly sympatric, but discrete. Although some intermediates exist, they are relatively few. Considering their distinct morphologies, we believe that varietal rank under *C. odoratus* is warranted...." For those wishing to distinguish varieties, the following key, modified from Jones et al. (1996) and O'Neill (1940), is provided.

1. Scales near the middle of the spikelet (2.7–)2.8–3.2 mm long; rachilla wings reaching or covering the shoulders of the achene; achenes (1.2–)1.3–1.5 mm long, (0.5–)0.6–0.7 mm wide; spikelets brownish _____ var. *odoratus*
1. Scales near the middle of the spikelet (2–)2.3–2.5(–2.6) mm long; rachilla wings rarely reaching and never covering the shoulders of the achene; achenes 0.8–1(–1.1) mm long, (0.3–)0.4–0.5 mm wide; spikelets reddish.
   2. Tip of scale reaching only to base of the scale next above on the same side of the rachis _____ var. *engelmannii*
   2. Tip of scale conspicuously reaching over the base of the scale next above on the same side of the rachis _____ var. *squarrosus*

Cyperus oxylepis Nees ex Steud., (sharp-scaled), SHARP-SCALE FLAT SEDGE. Tufted perennial, viscid when fresh; culms usually 50 cm or less tall; inflorescences with spikelets in ovoid, almost head-like spikes; spikelets strongly compressed, usually 2.5–4 mm wide; achenes ellipsoid, usually 2–2.4 mm long. Ditches, other wet areas; Brazos, Hardin, Harris, Houston, Jasper, Orange, Trinity, and Wood (Turner et al. 2003) cos.; mainly Gulf Prairies and Marshes; se U.S. from SC s to FL w to AR and TX. Jun–Nov. Native of South America. According to Tucker et al. (2002), this species "is easily recognized by its sticky leaves, culms, and bracts (in living plants), involute leaves, and golden brown spikelets." It is similar to *C. elegans*, which is also sticky with involute leaves, but it can be distinguished by its ellipsoid (vs. obovoid in *C. elegans*) achenes.

Cyperus plukenetii Fernald, (for Leonard Plukenet, 1642–1704, one of the original describers and illustrators of American plants), PLUKENET'S FLAT SEDGE. Tufted perennial 30–100 cm tall; culm bases hard, swollen, sometimes developing short knotty rhizomes; culms rough to the touch, with minute antrorse teeth; inflorescence with longest bract usually ± equal to or shorter than longest ray; spikes with spikelets ± perpendicular to the spike axis to markedly reflexed, enough of them reflexed to give the general appearance of the spikelets drooping

around the spike axis, the spikes usually wider toward apex; spikelets with only 1(–2) scales; achenes (2.4–)2.7–2.9(–3.2) mm long. Upland woods, bogs, sandy soils; widespread in East TX, also n margin of Gulf Prairies and Marshes; e U.S. from NJ s to FL w to MO and TX. Jun–Sep.

Cyperus polystachyos Rottb., (many-spiked), MANY-SPIKE FLAT SEDGE. Tufted perennial; culms usually 45 cm or less long; inflorescences variable, with 1–8(–12) main rays terminated by loose to dense spike-like or head-like clusters of spikelets, or clusters sometimes sessile or sometimes inflorescences secondarily branched; spikelets sessile to short-stalked, sometimes diverging ± at right angles from the axis, sometimes ± strongly ascending; achenes lenticular, 0.8–1.2 mm long, brownish to grayish, sometimes iridescent, sometimes with a grayish crusty appearance. Stream banks, moist sand; widespread in Pineywoods and Post Oak Savannah; widely distributed in e 1/3 of TX; e U.S. from ME s to FL w to OK and TX. Spring–fall. [*C. polystachyos* var. *leptostachyus* Boeck., *C. polystachyos* var. *texensis* (Torr.) Fernald] We are following Jones et al. (1997) in synonymizing var. *texensis*.

Cyperus pseudothyrsiflorus (Kük.) R. Carter & S.D. Jones, (mistaken for *Cyperus thyrsiflorus*). Tufted perennial 40 cm or less tall; leaves usually with knot-like septa visible under a hand lens owing to numerous cross veins between the main veins; inflorescences with spikelets in spikes, the spikes loose enough that the inflorescence axis is easily visible when pressed and dried; achenes 1.4–1.9 mm long. Disturbed areas, damp soils; Bexar, Cass, Gonzales, Liberty, Newton, Rusk, and Travis (Turner et al. 2003) cos.; also Gulf Prairies and Marshes, Edwards Plateau, and Trans-Pecos; in the U.S. known only from TX; also Mexico. Jul–Sep. [*C. uniflorus* Torr. & Hook. var. *pseudothyrsiflorus* Kük.] Tucker (1994) synonymized this taxon with *C. retroflexus*. However, we are following Carter and Jones (1997) and Tucker et al. (2002) in treating it as a distinct species.

Cyperus pseudovegetus Steud., (mistaken for *Cyperus vegetus*), MARSH FLAT SEDGE, SALTMARSH FLAT SEDGE. Tufted perennial usually 50(–80) cm or less tall; inflorescences usually with 3–10 main rays terminated by head-like clusters of spikelets, sometimes secondarily branched; spikelets small, 2.5–4 mm long; scales essentially linear, conspicuously sickle-shaped, 0.6–0.7 mm wide when spread out; achenes linear to linear-oblong, 1–1.5 mm long, maturing brownish. Sandy soils; widespread throughout East TX w to Cross Timbers and Prairies; also Gulf Prairies and Marshes and n part of South TX Plains; widespread in e 1/2 of the U.S. Jun–Oct. [*C. virens* Michx. var. *arenicola* (Boeck.) Shinners]

Cyperus reflexus Vahl, (bent back), BENT-AWN FLAT SEDGE. Perennial with creeping rhizomes, similar to *C. acuminatus* (which, however, has S-shaped spikelet scales) and *C. pseudovegetus* (which has much narrower spikelet scales); inflorescences with spikelets in digitate, dense, head-like clusters; inflorescence bracts 3–4, the longest erect or nearly so, appearing as a continuation of the culm; scales of spikelets ca. 1.1 mm wide when spread out, often reddish with greenish keels, straight at base but curved at tip; achenes pale brown, 0.9–1.2 mm long. Moist sand; widespread in e 1/2 of TX; FL, LA, OK, and TX. Spring–summer. [*C. arenicola* Steud., *C. fraternus* Kunth, *C. reflexus* var. *fraternus* (Kunth) Kuntze, *C. pseudovegetus* Steud. var. *arenicola* (Steud.) Kük.]

Cyperus retroflexus Buckley, (reflexed), ONE-FLOWER FLAT SEDGE. Tufted perennial usually 3–35 (–80) cm tall; inflorescences with spikelets in dense to loose spikes; scales of spikelets at maturity often deep red-brown with prominent green keel; achenes (1.8–)2–2.5 mm long. Sandy open woods or prairies; nearly throughout TX; s U.S. from AL n to MO and w to NM. May–Oct. [*C. retroflexus* var. *pumilus* (Britton) R. Carter & S.D. Jones, *C. uniflorus* Torr. & Hook. var. *pumilus* Britton, *C. uniflorus* var. *retroflexus* (Buckley) Kük.] We are following a number of authorities (e.g., Kartesz 1994, 1999; Tucker 1994; Tucker et al. 2002) in not recognizing infraspecific taxa in this species. Given the extensive overlap in morphological characters between the varieties and the lack of geographical isolation, treatment as a variable species without infraspecific taxa is

possibly best. However, the following varieties were recognized by Carter and Jones (1997). They indicated that despite "overlap in virtually every characteristic we examined," when combinations of characteristics were used, most specimens could be identified to variety. According to S.D. Jones (pers. comm.), both varieties occur throughout East TX, but var. *retroflexus* is by far the most common. For those wishing to distinguish varieties, the following key from Carter and Jones (1997) is provided.

1. Fertile floral scales 1.9–3(–3.3) mm long; rachilla wing usually membranaceous throughout; rachilla usually lacking lateral nerves; longest spikelets 2.2–5.8(–8) mm long; terminal sterile floral scale of spikelet often much reduced, less than 2/3 the length of fertile floral scales; longest peduncle less than 2.7(–3.9) cm long; plants diminutive, 3–35(–45) cm tall _____ var. *pumilus*
1. Fertile floral scales (2.8–)3–3.9 mm long; rachilla wing usually chartaceous beyond clasped achene angle, border membranaceous; rachilla usually with two lateral nerves, one along each side of median; longest spikelets 4.9–9(–11.3) mm long; terminal sterile floral scale usually not greatly reduced, 2/3 or more the length of fertile floral scales; longest peduncle (0.5–)2.4–6.8 cm long; except for depauperate specimens, plants usually greater than 25(–57) cm tall _____ var. *retroflexus*

Cyperus retrorsus Chapm., (twisted or turned backward), PINE-BARREN FLAT SEDGE. Tufted perennial; culms usually 50(–85) cm or less tall; inflorescences with spikelets in extremely densely cylindric or subcylindric spikes (so dense that outline of spike is smooth); spikes 6–8 (–10) mm broad by 7–18 mm long, more than 1/4 longer than broad; achenes 1.2–1.7 mm long. Ditches, roadsides, open woods, usually in sandy soils; Pineywoods and Gulf Prairies and Marshes w to Cross Timbers and Prairies and e Edwards Plateau; e U.S. from NY s to FL w to MO and TX. Jun–Oct. While some authorities (e.g., Kartesz 1999) recognize varieties in this species, because of indistinct boundaries even between species within this complex, we are following Tucker et al. (2002) in not recognizing infraspecific taxa within *C. retrorsus*. In addition, some authorities (e.g., Turner et al. 2003) recognize *C. cylindricus*, which is here synonymized with *C. retrorsus*. [*C. cylindricus* (Elliott) Britton, *C. ovularis* (Michx.) Torr. var. *cylindricus* (Elliott) Torr., *C. retrorsus* var. *cylindricus* (Elliott) Fernald & Griscom]

Cyperus rotundus L., (round), NUT-GRASS, NUT SEDGE, COCO-GRASS, PURPLE NUT-GRASS, PURPLE NUT SEDGE, PURPLE FLAT SEDGE. Deeply rhizomatous perennial 7–50 cm tall, forming colonies; rhizomes at intervals with tuber-like thickenings (allowing survival under extreme conditions); inflorescences with spikelets in relatively open spikes, each spike with 3–9(–12) spikelets; spikelets dark red-brown to purplish; achenes 1.4–1.8 mm long. Disturbed areas, waste places, cultivated fields, lawns; widespread in TX; s U.S. from VA s to FL w to CA. May–Oct. Native of the Old World? (while most authorities—e.g., Hatch et al. 1990—consider this species introduced, Tucker et al. 2002 do not). Often a pernicious weed known to adversely affect numerous crops and sometimes referred to as "the world's worst weed" (Holm et al. 1977; Mabberley 1987); it is considered a state noxious weed in AZ, CA, GA, and OK (Kartesz 1999). However, the tuber-like thickenings are "said to be relished by some game animals, particularly wild turkey" (Godfrey & Wooten 1979). Tucker et al. (2002) consider the underground stems in this species and in *C. esculentus* to be stolons; however, because they are underground, we treat them as rhizomes. They note that the two somewhat similar species can be distinguished as follows: *C. rotundus* with the stolons [rhizomes] indurate, wiry, springy when dried; and *C. esculentus* with the stolons [rhizomes] spongy, flexible when dried. ⊘ ? ☜

Cyperus setigerus Torr. & Hook., (bearing bristles), LEAN FLAT SEDGE, BRISTLED UMBRELLA SEDGE. Perennial usually 50–110 cm tall, with shallow creeping rhizomes, forming small colonies; inflorescences with spikelets in relatively open spikes; spikelets usually reddish brown; achenes 1.4–1.8 mm long. Stream or pond banks, low areas, ditches, in clay soils; mainly in w part of East TX (where clay soils predominate); also scattered elsewhere in TX; KS, MO, NM, OK, and TX. May–Sep. According to Yatskievych (1999), "*Cyperus setigerus* often produces a pleasant, sweet odor when crushed or dried."



Cyperus iria [GWO]



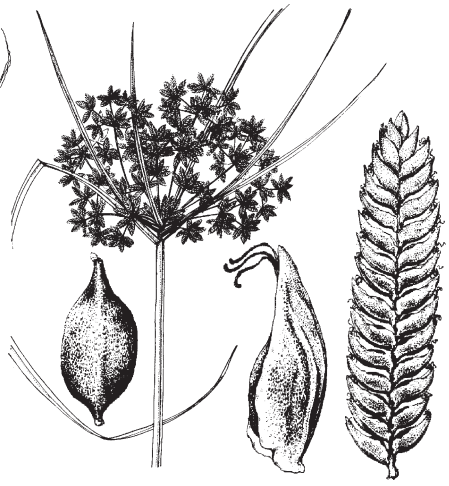
Cyperus lanceolatus [HEA]



Cyprus lentiginosus [FIE]



Cyperus lupulinus [BT2]



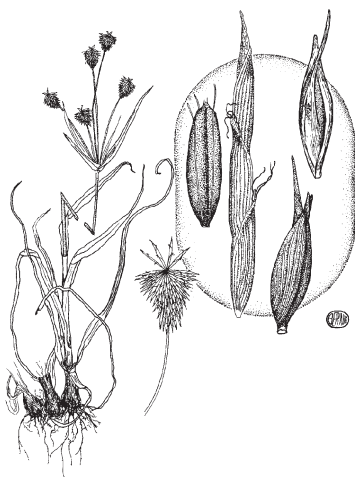
Cyperus ochraceus [CUM]



Cyperus odoratus [BT2]



Cyperus oxylepis [SBM]



Cyperus plukenetii [BT2]



Cyperus polystachyos [GWO]

Cyperus squarrosus L., (with recurved tips), BEARDED FLAT SEDGE, AWNED FLAT SEDGE. Tufted annual usually 3–20 cm tall, with persistent odor when crushed or dried, like coffee-and-chicory or curry powder (even after decades in a herbarium); inflorescences with spikelets in 1–3, often essentially sessile, head-like clusters, the spikelets ± digitately arranged or sometimes along a short axis; scale tips prominently recurved; achenes usually 0.7–1 mm long. Disturbed soils, sand; widespread in TX; s Canada and throughout the U.S. and ± cosmopolitan. Jun–Jul. [*C. aristatus* Rottb., *C. inflexus* Muhl., *C. squarrosus* var. *runyonii* (O'Neill) S.D. Jones & Wipff] This species is sometimes confused with *C. acuminatus* (scales of spikelets 3-nerved, with pointed but not awn-like tips) but can be distinguished by its spikelet scales having 5–11 nerves with long acuminate, awn-like tips. A similar species, *Cyperus cuspidatus* Kunth (with a sharp stiff point or cusp), COASTAL-PLAIN FLAT SEDGE, a minute annual to only 5(–9) cm tall with the scales of the spikelets strongly recurved at tip (and thus similar to *C. squarrosus*), is cited for TX by Tucker (1994) and by Kartesz (1999) for SC s to FL w to TX. However, Tucker et al. (2002), did not include TX within the range of this species. While we have no definitive evidence that this taxon is a member of the East TX flora, it is mentioned here as a note to encourage collectors to look for it. It can be distinguished from *C. squarrosus* as follows:

1. Scales of spikelet (0.6–)0.9–1.2 mm long (excluding recurved tip), with the recurved tip extending abruptly beyond the broad sides of the scale, each side of scales nerveless or with a single nerve near the midrib; plants without a spice-like odor _____ *C. cuspidatus*
1. Scales of spikelet (1.2–)1.3–1.8(–2.2) mm long (excluding recurved tip), with the sides of the scales gradually narrowed to the recurved tip, each side of scales with several distinct nerves; plants with a persistent spice-like odor _____ *C. squarrosus*

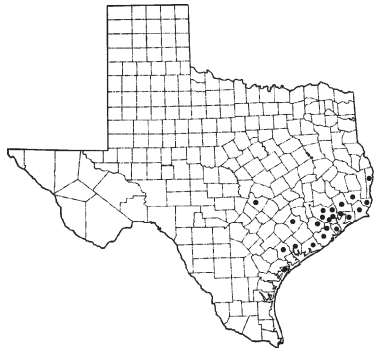
Cyperus strigosus L., (strigose, with straight appressed hairs bent at base), FALSE NUT-GRASS, STRAW-COLOR FLAT SEDGE. Tufted perennial without rhizomes; culms usually 20–110 cm tall, with base swollen, corm-like; spikelets usually pinnately arranged in often rather loose elongate spikes, the spike axis visible; achenes (1.5–)1.8–2.4 mm long. Low sandy soils; widespread in e 2/3 of TX, scattered to the w; s Canada and nearly throughout the U.S. Jun–Oct. [*C. hansenii* Britton, *C. stenolepis* Torr., *C. strigosus* var. *hansenii* (Britton) Kük., *C. strigosus* var. *stenolepis* (Torr.) Kük.] Two other common species, *C. odoratus* and *C. erythrorhizos* can be distinguished from *C. strigosus* as follows: *C. erythrorhizos* has spikelet scales much smaller (1.2–1.5 mm long) than those of *C. odoratus* (usually 2.2–2.8 mm long) or *C. strigosus* (usually 3.2–5 mm long). In addition, *C. strigosus* has flattened spikelets, while those of *C. odoratus* are subcylindric (Tucker et al. 2002). ⊞/284

Cyperus surinamensis Rottb., (of Surinam), TROPICAL FLAT SEDGE. Tufted perennial, short-lived, flowering first year, (10–)30–60(–80) cm tall; culms rough to the touch, with minute retrorse (= down-pointing) teeth; inflorescences with spikelets digitately arranged in crowded head-like clusters; achenes 0.7–0.9 mm long. Low moist areas; widespread in e 1/2 of TX; mainly se U.S. from SC s to FL w to OK and TX, also KS. Jul–Nov. This is the only East TX species with retrorse teeth on the culms and inflorescence rays (= main branches). Lipscomb (1978) discussed the range of this species.

Cyperus thyrsiflorus Jungh., (with bunch-like inflorescence), SOUTHERN FLAT SEDGE. Rhizomatous perennial usually 40 cm or less tall; inflorescences with spikelets in spikes, the spikes loose enough that the inflorescence axis is easily visible when pressed and dried; achenes 1.8–2.1 mm long. Wooded areas; Anderson, Colorado, Fayette, Harris (Turner et al. 2003), and Liberty (Brown et al. 2002a) cos.; also Gulf Prairies and Marshes and South TX Plains; se U.S. from GA s to FL w to TX. May–Sep. [*C. dissitiflorus* Nees ex Torr.]

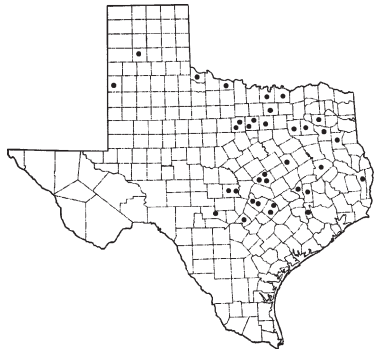
Cyperus virens Michx., (green), GREEN FLAT SEDGE. Tufted perennial (16–)60–100 cm tall; culms sharply 3-angled, scabrous on angles only; leaf blades, leaf sheaths, and bracts with knot-like


Cyperus involucratus


Cyperus iria


Cyperus lanceolatus


Cyperus lentiginosus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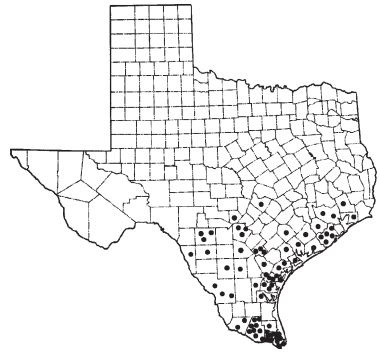
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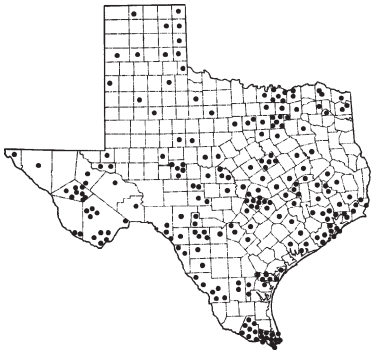
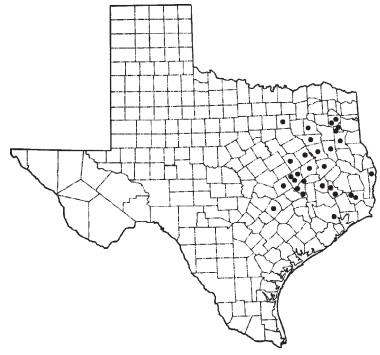
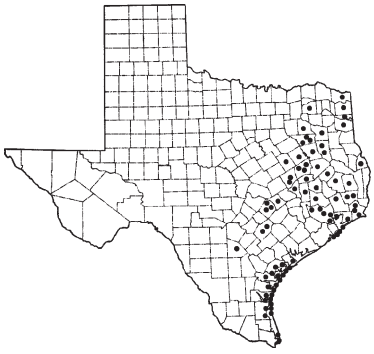
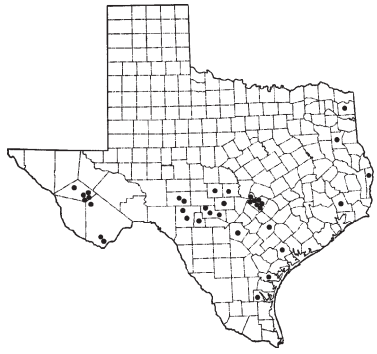
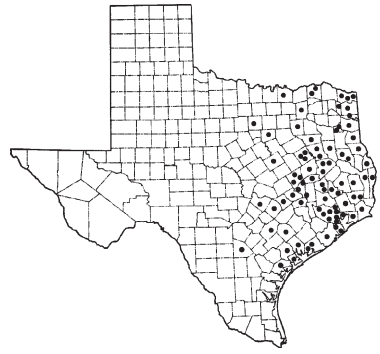

Cyperus odoratus


Cyperus oxylepis


Cyperus plukenetii


Cyperus polystachyos


Cyperus pseudothyrsiflorus


Cyperus pseudovegetus

septa visible under a hand lens; spikelets digitately arranged in head-like clusters; achenes 1.2–1.5 mm long. Intermittently wet, often disturbed habitats, including ditches, stream bottoms, and lake and pond margins (Carter et al. 1999); widespread in the e and s portions of East TX; also Gulf Prairies and Marshes; se U.S. from NC s to FL w to TX. (Apr–)May–Nov(–Dec). This species is related to and similar to *C. drummondii* (see key to species to distingush the two); it is also much more common in East TX than is *C. drummondii*.

Cyperus retrofractus (L.) Torr., (turned back), ROUGH FLAT SEDGE. Tufted perennial to ca. 90 cm tall; inflorescences with spikelets in loose spikes broadest near the apex; achenes (2.2–)2.5–3 mm long. Roadsides and other disturbed areas; while this species has long been considered a member of the TX flora (e.g., Correll & Johnston 1970; Hatch et al. 1990), our observations and those of Tucker et al. (2002) do not support its inclusion; it is included in the key and mentioned here as a note for clarity and to encourage collection of possible material in the extreme ne portion of the state where it is most likely to occur (since it is known from AR); all BRIT specimens previously identified as *C. retrofractus* are actually *C. hystricinus* and *C. plukenetii*. These three species are similar and care must be taken in distinguishing them. According to Tucker et al. (2002), *C. retrofractus* occurs to the n and e and does not reach TX; e U.S. from NJ s to GA w to AR and MO. Jul–Sep. [*C. dipsaciformis* Fernald, *C. retrofractus* var. *dipsaciformis* (Fernald) Kük., *Scirpus retrofractus* L.]

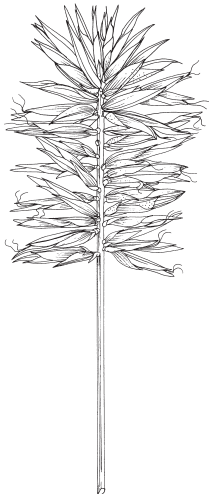
DULICHIUM Pers. THREE-WAY SEDGE

A monotypic genus endemic to North and Central America (Mastrogiuseppe 2002). It is disjunctly distributed in North America (e and w parts of the continent), was more widespread during the Pleistocene, and is known from fossils in Europe (Bell 1970; Wood 1970). The genus resembles *Cyperus* in having the spikelet scales 2-ranked but differs in having 6–9 perianth bristles subtending the achene (versus none in *Cyperus*) and axillary inflorescences (terminal in *Cyperus*). (Greek: *duo*, two, and *leichon*, scale, in reference to the two-ranked spikelet scales) REFERENCES: Bell 1970; Wood 1970; Tucker 1987; Mastrogiuseppe 2002.

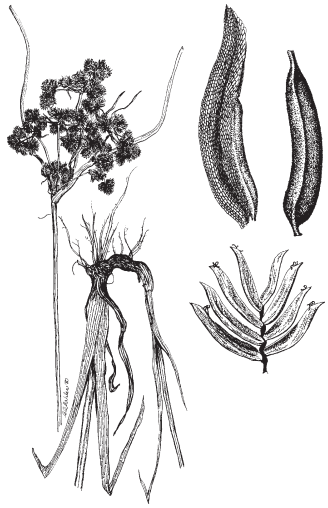
Dulichium arundinaceum (L.) Britton, (reed-like), THREE-WAY SEDGE, SHEATHED GALINGALE. Rhizomatous, clone-forming perennial; rhizomes horizontal; culms terete, hollow, appearing jointed, 0.3–1 m tall; leaves numerous, borne all along the stem, the lower ones reduced to sheaths or with only reduced blades, the upper ones strongly 3-ranked and with linear-lanceolate blades to 11 cm long and (2.5–)4–8 mm wide; inflorescences short-stalked unbranched spikes in the upper leaf axils (1 per axil), the spikes sometimes numerous (thus giving the appearance of a conspicuously leafy inflorescence); spikes with spikelets in 2 ranks, appearing flattened; spikelets linear, 1–2.5(–3) cm long, with 3–9 two-ranked scales, the lowermost scale of each spikelet sterile; bristles 6–9, retrorsely barbed, 1–2 times as long as the achene; stamens 3; style 2-branched; achenes ca. 2.5–4 mm long, narrowly elliptic, biconvex in cross section, with an elongate beak (= long, persistent style) but without a tubercle. Bogs, marshes, along streams, seepage areas, wet pinelands, at edge of or in water; Freestone, Henderson, Robertson, Van Zandt, Wood (BRIT), Cass, and Madison (Turner et al. 2003) cos. in the Pineywoods and Post Oak Savannah; widespread in the e 1/2 of the U.S. and ± disjunct to the w U.S (Mastrogiuseppe 2002); see p. 204 of introduction and Fig. 118. Jul–Oct. Yatskievych (1999) noted that the "jointed appearance of the aerial stems is caused by the ligules that extend as narrow, dark rings of tissue around the tops of the leaf sheaths."

ELEOCHARIS R. Br.
SPIKE-RUSH, DOG'S-HAIR-GRASS, SPIKE SEDGE

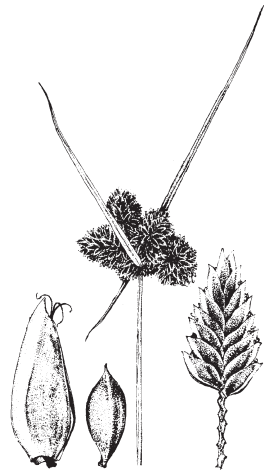
Culms (= stems) green and glabrous, round, flat, or angled, with two leaf sheaths present on basal part; leaf blades absent or rudimentary; inflorescence a single terminal spikelet at the end



Cyperus pseudothyrsiflorus [FNA]



Cyperus pseudovegetus [BT2]



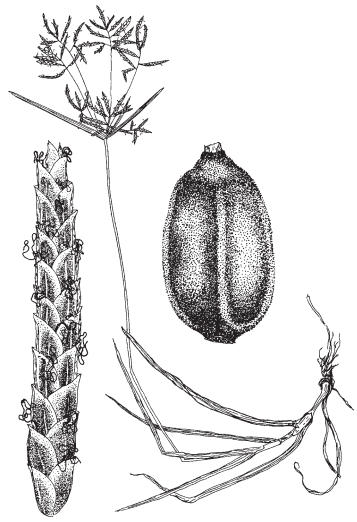
Cyperus reflexus [CUM]



Cyperus retroflexus [BT2]



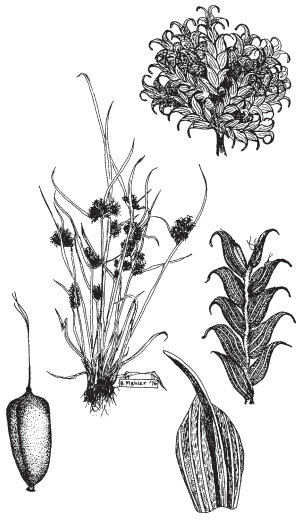
Cyperus retrorsus [CO1]



Cyperus rotundus [BT2]



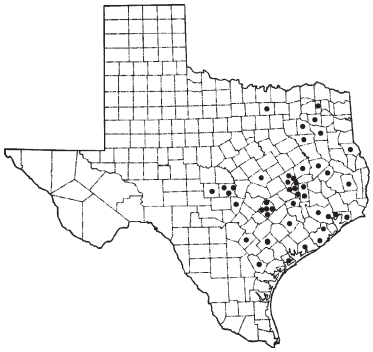
Cyperus setigerus [GLE]



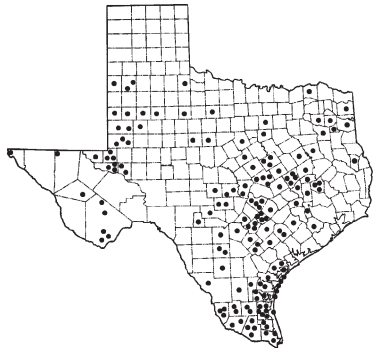
Cyperus squarrosus [BT2]



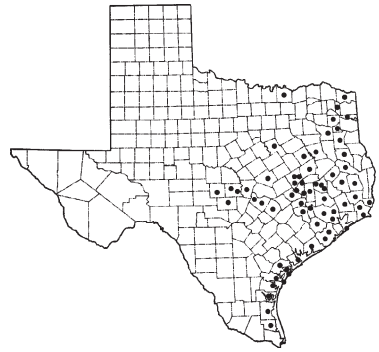
Cyperus strigosus [BT2]



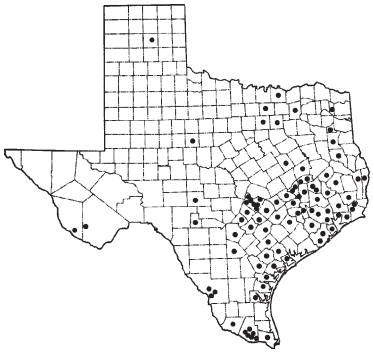
Cyperus reflexus



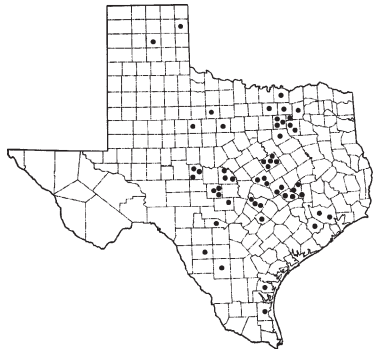
Cyperus retroflexus



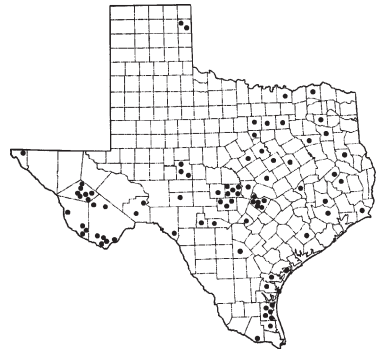
Cyperus retrorsus



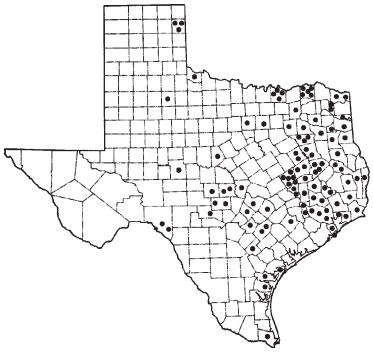
Cyperus rotundus



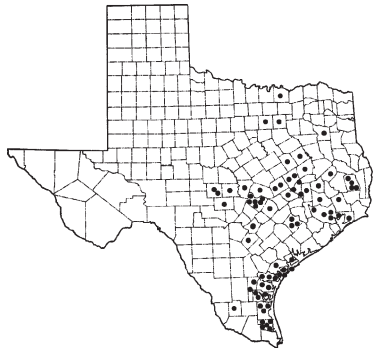
Cyperus setigerus



Cyperus squarrosus



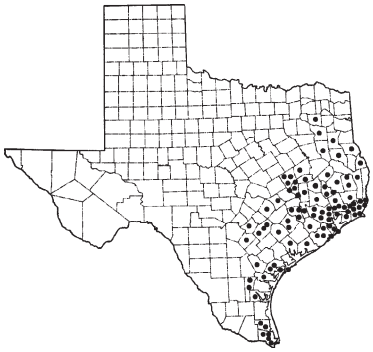
Cyperus strigosus



Cyperus surinamensis



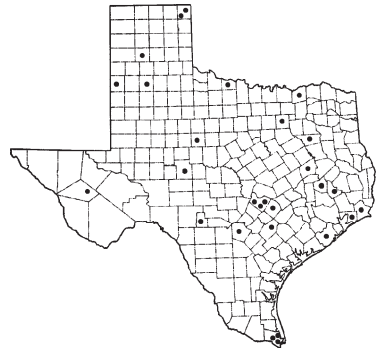
Cyperus thyrsiflorus



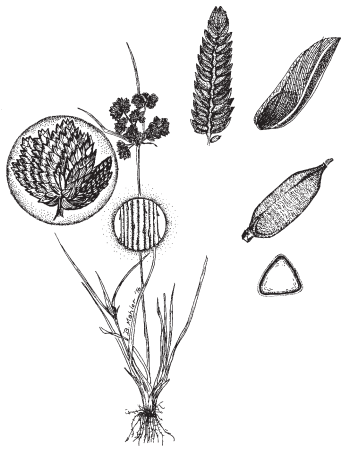
Cyperus virens



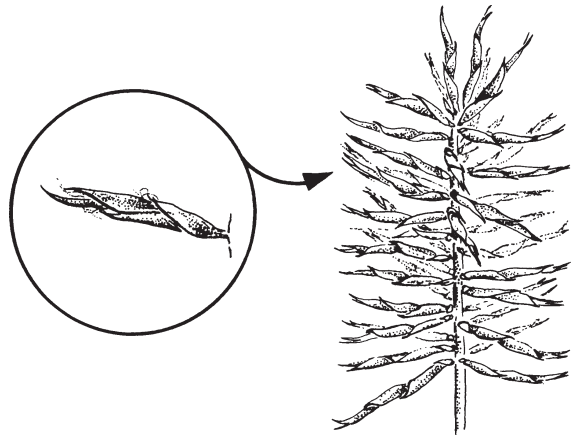
Dulichium arundinaceum



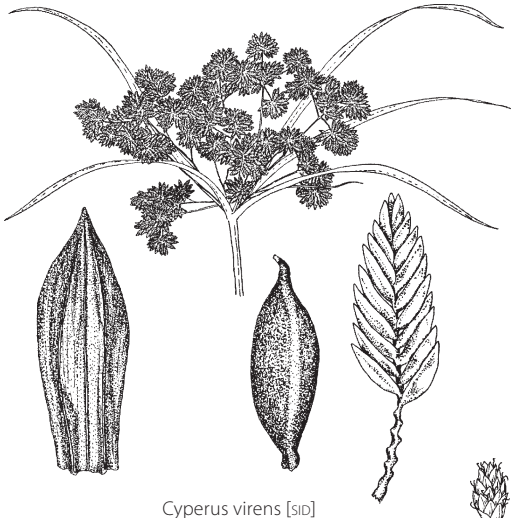
Eleocharis acicularis



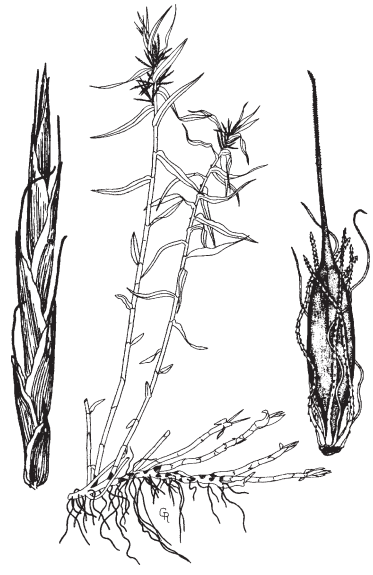
Cyperus surinamensis [BT2]



Cyperus thyrsiflorus [SBM]



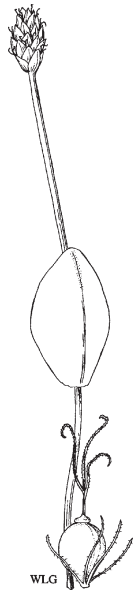
Cyperus virens [SID]



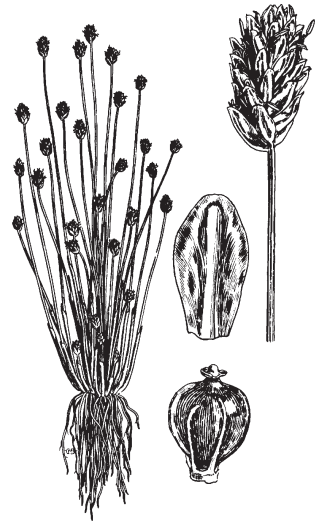
Dulichium arundinaceum [GWO]



Eleocharis acicularis [BT2]



Eleocharis albida [GLE]



Eleocharis atropurpurea [MAS]

of a usually elongate culm (hence the name SPIKE-RUSH), without bracts; scales of spikelets spirally arranged (± 2-ranked in 1 species—*E. baldwinii*); perianth of bristles or absent; achenes capped by a tubercle (= hardened persistent style).

A cosmopolitan genus of ca. 200 species with at least 145 in the New World (González-Elizondo & Tena-Flores 2000; Smith et al. 2002). *Eleocharis* is a taxonomically difficult genus because it is morphologically simple, with few useful characters and because parallelism and convergence are common (González-Elizondo & Tena-Florez 2000). While the shared character of achenes with a tubercle suggests a relationship with *Fimbristylis*, "recent evidence [anatomy, embryology] supports a closer relationship between *Scirpus* and *Eleocharis*" (Tucker 1987). Molecular data (Roalson & Friar 2000), however, suggest a more recent common ancestry between *Eleocharis* and *Bulbostylis*. While several species grow in ponds or other standing water with a stable water level, most species grow "where receding water levels leave the plants exposed in summer" (Tucker 1987). A number of species have been reported to be significant weeds, especially in rice fields (Tucker 1987). *Eleocharis dulcis* (Burm. f.) Hensch. (WATER-CHESTNUT), native to the Old World tropics, has underground storage organs often used in Chinese cuisine; the juice of the tubers is also reported to have antibiotic properties (Tucker 1987). Several species vegetatively proliferate from the spikelets, particularly when growing as submerged or floating aquatics. Such plants may reproduce entirely asexually by rooting of the proliferating spikelets when the culms lean or fall and touch a substrate or water (Smith et al. 2002). Having mature achenes is extremely important for the accurate identification of the East TX species. In the key and descriptions presented here, the measurements given for achenes do not include the tubercles. (Greek: *elos*, marsh, and *charis*, grace; many species being marsh plants)

REFERENCES: Fernald & Brackett 1929; Svenson 1929, 1939, 1953, 1957; Drapalik & Mohlenbrock 1960; Harms 1968, 1972; Godfrey & Wooten 1979; Larson & Catling 1996; González-Elizondo & Peterson 1997; González-Elizondo & Tena-Flores 2000; Roalson & Friar 2000; Smith 2001; 2002d; Bruhl & Smith 2002; González-Elizondo 2002; Menapace 2002; Smith et al. 2002.

1. Culms 2–6 mm wide; spikelet roughly the same diam. as the supporting culm OR distinctly thicker than the supporting culm; internal septa (= noticeable partitions or divisions often appearing externally as cross-lines at intervals) often, but not always, present along the culms.
   2. Culms conspicuously square (4-angled) in cross section _____ **E. quadrangulata**
   2. Culms not square, varying from ± rounded to flattened.
      3. Culm measured 1 cm below base of spikelet 3 mm or more wide; culms hollow and completely and regularly septate, the partitions noticeble visually and to touch if culm is run between the fingers.
         4. Perianth bristles shorter than to nearly equaling the achenes (often so delicate as to be lost) or sometimes absent (achenes should be measured separately from tubercles); culm just below spikelet nodulose (use hand lens to see knob-like structures on the culm); achenes obscurely sculptured to nearly smooth when viewed with a hand lens _____ **E. equisetoides**
         4. Perianth bristles exceeding the achenes in length; culm just below spikelet not nodulose; achenes noticeably sculptured when viewed with a hand lens _____ **E. interstincta**
      3. Culm measured 1 cm below base of spikelet 2 mm or less wide (can be much wider elsewhere); culms sometimes hollow and completely septate, usually not so or only incompletely and irregularly so.
         5. Culms round or subtrigonous, (1–)3–5 mm wide; spikelets usually 19–36(–50) mm long; scales of spikelets 3–4.4 mm wide, broadly rounded, with a darker (brownish to reddish) submarginal band; styles 3-branched; achenes ca. 2–2.8 mm long, the tubercle ± appearing as a continuation of the achene _____ **E. cellulosa**

5. Culms strongly flattened to round, 0.9–3 mm wide; spikelets 8–25 mm long; scales of spikelets 1–2.5 mm wide, acute to subacute or narrowly rounded, without a darker submarginal band; styles 2-branched; achenes 0.7–1.9 mm long, the tubercle ± distinct from the achene, the junction between the two clear.
   6. Scales of spikelet 100–500+ per spikelet, 1.5–2.5 mm long, 1–1.5 mm wide; achenes 0.7–1.1 mm long, the surface with a distinct finely reticulate pattern; tubercle 0.2–0.35 mm long; distal leaf sheath apex with a distinct tooth; culms round, internally hollow, with complete septa ca. 2–5 mm apart, these often visible externally _____ **E. montana**
   6. Scales of spikelet 15–100 per spikelet, 2–5.5 mm long, 1.5–2.5 mm wide; achenes (0.9–)1.1–1.9 mm long, the surface ± smooth in appearance; tubercle 0.3–0.7 mm long; distal leaf sheath apex with OR without a distinct tooth; culms strongly flattened to round, internally spongy, without complete septa.
      7. Lowermost scale of spikelets clasping 2/3(–3/4) of culm; all spikelets with scale above the lowermost empty; culms round or slightly compressed _____ **E. palustris**
      7. Lowermost scale of spikelets clasping 3/4+ of culm; spikelets with scale above the lowermost empty or with flower; culms round to markedly compressed _____ **E. macrostachya**

1. Culms 2 mm or less wide; spikelet usually distinctly thicker than the supporting culm; septa usually not present along the culms.
   8. Spikelets tiny, 1–2 mm thick in flower excluding styles or stamens, 2–9(–10) mm long; culms usually thread-like, typically 0.1–1 mm wide.
      9. Scales ± 2-ranked, the spikelets flattish, usually with only 2–4(–9) scales; tubercle ca. 1/3 or more the length of the achene _____ **E. baldwinii**
      9. Scales spirally arranged, the spikelets not flattish, with (3–)5–numerous scales; tubercle usually smaller (1/3 or less the length of the achene) or not distinct (except longer in *E. vivipara*).
         10. Surface of achenes with a number of distinct ribs or ridges running lengthwise with fine perpendicular lines between the ribs.
            11. Culms strongly flattened, 2-edged, the edges with numerous minute teeth visible at 10×–30× magnification; spikelets (3–)5–9 mm long, with 15–34 scales; scales of spikelets (2.2–)2.7–3.2 mm long _____ **E. wolfii**
            11. Culms circular in cross section or nearly so; spikelets usually 2–6 mm long, usually with 5–15 scales; scales of spikelets 1.5–2.5(–3.5) mm long.
               12. Culms usually 0.6–1 mm wide, spongy, without prominent ridges or angles, becoming wrinkled upon drying, 1–12 cm tall; anthers 0.3–0.5 mm long _____ **E. radicans**
               12. Culms usually 0.15–0.5(–0.7) mm wide, often with prominent lengthwise ridges or angles, not wrinkled upon drying, 2–25(–60) cm tall; anthers 0.5–1.5 mm long.
                  13. Achenes 0.5–0.7 mm long; scales of spikelet 1.5–1.7 mm long; culms 0.15–0.3 mm wide _____ **E. reverchonii**
                  13. Achenes 0.7–1.1 mm long; scales of spikelet 1.5–2.5(–3.5) mm long; culms 0.2–0.5(–0.7) mm wide _____ **E. acicularis**
         10. Surface of achenes without longitudinal ribs or ridges.
            14. Achenes trigonous (= 3-angled), sometimes bluntly so, to nearly round in cross section (a few sometimes biconvex), 0.5–1.5 mm long, variously colored but not dark reddish black to black; styles 3-branched (a few sometimes 2-branched).
               15. Achenes coarsely honey-combed reticulate (use hand lens or dissecting scope); leaf sheaths purplish red basally _____ **E. tenuis**
               15. Achenes smooth to finely reticulate; leaf sheaths various basally, sometimes purplish red, often not so.
                  16. Tubercle usually not differentiated from achene, blending into achene so that the junction is not visible (appearing as though tubercle not present); achenes 0.8–1.1 mm long _____ **E. parvula**

16. Tubercle well-differentiated from achene, the junction with achene clearly visible; achenes 0.5–0.8(–0.9) mm long.
    17. Achenes finely reticulate (use dissecting scope); tubercle > 1/3 length of achene; distal leaf sheath apex with a reddish marginal band _____ **E. vivipara**
    17. Achenes smooth; tubercle < 1/3 length of achene; distal leaf sheath apex without a reddish marginal band.
        18. Tubercle covering most of summit of achene; achenes often broadest ± at or near the middle; spikelets with lowermost scale similar to other scales _____ **E. minima**
        18. Tubercle tiny, perched on summit of achene and not covering most of it; achenes broadest above the middle; spikelets with lowermost scale different from other scales, usually longer and often resembling an involucral bract.
            19. Lowermost scale of spikelet (= scale at base of spikelet) with apex subacute to acute or with the midvein excurrent _____ **E. microcarpa**
            19. Lowermost scale of spikelets with apex rounded _____ **E. brittonii**
14. Achenes biconvex in cross section (= convex on both sides, ± lens-shaped), variously colored, including dark reddish black to black at maturity; styles usually 2-branched.
    20. Distal leaf sheaths with apex inflated, loose, often conspicuously wrinkled, frequently disintegrating, usually not purplish red at base; plants perennial, delicately rhizomatous and mat-forming; spikelets ellipsoid _____ **E. flavescens**
    20. Distal leaf sheaths with apex tightly sheathing, neither wrinkled nor disintegrating, sometimes purplish red at base; plants annual, tufted, not rhizomatous; spikelets ellipsoid to ovoid to nearly orbicular.
        21. Spikelets ellipsoid to lance-ovoid; achenes 0.3–0.6 mm long; perianth bristles white to nearly colorless; culms 2–15(–25) cm tall _____ **E. atropurpurea**
        21. Spikelets ovoid to nearly orbicular; achenes 0.5–1.1 mm long; perianth bristles usually red-brown (rarely whitish); culms 4–45 cm tall _____ **E. geniculata**

8. Spikelets usually larger, 1.8–5 mm thick in flower, 3–25 mm or more long; culms coarsely threadlike, wiry, or thickened, to 2 mm wide.
    22. Achenes biconvex in cross section (= convex on both sides, ± lens-shaped); styles usually 2-branched; stigmas usually 2.
        23. Plants annuals with only fleshy-fibrous roots, pulled up easily.
            24. Scales of spikelets definitely acute (= pointed); spikelets narrowly lanceoloid, acute to acuminate _____ **E. lanceolata**
            24. Scales of spikelets obtuse; spikelets lanceoloid to broadly ovoid to oblong-ovoid or nearly orbicular, obtuse to acute.
                25. Tubercle much narrower than summit of achene, 0.1–0.2 mm wide, somewhat constricted basally and thus slightly separated from achene, light-colored _____ **E. geniculata**
                25. Tubercle nearly as wide as summit of achene, 0.5–1 mm wide, in outline merging with achene, dark-colored.
                    26. Spikelets broadly ovoid to oblong-ovoid and obtuse, mostly 3–12 mm long; bristles mostly surpassing the tubercle; tubercle 1/3–nearly 1/2 as high as achene, 0.35–0.5 mm long _____ **E. obtusa**
                    26. Spikelets mostly lanceoloid and acute, usually 5–18(–20) mm long; bristles shorter than to barely reaching tip of tubercle; tubercle short, not more than 1/4 as high as achene, 0.1–0.3 mm long _____ **E. engelmannii**
        23. Plants perennials with rhizomes, often very difficult to pull up (and underground parts often lost), the rhizomes sometimes purplish red.

27. Spikelets relatively short, only (1.5–)3–7(–9) mm long even with age; leaf sheaths and rhizomes usually not purplish red; distal leaf sheaths with apex inflated, loose, thin-membranous and transparent, often conspicuously wrinkled, frequently disintegrating; plants 42 cm or less tall ____ **E. flavescens**

27. Spikelets relatively long, usually at least (5–)7 mm long in flower, to 25 mm long with age; leaf sheaths and rhizomes usually purplish red; distal leaf sheaths with apex firm and opaque, neither inflated nor wrinkled, usually not disintegrating; plants to 115 cm tall.

    28. Culms round, internally hollow, completely and regularly septate with usually externally visible septa ca. 2–5 mm apart; scales of spikelet 100–500+ per spikelet, 1.5–2.7 mm long, 1–1.5 mm wide; achenes 0.7–1.1 mm long, the surface with a distinct finely reticulate pattern; tubercle 0.2–0.35 mm long; distal leaf sheath apex with a distinct tooth ____ **E. montana**

    28. Culms round to conspicuously flattened, spongy internally; scales of spikelet 15–100 per spikelet, 2–5.5 mm long, 1.5–2.5 mm wide; achenes (0.9–)1.1–1.9 mm long, the surface ± smooth in appearance; tubercle 0.3–0.7 mm long; distal leaf sheath apex with OR without a distinct tooth.

        29. Lowermost scale of spikelets clasping 2/3(–3/4) of culm; all spikelets with scale above the lowermost empty; culms round or slightly compressed ____ **E. palustris**

        29. Lowermost scale of spikelets clasping 3/4 to all of culm; scale above the lowermost with flower or empty; culms round to markedly compressed.

            30. Scale above the lowermost scale of some spikelets empty; lowermost scale of some or all spikelets usually clasping less than all of culm; culms round to markedly compressed; anthers 1.3–2.7 mm long ____ **E. macrostachya**

            30. Scale above the lowermost scale of all spikelets with flower; lowermost scale of all spikelets clasping all of culm (amplexicaulous); culms round; anthers 1–1.8 mm long ____ **E. erythropoda**

22. Achenes trigonous (= 3-angled), sometimes bluntly so, to nearly rounded (definitely not biconvex) in cross section; styles 3-branched; stigmas 3.

    31. Tubercle huge, ca. as long and wide as achene; achenes coarsely honey-combed reticulate ____ **E. tuberculosa**

    31. Tubercle much smaller than achene; achenes smooth to finely reticulate to coarsely honey-combed reticulate.

        32. Surface of achenes with a number of distinct ribs or ridges running lengthwise, with fine horizontal lines between the ribs ____ **E. wolfii**

        32. Surface of achenes smooth, without longitudinal ribs or ridges.

            33. Achenes widest at apex, truncate, black or nearly so, with the tubercle flattish across the entire apex (sometimes slightly wider than the achene) and with a small central point; apex of distal leaf sheath truncate, with an abrupt awl-shaped tooth; spikelets sometimes proliferating ____ **E. melanocarpa**

            33. Achenes not widest at apex, not truncate, variously colored, the tubercle narrower, not stretching across the entire apex; apex of distal leaf sheath various; spikelets not proliferating except in *E. rostellata* and *E. vivipara*.

                34. Achenes constricted at summit to form a distinct narrow neck 0.2–0.3 mm long; species rare in East TX, known only from Hardin Co. ____ **E. elongata**

                34. Achenes variously shaped, often somewhat narrowed apically, but without a distinct narrow neck; including species widespread and common in East TX.

35. Tubercle not constricted at its base, ± continuous with achene, tapering into achene so that the junction is not structurally distinct (however, there can be a distinct color change); culms sometimes elongating and their spikelets rooting to form new plants _____ **E. rostellata**
35. Tubercle constricted at its base, not continuous with achene, the junction with achene clearly distinct structurally; culms not rooting at tips (spikelets) to form new plants.
    36. Achenes coarsely honey-combed reticulate (use hand lens or dissecting scope).
        37. Achenes 0.6–0.9 mm long; spikelets 3–6 mm long; leaf sheaths purplish red basally; rhizomes purplish red _____ **E. tenuis**
        37. Achenes 1.2–1.7(–2.4) mm long; spikelets (4–)6–14 mm long; leaf sheaths straw-colored to greenish basally; rhizomes not purplish red _____ **E. tortilis**
    36. Achenes smooth to finely reticulate.
        38. Scales of spikelets with long-pointed scarious tips, some or all tips usually bifid or notched.
            39. Rhizomes not easily observed, obscured by the persistent dead culm bases; all (including lowermost) scales of spikelets bifid _____ **E. occulta**
            39. Rhizomes evident; lowermost scale of spikelets entire __ **E. compressa**
        38. Scales of spikelets with rounded or broadly short-pointed tips that are not bifid or notched (but sometimes split and thus apparently bifid).
            40. Plants annual, without rhizomes; achenes 0.5–0.6 mm long; leaf sheaths usually pale brown to brownish or green basally _____ **E. brittonii**
            40. Plants perennial, with rhizomes; achenes 0.6–1.2 mm long; leaf sheaths brownish to yellowish or often purplish red basally.
                41. Leaf sheaths usually yellowish to brownish basally; spikelets 3–7(–9) mm long, usually proliferating vegetatively (plantlets sprouting from the spikelets); tubercles 0.2–0.5 mm tall _____ **E. vivipara**
                41. Leaf sheaths usually purplish red basally (sometimes brownish in *E. albida*); spikelets 4–14 mm long, not proliferating vegetatively; tubercles 0.1–0.3 mm tall.
                    42. Apex of distal leaf sheath light-colored marginally, angled to a point on one side but without an abrupt tooth; achenes smooth under magnification _____ **E. albida**
                    42. Apex of distal leaf sheath with a red or brown margin, ± perpendicular to culm, usually with an abrupt awl-shaped tooth on one side; achenes often with minute patterning under magnification.
                        43. Scales of spikelets broadly rounded apically (sometimes split and thus apparently notched); tubercles ca. as tall as wide; culms spongy internally; species widespread in East TX _____ **E. montevidensis**

43. Scales of spikelets usually acute or subacute apically; tubercles distinctly wider than tall; culms hollow with complete transverse septa 2–4 mm apart (these are evident only upon internal examination of culm); species known in East TX only from Guadalupe Co. at s margin of area _____ **E. ravenelii**

Eleocharis acicularis (L.) Roem. & Schult., (needle-shaped), NEEDLE SPIKE-RUSH, SLENDER SPIKE-RUSH, LEAST SPIKE-RUSH. Small perennial often forming mats, with hair-like rhizomes; culms 2–23(–60) cm tall, rounded to slightly flattened, usually with 4–12 angles or ridges; distal leaf sheath apex membranous, nearly truncate to angled on one side to a broad point; spikelets usually 2–6 mm long, ovoid to lanceoloid or subcylindric, usually with 5–15 scales (and thus flowers); achenes bluntly trigonous, 0.7–1.1 mm long, with a number of distinct ribs or ridges running lengthwise and many fine horizontal lines between the ribs, usually pearly white; tubercle small, 0.2 mm or less long. Damp soils, often on receding shorelines, sometimes submerged; Henderson, Leon (BRIT), Bastrop, Bexar, Fannin, Gonzales, San Jacinto, Travis, and Walker (Turner et al. 2003) cos.; scattered in TX; throughout Canada and the U.S. May–Aug, sporadically to Oct. [*E. acicularis* var. *gracilescens* Svenson, *E. acicularis* var. *porcata* S.G. Sm.; *E. acicularis* var. *submersa* (Nilsson) Svenson] This species is reported to be "able to grow in acidic runoff from Appalachian coal mines and flourish in streams with pH as low as 2.8" (Tucker 1987). Yatskievych (1999) reported that mats of this species "can grow so densely as to inhibit the establishment of other aquatic species. ..." "It is abundant and ecologically important throughout much of its range" (Smith et al. 2002). Smith et al. (2002) also noted that "Submerged, usually nonflowering plants are abundant throughout much of the range of the species." The variant, sometimes recognized as *E. acicularis* var. *porcata,* is sometimes mistaken for *E. wolfii* (Smith 2001, 2002d).

Eleocharis albida Torr., (white), WHITE SPIKE-RUSH. Rhizomatous perennial forming mats; culms 40 cm or less tall; distal leaf sheath apex light-colored marginally, angled to a point on one side, but without an abrupt tooth; spikelets 4–12 mm long, oblong to oblong-subcylindric, with 20–100 scales; achenes trigonous, 0.8–1 mm long, ripening dark brown; tubercles 0.2–0.3 mm long. Marshes, ditches, other wet areas; Hardin Co. (Turner et al. 2003); mainly Gulf Prairies and Marshes; se U.S. from MD s to FL w to TX, also NM. Summer.

Eleocharis atropurpurea (Retz.) J. Presl & C. Presl, (dark purple), PURPLE SPIKE-RUSH. Tufted annual; culms 2–15(–25) cm tall; distal leaf sheath apex angled on one side to a point; spikelets 2–6(–8) mm long, ellipsoid to lance-ovoid, with (10–)40–80(–100) scales; achenes biconvex, 0.3–0.6 mm long, dark reddish black to black at maturity; tubercle tiny, 0.2 mm or less long, perched on summit of achene. Lake and pond margins, ditches, and other wet areas; Bastrop, DeWitt, Hays, and Montgomery (Turner et al. 2003) cos.; sparsely scattered elsewhere in TX; sw Canada and widely scattered in the U.S. Jun–Sep. [*Scirpus atropurpureus* Retz.]

Eleocharis baldwinii (Torr.) Chapm., (for its discoverer, William Baldwin, 1779–1819, Pennsylvania botanist and physician), BALDWIN'S SPIKE-RUSH. Delicate tufted annual or perennial [?], stoloniferous, mat-forming; culms thread-like, 3–20(–30) cm tall, often arching; distal leaf sheath apex angled on one side to a broad point; spikelets flattish, 2–7 mm long, with few (2–4(–9)) scales, the spikelets often proliferating vegetatively; pistillate spikelets often present at base of plant; scales of spikelets ± 2-ranked, folded along the midrib and thus boat-like; achenes trigonous, ca. 0.5–0.9 mm long, whitish buffy to olive, grayish olive, or brownish olive; tubercle conic-subulate, 0.2–0.3(–0.4) mm long. Submerged to emergent in lakes, ponds, or other wet areas; scattered in East TX; se U.S. from NC s to FL w to AR and TX. End of Apr–Oct. [*E. capillacea* of authors, not Kunth]

Eleocharis brittonii Svenson ex Small, (for Nathaniel Lord Britton, 1859–1934, botanist at NY Botanical Garden), BRITTON'S SPIKE-RUSH. Tufted annual similar to *E. microcarpa*; culms 37 cm or less tall; spikelets ca. 2–10 mm long, ellipsoid to ovoid, with 13–76 scales, sometimes proliferating vegetatively; lowermost scale of spikelet different from other scales, usually longer and often resembling an involucral bract, rounded apically; achenes trigonous, ca. 0.5–0.6 mm long; tubercles tiny, 0.1 mm or less long. Wet areas including ponds and swamps, sometimes emergent; Austin, Hardin, Houston, Jasper, Montgomery, and Newton (S.G. Smith, pers. comm. of data from Jeremy Bruhl) cos.; also n Gulf Prairies and Marshes and Hockley Co. in the High Plains; because distributional data for this species was obtained after map pages for the flora were completed, no county distribution map is provided; se U.S. from SC s to FL w to MO and TX. Spring–fall. [*E. microcarpa* var. *brittonii* (Svenson ex Small) Svenson] This species has sometimes been included in the similar *E. microcarpa* (e.g., Correll & Johnston 1970). Without (or even with) achenes the two are often difficult to distinguish. Bruhl and Smith (2002) indicated that preliminary phenetic studies suggest some plants from the se U.S. (FL w to TX), while related to *E. brittonii*, may represent another entity warranting taxonomic recognition; TX plants at this time might thus better be called *Eleocharis* aff. *brittonii*. However, until further study is done, we are treating the TX plants as *E. brittonii*.

Eleocharis cellulosa Torr., (from the cellular surface of the achene), GULF COAST SPIKE-RUSH. Tufted rhizomatous perennial; culms erect, to 80 cm tall, (1–)3–5 mm wide; distal leaf sheath apex narrowed on one side to a triangular point, this with an abrupt awl-like tip; spikelets cylindric, usually 19–36(–50) mm long and (3–)3.5–5.6 mm thick, with many scales; scales of spikelets 3–4.4 mm wide, broadly rounded, with a darker (brownish to reddish) submarginal band; achenes biconvex, ca. 2–2.8 mm long, light brown; tubercle not at all basally constricted, appearing as a continuation of the achene, 0.1–0.5 mm long. Mud, wet areas, shorelines; Grayson (BRIT), Gonzales, Guadalupe, Jefferson, and Orange (Turner et al. 2003) cos., also Burnet Co. (S.D. Jones, pers. comm.) in Cross Timbers and Prairies, Gulf Prairies and Marshes, and Edwards Plateau; se U.S. from SC s to FL w to AR and TX. Spring–fall.

Eleocharis compressa Sull., (flattened), COMPRESSED SPIKE-RUSH, FLAT-STEM SPIKE-RUSH. Rhizomatous perennial forming mats; culms strongly flattened or not so, 8–28(–45) cm tall; distal leaf sheath apex nearly truncate; spikelets 3–8(–12) mm long, narrowly oblong or cylindric to narrowly elliptic to ovoid, with 20–60 scales; scales with long-pointed scarious tips (often bifid, except tip of lowermost scale of spikelet is entire); achenes trigonous, 0.8–1.2 mm long, yellow to golden brown to brown; tubercle small, 0.3 mm or less long. The two varieties of *E. compressa* have in the past been recognized as distinct species by most authorities. However, we are following Smith (2002d) who indicated that the two taxa intergrade completely and are most appropriately recognized at the varietal level.

1. Culms usually several-angled or -ribbed, not strongly flattened, 0.3–0.8 mm wide, 2 times or less wider than thick _____ var. **acutisquamata**
1. Culms strongly flattened, 0.5–1.8 mm wide, 2–5 times wider than thick _____ var. *compressa*

var. **acutisquamata** (Buckley) S.G. Sm., (with sharp-pointed, small, scale-like bracts or leaves), SHARP-SCALE SPIKE-RUSH. Pond margins or low areas of prairies, calcareous soils; scattered in East TX; also n Gulf Prairies and Marshes, Cross Timbers and Prairies, and Edwards Plateau; sw Canada and c U.S. Late Mar–May(–Jul). [*E. acutisquamata* Buckley] A newly described species, *Eleocharis occulta*, was recently segregated from this taxon (Smith 2001).

var. *compressa*, COMPRESSED SPIKE-RUSH, FLAT-STEM SPIKE-RUSH. Loamy usually moist soils, often calcareous conditions. According to S.D. Jones (pers. comm.), var. *compressa* occurs to the e and n and apparently does not reach TX; he indicates that TX material identified as var. *compressa* is actually var. *acutisquamata*. Brown and Marcus (1998) also did not find any TX material of *E.*

compressa and indicated that all TX specimens examined were referable to *E. acutisquamata*. In addition, Smith (2002d) did not consider var. *compressa* to occur in TX; the closest occurrence is in AR. We, likewise, have not found TX material but have included the variety here as a note for clarification. S Canada and widespread in the e 1/2 of the U.S. Spring. [*E. elliptica* Kunth var. *compressa* (Sull.) Drapalik & Mohlenbr.]

Eleocharis elongata Chapm., (elongate), SLIM SPIKE-RUSH. Rhizomatous perennial; culms to 80 cm tall; distal leaf sheath apex angled to a point on one side, often prolonged into a translucent portion to 1 mm long; spikelets (6–)9–24 mm long, with 7–26 scales; scales usually with a conspicuous brown to blackish submarginal band; achenes usually ± trigonous, ca. 0.7–1.5 mm long, constricted at summit to form a distinct narrow neck; tubercles 0.2–0.5 mm long. Usually in water, lake and pond margins; known in TX only from Hardin Co. (BRIT; Correll 1972a); AL, FL, NC, and TX. May–fall. *Eleocharis elongata* often forms submersed plants with numerous filiform flaccid culms without spikelets (González-Elizondo 2002). While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

Eleocharis engelmannii Steud., (for George Engelmann, 1809–1884, German-born botanist and physician of St. Louis), ENGELMANN'S SPIKE-RUSH. Annual similar to *E. obtusa* and perhaps not specifically distinct from it (e.g., Yatskievych 1999); distinguished as in the key to species. Shores of lakes and ponds, marshes; scattered in East TX; also Hood Co. (BRIT) in the Cross Timbers and Prairies and Gillespie Co. (Turner et al. 2003) in e Edwards Plateau; s Canada and widespread in the U.S. Spring–fall. [*E. engelmannii* var. *detonsa* A. Gray, *E. engelmannii* var. *monticola* (Fernald) Svenson, *E. engelmannii* var. *robusta* Fernald, *E. monticola* Fernald, *E. obtusa* (Willd.) Schult. var. *detonsa* (A. Gray) Drapalik & Mohlenbrock; *E. ovata* (Roth) Roem. & Schult. var. *detonsa* (A. Gray) Mohlenbr., *E. ovata* var. *engelmannii* (Steud.) Britton] This species has sometimes been combined with *E. obtusa* (e.g., Mahler 1988), and intermediates are known between the two species (Smith 2002d).

Eleocharis equisetoides (Elliott) Torr., (resembling *Equisetum*, horsetail), HORSETAIL SPIKE-RUSH. Coarse rhizomatous perennial; culms hollow and completely and regularly transverse septate, 60–100 cm tall, nodulose for their whole length (use hand lens to see knob-like structures on the culm); distal leaf sheath apex membranous, angled to a point to abruptly acuminate on one side; spikelets (15–)20–40(–55) mm long, the numerous scales persistent (unusual in that most species shed their scales as the fruits mature); achenes 1.8–2.5 mm long, biconvex to obscurely trigonous, yellowish to brownish or reddish brown, obscurely sculptured to nearly smooth when viewed with a hand lens; tubercle narrowly conic, < 1/2 length of achene, 0.6–1.2 mm long. Usually in water, edges of lakes or ponds and other wet areas; widespread in s 1/2 of East TX; se Canada and widespread in e 1/2 of the U.S., also CA. May–Jul(–Sep). This species is reported to be closely related to the Asian *E. dulcis* (WATER-CHESTNUT), with the pair representing an example of e Asian–e North American disjunct distribution (Wood 1970; Tucker 1987). This distribution pattern is discussed under the genus *Brachyelytrum* (Poaceae). *Eleocharis equisetoides* is often mistaken for *E. interstincta*.

Eleocharis erythropoda Steud., (red-footed), COW-KILL, POVERTY-GRASS. Perennial with rhizomes, mat-forming; culms terete, to 80 cm tall, 0.3–1.4 mm wide; distal leaf sheath apex slightly angled, sometimes with a minute tooth; spikelets 3–18 mm long, ovoid to lanceoloid or nearly cylindric, with 15–50 scales; achenes biconvex, 0.9–1.6 mm long, dark yellow to straw-colored or dark brown; tubercle 0.35–0.65 mm long. Shorelines and other wet areas; included based on citation for TX by Smith (2002d); also, according to S.D. Jones (pers. comm.), *E. erythropoda* is present along the TX-LA border and in the Rolling Plains; however, we have seen no East TX specimens and only tentatively include it as a member of the flora. Widespread in Canada and

the U.S. Summer. This species is part of the very difficult "*E. palustris* complex," which in TX is reported to include *E. erythropoda*, *E. macrostachya*, and *E. palustris* (Smith 2002d)—see *E. macrostachya* and *E. palustris* for further discussion. Due to uncertainty regarding species limits, all TX members of the *E. palustris* complex are mapped together as *E. palustris*; no separate county distribution map is provided for *E. erythropoda*. [*E. calva* Torr.—an invalid name, *Scirpus glaucus* Torr.] This species is apparently avoided by cattle, hence the common names (Catling 1994). Hybrids with *E. compressa* have been reported from Canada (Catling 1994).

Eleocharis flavescens (Poir.) Urb., (yellowish), PALE SPIKE-RUSH, YELLOW SPIKE-RUSH, WRINKLE-SHEATH SPIKE-RUSH. Perennial with elongate rhizomes 0.5–1 mm thick, delicately mat forming; culms 4–42 cm tall; distal leaf sheath with apex loose, thin-membranous and transparent, often conspicuously wrinkled, frequently disintegrating; spikelets (1.5–)3–7(–9) mm long, ellipsoid, with up to 65 scales; achenes biconvex, (0.4–)0.6–1.1 mm long; tubercle small, 0.2–0.7 mm long. Throughout the growing season. This species is similar to and can be confused with the annual *E. geniculata* (which has the apex of the leaf sheaths firm and opaque) (Godfrey & Wooten 1979). Menapace (2002) noted that the varieties "are difficult to delimit, especially in the south, and identifications of some specimens to variety are problematic."

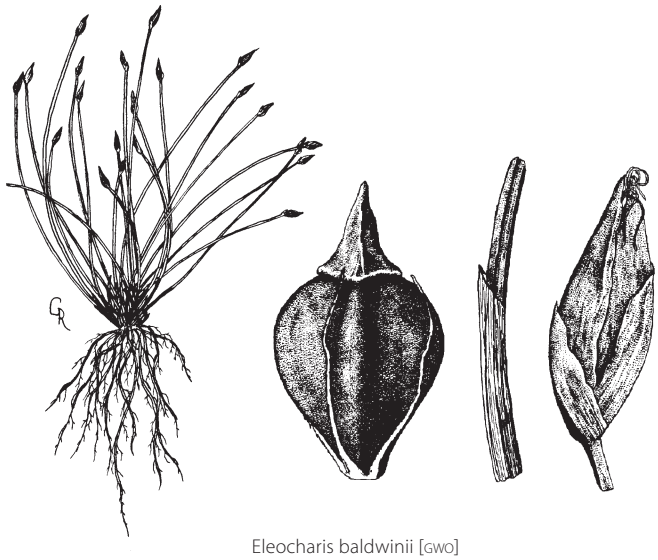
1. Achenes reddish just prior to maturity, dark brown to dark purplish black to nearly black at maturity, only rarely highly constricted just below tubercle; perianth bristles usually as long as achenes or shorter, sometimes vestigial _____ var. **flavescens**
1. Achenes green to almost brown, often highly constricted just below tubercle; perianth bristles usually longer than achenes (often to twice as long) _____ var. **olivacea**

var. **flavescens**, PALE SPIKE-RUSH. Culms to 42 cm tall; scales of spikelets brown to yellow-brown. Wet areas, sometimes in brackish conditions; sparsely distributed in e 1/2 of TX; se U.S. from VA s to FL w to AR and TX, also scattered in w 1/3 of the U.S. Jun–Oct. [*E. flaccida* (Rchb.) Urb.]

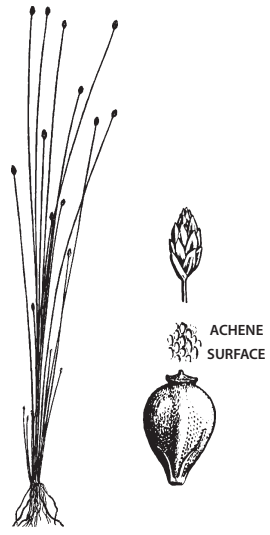
var. **olivacea** (Torr.) Gleason, (olive-colored, greenish or greenish-brown), GREEN SPIKE-RUSH, BRIGHT GREEN SPIKE-RUSH. Culms to 28 cm tall; scales of spikelets brown streaked with green. Margins of lakes and ponds, marshes, bogs, and other wet areas; Anderson, Cherokee, Houston (BRIT), Bastrop, Gonzales, Leon, and Milam (Turner et al. 2003 as *E. olivacea*) cos.; also extreme s TX; se Canada and widespread in the e 1/2 of the U.S. Jul–Oct. [*E. olivacea* Torr., *E. olivacea* var. *reductiseta* (Schuyler & Ferren) Schuyler & Ferren] This variety has often been treated as a separate species (e.g., Godfrey & Wooten 1979; Hatch et al. 1990; Kartesz 1999; Turner et al. 2003). However, due to the morphological similarities, we are following Menapace (2002) in treating it as a variety of *E. flavescens*.

Eleocharis geniculata (L.) Roem. & Schult., (jointed, bent like the knee), CAPITATE SPIKE-RUSH, BENT SPIKE-RUSH. Tufted annual 4–45 cm tall; distal leaf sheath apex angled on one side to a sharp point; spikelets (1–)3–6(–9) mm long, ovoid to broadly ovoid or nearly orbicular, usually with 28–50(–many) scales; achenes biconvex, 0.5–1.1 mm long, black or purplish black; tubercle small, 0.2–0.4 mm long. Moist calcareous soils, seeps, shores; mainly on w and s margins of East TX, also Angelina and Brazos (Turner et al. 2003) cos.; widespread in TX except Plains Country; se Canada and scattered in the U.S. except the nw. Throughout the growing season. [*E. caribaea* (Rottb.) S.F. Blake, *Scirpus geniculatus* L.] The name *E. caribaea* has often been used for this species (e.g., Hatch et al. 1990), but according to Menapace (2002), that name "is considered by most contemporary authorities to be misapplied." ⊠/285

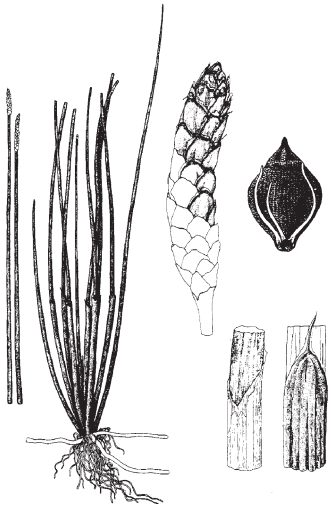
Eleocharis interstincta (Vahl) Roem. & Schult., (with a space between, interval), KNOTTED SPIKE-RUSH. Coarse rhizomatous perennial; culms hollow, completely and regularly transversely septate, 40–100 cm tall, sometimes nodulose (knobby) toward sheath, but not just below spikelet; distal leaf sheath apex angled on one side to a point; spikelets 22–45(–60) mm long, with numerous scales; achenes biconvex, 1.4–2.2 mm long, noticeably sculptured when viewed with a



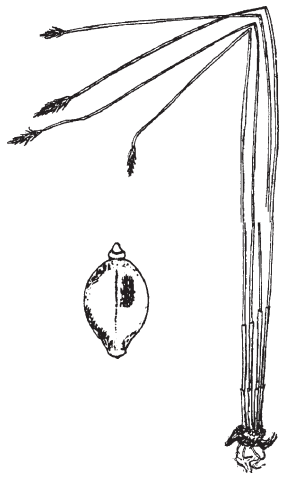
Eleocharis baldwinii [GWO]



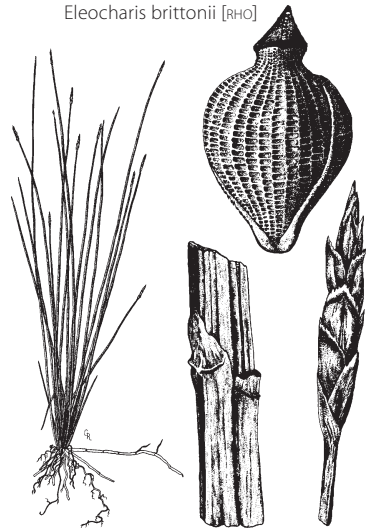
Eleocharis brittonii [RHO]



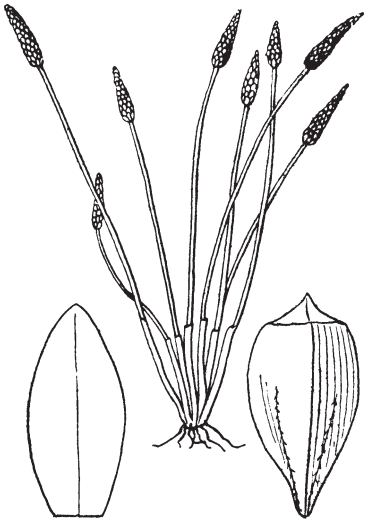
Eleocharis cellulosa [GWO]



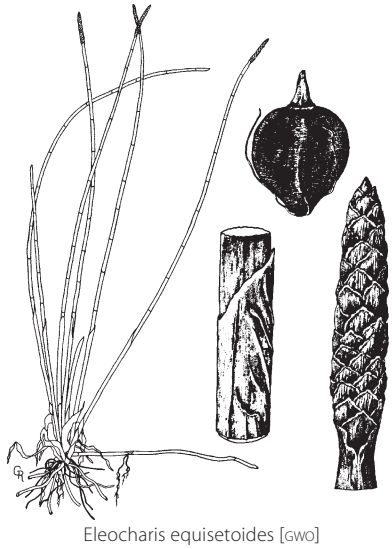
Eleocharis compressa var. acutisquamata [RHO]



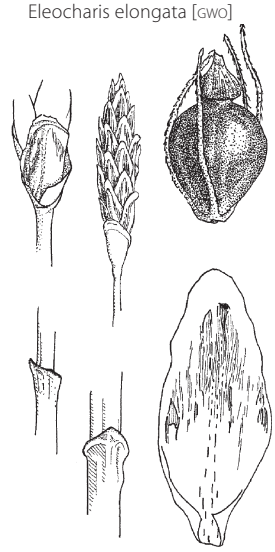
Eleocharis elongata [GWO]



Eleocharis engelmannii [ABR]



Eleocharis equisetoides [GWO]



Eleocharis erythropoda [FNA]

hand lens; tubercle long conic, ca. 1/2–3/4 the length of the achene. Usually in water, edge of ponds, lakes, other wet areas; Brazos, Jasper, Montgomery, and Walker (Turner et al. 2003) cos.; also scattered in s part of TX; FL, OK, and TX. Apr–Oct. [*Scirpus interstinctus* Vahl] *Eleocharis interstincta* is often mistaken for *E. equisetoides*.

Eleocharis lanceolata Fernald, (lanceolate, lance-shaped), LANCE-SPIKE SPIKE-RUSH, LANCE-LIKE SPIKE-RUSH, DAGGER-LEAF SPIKE-RUSH, LANCE-LEAF SPIKE-RUSH. Tufted annual 10–20(–40) cm tall; distal leaf sheath apex angled to a tooth-like point on one side; spikelets 3–8(–12) mm long, narrowly lanceoloid, acute to acuminate, with 25–100 scales; scales definitely acute; achenes biconvex, 0.8–1.2 mm long, brownish; tubercle not basally constricted, merging in outline with achenes, 0.5 mm or less long. Ditches, pond margins, other wet areas, sandy soils; Red River, Robertson (BRIT), Bowie, Grayson (Correll & Johnston 1970), Lamar (Carr 1994), Anderson, Kaufman, and Marion (Turner et al. 2003) cos.; also Wise Co. (Turner et al. 2003) in Cross Timbers and Prairies; apparently rare in TX; mainly sc U.S. (AR, KS, LA, MO, OK, TN, and TX). Summer–fall. [*E. obtusa* (Willd.) Schult. var. *lanceolata* (Fernald) Gilly]

Eleocharis macrostachya Britton, (large-spiked), PALE SPIKE-RUSH. Perennial with long rhizomes, mat-forming; culms to 100 cm tall, terete to markedly compressed (often conspicuously flattened), 0.5–2.5(–3.5) mm wide; distal leaf sheath apex truncate or slightly angled, sometimes with a distinct tooth; spikelets 5–40 mm long, narrowly lanceoloid to ovoid, with 30–80 scales; achenes biconvex, 1.1–1.9 mm long, yellow brown to dark brown at maturity; tubercle 0.35–0.7 mm long. Wet soils or shallow water, sometimes extremely abundant; Dallas, Grayson, Limestone, Robertson, and Van Zandt (BRIT) cos.; widespread in Canada and nearly throughout the U.S. except the far se. This species is part of the very difficult "*E. palustris* complex," which in TX includes *E. erythropoda*, *E. macrostachya*, and *E. palustris* (Smith 2002d). In the past, all TX members of the complex were treated as a single species, either as *E. macrostachya* (e.g., Correll & Johnston 1970) or as *E. palustris* (Jones et al. 1997; Diggs et al. 1999). Smith (2002d), however, recognized three species as occurring in the state. All East TX material at BRIT most closely fits *E. macrostachya*. While we are tentatively following Smith (2002d) in recognizing all three species, we are not fully convinced that the minor morphological differences warrant recognition at the species level—the differences do not seem as great as between other species in the genus. If all members of the complex were synonymized, the oldest name, *E. palustris* (basionym named by Linnaeus in 1753), would need to be used. In addition, Smith (2002d) stated that *E. macrostachya* (in the narrow sense) is extremely variable and perhaps a diploid-polyploid compex, and he described 3 "variants" for North America. He noted that one of these variants (*E. xyridiformis*), which is widespread in Texas, "almost certainly deserves taxonomic recognition, perhaps as a species." This variant is characterized by culms markedly flattened and with a tooth on the uppermost leaf sheaths of some or all culms. Further work on this entire group is clearly needed before there is certainty about the appropriate taxa to recognize in TX. Due to uncertainty regarding species limits, all TX members of the *E. palustris* complex are mapped together as *E. palustris*; no separate county distribution map is provided for *E. macrostachya*. Mostly spring–summer. [*E. perlonga* Fernald & Brackett; *E. xyridiformis* Fernald & Brackett]

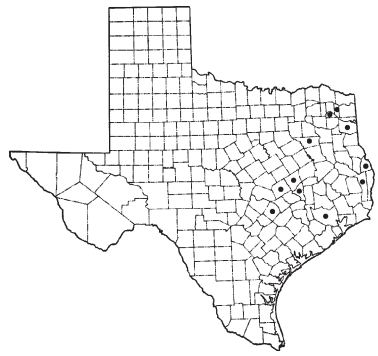
Eleocharis melanocarpa Torr., (black-fruited), BLACK-FRUIT SPIKE-RUSH. Tufted perennial; culms 10–70 cm tall, often arching or decumbent; distal leaf sheath apex truncate, with an abrupt awl-shaped tooth; spikelets (3–)6–15 mm long, sometimes proliferating; achenes trigonous, 0.8–1.2 mm long, widest at apex, truncate, black or nearly so; tubercle trigonous, flattish across the entire apex (sometimes slightly wider than the achene) and with a small central point. Marshy areas, pond margins, ditches, acidic soils; Upshur (BRIT), Burleson, and Leon (Turner et al. 2003) cos.; scattered in the e U.S. w to MI and TX. Spring–summer. This species sometimes proliferates by rooting from the culm tip (Radford et al. 1968). While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠



Eleocharis albida



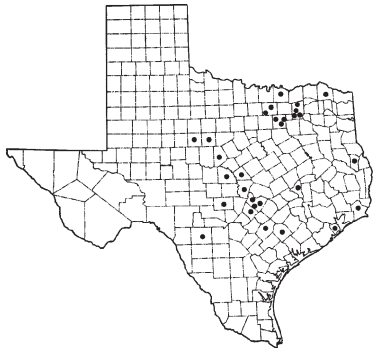
Eleocharis atropurpurea



Eleocharis baldwinii



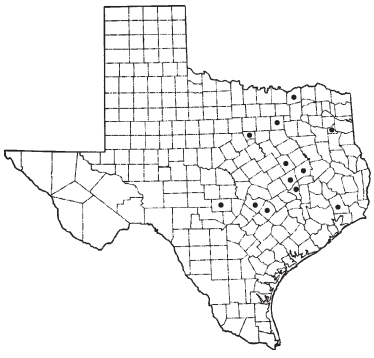
Eleocharis cellulosa



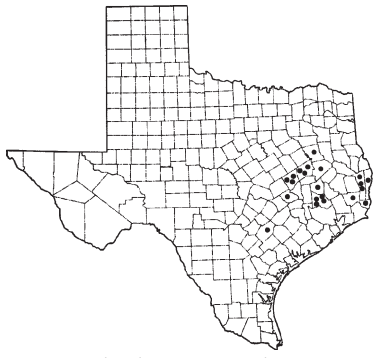
Eleocharis compressa var. acutisquamata



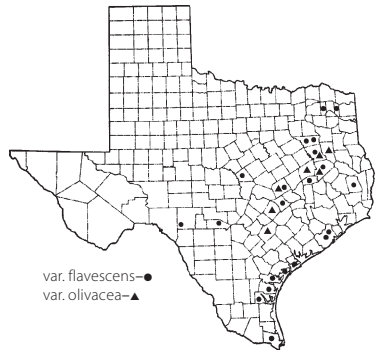
Eleocharis elongata



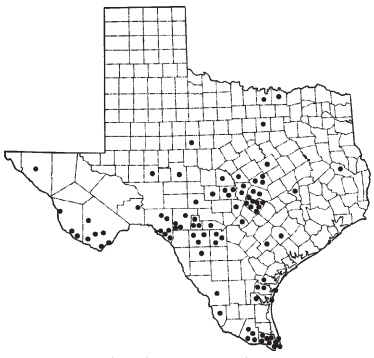
Eleocharis engelmannii



Eleocharis equisetoides



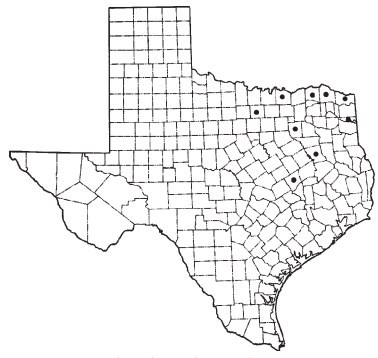
Eleocharis flavescens



Eleocharis geniculata



Eleocharis interstincta



Eleocharis lanceolata

Eleocharis microcarpa Torr., (small-fruited), SMALL-FRUIT SPIKE-RUSH, SMALL-SEED SPIKE-RUSH. Tufted annual; culms thread-like, (2–)10–40 cm tall; distal leaf sheath apex translucent, angled on one side to a rather long point; spikelets ca. 1.5–5(–10) mm long, sometimes proliferating vegetatively, lanceoloid to ellipsoid to ovoid, with lowermost scale different from other scales, usually longer and often resembling an involucral bract, subacute to acute; achenes trigonous to subterete, 0.5–0.8 mm long, pearly white to pale greenish gray or pale brown, sometimes with mottling or streaking; tubercle tiny, 0.1–0.3 mm long, perched on summit of achene and not covering most of it. Savannahs, ditches, shores of lakes, other wet areas; widespread in Pineywoods and Post Oak Savannah; also n Gulf Prairies and Marshes; e U.S. w to MI and TX. Apr–Nov. [*E. microcarpa* var. *filiculmis* Torr., *E. torreyana* Boeck.] Bruhl and Smith (2002) recognized two varieties in this species, and separated them as follows. According to Bruhl and Smith (2002), all TX plants are in var. *filiculmis*.

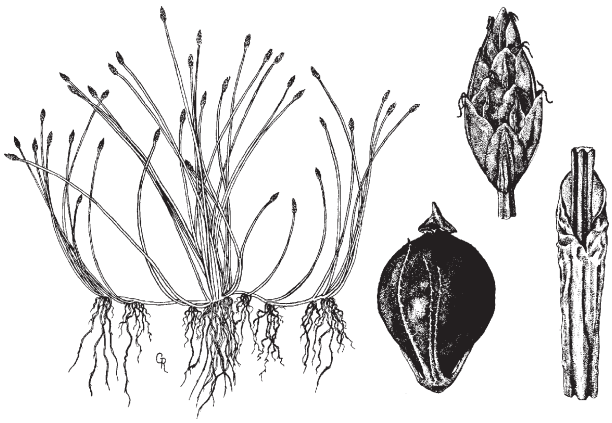
1. Perianth bristles 0.2–0.4 mm, shorter than achene; proximal scale of spikelets 0.4–0.5 mm wide _____ var. *microcarpa*

1. Perianth bristles 0.6–1 mm, as long as achene; proximal scale of spikelets 0.8–1 mm wide _____ var. *filiculmis*

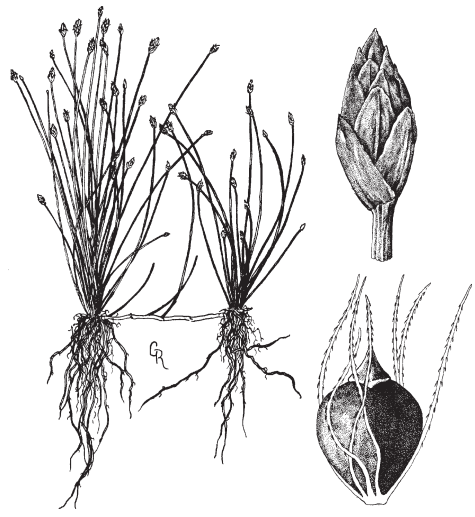
Eleocharis minima Kunth, (least, smallest), SMALL SPIKE-RUSH. Tufted annual, stoloniferous, forming mats; culms 3–7(–13) cm tall; distal leaf sheath apex translucent, angled on one side to a rather long-pointed apex; spikelets 2–5(–7) mm long, ovoid or ellipsoid, with (4–)10–28 scales, compressed laterally when young, becoming terete with age, sometimes proliferating vegetatively; achenes trigonous, 0.6–0.8 mm long, greenish to pale or reddish brown, often spotted; tubercle covering most of summit of achene, 0.1–0.3 mm long. Shallow water, lake shores and other wet areas; Henderson, Smith (BRIT), Bastrop, Marion, Newton, and Rusk (Turner et al. 2003) cos.; also Gulf Prairies and Marshes; FL, MD, and TX. Apr–Oct. [*E. minima* var. *ambigua* (Steud.) Kük., *Isolepis ambigua* Steud.] Bruhl and Smith (2002) noted that this species is sometimes confused with *E. baldwinii*.

Eleocharis montana (Kunth) Roem. & Schult., (pertaining to mountains), MOUNTAIN SPIKE-RUSH. Rhizomatous perennial, tufted or mat-forming; culms 20–55(–70) cm tall, hollow and completely and regularly septate with usually externally visible septa ca. 2–5 mm apart; distal leaf sheath apex truncate or nearly so, with a distinct tooth; spikelets 6–24 mm long, ovoid, with 100 or more small scales only 1–1.5 mm wide; achenes mostly biconvex, 0.7–1.1 mm long; tubercle 0.2–0.35 mm long. Ponds, margins of swamps, ditches, other wet areas; Hardin, Harris, Jasper, Jefferson, Montgomery (BRIT), Brazos, Liberty, Orange, and Waller (Turner et al. 2003) cos.; also n Gulf Prairies and Marshes; AL, AR, FL, GA, LA, and TX. Apr–Oct. [*E. nodulosa* (Roth) Schult., *E. montana* var. *nodulosa* (Roth) Svenson, *Scirpus montana* Kunth] This species is similar to *E. ravenelii* (which usually has trigonous achenes), and according to Smith (2002d), "The taxonomy of the septate-culmed species ... *Eleocharis montana* and *E. ravenelii* should be evaluated." Intermediates are also known between *E. montana* and *E. montevidensis* (Smith 2002d).

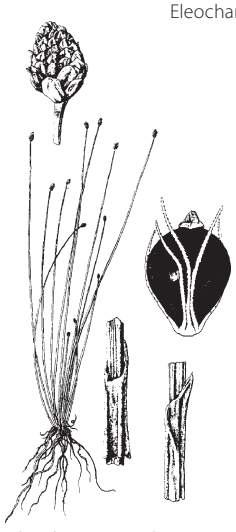
Eleocharis montevidensis Kunth, (of Montevideo, Uruguay, where the type was collected), SAND SPIKE-RUSH. Rhizomatous perennial 10–50 cm tall; distal leaf sheath apex with a red or brown margin, ± perpendicular to culm, with an abrupt awl-shaped tooth on one side; spikelets 3–14 mm long, variable in shape, ovoid to ellipsoid to subcylindric or lanceoloid, with 24–70(–110) scales; scales broadly rounded apically (sometimes split and thus apparently notched), usually wrinkled and recurved; achenes subtrigonous, 0.7–1.2 mm long, dark brown to almost blackish; tubercle ± conic, 0.3 mm or less long. Low ground, sandy or clay soils; widespread nearly throughout TX; s part of the U.S. from NC to CA. Late Mar–early Jul. [*E. arenicola* Torr., *E. montana* (Kunth) Roem. & Schult. subsp. *montevidensis* (Kunth) Osten, *E. palmeri* Svenson] According to Smith (2002d), the name *E. montana* was for many years misapplied to *E. montevidensis*.



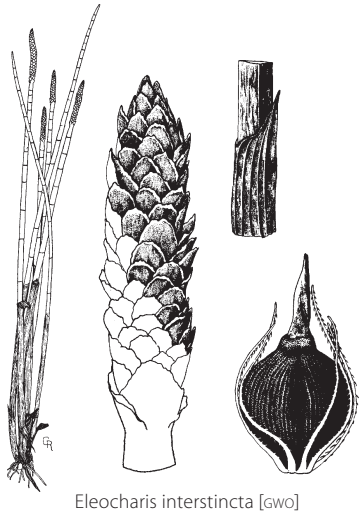
Eleocharis flavescens var. flavescens [GWO]



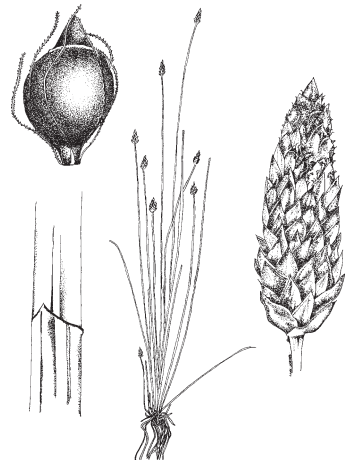
Eleocharis flavescens var. olivacea [GWO]



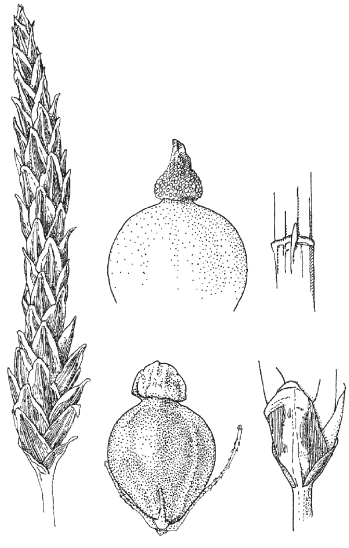
Eleocharis geniculata [GWO]



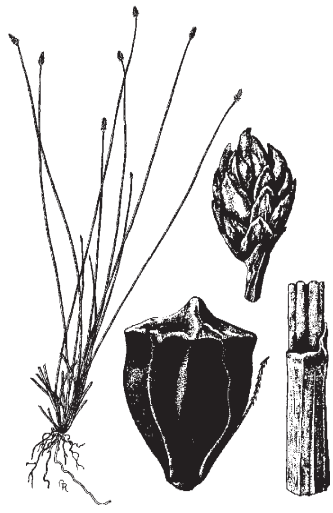
Eleocharis interstincta [GWO]



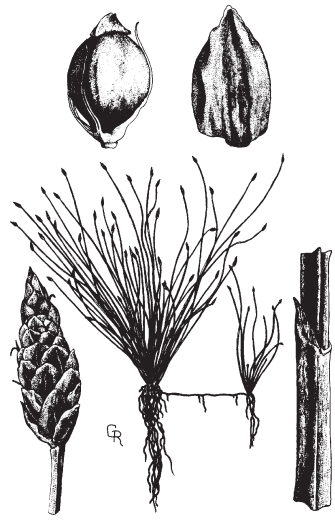
Eleocharis lanceolata [BT2]



Eleocharis macrostachya [FNA]



Eleocharis melanocarpa [GWO]



Eleocharis microcarpa [GWO]

Eleocharis obtusa (Willd.) Schult., (obtuse, blunt), BLUNT SPIKE-RUSH. Tufted annual 3–50 cm tall; distal leaf sheath apex angled to a short broad point with a minute tooth 0.3 mm or less long; spikelets ca. 3–12 mm long, usually broadly ovoid to oblong-ovoid, obtuse, usually with (15–)50–150 scales; stamens usually 3; styles usually both 2-fid and 3-fid in same spikelet; achenes mostly biconvex, 0.8–1.2(–1.5) mm long, pale to dark brown; tubercle 0.35–0.5 mm long, nearly as wide as summit of achene. Moist sandy soils, pond margins; widespread in East TX; also e Cross Timbers and Prairies, e Edwards Plateau, and Ochiltree Co. (Turner et al. 2003) in the Panhandle; s Canada and widespread in the U.S., more commonly in the e 1/2 of the country. Late Apr–Oct. [*E. ovata* (Roth) Roem. & Schult. var. *obtusa* (Willd.) Kük., *Scirpus obtusus* Willd.] Yatskievych (1999), following Gleason and Cronquist (1991), submerged this species and *E. engelmannii* into *E. ovata* (Roth) Roem. & Schult. (the oldest valid name for the complex), thus recognizing the taxonomically confusing *E. ovata* complex as a single species. He indicated that in Missouri he had been unable to find consistent differences between the three species. However, we are following Larson and Catling (1996) and the recent treatment in *Flora of North America* (Smith 2002d) in recognizing *E. obtusa* as a distinct species. Smith (2002d) noted that *E. ovata* "consistently differs in its mostly 2-fid styles, mostly two stamens, and especially its narrower tubercles [1/2–3/4 as wide as achene]." Intermediates with *E. engelmannii* also are known (Smith et al. 2002).

Eleocharis occulta S.G. Sm., (hidden, in reference to the rhizomes being concealed by the culm bases). Tufted rhizomatous perennial; culms 56 cm or less tall; distal leaf sheath apex truncate or nearly so; spikelets 3–10 mm long, ovoid, with 20–50 scales; scales with long-pointed scarious tips, all including the lowermost 2-fid apically; achenes obscurely trigonous, 0.7–1 mm long, medium to dark brown; tubercles tiny, 0.15 mm or less long. Seeps and other wet areas, often on calcareous soils; scattered in East TX, more commonly on w margin of area; also Cross Timbers and Prairies and e Edwards Plateau; endemic to OK and TX. Mar–Jul. This recently described (Smith 2001) species was long considered part of *E. acutisquamata* (which is here treated as *E. compressa* var. *acutisquamata*); these two similar species differ as indicated in the key. According to Smith (2002d), "*Eleocharis occulta* is very invariable in contrast to the extreme variability of *E. compressa*."

Eleocharis palustris (L.) Roem. & Schult., (marsh-loving), COMMON SPIKE-RUSH, MARSH SPIKE-RUSH. Rhizomatous perennial, mat-forming; culms terete or slightly compressed, 30–115 cm tall, 1.5–4.5 mm wide; distal leaf sheath apex angled to a short broad point; spikelets 5–25 mm long, with 30–100 scales; achenes biconvex, 1.1–1.9 mm long, straw-colored to dark brown; tubercle 0.3–0.7 mm long, basally constricted. Wet soils or shallow water; included based on citation for TX by Smith (2002d); we have seen no East TX material that is undisputedly *E. palustris* and thus only tentatively include the species as a member of the flora. However, the "*E. palustris* complex" (see discussion below and map) is found nearly throughout TX; widespread in Canada and throughout most of the U.S. except the extreme se. May–Jun, sporadically to Oct. This species is part of the very difficult "*E. palustris* complex," which in TX includes *E. erythropoda*, *E. macrostachya*, and *E. palustris* (Smith 2002d). Smith (2002d) noted that preliminary work indicates that "unstable chromosome structure and number as well as interspecific hybridization contribute to the taxonomic complexity of the *E. palustris* complex." See *E. macrostachya* for more discussion. Due to uncertainty regarding species limits, all TX members of the *E. palustris* complex are tentatively mapped together as *E. palustris* (which is the oldest name). The characters used in the key to separate *E. erythropoda*, *E. macrostachya*, and *E. palustris* are from Smith (2002d)—further research will be needed to determine their applicability to TX material, and it is possible that in the future only a single species will be recognized in the state. [*Scirpus palustris* L., *E. smallii* Britton]

Eleocharis parvula (Roem. & Schult.) Link ex Bluff, Nees, & Schauer, (very small), DWARF SPIKE-RUSH, SMALL SPIKE-RUSH, LITTLE-HEAD SPIKE-RUSH. Plant often very small, 2–7(–12) cm tall, form-

ing mats; rhizomes short, terminating in small tubers (0.5–1.5 mm in diam.); distal leaf sheath apex thinly membranous, often disintegrating, angled to a short broad point on one side; spikelets often very small, 2–5(–6) mm long, with 6–25 scales; achenes trigonous, 0.8–1.1 mm long including confluent tubercle, straw-colored to light to dark brown; tubercle scarcely recognizable as separate except under high magnification, 0.3 mm or less long. In mud, often in alkaline soils; widely scattered in TX; s Canada and widespread in the U.S. Apr–Aug. [*E. coloradoensis* (Britton) Gilly, *E. parvula* var. *coloradoensis* (Britton) Beetle, *E. parvula* var. *anachaeta* (Torr.) Svenson, *Scirpus coloradoensis* Britton, *Scirpus nanus* Spreng., *Scirpus parvulus* Roem. & Schult.] While we are not separating it pending further study (following Yatskievych 1999), Smith (2002d) distinguished *E. coloradoensis* and indicated that it, rather than *E. parvula*, occurs in TX. He separated this taxon from *E. parvula* as follows:

1. Perianth bristles present or very rarely absent, the longer equaling achene or exceeding tubercle; tubers (except buds) oblong, usually markedly curved; achenes smooth or faintly rough at 30×; floral scales 6–10 per spikelet _____ *E. parvula*
1. Perianth bristles absent or not more than 1/2 length of achene; tubers (except buds) obovoid to orbicular, not markedly curved, 0.7–1.5 mm thick; achenes clearly rugulose at 10× to finely rough at 30×; floral scales 6–25 per spikelet _____ *E. coloradoensis*

Eleocharis quadrangulata (Michx.) Roem. & Schult., (four-angled), SQUARE-STEM SPIKE-RUSH. Coarse rhizomatous perennial; culms erect, to 80(–150) cm tall, distinctly 4-sided, with incomplete transverse septa; distal leaf sheath apex with one side long acute to acuminate; spikelets linear-cylindric, usually (15–)20–42(–50) mm long, with (28–)40–90(–135) scales, the scales often persistent (unusual in that most species shed their scales as the fruits mature); achenes biconvex, ca. 2–3 mm long, usually yellowish to brown, reticulate when observed with a hand lens; tubercle longer than broad, 0.7–1.5 mm long, constricted basally, often dark though sometimes whitish. Mud, lake margins; widespread in e 1/2 of TX; se Canada (Ont.) and most of the e U.S., also CA and OR. Apr–Sep. [*E. quadrangulata* var. *crassior* Fernald, *Scirpus quadrangulatus* Michx.] ⊠/285

Eleocharis radicans (Poir.) Kunth, (rooting), ROOTED SPIKE-RUSH. Diminutive rhizomatous perennial, forming mats; culms very soft and spongy, 1–12 cm tall; distal leaf sheath with apex membranous, blunt; spikelets 2–3(–4) mm long, ovoid, with 5–15 scales; anthers very small, 0.3–0.5 mm long; achenes obscurely trigonous to subterete, 0.7–0.9 mm long, grayish to brownish, longitudinally ridged, with many fine horizontal lines between the ridges; tubercles ca. 0.15 mm long. Margins of lakes, bogs, seeps, other wet areas, sometimes submerged; Harris, Leon (BRIT), Gonzales, Grayson, Red River, and Robertson (Turner et al. 2003) cos.; AZ, CA, FL, LA, MI, OK, TX, and VA. Apr–Nov. [*E. acicularis* (L.) Roem. & Schult. var. *radicans* (Poir.) Britton, *E. lindheimeri* Svenson, *Scirpus radicans* Poir.]

Eleocharis ravenelii Britton in Small, (for its collector, H.W. Ravenel, 1814–1887), RIO GRANDE SPIKE-RUSH, SOUTH TEXAS SPIKE SEDGE. Perennial, with rhizomes, but these often not obvious; culms 20–55 cm tall, hollow, with complete septa internally, but these not visible externally; distal leaf sheath apex with a red or brown margin, ± perpendicular to culm, with an abrupt awl-shaped tooth on one side; spikelets 5–13 mm long, lanceoloid, with 10–100 scales, these 1–1.5 mm long; achenes compressed trigonous or some biconvex, 0.6–0.8 mm long, green to brown; tubercle 0.1–0.2 mm long, wider than long. Seasonally wet areas, ditches, low woods; Guadalupe Co. (Turner et al. 2003 as *E. austrotexana)* near sw margin of East TX; otherwise known in TX from only a few counties in the Gulf Prairies and Marshes and South TX Plains (Carr 2001; Turner et al. 2003); in the U.S. known only from TX. Spring-fall. [*E. austrotexana* M.C. Johnst.] This species has long gone under the name of *E. austrotexana* (e.g., Correll & Johnston 1970; Hatch et al. 1990). However, Smith (2002d) indicated that the holotype of *E. ravenelii* appears conspecific with *E. austrotexana*. We are therefore following Smith (2002d) in using the older

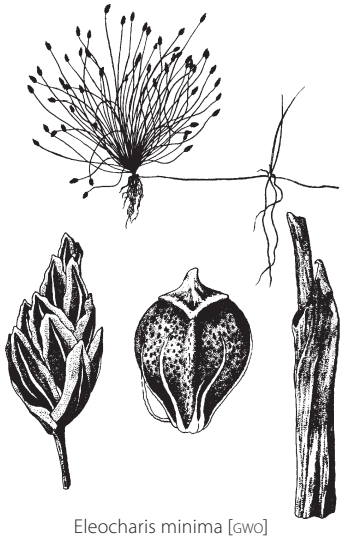
name *E. ravenelii*. Smith (2002d) noted that this species is apparently very uncommon, and that it closely resembles and is sometimes mistaken for slender-stemmed individuals of *E. montana*; that species can be distinguished by its spikelet scales 1.5 mm or more long and 100–500 per spikelet, its mostly larger and biconvex achenes, and its culm septa usually visible externally. Carr (2001) and Poole et al. (2002) recognized *E. austrotexana* and considered it a TX endemic and of conservation concern (G3, S3). While we are synonymizing *E. austrotexana* with *E. ravenelii*, because of its rareness in the state, we still consider the taxon to be of conservation concern in TX. ⚠

Eleocharis reverchonii Svenson, (for Julien Reverchon, 1837–1905, a French-American immigrant to Dallas and important botanical collector of early TX), REVERCHON'S SPIKE-RUSH. Perennial, rhizomatous (though not always evident); culms 25 cm or less tall; distal leaf sheath with apex blunt; spikelets 2–6 mm long, ovoid, with 5–15 scales, rarely proliferating (Smith 2002d); achenes trigonous, 0.5–0.7 mm long, longitudinally ridged, with many horizontal lines between the ridges; tubercle 0.15 mm or less long. Open wet areas; Dallas, Upshur (BRIT), Bastrop, Bexar, Caldwell, and Travis (Turner et al. 2003) cos.; sparsely scattered elsewhere in TX; apparently endemic to TX (Smith 2002d). Feb–Apr. This species is sometimes synonymized with *E. acicularis* (e.g., Correll & Johnston 1970; Hatch et al. 1990; Diggs et al. 1999) and Smith (2002d) noted that it "perhaps should be treated as a variety or subspecies of *E. acicularis*." However, we are following the recent treatment in Smith (2002d) who recognized it as a distinct species; he also indicated that it is of conservation concern. 🇪 ⚠

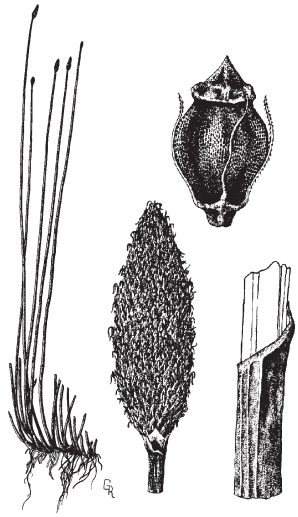
Eleocharis rostellata (Torr.) Torr., (with a small beak), BEAKED SPIKE-RUSH. Densely tufted and stoloniferous perennial, mat-forming; culms 25–80(–100) cm tall, some (stolons) arching or decumbent and taking root at the tip; distal leaf sheath with apex angled to a broad short point on one side; spikelets (5–)8–20 mm long, ovoid, sometimes proliferous, with 20–40 scales; achenes trigonous, variable, 1.5–1.8(–2.5) mm long; tubercle 0.5 mm or less long, ± appearing as a continuation of the achene, sometimes rudimentary or absent. Marshes, shorelines, other wet areas, brackish or alkaline conditions; Travis (BRIT), DeWitt, Gonzales, and Hays (Turner et al. 2003) cos. near s margin of East TX; mainly w 1/2 of TX; s Canada and widespread in the U.S. Apr–Aug. [*Scirpus rostellatus* Torr.] Smith (2002d) noted that this species can be highly competitive, sometimes forming large monospecific colonies.

Eleocharis tenuis (Willd.) Schult. var. **verrucosa** (Svenson) Svenson (sp.: slender; var.: covered with warts), SLENDER SPIKE-RUSH. Rhizomatous perennial, mat-forming; distal leaf sheath apex truncate or slightly angled to a broad short point on one side, rarely with a minute tooth; culms ca. 5–40 cm tall; spikelets 3–6 mm long, ovoid, with 20–60 scales; achenes trigonous, 0.6–0.9 mm long, honey-combed when examined with hand lens; tubercles depressed. Ditches, other wet areas; scattered in Pineywoods and Post Oak Savannah; also in n Gulf Prairies and Marshes; widespread in e 1/2 of the U.S. Mar–Jun. [*E. capitata* (L.) R. Brown var. *verrucosa* Svenson, *E. verrucosa* (Svenson) L.J. Harms] Yatskievych (1999) treated this taxon as a distinct species (*E. verrucosa*). However, according to Smith (2002d), "Harms used chromosome number as a basis for raising *Eleocharis tenuis* var. *verrucosa* to a species (L.J. Harms 1972), but he did not correlate chromosomes with morphology. There are too few chromosome number reports for use in defining taxa in the *E. tenuis* complex (A.E. Schuyler 1977)." Of the three varieties recognized in North America, only var. *verrucosa* is known to occur in TX (Smith 2002d).

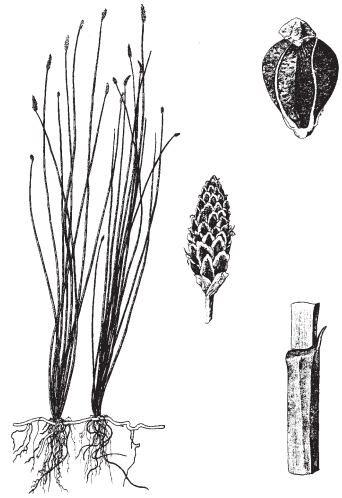
Eleocharis tortilis (Link) Schult., (twisted), TWISTED SPIKE-RUSH. Clump-forming perennial, with ascending rhizomes; culms 15–80 cm tall; distal leaf sheath with apex angled to a short point on one side; spikelets (4–)6–14 mm long, ovoid to lanceoloid or ellipsoid, with 10–25 scales; perianth bristles retrorsely barbed; achenes trigonous, 1.2–1.7(–2.4) mm long, coarsely honeycombed reticulate; tubercle 0.3–0.7(–1) mm long. Bogs, seeps, ditches, other wet places, sometimes emergent; widespread in East TX; se U.S. from MD s to FL w to AR and TX. May–Oct. [*Scirpus tortilis* Link] Smith (2002d) noted that "*Eleocharis tortilis* differs consistently from *E.*



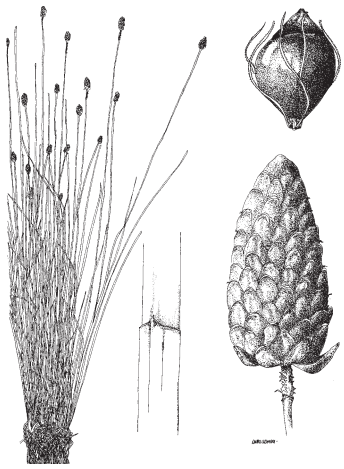
Eleocharis minima [GWO]



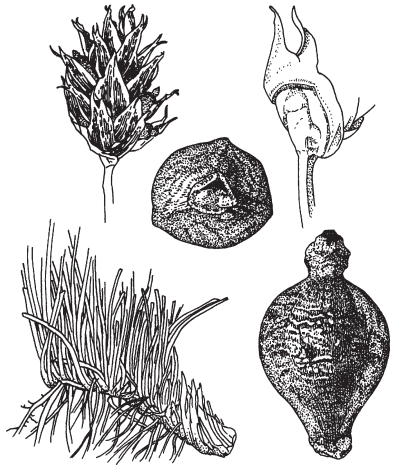
Eleocharis montana [GWO]



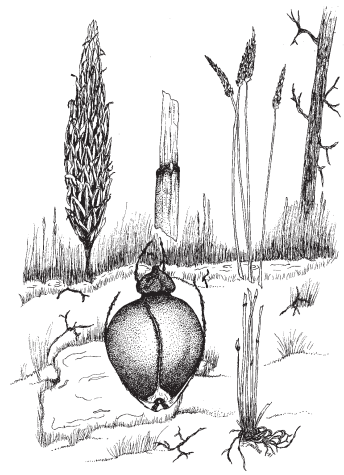
Eleocharis montevidensis [GWO]



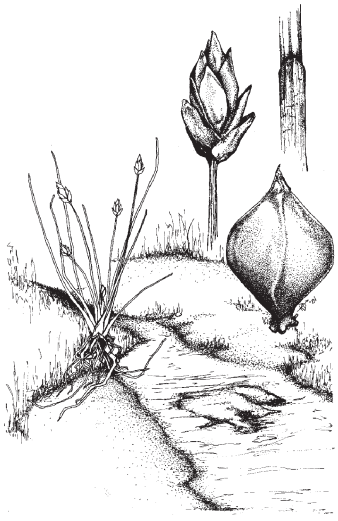
Eleocharis obtusa [BT2]



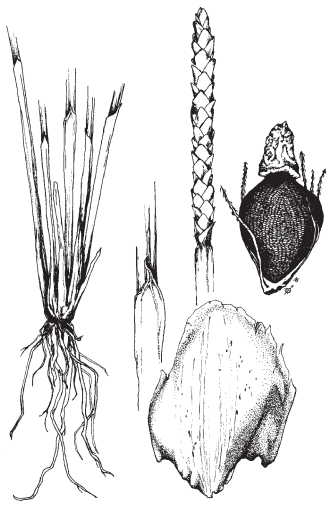
Eleocharis occulta [NOV]



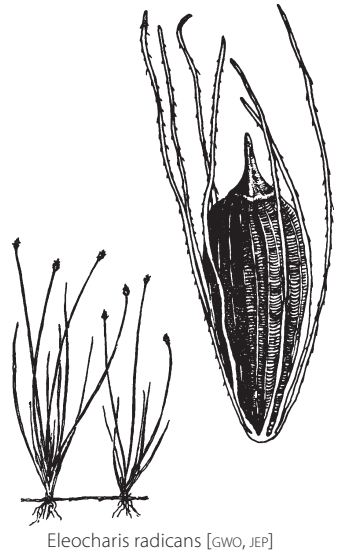
Eleocharis palustris [BT2]



Eleocharis parvula [BT2]



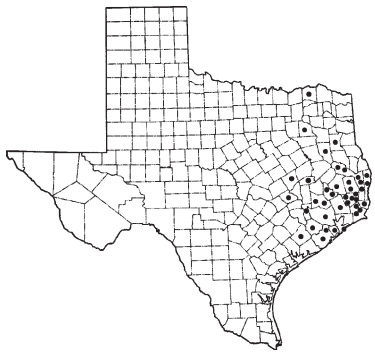
Eleocharis quadrangulata [BT2]



Eleocharis radicans [GWO, JEP]



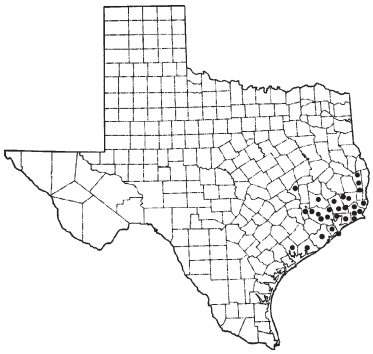
Eleocharis melanocarpa



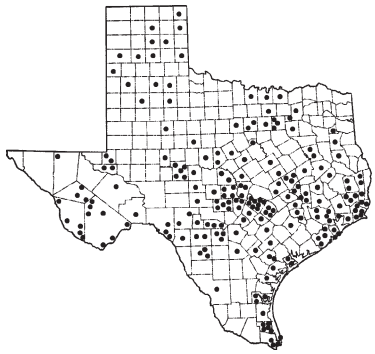
Eleocharis microcarpa



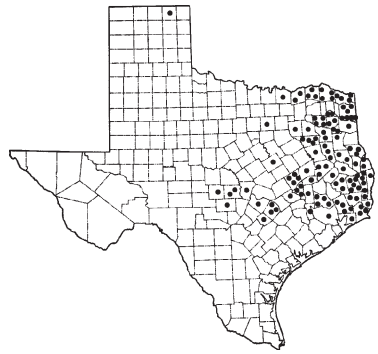
Eleocharis minima



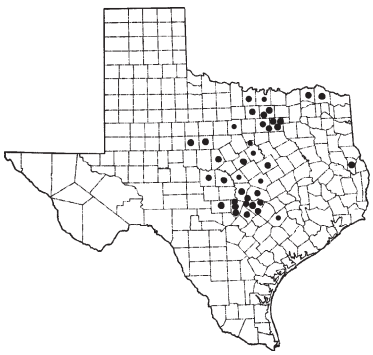
Eleocharis montana



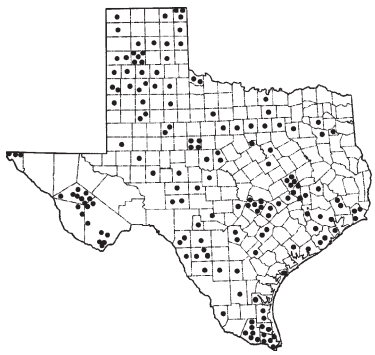
Eleocharis montevidensis



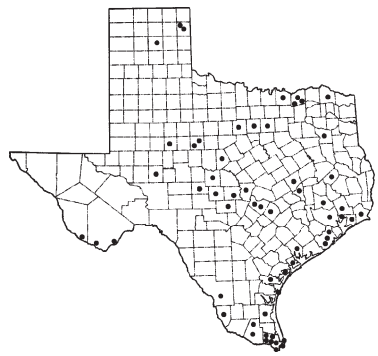
Eleocharis obtusa



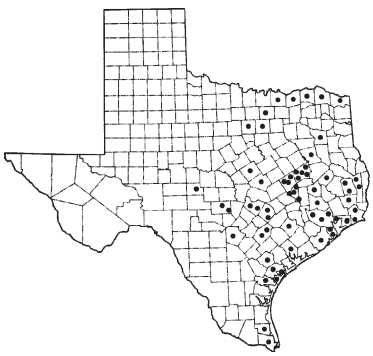
Eleocharis occulta



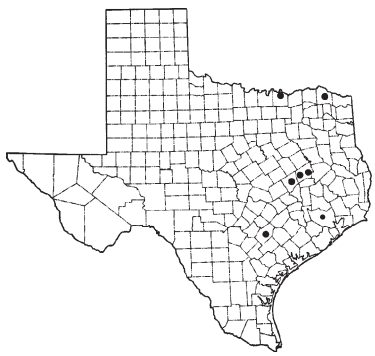
Eleocharis palustris



Eleocharis parvula



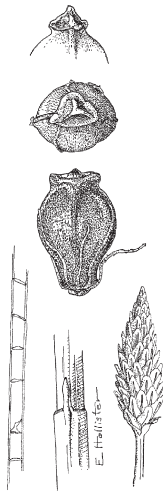
Eleocharis quadrangulata



Eleocharis radicans



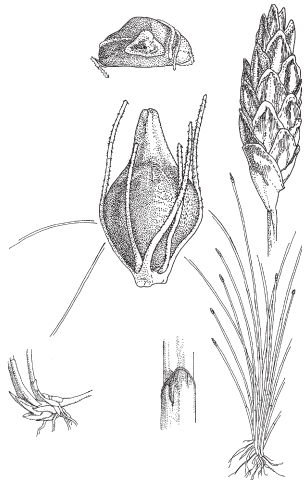
Eleocharis ravenelii



Eleocharis ravenelii [FNA]



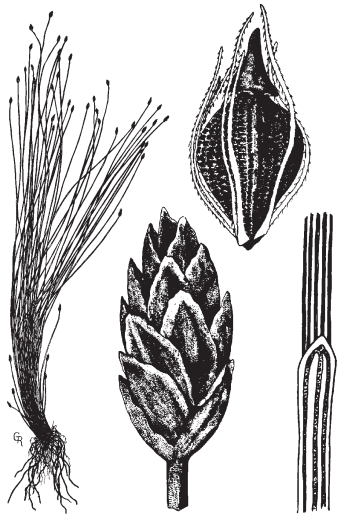
Eleocharis reverchonii [FNA, RHO]



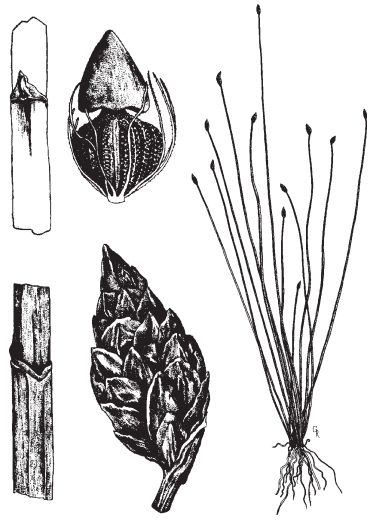
Eleocharis rostellata [FNA]



Eleocharis tenuis var. verrucosa [FNA]

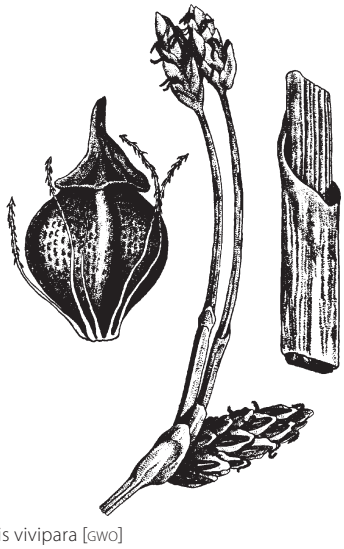


Eleocharis tortilis [GWO]



Eleocharis tuberculosa [GWO]





Eleocharis vivipara [GWO]



Eleocharis wolfii [GLE]

tuberculosa only in tubercle size. Most specimens of *E. tortilis* have culms that are sharply trigonous and no more than 0.5 mm wide. However, about two-thirds of the specimens of *E. tortilis* from Texas resemble *E. tuberculosa* in having culms that are elliptic or subelliptic in cross section and that sometimes reach 1 mm wide. Those elliptic-culmed plants may deserve taxonomic recognition."

Eleocharis tuberculosa (Michx.) Roem. & Schult., (with a tubercle), CONE-CAP SPIKE-RUSH. Clump-forming perennial, rhizomatous or not so; culms 15–80 cm tall; distal leaf sheath with apex angled to a short point on one side; spikelets 5–15 mm long; ovoid, with 10–30 scales; perianth bristles with barbs varying from divaricate to antrorse to retrorse; achenes trigonous, 0.9–1.5(–1.7) mm long, brownish; tubercle huge, ca. as large as achene, 0.9–1.7(–2.4) mm long. Lake and pond margins, bogs, other wet areas, sometimes emergent; widespread in the Pineywoods; also Gulf Prairies and Marshes; mainly se U.S. from NC s to FL w to AR and TX, also se Canada, MA and NJ. Apr–Oct. [*E. tuberculosa* var. *pubnicoensis* Fernald, *Scirpus tuberculosus* Michx.] According to Tucker (1987), this species "is distinctive in having perhaps the largest tubercle in any species of the genus—as large as the body of the mature achene."

Eleocharis vivipara Link, (viviparous, producing young plants instead of flowers), VIVIPAROUS SPIKE-RUSH, SPROUTING SPIKE-RUSH. Densely tufted and often stoloniferous perennial; culms (4–)7–30(–45) cm tall; distal leaf sheath with apex angled to a short point on one side, with a reddish marginal band; spikelets ca. 3–7(–9) mm long, ovoid to ellipsoid, with 5–25 scales, usually proliferous; achenes trigonous, 0.6–0.8(–0.9) mm long, finely reticulate to cancellate, often gray; tubercle 0.2–0.5 mm long, > 1/3 length of achenes. Pond margins, other wet areas, the plants aquatic, emergent, or terrestrial; Morris (BRIT), Anderson (*Holmes 12382 & Singhurst*; BAYLU), Jasper (*Holmes 12097 & Singhurst*; BAYLU), and Robertson (TAMU) cos.; se U.S. from NC s to FL w to TX. Apparently first cited for TX by Kessler and Starbuck (1983). While often not considered a member of the TX flora (e.g., Bruhl & Smith 2002; Turner et al. 2003), recent work by W. Holmes and J. Singhurst (pers. comm.) has confirmed the presence of the species in the state. Spring–fall. [*E. curtisii* Small] This species vegetatively proliferates apically (plantlets sprouting from the spikelets) and the culms act as stolons. According to Bruhl and Smith (2002), "Identification of vegetative (often aquatic) specimens is sometimes tentative. *Eleocharis vivipara* is often confused with *E. microcarpa* and *E. brittonii*, and sometimes with *E. baldwinii*. The red-spotted band at the sheath apex and the gray, cancellate achenes are characteristic of *E. vivipara*."

Eleocharis wolfii (A. Gray) A. Gray ex Britton, (for its discoverer, John Wolf, 1821–1897), WOLF'S SPIKE-RUSH. Rhizomatous perennial, forming mats; culms 10–30(–40) cm tall, to 1.2 mm wide, strongly flattened, the edges usually minutely toothed at 10×–30× magnification; distal leaf sheath with apex loose, ± pointed on one side; spikelets usually (3–)5–9 mm long, ovoid or lanceoloid, with 15–34 scales; achenes trigonous, 0.7–0.9(–1.1) mm long, longitudinally ridged, with many horizontal lines between ridges, usually white; tubercles small, 0.1–0.15 mm long. Ephemeral pools, wet depressions, other moist areas; Bowie, Morris (BRIT), and Jefferson (S.G. Smith, pers. comm.) cos.; also Burnet Co. to the w of East TX (S.G. Smith, pers. comm.); NY s to AL w to ND, CO, and TX. Apr–early summer. [*Scirpus wolfii* A. Gray] This species is sometimes confused with *E. acicularis*—however, *E. acicularis* can be distinguished by its ± round to slightly flattened or angled culms. *Eleocharis wolfii* is considered rare in a number of states (Kartesz 1999), and is possibly of conservation concern. ⚠

Eleocharis fallax Weatherby, (deceptive), CREEPING SPIKE-RUSH, was cited (apparently erroneously) for TX (Madison Co.) by Turner et al. (2003). Smith (2002d) considered this species to occur only in Nova Scotia, MA, and NJ. He noted that only three specimens had been observed from North America and indicated that its taxonomic status is problematic (possibly of hybrid origin). We have been unable to locate any TX material and therefore are not considering it a member of the East TX flora.

FIMBRISTYLIS Vahl FIMBRY

Annuals or perennials, usually cespitose, sometimes rhizomatous; leaves basal, filiform to linear; ligule of short hairs or absent; inflorescence a simple or compound, umbel-like cyme (sometimes referred to as an anthela) at end of flowering culm (scape), of peduncled or sessile spikelets, often subtended by a leafy involucre; scape usually longer than leaves; spikelets several–many-flowered; scales of spikelets spirally imbricate; flowers perfect; perianth absent; style base often dilated and fimbriate; stamens 1–3; achenes lenticular to biconvex, obovoid, or trigonous, often minutely reticulate-honey-combed, without a tubercle.

A genus of well over 100 to ca. 200 species, depending on circumscription, pantropical but with significant numbers in warm temperate regions (Tucker 1987; Kral 2002b). Most species grow in disturbed wet habitats (Kral 1971; Tucker 1987); some are used as copper indicators or for their fiber. *Abildgaardia*, *Bulbostylis*, and *Fimbristylis* share anatomical features not reported in any other Cyperaceae and are closely related. As a result, both *Abildgaardia* and *Bulbostylis* have sometimes been included in *Fimbristylis*, but the genera are separated by a number of characters (Kral 1971; Tucker 1987). Kral (1971) gave a detailed discussion of the relationships of these genera and the difficulty of generic delimitation in the Cyperaceae. (Latin: *fimbria*, a fringe, and Greek: *stylos*, pillar, column, or style, from the style being fringed with hairs in some species)

REFERENCES: Svenson 1957; Gordon-Gray 1971; Kral 1971, 2002b; Godfrey & Wooten 1979; Kolstad 1986a; Tucker 1987.

1. Styles 3-branched; achenes trigonous OR not so; spikelets usually 2–7 mm long; plants annual.
   2. Spikelets lanceolate to linear-oblong, usually 3–7 mm long, apically acute; scales of spikelets acute to acuminate; ligules of short hairs present; achenes trigonous, the surfaces not reticulate or only faintly so, smooth or warty especially at base ____ **F. autumnalis**
   2. Spikelets usually ovoid to nearly round, 1.5–4 mm long, apically rounded; scales of spikelets obtuse; ligules absent; achenes not trigonous or only obscurely so, obovoid, the surfaces reticulate and usually warty ____ **F. miliacea**
1. Styles 2-branched; achenes lenticular to biconvex or obovoid; spikelets 3–15(–20) mm long; plants annual or perennial.
   3. Plants low growing annuals to only 15 cm tall; spikelets sessile, all close together in a capitate cluster; leaf blades filiform, < 1 mm wide; achenes ca. 0.5–0.7 mm long ____ **F. vahlii**
   3. Plants annuals or perennials usually more than 15 cm tall (to 1.5(–2) m tall); spikelets (at least 1 or more) peduncled; leaf blades narrowly linear to linear, 1–5(–rarely more) mm wide; achenes 0.8 mm or more long.
      4. Plants perennials, with rhizomes (these usually either elongate and slender or short and knotty) OR with hard bulbose bases OR with leaf bases hard, leathery, and dark brown; ligules of short hairs present OR ligules absent or incomplete.
         5. Long, slender, scaly rhizomes present (can be observed if plant is carefully removed from the substrate); plant bases neither bulbose nor with hard, leathery, dark brown leaf bases; scapes typically compressed; ligules of short hairs present ____ **F. caroliniana**
         5. Long, slender, scaly rhizomes absent; plant bases EITHER bulbose, hard and knotty, often joined together into a short stoutish rhizome OR with leaf bases hard, leathery, and dark brown OR (in *F. puberula* var. *interior*) with dense clusters of short, slender, twisted, pale reddish-brown to orangish rhizomes; scapes not compressed or only slightly so; ligules of short hairs present OR ligules absent or incomplete.
            6. Plants densely cespitose, 80–150(–200) cm tall; bases of leaves hard, leathery, usually dark brown; plant bases neither bulbose nor with short rhizomes; scapes 1.5–2(–3) mm wide, ca. as wide as or wider than leaf blades ____ **F. castanea**
            6. Plants loosely cespitose in small tufts or with culms solitary, 15–60(–100) cm tall; bases of leaves not as above; plant bases EITHER bulbose, hard and knotty, often joined

together into a short stoutish rhizome OR with dense clusters of short, slender, twisted, pale reddish-brown to orangish rhizomes; scapes ca. 1 mm wide, narrower than to as wide as leaf blades _____ **F. puberula**

4. Plants annuals or (in *F. dichotoma*) perennials, with neither rhizomes nor hard bulbose bases (base can be thickened in *F. dichotoma*) nor hard leathery dark brown leaf bases; ligules of short hairs present.
   7. Leaf sheaths usually spreading hairy to tomentose; achenes 1.25–2 mm long; face (one side) of achene finely patterned, with 15 or more longitudinal rows of shallow pits, the face margin all around appearing paler _____ **F. tomentosa**
   7. Leaf sheaths spreading hairy to glabrous or pubescent; achenes 0.8–ca. 1.3 mm long; face of achene more coarsely reticulate, with 12 or fewer longitudinal rows of horizontally oriented rectangular pits, the face margin not appearing paler.
      8. Plants perennial, with thickened bases; leaf blades 2–3.5 mm wide; achenes without warts _____ **F. dichotoma**
      8. Plants annual; leaf blades usually 1–2.5 mm wide; achenes usually warty OR rarely without warts.
         9. Leaf blades hirsute-ciliate at least near base; achenes with warts only at apex of achene margin; inflorescence usually as wide as long or wider _____ **F. decipiens**
         9. Leaf blades glabrous to scabrid or minutely ciliate; achenes with warts more generally distributed OR achenes rarely without warts; inflorescence usually longer than wide _____ **F. annua**

Fimbristylis annua (All.) Roem. & Schult., (annual), ANNUAL FIMBRY. Cespitose annual; culms decumbent, ascending, or erect, to 50 cm tall; leaf blades narrowly linear, 1–2(–4) mm wide; spikelets lance-ovoid to ovoid to oblong, 3–8 mm long, apically acute; style flat, fimbriate; achenes 1–1.3 mm long, usually warty or rarely without warts; $2n = 30$ (Kral 2002b). Weedy areas; mainly s part of East TX, but also Dallas Co. (BRIT); sparsely scattered elsewhere in TX; widespread in e 1/2 of the U.S., also AZ. Oct. [*F. baldwiniana* (Schult.) Torr., *Scirpus annuus* All.] The extremes in variation of this species and *F. dichotoma* are sometimes "most difficult to place" (Kral 1971); however, *F. annua* is an annual and *F. dichotoma* is a perennial.

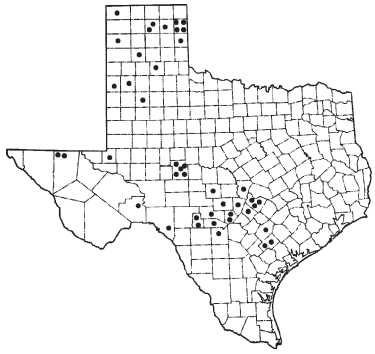
Fimbristylis autumnalis (L.) Roem. & Schult., (autumnal, of the fall), SLENDER FIMBRISTYLIS, SLENDER FIMBRY. Cespitose annual, 5–20 cm tall; leaf blades linear, to 4 mm wide; style slender, with 3-angled base, glabrous; achenes ca. 0.5–1 mm long, smooth to minutely warty; $2n = 10$ (Kral 2002b). Moist or wet, often sandy areas; widespread in e 1/2 of TX; se Canada and throughout the e U.S. w to SD and TX. (Jun–)Jul–Nov. [*Scirpus autumnalis* L.] This species can be a weed in rice fields (Tucker 1987).

Fimbristylis caroliniana (Lam.) Fernald, (of Carolina), CAROLINA FIMBRY. Rhizomatous perennial to 1.5(–2) m tall (one of the more robust species of *Fimbristylis*); leaf blades linear, 2–5(–rarely more) mm wide; scapes typically compressed; spikelets 5–15 mm long; style flat, fimbriolate; achenes ca. 1 mm long, finely reticulate, the horizontally oriented rectangular cells arranged in a number of fine vertical rows; $2n = 20, 30, 60$ (Kral 2002b). "Brackish, alkaline or mildly acid sands or sandy peats of beaches, duneswales, lakeshores, roadside ditches, more rarely savannas or flatwoods" (Kral 1971); Brazos, DeWitt, Harris, and Walker (Turner et al. 2003) cos.; also Gulf Prairies and Marshes; in general strictly coastal; mainly se U.S. from NJ s to FL w to TX. Jul–Sep. [*Scirpus carolinianus* Lam.] This species is most similar to *F. puberula* var. *interior*. However, *F. puberula* var. *interior* is only known from the sw part of East TX, while *F. caroliniana* is primarily coastal.

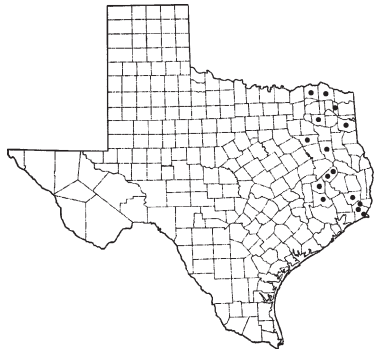
Fimbristylis castanea (Michx.) Vahl, (chestnut-brown, presumably from the color of the leaf bases), MARSH FIMBRY. Perennial 80–150(–200) cm tall; bases of leaves hard, leathery, usually dark brown; leaf blades linear, 1–2(–3) mm wide; spikelets 5–15(–20) mm long; style flat, fimbriate;



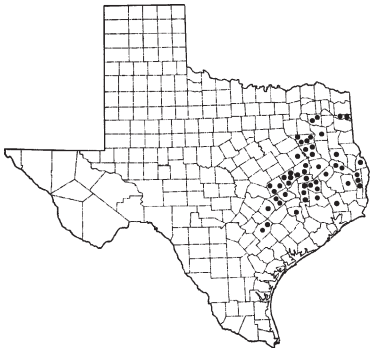
Eleocharis reverchonii



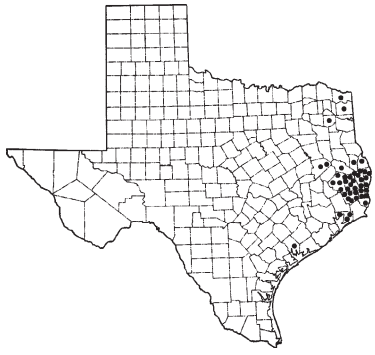
Eleocharis rostellata



Eleocharis tenuis var. verrucosa



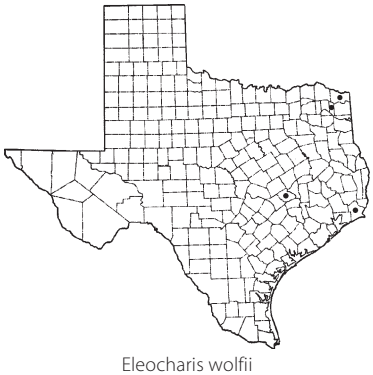
Eleocharis tortilis



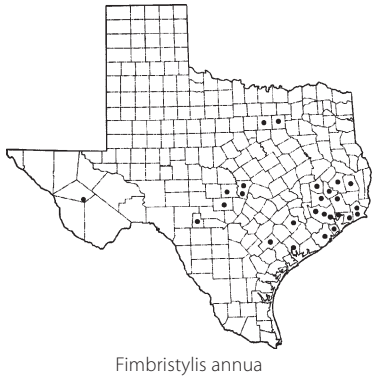
Eleocharis tuberculosa



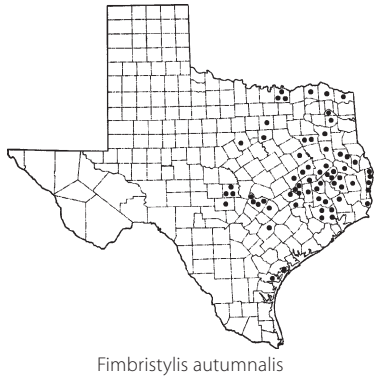
Eleocharis vivipara



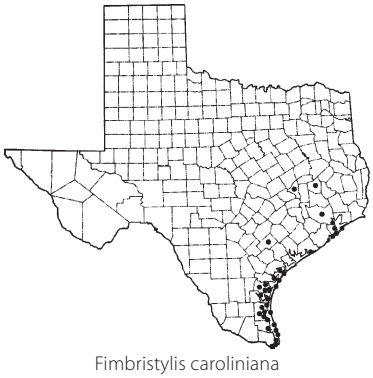
Eleocharis wolfii



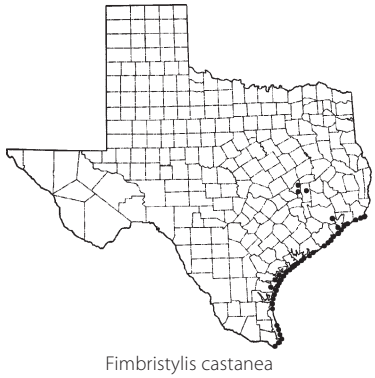
Fimbristylis annua



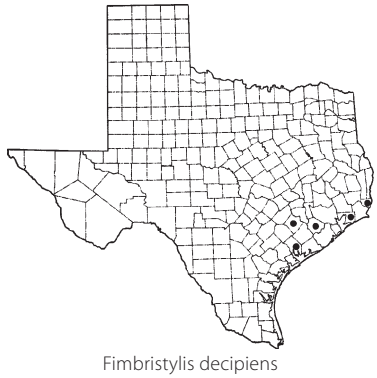
Fimbristylis autumnalis



Fimbristylis caroliniana



Fimbristylis castanea



Fimbristylis decipiens

achenes 1.5–2 mm long, minutely pitted; 2*n* = 20 (Kral 2002b). Primarily salt and brackish marshes; Brazos and Grimes (Turner et al. 2003) cos.; mainly Gulf Prairies and Marshes; this species is in general strictly coastal; NY s to FL w to TX. Summer–fall. [*Fimbristylis spadicea* (L.) Vahl var. *castanea* (Michx.) A. Gray, *Scirpus castaneus* Michx.] According to Kral (2002b), this species, while "commonly placed in synonymy of *F. spadicea* (L.) Vahl, a widespread salt marsh perennial of tropical America, is distinguishable by its relatively shorter spikelets, usually lower habit, and by its proportionately shorter involucral bracts."

Fimbristylis decipiens Kral, (deceptive, misleading), SOUTHERN FIMBRY. Annual to only 30 cm tall, similar to *F. annua*; leaf blades linear, 1.5–2.5 mm wide; spikelets 5–6 mm long; style flat, fimbriate; achenes ca. 1 mm long, minutely pitted, the margins minutely warty distally; 2*n* = 20 (Kral 2002b). Disturbed sites, low pinelands, banks, and fields; Colorado and Orange (Turner et al. 2003) cos. at se margin of East TX; also n Gulf Prairies and Marshes; se U.S. from NC s to FL w to TX. Late summer–fall. According to Kral (2002b): "In the Atlantic and Gulf Coastal plains, *Fimbristylis decipiens* often shares habitat with two close, likewise weedy, relatives: *F. dichotoma* and *F. annua*. From the former *F. decipiens* is distinguished by its annual habit, its papillose distal fruit edges, and the more spreading anthela [inflorescence] branches; from the latter it differs in its usually less papillose achene and its harder, more spreading foliage. No intergrades appear to occur among the three."

Fimbristylis dichotoma (L.) Vahl, (2-parted or forked), FORKED FIMBRY. Tufted perennial to 50 (–80) cm tall; leaf blades linear, 2–3.5 mm wide; inflorescences longer than broad; spikelets 4–8 mm long; style flat, fimbriate; achenes ca. 1 mm long, minutely pitted/cancellate, but the margins not warty distally; 2*n* = 20, 30 (Kral 2002b). Moist sunny habitats including savannahs, roadsides, fields, and grasslands; Harris, Jasper, Orange, Polk, and Tyler (Turner et al. 2003) cos. in se part of East TX; also Llano Co. (Turner et al. 2003) in the Edwards Plateau; se U.S. from NC s to FL w to TX. Jul–Sep. [*Scirpus dichotomus* L.] First reported for TX by Kral (1971); Kral (2002b) indicated that this species is often associated with rice cultivation and suggested that it is possibly introduced from Asia. ?☜

Fimbristylis miliacea (L.) Vahl, (resembling *Milium*—millet), GLOBE FIMBRISTYLIS, GLOBE FIMBRY, TROPICAL FIMBRY, GRASS-LIKE FIMBRY. Cespitose annual to 50(–100) cm tall; leaf blades linear, 1.5–2 mm wide; spikelets rather small (1.5–4 mm long); style slender, the base dilated, the apex pubescent; achenes ca. 1 mm long, reticulate and usually warty; 2*n* = 10 (Kral 2002b). Sandy areas; widespread in East TX; also n Gulf Prairies and Marshes; se U.S. from NC s to FL w to MO and TX. Aug–Oct. Native of Asia. [*Scirpus miliaceus* L.] Kral (1971) noted, "The history of introduction of this weed into the U.S.A. probably parallels that of rice, in that it is a common species of the rice growing countries of the Orient." Nomenclatural issues were discussed by Strong and Kral (1999). ☜

Fimbristylis puberula (Michx.) Vahl, (somewhat pubescent), HAIRY FIMBRY. Perennial 15–60(–100) cm tall; culms solitary or in small tufts; leaves pubescent or glabrous; inflorescences umbel-like; spikelets ± ovoid, 5–10 mm long, glabrous or variously puberulent; style flat, fimbriate; achenes ca. 1–1.8 mm long, minutely pitted; 2*n* = 20 (Kral 2002b). Sandy prairies, open woods, often in wet areas. Kral (1971) considered this as "perhaps the most widespread species of the genus in North America." Despite the epithet and common name, not all individuals are hairy. The following key to varieties is modified from Kral (1971) and Kolstad (1986a).

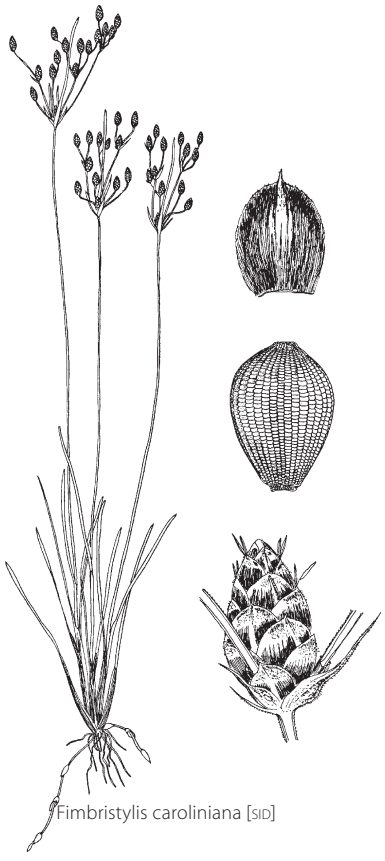
1. Base of culms less bulbose, producing clusters of slender orangish rhizomes; old leaf bases not persisting as shreddy remnants; outer surface of fertile scales seldom with any puberulence; longest bract of inflorescence usually longer than the inflorescence; ligules inconspicuous or often of short ascending hairs; leaf blades and sheaths mostly glabrous _____ var. **interior**
1. Base of culms distinctly bulbose, often jointed together into a stout, knotty rhizome; old leaf bases often persisting as shreddy remnants; outer surface of fertile scales usually with some



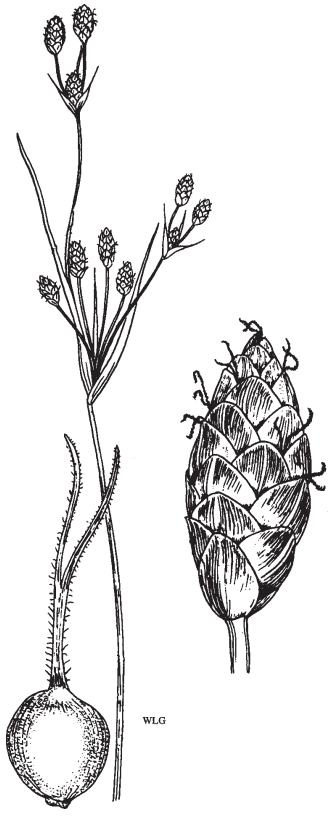
Fimbristylis annua [SID]



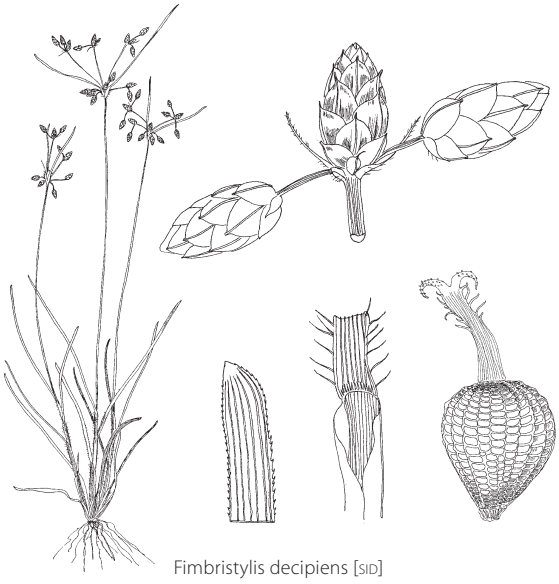
Fimbristylis autumnalis [SID]



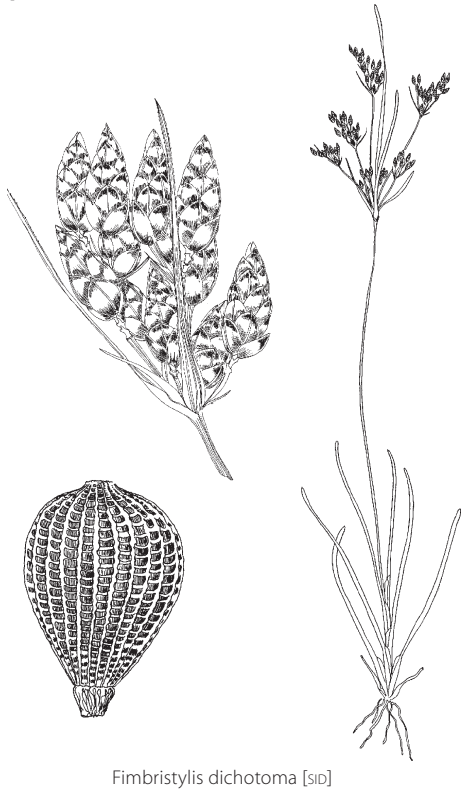
Fimbristylis caroliniana [SID]



Fimbristylis castanea [GLE]



Fimbristylis decipiens [SID]



Fimbristylis dichotoma [SID]

puberulence; longest bract of inflorescence usually much shorter than inflorescence; ligules inconspicuous to absent; leaf blades and sheaths glabrous or pubescent _____ var. **puberula**

var. **interior** (Britton) Kral, (inland). Kral (1971) mapped the species in the sw corner of East TX (counties not discernible); we are not aware of any other East TX records and only tentatively include this variety as a member of the East TX flora; in TX rarely to the w of our area; AZ, KS, NE, NM, OK, TX, and UT. Early summer–summer. [*F. interior* Britton] If this variety is confirmed for TX, it should probably be considered of conservation concern for the state.

var. **puberula**. Widespread in the e 1/2 of TX. This is the common variety in East TX; se Canada and widespread in e 1/2 of the U.S., also UT. Apr–Jul (usually finished flowering by early summer). [*F. drummondii* (Torr. & Hook. ex Torr.) Boeck., *Scirpus puberulus* Michx.]

Fimbristylis tomentosa Vahl, (densely woolly, with matted hairs), WOOLLY FIMBRY. Cespitose annual to 75 cm tall; leaf blades 2–4(–5) mm wide; spikelets 4–6 mm long; style flat, fimbriate; achenes 1.25–2 mm long (including the persistent and conspicuous pedicel joint), smooth or minutely pitted; $2n = 10$ (Kral 2002b). Disturbed habitats including pond margins, river banks, roadside ditches, canals, and agricultural grounds, in a variety of moist to wet substrates including sands, silts, and clays (Kral 1971); scattered mainly in s Pineywoods and Post Oak Savannah and n Gulf Prairies and Marshes; se U.S. from NC s to FL w to AR and TX. Jul–Sep. Native of Asia. [*F. pilosa* Vahl] While generally considered native (e.g., Hatch et al. 1990; Kartesz 1999), Kral (1971) indicated that "it is rare in U.S. herbaria, an indication that it may be a comparatively recent introduction." It can be a weed in rice fields. In fact, Kral (2002b) recently indicated that this species "apparently was introduced with early rice culture and is rapidly expanding its range." Kral (pers. comm.) notes that woolly is inappropriate as a common name for this species in that the hairs are straight.

Fimbristylis vahlii (Lam.) Link, (for Martin Hendriksen Vahl, 1749–1804, Danish botanist and student of Linnaeus), VAHL'S FIMBRISTYLIS, VAHL'S FIMBRY. Very low growing diminutive annual to only 15 cm tall; leaves filiform, < 1 mm wide; spikelets lance-ovoid to linear-ellipsoid or oblong-cylindric, apically obtuse or acute, 5–10 mm long; style slender, bulbose-based, smooth or papillate; achenes 0.5–0.7 mm long, minutely reticulate, the rectangular cells arranged horizontally in 5–7 vertical rows on a side; $2n = 20$ (Kral 2002b). Usually along lake margins, streams, or in disturbed bottomlands, often on alluvial soils, particularly those recently exposed by receding water; widespread mostly in e 1/2 of TX; widespread in the s U.S. from SC w to CA, n to IL and NE. Jul–Oct. [*Scirpus vahlii* (Lam.) Link] This diminutive species is often overlooked. According to Kral (1971), "Fruiting plants may develop from seed in a few weeks time, an indication that this is a species extremely efficient in getting the most out of the sort of temporary habitat it occupies." Kral (pers. comm.) also notes that the filiform leaves of this species have sometimes caused it to be confused with some *Bulbostylis* spp.

FUIRENA Rottb. UMBRELLA SEDGE, UMBRELLA-GRASS

Perennials or annuals to 1 m tall, usually cespitose, rhizomatous or not so; culms (= stems) obtusely triangular to nearly round; leaves cauline, usually hairy, the lowermost sometimes bladeless; ligules tubular, scarious; inflorescences condensed, often head-like, of 1–10 ovoid, mostly bur-like spikelets, bracted; scales of spikelets numerous, spirally imbricate, usually with a very conspicuous, often recurved, bristle-like awn; perianth of 3 stalked-bladed, scale-like or paddle-like structures, the blade often thickened, expanded, or swollen at maturity and also typically with 3 perianth bristles alternating with the stalked-bladed structures; achenes stipitate, strongly 3-angled, without tubercle.

A genus of ca. 30 species, cosmopolitan but particularly tropical and subtropical (Kral 2002a). In the past, some authors submerged *Fuirena* into *Scirpus*. (Named for Georg Fuiren, 1581–1628, a Danish botanist and physician)

REFERENCES: Coville 1890; Bush 1905; Svenson 1957; Kral 1978, 2002a; Tucker 1987.

1. Plants annual, without rhizomes; anthers 0.5–0.7 mm long.
   2. Perianth blades (pull back scales of spikelets to observe) with apex obtuse to truncate or retuse, usually with a subapical bristle, this with down-pointing barbs (tip of barb below attachment); achenes pale brown to nearly white _____ **F. simplex** var. **aristulata**
   2. Perianth blades tapering to an acuminate tip, without a subapical bristle (note: the acuminate tip does not have barbs); achenes deep lustrous brown or reddish brown _____ **F. pumila**
1. Plants perennial, with rhizomes; anthers 0.9–2 mm long.
   3. Bristles of perianth (typically three per flower in addition to the three stalked-bladed perianth parts) incurved, very short, no longer than the stipe of the achene, without barbs or with minute up-pointing barbs (tip of barb above attachment); perianth blades with apex obtuse or acute, neither conic nor acuminate; lower leaf sheaths with pubescence, the middle and especially the upper ones ± glabrous _____ **F. breviseta**
   3. Bristles of perianth erect or spreading, much longer, reaching well past the middle of the achene and sometimes longer than the achene, without barbs or with down-pointing barbs (tip of barb below attachment); perianth blades with apex either acuminate OR conic and swollen; all leaf sheaths either with pubescence OR lower leaf sheaths with pubescence, the middle and especially the upper ones ± glabrous.
      4. Upper leaf sheaths glabrous; perianth blades usually with a subapical bristle, the apex flattish or notched or turgid and conic; rhizomes simple, lacking corm-like shoot buds _____ **F. simplex** var. **simplex**
      4. Upper leaf sheaths with obvious pubescence; perianth blades without a subapical bristle, the apex either conic and swollen or acuminate; rhizomes producing corm-like shoot buds.
         5. Perianth blades with apex thinnish or thickened, acuminate, incurved; bristles of perianth retrorsely barbellate; anthers 1.3 mm or less long; swollen corm-like buds of rhizome not separated by narrower internodes _____ **F. squarrosa**
         5. Perianth blades swollen at maturity, narrowing to the conic and erect, sometimes apiculate apex; bristles of perianth smooth; anthers ca. 2 mm long; swollen corm-like buds of rhizome often separated by narrow internodes longer than corm width _____ **F. bushii**

Fuirena breviseta (Coville) Coville, (short-bristled), SALTMARSH UMBRELLA SEDGE. Rhizomatous perennial to 50(–100) cm tall, the stems developing from corm-like buds; lowermost leaf sheaths hispid, the upper ones nearly glabrous; spikelets 10–15(–20) mm long; perianth blades with apex obtuse or acute, neither conic nor acuminate; bristles of perianth incurved, very short, no longer than the stipe of the achene. Bogs, wet places, sandy soils; Hardin, Harris, Montgomery, Newton, Tyler (BRIT), Jasper, Jefferson, Liberty, and Morris (Turner et al. 2003) cos; also Gulf Prairies and Marshes; se U.S. from VA s to FL w to TX. Jul–Oct. [*F. squarrosa* Michx. var. *breviseta* Coville] This species can be readily distinguished by its very short perianth bristles, these not reaching the base of the blades of the stalked-bladed perianth parts; the bristles are also without barbs or weakly, usually upwardly barbed (vs. bristles reaching the blades of the perianth parts and often downwardly barbed in the other four East TX species). This species has often been synonymized with *F. squarrosa*; however, that species can be distinguished by its stalked-bladed perianth parts being acuminate and by its upper leaf sheaths having obvious pubescence (Kral 1978).

Fuirena bushii Kral, (for its discoverer, Benjamin Franklin Bush, 1858–1937, postmaster in MO and amateur botanist), BUSH'S UMBRELLA SEDGE. Rhizomatous perennial to 1 m tall, the rhizomes producing corm-like shoot buds; leaf sheaths strongly hirsute; leaf blades with pubescence; spikelets 10–15(–20) mm long; bristles of perianth reaching at least to base of blades of stalked-bladed perianth parts. Wet, acidic, usually sandy areas; widespread in East TX; AR, LA, OK, and TX. Jun–Oct. [*F. ciliata* Bush]

Fuirena pumila (Torr.) Spreng., (dwarf, very small), DWARF UMBRELLA SEDGE. Cespitose annual 8–30(–60) cm tall; leaf sheaths nearly glabrous to hispid; spikelets 5–8(–12) mm long; bristles of

perianth reaching at least to the base of blades of stalked-bladed perianth parts and often to near their tips. Moist to wet areas, usually sandy or sandy-peaty soils; Burleson, Colorado, Harris, Leon (BRIT), Freestone, Henderson, Madison, Robertson, and Van Zandt (Turner et al. 2003) cos.; also Gulf Prairies and Marshes; se Canada and e U.S. w to MI and TX. Aug–Sep. [*F. squarrosa* Michx. var. *pumila* Torr.] This species has often been considered a variety of *F. squarrosa*. However, it is annual, never produces corm-like rhizome buds, and has much smaller anthers (0.5–0.7 mm long) (Kral 1978).

Fuirena simplex Vahl, (unbranched), UMBRELLA SEDGE, WESTERN UMBRELLA-GRASS, WESTERN UMBRELLA SEDGE. Plant 10–40(–100) cm tall; leaf sheaths glabrous or only the lowest hirsute; leaf blades minutely scabrous or glabrous; spikelets 8–15(–20) mm long; bristles of perianth reaching at least base of blades of stalked-bladed perianth parts. Aquatic or wet places. Jun–Oct. This is a widespread variable species and is the most common *Fuirena* species in much of East TX. Kral (1978) distinguished two varieties as follows: ⚙/287

1. Plants nonrhizomatous, mostly annual, usually < 30 cm tall; anthers 0.5–0.6 mm long _____ var. **aristulata**
1. Plants rhizomatous, perennial, 20–40(–100) cm tall; anthers 0.9–1.2 mm long _____ var. **simplex**

var. **aristulata** (Torr.) Kral, (bearded or awned). Widespread in TX; AR, KS, LA, MO, NE, NM, OK, and TX. [*F. squarrosa* Michx. var. *aristulata* Torr.]

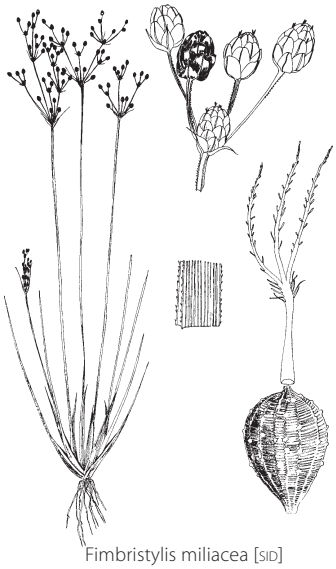
var. **simplex**. Rhizomes simple, lacking corm-like shoot buds. Reported to be an indicator of calcareous seepage (Yatskievych 1999); widespread in TX; AR, KS, NM, OK, and TX.

Fuirena squarrosa Michx., (with recurved tips), HAIRY UMBRELLA SEDGE, HAIRY UMBRELLA-GRASS. Rhizomatous perennial to 1 m tall, usually less, the rhizomes producing corm-like shoot buds; leaf sheaths strongly hispid-hirsute; leaf blades with pubescence; spikelets 10–20 mm long; bristles of perianth often reaching middle of blades of stalked-bladed perianth parts; anthers ca. 1–1.3 mm long. Wet areas, often on sandy substrates; widespread in East TX; scattered elsewhere in s 1/2 of TX; e U.S. from NY s to FL w to OK and TX. Jun–Oct. [*F. hispida* Elliott] According to Kral (2002a), this species "is most similar to *F. pumila* in perianth except it is perennial; to *F. breviseta* except its distal sheaths are hirsute, not glabrous; and to *F. bushii* except its perianth blade is flatter and the anthers shorter."

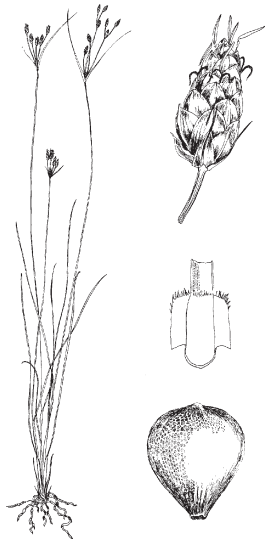
ISOLEPIS R. Br. BULRUSH, LATERAL BULRUSH

Small tufted annuals (or perennials?) 2–25(–40) cm tall, glabrous or nearly so; culms wiry, very thin, 0.2–0.5 mm thick near base; leaves near base of culms; ligules absent; leaf blades rudimentary to exceeding sheaths; inflorescences of 1–3(–10) sessile terete spikelets, appearing lateral, with 1(–2), spreading to erect, modified leaf (= involucral bract) sometimes appearing like a continuation of the culm; flowers 8–25 per spikelet; scales of spikelets spirally arranged, keeled, awnless or very short-awned; perianth absent; stigmas usually 3; achenes trigonous to thickly plano-convex, minutely papillose (this can sometimes be obscured by a whitish, wax-like, surface layer), without a tubercle but with a minute beak.

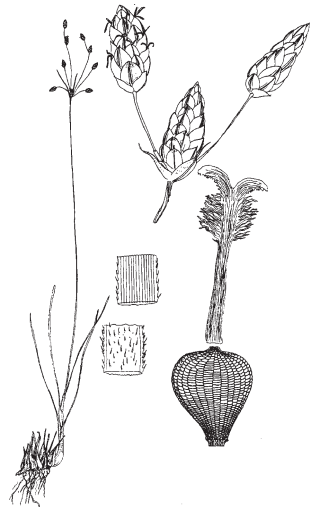
A cosmopolitan but predominantly s hemisphere genus of 69 species (Muasya & Simpson 2002; Smith 2002c), mostly of temperate and subtropical climates; when tropical, restricted to mountains at higher elevations. Three species are reported for TX (Smith 2002c). Previously included in *Scirpus* (e.g., Kartesz 1994) and according to some, better treated as a section or subgenus in *Scirpus* in the broad sense. We are following Smith (1995, 2002c) and Jones et al. (1997) in recognizing this segregate of *Scirpus* at the generic level. This approach is supported by phylogenetic studies (e.g., Bruhl 1995; Muasya et al. 2000b) which suggest that *Scirpus* sensu lato is polyphyletic. Recent molecular research (Muasya et al. 2001; Muasya & Simpson 2002) suggests that *Isolepis* is more closely related to *Cyperus* than to *Scirpus*. The key to species is modified from Smith (2002c). (Greek: *isos*, equal, and *lepis*, scale)



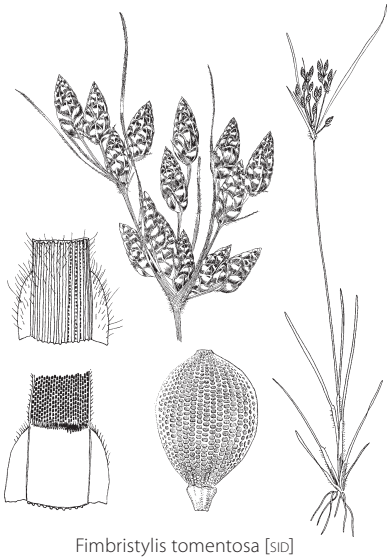
Fimbristylis miliacea [SID]



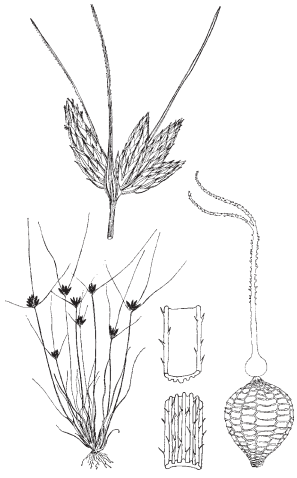
Fimbristylis puberula var. interior [SID]



Fimbristylis puberula var. puberula [SID]



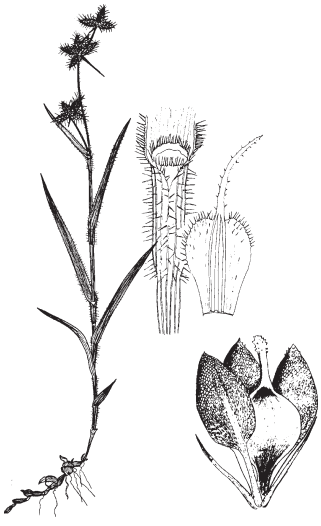
Fimbristylis tomentosa [SID]



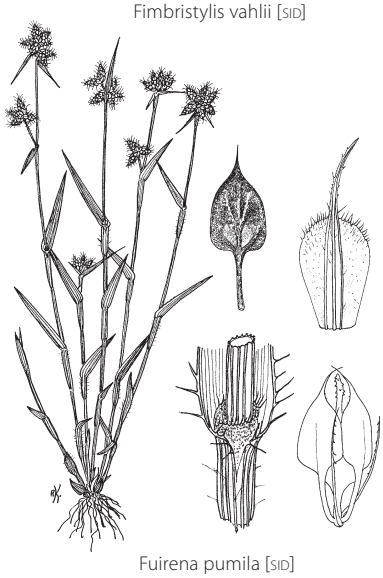
Fimbristylis vahlii [SID]



Fuirena breviseta [SID]



Fuirena bushii [SID]



Fuirena pumila [SID]



Fuirena simplex var. aristulata [SID]

REFERENCES: Beetle 1947; Johnston 1964a; Tucker 1987; Bruhl 1995; Smith 1995, 2002c; Smith & Yatskievych 1996; Muasya et al. 2000b, 2001; Muasya & Simpson 2002.

1. Scales of spikelets neither gibbous nor clasping shed achenes, usually at least partly orange-brown to red-brown or blackish; achenes compressed-trigonous or thickly plano-convex; leaf sheaths usually reddish near base; anthers 0.3–0.6 mm long; species primarily near coast _____ **I. cernua**
1. Scales of spikelets markedly gibbous (= swollen basally on one side), often clasping shed achenes, colorless to stramineous or orangish or greenish; achenes equilaterally trigonous; leaf sheaths green to stramineous or brown; anthers ca. 0.2 mm long; species widespread in East TX.
   2. Scales from middle of spikelet 1.8–2 mm long, short-awned (awns 0.2–0.5 mm long); achenes (1–)1.3–1.6 mm long _____ **I. carinata**
   2. Scales from middle of spikelet 1–1.2(–1.5) mm long, mucronate (the mucros 0.1 mm or less long); achenes 0.7–1 mm long _____ **I. pseudosetacea**

Isolepis carinata Hook. & Arn. ex Torr., (with a keel), ANNUAL BULRUSH, KEELED BULRUSH, KEELED LATERAL BULRUSH. Tufted annual 4–25(–30) cm tall; leaf blades 0.2–0.5 mm wide; involucral bract 5–30 mm long; spikelets usually solitary, sometimes 2(–3), 2–10 mm long, 1.5–2 mm wide; scales of spikelet strongly keeled. Moist sandy soils; widespread in East TX w to e Cross Timbers and Prairies and e Edwards Plateau; also n Gulf Prairies and Marshes; se 1/4 of U.S. from NC and FL w to KS and TX, also CA. Spring. [*I. koilolepis* Steud., *Scirpus koilolepis* (Steud.) Gleason, *Scirpus carinatus* (Hook. & Arn. ex Torr.) A. Gray, not Sm.]

Isolepis cernua (Vahl) Roem. & Schult., (drooping, nodding), LOW LATERAL BULRUSH. Tufted annual (perennial?) 4–40 cm tall; leaf blades 0.2–1 mm wide; involucral bract 2–6(–23) mm long; spikelet usually solitary, 2–5 mm long, 1–2 mm wide; scales of spikelet keeled near tip; achenes often with a white waxy coating. Moist sandy soils; Harris and Jefferson (Turner et al. 2003) cos. near boundary of Pineywoods and Gulf Prairies and Marshes; known in TX from only 2 counties; Pacific Coast and TX. Spring–fall. [*Scirpus cernuus* Vahl, *Scirpus cernuus* subsp. *californicus* (Torr.) Thorne, *Scirpus cernuus* var. *californicus* (Torr.) Beetle] According to Smith (2002c), this species was first collected in TX in 1974. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

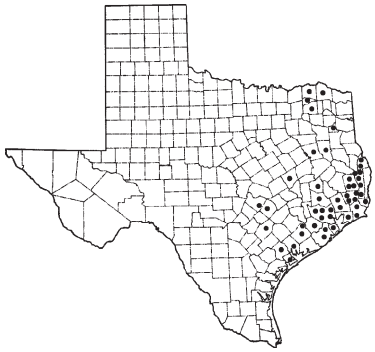
Isolepis pseudosetacea (Daveau) Laine, (false bristled), GULF COAST LATERAL BULRUSH. Tufted annual 2–20 cm tall; involucral bract 3–10(–25) mm long; spikelets 1–3, 2–8 mm long, 1–1.5 mm wide; scales of spikelet keeled. Moist sandy soils; Jasper, Montgomery, Rusk, Sabine (BRIT), Austin, Bastrop, Brazos, Madison, Tyler, and Walker (Turner et al. 2003) cos.; also n Gulf Prairies and Marshes; se U.S. from GA w to MO and TX. Spring–summer. [*Isolepis molesta* (M.C. Johnst.) S.G. Sm., *Scirpus molestus* M.C. Johnst., *Scirpus pseudosetaceus* Daveau (as *pseudo-setaceus*)] Johnston (1964a) indicated that while this species (as *S. molestus*) seems like a dwarf form of *I. carinata*, clear-cut differences exist and no intermediate specimens are known. The two species often grow intermixed (Yatskievych 1999; Smith 2002c), and this taxon should be looked for in mixed populations. While this species has long gone under the epithet *molestus/molesta* in either *Scirpus* or *Isolepis*, we are following Muasya and Simpson (2002) and Smith (2002c) in recognizing the older epithet *pseudosetacea*.

KYLLINGA Rottb. SPIKE SEDGE, GREEN-HEAD SEDGE

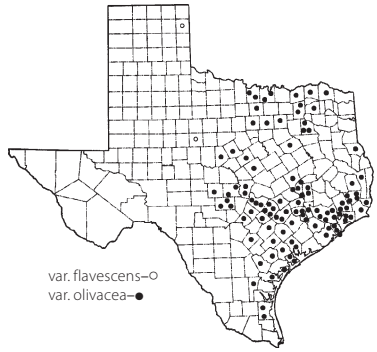
Small rhizomatous or tufted annuals or perennials to 40(–55) cm tall; inflorescence a single, cylindrical to ovoid or roundish, unlobed to 3-lobed, congested head or head-like mass, (3–)4–12(–17) mm long, subtended by usually 3–4 involucral bracts; spikelets flat, 1.8–4 mm long, each with only a single, fertile, bisexual flower and only 4 scales, 2 of these normal in size, the basal 2 minute, brownish, the scales 2-ranked; spiklets each deciduous as a unit; styles 2-branched; achene 1 per spikelet, lenticular, without a tubercle.



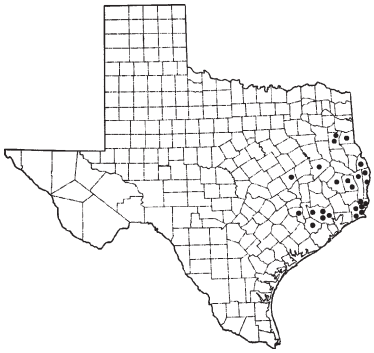
Fimbristylis dichotoma



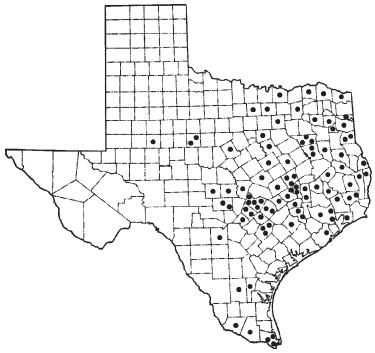
Fimbristylis miliacea



Fimbristylis puberula



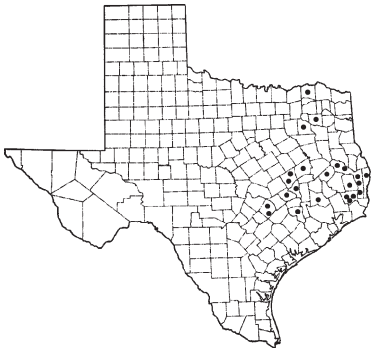
Fimbristylis tomentosa



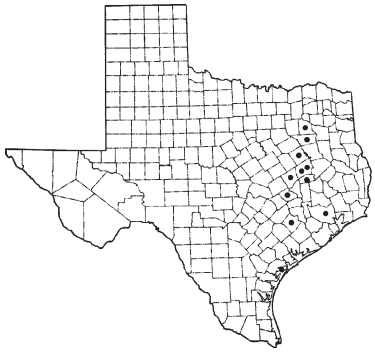
Fimbristylis vahlii



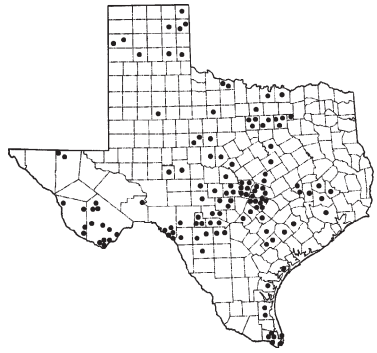
Fuirena breviseta



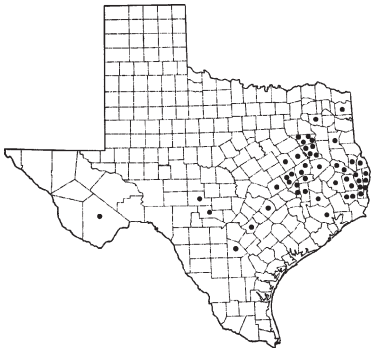
Fuirena bushii



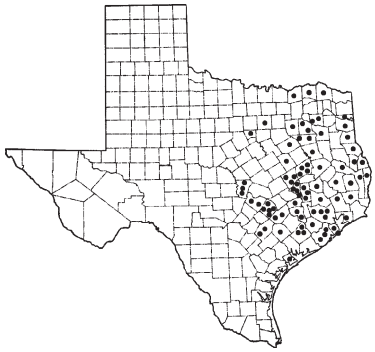
Fuirena pumila



Fuirena simplex
(both vars.)



Fuirena squarrosa



Isolepis carinata



Isolepis cernua

A genus of ca. 40–45 species, mostly of tropical or warm temperate regions worldwide, with the greatest diversity in tropical Africa and Madagascar; 8 occur in the New World (Tucker 1984a, 2002a). *Kyllinga* is closely related to and is sometimes included in the genus *Cyperus*. Recent molecular studies (e.g., Muasya et al. 2002) suggest that it is embedded within a paraphyletic *Cyperus*. However, *Kyllinga* can be distinguished by its spikelets with only 2 scales (plus 2 greatly reduced, minute, brownish, basal scales) and only 1 bisexual fertile flower. In addition, the "dense, sessile spikes of *Kyllinga* give the plants a different aspect from most species of *Cyperus* with their usually open, branched inflorescences" (Tucker 1984a). (Named for Peter Kylling, died 1696, Danish botanist)

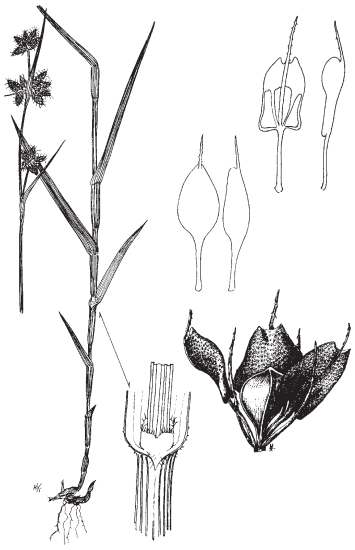
REFERENCES: Kükenthal 1935–1936; Johnston 1966; Delahoussaye & Thieret 1967; Padhye 1971; Tucker 1984a, 2002a.

1. Annuals, without rhizomes, densely tufted, with 4–20 culms per square cm, the stems not bulbose thickened at base; anthers 0.2–0.4 mm long; plants flowering in the fall _____ **K. pumila**
1. Perennials, rhizomatous, the rhizomes either elongate with stems arising at intervals of 3–15 mm OR the rhizomes short and knotted with stems arising < 3 mm apart (in this case the stems are ± bulbose-thickened at base); anthers 0.4–1.1 mm long; plants flowering spring to fall.
   2. Scales of spikelets hyaline, pale brownish to greenish; rhizomes elongate, the culms arising at intervals of 3–15 mm; longest inflorescence bract erect, appearing like a continuation of the culm, the other bracts ascending to horizontal; inflorescences usually without any visible lobing; achenes uniform light to medium brown; culms slender at base _____ **K. brevifolia**
   2. Scales of spikelets whitish; rhizomes short, knotted, the culms usually < 3 mm apart; inflorescence bracts all horizontal to reflexed; inflorescences often slightly 3-lobed; achenes when fully mature dark (blackish brown) with contrasting whitish stipitate base and apiculus; culms bulbose-thickened at the base _____ **K. odorata**

Kyllinga brevifolia Rottb., (short-leaved), SHORT-LEAF FLAT SEDGE, SHORT-LEAF SPIKE SEDGE, PERENNIAL GREEN-HEAD SEDGE. Perennial with reddish brown rhizomes to 20 cm long and 1–2 mm thick; culms 6–40(–55) cm tall; leaf blades 1–4 mm wide; stamens 1 or 2; anthers 0.8–1.1 mm long. Moist, typically open areas; primarily se part of East TX but scattered w to Dallas and Travis (Turner et al. 2003) cos., also n Gulf Prairies and Marshes, e Cross Timbers and Prairies, and e Edwards Plateau; se U.S. from NC s to FL w to OK and TX, also CA. Apr–Nov. [*Cyperus brevifolius* (Rottb.) Endl. ex Hassk.] The erect longest inflorescence bract of this species distinguishes it from the other two East TX species. It is considered a weed in some parts of the world (Holm et al. 1997).

Kyllinga odorata Vahl, (with an odor), FRAGRANT SPIKE SEDGE, WHITE-HEAD SEDGE. Strongly fragrant (citronella-like odor), rhizomatous, mat-forming perennial; culms usually 10–30(–45) cm tall; leaf blades 2–3(–4) mm wide; stamens 2; anthers (0.4–)0.6–0.8(–1) mm long. Moist, sandy, typically open areas; scattered primarily in s part of East TX; also n Gulf Prairies and Marshes; se U.S. from NC s to FL w to OK and TX, also NM. (Jun–)Jul–Oct(–Nov). [*Cyperus sesquiflorus* (Torr.) Mattf. & Kük. ex Kük., *K. sesquiflora* Torr.]. The whitish spikelet scales of this species distinguish it from the other two East TX species; it has been suggested (Tucker 1987) that the color may be an indication of insect involvement in pollination.

Kyllinga pumila Michx., (dwarf, very small), SLENDER-LEAF FLAT SEDGE, LOW SPIKE SEDGE, ANNUAL GREEN-HEAD SEDGE. Tufted, fragrant, diminutive annual; culms usually 5–19(–38) cm tall; leaf blades 1–2(–3.6) mm wide; scales of spikelets pale brownish to hyaline; stamens 2; achenes light brown. Moist, typically open or disturbed sites; scattered in Pineywoods, also Wood Co. (BRIT) in Post Oak Savannah and Grayson Co. (Johnston 1966) in Red River drainage; also Denton Co. (BRIT) in Cross Timbers and Prairies; widespread in e 1/2 of the U.S. Sep–Nov. [*Cyperus tenuifolius* (Steud.) Dandy, *K. tenuifolia* Steud.] Reported to be a weed of lawns and croplands in some areas (Tucker 1987).



Fuirena simplex var. simplex [SID, TOR]



Fuirena squarrosa [SID]



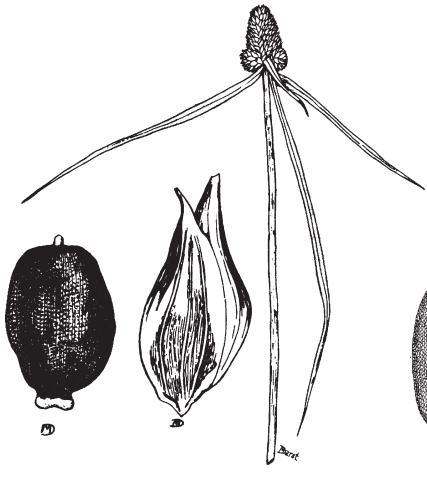
Isolepis carinata [BT2, MAS]



Isolepis cernua [ABR, JEP]



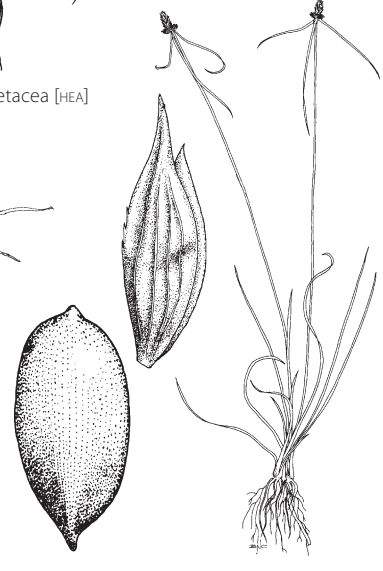
Isolepis pseudosetacea [HEA]



Kyllinga odorata [GWO]



Kyllinga brevifolia [BT2]



Kyllinga pumila [GWO]

LIPOCARPHA R. Br. HALFCHAFF SEDGE

Tufted, delicate, glabrous annuals 1–15(–20) cm tall; leaves basal, 2, one without blade; ligules absent; inflorescence of 1–3 ovoid, sessile, spikelet-like spikes 1–5(–8) mm long, the spikes of numerous single-flowered spikelets whose scales (here called floral scales in contrast to the included hyaline scales) are spirally and imbricately arranged to make the whole spike appear like a single spikelet; in ours inside each floral scale there is 1 inconspicuous hyaline scale or bracteole often split and torn by or adhering to the achene; floral scales with 2–3 prominent veins (often with two more conspicuous medial veins and a less conspicuous central vein); inflorescence subtended by 1–3 bracts, 1 of these much larger and appearing like a continuation of the culm, the inflorescence thus appearing lateral; stamen 1; stigmas 2; achenes narrowly obovoid to obovoid, terete, 0.4–0.8 mm long, granular, very minutely apiculate, without a tubercle.

A genus of ca. 35 species, pantropical and in some wet warm temperate regions (Tucker 2002b). The inflorescences and flowers are much reduced. Recent molecular studies (e.g., Muasya et al. 2002) suggest that it is embedded within a paraphyletic *Cyperus*. The species treated here as *Lipocarpha* have historically been segregated into the genus *Hemicarpha* (e.g., Friedland 1941), but according to a number of authors (e.g., Haines & Lye 1971; Tucker 1987, 2002b), the two extremely similar groups are more appropriately merged. However, Kral (2001) disagrees and maintains them as separate genera. According to Friedland's (1941) range map, three difficult to distinguish taxa occur in East TX. He recognized these as varieties of *Hemicarpa micrantha* and said that in order to key them, "... the spikelet must be boiled and then dissected under a binocular dissecting scope capable of at least a magnification of forty diameters." Tucker (1987, 2002b) and Kartesz (1994, 1999) recognized these taxa as species (*Lipocarpha aristulata* (Coville) G.C. Tucker, *L. drummondii* (Nees) G.C. Tucker, and *L. micrantha* (Vahl) G.C. Tucker). Using the key from Friedland (1941), we were completely unable to consistently distinguish the taxa; the following detailed key was developed by S.D. Jones using TX material. All three species are essentially identical vegetatively; reproductive material is thus essential for identification to species. The inconspicuous hyaline scale or bracteole inside each floral scale is not homologous to the scales or bristles of other members of the Cyperaceae (e.g., *Scirpus*). Rather, each "floret" of the "spikelet" is actually a highly reduced 1-flowered spikelet similar to those in *Kyllinga*. The hyaline scales are thus homologous to the sterile scales found in the spikelets of *Kyllinga* (Koyama 1982; Hooper 1986; Tucker 1987, 2002b; Goetghebeur & Van den Borre 1989; Yatskievych 1999). Therefore, while *Lipocarpha* superficially appears closer to such taxa as *Fimbristylis* or *Scirpus*, its actual relationships are with such genera as *Kyllinga* and *Cyperus* (Bruhl 1995; Yatskievych 1999). All three East TX species are inconspicuous and rather rarely collected. (Greek: *lipo*, to fall, and *carpha*, chaff, in reference to the deciduous transparent second scale of the spikelet in many species—Tucker 2002b)

REFERENCES: Friedland 1941; Svenson 1957; Haines & Lye 1971; Lawson 1973; Koyama 1982; Hooper 1986; Tucker 1987; Goetghebeur & Van den Borre 1989; Tucker 2002b.

1. Mid-upper floral scales of the spikelet-like spikes mostly tapering into a conspicuous awn 1/4 as long as to longer than the scale body; achenes obovoid, maturing dark reddish brown to blackish; inner hyaline scale as long as or longer than the achene and cupped around it, veinless _____ **L. aristulata**
1. Mid-upper floral scales of the spikelet-like spikes acute-triangular apically, awnless or at most with a short mucro; achenes obovoid or narrowly obovoid, maturing brown to reddish brown (but not as dark reddish brown to blackish as in *L. aristulata*); inner hyaline scale as long as the achene or longer and cupped around it OR shorter than the achene OR absent, if present, then 3–5-veined.
   2. Apices of floral scales incurved over top of the achenes; achenes not normally readily visible at maturity, narrowly obovoid; inner hyaline scale as long as or longer than the achene and cupped around it, not bifurcated; scales usually separating with achene _____ **L. drummondii**
   2. Apices of floral scales spreading, barely exceeding the achenes; achenes normally readily visible at maturity, obovoid; inner hyaline scale much shorter than achene or absent, usually bifurcated; inner scale usually left behind attached to the rachis when achene is shed _____ **L. micrantha**

Lipocarpha aristulata (Coville) G.C. Tucker, (bearded or awned), AWNED HALFCHAFF SEDGE. Spikelet-like spikes 1–5(–8) mm long; floral scales widest near middle; inner hyaline scale 0.5–0.8 mm long. Disturbed wet soils, exposed shorelines, usually sandy soils; Comal and Travis (Turner et al. 2003) cos. near sw margin of East TX; also range map given by Friedland (1941) clearly showed this taxon within East TX (counties not specified); scattered in w 2/3 of TX; w U.S. from MI, MO, and TX w to the Pacific coast. Jun–Nov. [*Hemicarpha aristulata* (Coville) Smyth, *Hemicarpha micrantha* (Vahl) Pax var. *aristulata* Coville]

Lipocarpha drummondii (Nees) G.C. Tucker, (for its discoverer, Thomas Drummond, 1780–1835, Scottish botanist and collector in North America), DRUMMOND'S HALFCHAFF SEDGE, COMMON HEMICARPHA. Spikelet-like spikes 1–5(–6) mm long; floral scales widest beyond middle. Disturbed wet soils, exposed shorelines, usually sandy soils; Smith (BRIT), Bastrop, Harrison, Lee, Leon, Travis, and Tyler (Turner et al. 2003) cos.; also Gulf Prairies and Marshes and e Cross Timbers and Prairies; c U.S. from OH s to TX w to NE and AZ. May–Nov. [*Hemicarpha drummondii* Nees, *H. micrantha* (Vahl) Pax var. *drummondii* (Nees) Friedl.]

Lipocarpha micrantha (Vahl) G.C. Tucker, (small-flowered), SMALL-FLOWER HALFCHAFF SEDGE. Spikelet-like spikes 1–3(–5) mm long; floral scales widest at or beyond middle. Moist sandy soils, seasonally wet areas, exposed shorelines; Brazos, Harrison, Henderson (BRIT), and Lee (Turner et al. 2003) cos.; also Gulf Prairies and Marshes (Calhoun Co.—BRIT), Cross Timbers and Prairies (Bosque, Hood, and Parker (BRIT) cos.) and Trans-Pecos; s Canada and widespread in the U.S. except the n Rocky Mt. area. Mar–Oct. [*Hemicarpha micrantha* (Vahl) Pax, *Hemicarpha micrantha* var. *minor* (Schrad.) Friedl., *Scirpus micranthus* Vahl]

RHYNCHOSPORA Vahl

BEAK-RUSH, HORNED-RUSH, BEAK SEDGE, WHITE-TOP

Tufted or clump-forming, sometimes rhizomatous perennials (rarely annuals), glabrous or with scabrous-margined leaf blades; culms (= stems) triangular in cross section; leaves basal and cauline; spikelets narrowly ovoid to fusiform or roundish, usually brownish or white (in a few species) or dark brown to nearly black (in a few species), usually 1–few-flowered, in loose or compact clusters, in spike-like or open panicles, or in a head-like cluster, the inflorescence with 1–few leafy bracts; scales of spikelets spirally arranged, the lower (1–)2–3 usually sterile; uppermost 1–2 florets usually without pistil; perianth of bristles or absent; achenes flattened to lenticular to nearly round in cross section, with a conspicuous tubercle or "beak" (= hardened and persistent style base) at the apex (hence the name BEAK-RUSH).

A genus of over 250 species nearly cosmopolitan in distribution, with greatest diversity in the New World tropics; they are mostly plants of sunny places with wet, acidic soils (Kral 2002c). Temperate North America is rich in species, with ca. 60 in the se U.S. (Tucker 1987). According to Yatskievych (1999), species of this genus "are generally considered poor forage for livestock. The tiny sharp teeth along the leaf margins are composed of silica, and they make the plants relatively unfit for consumption." However, many marshland species provide food for migratory waterfowl (Kral 2002c). In the key and descriptions presented here, the measurements given for achenes do not include the tubercles. (Greek: *rhyncos*, a snout, and *spora*, a seed, from the beaked achenes)
REFERENCES: Gale 1944; Godfrey & Wooten 1979; Nixon & Ward 1982; Thomas 1984, 1992; Tucker 1987; Kral 1999, 2002c; Bridges & Orzell 2000.

1. Scales of spikelets white; bracts below inflorescence with white base, the white zone conspicuous or inconspicuous; perianth bristles absent (section *Dichromena*, previously segregated as the genus *Dichromena*).
   2. Bracts exceeding spikelets 1–2(–3) in number, very narrow, mostly filiform; white zone on bract only at the very base, not longer than spikelets, inconspicuous; rhizomes absent; leaf blades 3–15 mm long, ca. 1(–2) mm broad basally, narrower (arcuate-filiform) distally _____ **R. nivea**

2. Bracts exceeding spikelets 3–10 in number, (1.5–)2.5–12 mm broad at base; white zone on bract very conspicuous, usually much longer than spikelets; rhizomes extensively creeping; leaf blades 6–27 mm long, 1.2–5.5 mm broad basally and at least 1 mm broad even ± distally.
   3. Bracts exceeding spikelets 3–6(–7) in number, the widest (basal) bract (1.4–)2–5 mm wide, the white portion (2.5–)5–20(–25) mm long; rhizomes usually not swollen at the nodes, straight; plants of neutral or basic soils _____ **R. colorata**
   3. Bracts exceeding spikelets usually (5–)7–10 in number, the widest basal bract 5–12 mm wide, the white portion 22–55 mm long; rhizomes swollen at the nodes and often bent; plants of acidic soils _____ **R. latifolia**

1. Scales of spikelets variously colored (but not white); bracts below inflorescence without white base; perianth bristles present or absent.
   4. Perianth bristles absent; achenes 0.6–1 mm long (achenes should be measured separately from tubercles); fertile flowers usually many (10 or more) per spikelet; spikelets typically borne singly on pedicels, dark brown to nearly black; plants annuals (section *Psilocarya*, species previously recognized as the genus *Psilocarya*).
      5. Achenes strongly transversely wrinkled, the wrinkles irregular and bone-colored; tubercle wider than long, ca. 1/2 or less as long as achene, 0.1–0.3 mm long; narrow portion of style not persistent beyond tubercle _____ **R. nitens**
      5. Achenes faintly wrinkled; tubercle nearly as long as wide, nearly as long as the achene, 0.5 mm long or longer; narrow portion of style usually persistent beyond tubercle _____ **R. scirpoides**
   4. Perianth bristles usually present (rarely absent), typically 6; achenes (0.8–)1–5 mm long; fertile flowers usually few (typically 1–5) per spikelet; spikelets (in most but not all species) in dense clusters, light to dark brown; plants perennial or rarely annuals.
      6. Mature spikelets conspicuously long, 15–26 mm (including exserted tubercle, 10–15 mm not including exserted tubercle); achenes 3.5–6 mm long; tubercle very long (10–20 mm long), at maturity exserted conspicuously like a bristle beyond the spikelet scales.
         7. Bristles subtending achene shorter than achene (usually ca. 1/3–2/3 as long); inflorescences usually relatively open, diffuse _____ **R. corniculata**
         7. Bristles (at least most) much longer than the achene (ca. 1.5–2.5 times as long); inflorescences with distinct tight clusters of spikelets _____ **R. macrostachya**
      6. Mature spikelets much shorter (2.5–9 mm); achenes 3 mm or less long; tubercle much shorter, usually 2.4 mm or less long (to 3–6 mm long in *R. indianolensis* and *R. tracyi*), usually not exserted conspicuously beyond the spikelet scales (slightly exserted beyond in *R. indianolensis* and *R. tracyi*).
         8. Tubercle 3–6 mm long, at maturity slightly exserted beyond the spikelet scales, ± bristle-like for its entire length and scarcely widened at base OR conspicuously widened at base; styles simple or 2-branched only at tip.
            9. Plants with slender scaly rhizomes < 2 mm thick; achenes 2.5–3(–4) mm long, 1.5–2 mm wide, the edges not crimped; tubercle ± bristle-like for its entire length, scarcely widened at base _____ **R. tracyi**
            9. Plants without rhizomes; achenes 3–4 mm long, 2–2.5 mm wide, the edges crimped; tubercle conic, its base widened and capping the summit of the achene _____ **R. indianolensis**
         8. Tubercle usually 2.4 mm or less long, not extending conspicuously beyond the spikelet scales, usually conspicuously widened at base; styles deeply divided into 2 slender stigmatic branches.
            10. Perianth bristles plumose (= with long slender lateral hairs), at least basally; tubercles narrowly to broadly conic to conic-subulate, 0.3–0.7 mm long.
               11. Spikelets borne individually on pedicels or in well-spaced clusters of 2–5, the individual spikelets usually (4–)4.5–6(–8) mm long _____ **R. oligantha**
               11. Spikelets mostly in tight clusters of 5–many, the individual spikelets 2–4(–4.5) mm long _____ **R. plumosa**

10. Perianth bristles variously smooth, with minute lateral barbs, or absent; tubercles variously shaped and of various lengths.
    12. Perianth bristles numerous (16–20), longer than the achenes _____ **R. macra**
    12. Perianth bristles 12 or fewer, longer or shorter than the achenes or absent.
        13. Perianth bristles usually with retrorse (= backward or downward, as on a fishing hook) barbs.
            14. Spikelets usually in dense globose or nearly globose clusters, the lower spikelets usually reflexed; achenes (1.8–)2–2.3(–2.4) mm long _____ **R. cephalantha**
            14. Spikelets usually in loose, turbinate (= top-shaped, inversely conical) or hemispheric clusters, the lower spikelets usually ascending or spreading (rarely reflexed); achenes 1.2–2 mm long.
                15. Each spikelet with only 1 achene; tubercle narrowly triangular-subulate, < 0.5 mm wide at base _____ **R. chalarocephala**
                15. Each spikelet usually with 2–3 achenes (if one-fruited, then an additional rudimentary floret also present); tubercle triangular-subulate, > 0.5 mm wide at base.
                    16. Achenes 1.5–2 mm long, the faces with a raised, central, pale bulge or hump; clusters of spikelets (spikelets several–many per cluster) in inflorescence usually borne in groups of more than 3; spikelets 4.5–6.5 mm long _____ **R. glomerata**
                    16. Achenes usually 1.2–1.5 mm long, the faces without a raised, central, bulge or hump, ± uniformly brown; clusters of spikelets in inflorescence borne singly or in groups of ca. 2–3; spikelets 3.5–4(–5) mm long _____ **R. capitellata**
        13. Perianth bristles with antrorse (= forward or upward) barbs or smooth (without barbs) OR perianth bristles absent.
            17. Surface of achenes smooth, without any ridges, wrinkles, pitting, or honeycomb-reticulation (use magnification).
                18. Longer perianth bristles usually half as long as the achene or shorter.
                    19. Culms and leaves usually < 1 mm wide; longer leaves equaling the flowering culms in length; culms weakly ascending to reclining, usually 50 cm or less tall; spikelets 2–3.2 mm long, with scales usually slightly notched at apex and with minute awn arising in notch (observe closely since sometimes folded and not appearing notched) _____ **R. debilis**
                    19. Culms and leaves 1–4 mm wide; leaves not as long as the flowering culms; culms stiffy erect, 40–130(–150) cm tall; spikelets (3–)3.5–5 mm long, with scales usually not notched, tipped by a minute awn _____ **R. fascicularis**
                18. Longer perianth bristles as long as to longer than the achene.
                    20. Tubercle nearly as long as the achene or slightly longer, long awl-shaped, 1.5–2 mm long _____ **R. gracilenta**
                    20. Tubercle much shorter than achene, broadly deltoid, 0.4–0.7 (–0.9) mm long.
                        21. Culms and leaves usually 1 mm or less wide, filiform; achenes 0.9–1.2 mm long, 0.6–0.8 mm wide; tubercle margins setose (= with minute bristles; use dissecting scope or strong hand lens) _____ **R. filifolia**
                        21. Culms and leaves 1.5–4 mm wide, coarser than filiform; achenes 1.3–1.9 mm long, 1–1.5 mm wide; tubercle margins not setose _____ **R. fascicularis**

17. Surface of achenes horizontally ridged, rugose (= wrinkled), pitted, or honeycombed-reticulate (use magnification).
    22. Perianth bristles absent (can be absent in *R. perplexa*); achenes 0.9 mm or less long; tubercle minute, to 0.15 mm long.
        23. Surface of achenes horizontally ridged (use hand lens or dissecting scope), not glassy in appearance _____ **R. pusilla**
        23. Surface of achenes faintly reticulate (using dissecting scope), but not horizontally ridged, somewhat glassy in appearance _____ **R. divergens**
    22. Perianth bristles usually present; achenes 1–2.2 mm long; tubercle larger, > 0.15 mm long.
        24. Culms and leaves filiform-wiry, almost thread-like, 1 mm or less wide.
            25. Perianth bristles shorter than achenes; tubercle deltoid to deltoid-conical, 0.3–0.6 mm long; spikelets 3–4(–4.5) mm long _____ **R. rariflora**
            25. Perianth bristles longer than achenes; tubercle taller and narrower, deltoid-subulate, 0.8–1.5 mm long; spikelets 4–5 mm long _____ **R. stenophylla**
        24. Culms and leaves stouter, not filiform-wiry, usually > 1 mm wide.
            26. Faces of the achenes flat or concave.
                27. Spikelets 5–7(–9) mm long; achenes 2 times as long as wide or longer, 2–2.5 mm long; tubercle 0.8–1.2 mm long _____ **R. inexpansa**
                27. Spikelets 2–3.5 mm long; achenes < 2 times as long as wide, 1–1.3 mm long; tubercle 0.2–0.5(–0.7) mm long.
                    28. Perianth bristles 6, surpassing the tubercle, often widely spreading; leaf blades 3–6 mm wide _____ **R. elliottii**
                    28. Perianth bristles 0–3(–6), absent or rudimentary, if present, < three-fourths as long as the achenes, not widely spreading; leaf blades 1.5–2.5 mm wide _____ **R. perplexa**

26. Faces of the achenes convex or swollen, sometimes with a central bulge.
    29. Inflorescence branches spreading nearly at right angles to the main inflorescence axis, the inflorescence appearing very open, each spikelet or small cluster of spikelets on a slender stalk; achenes yellowish to greenish yellow, tan, or pale brown _____ **R. miliacea**
    29. Inflorescence branches ascending, the inflorescence not as above; achenes brown to black.
        30. Spikelets 4–6(–7.5) mm long; achenes 2–2.5 mm long; plants of droughty sandhills, typically with longleaf pines _____ **R. grayi**
        30. Spikelets usually 2–4 mm long (to 5 mm long in *R. caduca*); achenes usually 1–1.8 mm long; plants of wet to seasonally moist habitats.
            31. Perianth bristles shorter than the achenes.
                32. Surface of achenes with horizontal rows of cells nearly circular in outline, brown to dark brown or almost black; summit of achenes often abruptly narrowed, with a distinct, smooth, collar-like ring or ridge fitted against the tubercle _____ **R. harveyi**
                32. Surface of achenes with horizontal rows of vertically oriented cells rectangular in outline, light brown to brown; summit of achenes usually gradually narrowed to tubercle base, usually lacking a collar-like ring or ridge.
                    33. Achenes 1–1.2 mm long, 0.8–1 mm wide; species possibly present in East TX _____ **R. microcarpa**
                    33. Achenes 1.2–1.8 mm long, 1–1.5 mm wide; species widespread and abundant in East TX.

34. Culms lax to spreading to stiffly erect, (10–)20–60(–80) cm tall; leaves usually 1–2(–3) mm wide; branchlets of the cymes terminating in small knobby glomerules, the bracts inconspicuous; spikelets (2–)2.5–3(–4) mm long, roundish, brown to dark brown; fertile spikelet scales 1.7–2.3 mm long, the midrib usually not extending past tip of scale _____ **R. globularis**
34. Culms stiffly erect, 60–100(–120) cm tall; leaves usually 2–5 mm wide; branchlets of the cymes usually terminating in dense glomerules, with setaceous bracts conspicuous (giving the inflorescence a bristly appearance); spikelets usually 3–4 mm long, elongate, reddish brown; fertile spikelet scales 2.5–3 mm long, the midrib often extending past tip of scale _____ **R. recognita**

31. Perianth bristles as long as the achenes or longer.
35. Tubercle margins smooth; achenes 1–1.2 mm long _____ **R. microcarpa**
35. Tubercle margins setose (= with minute bristles—use dissecting scope or strong hand lens); achenes 1.2–1.5 mm long.
36. Achenes nearly round to broadly obovoid, the surface with horizontal ridges (the cells oblong in outline); tubercle short deltoid; inflorescences with spikelet clusters dense; plants without evident rhizomes or with short rhizomes _____ **R. caduca**
36. Achenes ellipsoid to narrowly obovoid, the surface without horizontal ridges, merely minutely honey-combed (the cells nearly round in outline); tubercle deltoid-subulate (relatively narrower than in *R. caduca*); inflorescences with spikelet clusters mostly diffuse; plants usually with well-developed, often elongate rhizomes (to 10 cm or more long) _____ **R. mixta**

Rhynchospora caduca Elliott, (falling early, short-lived), ANGLE-STEM BEAK SEDGE, ANGLE-STEM BEAK-RUSH. Perennial 70–150 cm tall, often with short scaly rhizomes; inflorescences with spikelet clusters dense; spikelets (3–)4–5 mm long; achenes 1.3–1.5 mm long, nearly round to broadly obovoid, lenticular; tubercles 0.5–0.8 mm long, the margins with minute bristles. Ditches, other low or moist areas; mainly se part of East TX and n Gulf Prairies and Marshes, also Bowie Co. (BRIT) in Red River drainage and Gonzales Co. (Turner et al. 2003) near sw margin of East TX; also e Edwards Plateau; se U.S. from VA s to FL w to OK and TX. Apr–Nov. [*R. patula* A. Gray] This species intergrades with *R. mixta* (Kral 2002c).

Rhynchospora capitellata (Michx.) Vahl, (having a small head), BROWNISH BEAK SEDGE, POINT-BEAK BEAK-RUSH. Tufted perennial ca. 20–100 cm tall; inflorescences with clusters of spikelets usually borne singly or in groups of ca. 2–3; spikelets 3.5–4(–5) mm long; perianth bristles usually with retrorse barbs (very rarely antrorse); achenes usually 1.2–1.5 mm long, obovoid, lenticular; tubercles (0.8–)0.9–1.2(–1.6) mm long. Shorelines, boggy areas; widely scattered in East TX; se Canada and widespread in the e 1/2 of the U.S., also CA and OR. Jul–Aug. [*R. glomerata* (L.) Vahl var. *capitellata* (Michx.) Kük., *R. glomerata* var. *leptocarpa* Chapm. ex Britton, *R. glomerata* var. *minor* Britton, *R. leptocarpa* (Chapm. ex Britton) Small] This species intergrades with *R. glomerata* (Kral 2002c). Sorrie (2000) indicated that *R. leptocarpa* (Chapm. ex Britton) Small (occurring from NC s to FL w to LA) should be split from *R. capitellata*; Kral (2002c), however, noted that there is "a strong overlap" with *R. capitellata*. *Rhynchospora leptocarpa* was erroneously mapped for TX by Turner et al. (2003) (see Sorrie 2000).

Rhynchospora cephalantha A. Gray, (bearing heads), BUNCHED BEAK SEDGE. Tufted perennial 0.4–1.1(–1.5) m tall; inflorescences with spikelets in dense, globose or nearly globose, widely spaced clusters; spikelets 4–5(–6) mm long, each spikelet with only one achene; perianth bristles usually with retrorse barbs (very rarely antrorse); achenes (1.8–)2–2.3(–2.4) mm long, obovoid, lenticular; tubercle (1–)1.4–2.4 mm long, triangular-subulate, at least 0.5 mm wide at

base. Flatwood ponds (seasonally inundated depressions) within longleaf pine savannahs; Anderson, Hardin, Jasper, and Newton (BRIT) cos., typically on the Beaumont and Lissie geologic formations (Bridges & Orzell 1989a); mainly se U.S. from NJ s to FL w to TX, also NY. Aug–Nov. [*R. cephalantha* var. *attenuata* Gale] First reported in the literature for TX in 1989 (Bridges & Orzell 1989a).

Rhynchospora chalarocephala Fernald & Gale, (loose head), LOOSE-HEAD BEAK SEDGE. Tufted perennial to 1 m tall; inflorescences with spikelets usually in loose turbinate or hemispheric clusters; spikelets 3–5.5 mm long; achenes 1.4–1.7(–2) mm long, oblong-obovoid, lenticular; tubercle 1–1.6(–2) mm long. Hillside seepage bogs, typically on the Carrizo, Queen City, Catahoula, Willis, and Lissie geologic formations (Bridges & Orzell 1989a); Anderson, Angelina, Freestone, Henderson, Jasper, Newton (BRIT), Leon (Bridges & Orzell 1989a), Sabine, San Augustine, and Wood (Turner et al. 2003) cos.; se U.S. from NJ s to FL w to OK and TX. (Late Jun–) Aug–Sep(–Oct). First reported for TX in 1989 (Bridges & Orzell 1989a), but collected by Shinners as early as 1954 (*Shinners 19019*, Freestone Co.—BRIT).

Rhynchospora colorata (L.) H. Pfeiff., (colored), WHITE-TOP UMBRELLA-GRASS, STAR-RUSH WHITE-TOP SEDGE, UMBRELLA-GRASS, STAR-RUSH WHITE-TOP, NARROW-LEAF WHITE-TOP. Rhizomatous perennial to ca. 56(–70) cm tall; leaves cauline although sometimes crowded near base; inflorescence a hemispherical to globose head; bracts unequal in length, the longer ones (2.5–)5–13(–18) cm long; white zone on bracts conspicuous, (0.25–)0.5–2(–2.5) cm long; spikelets (3–)5–7(–8) mm long, with white scales; achenes ca. 1 mm long, broadly obovoid, tumidly lenticular. Open, often disturbed sites including pastures, roadsides, and savannahs, in sandy, neutral or slightly basic soils; widespread in s half of e TX n to Angelina and Leon (Turner et al. 2003) cos.; also Gulf Prairies and Marshes and Edwards Plateau.; se U.S. from VA s to FL w to AR and TX. (Spring–)Summer. Previously separated into the genus *Dichromena* [as *D. colorata* (L.) Hitchc.]. ⚙/296

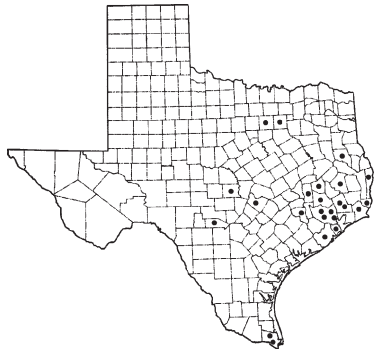
Rhynchospora corniculata (Lam.) A. Gray, (horned), HORNED BEAK-RUSH, HORNED-RUSH, SHORT-BRISTLE HORNED BEAK-RUSH. Coarse tufted perennial 0.5–1.5(–2) m tall, similar to *R. macrostachya*; culms sharply triangular; inflorescence large, with spreading branches; spikelets strikingly elongate (15–26 mm long including exserted tubercle), usually in clusters of 3–7(–14); bristles 3–6, but normally 5, unequal, ca. 2–5 mm long; achenes 3.5–5(–6) mm long, 2–3.5 mm wide, oblong-ellipsoid, the faces flattened, the margins thickened, often crimped; tubercle extremely conspicuous, long-subulate, 10–20 mm long. Mud, edge of ponds, or on decaying logs in water; widespread in e 1/3 of TX; e U.S. from DE s to FL w to IL and TX. Spring–Summer (fruit present into fall). [*R. corniculata* var. *interior* Fernald] ⚙/296

Rhynchospora debilis Gale, (weak, frail), SAVANNAH BEAK SEDGE. Delicate tufted perennial 50 cm or less tall, similar to *R. fascicularis* but shorter and less coarse; inflorescence usually of a single terminal cluster, rarely with 1–2 lateral clusters; spikelets 2–3.2 mm long; achenes 1.3–1.5 mm long, broadly obovoid to ± orbicular, lenticular; tubercle 0.3–0.4 mm long. Moist open areas, sandy or sandy peat soils; Hardin Co. (Turner et al. 2003); also Chambers Co. (Turner et al. 2003) in n Gulf Prairies and Marshes; se U.S. from VA s to FL w to TX. May–Oct. [*R. trichodes* of authors, not C.B. Clarke] In the se U.S., this species is a "common invader of cutover and bulldozed low pineland where it assumes a low-spreading habit, its many culms radiating from the common center like spokes in a wheel " (Kral 2002c). While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

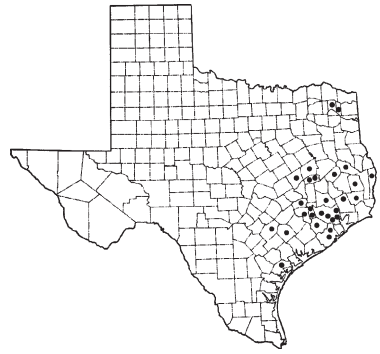
Rhynchospora divergens Chapm. ex M.A. Curtis, (wide-spreading), SPREADING BEAK SEDGE. Tufted perennial 60 cm or less tall, similar to *R. pusilla* but differing in texture of achenes (see key to species); spikelets 2–2.5(–3) mm long; perianth bristles absent; achenes 0.6–0.7 mm long,



Isolepis pseudosetacea



Kyllinga brevifolia



Kyllinga odorata



Kyllinga pumila



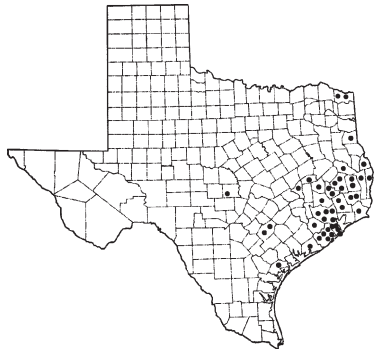
Lipocarpha aristulata



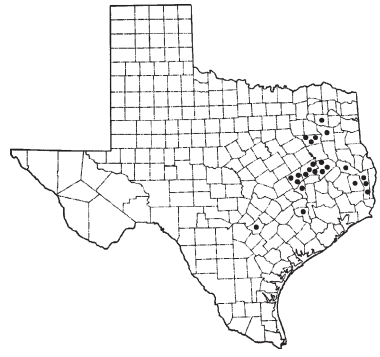
Lipocarpha drummondii



Lipocarpha micrantha



Rhynchospora caduca



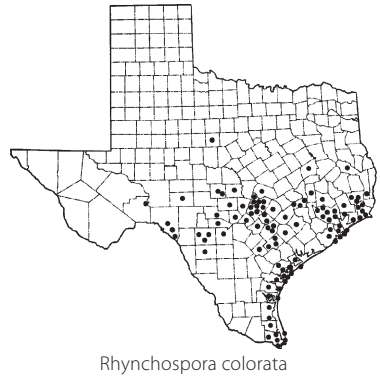
Rhynchospora capitellata



Rhynchospora cephalantha



Rhynchospora chalarocephala



Rhynchospora colorata

obovoid, lenticular; tubercle 0.1–0.15 mm long. Moist sand; Harris, Tyler (BRIT), Liberty, Angelina (Bridges & Orzell 1989a), Jasper, and Montgomery (Turner et al. 2003) cos.; also Gulf Prairies and Marshes; se U.S. from NC s to FL w to TX. May–Nov.

Rhynchospora elliottii A. Dietr., (for its discoverer, Stephen Elliott, 1771–1830, botanist and prominent citizen of South Carolina), ELLIOTT'S BEAK SEDGE. Tufted perennial 80–150 cm tall; inflorescences with terminal and lateral turbinate clusters, these often congested; spikelets (1.5–)2–3(–3.5) mm long; achenes 1–1.2 mm long, orbicular to broadly obovoid, strongly flattened; tubercle triangular or concavely triangular, 0.3–0.5(–0.7) mm long. Sands and peats of wet areas; Hardin, Liberty, Newton, Tyler (BRIT), and Jasper (Turner et al. 2003) cos.; also n Gulf Prairies and Marshes; se U.S. from NC s to FL w to TX. May–Sep. [*R. schoenoides* (Elliott) A.W. Wood] Similar to *R. microcarpa* but with taller coarser habit, long spreading perianth bristles (Kral 2002c), and achene differences (see key to species).

Rhynchospora fascicularis (Michx.) Vahl, (fascicled, clustered), FASCICLED BEAK SEDGE, STOUT BEAK-RUSH. Tufted perennial to 1.3(–1.5) m tall, similar to *R. debilis* but taller, more erect, and coarser; inflorescences with spikelets in dense, terminal and usually lateral, broadly turbinate to hemispheric clusters; spikelets (3–)3.5–5 mm long; perianth bristles shorter than to longer than achene; achenes 1.3–1.9 mm long, broadly ellipsoid to ± orbicular, lenticular; tubercle 0.4–0.7(–0.9) mm long. Ditches, savannahs, and other wet areas; Newton (BRIT), Angelina, Hardin, Jefferson, Trinity, and Tyler (Turner et al. 2003) cos.; also Gulf Prairies and Marshes; se U.S. from VA s to FL w to TX. Aug–Nov. [*R. distans* (Michx.) Vahl, *R. fascicularis* var. *distans* (Michx.) Chapm., *Schoenus fascicularis* Michx.]

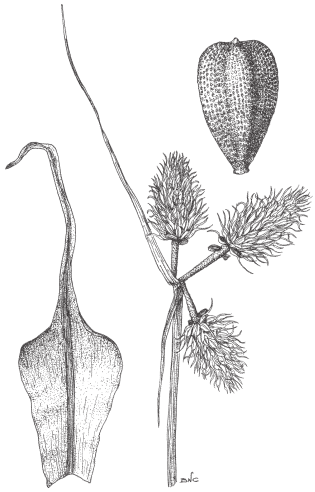
Rhynchospora filifolia A. Gray, (with thread-like leaves), THREAD-LEAF BEAK SEDGE, BRISTLE-LEAF BEAK-RUSH. Densely tufted perennial usually 33–65 cm tall; culms and leaves filiform; inflorescences with spikelets in narrowly turbinate to hemispheric, terminal and also 1–2 lateral clusters; spikelets 2.5–4 mm long; achenes 0.9–1.2 mm long, obovate, biconvex; tubercle 0.4–0.6 mm long, the margins with minute bristles. Sands and peats of wet areas; Hardin, Montgomery, Newton, Tyler (BRIT), Waller (Gale 1944), and Burleson (Turner et al. 2003) cos. in the se part of East TX; mainly se U.S. from NJ s to FL w to TX. May–Oct. [*R. fuscoides* C.B. Clarke]

Rhynchospora globularis (Chapm.) Small (globular, of a little ball or sphere), GLOBE BEAK-RUSH, GLOBE BEAK SEDGE. Tufted perennial 15–80 cm tall; inflorescences rather sparse, without a bristly appearance; spikelets 1–3-fruited, (2–)2.5–3(–4) mm long; bristles to 2/3 as long as achene; achenes 1.2–1.6 mm long, obovate, tumidly biconvex; tubercle 0.3–0.4 mm long. Varieties are not distinguished on the county distribution map. Kral (2002c) separated the 2 varieties occurring in TX as follows:

1. Spikelets broadly ovoid to subglobose; fruit [achene] body distinctly transversely wavy-rugose, intervals composed of irregular rows of vertical, rectangular alveolae _____ var. **globularis**
1. Spikelets ovoid; fruit body scarcely transversely wavy-rugose, instead with transverse, undulate rows of subisodiametric to very broadly rectangular cancellae or alveolae _____ var. **pinetorum**

var. **globularis**. Perennial 15–50 cm tall. Damp, sandy or peaty soils, disturbed sites; widespread in East TX and by far the most common variety in TX; Turner et al. (2003) mapped locations (without indicating variety) w to Fannin and Travis cos. and disjunct w to Winkler Co. (in the Trans-Pecos); also Gulf Prairies and Marshes; widespread in e U.S. from NJ s to FL w to IN and TX, also CA. May–Jun(–Sep). This taxon is often found with *R. recognita* (Kral 2002c) but can be distinguished by numerous characters (see key to species).

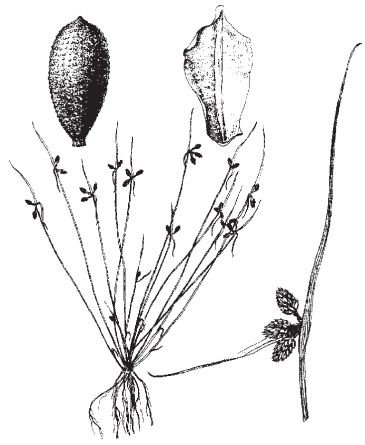
var. **pinetorum** (Britton & Small ex Small) Gale, (growing under pines). Plant 0.8 m or less tall. Moist sandy areas; Hardin Co. (BRIT—annotated by Kral), also Kral (1999) mapped two other TX locations, one in Dallas Co. in the ne part of East TX and one in Harris Co. at the se margin of East TX; se U.S. from NC s to FL w to TX. May. [*R. pinetorum* Britton & Small ex Small] While



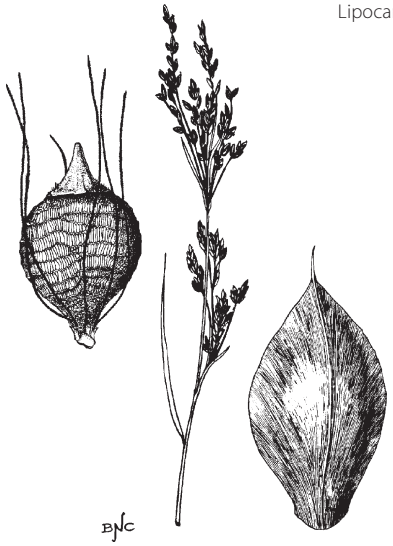
Lipocarpha aristulata [GWO]



Lipocarpha drummondii [MOH]



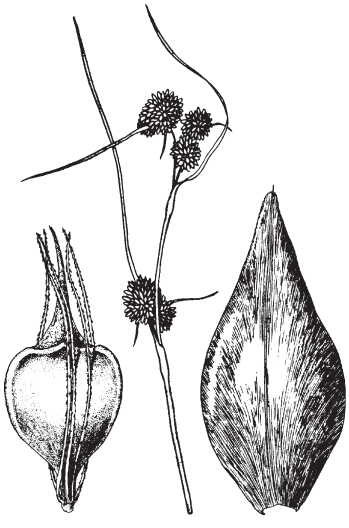
Lipocarpha micrantha [GWO]



Rhynchospora caduca [GWO]



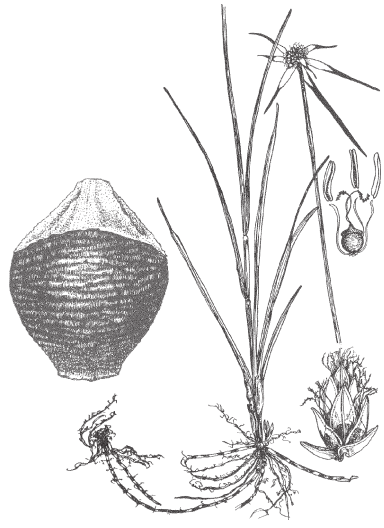
Rhynchospora capitellata [GWO]



Rhynchospora cephalantha [GWO]



Rhynchospora chalarocephala [GWO]



Rhynchospora colorata [GWO]

not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this variety to be of conservation concern in TX. ⚠

Rhynchospora glomerata (L.) Vahl, (in compact clusters), CLUSTER BEAK-RUSH, CLUSTERED BEAK SEDGE. Tufted perennial to 1.1(–1.5) m tall; inflorescences with clusters of spikelets (spikelets several–many per cluster) usually borne in groups of more than 3; spikelets 4.5–6.5 mm long; achenes 1.5–2 mm long, obovoid or orbicular lenticular; tubercle 1.3–1.8 mm long. Moist sandy or peaty soils; widespread in e 1/3 of TX; e U.S from NJ s to FL w to IL and TX. Jun–Sep. [*R. cymosa* Elliott, *R. glomerata* var. *angusta* Gale, *R. glomerata* var. *paniculata* Chapm.] According to Kral (2002c), this species is often associated with *R. capitellata* and *R. inexpansa*.

Rhynchospora gracilenta A. Gray, (slender, gracefully slight in form), SLENDER BEAK SEDGE, SLENDER BEAK-RUSH. Tufted perennial (10–)30–100 cm tall; inflorescences with spikelets in dense to sparse, narrowly turbinate to hemispheric clusters; spikelets (3.5–)4–5(–6) mm long; achenes 1.3–1.8(–2.1) mm long, broadly ellipsoid to suborbicular, lenticular; tubercle nearly as long as the achene or slightly longer, awl-shaped. Bogs, other moist areas, sandy or peaty soils; widespread in East TX, apparently most abundant in the s Pineywoods; e U.S. from NY s to FL w to OK and TX. Jun–Sep.

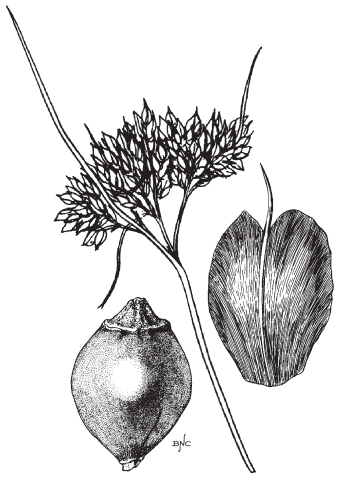
Rhynchospora grayi Kunth, (for Asa Gray, 1810–1888, botanist at Harvard and preeminent American plant taxonomist), GRAY'S BEAK SEDGE, GRAY'S BEAK-RUSH. Coarse tufted perennial usually 50–130 cm tall; leaf blades (1–)2.5–4 mm wide; inflorescences variable, loose to dense; spikelets 4–6(–7.5) mm long; achenes 2–2.5 mm long, broadly obovoid, tumid, the summit often abruptly narrowed, with a collar-like ring or ridge fitted against the tubercle ("apically buttressed to tubercle"—Kral 2002d), dark brown, the surface with wavy horizontal lines of small pit-like or raised structures (isodiametric cells); tubercle 0.4–0.6 mm long. Sandy pinelands, "droughty sandhills, mostly in the longleaf pine-deciduous scrub oak systems" (Kral 1999); Angelina, Hardin, Newton (BRIT), Liberty (Correll & Johnston 1970), Jasper, San Augustine, and Tyler (Turner et al. 2003) cos.; se U.S. from VA s to FL w to TX. Jun–Sep. This species is similar to *R. harveyi* but can be distinguished by its longer spikelets, longer achenes, and perianth bristles usually reaching at least to the tubercle base (Kral 1999).

Rhynchospora harveyi W. Boott, (for its discoverer, Francis Leroy Harvey, 1850–1900, of NY), HARVEY'S BEAK-RUSH, HARVEY'S BEAK SEDGE, PLANK BEAK-RUSH. Tufted perennial usually 50–110 cm tall; leaf blades 1.8–3 mm wide; inflorescences narrow, of 2–4 small clusters of spikelets; spikelets 3–3.5(–4) mm long, mostly 1-fruited; bristles < 1/2 length of achene; achenes 1.5–1.7 mm long, obovoid to subglobose, the summit often abruptly narrowed, with a collar-like ring or ridge fitted against the tubercle (apically "buttressed" to tubercle—Kral 2002d), tumid or lenticular, the surface with wavy horizontal lines of small pit-like or raised structures (isodiametric cells); tubercle conic, 0.3–0.5(–0.7) mm long. Areas that are at least seasonally moist in a variety of habitats ranging from basic prairie soils to more acidic, upland, wooded, sandy soils; widespread in e 1/3 of TX; mainly se U.S. from VA s to FL w to KS, OK, and TX. May–Jul(–Aug). [*R. earlei* Britton, *R. plankii* Britton ex Small]

Rhynchospora indianolensis Small, (of Indianola, TX), INDIANOLA BEAK SEDGE, INDIANOLA BEAK-RUSH. Tufted perennial to 1 m tall, without rhizomes; inflorescences terminal and axillary, the clusters nearly in umbels, some clearly pedunculate, hemispheric to nearly capitate; spikelets 6–7 mm long; achenes 3–4 mm long, obovoid, the surfaces level or concave, the margins thick, crimped; tubercle 3–4 mm long, conic, its base widened and capping the summit of the achene. Ditches, prairie swales, other wet areas; Colorado and Harris (Carr 2001) cos.; mainly Gulf Prairies and Marshes; endemic to TX (Kartesz 1999; Kral 2002c). May–Nov. This species has been considered by some authorities (e.g., Thomas 1992) to be conspecific with *R. scutellata* Griseb. a species ranging from the West Indies through Central America to Argentina; however, we are



Rhynchospora corniculata [CO1, GR4]



Rhynchospora debilis [GWO]



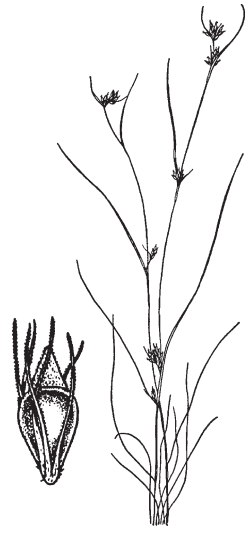
Rhynchospora divergens [HEB]



Rhynchospora elliottii [GWO]



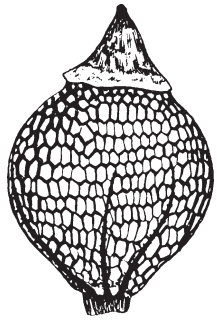
Rhynchospora fascicularis [GWO]



Rhynchospora filifolia [GLE]



Rhynchospora globularis var. globularis [GWO]



Rhynchospora globularis var. pinetorum [RHO]



Rhynchospora glomerata [GWO]

following Kral (2002c) in recognizing it as a distinct species. It is of conservation concern. (RARE 2001, 2002b: G3S3) ⚠

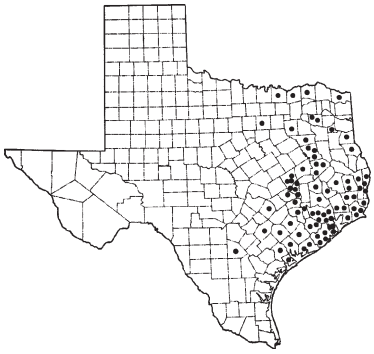
Rhynchospora inexpansa (Michx.) Vahl, (not expanded, not spreading), NODDING BEAK SEDGE, NODDING BEAK-RUSH. Tufted perennial 0.3–1.2 m tall; inflorescences with spikelet clusters on flexuous, often drooping stalks; spikelets 5–7(–9) mm long; bristles clearly surpassing the tubercle; achenes 2–2.5 mm long, narrowly oblong-ellipsoid, flattened; tubercle 0.8–1.2 mm long. Open pinelands, other low open areas; widespread in se part of East TX w to Montgomery and Walker cos. and n to Panola (Turner et al. 2003) cos.; also n margin of Gulf Prairies and Marshes; se U.S. from VA s to FL w to AR and TX. Jun–Oct.

Rhynchospora latifolia (Baldwin ex Elliott) W.W. Thomas, (broad-leaved), GIANT WHITE-TOP, SANDSWAMP WHITE-TOP. Rhizomatous perennial 25–125 cm tall; leaves mostly on basal half of culm; inflorescence a dense, hemispherical to globose head; bracts unequal in length, the longer ones 5.5–13 cm long; white zone on bracts conspicuous, 2.2–5.5 cm long; spikelets 4.5–7 mm long, with white scales; achenes 1.2–1.5 mm long, broadly obovoid to orbicular or nearly so, widest near middle, tumidly lenticular. Moist open areas, savannahs, acidic soils; se part of the Pineywoods; also n Gulf Prairies and Marshes.; se U.S. from NC s to FL w to TX. May–Aug. Previously separated into the genus *Dichromena* [as *D. latifolia* Baldwin ex Elliott] .This species is reported to be pollinated by insects (Thomas 1984). Section *Dichromena* (WHITE-TOPS) is primarily tropical—the evolution of insect pollination (white bracts, etc.) in this group may be an adaptation that allowed the group to move into tropical forests where insect and self-pollination can compensate for the lack of air movement and hence reduced wind pollination (Thomas 1984; Tucker 1987).

Rhynchospora macra (C.B. Clarke ex Britton) Small, (large, long), LARGE BEAK SEDGE, LARGE BEAK-RUSH. Tufted perennial ca. 40–80 cm tall; inflorescences with spikelet clusters turbinate to hemispheric; spikelets 4–5(–7) mm long, pale brown to nearly white; perianth bristles numerous (16–20), longer than the achenes; achenes (1.7–)2–2.1(–2.2) mm long, obovoid, lenticular; tubercle 0.8–1 mm long. Bogs and seeps, sandy soils; Robertson, Wood (BRIT), Houston (Gale 1944), Angelina, Jasper (MacRoberts & MacRoberts 1998a), Anderson, Freestone, Leon, and Newton (J. Singhurst, pers. comm.) cos.; se U.S. from SC s to FL w to TX. Aug–Oct. The spikelets of this species can sometimes be nearly white. However, *R. macra* is quite different from the truly white-spikeleted species (*R. colorata*, *R. latifolia*, and *R. nivea*), in that its bracts never have a basal white zone. This species is of conservation concern. (RARE 2001, 2002b: G3S1) ⚠

Rhynchospora macrostachya Torr. ex A. Gray, (large-spiked), TALL BEAK-RUSH, HORNED BEAK-RUSH, TALL HORNED BEAK SEDGE. Coarse perennial to 1.5(–1.7) m tall, similar to *R. corniculata* except for the longer bristles subtending the achenes; also inflorescence branches usually more stiffly erect rather than spreading, with spikelets usually in distinct tight clusters from the middle and upper nodes; spikelets strikingly elongate, to 26 mm long (including exserted tubercles); bristles usually 6, mostly 10–12 mm long, antrorsely barbed; achenes 5–6 mm long, obovoid, compressed; tubercle extremely conspicuous, 15–20 mm long. Shorelines, swamps, other wet areas; scattered in se part of East TX in Pineywoods and Post Oak Savannah and to the n in Red River drainage; also n Gulf Prairies and Marshes; widespread in e 1/2 of the U.S. May–Aug. [*R. corniculata* (Lam.) A. Gray var. *colpophylla* Fernald & Gale]

Rhynchospora microcarpa Baldwin ex A. Gray, (small-fruited), SOUTHERN BEAK SEDGE. Tufted perennial to 100 cm tall; inflorescences variable, the spikelet clusters often dense; spikelets 2–3 mm long; achenes 1–1.2 mm long, obovoid to globose, lenticular; tubercle 0.2–0.3 mm long. Wet areas; included based on citation for the Big Thicket National Preserve by National Park Service (1995a, 1995b); the only confirmed TX locations we are aware of are from the s part of the Gulf Prairies and Marshes—thus this species is possibly not a member of the East TX flora; se U.S. from NC s to FL w to TX. Jun–Sep. [*R. edisoniana* Britton ex Small]



Rhynchospora corniculata



Rhynchospora debilis



Rhynchospora divergens



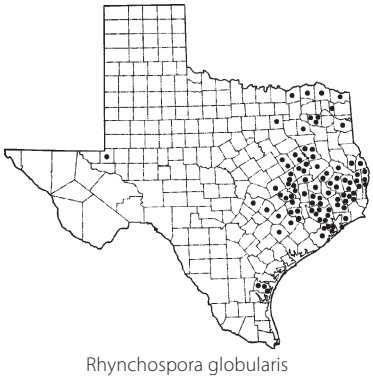
Rhynchospora elliottii



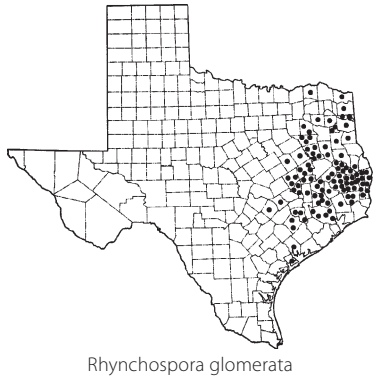
Rhynchospora fascicularis



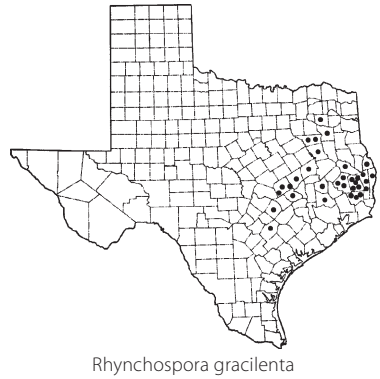
Rhynchospora filifolia



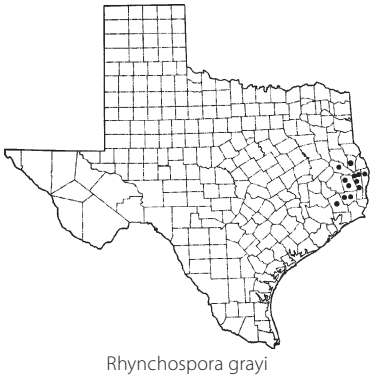
Rhynchospora globularis
(both vars.)



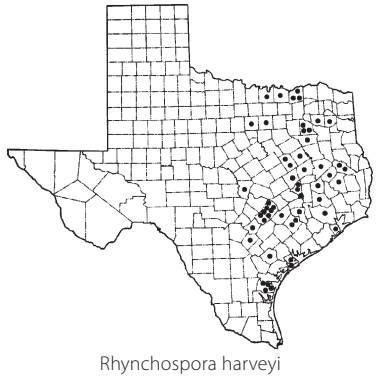
Rhynchospora glomerata



Rhynchospora gracilenta



Rhynchospora grayi



Rhynchospora harveyi



Rhynchospora indianolensis

Rhynchospora miliacea (Lam.) A. Gray, (pertaining to millet), MILLET BEAK SEDGE. Rhizomatous perennial to 1.5 m tall; inflorescence branches nearly at right angles to the main axis, the inflorescence appearing very open, each spikelet or small cluster of spikelets on a slender stalk; spikelets 2.5–3.5 mm long; achenes 1.1–1.2 mm long, broadly obovoid, tumidly biconvex; tubercle 0.2–0.3(–0.4) mm long, the margins with minute bristles. Seepage slopes in pine woodlands, other low wooded areas; Jasper, Tyler (BRIT), and Walker (Turner et al. 2003) cos. in se part of East TX; se U.S. from VA s to FL w to TX. Sep–Oct. [*Schoenus miliaceus* Lam.] This species was first reported for TX in 1982 (Nixon & Ward 1982). According to Kral (2002c), "The ultimate branches in *Rhynchospora miliacea* typically terminate in only one or two spikelets, the scales of which fall quickly, and the exposed fruits look like short miniature strings of beads." (TOES 1993: IV) ⚠

Rhynchospora mixta Britton, (mixed), MINGLED BEAK SEDGE. Rhizomatous perennial to 100 cm tall, the slender rhizomes often to 10 cm or more long; inflorescences with spikelet clusters mostly diffuse; spikelets usually 3–4 mm long; achenes 1.2–1.5 mm long, ellipsoid to narrowly obovoid, lenticular; tubercle 0.5–0.6(–0.8) mm long, the margins with minute bristles. Wet woods; Hardin, Harris, Jasper, Newton, Orange, Polk, San Jacinto (BRIT), Montgomery, Nacogdoches, and Walker (Turner et al. 2003) cos. in the se part of East TX; se U.S. from NC s to FL w to TX. May–Sep. [*R. prolifera* Small] This species can be confused with *R. caduca* (see key to species).

Rhynchospora nitens (Vahl) A. Gray, (shining), SHORT-BEAK BALD-RUSH, SHORT-BEAK BEAK SEDGE, BALD-RUSH. Glabrous annual 15–80(–100) cm tall; spikelets 4–6(–9) mm long, with numerous scales; perianth bristles absent; achenes 0.7–1 mm long, ca. as broad as long, nearly orbicular, tumidly lenticular; tubercle much wider than long. Wet open areas, sandy or sandy peat soils; Milam (BRCH), Hardin, and Jefferson (Turner et al. 2003) cos.; also Gulf Prairies and Marshes; scattered in the e U.S. w to MI and TX. Jul–Aug. Previously segregated into the genus *Psilocarya* [as *P. nitens* (Vahl) A.W. Wood or *P. portoricensis* Britton]

Rhynchospora nivea Boeck., (snowy, white), SNOWY WHITE-TOP SEDGE, SHOWY WHITE-TOP. Tufted glabrous perennial 7–30(–40) cm tall; inflorescence a small head of ca. 3–11 spikelets; longer bracts (0.7–)1.7–3.7(–6) cm long; white zone only at the very base of bract; spikelets 3.5–7(–8) mm long, with white scales; achenes 0.8–1 mm long, broadly obovoid, tumidly lenticular. Creek beds on limestone, wet areas, basic soils; Bell, Travis (BRIT), Hill (White et al. 1998b), Bexar, Comal, Dallas, Gonzales, Hays, Walker, and Williamson (Turner et al. 2003) cos., also collected along Turtle Creek, Dallas (Austin Chalk) in 1881 or 1882 by Reverchon, noted as "very rare" and not found there since (Thomas 1984; Mahler 1988); also Cross Timbers and Prairies and Edwards Plateau; OK and TX. Apr–Oct. Previously separated into the genus *Dichromena* [as *D. nivea* (Boeck.) Boeck. ex. Britton and *D. reverchonii* S.H. Wright]. Bees and flies have been observed visiting and presumably pollinating this species (Thomas 1984).

Rhynchospora oligantha A. Gray, (few-flowered), FEW-FLOWER BEAK-RUSH, FEATHER-BRISTLE BEAK SEDGE. Densely tufted perennial to 40 cm tall; inflorescences very sparse, with spikelets borne individually on pedicels or in well-spaced clusters of 2–5; spikelets usually (4–)4.5–6(–8) mm long; perianth bristles plumose at least near base; achenes (1.7–)2.2–2.5(–2.6) mm long, ellipsoid-obovoid, tumidly lenticular, with a distinctive neck at apex, narrowed and then flaring; tubercle 0.4–0.7 mm long. Swamps, bogs, pine savannahs; scattered in the Pineywoods and Post Oak Savannah; mainly se U.S. from N.J. s to FL w to TX. May–Aug.

Rhynchospora perplexa Britton, (puzzling, tangled), PINELAND BEAK SEDGE. Tufted perennial to 110 cm tall; inflorescences variable, with spikelet clusters often widely spaced; spikelets 2–3 mm long; perianth bristles 0–3(–6), absent or rudimentary; achenes 1–1.3 mm long, orbicular to broadly obovoid, strongly flattened; tubercles 0.2–0.3 mm long. Lake and pond margins, depressions, seeps, sandy or peaty soils; s part of East TX n to Leon Co. (Turner et al. 2003); also



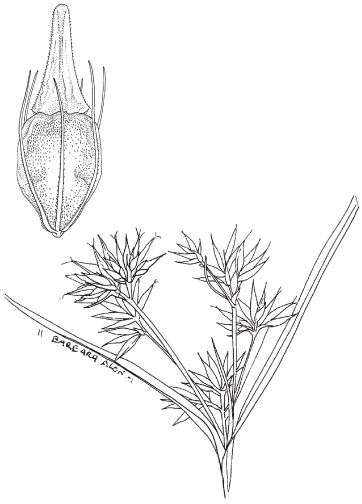
Rhynchospora gracilenta [GWO]



Rhynchospora grayi [GLE]



Rhynchospora harveyi [BT3, GR3]



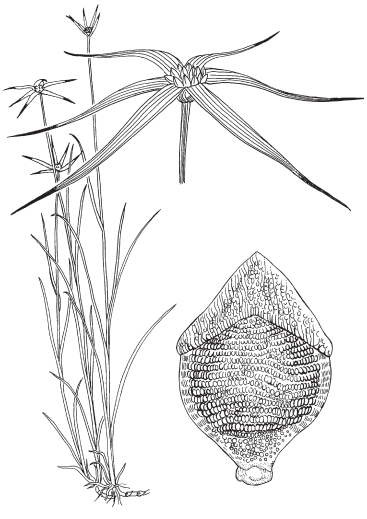
Rhynchospora indianolensis [FNA]



Rhynchospora inexpansa [GWO]



Rhynchospora macrostachya [CO1]



Rhynchospora latifolia [FNA]



Rhynchospora macra [GWO]

Gulf Prairies and Marshes; se U.S. from VA s to FL w to TX. Mostly May–Oct. [*R. perplexa* var. *virginiana* Fernald] Correll and Johnston (1970) questioned whether this species was distinct from *R. microcarpa*. However, according to Kral (2002c), the achenes of *R. perplexa* are "flattened, with fewer and much coarser transverse ridges, the intervals with very narrow vertical alveolae. The perianth in most instances is absent or rudimentary." This is in contrast to the achenes of *R. microcarpa*, which are biconvex with more transverse ridges (8 or more), the intervals more coarsely alveolate; in addition, in *R. microcarpa* the "perianth bristles are 6, evident, extending at least halfway up the fruit body."

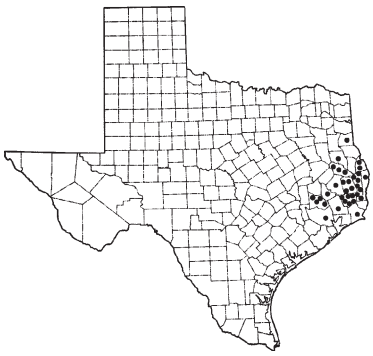
Rhynchospora plumosa Elliott, (feathery, plumed), PLUMED BEAK SEDGE. Tufted perennial ca. 20–80 cm tall; inflorescences variable, with spikelet clusters sparse to dense; spikelets 2–4(–4.5) mm long; perianth bristles plumose; achenes (1.2–)1.4–1.8(–2) mm long, obovoid to ellipsoid, tumid; tubercle ca. 0.3–0.5 mm long. Moist to dry sandy soils, typically in pine woods; Hardin, Jasper, Newton, Tyler (BRIT), and Bexar (Gale 1944) cos.; se U.S. from DE s to FL w to TX. Mar–Oct. [*R. semiplumosa* A. Gray] Kral (2002c) indicated that while this species displays two morphs, one shorter and with more filiform leaves, numerous intergrades prevent formal recognition of infraspecific taxa.

Rhynchospora pusilla Chapm. ex. M.A. Curtis, (very small), FAIRY BEAK SEDGE, LITTLE BEAK-RUSH. Tufted perennial to 50(–60) cm tall; inflorescences with 1–2(–3), dense to open, narrowly to broadly turbinate spikelet clusters; spikelets 2–3 mm long; perianth bristles absent; achenes (0.5–)0.6–0.9 mm long, obovoid, lenticular; tubercle 0.05–0.1 mm long. Moist sand or peat, low wet areas; Hardin, Harris, Jasper, Newton (BRIT), Angelina, Leon, Polk, Trinity, and Tyler (Turner et al. 2003) cos. in the se part of East TX; also Gulf Prairies and Marshes; se U.S. from NC s to FL w to TX. Jun–Sep. [*R. intermixta* C. Wright]

Rhynchospora rariflora (Michx.) Elliott, (sparsely- or few-flowered), FEW-FLOWER BEAK SEDGE, THREAD BEAK-RUSH. Delicate, densely tufted perennial to 60 cm tall, with compact slender rhizomes, similar to *R. stenophylla*; culms and leaves filiform-wiry, almost thread-like, 1 mm or less wide; inflorescences loose, sparse; spikelets 3–4(–4.5) mm long; achenes (1–)1.3–1.4(–1.5) mm long, obovoid, tumidly lenticular; tubercle 0.3–0.6 mm long. Bogs, other open wet areas; widespread in se part of East TX; also n edge of Gulf Prairies and Marshes; mainly se U.S. from NJ s to FL w to OK and TX. May–Jun. [*Schoenus rariflorus* Michx.]

Rhynchospora recognita (Gale) Kral, (acknowledged), COARSE-GLOBE BEAK SEDGE. Tufted perennial 60–100(–120) cm tall; culms stiffly erect; inflorescences with clusters of spikelets in groups, the spikelet clusters "exceeded by involucral bractlets giving them a 'bristly' look" (Kral 1999); spikelets usually 3–4 mm long; achenes usually 2–2.3 mm long, obovoid to suborbicular, tumidly lenticular, the surface horizontally rugose, with horizontal rows of vertically rectangular cells; tubercle 0.5–0.7 mm long. Moist sandy areas, including flatwoods, savannahs, ditches, and shorelines, aggressively invading disturbed areas; scattered in se portion of East TX n to Van Zandt Co. (BRIT); also Gulf Prairies and Marshes; widespread in the e 1/2 of the U.S., also CA. Spring–summer(–early fall). [*R. globularis* (Chapm.) Small var. *recognita* Gale; *R. obliterata* Gale] Kral (2002d) indicated that *R. recognita* sometimes produces sterile spikelets. This species is similar to *R. globularis* and the two are sometimes found together; however, "there are no evidences of intergradation" (Kral 1999). According to Kral (1999), "*R. recognita*, taller and more robust, puts its bristly looking rusty spikelet clusters at a level well above the lower, more lax and spreading culms of darker-spikeleted *R. globularis*." Kral (pers. comm.) notes that *R. compressa* J. Carey ex Chapm. (FLAT-FRUIT BEAK SEDGE), closely related to *R. recognita*, occurs in LA and is probably in East TX. *Rhynchospora compressa* is coarser, has blunter fertile scales less likely to have an excurrent midrib, and has the fruit flatter.

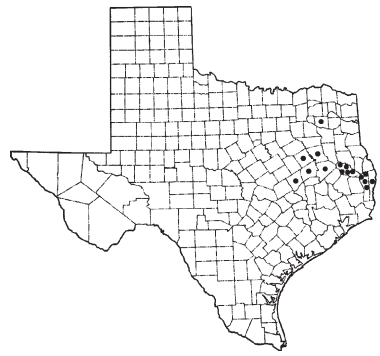
Rhynchospora scirpoides (Torr.) A. Gray, (resembling *Scirpus*, bulrush), LONG-BEAK BEAK SEDGE. Glabrous annual to ca. 70(–100) cm tall; inflorescences rather diffuse; spikelets 3–6(–8) mm



Rhynchospora inexpansa



Rhynchospora latifolia



Rhynchospora macra



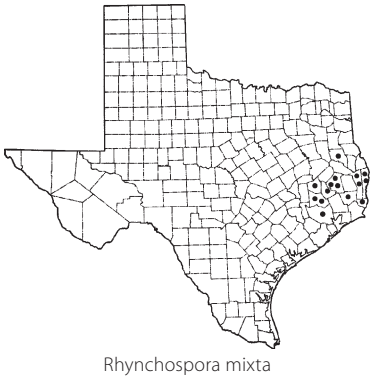
Rhynchospora macrostachya



Rhynchospora microcarpa



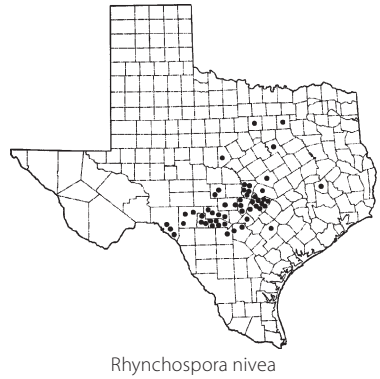
Rhynchospora miliacea



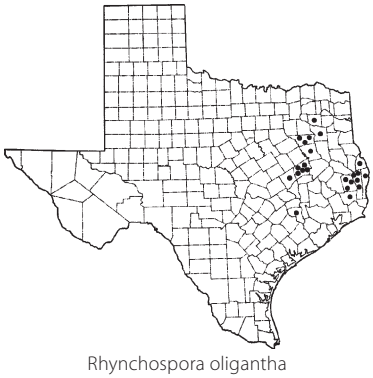
Rhynchospora mixta



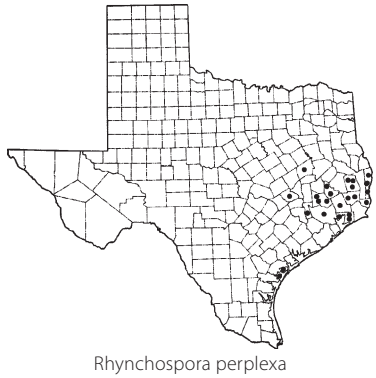
Rhynchospora nitens



Rhynchospora nivea



Rhynchospora oligantha



Rhynchospora perplexa



Rhynchospora plumosa

long, with numerous scales; perianth bristles absent; achenes 0.6–1 mm long, ± orbicular, tumidly lenticular; tubercle nearly as long as wide, from 0.5 mm long to ± as long as achene. Marshy or other wet areas, lake margins, disturbed wet sites in longleaf pine savannahs, sandy or sandy peat soils; Jasper, Newton (BRIT), Henderson, Houston, and Leon (Bridges & Orzell 1989a) cos.; scattered in the e U.S. w to WI and TX. Summer–Sep. Previously separated into the genus *Psilocarya* [as *P. scirpoides* Torr.]. First reported for TX in 1989 (Bridges & Orzell 1989a). This species is most frequent in the glaciated north central U.S., but "has isolated localities in most southeastern states" (Bridges & Orzell 1989a).

Rhynchospora stenophylla Chapm., (narrow-leaved), COASTAL-PLAIN BEAK SEDGE. Delicate, densely tufted perennial to 60(–90) cm tall, with compact rhizomes, similar to *R. rariflora*; culms and leaves filiform-wiry, almost thread-like, 1 mm or less wide; inflorescences loose, sparse; spikelets 4–5 mm long; achenes ca. 1.3–1.5 mm long, obovoid, tumidly lenticular; tubercle deltoid-subulate, 0.8–1.5 mm long. Peat bogs or adjacent areas, usually associated with the Eocene Queen City Sand; Anderson, Wood (Bridges & Orzell 1989a), Angelina (Turner et al. 2003), Freestone, and Leon (J. Singhurst, pers. comm.) cos.; se U.S. from NC s to FL w to TX. Jun–Aug.

Rhynchospora tracyi Britton, (named for the collector of the type specimen, Samuel M. Tracy, 1847–1920, botanist-agriculturist and namesake of the S.M. Tracy Herbarium (TAES) at Texas A&M Univ.), TRACY'S BEAK SEDGE. Perennial to 1.2 m tall; rhizomes long, slender; inflorescences terminal, of 1–4 dense, head-like clusters; spikelets 5–6 mm long; achenes 2.5–3(–4) mm long, obcordiform, compressed, the edges not crimped; tubercle 4–6 mm long, ± setose (= with minute bristles) for its entire length, scarcely widened at base. Open flatwood ponds, typically on the Beaumont and Lissie geologic formations (Bridges & Orzell 1989a); Newton, Tyler (BRIT), Hardin, and Jasper (Bridges & Orzell 1989a; Turner et al. 2003) cos.; se U.S. from NC s to FL w to TX. Late spring–fall. First reported for TX in 1989 (Bridges & Orzell 1989a). Kral (2002c) noted that this species can form extensive clones using its rhizomes and that its "wandlike, terete, supple culms, and round-capitate clusters of spikelets suggest a rush more than a sedge."

SCHOENOPLECTUS (Rchb.) Palla

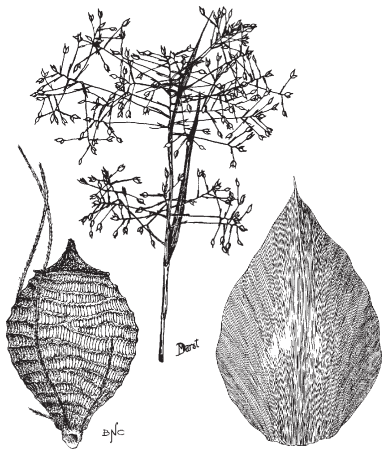
BULRUSH, NAKED-STEM BULRUSH, TULE, CLUB-RUSH

Rhizomatous perennials (*S. saximontanus*, which is rare in East TX, can be annual) of wet areas or in water; plants 0.3–3(–5) m tall (0.09–0.65 m tall in *S. saximontanus*), glabrous or nearly so; culms (= stems) sharply triangular or bluntly trigonous to nearly round in cross section; leaves all basal or rarely one on culm, with rudimentary to well-developed blades or rarely blades absent; ligules present; inflorescence of one–many sessile or pedicelled spikelets, if many in an open panicle, the inflorescence often appearing lateral, often with a single, erect, modified leaf (= involucral bract) appearing like a continuation of the culm; scales of spikelets spirally arranged, awnless to short-awned; perianth of bristles present or absent (in *S. saximontanus*); achenes plano-convex or biconvex to strongly trigonous, without a tubercle but with a short apical beak.

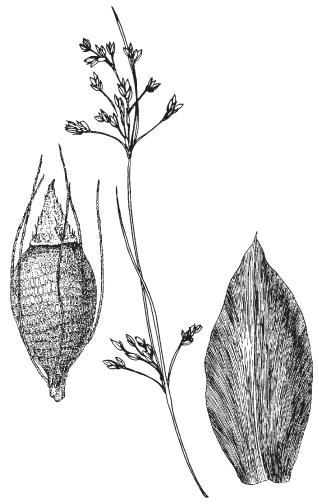
A cosmopolitan genus of ca. 77 species (Smith & Hayasaka 2001; Smith 2002b); 15 are native to North America and 2 have been introduced. Thirteen species are known to occur in TX (Smith 2002c; S.G. Smith, pers. comm.). Previously included in *Scirpus* (e.g., Kartesz 1994) and, according to some, better treated as a section or subgenus in *Scirpus* in the broad sense. We are following Smith (1995, 2002b) and Jones et al. (1997) in recognizing this segregate of *Scirpus* at the generic level. This approach is supported by phylogenetic studies (e.g., Bruhl 1995; Muasya et al. 2000b) which suggest that *Scirpus* sensu lato is polyphyletic. However, molecular evidence (e.g., Muasya et al. 2000b) suggests that *Schoenoplectus* itself is paraphyletic and that further work is needed to resolve relationships within this taxonomically complex group. Some species can be ecological dominants in wetlands and provide valuable food and habitat for wildlife (Smith 2002b). According to Yatskievych (1999), the "seeds of *Schoenoplectus* species



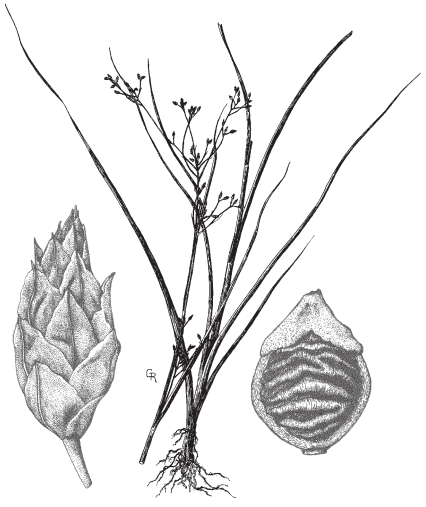
Rhynchospora microcarpa [GWO]



Rhynchospora miliacea [GWO]



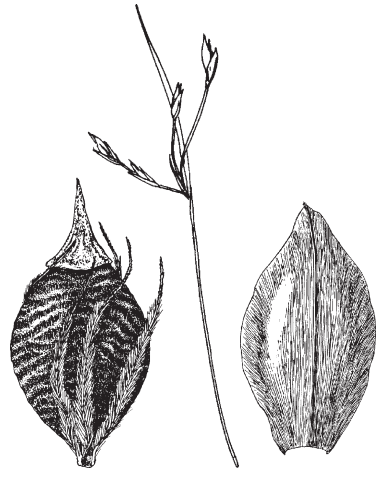
Rhynchospora mixta [GWO]



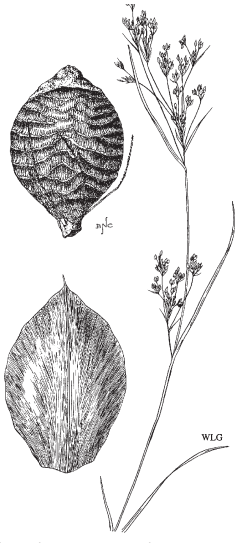
Rhynchospora nitens [GWO]



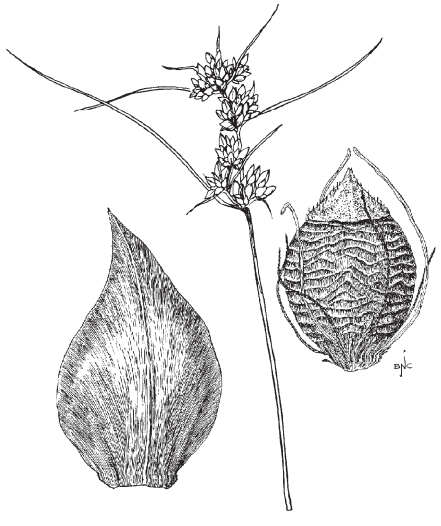
Rhynchospora nivea [CO1]



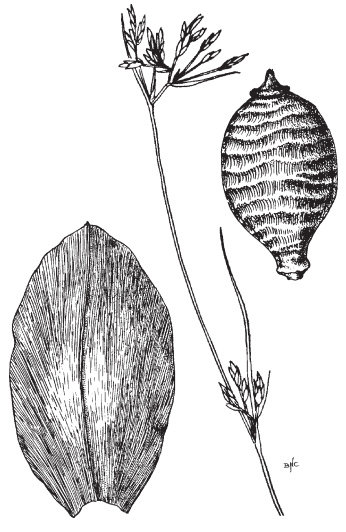
Rhynchospora oligantha [GWO]



Rhynchospora perplexa [GLE, GWO]



Rhynchospora plumosa [GWO]



Rhynchospora pusilla [GWO]

provide food for waterfowl, which disperse these bulrushes both in mud on their feet and feathers and as undigested seeds in their droppings." *Schoenoplectus* species were also extensively used by Native Americans in making baskets, mats, and roof thatching; *S. californicus* (known in South America as TOTORA) is still used for making the famous boats (balsas) seen on Lake Titicaca (Beetle 1950; Heiser 1978). (Greek: *schoeno*, a reed or rush-like, and *plectus*, twine, braid, plaited, twisted, or woven, in reference to the use of the culms in making useful objects (Smith 2002b) or possibly alluding to the mat-forming rhizomes of some species)

REFERENCES: Chase 1904; Beetle 1941, 1943, 1947; Koyama 1962, 1963; Smith 1969, 1995, 2002b; Dabbs 1971; Schuyler 1971, 1974; Raynal 1976; Heiser 1978; Tucker 1987; Shay et al. 1988; Strong 1993, 1994; Browning et al. 1995a; Bruhl 1995; Smith & Yatskievych 1996; Yatskievych 1999; Macía & Balslev 2000; Muasya et al. 2000b; Smith & Hayasaka 2001; O'Kennon & McLemore 2004; Smith et al. 2004.

1. Plants 9–65 cm tall; culms 0.5–1.5 mm thick near base; perianth bristles absent; achenes with ca. 10–20 prominent (use hand lens), transverse, wavy, mostly sharp ridges _____ **S. saximontanus**
1. Plants 30–500 cm tall; culms 2–23 mm thick near base; perianth bristles present; achenes smooth or nearly so.
   2. Inflorescences unbranched and all spikelets sessile; culms 2–6 mm thick near base, strongly triangular in cross section.
      3. Spikelet scales with apices notched 0.1–0.4 mm deep and awns 0.2–0.6 mm long; distal leaf blade much shorter than to equaling (rarely 1.5 times as long as) its sheath; inflorescence usually with only a single bladed bract, the blade 1–6 cm long (other bracts without blades) culms with sides usually noticeably concave when fresh; achenes 1.8–2.8 mm long _____ **S. americanus**
      3. Spikelet scales with apices notched (0.3–)0.5–1 mm deep and with awns (0.5–)1.5(–2.5) mm long; distal leaf blade (equaling–)2–5 times as long as its sheath; inflorescence with 1–2 much-reduced bracts (with blades reduced but present) in addition to the main bract, the blade of which is (1–)5–20 cm long; culms with sides usually flat or only slightly concave; achenes (2–)2.5–3.3 mm long long _____ **S. pungens**
   2. Inflorescences branched AND/OR some spikelets distinctly pedicelled; culms 5–23 mm thick near base, strongly to bluntly triangular or nearly round in cross section.
      4. Spikelets usually 8(–20) or fewer per inflorescence; scales of spikelets (4.5–)5–7 mm long, without an apical notch; culms sharply triangular in cross section, 5–9 mm thick near base; plants 0.6–1.5(–2) m tall; achenes 3–5 mm long _____ **S. etuberculatus**
      4. Spikelets 3–200 per inflorescence; scales of spikelet 2–4 mm long, notched at apex (note that a short awn can extend from the notch); culms nearly round to bluntly triangular in cross section, 8–23 mm thick near base; plants 1–5 m tall; achenes 1.5–2.6 mm long.
         5. Achene bristles 2–4 (2–3 different appearing stamens also present), with closely spaced lateral projections; culms bluntly triangular in cross section at least just below inflorescence when fresh; blades of distal leaves absent (sheath only) or to 2 cm long _____ **S. californicus**
         5. Achene bristles usually 4–6 (2–3 different appearing stamens also present), with well-spaced barbs; culms nearly round in cross section just below inflorescence when fresh; blades of distal leaves 0.2–22 cm long.
            6. Spikelets solitary or in clusters of 2–3, commonly all solitary; scales of spikelets 2–3.2(–3.5) mm long, often nearly smooth (but sometimes with reddish spots); awn of spikelet scales usually straight, 0.8 mm or less long _____ **S. tabernaemontani**
            6. Spikelets in clusters of 2–8 or some solitary; scales of spikelets 3–4 mm long, with conspicuous elongate reddish glutinous spots (under a hand lens); awn of spikelet scales usually bent or contorted, 0.5–2 mm long _____ **S. acutus**

Schoenoplectus acutus (Muhl. ex Bigelow) Á. Löve & D. Löve, (acute, sharp-pointed), HARD-STEM BULRUSH, ALKALI TULE, GREAT BULRUSH, HARD-STEM CLUB-RUSH. Perennial 0.8–3 m tall, forming

extensive colonies from stout creeping rhizomes; culms usually firm, not easily compressed, round in cross section; inflorescence with 3–190 spikelets; spikelets 6–24 mm long, sessile or short-pedicelled, the pedicels, if present, shorter than the spikelets; achenes plano-convex or unequally biconvex. Calcareous mud, usually in water; Grayson and Rockwall (BRIT) cos.; mainly w 1/2 of TX; widespread in Canada and most of the U.S. except the extreme se. May. [*Scirpus acutus* Muhl. ex Bigelow] According to Beetle (1950), this species, which was used for mats and roofing, "... was very important in the Indian cultures of western North America." Yatskievych (1999) indicated that Native Americans utilized the seeds, rhizomes (dried and ground into flour), and young growth (eaten raw or boiled) for food. While we are not distinguishing varieties for East TX (due to paucity of available material), Smith (2002b) recognized 2 varieties as occurring in TX (var. *acutus* and var. *occidentalis* (S.Watson) S.G. Sm.), and separated them using the following characters:

1. Styles 2-fid; achenes plano-convex; culms mostly very firm, the air cavities in distal 1/4 of culm mostly ca. 0.5 mm wide _____ var. *acutus*
1. Styles 3-fid (at least some); some achenes compressed, obtusely trigonous; culm firm to soft, the larger air cavities in distal 1/4 of culms 1–2.5 mm wide _____ var. *occidentalis*

Schoenoplectus americanus (Pers.) Volk. ex Schinz & R. Keller, (of America), CHAIRMAKER'S CLUB-RUSH, OLNEY THREE-SQUARE, SALTMARSH BULRUSH, AMERICAN BULRUSH. Perennial 0.5–1.5 (–2.5) m tall from long-creeping rhizomes; distal leaf blade much shorter than to equaling or rarely ca. 1.5 times longer than its sheath; inflorescence of 2–15(–20) spikelets; spikelets 5–15 mm long; spikelet scales with apices notched 0.1–0.4 mm deep and awns 0.2–0.6 mm long; bristles (2–)4–6(–7) per flower; achenes unequally biconvex to compressed trigonous. Marshy areas, sometimes emergent in water, often in brackish, saline, or alkaline conditions; Ellis (BRIT), DeWitt, Jefferson, and Lavaca (Turner et al. 2003) cos.; also Gulf Prairies and Marshes; s Canada and widespread in much of the U.S. except the nc part. Jun–Sep. [*Scirpus americanus* Pers., *Scirpus chilensis* Nees & Meyen ex Kunth, *Scirpus conglomeratus* Kunth, *Scirpus olneyi* A. Gray, *Scirpus pungens* Vahl. var. *longisetus* Benth. & F. Muell.] Because of nomenclatural confusion, this species in the past was widely known as *Scirpus olneyi* (e.g., Correll & Johnston 1970). Schuyler (1974) clarified issues of nomenclature. It is very similar to *S. pungens* and is reported to cross with that species and produce sterile hybrids (Tucker 1987; Strong 1994; Yatskievych 1999; Smith 2002b).

Schoenoplectus californicus (C.A. Mey.) Soják, (of California), CALIFORNIA BULRUSH, GIANT BULRUSH, TOTORA, TULE, CALIFORNIA TULE, CALIFORNIA CLUB-RUSH. Perennial 1–3(–4) m tall, from long stout rhizomes and tight subrhizomatous knots; culms bluntly trigonous at least near inflorescence; inflorescence branched; spikelets 5–11 mm long, 25–150 or more per inflorescence; achenes plano-convex or biconvex. Mud or shallow water; widespread in TX; widespread in s 1/2 of the U.S. Spring and summer. [*Scirpus californicus* (C.A. Mey.) Steud.] This species is reported to form sterile hybrids with *S. acutus* in CA (Smith 1995, 2002b). It is of significant economic and cultural importance to indigenous people of the Andes of South America and is economically one of the most important New World Cyperaceae—its stems are used in making mats, handicrafts, small boats, shelters, fuel, and as fodder for cattle. It is known from the archaeological record, having been used since pre-Columbian times (Macía & Balslev 2000).

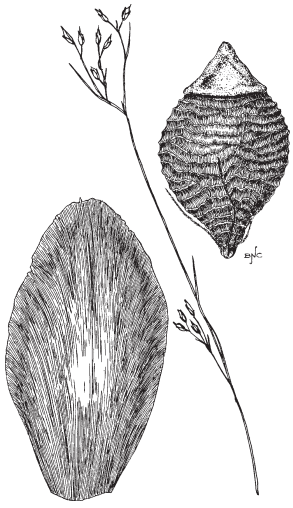
Schoenoplectus etuberculatus (Steud.) Soják, (without tubercle), CANBY'S CLUB-RUSH, CANBY'S BULRUSH. Perennial 0.6–1.5(–2) m tall, from delicate long-creeping rhizomes; culms soft, easily compressed; leaves basal; distal leaf blade longer than sheath; inflorescence unbranched or sometimes branched, usually with 8(–20) or fewer spikelets per inflorescence; spikelets 10–20 (–25) mm long, conspicuously pedicelled, most pedicels longer than the spikelets; bristles usually 6 per flower; achenes compressed trigonous. Plants often submerged in water and leaves often flaccid and ribbon-like; marshes, ponds, other wet areas; known in TX only from Hardin,

Newton (BRIT), and Jasper (Turner et al. 2003) cos.; mainly se U.S. from RI s to FL w to MO and TX. Jun–Oct. [*Scirpus etuberculatus* (Steud.) Kuntze] This species was first reported for TX (Hardin Co.) by Correll (1972a). While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

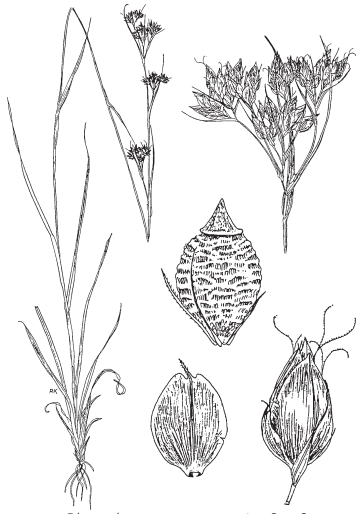
Schoenoplectus pungens (Vahl) Palla, (piercing, sharp-pointed), AMERICAN BULRUSH, SWORD-GRASS, THREE-SQUARE BULRUSH, COMMON THREE-SQUARE, THREE-SQUARE, CHAIRMAKER'S RUSH. Perennial 0.3–1.2(–2) m tall from long-creeping rhizomes; distal leaf blade 2–5 times longer than to rarely equaling its sheath; inflorescence of 1–4(–10) spikelets; spikelets 5–20(–23) mm long; bristles (3–)4–6(–8) per flower; spikelet scales with apices notched (0.3–)0.5–1 mm deep and awns (0.5–)1.5(–2.5) mm long; achenes unequally lenticular (= biconvex) to slightly trigonous. Wet soils, sometimes emergent in water; widely scattered in TX; widespread in Canada and nearly throughout the U.S. Apr–Jul. [*S. pungens* var. *longispicatus* (Britton) S.G. Sm., *Scirpus pungens* Vahl, *Scirpus pungens* var. *longispicatus* (Britton) Cronquist, *Scirpus pungens* var. *polyphyllus* Boeck., *Scirpus americanus* of authors, not Pers., *Scirpus americanus* Pers. var. *longispicatus* Britton] Because of nomenclatural confusion, this species in the past was widely known as *Scirpus americanus* (e.g., Correll & Johnston 1970), an epithet that belongs to plants previously called *S. olneyi*. Schuyler (1974) clarified issues of nomenclature. Hybrids between *S. pungens* and *S. americanus* are known (Smith 2002b). Varieties are sometimes recognized in *S. pungens* (e.g., Smith 1995), but pending further study we are following Kolstad (1986b) and Smith (2002b) in not recognizing infraspecific taxa. This species (apparently referred to as *S. americanus* in Burrows and Tyrl 2001) is suspected to be a cause of acute respiratory distress syndrome (ARDS) in cattle when they are moved from a poor pasture into one with a lush growth of the species—the cause is thought to be an increase in the level of ruminal tryptophan which is subsequently converted into toxins causing lung damage (Burrows & Tyrl 2001). ☠

Schoenoplectus saximontanus (Fernald) J. Raynal, (rocky mountain), ROCKY MOUNTAIN BULRUSH, ROCKY MOUNTAIN CLUB-RUSH. Small annual or perennial 9–65 cm tall; rhizomes inconspicuous, ca. 1 mm thick; culms cylindric, ridged when dry; 0–2 smaller bracts sometimes present in addition to the erect bract which appears like a continuation of the culm; inflorescences with 1–10(–20) spikelets, sessile, sometimes with 1–2 branches; spikelets 5–20 mm long; scales with a slightly recurved awn ca. 0.2–0.5 mm long; stigmas 3; achenes strongly trigonous, 1.3–1.8 mm long. Damp soils or emergent from water; Austin, Bexar, and Travis (Turner et al. 2003) cos.; in a band from the Panhandle to s TX; sw Canada (B.C.) and scattered in the U.S.—CA, CO, IL, KS, MO, NE, OH, OK, SD, TX, UT, and WY. Spring–fall. [*Scirpus bergsonii* Schuyler, *Scirpus saximontanus* Fernald, *Scirpus supinus* L. var. *saximontanus* (Fernald) T. Koyama] In addition to normal spikelets, this species often exhibits amphicarpy, "the production of individual florets wrapped in the leaf sheaths at the stem bases (noticeable only by the long style protruding from the tip of the leaf sheath)" (Yatskievych 1999). This diminutive species superficially resembles members of the genus *Isolepis* (BULRUSH, LATERAL BULRUSH).

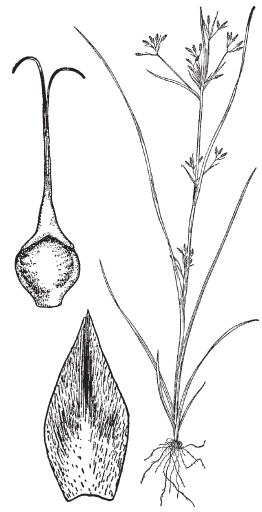
Schoenoplectus tabernaemontani (C.C. Gmel.) Palla, (for Jacob Theodore von Bergzabern, died 1590, Heidelberg botany professor who Latinized his name as Tabernaemontanus), GREAT BULRUSH, SOFT-STEM BULRUSH, GIANT TULE, SOFT-STEM CLUB-RUSH. Rhizomatous perennial 1–3(–5) m tall; culms usually soft, easily compressed; spikelets 5–11(–17) mm long, 15–200 per inflorescence; bristles 6 per flower; achenes plano-convex or unequally biconvex, 1.5–2.8 mm long. Wet ground, shallow water around lakes; Robertson (BRIT), Gonzales, Hays, Panola, and Travis (Turner et al. 2003) cos.; widely scattered in TX; throughout Canada and the U.S. May–Jul, occasionally to Oct. [*Scirpus lacustris* L. subsp. *tabernaemontani* (C.C. Gmel.) Syme, *Scirpus tabernaemontani* C.C. Gmel., *Scirpus validus* Vahl] The terete (= round in cross section) fresh culms (observed just below inflorescence) of this species help distinguish it from the similar *S. californicus* with bluntly



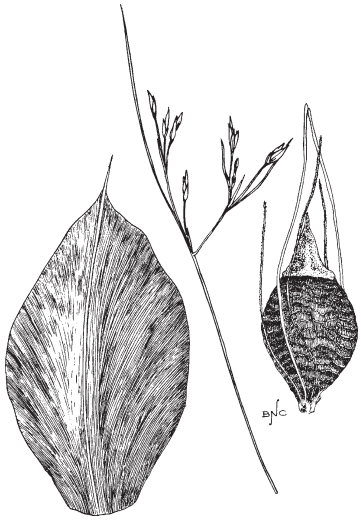
Rhynchospora rariflora [GWO]



Rhynchospora recognita [NOV]



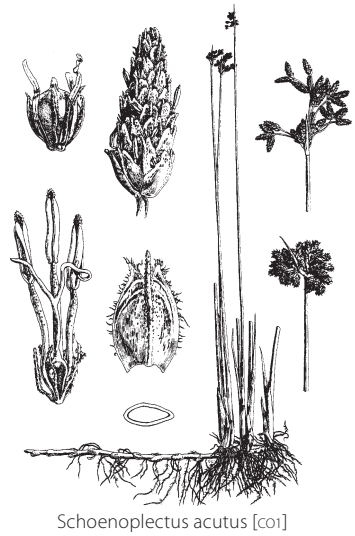
Rhynchospora scirpoides [GLE]



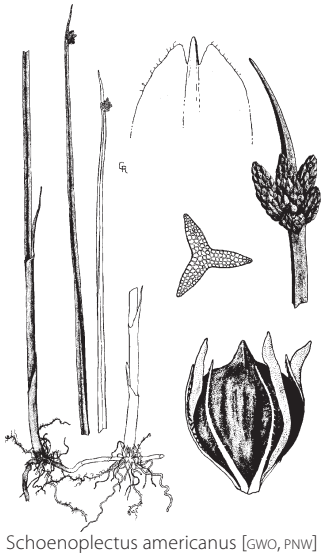
Rhynchospora stenophylla [GWO]



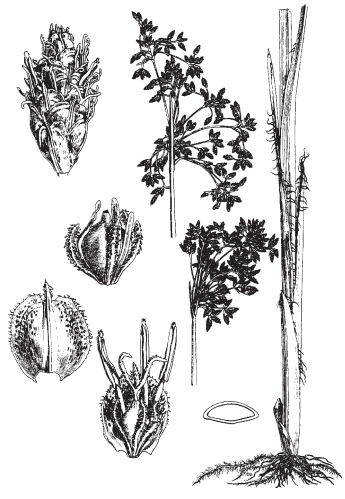
Rhynchospora tracyi [GWO]



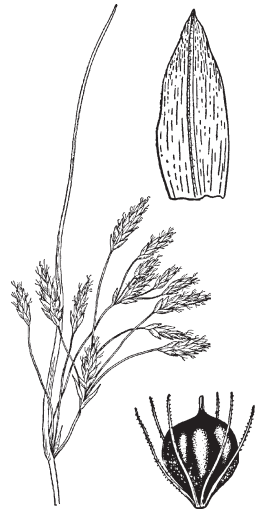
Schoenoplectus acutus [CO1]



Schoenoplectus americanus [GWO, PNW]



Schoenoplectus californicus [MAS]



Schoenoplectus etuberculatus [GLE]

trigonous culms. Hybrids between *S. tabernaemontani* and the closely related *S. acutus* have been reported (Smith 1969; Dabbs 1971; Strong 1994; Smith & Yatskievych 1996).

Schoenoplectus hallii (A. Gray) S.G. Sm., (for its discoverer, Elihu Hall, 1822–1882), HALL'S BULRUSH, HALL'S CLUB-RUSH. Small annual or perennial to 35(–80) cm tall, very similar to *S. saximontanus*; rhizomes inconspicuous; culms cylindric, ridged when dry; 0–1 smaller bract sometimes present in addition to the erect bract which appears like a continuation of the culm; inflorescences with 1–5 spikelets, usually sessile or nearly so, rarely a short-stalked cluster also present; spikelets 5–13(–20) mm long; perianth bristles absent; achenes with 15–18 prominent (use hand lens), transverse, wavy, mostly sharp ridges, 1.3–1.7 mm long. Emergent from water along receding water lines to terrestrial in wet areas; this species was cited by Hatch et al. (1990) for vegetational areas 2, 3, 6, 7, and 9. However, it is not cited for TX by either Kartesz (1999), Smith (2002b), or Turner et al. (2003), and the only TX specimens we are aware of are from recent Wise Co. collections (*O'Kennon & McLemore, 18,344, 18,853, 19,070*, BRIT—identified by S.G. Smith; O'Kennon & McLemore 2004). Smith (2002b) indicated that many reports of this species are based on misidentified specimens of *S. saximontanus*. We are therefore not considering it a member of the East TX flora; it is included here as a note for clarification. The species is scattered mainly in the midwestern U.S. (IA, IL, IN, KS, KY, MI, MO, NE, OK, TX, and WI) but is also known (apparently extirpated) from GA and MA (McKenzie 1998; O'Kennon & McLemore 2004). Jul–Oct. [*Scirpus hallii* A. Gray, *Scirpus supinus* L. var. *hallii* (A. Gray) A. Gray] Yatskievych (1999) noted that this species is unusual and uncommon throughout its range. He also noted that its distribution is identical to that of *Echinodorus tenellus* (Alismataceae); therefore, it should be looked for where that species is found. This species shares the phenomenon of amphicarpy with *S. saximontanus* (see explanation under that species). It can be distinguished from *S. saximontanus* by its 2 stigmas and achenes nearly plano-convex, with one side almost flat or slightly concave, the other side rounded. A putative hybrid between these two species has been discovered in OK (Smith et al. 2004). While *S. hallii* is usually annual, in Wise Co. TX many perennial plants have been observed; fluctuating margins of small sandy clay ponds is the habitat of the TX populations (O'Kennon & McLemore 2004). Smith (2002c) indicated that *S. hallii* is of conservation concern. (G2S1—J. Poole, pers. comm.) ⚠

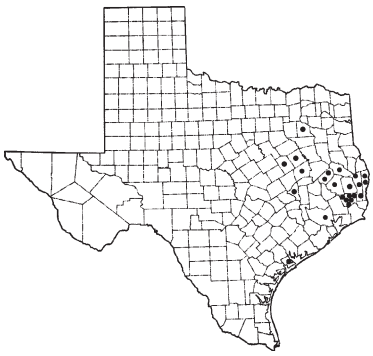
Schoenoplectus erectus (Poir.) Palla ex J. Raynal subsp. *raynalii* (Schuyler) Lye, SHARP-SCALE CLUB-RUSH, which is known in TX to the s of East TX (Atascosa Co., *V.L. Cory s.n.*, MICH; S.G. Smith, pers. comm.), is quite similar to *S. hallii*. Smith (2002b) distinguished the two as follows:

1. Achenes adaxially concave or sometimes nearly plane; spikelet scale flanks pale orange to nearly colorless _____ *S. hallii*
1. Achenes adaxially longitudinally convex or horizontally slightly convex with convex center; spikelet scale flanks often distally orange- or red-brown _____ *S. erectus*

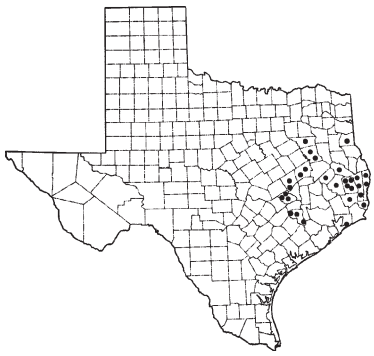
SCIRPUS L. BULRUSH

Perennials of wet areas, usually with (rarely without) rhizomes; plants glabrous; culms (= stems) obtusely triangular, with well-developed leaves; inflorescences of many spikelets in open to ± congested panicles, appearing terminal, with 2 or more well-developed leaf-like involucral bracts; individual spikelets distinctly stalked or else sessile and in clusters; spikelets with many florets; scales of spikelets spirally arranged, awnless or essentially so; perianth of bristles usually present; achenes trigonous to plano-convex, without a tubercle.

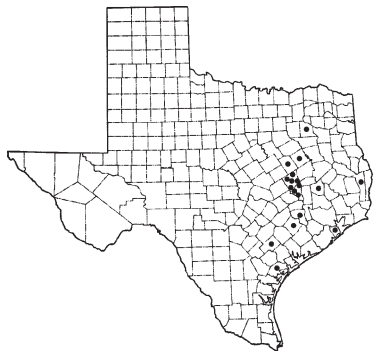
In the strict sense, a cosmopolitan genus of ca. 35 species (Whittemore & Schuyler 2002). *Bolboschoenus*, *Isolepis*, and *Schoenoplectus* have traditionally been treated as part of *Scirpus* sensu lato (e.g., Mabberley 1987; Kartesz 1994). If treated in such a broad traditional sense, of species with bisexual flowers and terete spikelets, the genus contains ca. 200–300 species (Tucker 1987; Mabberley 1997). However, we are following Strong (1994), Smith (1995, 2002a,



Rhynchospora pusilla



Rhynchospora rariflora



Rhynchospora recognita



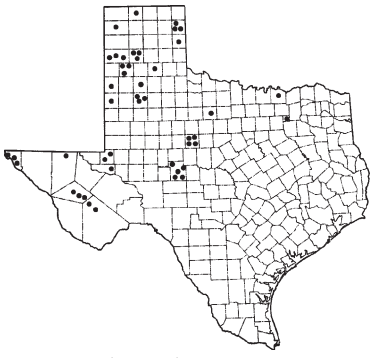
Rhynchospora scirpoides



Rhynchospora stenophylla



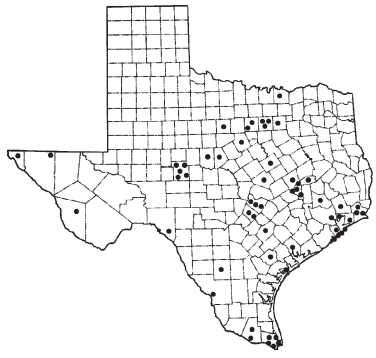
Rhynchospora tracyi



Schoenoplectus acutus



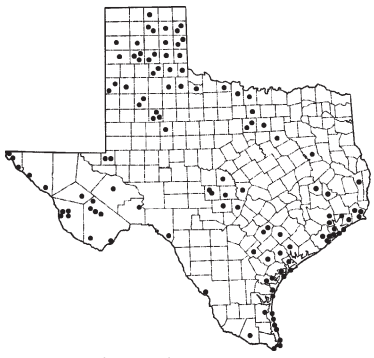
Schoenoplectus americanus



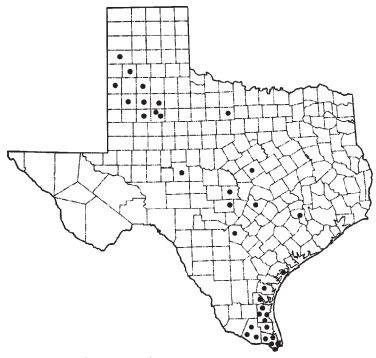
Schoenoplectus californicus



Schoenoplectus etuberculatus



Schoenoplectus pungens



Schoenoplectus saximontanus

2002b, 2002c), Jones et al. (1997), and Whittemore and Schuyler (2002) in recognizing the segregates of *Scirpus* at the generic level. This approach is supported by phylogenetic studies (e.g., Bruhl 1995; Muasya et al. 2000b) which suggest that *Scirpus* sensu lato is polyphyletic, being made up of a number of superficially similar but not closely related species. According to Yatskievych (1999), the "seeds of *Scirpus* species provide food for waterfowl, which disperse these bulrushes both in mud on their feet and feathers and as undigested seeds in their droppings." (The Latin name of a bulrush)

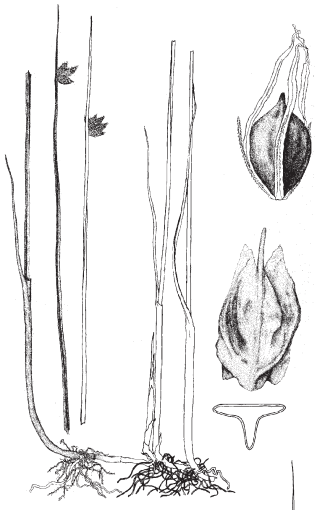
REFERENCES: Beetle 1947; Schuyler 1966, 1967; Lye 1971a; Strong 1993, 1994; Bruhl 1995; Smith 1995; Smith & Yatskievych 1996; Muasya et al. 2000b; Whittemore & Schuyler 2002.

1. Perianth bristles very long, obviously and greatly exceeding the scales of spikelets in length; mature inflorescences appearing almost woolly to the naked eye _____ **S. cyperinus**
1. Perianth bristles shorter than to slightly exceeding the scales of spikelets in length; mature inflorescences not appearing woolly.
   2. Spikelets mostly distinctly stalked, not arranged in tight clusters; scales of spikelets with prominent green-keeled midrib; perianth bristles curled or contorted.
      3. Leaves 4–8 per culm; scales of spikelets 1.7–2.5 mm long; mature spikelets usually > 2 mm wide (from ca. 2–3.5 mm); perianth bristles without teeth; species widespread and common in East TX _____ **S. pendulus**
      3. Leaves 10–20 per culm; scales of spikelets 1.2–1.8 mm long; mature spikelets usually 2 mm or less wide; perianth bristles with delicate teeth in distal half; species known only from extreme e edge of East TX _____ **S. divaricatus**
   2. Spikelets sessile or nearly so in many tight head-like clusters; scales of spikelets without prominent green-keeled midrib; perianth bristles, if present, straight or slightly curved.
      4. Perianth bristles 0–3, shorter than achenes _____ **S. georgianus**
      4. Perianth bristles usually 5 or 6, shorter than or a little longer than the achenes _____ **S. atrovirens**

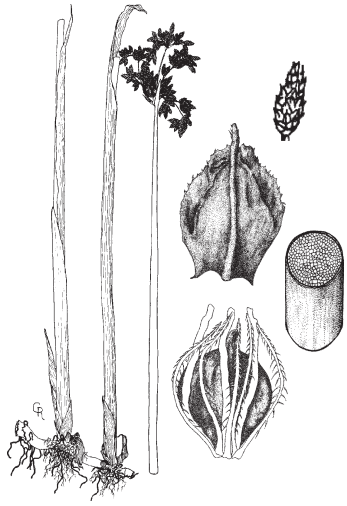
Scirpus atrovirens Willd., (dark green), PALE BULRUSH, DARK-GREEN BULRUSH, COMMON BULRUSH. Rhizomatous perennial to 1.5 m tall, resembling *S. georgianus*; leaves usually 9(–11) or fewer, mostly on the lower half of culm; sheaths and blades of lower leaves usually cross-septate; inflorescences occasionally with bulbils proliferating to form leaves; spikelets 2–5(–8) mm long; n = 28 (Schuyler 1976). Moist areas; Grayson (BRIT), Angelina, Franklin, Panola, Sabine, and San Augustine (Turner et al. 2003) cos.; also Hemphill and Lubbock (Turner et al. 2003) cos. in the Panhandle; se Canada and widespread in e 1/2 of the U.S., also AZ and MT. Summer. This species is known to hybridize with *S. georgianus* (Whittemore & Schuyler 2002). However, Whittemore and Schuyler (2002) noted that while the two species are similar, the characteristics separating them remain constant even where they occur together.

Scirpus cyperinus (L.) Kunth, (resembling *Cyperus*), WOOLLY-GRASS BULRUSH; COTTON-GRASS BULRUSH, WOOL-GRASS. Perennial 0.8–2 m tall, perennating by short tough rhizomes; leaves 5–10, along most of culm; inflorescences with stalked spikelets or sessile spikelets arranged in small clusters; spikelets 3–6(–9) mm long; n = 33 (Schuyler 1967). Wet or boggy places; widely scattered in East TX w to Lamar (BRIT), Dallas, and Robertson (Turner et al. 2003) cos.; also Hemphill Co. (Turner et al. 2003) in the Panhandle; se Canada and widespread in e 1/2 of the U.S., also OR and WA. Summer. [*S. cyperinus* var. *rubricosus* (Fernald) Gilly, *S. eriophorum* Michx., *S. rubricosus* Fernald]

Scirpus divaricatus Elliott, (spreading, widely divergent), SPREADING BULRUSH. Perennial 0.5–1.5 m tall, not distinctly rhizomatous, perennating by basal offshoots; culms varying from erect to sprawling; leaves present along most of culm; spikelets 4–15 mm long; n = 14 (Schuyler 1967). Wet woods and swamps; Hardin Co. (*Nixon & Ward 10906*, BRIT); se U.S. from VA s to FL w to MO and TX. This species was first reported for TX in 1982 (Nixon & Ward 1982). (TOES 1993: IV) ⚠



Schoenoplectus pungens [MAS]



Schoenoplectus tabernaemontani [CO1]



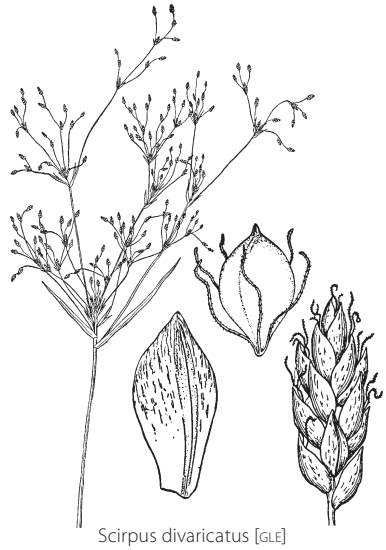
Scirpus atrovirens [CO1]



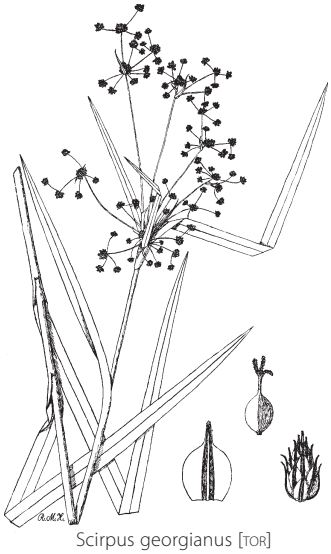
Schoenoplectus saximontanus [HEA]



Scirpus cyperinus [GWO]



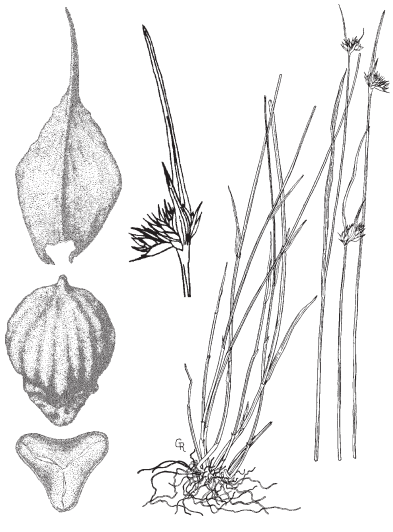
Scirpus divaricatus [GLE]



Scirpus georgianus [TOR]



Scirpus pendulus [CO1]



Scleria baldwinii [GWO]

Scirpus georgianus R.M. Harper, (of Georgia), GEORGIA BULRUSH, COMMON BULRUSH. Tufted perennial, 0.5–1.5 m tall, with short rhizomes; leaves usually 9(–12) or fewer, mostly on the lower half of the culm; sheaths and blades usually not conspicuously cross-septate; inflorescences occasionally with axillary bulbils; spikelets 2–4(–5) mm or less long; perianth bristles absent or rudimentary; n = 25, 26, 27 (Schuyler 1967, 1976). Moist or wet soils; Anderson, Dallas, Hunt, Lamar, Red River, Sabine, San Augustine, Van Zandt, and Walker (Turner et al. 2003) cos., primarily in n part of East TX; also e Cross Timbers and Prairies; se Canada and widespread in the e 1/2 of the U.S. Spring. [*Scirpus atrovirens* Willd. var. *georgianus* (R.M. Harper) Fernald] Often in the past included in or treated as a variety of *S. atrovirens* (e.g., Radford et al. 1968; Godfrey & Wooten 1979).

Scirpus pendulus Muhl., (pendulous, hanging), RUFOUS BULRUSH. Tufted perennial to 1.5 m tall, with short rhizomes; leaves 4–8, along most of stem; spikelets (4–)5–11(–12) mm long; n = 20 (Schuyler 1967). Ditches, streambeds, pond margins; widespread in East TX; also e Cross Timbers and Prairies and Hemphill Co. (BRIT) in the Panhandle; se Canada and widespread in the U.S., particularly the e 2/3. Apr–Jun. [*S. lineatus* of TX authors, not Michx.] This species was long known as *S. lineatus*; that name is correctly used for the DROOPING BULRUSH (Schuyler 1966), a species that occurs in the e U.S. from VA s to FL w to LA.

SCLERIA Bergius NUT-RUSH

Monoecious rhizomatous perennials or occasionally annuals, usually less than 1 m tall; culms (= stems) sharply triangular, leafy; inflorescences terminal and often also axillary, of small, compact clusters of few spikelets, leafy-bracted at base; staminate and pistillate spikelets often mixed within a cluster; spikelets few-flowered, the scales spirally arranged; perianth absent; achenes globose or ovoid to obovoid, usually with a whitish, bony, or crustaceous outer layer, smooth to variously roughened, without an apical tubercle, often, but not always, on a hardened, disk-like, ring-like, or 3-lobed (and almost calyx-like) basal pad (= hypogynium).

A genus of ca. 200 species (Reznicek et al. 2002) of tropical and warm areas. Several centers of diversity include tropical South America, tropical Africa, and se Asia; many species are endemic to relatively small areas (Tucker 1987; Mabberley 1997). Because achene characters are critical in identification to species, care should be taken to collect individuals in fruit. The following treatment draws significantly on Reznicek et al. (2002). (Greek: *skleros*, harsh, "the culms of the type species being bound together into whips for beating slaves in Surinam; often incorrectly said to be derived from Greek *skleria*, tough, in reference to the achene walls"—Tucker 1987)

REFERENCES: Core 1936, 1966; Fernald 1943; Fairey 1967; Kessler 1987; Tucker 1987; Reznicek et al. 2002; Camelbeke et al. 2003.

1. Achene body smooth or with longitudinal ridges.
   2. Achene body subtended by a disk-like, ring-like, or 3-lobed (and almost calyx-like) basal pad, the base of the achene body itself (not the pad) ± circular.
      3. Basal pad disk-like or ring-like, without lobes (but tubercles can be present), either with a rough whitish crust or with 8 or 9 papillose tubercles (use hand lens).
         4. Basal pad completely covered with rough whitish crust, without distinct tubercles ___ **S. triglomerata**
         4. Basal pad not covered with rough whitish crust, but with 8 or 9 papillose tubercles ____ **S. oligantha**
      3. Basal pad 3-lobed (almost calyx like), but without either a whitish crust or tubercles.
         5. Lowest lateral spikelet cluster spreading or drooping on filiform, flexuous stalk (15–)20–100 mm long; achene body usually with tufts or lines of spreading, whitish or tawny hairs on ridges, rarely glabrous; uppermost lateral spikelet cluster with bract (including sheath) usually 1/4–3/4 the length of terminal internode; species widespread in e part of East TX _____ **S. muehlenbergii**

5. Lowest lateral spikelet cluster erect, sessile or on a stiff, ± erect stalk to 20(–90) mm long; achene body glabrous; uppermost lateral spikelet cluster with bract (including sheath) usually 3/4 or more the length of terminal internode; species rare in East TX, known only from Newton Co. _____ **S. reticularis**

2. Achene body not subtented by a basal pad, the base of the achene body ± triangular.
   6. Inflorescence with a single terminal cluster of spikelets; scales of spikelets and leaf sheaths glabrous.
      7. Achene body ca. 2(–3) mm long, at very base triangular with a pair of iridescent pits on each of the three sides _____ **S. georgiana**
      7. Achene body ca. 3–4 mm long, at very base triangular, but without pits _____ **S. baldwinii**
   6. Inflorescence spike-like and interrupted, with 3–8 distinct, well-spaced clusters of spikelets in addition to the terminal cluster; scales of spikelets and sometimes also leaf sheaths with conspicuous ± straight hairs _____ **S. distans**

1. Achene body either conspicuously rough (reticulate or warty) OR with horizontal ridges.
   8. Inflorescence solitary, terminal, spike-like, and interrupted, with (2–)3–7(–9) distinct, well-spaced clusters of spikelets in addition to the terminal cluster; plants annual, without rhizomes; achenes without basal pad, the achene body usually 1–1.5 mm long _____ **S. verticillata**
   8. Inflorescence EITHER a single head-like cluster of spikelets with 1 or 2 additional clusters sometimes in close proximity to the first OR inflorescence with both terminal and axillary compact clusters; plants annual or perennial, with or without rhizomes; achenes with a disk-like, ring-like, or 3-lobed (and almost calyx-like) basal pad, the achene body 1–3.6 mm long.
      9. Basal pad not distinctly 3-lobed, but with 3–6 tubercles; inflorescence a single head-like cluster of spikelets with 1 or 2 additional clusters sometimes in close proximity to the first, but without obvious branches.
         10. Achene body (1.5–)2–3.6 mm long; basal pad bearing 3 entire or 2-lobed tubercles (since the lobing is often irregular and sometimes deep, what appear to be 4–6 tubercles can sometimes be observed) _____ **S. ciliata**
         10. Achene body 1–2(–2.5) mm long; basal pad bearing 6 tubercles (these in pairs) _____ **S. pauciflora**
      9. Basal pad 3-lobed, almost calyx-like in appearance, without tubercles; inflorescence with both terminal and axillary compact clusters, usually with visible branches.
         11. Lowest lateral spikelet cluster spreading or drooping on filiform, flexuous stalk (15–)20–100 mm long; achene body usually with tufts or lines of spreading, whitish or tawny hairs on ridges, rarely glabrous; uppermost lateral spikelet cluster with bract (including sheath) usually 1/4–3/4 the length of terminal internode; species widespread in e part of East TX _____ **S. muehlenbergii**
         11. Lowest lateral spikelet cluster erect, sessile or on a stiff, ± erect stalk to 20(–90) mm long; achene body glabrous; uppermost lateral spikelet cluster with bract (including sheath) usually 3/4 or more the length of terminal internode; species rare in East TX, known only from Newton Co. _____ **S. reticularis**

Scleria baldwinii (Torr.) Steud., (probably for William Baldwin, 1779–1819, botanist and physician of Pennsylvania), BALDWIN'S NUT-RUSH. Perennial 30–90 cm tall, similar to *S. georgiana* but with rhizomes relatively thicker, more spreading, and knotty; inflorescence a single head-like cluster; achene body usually not subtended by a basal pad, 3–4 mm long, smooth or longitudinally ribbed, triangular at very base, but without pits. Wet pinelands and savannahs, margins of swamps, and wet areas, often in shallow water, sandy or sandy peat soils; known in TX from Harris, Newton (BRIT), and Tyler (Turner et al. 2003) cos.; se U.S. from SC s to FL w to TX. May–Oct. [*S. costata* (Britton) Small] According to Kessler (1987), this species is often confused with *S. triglomerata*. However, it can be distinguished by the larger size of the achenes (3–4 mm versus 1.5–3 mm in *S. triglomerata)* and the lack of the basal pad covered with a rough white crust, characteristic of *S. triglomerata.* While not officially designated as such (e.g., TOES 1993; Carr

2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

Scleria ciliata Michx., (ciliate, fringed), FRINGED NUT-RUSH, CILIATE NUT-RUSH. Rhizomatous perennial 20–70(–90) cm tall, pubescent to glabrous; inflorescence usually a single head-like cluster of spikelets, with 1 or 2 additional clusters sometimes in close proximity to the first; achene body (1.5–)2–3.6 mm long, irregularly warty and sometimes with horizontal ridges; basal pad bearing 3 entire or 2-lobed tubercles. Moist to dry sandy woods or open areas; e 1/3 of TX; se U.S. from VA s to FL w to MO and TX. Varieties are not distinguished on the county distribution map. The key to varieties is modified from Reznicek et al. (2002).

1. Culms glabrous or essentially so; leaves and bracts not ciliate _____ var. **glabra**
1. Culms pubescent; leaves and bracts ciliate.
   2. Widest leaves 1–3.5 mm wide; achenes 2–3 mm long, 1.5–2.3 mm wide _____ var. **ciliata**
   2. Widest leaves 3.5–7 mm wide; achenes 2.6–3.6 mm long, 2–2.6 mm wide _____ var. **elliottii**

var. **ciliata**, FRINGED NUT-RUSH. Pineywoods and Gulf Prairies and Marshes w to Bastrop Co. (BRIT) in the s part of East TX and to Montague (BRIT) and Wise (Turner et al. 2003) cos. in the Cross Timbers and Prairies; se U.S. from VA s to FL w to MO and TX. Late Apr–Jul.

var. **elliottii** (Chapm.) Fernald, (for Stephen Elliott, 1771–1830). Hardin Co. (*Cory 52,781*, MICH—information provided by A. Reznicek, pers. comm.); while we have seen no material of this variety from East TX, Reznicek et al. (2002) cited it as occurring in TX (based on the Cory specimen), and noted that it "grows primarily on the outer Coastal Plain"; se U.S. from VA s to FL w to TX. [*S. elliottii* Chapm.] Reznicek (pers. comm.) notes that this variety is "probably a distinct species." While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this variety to be of conservation concern in TX. ⚠

var. **glabra (**Chapm.) Fairey, (smooth, hairless), BRITTON'S NUT-RUSH. Jefferson Co. (Correll & Johnston 1970) and also cited for the Post Oak Savannah by Hatch et al. (1990); se U.S. from NC s to FL w to TX. Summer. [*S. brittonii* Core ex Small, *S. pauciflora* Muhl. ex Willd. var. *glabra* Chapm.] This taxon has variously been recognized as a distinct species (e.g., *S. brittonii*—e.g., Core 1966; Correll & Johnston 1970), a variety (Fairey 1967; Reznicek et al. 2002), or not recognized as distinct (e.g., Kessler 1987). The fact that it appears to be based solely on pubescence raises questions about its biological reality. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this variety to be of conservation concern in TX. ⚠

Scleria distans Sw., (widely separated), RIVER-SWAMP NUT-RUSH. Rhizomatous perennial usually 15–65 cm tall; inflorescence spike-like and interrupted, with 3–8 distinct well-spaced clusters of spikelets in addition to the terminal cluster; achene body not subtended by a basal pad, 1–2 mm long, usually smooth. Moist to dry pine barrens and grassy areas, sandy or sandy peat soils; known in TX only from Waller Co. (Correll & Johnston 1970; Turner et al. 2003 as *S. hirtella*); se U.S. from NC s to FL w to TX. Spring–summer. [*S. hirtella* of authors, not Sw., *S. nutans* Willd. ex Kunth] This species has long gone under the name of *S. hirtella* (e.g., Hatch et al. 1990; Kartesz 1999; Turner et al. 2003). However, according to Reznicek et al. (2002), the name *S. hirtella*, "properly belongs to an annual species of tropical America." Though generally smooth, the achene can sometimes have some surface irregularities (Kessler 1987). While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

Scleria georgiana Core, (of Georgia), SLENDER-FRUIT NUT-RUSH, GEORGIA NUT-RUSH. Rhizomatous perennial 30–50 cm tall; inflorescence a single terminal cluster of spikelets; achene body not subtended by a basal pad, ca. 2(–3) mm long, smooth or longitudinally ridged, at very base triangular

with a pair of iridescent pits on each of the three sides. Wet pine savannahs, bogs, sandy or sandy peat soils; Hardin, Harris, Jasper, Tyler (BRIT), Angelina, Austin, Newton, and Polk (Turner et al. 2003) cos. in the se part of East TX; also n Gulf Prairies and Marshes; se U.S. from NC s to FL w to TX. Apr–Sep. [*S. gracilis* Elliott, not Rich.] Except for achene characters, this species is very similar to *S. baldwinii*.

Scleria muehlenbergii Steud.., (for Gotthilf Henry Ernest Muhlenberg, 1753–1815, distinguished American botanist and Lutheran minister of PA), MUHLENBERG'S NUT-GRASS. Annual with fibrous roots or rhizomatous perennial, 15–90(–125) cm tall; leaf blades 1–5(–8) mm wide; inflorescence with axillary and terminal clusters of spikelets; achene body 1–3 mm long, reticulate to smooth, usually with tufts or lines of spreading, whitish or tawny hairs on ridges, rarely glabrous; basal pad of achene 3-lobed (the lobes appressed to the base of the achene and almost "calyx-like"—Yatskievych 1999) but without tubercles. Open, moist to wet areas, often in shallow water, sandy or sandy peat soils; widespread in e part of East TX w to Henderson (BRIT), Austin, and Burleson (Turner et al. 2003) cos., also Guadalupe Co. (Turner et al. 2003) near sw margin of East TX; widespread in the e 1/2 of the U.S. Jun–Nov. [*S. reticularis* Michx. var. *pubescens* Britton, *S. setacea* of authors, not Poir.] Regarding the epithet *muhlenbergii*—since the original publication has the epithet with an umlaut over ü, the correct spelling is *muehlenbergii* rather than the more common usage, *muhlenbergii*—see *International Code of Botanical Nomenclature* Article 60.6 (Greuter et al. 2000). This species has often been treated either as a variety of *S. reticularis* (var. *pubescens*—e.g., Fairey 1967; Yatskievych 1999) or synonymized with *S. reticularis* (e.g. Godfrey & Wooten 1979; Kessler 1987; Jones et al. 1997). However, we are following Kartesz (1999), Reznicek et al. (2002), and A. Reznicek (pers. comm.) in recognizing it as a separate species.

Scleria oligantha Michx., (few-flowered), LITTLE-HEAD NUT-RUSH, FEW-FLOWER NUT-RUSH. Rhizomatous perennial 30–60(–70) cm tall; inflorescence of 2–5 axillary and terminal clusters of spikelets; achene body 2.5–4 mm long, smooth; basal pad not covered with rough white crust, but with 8 or 9 papillose tubercles. Sandy upland woods, floodplain woods, and drainage areas; widespread in East TX, also n Gulf Prairies and Marshes; widespread in e 1/2 of the U.S. except the far n. Mainly late Apr–Jun, rarely later.

Scleria pauciflora Muhl. ex Willd., (few-flowered), FEW-FLOWER NUT-RUSH, CAROLINA NUT-RUSH, CAROLINA NUT-GRASS. Rhizomatous perennial 20–50 cm tall; inflorescence usually a single head-like cluster of spikelets, with 1 or 2 additional clusters sometimes in close proximity to the first; achene body 1–2(–2.5) mm long, irregularly warty and sometimes with horizontal ridges; basal pad bearing 6 tubercles (these in pairs). Moist sandy soils, savannahs, forest openings, seepage slopes; widely scattered in East TX; also Gulf Prairies and Marshes; se Canada and widespread in e 1/2 of the U.S. May–Sep. [*S. ciliata* Michx. var. *pauciflora* (Muhl. ex Willd.) Kük.] While some authorities (e.g., Kartesz 1999, who cites var. *caroliniana* (Willd.) A.W. Wood for TX) recognize varieties in this species, we are following Yatskievych (1999) in not recognizing "a number of poorly differentiated morphological races" at the varietal level. Reznicek et al. (2002) recognized two varieties, but cited only var. *pauciflora* from TX—apparently only one taxon occurs in the state. As indicated by Kessler (1987), this species intergrades with *S. ciliata*. While generally recognized as a separate species (e.g., Kartesz 1999; Yatskievych 1999; Reznicek et al. 2002), according to Kessler (1987), "*S. pauciflora* may be a variety of *S. ciliata*." Further study is needed to determine the appropriate level at which to recognize this taxon. Fairey and Whittemore (1999) discussed nomenclatural issues regarding this species.

Scleria reticularis Michx., (netted), NETTED NUT-RUSH. Annual with fibrous roots or rhizomatous perennial, (6–)15–50 cm tall, similar to *S. muehlenbergii*, but distinguished as in the key; leaf blades 1–3.5 mm wide; achene body reticulate to smooth, glabrous; basal pad of achene 3-lobed, without tubercles. Open, moist to wet areas of sandy or sandy peat soils; Newton Co. (*Bridges & Orzell*, MO—specimen seen by A. Reznicek, pers. comm.) at e edge of East TX; this is the only

known collection of the species in TX—all other East TX specimens (e.g., Anderson, Henderson, Jasper, Polk, and Tyler county sheets at BRIT) of this complex we have seen have pubescent fruits and thus fall into *S. muehlenbergii*; Reznicek (pers. comm.) noted that *S. reticularis* is "undoubtedly rare and disjunct in Texas"; no county distribution map is provided; e U.S. w to WI and MS, disjunct to TX. Summer–fall. According to Reznicek et al. (2002), *S. reticularis* "is a smaller plant and less widely distributed than *S. muehlenbergii*. ..." and "differs from *S. muehlenbergii* in having the lobe[s] of the hypogynium obtuse and emarginate at the apex rather than obtuse to acute, the terminal internode of the stem usually 3–8 cm rather than 6–30 cm, and scales of pistillate flowers mostly 3–4 mm rather than 4–5 mm." There are nomenclatural problems with *S. reticularis,* and a proposal (Camelbeke et al. 2003) has been made to conserve the name with a new, conserved type. By using *S. reticularis*, we are following the recommendations of this proposal. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

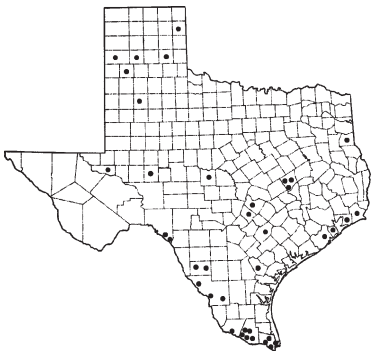
Scleria triglomerata Michx., (three-clustered), WHIP-GRASS, WHIP NUT-RUSH, TALL NUT-RUSH, TALL NUT-GRASS. Rhizomatous perennial (20–)40–100 cm tall; inflorescence of 1–3 head-like masses of spikelets; achene body 1.5–3.5 mm long, smooth; basal pad completely covered with rough whitish crust, without distinct tubercles. Sandy open woods, savannahs, low areas, moist to dry sites; Pineywoods and Gulf Prairies and Marshes w to East Cross Timbers; se Canada and widespread in e 1/2 of the U.S. Jun. [*S. flaccida* Steud., *S. minor* (Britton) W. Stone, *S. nitida* Willd., *S. triglomerata* var. *minor* Britton] The fruits are reportedly dispersed by ants, with the basal pad (= hypogynium) acting as an elaiosome (= appendage used in dispersal by ants or other insects) (Gaddy 1986; Tucker 1987). While we are tentatively treating this species broadly (as do Jones et al. 1997), some authorities believe the variation present warrants recognition of the segregate *S. minor*; at this point we have seen no TX material that supports such separation. The Newton Co. collection (*Correll, Johnson, & Edwin 22269*, duplicate at BRIT) cited by Core (1966) as *S. minor* has leaves to ca. 5 mm wide and achenes more than 2 mm long. Core also noted that *S. minor* is "perhaps only a reduced state of *S. triglomerata*." Reznicek et al. (2002) cited both *S. triglomerata* and *S. minor* for TX, distinguishing the two as follows:

1. Leaves 3–9 mm wide; achenes 2–3 mm [long] _____ *S. triglomerata*
1. Leaves 1–2.5 mm wide; achenes 1.5–2 mm [long] _____ *S. minor*

Scleria verticillata Muhl. ex Willd., (whorled), LOW NUT-RUSH, WHORLED NUT-RUSH, LOW NUT-GRASS, WHORLED NUT-GRASS. Slender, tufted, often inconspicuous annual from fibrous aromatic roots, 10–60 cm tall; inflorescence spike-like and interrupted, with (2–)3–7(–9) distinct, well-spaced clusters of spikelets in addition to the terminal cluster; achene body not subtended by a basal pad, usually 1–1.5 mm long, warty to wrinkled or horizontally ridged., Savannahs, pinelands, stream banks, seeps, sometimes in shallow water, wet sand, sandy peat, or marl soils, and wet areas on rocks; collected in Dallas Co. by Reverchon (Core 1966), also Liberty (Bridges & Orzell 1989a), Guadalupe, Hays, Limestone, Travis (Turner et al. 2003), and Polk (J. Singhurst, pers. comm.) cos.; also Cross Timbers and Prairies (Wise Co.—BRIT, TAMU) and e Edwards Plateau (e.g., at margin of temporary pool on granite outcrop, Llano Co., *Walters 937*, BRIT); se Canada and widespread in e 1/2 of the U.S. Jul–Sep. [*S. tenella* Kunth] This species is somewhat similar to *S. distans* but can be distinguished by its rough achenes and glabrous spikelet scales versus smooth achenes and spikelet scales with conspicuous ± straight hairs in *S. distans*.

DIOSCOREACEAE R. Br. YAM FAMILY

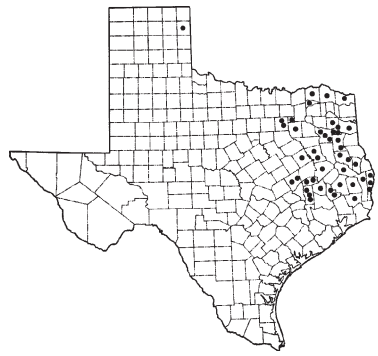
A medium-sized family of ca. 650 species in 7 genera (Raz 2002), with the number of genera recognized by various authorities ranging from 3–20 (Raz 2002). Some authorities (e.g.,



Schoenoplectus tabernaemontani



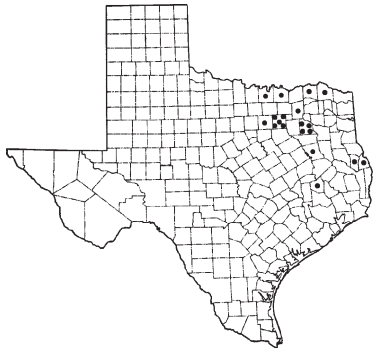
Scirpus atrovirens



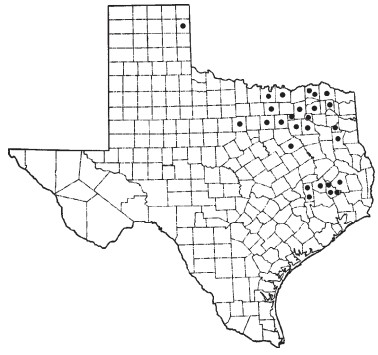
Scirpus cyperinus



Scirpus divaricatus



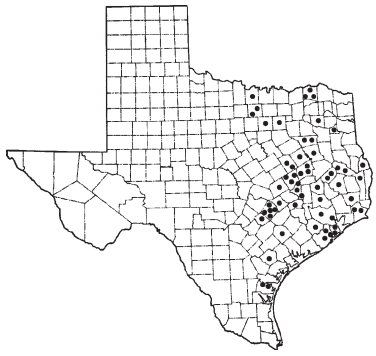
Scirpus georgianus



Scirpus pendulus



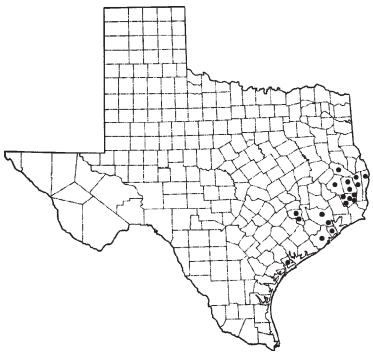
Scleria baldwinii



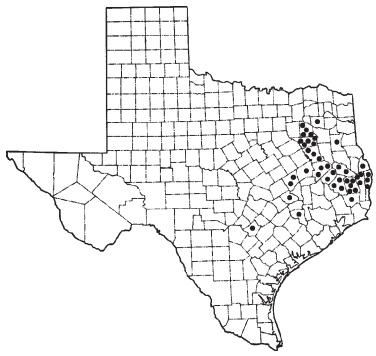
Scleria ciliata
(all vars.)



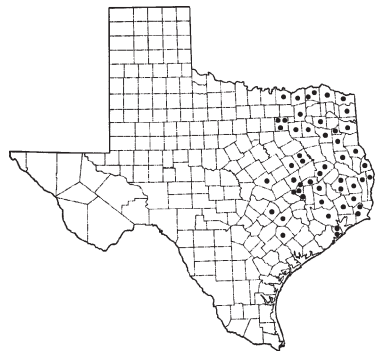
Scleria distans



Scleria georgiana



Scleria muehlenbergii



Scleria oligantha

Mabberley 1997) recognize as many as 880 species, while others (e.g., Caddick et al. 2002b) consider the family to contain only 364–414 species (due in part to lumping)—circumscription of the family thus remains controversial (Raz 2002). The species are mostly herbaceous twining vines from tubers or rhizomes, found throughout tropical and warm areas with a few in the n temperate zone; most species are in the genus *Dioscorea*. The Dioscoreales were thought by some authorities to resemble the ancestral monocots (Dahlgren et al. 1985), in part because they have a number of characters reminiscent of dicots (Bouman 1995), including ± net-veined leaves. However, recent molecular analyses (e.g., Chase et al. 2000) do not support this viewpoint, and show such groups as Acorales and Alismatales diverging before the Dioscoreales. A number of molecular studies (e.g., Caddick et al. 2002a, 2002b) have suggested that the order contains four families—Dioscoreaceae, Burmanniaceae, Thismiaceae (sometimes combined with Burmanniaceae), and Nartheciaceae—and is related to Pandanales. However, other recent molecular work (e.g., Neyland 2002) disputes this and indicates that the Burmanniaceae and Thismiaceae should be placed in a separate order. While Dioscoreaceae were once thought to be related to Smilacaceae (e.g., Dahlgren et al. 1985), Smilacaceae are currently placed in order Liliales, and the resemblances between the families are now recognized to be due to convergence. Dioscoreaceae have inconspicuous flowers which are pollinated mainly by flies or other insects, while fruit dispersal is typically by wind (Judd et al. 1999). ☠ Raphides are usually present, as are steroidal saponins, tannins, and often lactone alkaloids. (subclass Liliidae—Cronquist; order Dioscoreales—APG II)

FAMILY RECOGNITION IN THE FIELD: herbaceous twining vines with alternate or sometimes opposite or whorled, petiolate, cordate-ovate leaves with (5–)7–11(–13) main veins; flowers very small, with 6 stamens and an inferior ovary; fruit a 3-winged capsule.

REFERENCES: Burkill 1960; Dahlgren et al. 1985; Al-Shehbaz & Schubert 1989; Conran 1989; Bouman 1995; Huber 1998; Yatskievych 1999; Caddick et al. 2000, 2002a, 2002b; Raz 2002.

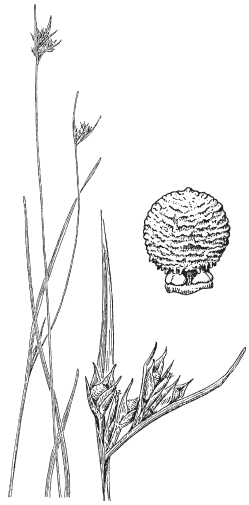
DIOSCOREA L. YAM

Dioecious perennials from rhizomes or tubers; stems to 6(–20) m or more long, leaning on other plants or twining-climbing; leaves alternate, opposite, whorled, or a mixture of these, long-petiolate; leaf blades cordate-ovate, cordate at base, acute to acuminate at apex, with (5–)7–11(–13) main, convergent, parallel veins and numerous cross veins; flowers very small, whitish to greenish yellow, in axillary panicles or spikes; perianth radially symmetrical; tepals in 2 whorls of 3 each, 0.2–2 mm long; stamens 6; ovary inferior; stigmas 3, bilobed; capsules 3-winged, 1.2–3 cm long, loculicidal, splitting through wings; seeds flat, winged.

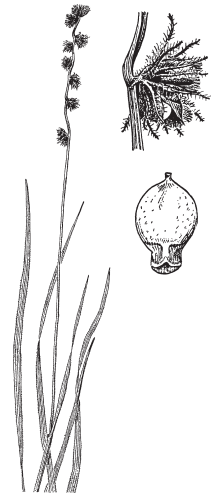
A genus of ca. 600 species (Raz 2002) of tropical and warm areas, with a center of diversity in se Asia (Dahlgren et al. 1985). Recent molecular evidence (Caddick et al. 2000) indicates that in order for *Dioscorea* to be monophyletic, three small dioecious genera, *Nararepenta* Matuda, *Rajania* L., and *Tamus* L., need to be included within it. *Dioscorea* species (YAMS) are cultivated in some areas, particularly w Africa and the West Indies, as a subsistence crop; the edible part is typically an underground tuberous stem (edible aerial bulbils are present in some species). YAMS are often confused with SWEET POTATOES (*Ipomoea batatas* in the MORNING GLORY FAMILY—Convolvulaceae), which are cultivated for their edible roots. A number of species, including *D. bulbifera*, have sessile secretory glands or extrafloral nectaries on the leaves, the structures possibly serving either to attract ants (which then protect the plant) or functioning as hydathodes (= structures which release water under humid conditions) (Burkill 1960; Huber 1998). ☠ The tubers of numerous species are highly toxic (containing alkaloids, sapogenins, or tannins) and "have been widely used as a source of poison for fishing, hunting, or criminal purposes" (Al-Shehbaz & Schubert 1989) (e.g., putting grated tubers of some species into a stream can stupefy fish). Proper preparation of edible YAMS to remove toxins is necessary. The storage tubers of Mexican species of *Dioscorea* have served as a source of steroidal precursor molecules (e.g., the



Scleria ciliata var. ciliata [LUN]



Scleria ciliata var. glabra [LUN]



Scleria distans [LUN]



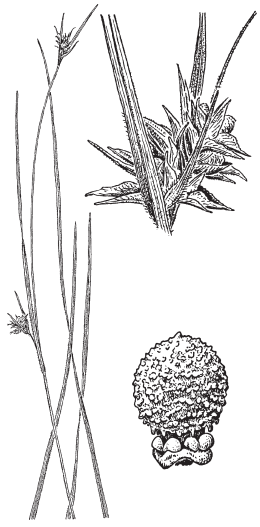
Scleria georgiana [LUN]



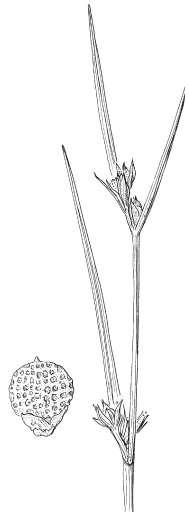
Scleria muehlenbergii [GLE, YAT]



Scleria oligantha [LUN]



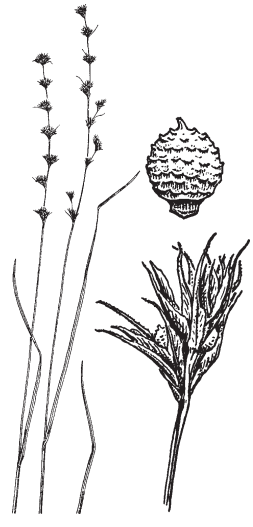
Scleria pauciflora [LUN]



Scleria reticularis [FNA]



Scleria triglomerata [LUN]



Scleria verticillata [LUN]

sapogenin diosgenin) used by the pharmaceutical industry for anti-inflammatory medications (e.g., cortisone) and the active ingredients in early birth control pills (Martin 1969; Lewis & Elvin-Lewis 1977; Huber 1998; Judd et al. 1999). (Named for Dioscorides, Greek naturalist of the first century A.D., who wrote *De Materia Medica*, a description of ca. 600 plants used medicinally, and "who served as a physician in the army of the Roman emperors Claudius and Nero"—Bouman 1995)

REFERENCES: Bartlett 1910; Xifreda 2000.

1. Plants with conspicuous, axillary, aerial bulbils; leaves usually all alternate; petioles with flanged or auriculate (= with earlobe-like appendages or flaps of tissue) bases; rhizomes absent, tubers present or not so; introduced species _____ **D. bulbifera**
1. Plants without aerial bulbils; leaves of at least lower nodes usually opposite or in whorls; petioles without auriculate bases; rhizomes present; native species _____ **D. villosa**

Dioscorea bulbifera L., (bulb-bearing), AIR-POTATO, AIR YAM, AERIAL YAM, POTATO YAM. Underground tubers small or absent; stems to 6(–20) m or more long, twining counter-clockwise (this is also referred to as sinistrorse = twining upward from right to left), with conspicuous, axillary, subspherical or angled, aerial bulbils, these sometimes huge (up to 2 kg)—Huber (1998) indicated that these structures would better be referred to as tubers; leaves usually all alternate; leaf blades 5–25 cm long, to 18(–26) cm wide; petioles auriculate or flanged at base; capsules to ca. 2.5 cm long. Deep woods, along stream banks; Cass Co. (*Amerson 274*, BRIT; label noted that "tubers produced on aerial stems"; Correll 1972a) in the Pineywoods; FL, LA, MS, and TX. Late summer–early fall; however, plants growing in North America rarely flower, and those that do are typically pistillate (Raz 2002). Native of tropical Asia and possibly also Africa. This species contains diosgenin, alkaloids, oxalates, and other toxins (Morton 1982); it has both inedible and edible forms (Bailey & Bailey 1976). It is cultivated (primarily in Oceania) for the aerial bulbils and was introduced to the New World during the slave trade (Al-Shehbaz & Schubert 1989). This species can be distinguished from another introduced bulbil-bearing species, *D. polystachya* Turcz. (incorrectly referred to by some authors as *D. oppositifolia*), CHINESE YAM, CINNAMON VINE (known from AR and much of the e U.S.); the latter has nonauriculate petiolar bases, usually opposite leaves, and dextrorse (= twining upward from left to right—clockwise) stems (Al-Shehbaz & Schubert 1989; Ting & Gilbert 2000; Raz 2002). ☠ ☜ ⚙/285

Dioscorea villosa L., (soft-hairy), WILD YAM, ATLANTIC YAM, COLIC ROOT, YAM ROOT, FOUR-LEAF YAM. Rhizomes 5–15 mm thick, ± smooth and straight, from not much branched to contorted irregularly or with many short branches; stems to 5 m long, sinistrorse; leaves, except for the lowest, all alternate or those of lower nodes whorled and those above opposite to alternate; leaf blades 5–15 cm long; capsules 1.2–3 cm long; seeds 7–18 mm wide. Low to moist rich woods; mainly Pineywoods, also Anderson (Fleming et al. 2002) and Madison (Turner et al. 2003) cos. near the e margin of the Post Oak Savannah and in Red River drainage w to Lamar (BRIT); se Canada (Ont.) and e U.S. from NY s to FL w to MN and TX. Apr–Jun. [*D. quaternata* J.F. Gmel., *D. villosa* var. *glabrifolia* (Bartlett) Fernald] Native TX *Dioscorea* have traditionally been divided into two species, *D. quaternata* and *D. villosa* (e.g., Correll & Johnston 1970; Turner et al. 2003). However, we are following Raz (2002) who synonymized *D. quaternata* with *D. villosa*, indicating, "At present, I can find no natural gaps in the variation between the plants that have been called (albeit ambiguously; see H.H. Bartlett 1910) *D. villosa* and those called *D. quaternata*." Raz (pers. comm.) further indicated that while there are morphological extremes that can be recognized, "every morphological intermediate that can exist between these extremes, does in fact exist." While the indigenous species have low levels of saponins, the rhizomes of *D. villosa* were used by some Native Americans to ease the pain of childbirth, and an alcohol extract was used in the 19th century as a treatment for colic (Raz 2002). If one chooses to recognize two native species in TX, characters such as the following might prove useful in recognizing the "morphological extremes":

1. Petioles usually pubescent at junction with leaf blade, usually 7 cm or more long on well-developed leaves; leaves in whorls of 4–7 at 1 or more lower nodes; rhizomes neither smooth nor straight (contorted and with many knobs or short side branches), 10–15 mm in diam.; fresh stems ± round in cross section _____ *D. quaternata*
1. Petioles glabrous at junction with leaf blade, usually 6 cm or less long on well-developed leaves; leaves of lower nodes at most opposite or with 3 in close proximity; rhizomes relatively smooth and straight (knobs or side branches few or none), 5–10 mm in diam.; fresh stems polygonal in cross section (with 8–14 angles) _____ *D. villosa*

ERIOCAULACEAE P. Beauv ex Desv. PIPEWORT FAMILY

Small, scapose, monoecious (usually) or dioecious, biennial or perennial herbs; leaves in a rosette, crowded, spirally arranged, linear and grass-like in appearance, often long-tapering; inflorescence a compact (2–20 mm broad), often whitish head solitary at the end of an elongate, naked, angled scape, the scape with a basal sheath; heads composed of involucral bracts and numerous unisexual flowers, the flowers each subtended by 1(–2) scarious receptacular bracts; flowers small, with chaffy perianth parts; perianth parts and bracts often with clavate, multicellular, often conspicuous, sometimes whitish hairs; sepals 2–3, distinct or fused; petals 2–3 or reduced or absent; stamens 2–6; gynoecium of 2–3 carpels; ovary superior, on a gynophore, 2–3 locular, each locule with a single ovule; fruit a thin-walled loculicidal capsule.

The Eriocaulaceae is a medium-large (1,200+ species in ca. 13 genera—Kral 2000b) family of usually perennial, small, scapose herbs distributed mainly in the tropics and warm areas, especially in the Americas; a few are in temperate regions. Most species grow in full sun in wet acidic soils or in aquatic situations (Kral 2000b). Because of the involucrate heads of many small flowers, the Eriocaulaceae are sometimes referred to as the "Compositae of the monocots" (Judd et al. 1999). This distinctive monophyletic family (Judd et al. 1999) seems to have a close relationship with Xyridaceae (Linder & Kellogg 1995; Stützel 1998; Givnish et al. 1999). The following treatment is modified from those by Kral (1966b, 1979b, 2000b). (subclass Commelinidae—Cronquist; order Poales—APG II)

FAMILY RECOGNITION IN THE FIELD: wet area herbs with a basal rosette of linear, grass-like leaves; flowers small and inconspicuous, in a small (2–20 mm in diam.) compact head at the end of an elongate naked scape, the head often with a whitish appearance.

REFERENCES: Moldenke 1937, 1961; Kral 1966b, 1979b, 1989, 2000b; Dahlgren et al. 1985; Stützel 1998; Giulietti et al. 2000.

1. Roots (larger ones) thickened, pale, septate, appearing unbranched; lacunar tissue (= air spaces) in the leaves evident to the naked eye; scapes glabrous AND heads 3–20 mm broad; perianth parts in 2s, the sepals separate or united into a spathe, the petals united for most of their length into a corolla tube which is 2-lobed above, each lobe adaxially bearing a jet black gland; heads 3–20 mm broad; stamens (3–)4(–6), the ripe anther surfaces of all native species black; carpels 2, the style 2-branched, the gynoecium on a conspicuous gynophore _____ **Eriocaulon**
1. Roots fibrous and evidently branched; lacunar tissue in the leaves not evident to the naked eye; scapes EITHER sparsely to densely hairy OR heads very small (2–3.5 mm broad); perianth parts usually in 3s, the sepals separate, the petals absent or reduced to small eglandular hairs or scales; heads 2–7(–9) mm broad; stamens 2 or 3, the anthers yellowish or pale; carpels 2 or 3, the style 2- or 3-branched (the branches bifid), the gynophore conspicuous or inconspicuous _____ **Lachnocaulon**

ERIOCAULON L. PIPEWORT, BUTTON-RODS, HAT-PINS

Clump-forming, usually monoecious, perennial or biennial (except sometimes annual in *E. kornickianum)* herbs reproducing vegetatively by lateral offshoots or rhizomes; leaves ± all in

basal rosette, linear, sheath-like at base; inflorescence a compact, hemispherical to globose head terminating an elongate scape; bracts and perianth parts often with conspicuous, clavate, whitish hairs; flowers small (ca. 3 mm or less long) and crowded together; sepals 2; petals 2; male flowers with (3–)4(–6) stamens; carpels 2.

A genus of ca. 400 species of tropical and warm areas, including Japan and North America, most aquatic or in wet, acidic habitats (Kral 2000b). The dried inflorescences are sometimes used in floral arrangements (Judd et al. 1999). (Greek: *erion*, wool, and *caulos*, a stalk, from the wool at the base of the scape in the first named species)
REFERENCES: Kral 1966b; Watson et al. 1994.

1. Heads 3–4 mm broad at flowering time, dark gray or gray-green except for pale "rims" of white ciliate perianth parts and receptacular bracts and pale outer involucral bracts; plants diminutive, the mature scapes only 5–8 cm long; receptacle surface glabrous; species rare in East TX _____ **E. koernickianum**

1. Heads 5–20 mm broad at flowering time, white or gray; plants usually larger, the mature scapes 5–110 cm long; receptacle surface hairy; including species widespread and common (in appropriate habitats) in East TX.
   2. Heads soft, much compressed when pressed and dried; sheaths of the scapes exceeding all or most leaves in length; involucral bracts grayish, obtuse or rounded apically; receptacular bracts grayish, acute apically; petals of pistillate flowers with inner (= adaxial) surface villous; clavate hairs of perianth with all cells whitened and opaque; plants of aquatic or wet situations, flowering and fruiting in winter, spring, or early summer.
      3. Heads 10–20 mm broad at flowering time; scapes 20–70 cm long; leaves 5–30 cm long; roots usually 1 mm or more broad; corollas of staminate flowers with lobes conspicuously unequal _____ **E. compressum**
      3. Heads usually ca. 5–10 mm broad at flowering time; scapes usually 5–30 cm long; leaves 1–5(–7) cm long; roots usually 1 mm or less broad; corollas of staminate flowers with lobes subequal _____ **E. texense**
   2. Heads very hard, only slightly compressed when pressed and dried; sheaths of the scapes usually exceeded in length by most of the leaves; involucral bracts straw-colored, acute apically; receptacular bracts pale, narrowly acute to acuminate apically; petals of pistillate flowers with inner surface glabrous; clavate hairs of the perianth with terminal cells whitened and opaque, but some or all of such hairs with basal cells not white but transparent; plants of moist but seldom aquatic or permanently wet situations, flowering late spring or summer and fruiting in summer and fall _____ **E. decangulare**

Eriocaulon compressum Lam., (compressed, flattened), FLATTENED PIPEWORT. Leaves 5–30 cm long; mature scapes 20–70 cm long; mature (flowering) heads hemispherical or globose, 10–20 mm broad, chalk white except for the dark exserted tips of the receptacular bracts and anthers; outer involucral bracts 2–3 mm long, obtuse or rounded, grayish-translucent; surface of receptacle with multicellular, translucent hairs; receptacular bracts acute; sepals translucent, with clavate white hairs on the back. Sands or sandy peats of wet areas such as acid ponds, swamps, and pine savannahs; Newton (BRIT), Hardin (TAES), Anderson (TAMU), Jasper, Tyler (VDB), and Jefferson (Turner et al. 2003) cos. in the Pineywoods; also n Gulf Prairies and Marshes; se U.S. from VA s to FL w to TX. Spring. Kral (1966b) indicated that "This is perhaps the showiest of all the Eriocaulaceae of the southeastern United States, in springtime so abundantly decorating the shallow water of pinelands as to appear like a shower of white confetti." This is the most aquatic of the species occurring in East TX (Kral 2000b). (TOES 1993: V) ⚠

Eriocaulon decangulare L., (ten-angled), TEN-ANGLE PIPEWORT, PIPEWORT. Leaves 10–40 cm long; mature scapes 30–110 cm long; mature heads subglobose, 10–20 mm broad, dull white, hard; lowermost flowers and receptacular bracts reflexed and obscuring the subtending involucral

bracts; outer involucral bracts narrowly ovate to lanceolate, 2–4 mm long, acuminate, straw-colored, with clavate white hairs apically; surface of receptacle villous; receptacular bracts narrowly acute to acuminate, sometimes visibly exserted; sepals 2–3 mm long, yellowish white, with clavate white hairs on keel and apex. Meadows, swamps, pond margins, bogs; widespread in appropriate habitats in the Pineywoods and Post Oak Savannah; also n Gulf Prairies and Marshes; e U.S. from NY s to FL w to OK and TX. May–Sep. This is the most robust of the East TX pipeworts. ❁/286

Eriocaulon koernickianum Van Heurck & Müll. Arg., (for Friedrich August Körnicke, 1828–1908, German botanist), SMALL-HEAD PIPEWORT, GULF PIPEWORT, DWARF PIPEWORT. Plant annual or weakly perennial, diminutive, the leaves 1–5 cm long, the mature scapes 5–8 cm long; sheath of scapes about the length of the leaves; mature heads subglobose or short-oblong, 3–4 mm broad, dark gray or gray-green except for the pale "rims" of white ciliate perianth parts and bracts and pale outer bracts; outer involucral bracts broadly oblong to suborbicular, reflexed at maturity, 1–1.25 mm long, rounded, straw-colored, translucent, not hidden by perianth parts and receptacular bracts; surface of receptacle glabrous; receptacular bracts acute to obtuse; sepals ca. 1 mm long, gray-translucent, glabrous or with scattered hairs on the back apically. Upland seeps, bogs, permanently wet seepage slopes or marsh/bog edges that are not overshadowed by taller vegetation, often on sphagnum mats, acidic sands to sandy silts, often associated with sandstone or other rocky outcrops; Anderson, Brazos, Freestone (BRIT), Polk, Tyler (Kral 1966a), Henderson, Limestone (MacRoberts & MacRoberts 1999), and Leon (Carr 2001) cos. in the s portions of the Post Oak Savannah and Pineywoods (MacRoberts & MacRoberts (1999) could not confirm the Polk and Tyler county records); also Gillespie Co. (BRIT) at Enchanted Rock State Natural Area in the e Edwards Plateau; AR, GA, OK, and TX. Spring–early fall. This rare species was cited by Kral (2000b) as being of conservation concern, has declined in the recent past, and is a Federal Candidate Species (Watson et al. 1994). Its conservation biology was discussed by Watson et al. (1994)—a number of factors appear to be contributing to its rareness, including no vegetative reproduction, low seed set, genetic homogeneity, poor competitive ability, annual or weak perennial life history, and a restricted habitat. (TOES 1993: V; RARE 2002a: G2S1SOC) ⚠

Eriocaulon texense Körn., (of Texas), TEXAS PIPEWORT, PIPEWORT. In habit resembling a diminutive *E. compressum* (Kral 2000b); leaves 1–5 cm long; mature scapes 5–30 cm long, mature head usually hemispherical, 5–10 mm broad, gray except for the white hairs of the receptacular bracts and perianth parts and the straw-colored outer involucral bracts, soft; outer involucral bracts suborbicular to broadly ovate, ca. 1.5 mm long, rounded to acute, at maturity usually hidden by the florets (but evident earlier); surface of receptacle with numerous hairs; receptacular bracts acute; sepals ca. 1.5 mm long, dark gray apically, with clavate white hairs on keel and sometimes on margins apically. Wet acidic areas, sphagnous bogs (often with *Sarracenia*—PITCHERPLANT); widespread in s part of Pineywoods and Post Oak Savannah w to Henderson, Milam (TAES), Austin, and Freestone (Turner et al. 2003) cos.; se U.S. from NC s to FL w to TX. Moldenke (1961) indicated Cory recorded the species from the Blackland Prairie. Apr–Jun.

Eriocaulon aquaticum (Hill) Druce, (aquatic), SEVEN-ANGLE PIPEWORT, WHITE-BUTTONS, DUCK-GRASS, [*E. septangulare* With.], was reported for TX in vegetational areas 1 and 4 by Hatch et al. (1990). However, Kral (1979b; 2000b) indicated it occurs in Canada and the n U.S. s only to Alabama; R. Kral (pers. comm.) confirmed that this species does not occur in TX. According to Kral, "Early reports of *E. aquaticum* (*E. septangulare*) were based on lack of understanding of the similar-looking *E. texense*." *Eriocaulon aquaticum* can be distinguished by the heads which are small (4–5 mm wide) and ± dark in appearance due to usually gray to almost black receptacular bracts and perianth parts (only tips of perianth parts and receptacular bracts have whitish hairs); also the receptacles are glabrous.

LACHNOCAULON Kunth

HAIRY PIPEWORT, BOG-BUTTONS, BOG BACHELOR'S-BUTTONS

Perennial scapose monoecious herbs, ours clump formers, the rosettes often aggregated into mats; stems with old leaf bases persistent as scales; leaves linear, from a clasping or sheathing base; inflorescence a globose to hemispheric or short-cylindric head terminating an elongate scape; bracts and sepals usually with clavate, multicellular hairs; sepals usually 3; petals absent or reduced to small hairs or scales; stamens 2–3, elevated on an androphore; gynoecium 2- or 3-carpellate.

A genus of ca. 10 species (Kral 2000b), of the se U.S. and the West Indies; they are typically found in acidic habitats, often with *Sphagnum*. (Greek: *lachno*, downy or woolly, and *caulus*, stalk or stem, in reference to the long hairs on the scapes of the type species—Kral 1989)
REFERENCE: Kral 1966b; MacRoberts 1989.

1. Scapes 15–40 cm long, sparsely to densely hairy; mature heads usually 4–7(–9) mm broad; hairs at apices of receptacular bracts and perianth parts white, opaque, this imparting a pale gray or whitish color to the heads; leaves 2.5–5.5(–12) cm long; stamens 3; styles 3, bifid _____ **L. anceps**
1. Scapes 5–10 cm long, glabrous; mature heads 2–3.5 mm broad; hairs at apices of receptacular bracts and perianth parts not white, translucent, the brown bracts and/or perianth parts imparting their own color to the heads; leaves 0.6–1(–2) cm long; stamens 2; styles 2, bifid _____ **L. digynum**

Lachnocaulon anceps (Walter) Morong, (two-edged), WHITE-HEAD BOG-BUTTON, HAIRY PIPEWORT. Longer involucral bracts oblong or obovate, 1–1.5 mm long; receptacular bracts 1.5–2 mm long; sepals 1.5–2 mm long (male flowers) or 2–3 mm long (female flowers); gynoecium 3-carpellate. Moist to dry sands, bogs, other wet areas, acid substrates; Angelina, Tyler (BRIT), Hardin, Jasper (BRIT, VDB), Jefferson, Newton, Polk, Sabine, Trinity (Turner et al. 2003) cos. in the se part of the Pineywoods, Leon Co. (J. Singhurst, pers. comm.) in the Post Oak Savannah, and Bexar Co. (Turner et al. 2003) at the w edge of East TX; se U.S. from VA s to FL w to TX (but disjunct across much of LA—Kral 2000b). May–Oct. [*Eriocaulon anceps* Walter]

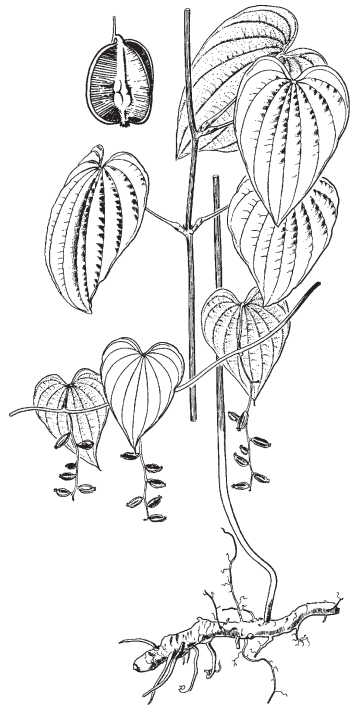
Lachnocaulon digynum Körn., (two female, in reference to the 2-carpellate gynoecium), PINELAND BOG-BUTTON, TINY BOG-BUTTONS, TINY BUG-BOTTOMS. Longer involucral bracts triangular, ca. 1 mm long; receptacular bracts 1–1.3 mm long; sepals ca. 1 mm long (in both male and female flowers); gynoecium 2-carpellate. Wet sands, bogs, wetland pine savannahs, other wet areas, acid substrates (primarily Catahoula Formation); Newton (BRIT) and Jasper (Bridges & Orzell 1989a; Poole et al. 2002; Turner et al. 2003) cos. in the se portion of the Pineywoods (this area was also mapped without specific county in Kral 2000b); scattered in se U.S. from FL w to TX (but disjunct across much of LA—Kral 2000b). Summer–fall. Kral (1966b) noted that the small, often densely aggregated rosettes are reminiscent of large *Polytrichum* species (mosses). Kartesz (1999) considered this species to be rare throughout its range, and it is here considered of conservation concern. It was first reported for TX in 1989 (Bridges & Orzell 1989a). (RARE 2002a: G3S1SOC) ⚠

HEMEROCALLIDACEAE R. Br. DAY-LILY FAMILY

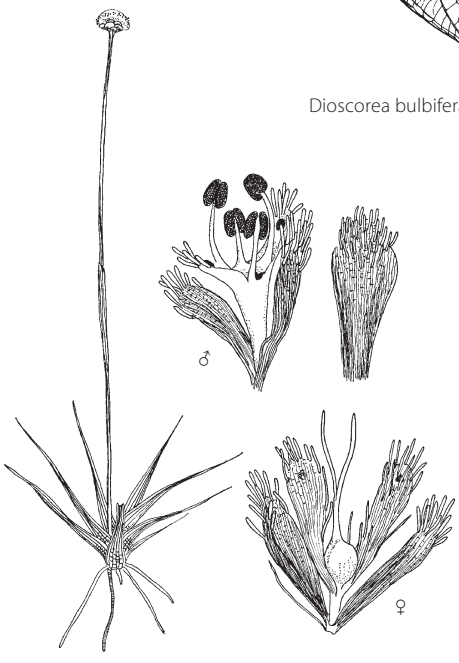
A small family of 16 to 18 genera and ca. 85–120 species (including plants sometimes placed in the Phormiaceae) of rhizomatous herbs native primarily to the s hemisphere, especially Australia (Zomlefer 1998). The genera have been variously treated in terms of family affiliation. Many authorities have put them in a broadly defined and clearly polyphyletic (but practical) Liliaceae (e.g., Correll & Johnston 1970; Cronquist 1988; Diggs et al. 1999), based on superficial floral similarities to the genus *Lilium*, while others (e.g., Traub 1963a) have put them in the Amaryllidaceae based on characters of the inflorescence, etc. The Hemerocallidaceae has been recognized as a distinct family by a variety of authorities (e.g., Clifford et al. 1998; Reveal & Pires



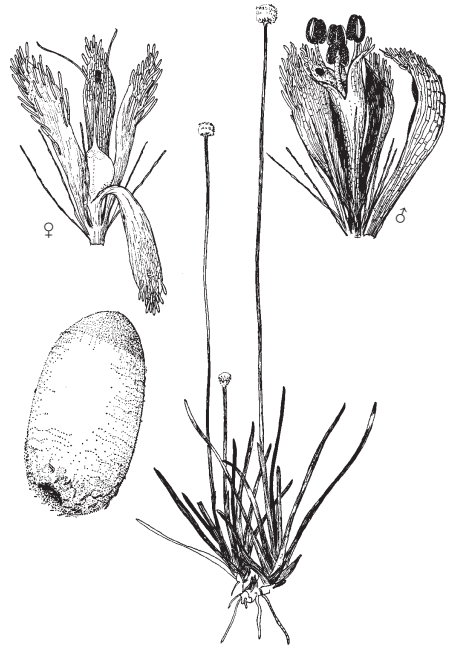
Dioscorea bulbifera [HEB]



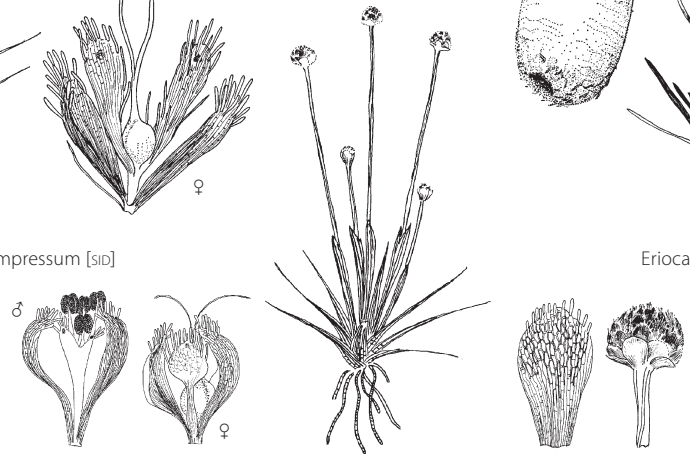
Dioscorea villosa [YAT]



Eriocaulon compressum [SID]



Eriocaulon decangulare [SID]



Eriocaulon koernickianum [SID]

2002) but has been variously delimited. Mabberley (1997), for example, treated the family as having a single genus (15 species), while Clifford et al. (1998) considered it to have 13 genera and ca. 50 species. We are recognizing the Hemerocallidaceae and are following Zomlefer's (1998) circumscription (Chase et al. 1996 delimited the family similarly under the later name Phormiaceae). Based on cladistic analyses, the Hemerocallidaceae is in order Asparagales. As such, it is more closely related to families such as the Iridaceae and Orchidaceae than it is to many other taxa often put in a broadly defined Liliaceae (Chase et al. 1995a, 1995b, 1996; Zomlefer 1999). For a detailed discussion of the groups formerly treated as Liliaceae in the broad sense, see the family synopsis of the Liliaceae (here treated in a restricted sense) on page 726. Recently, the Angiosperm Phylogeny Group (APG II 2003) proposed optionally including Hemerocallidaceae in a very broadly defined Xanthorrhoeaceae (including the Australian xerophytes known as GRASS-TREES). (subclass Liliidae—Cronquist; order Asparagales—APG II)

FAMILY RECOGNITION IN THE FIELD: lily-like, rhizomatous perennials with numerous, basal, long-linear leaves and several very large, showy, yellow or orange flowers at the end of a naked scape; the ovary superior and the perianth forming a tube basally.

REFERENCES: Traub 1963a; Dahlgren et al. 1985; Chase et al. 1996; Clifford et al. 1998; Zomlefer 1998; McPherson et al. 2004.

HEMEROCALLIS L. DAY-LILY

Perennials, rhizomatous, with fleshy roots having tuberous swellings; leaves basal, 2-ranked, numerous, sessile, linear; scapes taller than leaves; flowers several, in a typically 2-branched helicoid cyme, large and showy; tepals 6, connate at base forming a short tube; stamens 6, inserted at summit of perianth tube; ovary superior, with 3 locules; style 1; fruit a capsule.

An ornamentally and economically important genus of ca. 15–30 species native to temperate eastern Asia (Chung & Kang 1994; Mabberley 1997; Clifford et al. 1998; Zomlefer 1998; Straley & Utech 2002b). DAY-LILIES superficially resemble the true LILIES (*Lilium;* Liliaceae) in general habit and flower structure but can be distinguished by the rhizomes and the black, prismatic to rounded seeds (vs. the bulb and pale brown, flat seeds of *Lilium*) (Zomlefer 1998). *Hemerocallis* species have a long history of human usage; they are mentioned in written Chinese folklore dating to ca. 500 BC (Zomlefer 1998). DAY-LILIES are among the most common garden plants in the U.S., with an active society, the American Hemerocallis Society, devoted to their cultivation—many of the over 38,000 cultivars are of hybrid origin. The two species cultivated in East TX were both introduced into Europe from Asia by the 1570s (Zomlefer 1998). ☠ While a number of species have been used medicinally (e.g., pain relief, arsenic-poisoning antidote, treatment for schistosomiasis) or are known to be poisonous due to the presence of the neurotoxin hemerocallin (and possibly also colchicine), some are important food plants in Asia, with the flowers, shoots, and roots (after proper preparation) being eaten (Zomlefer 1998; Burrows & Tyrl 2001; Straley & Utech 2002b). The common name DAY-LILY is in reference to the flowers lasting only one day (Durant 1976). (Greek: *hemera*, a day, and *callus*, beauty, referring to the showy flowers lasting one day)

REFERENCES: Bailey 1930; Stout 1934, 1941; Xiaobai 1986; Erhardt 1992; Schabell 1993; Chung & Kang 1994; Straley & Utech 2002b.

1. Flowers predominantly orange with darker reticulate veins, not fragrant; inner perianth lobes with margins wavy; capsules not or only rarely developing, usually without viable seeds _____ **H. fulva**
1. Flowers bright yellow, with parallel veins, fragrant; inner perianth lobes with margins flat, not wavy; capsules developing with viable seeds _____ **H. lilioasphodelus**

Hemerocallis fulva (L.) L., (tawny, dull yellow-brown), ORANGE DAY-LILY, FULVOUS DAY-LILY, TAWNY DAY-LILY, EUROPA DAY-LILY. Leaves to 1 m long and 2.5(–3) cm wide; scape 0.7–1.5 m tall; perianth usually predominantly orange, with darker reticulate veins, sometimes with a darker reddish

orange zone toward the base and then yellowish basally, 8.5–12 cm long, broadly campanulate to funnelform with a cylindrical tube; perianth lobes spreading to slightly recurved; seeds not maturing (plant spreading from root or rhizome fragments). Widely cultivated, long persisting, and sometimes escaping; Lamar Co. (BRIT), also Grayson Co. (G. Diggs, pers. obs.); se Canada, widespread in the e 1/2 of the U.S. and scattered in the nw. Late spring–early summer. Native of e Asia. [*H. lilioasphodelus* L. var. *fulvus* L.] The dried flowers are used to flavor food in China and Japan (Mabberley 1987). According to Zomlefer (1998), the material of this species naturalized in the se U.S. is cultivar 'Europa.' It is a self-sterile autotriploid with $2n = 33$. This clone, which is the most widely distributed DAY-LILY in the world, was imported to North America probably in the 17th century (Zomlefer 1998). There are now "more than 13,000 named clones" (Straley & Utech 2002b) of this ornamentally important species. Flowers occur in nearly every color except true blue—the pigments responsible for blue coloration are reddish/purple at the pH of DAY-LILY sap (Darrell Apps, pers. comm.). ☞ ⊠/288

Hemerocallis lilioasphodelus L., (lily and *Asphodelus*, a genus of the Asphodelaceae previously placed in the Liliaceae), YELLOW DAY-LILY, LEMON DAY-LILY, LEMON-LILY, CUSTARD-LILY. Leaves to 65 cm long and 1.5 cm wide; scape 0.5–1 m tall; perianth bright yellow, with parallel veins, ca. 7–8 cm long; capsules producing viable seeds, the seeds black, shiny, 3–5 mm in diam.; $2n = 22$ (Zomlefer 1998). Cultivated, persisting, and spreading?; Zomlefer (1998, based on Kartesz 1997) indicated that this species may be naturalized in TX; Straley and Utech (2002b) also cited it for TX (without specific county indicated), presumably in the e part of the state; included based on these citations; no county distribution map is provided; se Canada and most of the U.S. except for the far sw. Late spring–summer. Native of e Asia. [*H. flava* (L.) L.] Schabell (1993) discussed the nomenclatural and horticultural history of *H. lilioasphodelus*. While we are following Straley and Utech (2002b) in recognizing Linnaeus as the authority for this species, Dress (1955) indicated that it should be (L.) L. emend. Hyl. This species is much less aggressive than *H. fulva* and escapes only sporadically (Straley & Utech 2002b). ☞

HYACINTHACEAE Batsch ex Borkh.
HYACINTH FAMILY

Bulbose, scapose perennials; leaves ± all in a basal rosette; inflorescence usually a terminal raceme or in 1 species corymbose; tepals 6, similar, distinct or connate for ca. 1/2 or more of their length; stamens 6; ovary superior, of 3 carpels; style 1; fruit a capsule.

A medium-sized (ca. 67 genera and 900 species) subcosmopolitan family with greatest diversity in the Mediterranean region and s Africa (Speta 1998b). Many are cultivated as ornamentals. In the past, many authorities put the genera in a broadly defined and clearly polyphyletic (but practical) Liliaceae (e.g., Correll & Johnston 1970; Cronquist 1988; Diggs et al. 1999), based on superficial similarities of the flower structure to that of the genus *Lilium*. However, based on phylogenetic analyses (e.g., Chase et al. 2000), we are following Speta (1998b) and Wetschnig and Pfosser (2003) in recognizing the Hyacinthaceae as a separate family in the order Asparagales. As such, it is more closely related to Asparagales families such as the Agavaceae, Iridaceae and Orchidaceae than it is to many other taxa often put in a broadly defined Liliaceae (Chase et al. 1995a, 1995b, 1996; Fay & Chase 1996, 2000; Fay et al. 2000). Recently, the Angiosperm Phylogeny Group (APG II 2003) proposed optionally including the Hyacinthaceae in a very broadly defined Asparagaceae (along with such families as Agavaceae). For a detailed discussion of the groups formerly treated as Liliaceae in the broad sense, see the family synopsis of the Liliaceae (here treated in a restricted sense) on page 726. (subclass Liliidae—Cronquist; order Asparagales—APG II)

FAMILY RECOGNITION IN THE FIELD: scapose, bulbose herbs usually with numerous flowers in racemes and only a single style.

REFERENCES: Dahlgren et al. 1985; Speta 1998b; Pfosser & Speta 1999; Stedje 2001.

1. Tepals connate into a tube for ca. 1/2 or more of their length.
   2. Perianth 6 mm or less long, blackish blue to sky blue, with teeth < 1/4 as long as tube, the tube constricted at the mouth ____ **Muscari**
   2. Perianth (10–)17–25 mm long, violet-blue to white, rosy, or rarely yellowish, with teeth nearly as long as the tube, the tube not constricted at the mouth ____ **Hyacinthus**
1. Tepals distinct, not forming a tube.
   3. Tepals strikingly white inside, green with white margins outside, 14–22(–30) mm long; inflorescence corymbose ____ **Ornithogalum**
   3. Perianth variously colored, but not as above, 4.5–17 mm long; inflorescence a raceme.
      4. Tepals yellow to white or greenish white, with green or red stripe on abaxial surface, 4.5–7 mm long; ovules 2 per locule ____ **Schoenolirion**
      4. Tepals light blue to blue-violet, lavender, or blue, rarely whitish, 5–17 mm long; ovules 1–12 per locule.
         5. Tepals each 3- or 5-veined, 6–17 mm long; anthers bright yellow; native species widespread in East TX ____ **Camassia**
         5. Tepals each 1-veined, 5–7 mm long; anthers greenish to bluish; introduced species known in East TX only from Navarro and possibly Harrison cos. ____ **Scilla**

CAMASSIA Lindl. WILD-HYACINTH

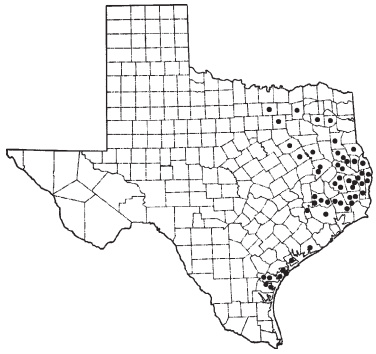
A North American genus of 5–6 species (Ranker & Hogan 2002). The bulbs of some species (e.g., *C. quamash* (Pursh) Greene—CAMAS or QUAMASH of Native Americans) were extensively used as food by Native Americans in the nw U.S. (Kindscher 1987); some are cultivated as ornamentals. Recent molecular evidence (e.g., Clary & Simpson 1995; Bogler & Simpson 1996; Fay & Chase 1996; Pfosser & Speta 1999) suggests that *Camassia* (and presumably the related genus *Schoenolirion*) may be more closely related to the Agavaceae than to other members of the Hyacinthaceae and that it should possibly be put in the Agavaceae or placed in its own family. However, until further work clarifies its phylogenetic position relative to other monocot families, we are maintaining it in the Hyacinthaceae for practical reasons. Reveal and Pires (2002) noted that recognition at the family level seems "premature given the available evidence." (From the Native American (Chinook or Shoshone) name for a bulb, *quamash* or *camas*; the use of quamash was discussed by Meriwether Lewis in his journal of the Lewis and Clark expedition—Durant 1976; Ranker & Hogan 2002)

REFERENCES: Gould 1942; Steyermark 1961; Ranker & Schnabel 1986; Ranker & Hogan 2002.

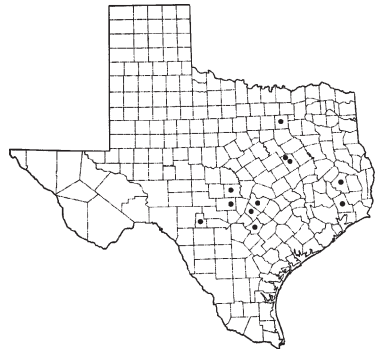
Camassia scilloides (Raf.) Cory, (resembling the genus *Scilla*), WILD-HYACINTH, EASTERN CAMAS, ATLANTIC CAMASSIA, CAMAS, CAMAS-LILY, MEADOW-HYACINTH, INDIGO-SQUILL, SIKO, PRAIRIE CAMAS. Bulbose perennial, without onion or garlic odor, the bulbs sometimes clustered; leaves 3–8, crowded toward base of the unbranched stem, to 80 cm long and 5–20 mm wide, their bases clasping and surrounded by a sheathing, somewhat papery bract; stem leaves reduced and bract-like; inflorescence an elongating, erect, terminal raceme; flowers sweet-scented; perianth radially symmetrical, spreading, the 6 segments free, 6–17 mm long, light blue to lavender to rarely whitish, persistent after withering; anthers bright yellow; capsule 3-locular, with 2–5 seeds per locule. Open woods and prairies; East TX w to West Cross Timbers and e Edwards Plateau; se Canada and e 1/2 of the U.S. w to KS, OK, and TX. Apr–Jun (individuals sometimes segregated as *C. angusta* reported to flower about 2–3 weeks later than sympatric populations of *C. scilloides*—Ranker & Hogan 2002). [*C. angusta* (Engelm. & A. Gray) Blank., *Cyanotris scilloides* Raf., *Schoenolirion texanum* (Scheele) A. Gray—according to Sherman (1979) and Ranker and Hogan (2002), this name was based on *Ornithogalum texanum* Scheele, representative of *Camassia scilloides* (Raf.) Cory, not *Schoenolirion*] The bulb is edible and was an important food source for Native Americans and early settlers; however, it resembles that of the



Scleria pauciflora



Scleria triglomerata



Scleria verticillata



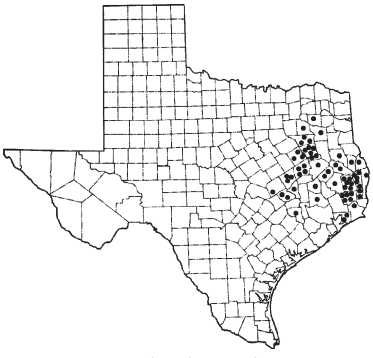
Dioscorea bulbifera



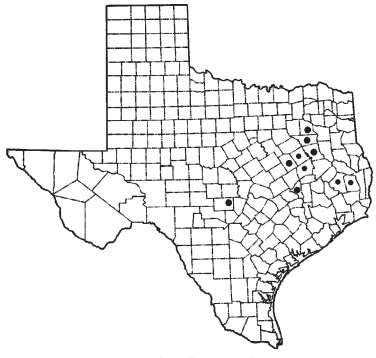
Dioscorea villosa



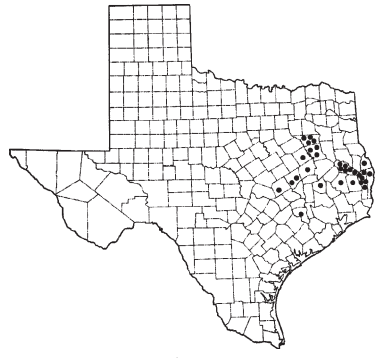
Eriocaulon compressum



Eriocaulon decangulare



Eriocaulon koernickianum



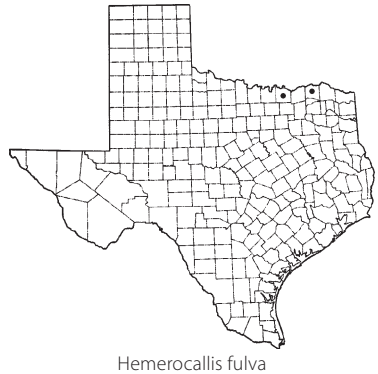
Eriocaulon texense



Lachnocaulon anceps



Lachnocaulon digynum



Hemerocallis fulva

potentially fatal *Zigadenus nuttallii* (DEATH CAMAS; Melanthiaceae) (Ajilvsgi 1984; Kindscher 1987). A number of authorities segregate some sympatric populations as *C. angusta* (see key below). There has long been disagreement over the recognition of that taxon. Gould (1942) synonymized it with *C. scilloides*, but indicated that it perhaps deserved subspecific recognition. Steyermark (1961) treated it as a separate species, saying, "most of the specimens examined fall readily into either *C. angusta* or *C. scilloides*." Likewise, Ranker and Schnabel (1986) recognized it at the specific level, suggesting that it was probably a derivative of *C. scilloides*, the two species thus representing a progenitor-derivative pair. Yatskievych (1999) and Ranker and Hogan (2002) also recognized *C. angusta*, but Turner et al. (2003) did not recognize the species for TX. While the individuals recognized as *C. angusta* often flower later and have "taxon-specific patterns of morphological and isozymic variation" (Ranker & Schnabel 1986), there is substantial morphological intergradation with other plants of *C. scilloides*. This is particularly true in TX where the two appear much less distinct than further to the n (Steyermark 1961). In fact, we cannot consistently separate TX individuals into two distinct groups and therefore are tentatively treating all plants within a variable *C. scilloides*. This seems to be an excellent example of a species partially but not completely separated into two distinct species by the process of evolution. For those wishing to attempt to separate *C. angusta*, the following key, modified from those in Steyermark (1961), Yatskievych (1999), and Ranker and Hogan (2002) may prove helpful. ⚅/279

1. Inflorescences 27–87 cm long, with (30–)40–100 flowers (including pedicels remaining after spent flowers have fallen off); aerial stems with (1–)3–28 (few in TX plants) linear, bract-like leaves below the lowermost flowers; perianth 6–8.5(–13) mm long; fruits ovoid-ellipsoid; pedicels in fruit incurving-erect or nearly so, appearing close to the axis of the inflorescence, 6–12 mm long; styles 2.5–5.5 mm long _____ *C. angusta*

1. Inflorescences 19–47 cm long, with 7–50(–85) flowers; aerial stems with 0–2(–5) linear, bract-like leaves below the lowermost flowers; perianth (7–)8–17 mm long; fruits subglobose; pedicels in fruit ascending to horizontal, spreading away from the axis of the inflorescence, 5–30 mm long; styles 4–8(–11) mm long _____ *C. scilloides*

HYACINTHUS L. HYACINTH

A genus of 3 species ranging from the Near East to s Turkmenistan and ne Iran (Speta 1998b); it is well known for its cultivated ornamentals. ("Greek name used by Homer, the flowers being said to have sprung from the blood of Hyakinthos, a youth accidentally killed by Apollo"—Hyam & Pankhurst 1995. However, Mabberley (1997) indicated that name was very ancient, pre-Greek and non-Indoeuropean, originally the name of a god associated with spring) REFERENCES: Bentzer et al. 1974; Speta 1998b.

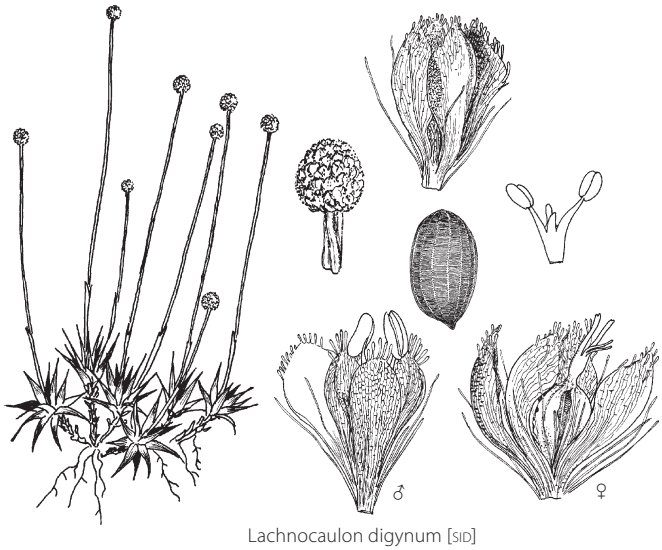
Hyacinthus orientalis L., (oriental), HYACINTH, GARDEN HYACINTH. Bulbose perennial 10–30 cm tall; leaves crowded at base, ± clasping and sheathing, 5–40 mm wide; flowers sweet-scented, short-pedicelled, in an erect, spike-like raceme; perianth narrowly campanulate with recurved lobes, violet-blue to white, rosy, or rarely yellowish, (10–)17–25 mm long; anthers longer than filaments, included; capsule 10–15 mm long; seeds with an appendage (elaiosome). In 1893 Reverchon wrote that a wild strain of this had self-sown and escaped from his garden in Dallas, maintaining itself for several years (Mahler 1988). Modern cultivated varieties sometimes persist about old farms and gardens but are not known to produce seed; Collin and Hunt (BRIT) cos.; scattered in the U.S. (CA, KY, PA, TX, UT, and VA). Late Feb–Mar. Native of the e Mediterranean region. All parts of the plant, but especially the bulb, can cause toxicity problems (digestive tract disturbances, dermatitis) in humans and livestock, apparently due to alkaloids such as lycorine and also possibly the presence of raphides (bundles of microscopic, needle-like calcium oxalate crystals) (Stephens 1980; Spoerke & Smolinske 1990; Burrows & Tyrl 2001). As evidenced by the elaiosome, in its native habitat this species apparently has it seeds dispersed by ants (Bentzer et al. 1974). ☠☜



Eriocaulon texense [GWO, SID]



Lachnocaulon anceps [SID]



Lachnocaulon digynum [SID]



Hemerocallis lilioasphodelus [GLE]



Hemerocallis fulva [GAR, YAT]



Camassia scilloides [BB2, YAT]

MUSCARI Mill. GRAPE-HYACINTH

Low-growing bulbose perennials, without onion or garlic odor; leaves basal, usually 2–6, arched or loosely coiled and spreading, nearly as long as to slightly longer than flowering stem; inflorescences scapose, terminal, racemose, with 12–40 flowers, the apical flowers often sterile and slightly smaller; flowers fragrant; tepals 6, connate for most of their length, the perianth radially symmetrical, globose to cylindrical, strongly constricted distally, sky blue to blackish blue, except for white recurved teeth; capsule with 6 black globose seeds.

A genus of ca. 30 species (Straley & Utech 2002e) of the Mediterranean and temperate Europe to c Asia (Speta 1998b). Some contain alkaloids including colchicine. A number are cultivated as ornamentals for their early spring flowers, and the flowers of some are used in scent making. The following key is modified from Straley and Utech (2002e). (Greek: *muschos*, musk, in reference to the musky flower odor of some species)
REFERENCES: Davis & Stuart 1980; Straley & Utech 2002e.

1. Perianth tubes of fertile flowers sky blue, 2–4 mm long, globose; racemes with 12–20 flowers, dense at first but becoming less so; bulbs usually without bulblets _____ **M. botryoides**
1. Perianth tubes of fertile flowers usually blackish blue, 4–6 mm long, obovoid to oblong-urceolate or cylindrical; racemes with 20–40 flowers, dense; bulbs often with bulblets _____ **M. neglectum**

Muscari botryoides (L.) Mill., (like a cluster of grapes), COMMON GRAPE-HYACINTH, MUSCARI, GRAVEYARD HYACINTH. Plant to 35(–40) cm tall; bulbs not producing offsets, with translucent to light brown or grayish brown tunics (= loose, membranous, outer skin or coat); leaf blades usually 3–8(–12) mm wide, usually linear-oblanceolate; pedicels (0.5–)1–3(–5) mm long; perianth sky blue with whitish teeth; capsules globose, ca. 4–6 mm in diam. Cultivated and persisting or possibly spreading; Caldwell Co. (TAES) near the sw margin of East TX; se Canada and widespread in the e 1/2 of the U.S., scattered further w. Spring. Native of Europe. [*Hyacinthus botryoides* L.] This species is particularly cold-hardy (Straley & Utech 2002e).

Muscari neglectum Guss. ex Ten., (overlooked), STARCH GRAPE-HYACINTH. Plant to 25(–30) cm tall; bulbs often with offsets (bulblets), with reddish brown to dark brown tunics; leaf blades 2–5(–8) mm wide, linear; pedicels (0.5–)2–5 mm long; flowers with musky odor; perianth dark blue with whitish teeth (rarely all white); capsules ovoid to obovoid, 5–10 mm long. Cultivated widely, escaping and naturalizing in yards, fields, and roadsides, sometimes in large numbers; w 1/2 of East TX; scattered further w in TX; widespread in the e U.S. w to WI and TX. Mar–early Apr. Native of the Mediterranean region. [*Hyacinthus racemosus* L., *M. racemosus* (L.) Lam. & DC.] This species has often been incorrectly referred to as *M. racemosus*. It is reported to be very variable in its native range and to vary in chromosome complement from diploid to octoploid (Davis & Stuart 1980).

Muscari armeniacum Leichtlin ex Baker, (of Armenia), ARMENIAN GRAPE-HYACINTH, is now being cultivated and is likely to be found persisting or spreading in East TX. This vigorous species with obovoid to oblong-urceolate perianth tubes is similar to *M. neglectum* (and difficult to distinguish in herbarium specimens—Straley & Utech 2002e), but it can be recognized easily when fresh by its paler, bright blue flowers which are sometimes tinged with purple. Flowering spring. Native of Europe and ne Asia.

ORNITHOGALUM L. STAR-OF-BETHLEHEM, FALSE SEA-ONION

An African and Eurasian genus of ca. 100–150 species (Straley & Utech 2002f). Some authorities treat the genus as having up to 200 species (Mabberley 1997), while others (e.g., Speta 1998b) treat it much more narrowly—ca. 50 species. A number are cultivated as ornamentals, and some are used for their edible bulbs. However, some species have alkaloids including colchicine;

some are toxic to humans and animals, with digitalis-like glycosides causing symptoms including digestive disturbance, blindness, and cardiotoxicity (Burrows & Tyrl 2001; Straley & Utech 2002f). (Greek: *ornis*, a bird, and *gala*, milk; this was an expression used by the ancient Greeks to describe something amazing—Love 1994).
REFERENCES: Raamsdonk & Heringa 1987; Moret 1992; DeMars 1995; Straley & Utech 2002f.

Ornithogalum umbellatum L., (with umbels), STAR-OF-BETHLEHEM, SLEEPY-DICK. Bulbose, scapose perennial 10–35(–40) cm tall; leaves basal, longer than flowering stem, usually 3–5 mm wide, with a white stripe on upper surface; inflorescence a simple corymb with up to 20 flowers; flowers subtended by conspicuous, clasping, papery, acuminate bracts; perianth broadly funnelform or nearly rotate; perianth segments 14–22(–30) mm long, strikingly white inside, green with white margins outside; capsule with numerous seeds. Low, often shady ground, cultivated, escaped, and naturalized; Collin, Dallas, and Grayson (BRIT) cos. in the Blackland Prairie; also Tarrant Co. (R. O'Kennon, pers. obs.) in the Cross Timbers and Prairies and Gillespie Co. (BRIT) on the Edwards Plateau; se Canada and widespread in e U.S. w to SD and TX, also B.C., ID, OR, UT, and WA. Apr. Native of Europe. This species "produces many offsetting bulblets that are transported in soil and can become rampant weeds" (Straley & Utech 2002f). The flowers open just before noon and close before sunset (and remain closed on cloudy days) (Straley & Utech 2002f). The species is complex genetically, being very variable in chromosome number—from $2n = 18$ to $2n = 108$. (Raamsdonk & Heringa 1987; Moret 1992; Straley & Utech 2002f). All parts of the plant, particularly the bulbs, are considered poisonous to humans and animals, due to the presence of a digitalis-like alkaloid or cardiac glycosides, including convallatoxin and convalloside. Livestock deaths have been reported (Muenscher 1951; Kingsbury 1964; Fuller & McClintock 1986; Blackwell 1990; Spoerke & Smolinske 1990; Foster & Caras 1994; Straley & Utech 2002f). ☠ ☜ ▣/293

SCHOENOLIRION Torr. ex E.M. Durand SUNNY-BELL

Glabrous, scapose perennial herbs with prominent fleshy bulb at the top of a vertical rootstock; leaves 2–7, arising from top of bulb, basal, flat to ± keeled, grass-like, the bases withering to persistent scales; inflorescence usually an unbranched raceme; pedicels slender, usually longer than the flowers and bracts; perianth yellow or white to greenish white; perianth segments 6, distinct, spreading, persistent after withering; stamens 6, of equal length, shorter than perianth segments, the inner 3 nectariferous basally; capsule flattened and indented apically, 3-lobed; ovules 2 per locule; seeds subglobose, usually flattened on one side, glossy black, 2–3 mm broad.

☙ A genus of 3 species of the se U.S.; related to the w U.S. genus *Hastingsia* (Speta 1998b; Sherman 2002) and to *Camassia* (Reveal & Pires 2002). The phylogenetic placement of these genera is unclear—see discussion under *Camassia*. The following treatment draws heavily on those by Sherman and Becking (1991) and Sherman (2002). (Greek: *schoinos*, rush, and *leirion*, a lily)
REFERENCES: Gray 1876; Sherman 1969, 1979, 2002; Nixon et al. 1980a; Nixon & Ward 1981; Sherman & Becking 1991.

1. Perianth segments yellow, with green or reddish stripe on abaxial surface, 3–5-veined; pistil greenish yellow or green; leaves mostly equaling or longer than the inflorescence _____ **S. croceum**
1. Perianth segments white or greenish white, with green stripe on abaxial surface, mostly 3-veined; pistil green; leaves mostly shorter than the inflorescence _____ **S. wrightii**

Schoenolirion croceum (Michx.) A.W. Wood, (saffron-colored, yellow), YELLOW SUNNY-BELL, SUNNY-BELL, SWAMP-CANDLE. Leaves to 32 cm long, 4–8 mm wide; scape to ca. 20–35 cm tall; raceme to ca. 15 cm long; bracts often tinged with purple; pedicels ca. 4–20 mm long; perianth segments 4.5–7 mm long. Moist pinelands and boggy areas; s portions of the Pineywoods and Post Oak Savannah (the distribution maps of *S. croceum* and *S. wrightii* were inadvertently

switched in Turner et. al. 2003); se U.S. from NC s to FL w to TX. Mid-Mar–mid-Apr, dormant by late Jun. [*Oxytria crocea* (Michx.) Raf., *Phalangium croceum* Michx.]

Schoenolirion wrightii Sherman, (for Charles Wright, 1811–1885, TX collector), TEXAS SUNNY-BELL. Very similar to *S. croceum* except as noted in the key. Natural prairie-like openings among woodlands, open barrens, rocky outcrops (e.g., Catahoula), roadsides, moist open areas; Brazos, Fayette, Grimes, Jasper, San Jacinto, Walker (BRIT), and Austin (Correll & Johnston 1970) cos. in the s portions of the Pineywoods and Post Oak Savannah; AL, AR, LA, and TX. Late Mar–mid-Apr, dormant by mid-Jun. [According to Sherman (1979), the name *S. texanum* (Scheele) A. Gray was based on *Ornithogalum texanum* Scheele, representative of *Camassia scilloides* (Raf.) Cory, not *Schoenolirion*; *S. texanum* is therefore not a nomenclatural synonym of *S. wrightii*, even though this plant appears under the name *S. texanum* in various publications] Nixon and Ward (1981) indicated that this rare species is probably edaphically restricted, with TX populations occurring on sandy loams or sandy clay loams of the Browndell and Kitterll Soil Series with pH of 5.5–6.3. Sherman (2002) suggested that, "Treatment of these white-flowered plants as a species distinct from *Schoenolirion croceum* is very tenuous; tepal color seems to be the only consistent difference between the two. ... In future treatments of the genus, *S. wrightii* may be considered to be a color form or variety of *S. croceum*." (RARE 2001 and RARE 2002b: G3S2) ⚠ ⚅/297

SCILLA L. SQUILL

A genus of ca. 50 species of temperate Africa and Eurasia, especially the Mediterranean region and sw Asia (McNeill 2002). Speta (1998a, 1998b) controversially treated the genus much more narrowly (ca. 30 species), recognizing a number of small segregate genera (Stedje 2001; McNeill 2002). Some species are cultivated as ornamentals for their showy flowers. A number of species have ant-dispersed seeds. The following treatment relies heavily on works by McNeill (1980, 2002). (Greek: *skilla*, squill, the medicinal plant *Urginea maritima* (previously known as *Scilla maritima*)—McNeill 2002)
REFERENCES: McNeill 1980, 2002; Speta 1998a.

Scilla hyacinthoides L., (resembling *Hyacinthus*, hyacinth), HYACINTH SQUILL. Scapose perennial from a scaly bulb to 5 cm in diam.; leaves basal, 8–12, to 40 cm long, 1.5–3 cm wide, linear-oblong; scapes 30–80 cm tall; inflorescence racemose, with 40–150 long-pedicelled flowers; bracts minute, ca. 1.5 mm long; tepals 6, distinct, 5–7 mm long, blue-violet; stamens with filaments inserted at base of perianth; anthers greenish; capsule subglobose. Collected from along roadside fencerow in Navarro Co. (*Lipscomb 3358*, BRIT; McNeill 2002); no other TX locations known; LA and TX. Apr. Native of the Mediterranean region. [*Nectaroscilla hyacinthoides* (L.) Parl.]

Scilla siberica Haw., (of Siberia), SIBERIAN SQUILL, has been observed possibly spreading from cultivation near Caddo Lake in Harrison Co. in the Pineywoods (R. O'Kennon, pers. obs.). This bulbose, scapose perennial can be easily distinguished from *S. hyacinthoides* by its fewer leaves (2–4), its inflorescences with few (1–2(–5)) drooping flowers with bright to deep blue tepals 12–16 mm long, and its early to mid-spring flowering period. Naturalized in Canada and the ne U.S. w to MO and WI. Native of Russia and possibly n Iran. [*Othocallis siberica* (Haw.) Speta]

HYDROCHARITACEAE Juss.
FROG'S-BIT, TAPE-GRASS, OR WATERWEED FAMILY

Plants aquatic herbs, monoecious, dioecious, or with perfect flowers; either submersed aquatics or in *Limnobium*, aquatics free-floating or rooted in mud; leaves basal or subopposite, opposite, or in whorls along the stem, or in *Limnobium* in rosettes or clusters; flowers at or above the water surface or borne underwater; inflorescences with a spathe; perianth 3-merous or minute or absent; fruits usually ripening underwater and usually indehiscent or irregularly dehiscent.

A small (116 species in 17 genera—Haynes 2000b, 2000d) cosmopolitan but mainly tropical family of aquatics, including *Elodea* (WATERWEED, DITCH-MOSS) and the notorious aquatic weed *Hydrilla*. The family is notable for its wide variety of pollination mechanisms, which range from anemophily (= wind-pollination) to entomophily (= insect-pollination) and hydrophily (= water-mediated pollination). Unusual mechanisms include male flowers that detatch and float or sail to the female flower and anthers that explode and scatter pollen over the water surface. It is one of relatively few families that exhibit hydrophily; both hypohydrophily (= pollination under water) and epihydrophily (= pollination at the water surface) are known in the Hydrocharitaceae (Philbrick 1991, 1993). According to Haynes and Holm-Nielsen (2001), the family "presents the greatest diversity of types of hydrophily in the angiosperms." A number of species are used as aquarium plants and some have become noxious aquatic weeds. We are following Thorne (1993a) and R. Haynes (pers. comm.) in including here *Najas*, a genus previously recognized in its own family (see additional discussion in the generic synopsis of *Najas*). The Hydrocharitaceae appears related to families such as the Alismataceae, Aponogetonaceae, Butomaceae, and Limnocharitaceae (Les & Haynes 1995; Cook 1998a). Molecular analyses (e.g., Duvall et al. 1993b; Chase et al. 2000; Soltis et al. 2000) indicate that the Alismatales are phylogenetically near the base of the monocotyledons—Acoraceae are the sister group to all other monocots, with Hydrocharitaceae (and other members of the Alismatales) in the next most basal clade. Family name from *Hydrocharis*, FROGBIT, an Old World genus of 3–6 species of floating aquatics. (Greek: *hydr-*, water, and *charis*, graceful, in reference to the habit) (subclass Alismatidae—Cronquist; order Alismatales—APG II)

FAMILY RECOGNITION IN THE FIELD: EITHER submersed aquatic herbs with leaves simple, linear to linear-lanceolate or narrowly oblong, subopposite to opposite or whorled or long and ribbon-like and clustered at base of plant OR in *Limnobium*, aquatics free-floating or rooted in mud, with long-petiolate leaves with ovate to suborbicular or reniform blades.

REFERENCES: Kaul 1968a, 1970; Ancibor 1979; Dahlgren et al. 1985; Thorne 1993a; Cook 1998a; Haynes et al. 1998a; Haynes 2000b, 2000d; Haynes & Holm-Nielsen 2001.

1. Leaves with distinct petioles; leaf blades lanceolate to ovate, suborbicular, or reniform, 30–210 mm wide; plants with mostly emersed or floating leaves OR plants ± completely submersed.
   2. Leaf blades mostly emersed or floating, the floating leaves with honeycomb-like aerenchyma (= spongy tissue with large air spaces providing buoyancy) on the lower surface; petals 4–14 mm long; flowers unisexual (the plants monoecious), on pedicels 30–120 mm long; spathes neither winged nor ribbed _____ **Limnobium**
   2. Leaf blades mostly submersed, without aerenchyma; petals 20–30 mm long; spathes winged or ribbed; flowers bisexual, sessile in the peduncled, winged or ribbed spathes _____ **Ottelia**
1. Leaves without distinct petioles, relatively much narrower, EITHER linear to oblong and 3(–5) mm or less wide OR long and ribbon-like, to only 8(–25) mm wide; plants completely submersed.
   3. Leaves clustered at base of plant on a very short stem, long and ribbon-like, the sessile blades 8–60(–nearly 100) cm long, to 8(–20) mm wide _____ **Vallisneria**
   3. Leaves subopposite, opposite, or whorled, distributed along the elongate stem, the sessile blades 4.5 cm or less long, 3(–5) mm or less wide.
      4. Leaves subopposite or opposite (some can occasionally appear whorled where branches arise—if so, they are dilated at base); flowers sessile or subsessile, borne underwater; perianth absent; including extremely abundant native species _____ **Najas**
      4. Leaves in distinct whorls of (2–)3–8, not dilated at base; flowers (male and/or female) borne at the water surface on a thread-like stalk 3–6 cm long; perianth 3–10 mm long, white or translucent, visible with the naked eye; introduced species found in an increasing number of lakes in East TX.
         5. Leaves usually 2–3(–4) cm long, serrulate (teeth scarcely visible to the naked eye) marginally but lacking teeth on the midvein beneath (fresh leaves thus not rough to the

touch); male flowers borne at the water surface on a thread-like stalk, with conspicuous white perianth parts 8–10 mm long _____ **Egeria**

5. Leaves usually 1.5(–2) cm or less long, visibly serrate marginally and with teeth on the midvein beneath (fresh leaves thus rough to the touch); male flowers detaching and floating to the surface, the perianth parts translucent, colorless, 3–5 mm long _____ **Hydrilla**

EGERIA Planch.
SOUTH AMERICAN ELODEA, BRAZILIAN WATERWEED

A genus of 2 species of subtropical South America (Brazil and Argentina) (Haynes & Holm-Nielsen 2001), sometimes treated in *Elodea* (an American genus of 5 species—Haynes 2000b). *Elodea canadensis* Michx., known from OK but apparently not TX, can be distinguished from the somewhat similar *Egeria densa* and *Hydrilla verticillata* using the following characters: leaves opposite or in whorls of three, mostly 0.8–1.5 cm long, leaf margins lacking teeth perceptible to the naked eye, and leaf midveins lacking teeth. *Egeria* has nectariferous flowers and a relatively large perianth (Catling & Wojtas 1986); it is presumably animal-pollinated, in contrast to the many hydrophilous taxa observed in this family. (Latin, *egeri*, a nymph, named after a Roman goddess of water or mythical water nymph, in reference to the aquatic habitat)
REFERENCES: St. John 1965; Lazor 1975; Cook & Urmi-König 1984; Catling & Wojtas 1986.

Egeria densa Planch., (dense), WATERWEED, BRAZILIAN WATERWEED, COMMON WATERWEED. Perennial, submersed aquatic, rooting at bottom or drifting if broken; lowermost leaves opposite or in whorls of 3; rest of leaves in whorls of 4–6(–8); leaves crowded, usually linear-lanceolate, serrulate, transparent, usually 2–3(–4) cm long and 3(–5) mm wide; flowers 3-merous; male spathes 2–4-flowered, in upper axils; male flowers reaching the surface on a long thread-like hypanthium 3–6 cm long; petals white, ca. 8–10 mm long, much longer than the sepals; anthers 9; female flowers not observed (female plants not observed outside the species' native range, and reproduction here thus entirely by vegetative means—Haynes & Holm-Nielsen 2001). Lakes and ponds, probably rapidly spreading; Dallas, Grayson (Lake Ray Roberts), Hays, Lamar (Pat Mayse Lake) (BRIT), Harrison, Marion, Nacogdoches, Sabine, San Augustine (ASTC), Leon, and Newton (Turner et al. 2003) cos.; also Brown and Comanche (HPC) cos. in Cross Timbers and Prairies; sw Canada (B.C.) and widespread in the U.S. except the nc part. [*Anacharis densa* (Planch.) Vict., *Elodea densa* (Planch.) Casp.] Native of se Brazil. This species is widely sold for use in aquaria but is probably spread from lake to lake mainly by boats or boat trailers. It is also widely used in biological laboratories because of the thin (2 cell-layers thick) leaves which can be easily used to demonstrate plant cell structure and cytoplasmic streaming (Haynes 2000b). It is commonly called "elodea" even though this is the scientific name of a related genus. This species is considered noxious in CA, NC, OR, and WA (Kartesz 1999).

Egeria najas Planch., (for *Najas*, naiad, water-nymph, bushy-pondweed, another genus in the Hydrocharitaceae), NARROW-LEAF ANACHARIS, LIGHT GREEN ANACHARIS, the other member of the genus and also a native of southeastern Brazil, is widely used in the aquarium trade and is of potential concern as a problematic exotic (Catling & Mitrow 2001). While not known from TX, it is mentioned here as a note to alert collectors of it as a possibility. It resembles both *Egeria densa* and *Hydrilla verticillata* but can be distinguished by the following key from Catling and Mitrow (2001).

1. Leaves with obscure serrations or marginal prickles (requiring magnification to be readily observed) and leaf edges straight _____ *E. densa*
1. Leaves with prominent serrations or marginal prickles (readily seen without magnification) and leaf edges conspicuously concave or straight between the serrations.
   2. Leaves long-attenuate, concave between the serrations, their midvein without prickles on abaxial (lower) leaf surface; scales in the leaf axis absent or to 0.36 mm long, mostly smooth-

margined and lacking a fringe of orange-brown hairs; internodes mostly much shorter than the leaves and up to 10 mm long 1 dm below the growing tip; flowers with round petals and with nectaries _____ *E. najas*

2. Leaves linear to attenuate, straight to slightly concave between the serrations, their midvein sometimes with prickles on the abaxial leaf surface; scales in the leaf axis mostly ca. 0.5 mm long, mostly with a fringe of orange-brown hairs; internodes mostly as long as the leaves and up to 50 mm long 1 dm below the growing tip; flowers with linear petals, lacking nectaries _____ *Hydrilla verticillata*

HYDRILLA Rich. WATER-THYME

A monotypic Old World genus (Haynes & Holm-Nielsen 2001) introduced into the U.S. and Central America. The male flowers are released underwater, rise unopened to the surface, and float to the female flowers (an example of epihydrophily—see discussion in *Vallisneria* generic synopsis). Cook and Lüönd (1982) indicated that during flower opening the stamens spring upward, the anthers burst, and pollen is scattered in the air. Some of this lands on the female flowers and some on the surface of the water; apparently the pollen grains landing on the water are lost in terms of reproduction and only those actually landing on the female flower are involved in pollination. Even though the effective pollen grains never contact the water, the male flowers float and the system can thus be described as epihydrophily. (Greek: *hydr-*, water, in reference to the habitat, plus the diminutive suffix—Haynes & Holm-Nielsen 2001)
REFERENCES: Lazor 1975; Godfrey & Wooten 1979; Cook & Lüönd 1982; Pieterse 1983; Steward et al. 1984; Langeland 1996.

Hydrilla verticillata (L.f.) Royle, (whorled), WATER-THYME. Perennial, submersed, dioecious or monoecious aquatic; horizontal stems in the substrate sometimes forming turions (= swollen structure or offshoot, often serving to overwinter); erect stems branching, capable of ascending as much as 8.5 m (Godfrey & Wooten 1979) and growing horizontally near the water surface; leaves in whorls of (2–)3–8, sessile, mostly 1.5(–2) cm or less long, 1.5–2 mm wide, narrowly oblong, visibly serrate marginally, with a single vein which on the lower surface bears conical protrusions tipped with teeth (fresh leaves thus noticeably rough to the touch); staminate flowers detaching and floating to the surface; pistillate flowers reaching the surface at the end of an elongate, thread-like floral tube 4–5 cm long; perianth segments 6, colorless, very inconspicuous, 3–5 mm long; fruits 5–6 mm long, ± fusiform. Lakes and other aquatic habitats; rapidly spreading at present in East TX (M. Smart, pers. comm); probably spread vegetatively from lake to lake by boats or boat trailers and also intentionally by fishermen (L. Hartman, pers. comm.) to "improve" the habitat (this is both illegal and ill-advised, since it ultimately degrades the fishery); scattered in e 1/3 of TX. Summer–fall. Native of the Old World, probably the warmer areas of Asia (Cook & Lüönd 1982). Austin (1978) indicated that the species apparently first entered the U.S. at Miami, FL in 1959, while Blackburn et al. (in Steward et al. 1984) noted that female plants were first reported in the U.S. in 1960 from South Florida (misidentified as *Elodea canadensis*). Monoecious plants were first observed in the U.S. in Washington, D.C. in 1982. Female (dioecious) individuals are triploid, while monoecious plants are diploid (Steward et al. 1984). Since its introduction in FL, this problematic species has spread across the southern U.S. to TX, AZ, CA, and WA, and up the east coast to DE, MD, and CT. The earliest TX collection we are aware of is from 1974 (*Amerson 2097*, BRIT), while the species was first collected in LA in 1973 (Solymosy 1974). *Hydrilla verticillata* is a serious invasive pest which can completely dominate aquatic habitats, eliminating native species, clogging waterways, and severely curtailing recreational use (Steward et al. 1984; Flack & Furlow 1996; Langeland 1996; Kartesz 1999). It is considered by many wetland biologists as "potentially the most dreaded species of aquatic weed in warm temperate areas" (Crow & Hellquist 2000a). In TX, *H. verticillata* is considered a "harmful or potentially harmful exotic plant," and it is illegal to release, import, sell,

purchase, propagate, or possess this species in the state (Harvey 1998). It is also considered noxious in AZ, CA, OR, and SC (Kartesz) and is a U.S. federal noxious weed (Kartesz 1999; USDA Natural Resources Conservation Service 2002). The special hibernating or overwintering organs (turions), which are short specialized shoots, can be of two types: axillary (cylindrical or conical in shape) or subterranean (± boat-shaped) (Pieterse 1983). *Hydrilla* can easily be confused with *Egeria densa* (see key to genera).

LIMNOBIUM Rich. FROG'S-BIT, AMERICAN FROG'S-BIT, SPONGEPLANT

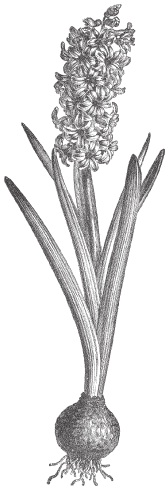
Depending on taxonomic authority, a genus of 2 species (Haynes 2000b; Haynes & Holm-Nielsen 2001) or 1 very variable species composed of 2 subspecies (Lowden 1992). The genus occurs from the e U.S. s to Argentina. Pollination is accomplished by pollen movement through the air (nectar and scent are lacking). Pollen released from anthers in the male flowers falls onto a pollen-collecting platform composed of the spreading sepals and petal bases; from there the pollen can be blown or fall onto the female flowers which are often positioned below the male flowers (Cook & Urmi-König 1983; Cook 1998a). (Greek: *limnobios*, living in pools)
REFERENCES: Wilder 1974a; Díaz-Miranda et al. 1981; Hunziker 1981; Catling & Dore 1982; Cook & Urmi-König 1983; Lowden 1992; Les & Capers 1999.

Limnobium spongia (Bosc) Rich. ex Steud., (a sponge), COMMON FROG'S-BIT, AMERICAN FROG'S-BIT, AMERICAN SPONGEPLANT. Free-floating or rooting, stoloniferous, perennial, aquatic herb, sometimes forming mats; roots pendent, conspicuous; plants of two types: plantlets developing from seeds or at the ends of runners produce floating rosettes of nearly reniform leaves with a characteristic obvious central disk of purplish spongy tissue beneath; from these rosettes develop more robust, flowering and fruiting plants with a short axis and erect to ascending, long-petioled leaves (Godfrey & Wooten 1979); leaves mostly emersed or floating; leaf blades ovate to suborbicular or reniform, 3–7(–10) cm long, 3–7(–8) cm wide, firm-textured, entire or nearly so, basally cordate to rounded, apically obtuse or rounded, with 5–8 principal veins; petioles 1–15 (–40) cm long; flowers unisexual (plants monoecious), held above water on pedicels from spathes that are sessile or on scapes shorter than the petioles; spathes composed of 1 or 2 free bracts, usually with 1 or 2 flowers open at a time; pedicels 3–12 cm long; sepals 3(–4), greenish purple; petals 3(–4), greenish white to yellowish, (4–)7.4–13.6(–14) mm long; stamens (3–)9–12 (–18), with filaments fused to form a column from which anthers diverge at different levels; anthers ca. 2–4 mm long; staminodes 0–5, linear; styles usually 6–9, filiform, deeply 2-parted; ovary inferior; fruit a berry, subglobose to globose, ca. 6–15 mm long, on a stout recurved peduncle, developing below the water surface; seeds numerous, with erect, spike-like hairs. Shallow, mostly stagnant, quiet water; Harrison (Caddo Lake), Liberty (BRIT), Jefferson, Marion, Panola, Polk, Shelby, Wood (ASTC), and Leon (TAMU) cos. in the Pineywoods and e Post Oak Savannah; also n Gulf Prairies and Marshes; e U.S. from MD s to FL w to MO and TX, also NY. Jun–Oct. [*Hydrocharis cordifolia* Nutt., *Hydrocharis spongia* Bosc] This species is sometimes cultivated as an ornamental. The root hairs are used in the laboratory (under high magnification) to demonstrate cytoplasmic streaming (Mabberley 1997). Where common, the fruits of this species can be an important food for ducks (Les & Capers 1999).

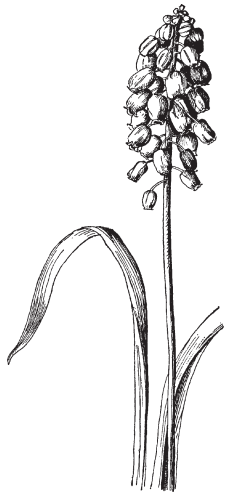
NAJAS L. NAIAD, WATER-NYMPH, BUSHY-PONDWEED

Submersed, monoecious or dioecious, aquatic herbs; leaves subopposite, opposite, or crowded and appearing whorled but inserted at barely different levels, linear or linear-lanceolate, 3 mm wide or less, with sheathing bases; flowers axillary, few, without a perianth; staminate flowers with 1 stamen; pistillate flowers sessile, 1-carpellate; stigmas 2–4; fruit a 1-seeded nutlet enclosed in a loose coat.

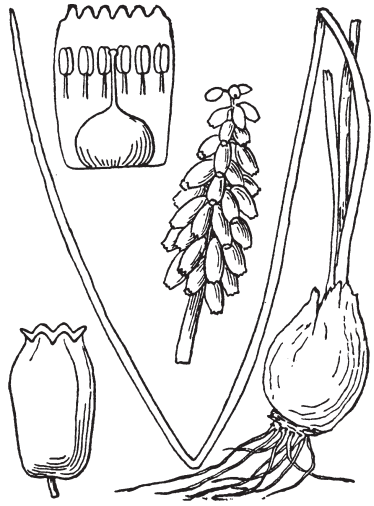
A cosmopolitan genus of 40 species (Haynes 2000d). The stems have reduced xylem which lacks vessels. Some are serious weeds in rice fields, but make good green fertilizer. *Najas* species



Hyacinthus orientalis [NIC]



Muscari botryoides [BA3]



Muscari neglectum [BB2]



Ornithogalum umbellatum [NIC]



Schoenolirion croceum [CO1]



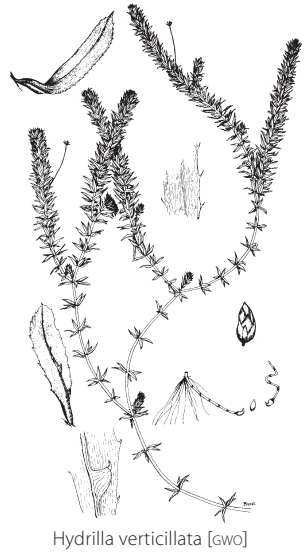
Schoenolirion wrightii [SID]



Scilla hyacinthoides [FVA]



Egeria densa [MAS]



Hydrilla verticillata [GWO]

are an important source of food for waterfowl and fish. However, they are capable of vigorous growth and may become so dense as to impede water flow and the movement of boats (Tyrl et al. 1994). *Najas* is one of relatively few genera that exhibits hypohydrophily or "submarine pollination" (= pollination under water) in contrast to some cases of hydrophily in which pollination occurs at the water surface (= epihydrophily; e.g., *Hydrilla*, *Vallisneria*) (Cox 1988; Philbrick 1991, 1993). The pollen grains, which germinate before leaving the anther and produce an elongate pollen tube, are thus long and noodle-like with a very large surface area, maximizing the probability of contacting a stigma as they move through the water (Cox 1985). Due to its extreme adaptation to the aquatic environment, *Najas* is among the most structurally reduced angiosperms (Les et al. 1993). Its phylogenetic placement is thus difficult. While traditionally recognized in its own family, the Najadaceae (e.g., Kartesz 1994, 1999; Jones et al. 1997; Haynes 2000d), Thorne (1993a) placed *Najas* in the Hydrocharitaceae, and there is molecular and morphological evidence supporting this placement (R. Haynes, pers. comm.; Les et al. 1993; Les & Haynes 1995; Haynes 2000d). Shaffer-Fehre (1991b), for example, put *Najas* in the Hydrocharitaceae based on seed coat anatomy, since the seed coats of *Najas* contain structures otherwise only found in the Hydrocharitaceae. Haynes et al. (1998a) concluded, "The preponderance of phylogenetic evidence indicates that *Najas* is embedded in the Hydrocharitaceae; it clearly belongs within the order Alismatales." However, there is no complete agreement on its rank, and family level recognition may be more appropriate—Reveal and Pires (2002), for example, continue to recognize the Najadaceae. (Greek: *Naias*, a water-nymph)

REFERENCES: Morong 1893; Taylor 1909b; Clausen 1936; Haynes & Wentz 1974; Haynes 1977, 1979, 2000d; Stuckey 1985; Lowden 1986; Shaffer-Fehre 1991a, 1991b; Les et al. 1993; Les & Haynes 1995; Haynes & Hellquist 1996; Haynes et al. 1998a.

1. Leaves usually minutely denticulate (appearing entire to the naked eye) or nearly entire; internodes and midvein on lower surface of leaves unarmed _____ **N. guadalupensis**
1. Leaves coarsely and obviously (to the naked eye) toothed; internodes and often midvein on lower surface of leaves armed with small spines _____ **N. marina**

Najas guadalupensis (Spreng.) Magnus, (for the Caribbean Island of Guadeloupe, where the type was collected), COMMON WATER-NYMPH, SOUTHERN NAIAD, GUADELOUPE WATER-NYMPH. Plant monoecious; leaves to 25 mm long and 2 mm wide, usually ca. 10 mm long and 1 mm wide, appearing entire; seeds fusiform, 2–3 mm long, 0.4–0.8 mm wide, areolate, the areolae in rows and easily seen under low magnification. Often very abundant; possibly in nearly every tank, pond, and lake in East TX, also streams and ditches; throughout TX; s Canada and nearly throughout the U.S. Jun–Sep.

Najas marina L., (of the sea), HOLLY-LEAF WATER-NYMPH, SPINY NAIAD. Plant dioecious; leaves to 45 mm long and 3 mm wide, with 8–13 teeth per side; seeds ovoid, 4–5 mm long, 1.2–2.3 mm wide, smooth or minutely areolate, the areolae irregularly arranged. Lakes and ponds; typically in brackish or highly alkaline waters (Haynes 2000d); Travis Co. (BRIT) near w edge of Blackland Prairie; also sparsely scattered in TX in Somervell (BRIT), Cameron, Tom Green, Travis, Zapata (Stuckey 1985), and Terrell (Turner et al. 2003) cos.; widely scattered in the ne, nc, se, and sw U.S. May–Jul.

Najas minor All., (smaller), BRITTLE WATER-NYMPH. This Old World native is widespread in the e U.S. and is known as close as s OK and e LA (Sullivan 1981; Haynes 2000d). It would thus not be unexpected in East TX. It can be distinguished from *N. guadalupensis* (leaves flaccid, with ca. 50–100 minute teeth per side—use magnification) and *N. marina* (internodes and often midvein on lower surface of leaves armed with small spines) by its stiff leaves with 7–15 teeth per side (the leaves becoming recurved about mid-summer) and the unarmed internodes and lower leaf surfaces. This species is considered to be a state noxious weed in SC (Kartesz 1999).

OTTELIA Pers. DUCK-LETTUCE

A mostly Old World genus of 21 species of tropical and subtropical Africa, Asia, Australia, and South America (Cook 1998a; Haynes 2000b; Haynes & Holm-Nielsen 2001). Unlike many members of the family that have unusual water-mediated pollination mechanisms, the flowers of some *Ottelia* species have a sweet odor and are apparently insect-pollinated (Cook 1998a). (Malayan: *ottel-ambel*, apparently from *otta*, to stick to, in reference to thin leaves that stick to the body, and *ambel*, *Nymphaea*—Haynes & Holm-Nielsen 2001)
REFERENCES: Dike 1969; Holmes 1978; Turner 1980; Cook et al. 1984; Cook & Urmi-König 1984.

Ottelia alismoides (L.) Pers., (like *Alisma*—water-plantain), DUCK-LETTUCE. Aquatic with rosette growth habit, rooted in substrate; leaves ± basal, usually submersed, petiolate; leaf blades variable in shape, lanceolate to broadly ovate, to 17 cm long and 21 cm wide, with curving, ± parallel veins—resembling those of a plantain (*Plantago*), very thin, marginally entire or crisped; inflorescence a peduncle to 30 cm long terminated by a spathe bearing a single flower; spathe with a 2-segmented tip, with 2–10 longitudinal wings or ribs, 2 of which are often larger; flower bisexual, fragrant; sepals 3, 10–16 mm long; petals 3, 20–30 mm long, white to pinkish, yellow basally, obovate; stamens 3–12; anthers bright yellow; ovary 1; fruit to ca. 4 cm long, oblong, beaked, irregularly ribbed or winged, irregularly dehiscent; seeds numerous. Shallow water; in TX known only from Jefferson Co. (*L.E. Brown 13142*, 1988, ASTC; *S.L. Hatch 6748*, 1997, TAES) near the se margin of East TX. This species has been known from the LA side of Toledo Bend Reservoir since 1977 (Holmes 1978). It is known in the U.S. only from CA (apparently exterminated), LA, and TX (Kartesz 1999) and was first collected in North America in LA in 1939 (Haynes 2000b). Spring–summer. [*Stratiotes alismoides* L.] Native of ne Africa, Asia, Malay Archipelago, and Australia (Turner 1980). This species is reported to be exclusively self-pollinated, with pollination occurring before the flowers open (Haynes & Holm-Nielsen 2001). It is a problematic weed (of rice fields, etc.), requiring control measures in parts of Asia (Turner 1980), and it is a U.S. federal noxious weed (Kartesz 1999; USDA Natural Resources Conservation Service 2002). In the U.S., it is apparently found primarily in rice-producing areas (Haynes & Holm-Nielsen 2001) and was probably inadvertently brought into North America with rice seed (Dike in Haynes 2000b).

VALLISNERIA L. TAPE-GRASS, EEL-GRASS, WILD-CELERY

A genus of 2 (Lowden 1982; Haynes 2000b) or possibly more (Haynes & Holm-Nielsen 2001) species of tropical and warm temperate areas of the world. Pollination occurs when male flowers break off, float to the surface, open, and float to the female flowers which are borne at the surface on long peduncles. The female flowers create a slight depression in the surface of the water and the male flowers fall into this depression (Cox 1988). This type of hydrophily (= water-mediated pollination) occurring at the water surface is known as epihydrophily (in contrast to hypohydrophily or underwater pollination as seen in *Najas*) (Philbrick 1993). Some workers (e.g., Cox 1988) further divide epihydrophily into a category in which pollen is transported just above the surface of the water (e.g., *Vallisneria*) and a category in which pollen is transported directly on the surface of the water (e.g., *Elodea*). (Named for Antonio Vallisneri, 1661–1730, an Italian botanist)
REFERENCES: Rydberg 1909; Fernald 1918; Wilder 1974b; Lowden 1982.

Vallisneria americana Michx., (of America), AMERICAN EEL-GRASS, EEL-GRASS, AMERICAN WILD-CELERY, WATER-CELERY, DUCK-CELERY. Submersed, stoloniferous, dioecious aquatic; leaves clustered at base of plant on a very short stem, long and ribbon-like, 8–60(–nearly 100) cm long, to 8(–25) mm wide; male flowers numerous, tiny, breaking from a spathe and free-floating at maturity, with 3 very thin, transparent sepals, 1 transparent petal, 2 stamens with filaments partly united, and 1 staminode; female flowers solitary(–few) in pedunculate spathes at the water sur-

face at flowering time, with 3 thickish persistent sepals 3–4(–6.5) mm long, 3 rudimentary, soon-disintegrating petals to ca. 2 mm long, 3 bifid stigmas, and 3 staminodes; peduncles to 1 m long, coiling after pollination and pulling the flowers below the surface; fruits cylindric, 8–18 cm long; to ca. 5 mm in diam.; seeds numerous. Lakes, flowing streams; Bexar and Hays (BRIT) cos. at sw margin of East TX, Jefferson Co. (TAES) near se margin of Pineywoods, and introduced into Lake Ray Roberts (Grayson Co.) (M. Hackett, pers. comm.) at w margin of Blackland Prairie; s Canada, throughout most of the e U.S. w to ND and TX, and scattered in w U.S. Apr–Jul. [*V. spiralis* of authors, not L.] Where abundant in the n U.S., this species is a valuable wildlife food. It is known to produce turions (= swollen structures or offshoots, often serving to overwinter) (Wilder 1974b). *Vallisneria* has been used as a biomonitor to assess the amount of toxins in sediments and the levels of organic contamination in aquatic habitats (Biernacki & Lovett-Doust 1997). Vegetative material of *Vallisneria* can be confused with some *Sagittaria* (Alismataceae) or *Sparganium* (Sparganiaceae) species because of the superficial similarity of their ribbon-like submerged leaves. However, of the three, only *Vallisneria* has a band of lacunae on either side of the midrib (the leaf thus with a three-zoned appearance), only *Sagittaria* has milky sap, and only *Sparganium* has leaves that are triangular in cross section basally (Haynes & Holm-Nielsen 2001).

HYPOXIDACEAE R. Br. STAR-GRASS FAMILY

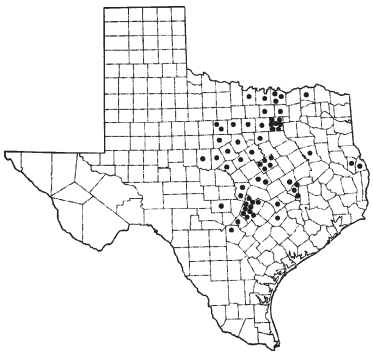
A small, mainly s hemisphere family of 9 genera and ca. 140 species (Judd 2000) of herbs with corms or rhizomes; only *Hypoxis* occurs in North America. Some are cultivated as ornamentals. The genera have been variously treated in terms of family affiliation. Many authorities have put them in a broadly defined and clearly polyphyletic (but practical) Liliaceae (e.g., Cronquist 1988; Diggs et al. 1999), based on superficial similarities in flower structure to the genus *Lilium*, while others (e.g., Correll & Johnston 1970) have treated them in a heterogeneous and polyphyletic Amaryllidaceae because of their inferior ovary. However, based on phylogenetic analyses (e.g., Chase et al. 2000; Fay et al. 2000), we are following Dahlgren et al. (1985) and Judd (2000) in recognizing the Hypoxidaceae as a separate family in the order Asparagales. As such, it is more closely related to other Asparagales families such as the Iridaceae and Orchidaceae than it is to many taxa typically put in a broadly defined Liliaceae (Chase et al. 1995a, 1995b, 1996, 2000; Fay et al. 2000). Based on morphological, anatomical, and molecular characters, the family appears monophyletic, but generic limits in the group need "thorough examination" (Rudall et al. 1998a). For a detailed discussion of the groups formerly treated as Liliaceae in the broad sense, see the family synopsis of the Liliaceae (here treated in a restricted sense) on page 726. (subclass Liliidae—Cronquist; order Asparagales—APG II)

FAMILY RECOGNITION IN THE FIELD: small scapose herbs with 1–few, usually yellow flowers and narrowly linear, grass-like, often pilose leaves.

REFERENCES: Dahlgren et al. 1985; Stone 1986; Nordal 1998; Rudall et al. 1998a; Judd 2000.

HYPOXIS L. YELLOW STAR-GRASS, GOLDSTAR

Small scapose perennials from a small corm; leaves all in a basal rosette, slender, grass-like, with closed, tubular basal sheaths, the partly decomposed bases of the old leaves sometimes persistent (in some species disintegrating into bristly fibers); several additional papery sheaths sometimes present outside the leaves; irregular stellate pubescence typically present; flowers 1–5(–7), solitary or in a raceme or umbel-like inflorescence with a pair of opposite, thread-like bracts at its base, the inflorescence shorter than the leaves; perianth nearly rotate when fully open; perianth segments 6, united only at base, persistent, yellow (or in cleistogamous flowers greenish or whitish), usually greenish outside; stamens 6, half as long as the perianth or shorter; ovary inferior; fruit a capsule.



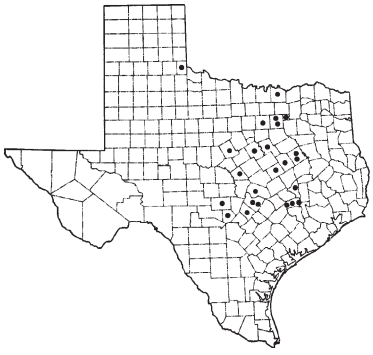
Camassia scilloides



Hyacinthus orientalis



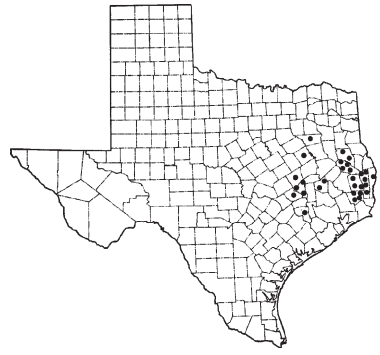
Muscari botryoides



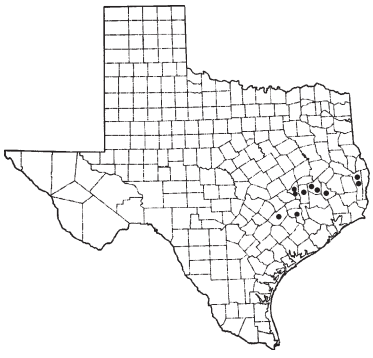
Muscari neglectum



Ornithogalum umbellatum



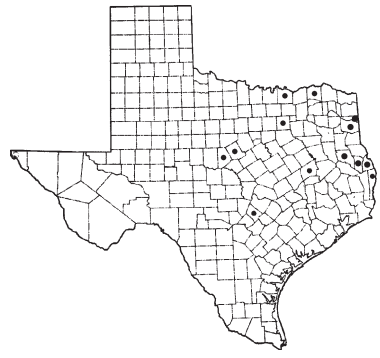
Schoenolirion croceum



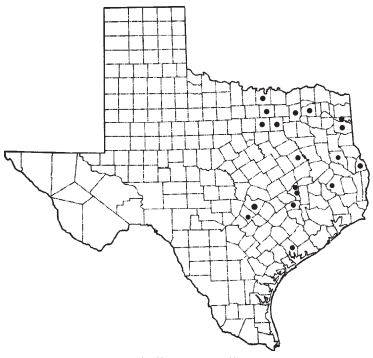
Schoenolirion wrightii



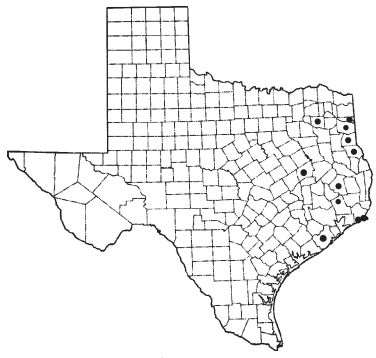
Scilla hyacinthoides



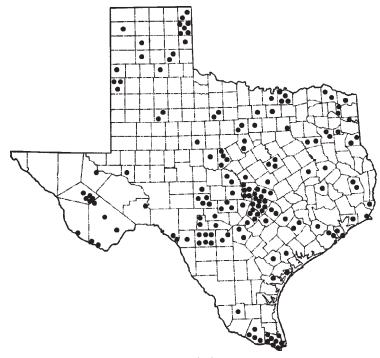
Egeria densa



Hydrilla verticillata



Limnobium spongia



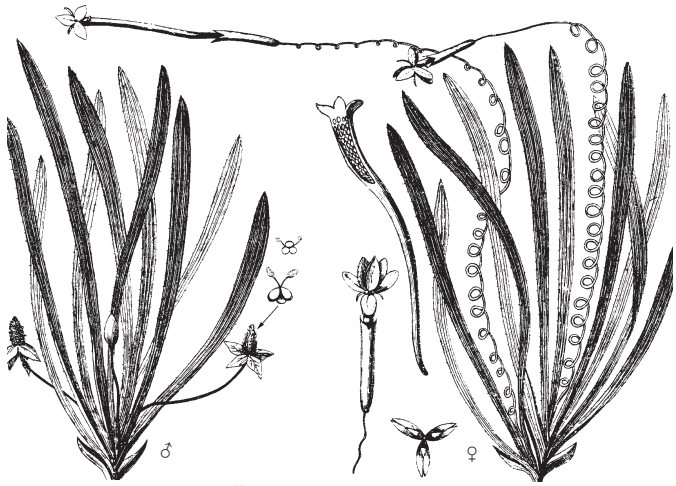
Najas guadalupensis

A primarily s hemisphere genus of 100 species (Herndon 2002) found in Africa, North America, South America, s Asia, Australia, and especially s Africa (Judd 2000). Nordal (1998) suggested that the number of species is uncertain because of the presence of apomictic forms. The group is taxonomically difficult, and observation of seed characters under magnification is "often required for definitive identification" (Judd 2000). Herndon (1992a) noted that the difficulty is due to "phenotypic plasticity combined with the similarity in size and general appearance of all North American species." In addition, species concepts within the genus are unsettled—e.g., the status of *H. longii* (here synonymized with *H. sessilis*). This is partly due to the fact that *Hypoxis* species show significant morphological variability associated in part with whether at any given time chasmogamous or cleistogamous flowers are being produced (Herndon 1988). Some authorities (e.g., Britt 1967; Radford et al. 1968) indicated that the species included here are poorly defined and perhaps all belong to a single polymorphic species; however, we are following Herndon (2002) in recognizing five species in East TX. Some species (e.g., *H. sessilis*) have adapted to periodic burning and bloom most actively after their habitat has been burned; this may be the result of increased light levels and/or an increase in nutrient availability (Herndon 1988). Flowers typically open soon after sunrise and close by noon or shortly after (Herndon 1988, 1992a, 1992b). The following key to species is modified from Herndon (2002). (Old name taken over by Linnaeus; Greek: *hypo*, beneath, and *oxys*, sharp, in reference to the base of the capsule)

REFERENCES: Brackett 1923; Britt 1967; Taylor & Taylor 1977, 1981b; Godfrey & Wooten 1979; Herndon 1988, 1992a, 1992b, 2002.

1. Leaves glabrous or nearly so; seeds black, lustrous.
   2. Pedicels usually twice as long as bracts or longer, usually 9–25 mm long; ovary obconic, densely pubescent; tepals much longer than ovary; capsules only slightly longer than wide, 2–6 mm long; flowers usually (1–)2–5(–7) per inflorescence, in a ± umbellate arrangement, the proximal 2 flowers paired _____ **H. hirsuta**
   2. Pedicels usually shorter than bracts, usually 12 mm or less long; ovary cylindric, glabrate to sparsely pubescent; tepals at most twice as long as ovary; capsules usually much longer than wide, 5–10 mm long; flowers 1–3(–7) per inflorescence, the proximal 2 flowers (if 2 or more present) not paired _____ **H. curtissii**
1. Leaves sparsely to densely pubescent to pilose; seeds black and lustrous to dull and brown to iridescent.
   3. Pedicels usually twice as long as bracts or longer; flowers usually (1–)2–5(–7) per inflorescence, in a ± umbellate arrangement, the proximal 2 flowers paired _____ **H. hirsuta**
   3. Pedicels usually less than twice as long as bracts; flowers usually 1–2(–4) per inflorescence, the proximal 2 flowers (if 2 or more present) not paired.
      4. Pedicels usually longer than bracts; tepals longer than pedicel; anthers 1.5–3.5 mm long; seeds black, lustrous; bases of old leaves disintegrating into persistent bristly fibers _____ **H. rigida**
      4. Pedicels shorter than to longer than bracts; tepals shorter than to longer than pedicel; anthers 0.6–2.2 mm long; seeds either iridescent OR dull, brown; bases of old leaves not becoming bristly fibrous OR sometimes disintegrating into bristly fibers.
         5. Tepals 1.5–2 times as long as ovary; seeds iridescent, black beneath a film or coating of a golden-brown iridescent substance; pedicel usually slightly shorter than to as long as bracts _____ **H. sessilis**
         5. Tepals less than 1.5 times as long as ovary; seeds dull, brown, not iridescent; pedicel usually longer than bracts _____ **H. wrightii**

Hypoxis curtissii Rose, (for A.H. Curtiss, 1845–1907, collector of the type specimen), SWAMP YELLOW STAR-GRASS, COMMON YELLOW STAR-GRASS, CURTISS' YELLOW STAR-GRASS, CLUBPOD GOLDSTAR. Plant similar to *H. hirsuta*; leaves glabrous or nearly so, 3–12 mm wide; inflorescence with 1–3(–7) flowers, the proximal 2 flowers (if 2 or more present) not paired; capsule 5–10 mm



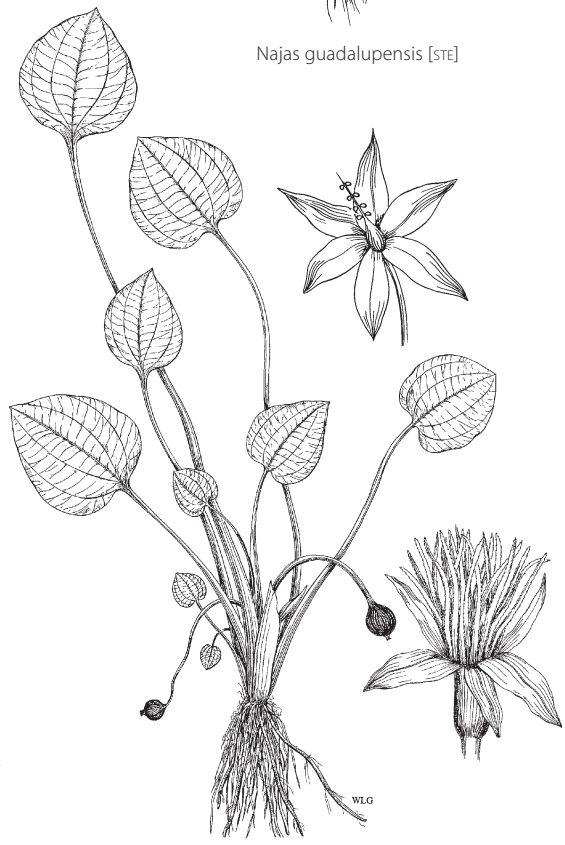
Vallisneria americana [LAM]



Najas guadalupensis [STE]



Ottelia alismoides [EN2]



Limnobium spongia [GLE]





Najas marina [MAS]

long; seeds black, lustrous, coarsely muricate, the projections blunt pointed. Streambanks, floodplains, wet woods, typically in wet mucky soils; Jefferson (BRIT), Angelina, Hardin, Harris, Newton (Turner et al. 2003), and Liberty (Brown et al. 2002) cos. in the Pineywoods, also n margin of Gulf Prairies and Marshes; se U.S. from VA s to FL w to TX; se Canada and widespread in the e U.S. w to ND, CO, and TX. Flowering throughout the growing season. [*H. leptocarpa* (Engelm. & A. Gray) Small, *H. hirsuta* (L.) Coville var. *leptocarpa* (Engelm. & A. Gray) Brackett] According to Herndon (2002), when not in flower, the rosettes of this species "can be easily mistaken for *Cyperus*." Herndon (1992b) clarified nomenclature for this species.

Hypoxis hirsuta (L.) Coville, (hairy), YELLOW STAR-GRASS, COMMON GOLDSTAR, EASTERN YELLOW STAR-GRASS. Corm 5–20 mm thick; leaves linear, 10–60 cm long, 1–8(–rarely more) mm wide, glabrous to densely pubescent; flowering stems 6–20(–35) cm tall, from half as long as the leaves to almost as long; inflorescence with (1–)2–5(–7) flowers in a ± umbellate arrangement; perianth segments (3–)6–12 mm long, to 18 mm with age, lanceolate to elliptic; capsules 2–6 mm long; seeds black, lustrous, coarsely muricate, the projections sharp pointed. Open woods, prairies, and roadsides, typically on well-drained sites; Pineywoods and Gulf Prairies and Marshes w to Dallas and Grayson (BRIT) cos.; also Montague (R. O'Kennon, pers. obs.) and Wise (BRIT) cos. in the Cross Timbers and Prairies; se Canada and e U.S. w to SD and TX. Late Mar–early May. [*H. erecta* L., *H. micrantha* Pollard] This is by far the most widespread and abundant *Hypoxis* in East TX. ⚅/289

Hypoxis rigida Chapm., (rigid, stiff), CHAPMAN'S YELLOW STAR-GRASS. Plant similar to *H. hirsuta*; corm 6–15 mm thick; leaves sparsely to densely pubescent, (0.8–)1–2(–2.6) mm wide, the old leaf bases persisting as bristly fibers; inflorescence with 1–2(–4) flowers, the proximal 2 flowers (if 2 or more present) not paired; seeds black, lustrous, with rounded pebbling. Floodplains, low pinelands, sandy woods, savannahs, bog margins, and ditches; Hardin and Jasper (BRIT—identified by A. Herndon) cos.; se U.S. from SC s to FL w to TX. Spring–summer. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

Hypoxis sessilis L., (sessile, stalkless), GLOSS-SEED YELLOW STAR-GRASS, GLOSS-SEED GOLD STAR. Plant similar to *H. hirsuta*; corm 5–10 mm thick; leaves linear, 10–60 cm long, 1–5(–6) mm wide, the old leaf bases usually not disintegrating into bristly fibers; flowers usually 1(–2), if 2 present, these not paired; capsules 3–11 mm long; seeds with a loose film or coating of a golden-brown iridescent substance, with rounded pebbling. Mesic to dry pinelands, pine-hardwood forests, forest margins, sandy openings; Pineywoods—A. Herndon tentatively identified BRIT specimens from Hardin and Tyler cos. as *H. sessilis*, also Jefferson and Polk (Turner et al. 2003) cos.; also n Gulf Prairies and Marshes; cleistogamous forms—previously known as *H. longii*—have been reported for Bowie and Cass cos. (Taylor & Taylor 1981b; mapped by Turner et al. 2003); these specimens (at BRIT) were subsequently annotated by A. Herndon as *H. sessilis*; se U.S. from VA s to FL w to AR, OK, and TX. Mar–summer(–Sep), but throughout growing season in response to fire or disturbance (Herndon 2002). [*H. longii* Fernald] We are following Herndon (1988, 2002) in synonymizing *H. longii*, with greenish or whitish cleistogamous flowers and short perianth segments (ca. 3 mm or less long) with *H. sessilis*; both chasmogamous and cleistogamous forms are found in the same population. However, according to Taylor and Taylor (1981b), "Our observations do not support this conclusion [that *H. longii* and *H. sessilis* are conspecific]. Quite to the contrary, we feel that *H. longii* is the most distinct of all the species of *Hypoxis* that we know."

Hypoxis wrightii (Baker) Brackett, (for Charles Wright, 1811–1885, who collected the type specimen in Cuba), BRISTLE-SEED STAR-GRASS, BRISTLE-SEED YELLOW STAR-GRASS, BRISTLE-SEED GOLDSTAR. Plant similar to *H. hirsuta*; corm 4–12 mm thick; leaves 2.1(–2.6) mm or less wide, sparsely to densely pubescent, the old leaf bases sometimes disintegrating into bristly fibers;

inflorescences with 1–2(–3) flowers, the proximal 2 flowers (if 2 or more present) not paired; capsules 4–9 mm long; seeds dark brown, dull, minutely muricate, the projections pointed. Open pinelands, sandy soils; Hardin, Nacogdoches (BRIT—identified by A. Herndon), Austin, Robertson, and Walker (Turner et al. 2003) cos. in the Pineywoods and Post Oak Savannah; se U.S. from NC s to FL w to TX. Mainly spring, but throughout the growing season in response to fire. [*H. juncea* Sm. var. *wrightii* Baker, *H. micrantha* Pollard, misapplied] Herndon (1992b) showed that the name *H. micrantha* has long been misapplied to this species (e.g., Brackett 1923; Correll & Johnston 1970; Hatch et al. 1990); *H. micrantha* is actually a synonym of *H. hirsuta*.

IRIDACEAE Juss. IRIS FAMILY

Perennial or rarely annual herbs from fibrous roots or a bulb, corm, or rhizome; leaves mostly basal or alternate, distichous (2-ranked), the stem and leaves together often having a flattened appearance; leaf bases sheathing the stem; leaf blades oriented edgewise to the stem, laterally compressed (unifacial) or flat, pleated, or concave, or with prominent midrib; inflorescences various; flowers arising from a spathe of bracts; perianth parts 6, in 1 or 2 whorls, similar or of 2 different sizes or shapes; stamens 3, opposite the outer perianth whorl; pistil 1; style branches filiform or nearly so or petaloid in *Iris*; ovary inferior; fruit a capsule.

A medium-large family (1,810 species in 92 genera—Goldblatt 2002a) of nearly worldwide distribution (but rare in tropical lowlands), especially s Africa, e Mediterranean, and Central and South America. The center of taxonomic diversity and endemism for the Iridaceae is Africa, with ca. 950 species endemic to s Africa (Bernhardt & Goldblatt 2000). Both morphological and molecular studies indicate the family is monophyletic (e.g., Goldblatt 1990; Rudall 1994; Chase et al. 1995a; Souza-Chies et al. 1997; Fay et al. 2000; Reeves et al. 2001) and place it in the Asparagales. The family includes many important ornamentals in addition to *Iris*, including *Belamcanda* (LEOPARD-LILY), *Crocus*, *Freesia*, *Gladiolus*, *Ixia* (CORN-LILY), and *Tigridia* (TIGER-FLOWER). The world's most expensive spice, saffron, important as a food coloring, is obtained from the stigmas of *Crocus sativus* L. (subclass Liliidae—Cronquist; order Asparagales—APG II)
FAMILY RECOGNITION IN THE FIELD: herbs with distichous leaves and flowers subtended by bracts, with a 6-parted, petaloid perianth, 3 stamens, and a 3-celled inferior ovary; the somewhat similar monocot families with petaloid perianths previously placed in the Liliaceae (e.g., Cronquist 1988) have 6 stamens and a superior or inferior ovary.
REFERENCES: Small & Alexander 1931; Goldblatt 1975, 1990, 2002a; Dahlgren et al. 1985; Rudall 1994; Goldblatt & Takei 1997; Souza-Chies et al. 1997; Bernhardt & Goldblatt 2000; Reeves et al. 2001.

1. Flowers in spikes (= indeterminate inflorescence with sessile flowers on a ± elongate floral axis) or panicles of spikes; plants from corms (= bulb-like usually subterranean stem base, but solid instead of comprising layers of modified leaves as in a true bulb).
   2. Flowers in panicles of spikes; perianth orange or orange-red; style branches notched distally ____ **Crocosmia**
   2. Flowers in unbranched spikes; perianth pink to light purple to reddish purple; style branches expanded distally ____ **Gladiolus**
1. Flowers not in spikes; plants from true bulbs or rhizomes or with only fibrous roots.
   3. Leaves laterally compressed, often appearing ± flat (or nearly cylindrical in *I. xiphium*); plant from a rhizome or the rhizome obsolete and roots fibrous (except *Iris xiphium* with a bulb).
      4. Perianth orangish red to orange, with darker red to brownish purple spots, the segments all similar, 7–9 mm wide; capsule opening to expose a blackberry-like cluster of globose, shiny, black seeds ____ **Belamcanda**
      4. Perianth variously colored and shaped, bluish to purplish, rose, yellow, or white (OR dark red to reddish brown, coppery brown, or orange—in 1 species of *Iris*, which has perianth segments of two sizes and much wider than 9 mm); capsule not as above.

5. Perianth whorls similar in size and positioning (but some can be narrower than others); style branches filiform, entire; flowers small (ca. 12 mm or less long); plants vegetatively like miniature irises, the leaves small (< 1 cm wide) _____ **Sisyrinchium**
5. Perianth whorls not similar in size or positioning, the inner whorl (petals) erect (except in *Iris fulva*), the outer whorl (sepals) reflexed; style branches petaloid, cleft at apex; flowers much more than 12 mm long; plants much larger vegetatively, the leaves usually 1.5–4 cm wide (except in *Iris xiphium* with nearly cylindrical leaves) _____ **Iris**

3. Leaves plicate (= folded like a fan), occasionally so narrow that pleats not developed; plant from a bulb.
6. Perianth whorls nearly equal in size and appearance, uniformly blue except lighter to white at very base, giving the perianth the appearance of having a white "eye"; anthers 11–15 mm long (OR in plants occurring to the n of TX only 3–8 mm long) _____ **Nemastylis**
6. Perianth whorls conspicuously unequal in size, variously patterned, either with the very small inner whorl (petals) dark (blackish violet) toward base or with the inner whorl spotted reddish brown over yellow toward base; anthers 6–10 mm long.
7. Flowers primarily dark purple to rose-purple, toward base yellow with reddish brown spots; outer, larger perianth parts ovate; inner perianth parts ca. 15 mm long, obtuse apically; cauline leaves leaf-like toward base of stem, becoming bract-like above; the three style branches deeply divided _____ **Alophia**
7. Flowers primarily blue or purple-blue, yellow color never present; outer larger perianth parts (sepals) lanceolate to broadly so, with a violet halo (= ring) outlining the whitish, purple-dotted base; inner perianth parts (petals) much smaller, 8–12 mm long, blackish violet toward base, acuminate apically; cauline leaves, if present, reduced and bract-like; the three style branches divided near apex _____ **Herbertia**

ALOPHIA Herb. PROPELLER-FLOWER

A genus of ca. 5 species of perennial herbs native from the s United States to South America (Goldblatt 2002d); some are used as cultivated ornamentals. Some species have "oil flowers" which have elaiophores (= oil-secreting organs). The oils produced by these structures, rather than nectar or pollen, serve as a reward for specialized bees which pollinate the flowers (Buchmann 1987). Generic relationships of *Alophia* are unclear, and there may be a relationship with the monotypic Mesoamerican genus *Ainea* (Goldblatt 1992). (Greek: *a*, without, and *lophos*, crest)
REFERENCES: Goldblatt & Howard 1992; Goldblatt 2002d.

Alophia drummondii (Graham) R.C. Foster, (for its discoverer, Thomas Drummond, 1780–1835, Scottish botanist and collector in North America), PURPLE PLEAT-LEAF, PROPELLER-FLOWER. Perennial from a shallow bulb; basal leaves sheathing, narrowly linear to linear-lanceolate, plicate, to ca. 30 cm long and 2 cm wide; cauline leaves leaf-like near base of stem, bract-like above; flowering stem to 45(–75) cm tall; flowers few, emerging from the spathes, lasting only one day; perianth velvety dark purple to rose-purple (rarely white), toward the base yellow with reddish brown spots, to ca. 25 mm long, the outer whorl of perianth parts somewhat larger than the 3 longitudinally cupped and apically crimped inner; anthers 6–8 mm long; capsules obovoid-oblong, ca. 1.5–3 cm long. Sandy soils, grassy areas, and open woods; widespread in e 1/3 of TX; AR, LA, MS, OK, and TX. Mostly May–Jul. [*Nemastylis purpurea* Herb., *Eustylis purpurea* (Herb.) Engelm. & A. Gray, not *A. drummondii* in the sense of Correll & Johnston (1970)]. The name *Alophia drummondii* has in the past been used mistakenly for *Herbertia lahue* (e.g., Correll & Johnston 1970), and the two species have often been confused. However, they are quite distinct (Goldblatt 2002d) (for comparison see color photographs on pages 275 and 288). While this species presumably outcrosses as evidenced by its showy flowers, it is self-compatible, possibly to ensure seed production in the absence of pollinators (Goldblatt & Howard 1992). ⊞/275

BELAMCANDA Adans.
LEOPARD-LILY, BLACKBERRY-LILY, LEOPARD-FLOWER

A genus of 1 or 2 species of Asia including Japan (Goldblatt 2002b); widely cultivated and naturalized; also used medicinally. Recent molecular studies (Tillie et al. 2001; Carol Wilson, pers. comm.) place the genus within *Iris*. As such, from a cladistic standpoint, *Iris* is thus paraphyletic and inappropriate for formal recognition without the inclusion of *Belamcanda*. (Latinized version of the East Asiatic vernacular name)
REFERENCE: Tillie et al. 2001; Goldblatt 2002b.

Belamcanda chinensis (L.) DC., (of China), BLACKBERRY-LILY, LEOPARD-LILY, LEOPARD-FLOWER. Perennial from orangish yellow rhizomes; stems 30–130 cm tall, erect or ascending; leaves basal and cauline, folded lengthwise in the basal 1/3–1/2 and in the distal portion expanded parallel to the stem axis (unifacial) and laterally compressed (appearing ± flat), 15–32 mm wide; inflorescence a panicle with cymose flower clusters; flowers open for only 1 day; perianth 20–32(–35) mm long, orangish red to orange, with darker red to brownish purple spots; tepals similar, spreading, 7–9 mm wide, fused at very base; capsule 18–30 mm long, opening to expose the cluster of globose, shiny, black seeds (seeds usually brown in Iridaceae—Mabberley 1997). Ornamental escaped in pastures, roadsides, thickets, and at edge of wooded areas; Titus Co. (BRIT) in the Post Oak Savannah, also cited for the Pineywoods by Hatch et al. (1990); e U.S. from VT s to FL w to SD and TX. Apr–Jul. Native of w Asia. [*Gemmingia chinensis* (L.) Kuntze] The common names are derived from the blackberry-like appearance of the cluster of seeds after the capsule opens (Yatskievych 1999) and from the spotted orange flowers. /277

CROCOSMIA Planch. MONTBRETIA

A genus of 9 species endemic to sub-Saharan Africa and Madagascar (Goldblatt 2002f); related to *Tritonia*, another African genus. A number are grown as ornamentals. The common name commemorates A.F.C. de Montbret, the botanist on an 18th century French expedition to Egypt (Shosteck 1974). (Greek: *krokos*, saffron, and *osme*, smell; in reference to the dried flowers, which when boiled in water give the odor of saffron)
REFERENCES: de Vos 1984; Goldblatt 2002f; Goldblatt et al. 2004.

Crocosmia ×**crocosmiiflora** (Lemoine) N.E. Br. [*C. aurea* (Hook.) Planch. × *C. pottsii* (Baker) N.E. Br.], (with flowers like *Crocosmia*—the plant was originally described in another genus), MONTBRETIA. Perennial from corm 15–25 mm in diam.; stems to 90–120 cm tall, slightly longer than leaves; leaves linear, acuminate, 7–20(–25) mm wide; leaf bases sheathing the flowering stem; inflorescence a panicle of spikes; flowers odorless; perianth orange or orange-red, ca. 38–50 mm across, with segments united into a tube 10–15 mm long, the lobes spreading, subequal, usually longer than the tube; stamens exserted, the filaments 15–22 mm long, the anthers 6–8 mm long; fruit a globose, 3-valved capsule. Escaped cultivated ornamental, thickets; Hardin Co. (*Amerson & Watson, s.n.*, BRIT; *Cory 56667*, BRIT; Correll 1972a) in the Pineywoods; sw Canada (B.C.) and scattered in the U.S.—CA, FL, MS, NC, OR, SC, WA, and TX. Summer. The parental species are native to Africa; this hybrid was developed in 1880 in France by the horticulturist Lemoine (de Vos 1984; Mabberley 1997). [*Montbretia* ×*crocosmiiflora* Lemoine, *Tritonia* ×*crocosmiiflora* (Lemoine) Nichols.] It is reported to be attractive to hummingbirds (Kartesz 1999).

GLADIOLUS L. SWORD-LILY, CORN-FLAG

Glabrous perennials from corms; stems usually unbranched; leaves sword-shaped, compressed laterally (appearing ± flat), reaching nearly to base of spike; inflorescence a spike with 6–20 flowers; outer bract of spathe longer than inner; flowers showy, ours unscented; perianth segments (tepals) 6, connate basally into a somewhat curved tube, in ours pink to light purple to reddish purple, unequal; capsules oblong to globose.

A genus of ca. 260 species (Goldblatt 2002g) of perennial herbs (second in size in the Iridaceae only to *Iris*) with an unusual degree of diversity in floral characteristics. The genus is primarily African (with more than 240 species on that continent), with the center of distribution in s Africa (where there are at least 150 species) but ranging to s Europe, the Mediterranean, and the Middle East as far e as Iran and Afghanistan (Goldblatt 1996). A number of species and hybrids are widely cultivated, with over 30,000 cultivars known. "Almost all gladioluses seen for sale as cut flowers or for garden culture have a hybrid origin" (Goldblatt 1996). In fact, the "common, large-flowered hybrids are the product of crossing between four or five species, followed by selection" (Goldblatt 2002g). According to Park (1976), "on a worldwide basis the gladiolus is the second most popular commercial and cut flower after the rose." Pollination strategies within the genus are unusually diverse, with pollinators including bees, moths, butterflies, birds, and long-proboscid flies (Goldblatt et al. 1998; Goldblatt & Manning 1999). ☠ Some species are reported to be toxic to livestock (Burrows & Tyrl 2001). Due to extensive hybridization in the genus, it is not surprising that the escaped/naturalized *Gladiolus* found in TX are difficult to assign with certainty to species. According to Goldblatt (2002g), only *G. communis* occurs in the state; however, specimens that key to *G. italicus* are known from Brazos and Madison (TAMU) cos. Therefore both species are tentatively included for East TX. The key to species is modified from Goldblatt (2002g). (Diminutive of Latin: *gladius*, sword, in reference to the shape of the leaves; note also *gladiator*, swordsman)
REFERENCES: Park 1976; Goldblatt 1996, 2002g.

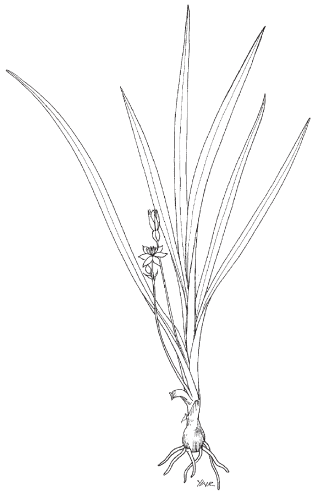
1. Anthers 10–13 mm long, shorter than to ± equaling the filaments; capsules oblong, 18–24 mm long; seeds winged; perianth reddish purple ____ **G. communis**
1. Anthers ca. 15 mm long, longer than the filaments; capsules globose, 10–12 mm long; seeds not winged; perianth pink to light purple ____ **G. italicus**

Gladiolus communis L., (common), FALSE CORN-FLAG, TURKISH CORN-FLAG, CORN-FLAG, BYZANTINE GLADIOLUS. Stems 50–100 cm tall; leaves 3–5, 30–70 cm long, 6–25 mm wide; flowers 10–20 per spike; perianth tube 10–12 mm long; perianth lobes ca. 18–40 mm long, predominantly reddish purple, the outer 3 with narrow median white streak; seeds 4–6 mm in diam. Escaped cultivated ornamental, roadsides; Red River (ASTC) and Harrison (Shinners 1958 as *G. byzantinus*) cos. and cited for TX (without specific county indicated, presumably in the e part of the state) by Goldblatt (2002g); se U.S. from NC s to AL w to AR and TX. Late Apr–May. Native of the Mediterranean region. [*G. byzantinus* Mill., *G. communis* subsp. *byzantinus* (Mill.) A. Ham.] *Gladiolus communis* is the type species of the genus. While this taxon has been variously treated taxonomically (e.g., as *G. byzantinus* or *G. communis* subsp. *byzantinus*—e.g., Kartesz 1999), we are following Goldblatt (2002g) in treating it in an undivided *G. communis*. He indicated that "Distinction at even subspecific rank does not seem warranted." ☞ ⚅/287

Gladiolus italicus Mill., (of Italy), ITALIAN GLADIOLUS. Plant similar to *G. communis*; stems 50–100 cm tall; leaves 3–5, 20–50 cm long, 5–22 mm wide; flowers 6–16 per spike; perianth tube 10–12 mm long; perianth lobes 20–50 mm long, predominantly pink to light purple, the outer 3 with a median white streak; seeds 3 mm or less in diam. Escaped cultivated ornamental; while Goldblatt (2002g) cited this species as occurring in the U.S. only in CA, specimens from Brazos (TAMU) and Madison (TAMU; Neill & Wilson 2001) cos. seem to more closely match this species than *G. communis*—anthers are ca. 15 mm long and slightly longer than the filaments; the species is therefore included based on those specimens; CA and TX. Apr–May. Probably native to Near East (Goldblatt 2002g). [*G. segetum* Ker Gawl.] ☞

HERBERTIA Sweet PRAIRIE-NYMPH

A mainly South American genus of ca. 5 species (Goldblatt 2002c) of perennial herbs, with 1 species in TX and LA; some are cultivated as ornamentals. (Named for William Herbert, 1778–



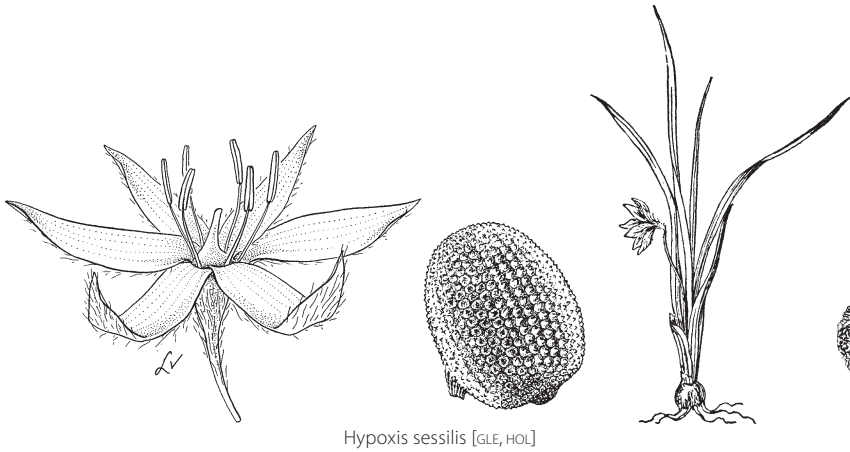
Hypoxis curtissii [FNA]



Hypoxis hirsuta [GLE]



Hypoxis rigida [RHO]



Hypoxis sessilis [GLE, HOL]



Hypoxis wrightii [RHO]



Alophia drummondii [DOR]



Belamcanda chinensis [GLE, YAT]



Crocosmia ×crocosmiiflora [BA1]

1847, prominent British botanist, Dean of Manchester, and an authority on bulbiferous plants) REFERENCES: Goldblatt 1975, 1977 [1978], 2002c.

Herbertia lahue (Molina) Goldblatt, (derivation unknown), HERBERTIA, PRAIRIE-NYMPH. Scapose perennial herb from a bulb; leaves with sheathing bases, narrowly linear, plicate, to ca. 20 cm long, usually 6 mm or less wide, cauline leaves, if present, reduced and bract-like; scape to ca. 15(–30) cm tall; spathes with 1–2(+) flowers; perianth ca. 5 cm across; 3 outer segments (sepals) usually pale or dark lavender with whitish, purple spotted/patterned base, to 28 mm long; 3 inner segments (petals) much smaller, with upper part violet and lower blackish violet, sometimes with white spots; anthers 7–10 mm long; capsules obovoid-oblong, to 2.5 cm long. Grasslands and prairies; s Pineywoods w to s Blackland Prairie (e.g., Comal and Williamson cos.—Turner et al. 2003), also Dallas Co.—probably introduced with sod—R. O'Kennon, pers. obs.; also Denton Co. (BRIT) just to the w of East TX, Gulf Prairies and Marshes, and South TX Plains; FL, MS, LA, and TX; the species is also known from South America. Mar–May. [*Alophia drummondii* of Correll & Johnston (1970) and Mahler (1988), not (Graham) R.C. Foster, *H. caerulea* (Herb.) Herb., *H. lahue* subsp. *caerulea* (Herb.) Goldblatt, *Trifurcia lahue* (Molina) Goldblatt subsp. *caerulea* (Herb.) Goldblatt] The name *Alophia drummondii* was misapplied by Correll and Johnston (1970) and Mahler (1988) to this species, which is correctly placed in *Herbertia* (Goldblatt 1977 [1978]). While TX plants have often been referred to subsp. *caerulea* (e.g., Diggs et al. 1999; Kartesz 1999), according to Goldblatt (2002c), "The variation in North American populations makes it impossible to maintain even subspecies in *H. lahue* on the basis of available information." ⚅/288

IRIS L. FLAG, FLEUR-DE-LIS

Ours perennials from rhizomes (from a bulb in *I. xiphium*); leaves laterally compressed (appearing ± flat) (nearly cylindrical in *I. xiphium*), distichous (2-ranked) and overlapping, inflorescence unbranched or sometimes with few branches, of 1–several clusters of flowers (coflorescences) subtended by reduced leaf-like bracts, the individual clusters with 1–3 flowers enclosed by a spathe (pair of herbaceous or papery bracts); flowers usually large and showy, often bluish, purplish, or white, but also yellow or red to reddish brown, coppery brown, or orange (and variously colored in cultivated forms), usually fragrant; perianth segments of 2 types, the outer (= sepals = falls) deflexed or spreading, typically with signal area (variously differently colored, with ridge, crest, pubescence, beard, etc.) at junction of claw (= narrow base) and blade, the inner segments (= petals = standards) usually erect; style divided into 3 petaloid branches; each style branch typically terminating in a cleft crest and each with a stamen positioned between it and a sepal; perianth tube present; fruit a multi-seeded capsule.

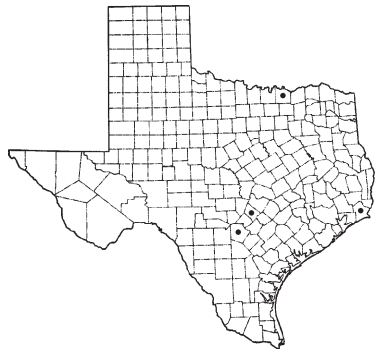
A mostly n temperate genus of ca. 280 species (Henderson 2002). *Iris* species are very important ornamentally; e.g., they are the "fleur-de-lis" of French royalty (Tveten & Tveten 1993). There are innumerable cultivars and hybrids, and *Iris* cultivation may date to ancient Egyptian times. Several species (particularly *I. pallida*) are also grown for orris root, a powder with the odor of violets; it is obtained from rhizomes and used in perfumes. ☠ Leaves and especially the rhizomes of some species (e.g., *I. germanica*, *I. pseudacorus*) contain an irritating resinous substance (irisin). Toxic terpenoids and quinines have also been isolated from various species. Handling irises can cause dermatitis, and ingestion can result in severe digestive upset and even death. However, because of their bitter taste, *Iris* plants are usually not eaten by humans or animals. *Iris* rhizomes should not be stored in areas accessible to dogs (Schmutz & Hamilton 1979; Lampe & McCann 1985; Fuller & McClintock 1986; Weathers 1998; Burrows & Tyrl 2001). A number of *Iris* species (*I. brevicaulis*, *I. fulva*, *I. giganticaerulea*, *I.* ×*nelsonii*) and their hybrids are referred to as LOUISIANA IRISES (Caillet et al. 2000). Some of the hybrids are cultivated in East TX (e.g., by Edith Wolford of Fannin Co.), especially in wet areas such as pond margins. These



Najas marina



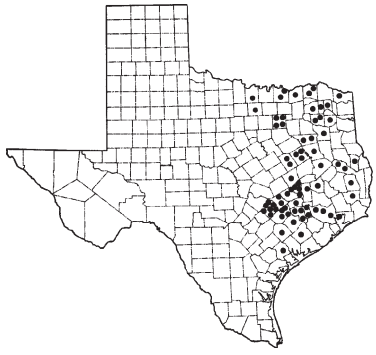
Ottelia alismoides



Vallisneria americana



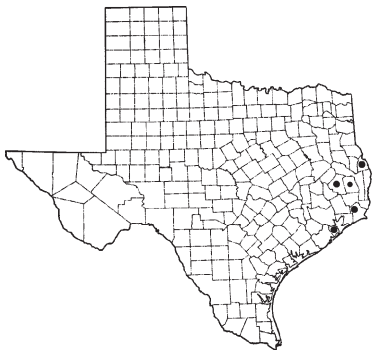
Hypoxis curtissii



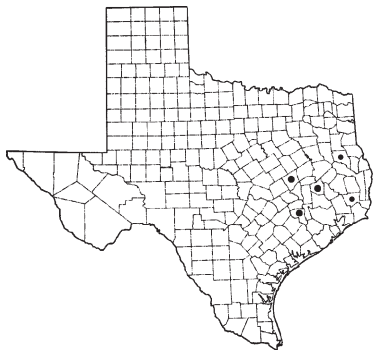
Hypoxis hirsuta



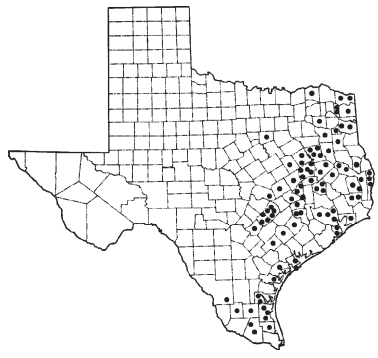
Hypoxis rigida



Hypoxis sessilis



Hypoxis wrightii



Alophia drummondii



Belamcanda chinensis



Crocosmia ×crocosmiiflora



Gladiolus communis

LOUISIANA IRISES are rhizomatous, have laterally compressed (flat-appearing) leaves and beardless falls, and are very variable in color. Hybridization, including introgressive hybridization (= hybridization resulting in movement of genes from one species to another), in LOUISIANA IRISES has been studied in detail and has been argued to be of long-term evolutionary significance (e.g., Anderson 1949; Arnold et al. 1990a, 1990b, 1991, 1992; Nason et al. 1992; Arnold 1993; Arnold & Wesselingh 2000). Pollination in IRISES: each petal-like style branch is opposite one of the three outer perianth segments (= sepals) and there is a stamen between it and the sepal. The sepals typically act as landing platforms for pollinating insects such as bees. On the underside of each style branch, near the apex, is a little flap of tissue whose upper surface is sticky—this is the stigma. When an insect (presumably carrying pollen) lands on one of the sepals, it starts to crawl in between the sepal and the adjacent style branch in search of nectar. In the process, it makes contact with the sexual organs of the flower. As the pollinator enters the constricted space, it brushes against the flap of stigmatic tissue which is pulled downward to expose the sticky stigmatic surface. As a result, pollen on the insect's body is rubbed off onto the sticky receptive surface of the stigma. In addition, pollen from the adjacent anther is deposited onto the insect's body during its foraging for nectar. When the pollinating insect exits the reproductive area of the flower (carrying the flower's pollen), the little flap of stigmatic tissue is moved back upward, which is thought to prevent self-pollination (Faegri & van der Pijl 1979; Mabberley 1997). IRISES are also known to produce self-incompatible pollen, which promotes cross-pollination and prevents self-fertilization. "Asexual reproduction in many *Iris* species may be more important than sexual reproduction in their persistence, and many hybrid clones may persist for decades in sites no longer cultivated" (Henderson 2002). The common name FLAG is derived from the Middle English *flakken*, to flutter, in reference to fluttering in the wind (Durant 1976). (Named after Iris, Greek goddess of the rainbow, from the varied flower colors)

REFERENCES: Dykes 1913; Anderson 1936, 1949; Foster 1937; Riley 1938; Arnold et al. 1990a, 1990b, 1991, 1992, 1993; Mathew 1990; Henderson 1992, 1994, 2002; Nason et al. 1992; Arnold 1993, 1994; Cruzan et al. 1993; Species Group of the British Iris Society 1997; Arnold & Wesselingh 2000; Caillet et al. 2000.

1. Leaves nearly cylindrical, channeled on upper surface; plant with a bulb _____ **I. xiphium**
1. Leaves laterally compressed, appearing ± flat, the two surfaces identical; plant with a thick rhizome.
   2. Perianth dark red to reddish brown, coppery brown, orange, or yellow (without blue or purple coloration when fresh, but sometimes drying with purple areas); sepals (= falls) without a beard (= hairy patch).
      3. Perianth bright yellow to golden yellow; fruits 3-angled; petals (= standards) much shorter than sepals _____ **I. pseudacorus**
      3. Perianth dark red to reddish brown, coppery brown, or orange; fruits 6 angled; petals nearly as long as sepals (but narrower) _____ **I. fulva**
   2. Perianth bluish, purplish, or white (or variously colored in cultivated forms); sepals without an obvious beard OR with a beard of multicellular hairs.
      4. Sepals with a beard of multicellular hairs; petals (= standards) 30–60 mm wide; introduced species.
         5. Spathes entirely scarious (= dry, papery, and translucent or transparent) and silvery white at flowering time, 20–35 mm long; perianth tube 8–13 mm long _____ **I. pallida**
         5. Spathes scarious in the upper half, the lower half greenish, sometimes with purplish tinge at base at flowering time, 35–55 mm long; perianth tube 17–25 mm long _____ **I. germanica**
      4. Sepals without an obvious beard (but can have very short pubescence); petals 10–30 mm wide; native species.
         6. Cauline leaf immediately subtending spathes usually shorter than to slightly longer than the spathes or absent; stems nearly as long as or longer than the basal leaves, not zigzag; ovaries and fruits 3-angled _____ **I. virginica**

6. Cauline leaf immediately subtending spathes usually more than twice as long as the spathes; stems shorter than the basal leaves to nearly as long as the basal leaves, usually ± zigzag; ovaries and fruits 6-angled.
   7. Spathes usually 8 cm or more long; stems usually > 35 cm tall; petals usually notched at apex _____ **I. ×flexicaulis**
   7. Spathes 3–5 cm long; stems 35 cm or less tall; petals rounded to subacute at apex _____ **I. brevicaulis**

Iris brevicaulis Raf., (short-stemmed), SHORT-STEM IRIS, LAMANCE IRIS, ZIGZAG IRIS. Stems zigzag, much shorter than the basal leaves, only 10–35 cm long; basal leaves 35–70 cm long; sepals (= falls) 25–30 mm wide, deep blue or blue-purple with a greenish yellow claw and a raised, yellow-white, short-pubescent, central ridge (crest) that acts as a signal area at junction of blade and claw; petals (= standards) 15–20 mm wide, very slightly lighter than sepals (perianth very rarely white); fruits 6-angled. Swamps, wet meadows, damp woods, marshes, and bottomlands; Bowie, Sabine, Titus (BRIT), Hardin, Houston, Liberty, and Tyler (Turner et al. 2003) cos., Pineywoods and n edge of Gulf Prairies and Marshes; se Canada (Ont.) and e U.S. from IN s to FL w to KS, OK, and TX. Apr–Jun. [*I. foliosa* Mack. & Bush] *Iris brevicaulis* is reported to hybridize with *I. fulva* to produce *I.* ×*fulvala* Dykes, and with *I. giganticaerulea* to produce *I.* ×*flexicaulis* (discussed below) (Henderson 2002).

Iris ×**flexicaulis** Small [*I. brevicaulis* × *I. giganticaerulea*], (having a pliant stem), ZIGZAG BLUE FLAG. Stems usually ± zigzag, shorter than to nearly as long as basal leaves; sepals ca. 30 mm wide, bluish purple with a greenish yellow claw and raised, yellow-white, short-pubescent, central ridge (crest) that acts as a signal area at junction of blade and claw; petals colored similarly to main part of the sepals, narrowly spatulate, ca. 15 mm wide; fruits 6-angled. Wet roadsides, marshes, low woods, lowlands; Hardin, Sabine (BRIT), Red River (BAYLU), Brazos, Jefferson, Madison, Nacogdoches, Newton, Red River, San Jacinto, and Trinity (Turner et al. 2003) cos.; also n Gulf Prairies and Marshes; LA and TX. Mar–May. [*I. hexagona* Walter var. *flexicaulis* (Small) R.C. Foster] This taxon has long been treated in TX as *I. hexagona* Walter var. *flexicaulis* (Small) R.C. Foster (e.g., Correll & Johnston 1970; Kartesz 1999) or simply *I. hexagona* (Turner et al. 2003). However, Henderson (2002), in his recent treatment of the genus for *Flora of North America*, indicated that this entity should actually be treated as *I.* ×*flexicaulis*, which he considers to be a hybrid between *I. brevicaulis* and *I. giganticaerulea* Small (GIANT BLUE IRIS). Based on this recent work, we are following Henderson (2002) for nomenclature of this taxon and tentatively treating it as a hybrid. However, no *I. giganticaerulea* is known from TX (only known from AL, LA, and MS—Henderson 2002), and if *I.* ×*flexicaulis* is indeed a hybrid, it is widespread and apparently reproducing on its own. Numerous populations of what we consider to be *I.* ×*flexicaulis* have been observed along wet roadsides in Hardin Co. (e.g., *Diggs & George s.n.* BRIT), as well as other areas of East TX. This taxon is thus possibly worthy of recognition as a distinct species or as a variety of *I. hexagona* or some other species—field work on this complex in TX is needed to determine the status of *I.* ×*flexicaulis* and its relationship with other taxa. According to Henderson (2002), the true *I. hexagona* is found only in FL and SC, and is considered one of the rarest North American irises. /290

Iris fulva Ker Gawl., (tawny orange), RED FLAG, COPPER IRIS, RED IRIS. Stems usually longer than the leaves, 40–90 cm long; leaves ca. 15–25 mm wide; perianth dark red to reddish brown, coppery brown, or orange; sepals to 38 mm wide; petals to 18(–20) mm wide, drooping; fruits 6-angled. Marshes, swamps, wet meadows, ditches, and stream banks; Sabine Co. (*Singhurst 10317*, BAYLU) in the Pineywoods; e U.S. from AR, IL, KY, LA, MS, MO, TN, and TX. Spring. [*I. ecristata* Alexander] The perianth color is extremely distinctive; however, it can change when dried, becoming tan to light brown with purple areas (Yatskievych 1999). Henderson (2002) noted that, "*Iris fulva* hybridizes with *I. brevicaulis* to produce *I.* ×*fulvala* Dykes, which has reddish purple

sepals" and "with *I. giganticaerulea* to produce *I.* ×*vinicolor* Small" According to Caillet et al. (2000), hybridization, primarily between *I. fulva* and *I. giganticaerulea* Small, has resulted in the evolution of the stable hybrid *I.* ×*nelsonii* Randolph, known only from LA. Alternatively, Arnold (1993) suggested that reticulate evolution (= "hybridization between divergent lineages") involving *I. fulva*, *I. hexagona* [actually *I. giganticaerulea*?], and *I. brevicaulis* was involved in the origin of *I.* ×*nelsonii*. These are examples of the extensive influence of hybridization in the genus. The Sabine Co. collection by Singhurst appears to be the only documented report of *I. fulva* from TX (Singhurst et al. 2002b). Although not officially recognized as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), since this species is confirmed from only one county in the state, we consider it to be of conservation concern in TX. ⚠ 🏵/290

Iris germanica L., (German), GARDEN IRIS, GERMAN IRIS, BLUE FLAG. Stems longer than the leaves, 40–100(–120) cm long; perianth bluish violet to white or variously colored in a diversity of cultivated forms; sepals 40–60 mm wide; petals 45–60 mm wide; sepal beard usually white, yellow, or brownish; fruits 3-angled. This is the commonly cultivated *Iris* widely planted in TX; it persists indefinitely (e.g., at homesite in Hagerman National Wildlife Refuge abandoned for more than 50 years) and escapes widely; Grayson, Marion, Morris (BRIT), and Dallas (Ed McWilliams, pers. comm.) cos.; s Canada and widespread in the e U.S. w to MN, KS, and TX, also CA, UT, and WY. Spring. This species is not known in nature, but it is possibly of hybrid origin; some researchers suggest European ancestors (Henderson 1992, 2002). *Iris germanica* is the most widely cultivated species in the genus, and an incredible variety of colors or color combinations is known. This species is reported to be toxic (Lampe & McCann 1985). Numerous other species have been hybridized with *I. germanica* (including tetraploids)—the name *I.* ×*conglomerata* N.C. Hend. has been proposed for these hybrids. ☠ ☜

Iris pallida Lam., (pale), BLUE FLAG, ORRIS, DALMATIAN IRIS, SWEET IRIS. Stems longer than the leaves, 40–100(–120) cm long; perianth lilac to violet or blue-violet; sepals 30–50 mm wide; petals 30–50 mm wide; sepal beard conspicuous, usually yellow. Cultivated and escaping; Dallas Co. (BRIT); also Tarrant Co. (R. O'Kennon, pers. obs.) to the w of East TX; se Canada (Ont.), AR, CA, GA, IN, LA, MO, TN, and TX. Apr–May. Native of Europe. ☜

Iris pseudacorus L., (false sweet-flag), YELLOW FLAG, YELLOW IRIS, PALE-YELLOW IRIS, YELLOW WATER IRIS. Stems 70–150 cm tall; perianth yellow; sepals 20–30(–40) mm wide; petals much shorter and narrower than sepals, 4–8 mm wide; fruits 3-angled. Commonly cultivated and escaping, in ponds and lake margins; Polk (BAYLU), Montgomery (ASTC), Gonzales, and Hardin (Turner et al. 2003) cos.; sparsely scattered in e 1/2 of TX; widespread in much of Canada and the U.S. Apr–May. Native to Europe and n Africa. This species is reported to be toxic (Lampe & McCann 1985). It is considered to be a state noxious weed in UT (Kartesz 1999). ⊘ ☠ ☜ 🏵/290

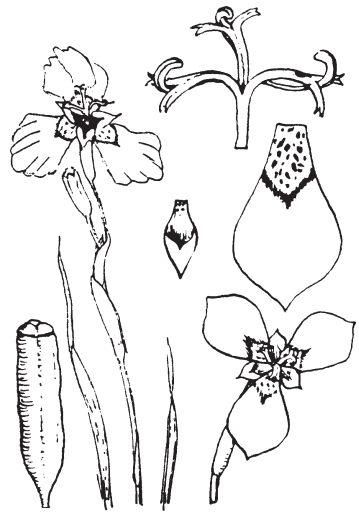
Iris virginica L., (of Virginia), VIRGINIA IRIS, SOUTHERN BLUE FLAG, BLUE FLAG. Stems nearly as long as or longer than the basal leaves, 50–100 cm long; sepals to 40 mm wide, pale blue to lavender-blue or purple, with darker blue or purple lines, with claw green or yellow-green medially, bordered by yellow with blue or purple lines, the yellow extending onto base of limb; petals colored similarly to main part of the sepals, 10–30 mm wide; fruits usually 3-angled. Lowlands; widespread in the Pineywoods and Post Oak Savannah; also n Gulf Prairies and Marshes; se Canada (Ont. and Que.) and much of the e U.S. w to MN and TX. Mar–May. [*I. shrevei* Small, *I. versicolor* L. var. *shrevei* (Small) Boivin, *I. virginica* var. *shrevei* (Small) E.S. Anderson] While TX plants of this species have sometimes been recognized as var. *shrevei* (e.g., Hatch et al. 1990), we are following Henderson (2002), who studied the species throughout its entire range, in not formally recognizing varieties. However, Henderson (2002) noted that, "Plants of *Iris virginica* from the southeastern and south-central states having stems 2–3-branched and seldom falling to the ground after flowering, and with capsules long-cylindric have been recognized as var. *shrevei*" (Henderson 2002). 🏵/290



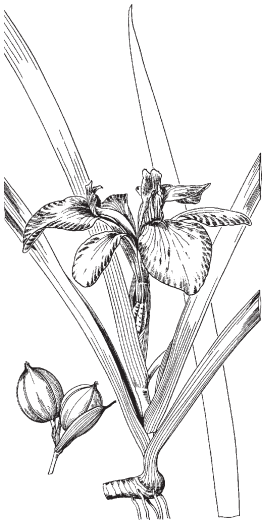
Gladiolus communis [EN2]



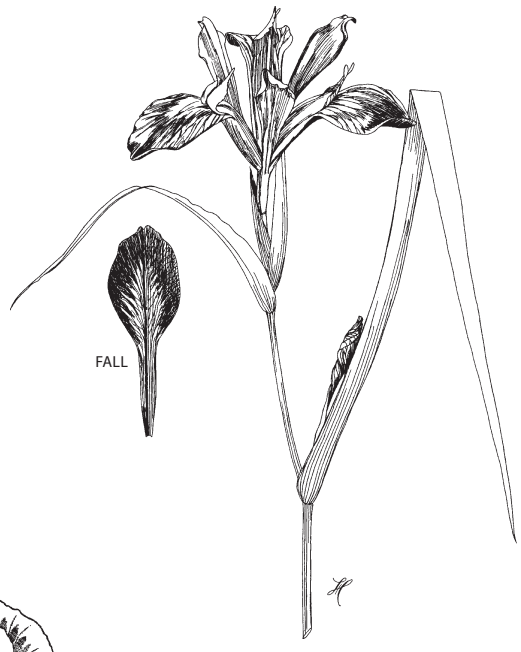
Gladiolus italicus [ROL]



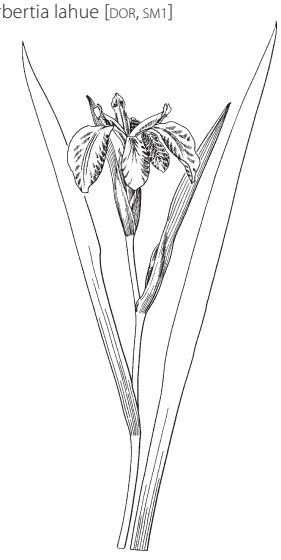
Herbertia lahue [DOR, SM1]



Iris brevicaulis [YAT]



Iris ×flexicaulis [HEB]



Iris fulva [YAT]





Iris germanica [NIC, YAT]



Iris pallida [NIC]

Iris xiphium L., (sword-leaved), DUTCH IRIS, SPANISH IRIS. Plant from a bulb; leaves nearly cylindrical, channeled on upper surface; flowers usually solitary; perianth blue (to other colors in cultivated forms); sepals 18–25 mm wide; petals 15–20 mm wide. Cultivated and escaping; Dallas Co. (BRIT); LA, TN, and TX. Apr–May. Native to Europe and n Africa.

NEMASTYLIS Nutt. CELESTIAL, PLEAT-LEAF, SHELL-FLOWER

Small herbaceous perennials from bulbs; stems erect; leaves few, linear, plicate; inflorescences 1–3 per stem, from the upper leaf axils, each with 1–2 flowers enclosed by a spathe (pair of herbaceous bracts); perianth ± flat or saucer-shaped, radially symmetrical, light blue to bright blue, usually with a white or light "eye," the inner and outer whorls similar, fused basally; filaments free to united; anthers longer than the filaments, becoming spirally twisted after dehiscence (except in *N. selidandra*); style deeply 3-lobed, the lobes again deeply 2-lobed; capsule 10–20 mm long, truncate, opening apically.

A genus of 5 species ranging from the s U.S. to Central America (Goldblatt 2002e). (Greek: *nema*, a thread, and *stylos*, pillar, column, or style, for the slender style branches)
REFERENCES: Foster 1945; Goldblatt 1975, 2002e; Ravenna 2004.

1. Cauline leaves well-developed, the broadest ones 5–11(–20) mm wide, usually at least one longer than the inflorescence; anthers 11–15 mm long; tepals 25–30 mm long; tepals 25–30 mm long; bulbs 2–3 cm in diam. _____ **N. geminiflora**
1. Cauline leaves narrow, the broadest ones 1–4 mm wide or bract-like, ca. as long as the inflorescence; anthers 3–8 mm long; tepals 18–25 mm long; bulbs ca. 1 cm in diam. _____ **N. nuttallii**

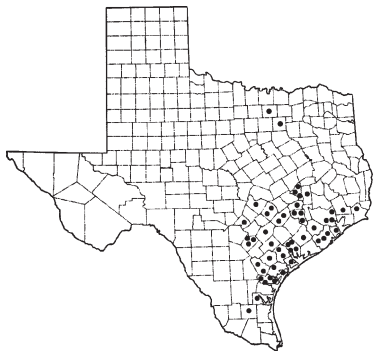
Nemastylis geminiflora Nutt., (twin-flowered), PRAIRIE CELESTIAL, PRAIRIE PLEAT-LEAF, CELESTIAL-LILY, PRAIRIE-IRIS. Basal leaves (2–)3, 20–40 cm long; cauline leaves 2 or 3, 15–35 cm long; flowering stems 12–40(–46) cm tall; spathes 1–2-flowered; tepals subequal, 2.5–3 cm long, blue, lighter at base giving the perianth the appearance of an "eye"; filaments separate or fused basally. Prairies or open oak woods; widespread in TX w to Rolling Plains and e Edwards Plateau; AL w to KS and TX. Mar–May. [*N. texana* Whitehouse] According to Wills and Irwin (1961), the flowers are only open for a few hours, opening in late morning and the perianth parts usually curling up before 3 p.m. In East Texas, this is an indicator species—its presence usually indicates a native prairie community. It is quickly climinated by plowing or overgrazing. /292

Nemastylis nuttallii Pickering ex R.C. Foster, (for Sir Thomas Nuttall, 1786–1859, English-American botanist). Basal leaves 1–2 or lacking, cauline leaves usually 2, the upper reduced and bract-like; spathes 1(–2)-flowered; tepals subequal, 1.8–2.5 cm long, pale blue; filaments fused nearly entirely or in the lower half. Wet prairies, barrens, bluffs; included based on citation by Hatch et al. (1990) for Post Oak Savannah and Blackland Prairie; however, we have seen no TX material, and Goldblatt (1975, 2002e) gave range maps showing only AR, OK, and MO. Yatskievych (1999) also indicated that the species was endemic to the Ozark Plateau (AR, MO, OK). Its occurrence in East TX is therefore questionable; no county distribution map is provided. Late May–Jul. The flowers are reported to last only a few hours, opening in late afternoon (ca. 5 p.m.) and closing ca. 7 p.m. (Yatskievych 1999; Goldblatt 2002e).

Nemastylis selidandra Ravenna, (linear male, in reference to the anthers which are straight even after dehiscence), was recently described from w Comal Co., just w of East TX (Ravenna 2004). This species is known only from the type collection (*Correll 32517*, Holotype: CTES—Instituto de Botánica del Nordeste Corrientes; Isotype: TEX). It is described as differing from *N. geminiflora* in having "a taller, slender habit, a rather simple inflorescence bearing few long-peduncled spathes, and anthers that remain nearly straight even after dehiscence" (Ravenna 2004). We have seen no material of this new species.



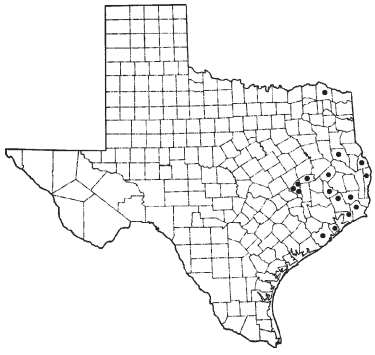
Gladiolus italicus



Herbertia lahue



Iris brevicaulis



Iris ×flexicaulis



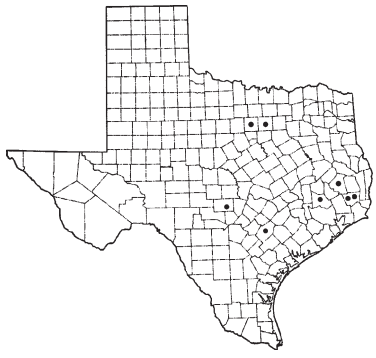
Iris fulva



Iris germanica



Iris pallida



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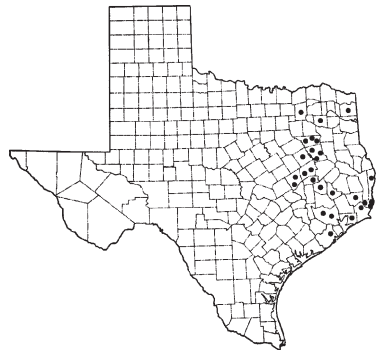
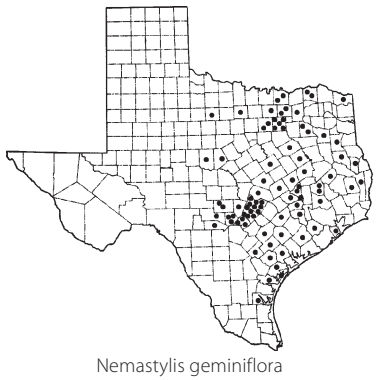


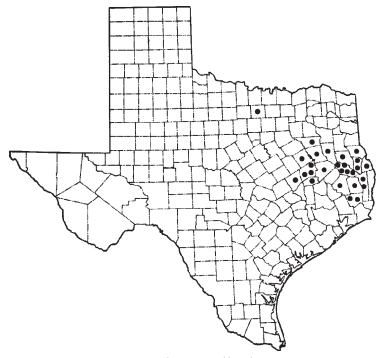
Iris virginica



Iris xiphium



Nemastylis geminiflora



Sisyrinchium albidum

SISYRINCHIUM L. BLUE-EYED-GRASS, GRASS-VIOLET

Perennials or less commonly annuals from fleshy-fibrous roots, sometimes with obscure rhizomes; vegetatively like miniature irises, but often described as grass-like; stems typically 2-winged, unbranched and leaves all basal or stems branched and leaves basal and cauline; leaves few, distichous (2-ranked), linear, flat; flowers few, in small cyme-like clusters, from a pair of bracts (referred to as the spathe), closed at night or in cloudy weather, not fragrant; peduncles ± indistinguishable from stems; perianth radially symmetrical, the ± separate tepals similar or alternating narrow and wide, of various shades of blue to purple, violet, rose, white, or yellow, the flowers usually with a yellow center or "eye," or in one species (*S. rosulatum*) with a purple to maroon "eye ring"; stamens with filaments usually connate into a narrow column, the anthers separate.

A mainly American (especially Central and South America) genus of ca. 80 species with 1 in Hawaii, 1 in Ireland, and 1 in New Zealand (these possibly naturalized) (Cholewa & Henderson 2002); some are cultivated as ornamentals. A number of species have "oil flowers" which have elaiophores (= oil-secreting organs). The oils (instead of nectar or pollen) produced by these structures serve as a reward for specialized bees which pollinate the flowers (Buchmann 1987; Cocucci & Vogel 2001). The genus is a variable, phenotypically plastic, and taxonomically difficult group that needs detailed study; hybridization occurs (particularly in TX), further complicating the picture (see note following *S. sagittiferum*). In addition, Cholewa and Henderson (2002) pointed out that, "*Sisyrinchium* is a complex polyploid taxon in which the species are not always easily distinguished." Shinners (1958) indicated that this is "One of the most difficult genera in the Texas flora." Mosquin (1970) proposed combining a number of the species, including *S. albidum*, *S. angustifolium*, *S. campestre*, and *S. langloisii*, into a single, widespread, variable taxon. While there are many taxonomic problems to be worked out in this genus, recent studies (e.g., Hornberger 1991; Cholewa & Henderson 2002) have somewhat clarified the situation. In the following treatment, we are in general following the species concepts of Cholewa and Henderson (2002). It should be noted that species are variable, intermediates are to be expected, and fresh or carefully pressed material is sometimes necessary for definitive identification. Unfortunately, "Accurate identification requires examining more than one individual in order to discount uncommon or atypical character states" (Cholewa & Henderson 2002). Although the flowers are relatively small, the plants are often extremely abundant, making showy displays along roadsides and open areas. The most widely used common name, BLUE-EYED-GRASS, is doubly incorrect, the plants having neither a blue center or "eye" nor being related to grasses; they do, however, often look superficially like grasses with bluish flowers. (Name used by Theophrastus for some plant, later transferred to this genus; possibly derived from Greek: *sys*, pig, and *rhynchus*, snout or beak, in reference to pigs grubbing for the roots—Shosteck 1974)
REFERENCES: Bicknell 1901; Shinners 1962a; Oliver 1969; Mosquin 1970; Goldblatt et al. 1989, 1990; Hornberger 1991; Cocucci & Vogel 2001; Cholewa & Henderson 2002.

1. Perianth campanulate-urceolate, flaring distally rather than at base; tepals lavender-pink to lavender-rose, purple-rose, yellow, or white; plants usually annuals (can be short-lived perennials).
   2. Perianth with a yellow "eye," the tepals otherwise lavender-pink to purple-rose, occasionally white, rarely yellow; 3–6.3 mm long; capsules more elongate than globose, ca. 4–5.5 mm long; stems with 3–5 nodes; filaments connate nearly their full length _____ **S. minus**
   2. Perianth with a purple to maroon or red-brown "eye ring" or markings near center (however, innermost throat of perianth can be yellow), the tepals otherwise yellow to white, pink, or lavender-rose, (4–)5–11(–16 mm) long; capsules globose, ca. 2–4 mm long; stems with only 1–2(–3) nodes; filaments connate 1/2 their length or less _____ **S. rosulatum**
1. Perianth ± rotate, flaring from base or even reflexed; tepals pale to deep blue to blue-purple, blue-violet, or white; plants perennials.

3. Inflorescences usually paired (two pairs of spathe bracts borne in such close proximity that 1 pair often obscured), immediately subtended by a bract-like leaf much longer than the spathe (this bract-like leaf so close as to be touching the spathe); flowers usually white, sometimes light blue; stems without additional leaves other than those immediately subtending inflorescences _____ **S. albidum**

3. Inflorescences borne singly (each pair of spathe bracts clearly distinct from other pairs), not immediately subtended by a leaf (the subtending leaf, if present, not touching spathe); flowers white to light blue to blue-violet, purple-blue, or blue; stems with OR without leaves.
   4. Stems unbranched (or most individuals of a population with unbranched stems), without leaves/bract-like leaves other than paired bracts of the spathe.
      5. Outer spathe bract with margins free or rarely basally connate 1 mm or less, 10–32 mm longer than the inner spathe bract; tepals white to light blue _____ **S. campestre**
      5. Outer spathe bract with margins basally connate for 1–6.1 mm, ca. equaling the inner spathe bract in length to 13 mm longer than the inner spathe bract; tepals blue to bluish violet.
         6. Outer spathe bract 6.2–13 mm longer than inner; leaf bases becoming fibrous and persisting in tufts; capsules ca. 3–4 mm long; plants drying dark brown to reddish brown or brownish olive _____ **S. sagittiferum**
         6. Outer spathe bract ca. as long as inner; leaf bases not persistent in tufts; capsules 5–7 mm long; plants drying pale to olive green or occasionally bronze _____ **S. biforme**
   4. Stems branched (or most individuals of a population with branched stems), with leaves/bract-like leaves in addition to the paired bracts of the spathes.
      7. Main stems usually more than 2 mm wide.
         8. Lowest internode 10–30 cm long, often longer than the longest leaf; stems broadly 2-winged, with each wing as wide as central portion of stem and often 1 mm or more wide; tepals pale blue to bluish violet, rarely white _____ **S. angustifolium**
         8. Lowest internode 2.6–19 mm long, shorter than to equal to the longest leaf; stems not broadly winged; tepals light bluish violet to purplish blue or blue.
            9. Spathe bracts and/or stems, including peduncles, scabrous at least apically; hyaline margins of inner spathe bract acuminate to acute apically _____ **S. pruinosum**
            9. Spathe bracts and stems glabrous; hyaline margins of inner spathe bract broadly acute to obtuse or lobed apically _____ **S. ensigerum**
      7. Main stems usually 2 mm or less wide.
         10. Margins of outer spathe bract basally connate for 3.8–6.1 mm.
            11. Ovaries blackish, in sharp contrast to the much lighter foliage; tepals light blue to purplish blue, occasionally white; capsules 2–4 mm long _____ **S. atlanticum**
            11. Ovaries similar to foliage in color; tepals light blue; capsules 5–7 mm long _____ **S. biforme**
         10. Margins of outer spathe bract basally connate for 2.2–3.8(–5) mm.
            12. Plants very erect; stems 5–7 times as long as the peduncles (peduncles measured from axil of subtending leaf to base of spathe); lowest internode 11–36 cm long, often longer than the leaves; ovaries blackish, in sharp contrast to much lighter foliage; plants found in East TX only in extreme s part of Pineywoods _____ **S. atlanticum**
            12. Plants spreading to erect; stems ca. 4 times as long as the peduncles or less; lowest internode 3.2–12.5 cm long, equaling or shorter than the leaves; ovaries similar to foliage in color; plants widespread throughout East TX.
               13. Spathe bracts and/or stems including peduncles scabrous at least apically, the outer spathe bract 2.5–5.5 mm longer than inner, green; capsule tan to light brown _____ **S. pruinosum**

13. Spathe bracts and stems glabrous, the outer spathe bract 0.9–2.7 mm longer than inner, usually purple-tinged at base and sometimes along margins; capsule medium brown to black _____ **S. langloisii**

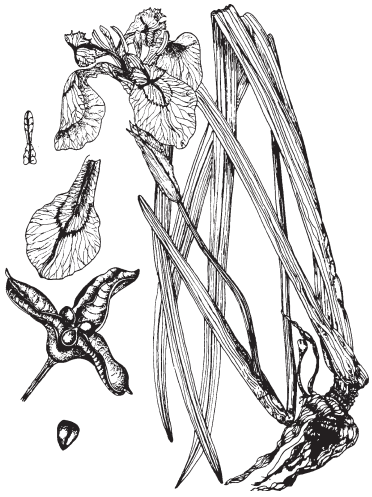
Sisyrinchium albidum Raf., (white), WHITE BLUE-EYED-GRASS. Plant 20–40 cm tall, drying yellowish to light olive; stems broadly winged, 1.5–3.4 mm wide, unbranched, with only a single bract-like leaf (basal leaves also present); bract-like leaf so close to the spathes as to appear to be a much elongated outer bract of the sessile spathes; inflorescences paired (this is the only East TX species that typically has paired inflorescences), one often obscured by the immediately subtending bract-like leaf; flowers usually white, sometimes light blue, with yellow "eye"; capsules 2.8–4 mm long. Open woods, exposed areas, often on sandy or rocky soils; Pineywoods and Post Oak Savannah; also Wise Co. (BRIT) in Cross Timbers and Prairies; se Canada (Ont.) and much of the e U.S. w to WI and TX (but not the far ne). Mar–Apr.

Sisyrinchium angustifolium Mill., (narrow-leaved), NARROW-LEAF BLUE-EYED-GRASS. Plant to 45 cm tall, often darkening upon drying; stems branched, with 1–2 nodes, 2.3–6 mm wide, broadly winged, the lowest internode often longer than the longest leaf; flowers light blue to bluish violet to rarely white, with yellow "eye"; capsules 4–5.5(–7) mm long. Sandy woods; widespread in East TX; also n Gulf Prairies and Marshes and scattered in nw part of TX; se Canada and e U.S. w to the Great Lakes region and TX. Mar–May. [*S. bermudiana* of authors, not L.]

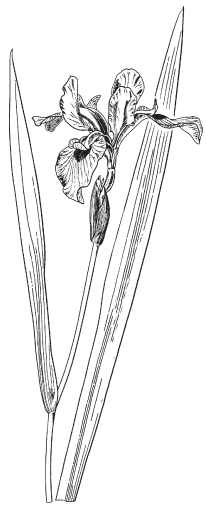
Sisyrinchium atlanticum E.P. Bicknell, (Atlantic), EASTERN BLUE-EYED-GRASS. Plant 23–70 cm tall, drying light green or yellowish; stems branched, with 1–2 nodes, ca. 2 mm or less wide, the lowest internode often longer than the leaves; leaves 1–4 mm wide; perianth light blue to purplish blue, occasionally white, with yellow "eye"; ovaries blackish, in sharp contrast to the much lighter foliage; capsules ca. 2–4 mm long. Wet areas; Hardin, Jasper (BRIT), Jefferson, Montgomery, Orange, and Tyler (Turner et al. 2003) cos. in the s Pineywoods; also n Gulf Prairies and Marshes; se Canada (N.S.) and most of e U.S. w to MI and TX. Apr–May. [*S. apiculatum* E.P. Bicknell, *S. mucronatum* Michx. var. *atlanticum* (E.P. Bicknell) Ahles] This species can sometimes be confused with *S. angustifolium* (Yatskievych 1999), but it can be distinguished by its narrow stem width (1–2 mm wide vs. 2.3–6 mm wide in *S. angustifolium*) and by the outer of the paired spathe bracts being similar in length to the inner (vs. the outer ca. 2–10 mm longer than the inner in *S. angustifolium*). Anita Cholewa (pers. comm.) also noted that *S. atlanticum* can be recognized by the contrast in color between the ovaries/fruits and the foliage.

Sisyrinchium biforme E.P. Bicknell, (having 2 forms), WIRY BLUE-EYED-GRASS. Plant to 47 cm tall; stems usually unbranched or branched with 1 node, < 2 mm wide; perianth light blue, with yellow "eye"; capsules 5–7 mm long. Sandy river banks; Travis (Oliver 1969 as *S. dimorphum*), Harris, Hays, and Liberty (Turner et al. 2003) cos.; mainly Gulf Prairies and Marshes and Edwards Plateau; LA and TX. Spring–early summer. [*S. dimorphum* R. Oliver] While we are tentatively following Cholewa and Henderson (2002) in treating *S. dimorphum* within *S. biforme*, we are unsure as to the best treatment of these plants. As can be noted from the distribution maps in Turner et al. (2003) (who recognized two species), the range of the two taxa are strikingly different—*S. biforme* (in the narrow sense) coastal, and *S. dimorphum* occurring from the w edge of East TX across the Edwards Plateau. The county distribution map presented here includes individuals treated by Turner et al. (2003) as *S. biforme* and *S. dimorphum*. It is quite possible that two species are involved—further study is definitely warranted.

Sisyrinchium campestre E.P. Bicknell, (of the plains or fields), PRAIRIE BLUE-EYED-GRASS. Plant 15–28(–40) cm tall, without fibrous leaf bases attached to the stems (in contrast to the somewhat similar *S. sagittiferum*), drying light green to olive or ashy olive, sometimes purplish basally; stems 2.5 mm or less wide; unbranched, either without bracts or bract-like leaves other than those composing the spathe or with one bract rarely present; spathe bracts not conspicuously



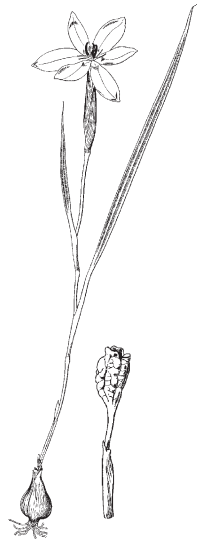
Iris pseudacorus [CO1]



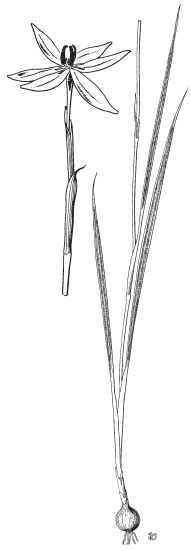
Iris virginica [YAT]



Iris xiphium [BT3]



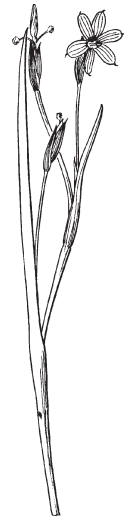
Nemastylis geminiflora [YAT]



Nemastylis nuttallii [YAT]



Sisyrinchium albidum [GLE]



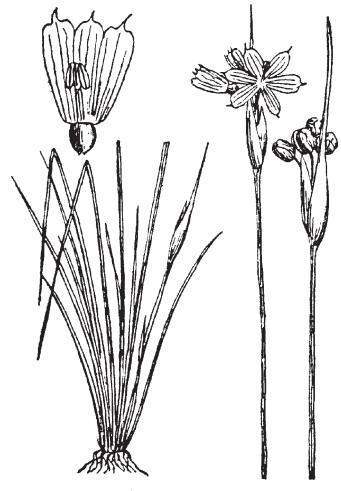
Sisyrinchium atlanticum [GLE]



Sisyrinchium angustifolium [TOR]



Sisyrinchium biforme [HEB]



Sisyrinchium campestre [BB2]

wider than the stems; outer spathe bract with margins usually free at base (rarely united for 1 mm or less); perianth white to light blue, with yellow "eye"; capsules 3–5 mm long. Prairies; Delta, Grayson, Fannin, Nacogdoches (BRIT), Harris, Jasper, Lamar, and Walker (Turner et al. 2003) cos.; sc Canada (Man.) and c U.S. from MI and LA w to ND and TX. Apr–May.

Sisyrinchium ensigerum E.P. Bicknell, (sword-bearing), SWORD-LEAF BLUE-EYED-GRASS. Plant usually 15–32 cm tall, drying olive green to yellowish bronze; stems solitary or few (plants rarely cespitose), branched, with 1–2 nodes, sometimes slightly to strongly glaucous or gray-green, ca. 2–5 mm wide; perianth blue to bluish violet, with yellow "eye"; capsules ca. 4–5 mm long. Prairies; Bell, Grayson (BRIT), and Travis (Turner et al. 2003) cos.; w edge of Blackland Prairie s and w to w TX; KS, OK, and TX. Apr–May. [*S. chilense* of TX authors, probably not Hook., *S. scabrum* of TX authors, probably not Cham. & Schltdl.] The names *S. chilense* Hook. and *S. scabrum* Cham. & Schltdl. have often been used in TX (e.g., Turner et al. 2003) for what is here considered *S. ensigerum*. However, we are following Cholewa and Henderson (2002) in treating the taxon as *S. ensigerum*; unfortunately, the other names (*S. chilense* and *S. scabrum*) were not accounted for in their recent treatment. According to A. Cholewa (pers. comm.), *S. chilense* and *S. scabrum* in their proper senses should not be considered synonyms of *S. ensigerum*. Plants of se TX, presumably hybrids, often show the influence of this species as well as *S. langloisii* and *S. pruinosum*—many specimens will thus not key to species. This species complex clearly needs nomenclatural work, as well as detailed field study in TX and surrounding areas.

Sisyrinchium langloisii Greene, (for Rev. A.B. Langlois, 1832–1900, French-born clergyman and botanist in LA), PALE BLUE-EYED-GRASS, ROADSIDE BLUE-EYED-GRASS. Plant 12–35 cm tall, drying olive to bronze-olive; stems usually numerous, branched, with 1–2 nodes, usually 2 mm or less wide; perianth light blue to bluish violet or white, with yellow "eye," pale outside; capsules ca. 3–5 mm long. Sandy woods; throughout e 1/3 of TX; AL, AR, GA, LA, MS, OK, TN, and TX. (Mar–) Apr–May. This species intergrades/apparently hybridizes with *S. ensigerum* and *S. pruinosum* in East TX; Kartesz (1999) considered *S. pruinosum* to be a synonym of *S. langloisii*.

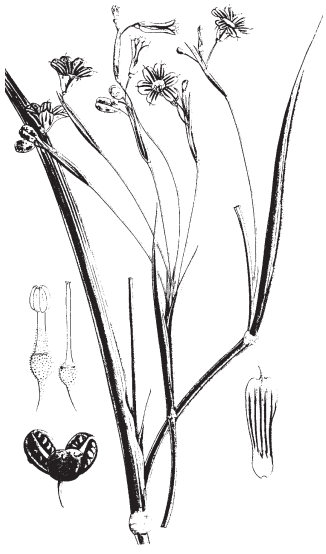
Sisyrinchium minus Engelm. & A. Gray, (smaller), LEAST BLUE-EYED-GRASS, DWARF BLUE-EYED-GRASS. Prostrate to erect annual 4–24(–26) cm tall, drying olive-green, sometimes darker; stems branched, with 3–5 nodes, usually 2 mm or less wide; perianth campanulate-urceolate, flaring distally rather than at base (the only other East TX species with this character is *S. rosulatum*), lavender-pink to purple-rose, occasionally white, rarely yellow, with yellow "eye," the tepals short in comparison to other East TX species, 6.3 mm or less long; capsules ca. 4–5.5 mm long, more elongate than globose. Sandy soils; scattered in much of e 1/2 of TX; LA, MS, and TX. (Mar–)Apr.

Sisyrinchium pruinosum E.P. Bicknell, (with a white glistening coating or bloom), DOTTED BLUE-EYED-GRASS. Plant 9–30 cm tall, drying ashy to bronze-olive; stems numerous, branched, with 1–2 nodes, ca. 1–3 mm wide; leaves 1–3 mm wide; perianth light violet-blue to purple-blue, rarely white or very rarely mottled, with yellow "eye," pale outside; capsules 3–6 mm long. Prairies, disturbed sites, often a lawn weed; scattered in much of e 1/2 of TX; AL, AR, KS, NE, OK, and TX. (Mar–)Apr(–May). Hornberger (1991), Kartesz (1994, 1999), and Jones et al. (1997) synonymized this taxon with *S. langloisii*, while Cholewa and Henderson (2002) recognized it as distinct. Pending a treatment of the group as a whole, we are maintaining it as a separate species. Herbarium specimens in this complex (including *S. ensigerum*, *S. langloisii*, and *S. pruinosum*) are frequently misidentified, and many show the influence of all 3 species. ⚄/298

Sisyrinchium rosulatum E.P. Bicknell, (beaked), SPREADING BLUE-EYED-GRASS, ANNUAL BLUE-EYED-GRASS. Plant 5–36 cm tall, drying yellowish green to olive green; stems branched, with 1–2(–3) nodes or rarely unbranched, ca. 1–2 mm wide; leaves 1–4 mm wide; perianth campanulate-urceolate, flaring distally rather than at base (the only other East TX species with this



Sisyrinchium rosulatum [HEB[



Sisyrinchium ensigerum [CUR]



Sisyrinchium langloisii [HEA]



Sisyrinchium sagittiferum [HEA]



Sisyrinchium minus [ADD]



Sisyrinchium pruinosum [SHI]

character is *S. minus*), yellow to white, pink, or lavender-rose, with purple to maroon stripes and purple to maroon "eye ring" or markings near center (however, innermost throat of perianth can be yellow); filaments inflated at base (vs. tapering gradually from base to apex in all other East TX species), connate at base or at most to 1/2 their length; capsules ca. 2–4 mm long, globose. Disturbed areas, roadsides, lawns, prairies, old fields, river bottoms, pine woods; Pineywoods and Post Oak Savannah; also n Gulf Prairies and Marshes; se U.S. from VA s to FL w to TX. Apr–May. [*S. exile* E.P. Bicknell] Correll and Johnston (1970) indicated that this species hybridizes with *S. albidum*, *S. langloisii*, and *S. pruinosum*. We are following a number of recent authors (e.g., Kartesz 1999; Cholewa & Henderson 2002), in submerging *S. exile* into *S. rosulatum*. However, Turner et al. (2003) recognized *S. exile* as distinct species. Cholewa and Henderson (2002) described *S. rosulatum* as "weedy throughout much of its range." ⚅/298

Sisyrinchium sagittiferum E.P. Bicknell, (arrow-bearing), SPEAR-BRACT BLUE-EYED-GRASS. Plant 10–30(–45) cm tall; stems unbranched, without bracts or bract-like leaves other than those composing the spathe, ca. 1–2 mm wide; leaf bases becoming fibrous and persisting in tufts; perianth blue to bluish violet, with yellow "eye"; capsules ca. 3–4 mm long. Low wet areas; Pineywoods and Post Oak Savannah; also n Gulf Prairies and Marshes; AL, LA, and TX. Mar–Apr. This species is similar to *S. campestre* but differs as follows: outer spathe bract slightly connate at base (for 1–2.7 mm); spathes conspicuously wider than the stems; fibrous leaf bases usually attached to the stems; plants drying darker (dark brown to reddish brown or brownish olive); flowers usually darker in color (see description of *S. campestre*). ⚅/298

An additional species, *S. texanum* E.B. Bicknell, has been reported for TX (Bicknell 1901). Several authors (e.g., Correll & Johnston 1970) considered *S. texanum* E.P. Bicknell as synonymous with *S. sagittiferum*. However, after studying the group in detail for their *Flora of North America* treatment, Cholewa and Henderson (2002) pointed out that *S. texanum* has branched stems and is thus not appropriately placed in *S. sagittiferum*. Cholewa and Henderson (2002) concluded that:

> "In eastern Texas (especially) and adjacent states, intermediates between *Sisyrinchium ensigerum*, *S. pruinosum*, *S. langloisii*, and perhaps *S. sagittiferum* can be found. These have been referred to *S. texanum* E. P. Bicknell (D. S. Correll and M. C. Johnston 1970), and Bicknell's original description of that entity does mention a high degree of variability. Many of the specimens that we examined that were previously labeled *S. texanum* exhibit character states intermediate between those of *S. langloisii* and *S. pruinosum* or *S. ensigerum*. The types of *S. texanum* that we examined (*Bray s.n.*, NY; *Bush 32*, NY; *Hall 636*, NY) would key to *S. langloisii* or *S. pruinosum* but exhibit several intermediate character states. Further, although K. L. Hornberger (1987, 1991) and D. S. Correll and M. C. Johnston (1970) considered *S. texanum* synonymous with *S. sagittiferum* (which they described as a branched species), E. P. Bicknell (1899, 1901) clearly indicated that the latter is unbranched, and thus it probably does not play a role in *S. texanum*. Much more work is needed to resolve the proper disposition of *S. texanum* and the true nature of this complex of southern species."

JUNCACEAE Juss. RUSH FAMILY

Grass-like or sedge-like perennials or less commonly annuals; stems pithy or hollow, round or somewhat compressed on one side, with smooth nodes; leaves basal and/or cauline, with open or closed, tubular, basal sheath smoothly continuous with the blade or with margins or inner lining prolonged at summit into auricles; leaf blades flat or terete; inflorescences of spike-like racemes, panicles, or head-like clusters (referred to below as heads); flowers usually bisexual, radially symmetrical; perianth of 2 similar whorls of 3, narrow, scaly, green to red-brown or yellowish perianth parts (tepals); stamens 3 or 6; pistil 1; ovary superior; fruit a dry dehiscent capsule; seeds 3–numerous, often with appendages.

A small (ca. 350 species in 8–9 genera—Balslev 1998; Brooks & Clemants 2000) nearly cosmopolitan family of herbs primarily of temperate and cold areas and tropical mountains

mainly in wet or damp habitats. The monotypic s African genus *Prionium* (woody trunk to > 1 m long, juncaceous flowers), which was previously treated in Juncaceae (e.g., Balslev 1998), is now excluded based on molecular evidence (e.g., Plunkett et al. 1995; Munro & Linder 1998; Chase et al. 2000). Pollination in the family is predominantly by anemophily (= wind-pollination); specific adaptations for wind-pollination include many-flowered inflorescences, abundant smooth pollen, and large stigmatic surfaces (Balslev 1998). While previously believed to be associated with the Liliales (due to superficial resemblances), the family is now considered to be related to the Cyperaceae (e.g., Dahlgren et al. 1985; Duvall et al. 1993b; Simpson 1995; Chase et al. 2000) and more distantly to other families of the Poales, including Poaceae and Xyridaceae (Chase et al. 2000). In fact, some molecular data suggest that Juncaceae and Cyperaceae are sister taxa (Chase et al. 1995b; Linder & Kellogg 1995), or even that Cyperaceae may be derived from within Juncaceae, possibly making Juncaceae paraphyletic (Plunkett et al. 1995; Munro & Linder 1998). According to Plunkett et al. (1995), the "progenitor-derivative relationship of Juncaceae and Cyperaceae ... reveals an additional example of paraphyletic families which presents a series of taxonomic dilemmas." A number of similar situations exist (e.g., Brassicaceae and Capparaceae, Cactaceae and Portulacaceae), and if paraphyletic families are disallowed (as favored by many cladists), taxonomists are thus faced with wholesale rearrangement of many long established and easily recognized families—see Appendices 5 and 6 for further discussion of these issues. (subclass Commelinidae—Cronquist; order Poales—APG II)

FAMILY RECOGNITION IN THE FIELD: grass-like or sedge-like herbs with mostly basal, tufted, linear leaves in (2–)3 ranks; flowers inconspicuous with *6 scaly perianth segments* (= tepals), often clustered but not in spikelets; fruit a *capsule*; the somewhat similar Poaceae and Cyperaceae have 1-seeded fruits, either lack a perianth or have the perianth very reduced, and have flowers in spikelets.

REFERENCES: Dahlgren et al. 1985; Plunkett et al. 1995; Simpson 1995; Balslev 1996, 1998; Munro & Linder 1998; Brooks & Clemants 2000.

1. Plants glabrous; seeds numerous per capsule; capsules usually 3-celled (sometimes imperfectly so); leaf blades terete (= rounded in cross section) or flat; leaf sheaths open _____ **Juncus**
1. Plants with pubescence; seeds 3 per capsule; capsules 1-celled; leaf blades flat; leaf sheaths closed _____ **Luzula**

JUNCUS L. RUSH

Glabrous perennial or annual (only 2 East TX species) herbs with fibrous roots, many species rhizomatous; leaf blades flat or terete, sometimes septate (= with internal cross-partitions sometimes resulting in conspicuous ring-like bands visible externally); leaf sheaths open; inflorescences variable, sometimes with numerous rebranched branches, terminal or appearing lateral; flowers solitary on pedicels or often in head-like clusters; capsules usually 3-celled (sometimes imperfectly so and thus apparently unilocular); seeds numerous.

A genus of ca. 300 species (Brooks & Clemants 2000), cosmopolitan in distribution but rare in the tropics. Because inflorescence, flower, and fruit characters are widely used in the following key, fertile specimens are essential for accurate identifications. Some species (e.g., *J. effusus* and *J. squarrosus* L.) have been used in making baskets and chair bottoms (Judd et al. 1999). (Latin: *iuncus*, name for rush; derived from *iungere*, to join or bind, from use of the stems for tying)

REFERENCES: Engelmann 1868; Wiegand 1900; Fernald & Wiegand 1910; Eleuterius 1975, 1978; Hermann 1975; Hämet-Ahti 1980; Catling & Spicer 1987; Brooks 1989; Snogerup 1993; Brooks & Whittemore 1999; Kirschner et al. 1999.

1. Inflorescence appearing lateral (= appearing to originate from the side of the "stem"), the "stem" apparently continuing beyond it (actually the "stem" beyond the inflorescence is a stem-like involucral bract and the inflorescence is thus pseudolateral); leafy bracts (other than the stem-like bract) absent or much shorter than inflorescence.

2. Flowers in clusters of usually 2–8(–25), the clusters subtended by as many bracteoles as there are flowers, the individual flowers usually without their own bracteoles (occasionally an extra bracteole will be present below an individual flower); plants typically of brackish waters; species rare in se part of East TX _____ **J. roemerianus**
2. Flowers solitary (can be deceptively crowded), the individual flowers usually subtended by a pair of bracteoles, any apparent cluster of flowers not subtended by a set of bracteoles (note: nodes of inflorescence also typically have a bracteole); plants common in freshwater situations; including species widespread and common in East TX.
   3. Upper leaf sheaths without blades; capsules obovoid, clearly longer than broad, obtuse, truncate, or even depressed apically, (1.5–)1.7–3.2 mm long; flowers numerous, 30–100 per panicle; perianth 1.9–2.6(–3.5) mm long _____ **J. effusus**
   3. Upper leaf sheaths with blades; capsules spherical (rarely slightly ovoid), ca. as broad as long, apically turgid, not at all truncate or depressed, (3–)3.5–5 mm long; flowers few, 2–25 per panicle; perianth 3.5–5 mm long _____ **J. coriaceus**

1. Inflorescence(s) terminal, or both terminal and appearing lateral; leafy bracts present below inflorescence, these either short or long.
   4. Small tufted annuals 5–18(–40) cm tall; leaves ca. 0.5 mm or less broad, inrolled or flat, not nodulose (= without knot-like septa or cross-partitions).
      5. Flowering stems usually branched; inflorescence not head-like; leaf blades inrolled, filiform; bracteoles usually 2 beneath each flower; stamens often 6, rarely 3 _____ **J. bufonius**
      5. Flowering stems unbranched; inflorescence of 1–2 head-like clusters which appear sessile; leaf blades flat; bracteoles not present beneath each flower; stamens 3 _____ **J. capitatus**
   4. Perennials 8–150+ cm tall; leaves various.
      6. Flowers solitary at ends of pedicels or in few-flowered clusters, not forming a dense head-like cluster or glomerule (sometimes clustered in *J. dudleyi*); leaf blades usually thin and flat, or slender and terete, neither equitant (= 2-ranked, folded around a stem in the manner of the legs of a rider around a horse) nor nodulose (= with knot-like septa or cross-partitions); each individual flower closely subtended by a pair of opposite (or nearly so) bracteoles clearly smaller than the perianth (except without bracteoles in *J. marginatus* and *J. repens*).
         7. Flowers solitary at ends of pedicels (but may be crowded); stamens 6.
            8. Capsules oblong, distinctly 3-locular; leaf blades flat or inrolled; species limited to w part of East TX (Grayson and Navarro cos.) _____ **J. brachyphyllus**
            8. Capsules oblong-ovoid to globose-ovoid, apparently 1-locular or incompletely 3-locular; leaf blades flat, inrolled, or terete; including species widespread in East TX.
               9. Leaf auricles (at summit of leaf sheath) 1–3.5(–5) mm long, prolonged, distinctly longer than broad, scarious (= thin and dry) or scarious margined.
                  10. Plants (30–)70–90 cm tall; leaf blades (10–)20–30 cm long; capsules < 3/4 as long as perianth, 2–3.2 mm long, widely spaced along the usually uncongested branches of the inflorescence _____ **J. anthelatus**
                  10. Plants 8–30(–50) cm tall; leaf blades 3–12 cm long; capsules 3/4 or more as long as perianth, (3.3–)3.8–4.7 mm long, ± crowded, the branches of the inflorescence often congested _____ **J. tenuis**
               9. Leaf auricles 0.3–1 mm long, rounded, not longer than broad, papery or leathery.
                  11. Leaf blades usually strongly inrolled, thread-like, grooved on one side or terete; bracteoles subtending flowers acute or acuminate; flowers few and widely scattered _____ **J. dichotomus**
                  11. Leaf blades flat or inrolled; bracteoles subtending flowers obtuse or acute; flowers often rather crowded.
                     12. Flowers partly solitary, partly in tight clusters of 2–5; main inflorescence bractusually longer than inflorescence; auricles (at summit of leaf sheath)

yellowish, leathery-papery; perianth segments (= tepals) spreading in fruit, 4–5 mm long; capsules 2.9–3.6 mm long _____ **J. dudleyi**

12. Flowers solitary though crowded; main inflorescence bract usually shorter than inflorescence; auricles whitish, papery; perianth segments not spreading in fruit, 3–4.5 mm long; capsules (3.3–)3.8–4.7 mm long _____ **J. interior**

7. Flowers (at least terminal ones) sessile in 2s or 3s, or in small clusters; stamens 3 or 6 (in *J. dudleyi*).

13. Stems arching, often creeping and rooting at the nodes, sometimes floating or growing submersed along bottom, often forming extensive mats in shallow water; flowering stems 30 cm or less tall; capsules 3.5–5.5 mm long; perianth 5–7(–9) mm long; plants of e and s parts of East TX _____ **J. repens**

13. Stems erect, never rooting at the nodes; flowering stems 20–90(–130) cm tall; capsules 1.8–3.6 mm long; perianth 5 mm or less long; plants widespread in East TX.

14. Perianth 1.8–3.3(–3.5) mm long; capsules about equaling the perianth, 1.8–2.9 mm long; auricles papery; main inflorescence bract usually shorter than inflorescence; inflorescences often rather open _____ **J. marginatus**

14. Perianth 4–5 mm long; capsules distinctly shorter than perianth, 2.9–3.6 mm long; auricles leathery-papery; main inflorescence bract usually longer than inflorescence; inflorescences usually of dense, almost head-like clusters _____ **J. dudleyi**

6. Flowers often forming dense heads or head-like clusters or glomerules; leaf blades mostly rather thick and fleshy (or spongy), equitant, usually nodulose (however, *J. marginatus, J. filipendulus,* and *J. repens* which have thin flat leaves are neither equitant nor nodulose); each individual flower not subtended by bracteoles.

15. Leaf blades thin and flat, neither equitant nor nodulose; stamens 3.

16. Stems arching, often creeping and rooting at the nodes, sometimes floating or growing submersed along bottom, often forming extensive mats in shallow water; flowering stems 30 cm or less tall; capsules 3.5–5.5 mm long; perianth 5–7(–9) mm long; species of e and s parts of East TX _____ **J. repens**

16. Stems erect, never rooting at the nodes; flowering stems 15–90(–130) cm tall; capsules 1.8–3.2 mm long; perianth 5 mm or less long; including species widespread in East TX.

17. Panicles much-branched, with 10–80+ head-like clusters; perianth 1.8–3.3(–3.5) mm long, the perianth segments (= tepals) straw-colored with green stripe in middle; capsules usually about equal to perianth in length; stems 1.5–3 mm broad in broadest dimension; species widespread throughout East TX _____ **J. marginatus**

17. Panicles few-branched, of 2–5(–10) head-like clusters; perianth 3.5–5 mm long, the perianth segments dark brown, usually with green stripe in middle; capsules shorter than perianth; stems 0.5–1 mm broad in broadest dimension; species of w margin of East TX _____ **J. filipendulus**

15. Leaf blades rather thick and fleshy or spongy, equitant, often nodulose; stamens 3 or 6.

18. Flowers in globose heads 6–18 mm high and broad, 15–60 per head; plants with OR without rhizomes.

19. Heads 6–8 mm broad in flower, 7–10 mm in fruit; perianth 2–3.8 mm long.

20. Capsule 1/4–2/3 as long as the perianth, ovoid to obovoid, abruptly apiculate, 1.5–2.7 mm long _____ **J. brachycarpus**

20. Capsule equaling or exceeding the perianth, slender, tapering uniformly to an elongate apex, 2.9–4 mm long _____ **J. scirpoides**

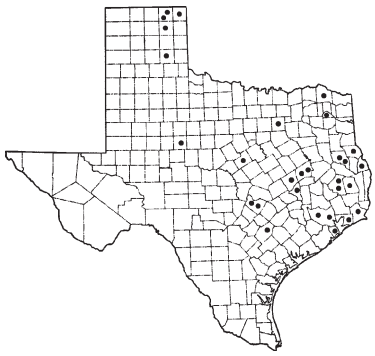
19. Heads 8–15 mm broad in flower, 10–18 mm in fruit; perianth 3–6 mm long.

21. Heads closely crowded, few or none widely spaced; branches of inflorescence, if present, to only 4 cm long; leafy bract at base of inflorescence slightly to greatly exceeding the inflorescence _____ **J. torreyi**

21. Heads mostly well-separated, long-peduncled or separated on the branches by naked internodes longer than diameter of heads; branches of inflorescence 1.5–30 cm long; leafy bract at base of inflorescence shorter to slightly longer than inflorescence.
    22. Larger leaf blades 0.7–2(–2.5) mm wide; branches of inflorescence 1.5–10(–12) cm long _____ **J. texanus**
    22. Larger leaf blades 2.5–8 mm wide; branches of inflorescence 2–30 cm long.
        23. Leaf blades 2.5–4(–6) mm thick in the larger dimension, with several tough complete septa (= internal cross-partitions), tough and resistant to crushing; stems 3–5 mm thick basally; leaves and stems grayish or olivaceous; heads (10–)12–15 mm broad; valves of capsules spreading and free after dehiscence _____ **J. validus**
        23. Leaf blades 4–8 mm thick in the larger dimension, with many weak incomplete septa, mostly crushed flat in herbarium specimens; stems 6–10 mm thick basally; leaves and stems greenish; heads 10–12 mm broad; valves of capsules remaining united at their tips after dehiscence _____ **J. polycephalus**

18. Flowers in small (3–8 mm high, 1–8 mm broad), narrow to hemispherical or nearly globose heads, usually 2–10(–20) (rarely solitary) per head; plants without rhizomes.
    24. Seeds caudate (= with tails ± as long as body of seed), 1.8–2.6 mm long including tail; perianth much shorter than capsule; capsule conspicuously acuminate at apex _____ **J. trigonocarpus**
    24. Seeds not caudate, 0.3–0.6 mm long; perianth much shorter to ca. as long as capsule; capsules acute at apex.
        25. Capsule distinctly elongated, becoming 3.8–6 mm long, ca. twice as long as the perianth _____ **J. diffusissimus**
        25. Capsule equaling or slightly exceeding the perianth, 1.9–3.7(–4.2) mm long (to 1.3 times as long as perianth).
            26. Heads (= flower clusters) 5–20(–ca. 50) per inflorescence (the heads usually not appearing crowded in the inflorescence); capsule 2.3–4 (–4.2) mm long, ca. equal to or to ca. 1/3 longer than perianth.
                27. Capsule ca. equal to or only slightly exceeding perianth in length; perianth 2.5–3.9(–4) mm long; plants 20–100 cm tall _____ **J. acuminatus**
                27. Capsule ca. 1/3 longer than perianth (clearly exserted out of perianth); perianth 1.2–2.5(–2.8) mm long; plants 10–25(–40) cm tall _____ **J. debilis**
            26. Heads 30–200 or more per inflorescence (the heads often appearing crowded in the inflorescence); capsule 1.9–2.9 mm long, ca. equal to or only slightly exceeding perianth.
                28. Leaf blades with conspicuous ring-like bands visible externally where there are internal septa (= cross-partitions), 20–64 cm long, often more than 2 mm wide; stems 4–6 mm in diam.; roots without tubers; capsule (1.9–)2.3–2.5 mm long; perianth 2.2 mm or less long; species widespread and common ± throughout East TX _____ **J. nodatus**
                28. Leaf blades with ring-like bands ± faint, 2-16 cm long, 2 mm or less wide; stems 1–3 mm in diam.; roots usually with tubers at their tips; capsule 2.4–2.9 mm long; perianth (2.2–)2.4–2.9 mm long; species rare, if present, in s part of East TX _____ **J. elliottii**

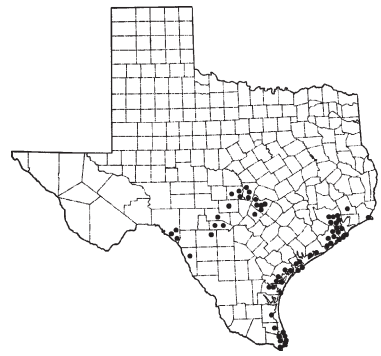
Juncus acuminatus Michx., (long-pointed, tapering to tip), KNOT-LEAF RUSH, SHARP-FRUIT RUSH. Resembling *J. nodatus*, but inflorescences more open; tufted perennial 20–100 cm tall, not



Sisyrinchium angustifolium



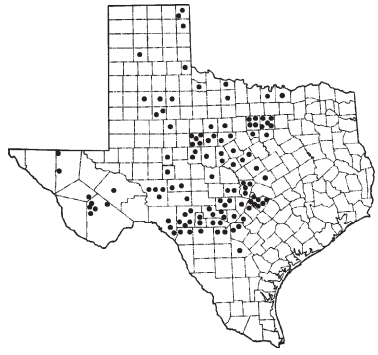
Sisyrinchium atlanticum



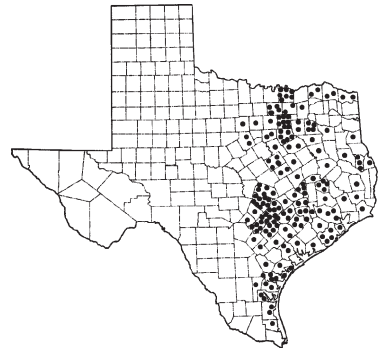
Sisyrinchium biforme



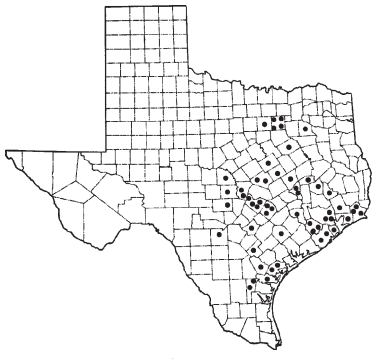
Sisyrinchium campestre



Sisyrinchium ensigerum



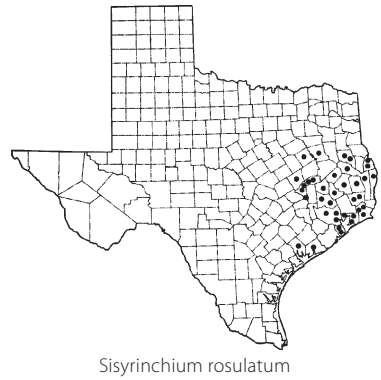
Sisyrinchium langloisii



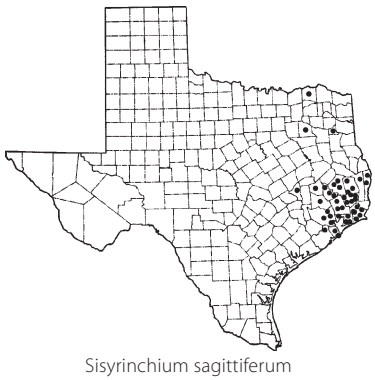
Sisyrinchium minus



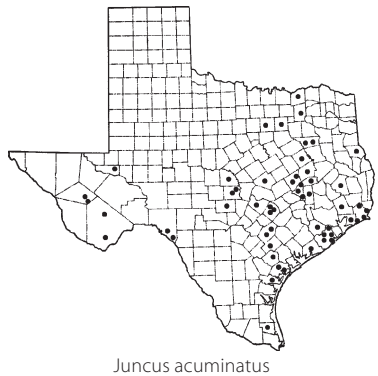
Sisyrinchium pruinosum



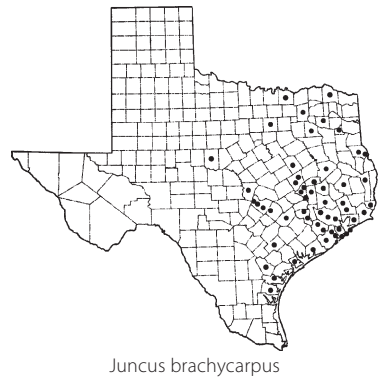
Sisyrinchium rosulatum



Sisyrinchium sagittiferum



Juncus acuminatus



Juncus brachycarpus

rhizomatous; leaf blades with ring-like bands visible externally where there are internal cross partitions (the bands are often inconspicuous); perianth 2.5–3.9(–4) mm long; capsule 2.6–4 mm long. Wet places; widespread in e 1/2 of TX, widely scattered further w; s edge of Canada and throughout the e U.S. w to MN and TX, scattered further w. Apr–Jul.

Juncus anthelatus (Wiegand) R.E. Brooks, (with lateral branches exceeding central axis). Tufted perennial (30–)70–90 cm tall, similar to but larger than *J. tenuis*, without obvious rhizomes; internodes of inflorescence more than 6 mm long; perianth 3.2–4.5 mm long; anthers 0.3–0.7 mm long; capsule 2–3.2 mm long. Moist, partially exposed or shaded areas; included based on range map in Brooks and Clemants (2000) showing occurrence (specific counties not indicated) in extreme ne part of East TX; therefore, no county distribution map is included; se Canada and throughout much of e U.S. w to MN and TX. Spring (usually 1–2 weeks earlier than *J. tenuis* in the same area—Brooks & Whittemore 1999). [*J. tenuis* Willd. var. *anthelatus* Wiegand] Kartesz (1999) submerged this species into *J. tenuis*; however, we are following Brooks and Whittemore (1999) and Brooks and Clemants (2000) in recognizing it at the species level.

Juncus brachycarpus Engelm., (short-fruited), WHITE-ROOT RUSH. Perennial with stems 15–80 (–90) cm tall, closely arranged along the rhizomes; rhizomes 3–4 mm in diam., tuberous, whitish; perianth 2.2–3.8 mm long, the outer whorl longer; capsule 1.5–2.7 mm long, included within perianth. Damp sandy ground; widespread in e 1/2 of TX; se Canada and e U.S. w to MN and TX. May–Jun, sporadically to Jul. As indicated by Yatskievych (1999), the strongly unequal inner and outer perianth whorls nearly concealing the short capsules differentiate *J. brachycarpus* from similar species (e.g., *J. scirpoides* with inner and outer perianth whorls nearly equal). ⚅/290

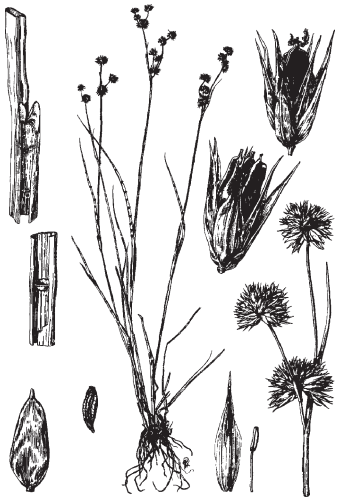
Juncus brachyphyllus Wiegand, (short-leaved), SMALL-HEAD RUSH, SHORT-LEAF RUSH. Tufted perennial 40–80(–90) cm tall, without obvious rhizomes; perianth 3.5–5.7(–9) mm long; capsule (2.6–)3–4.7 mm long. Low, sandy or rocky, open ground; Grayson and Navarro (BRIT) cos. in w part of East TX; also Bosque and Wise (BRIT) cos. in Cross Timbers and Prairies; in TX apparently known only from these areas; AR, KS, MO, NE, OK, and TX and scattered in Pacific nw. Apr–Jun. This species is difficult to distinguish from similar species (e.g., *J. dudleyi*, *J. interior*), except by its distinctly 3-locular capsules.

Juncus bufonius L., (pertaining to a toad), TOAD RUSH. Small tufted annual 4–18(–40) cm tall; stems often reddish tinged; inflorescence 1/4–3/4 the total height of the plant; perianth 3–7+ mm long; capsule 2.7–4.5 mm long. Damp sandy soils; widespread mainly in e 1/2 of TX, scattered further w; widespread throughout the U.S. and Canada. Late Apr–Jun. This species is part of a highly polymorphic polyploid complex occurring nearly worldwide (Yatskievych 1999; Brooks & Clemants 2000). It is one of only two small annual *Juncus* species occurring in East TX; the other is the introduced *J. capitatus*.

Juncus capitatus Weigel, (headed), CAPPED RUSH, LEAFY-BRACT DWARF RUSH. Small tufted annual usually less than 10 cm tall; leaves all basal; perianth 3–5 mm long; capsule 1.2–1.7 mm long. Sandy soils; scattered in East TX; CA, LA, OK, and TX. May–Jun. This species was first reported for TX by Gould in 1962 from Walker Co.; Keeney and Lipscomb (1985) gave additional locations. Native of the Old World. ☜

Juncus coriaceus Mack., (leathery), LEATHERY RUSH. Perennial 30–100 cm tall, densely tufted; inflorescence appearing lateral; perianth 3.5–5 mm long; capsule (3–)3.5–5 mm long. Moist sand; Pineywoods and Post Oak Savannah and w in Red River drainage to Lamar Co. (Carr 1994); also n edge of Gulf Prairies and Marshes; se U.S. from DE s to FL w to OK and TX. Summer.

Juncus debilis A. Gray, (weak, frail), WEAK RUSH. Resembling *J. diffusissimus*, but with shorter capsules; tufted perennial 10–25(–40) cm tall, the stems and leaves sometimes elongating and very weak when permanently submersed; perianth 1.2–2.5(–2.8) mm long; capsule 2.3–3.7(–4.2)



Juncus acuminatus [MAS]



Juncus anthelatus [HEB]



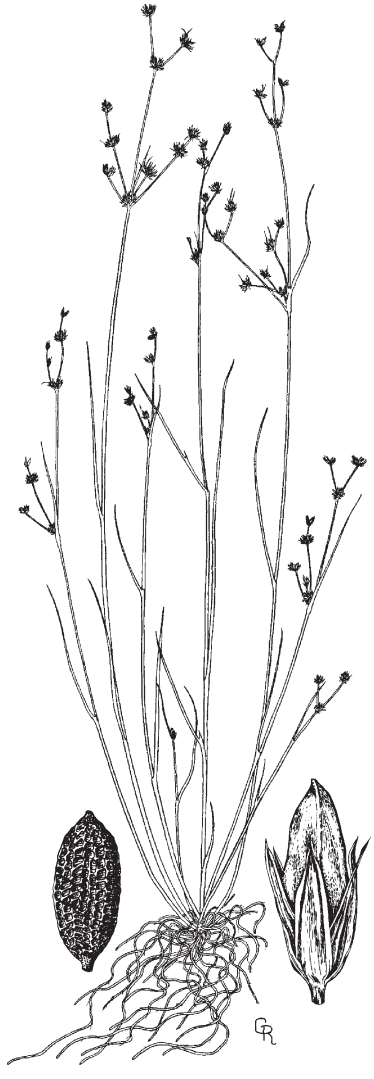
Juncus brachycarpus [GR4]



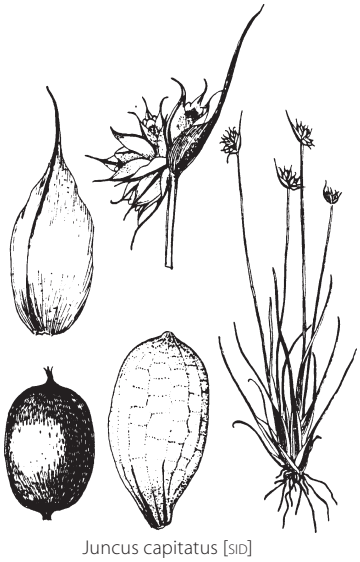
Juncus brachyphyllus [ABR]



Juncus bufonius [BT3]



Juncus debilis [GWO]



Juncus capitatus [SID]



Juncus coriaceus [GWO]

mm long. Very wet areas, often in soft mucky substrates; Harrison, Newton (BRIT), Polk (TAES), Jasper, Madison, and Marion (Turner et al. 2003) cos., primarily Pineywoods; also n Gulf Prairies and Marshes; e U.S. from NY s to FL w to MO and TX. Summer. [*J. acuminatus* Michx. var. *debilis* (A. Gray) Engelm.]

Juncus dichotomus Elliott, (2-parted or forked), FORKED RUSH. Resembling *J. interior*, but inflorescence with fewer, widely scattered flowers; tufted perennial 35–80(–100) cm tall, rhizomatous; perianth 3–4.5(–5.5) mm long; capsule (2.5–)2.8–4(–4.5) mm long. Sandy woods or open ground, on slopes or in low places; Pineywoods w through much of East TX; also n Gulf Prairies and Marshes and e Edwards Plateau; e U.S. w to OH and TX, also CO. May.

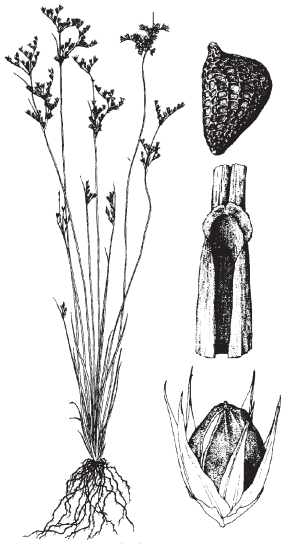
Juncus diffusissimus Buckley, (most diffuse), SLIM-POD RUSH. Perennial with stems few to many in dense, rounded clumps 15–65 cm tall; inflorescence very open; perianth (2–)2.3–2.8(–3.5) mm long; capsule 3.8–6 mm long. Damp sandy ground; in much of the e 1/2 of TX except the South TX Plains; mainly e U.S. from CT s to FL w to KS and TX, also CA and WA. May–Jun, less frequently to Oct. The linear to linear-lanceolate capsules twice as long as the perianths are distinctive.

Juncus dudleyi Wiegand, (for its discoverer, William Russell Dudley, 1849–1911), DUDLEY'S RUSH. Similar to *J. interior*, distinguished as in the key; tufted perennial with stems 25–100(–125) cm tall, without obvious rhizomes; perianth 4–5 mm long; capsule 2.9–3.6 mm long. Low ground; sparsely scattered in much of TX; widespread throughout most of the U.S. and Canada. Jun. [*J. tenuis* Willd. var. *dudleyi* (Wiegand) F.J. Herm.] This species is unusual in having leathery-papery, yellow leaf auricles.

Juncus effusus L., (loosely spreading), COMMON RUSH, SOFT RUSH, LAMP RUSH, BOG RUSH. Perennial forming dense, rounded clumps 50–130 cm tall; stems with rhizomatous base; rhizomes thick, scaly; leaves basal or nearly so, with very small blades or none; inflorescence appearing lateral, a rather compact panicle, almost head-like while young; perianth 1.9–2.6(–3.5) mm long; capsule (1.5–)1.7–3.2 mm long. Wet open ground; widespread in East TX; also n Gulf Prairies and Marshes and East Cross Timbers; widespread throughout much of the U.S. and s Canada. Late Apr–Jun. [*J. effusus* var. *solutus* Fernald & Wiegand] While TX material of this species has often been recognized as var. *solutus* (e.g., Diggs et al. 1999), we are following Brooks and Clemants (2000) in not recognizing varieties. They indicated that when considered broadly across North America, the currently recognized infraspecific taxa did not warrant recognition. However, S. Clemants (pers. comm.) suggests that varietal recognition may be appropriate. Ervin and Wetzel (2000) demonstrated that this species exhibits allelochemical autotoxicity (seedlings were suppressed by adult plants of the same species), possibly as a way of avoiding infraspecific competition.

Juncus elliottii Chapm., (for its discoverer, Stephen Elliott, 1771–1830, Carolinian botanist), ELLIOTT'S RUSH, BOG RUSH. Resembling *J. nodatus*, but vegetatively smaller and distinguished as in the key; tufted perennial 30–50(–90) cm tall; roots, at least some, with tubers at their tips; perianth (2.2–)2.4–2.9 mm long; capsule 2.4–2.9 mm long. Wet or moist areas; s part of East TX in Harris (*Correll 32914*, NY—identified by S. Clemants), Tyler (MacRoberts et al. 2002a), Walker, and Waller (SHST—collections reported on Digital Flora of Texas Herbarium Specimen Browser (2002) but not seen) cos.; Turner et al. (2003) did not include this species for TX; no county distribution map is provided; se U.S. from DE s to FL w to AR and TX. May–Summer.

Juncus filipendulus Buckley, (hanging thread), RING-SEED RUSH. Perennial, tufted or from slightly swollen bases, without well-developed rhizomes; stems 15–30(–35) cm tall; perianth 3.5–5 mm long; capsule 2.6–3.2 mm long. Moist soils or along streams; Bell, Travis (BRIT), Hays, and Williamson (Turner et al. 2003) cos. near w margin of East TX; also Cross Timbers and Prairies and Edwards Plateau; AL, GA, KY, OK, TN, and TX. Spring–summer.



Juncus dichotomus [GWO]



Juncus diffusissimus [BT3, EN1]



Juncus dudleyi [EN1]



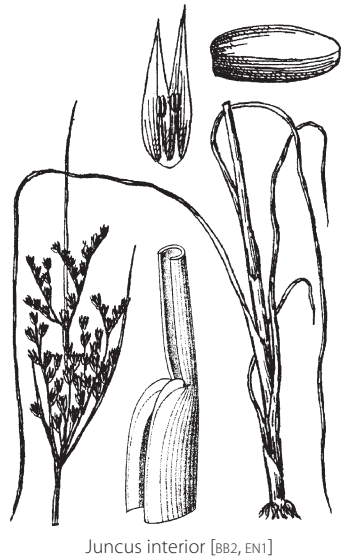
Juncus effusus [GWO]



Juncus elliottii [GWO]



Juncus filipendulus [CO1]



Juncus interior [BB2, EN1]



Juncus marginatus [BB2]

Juncus interior Wiegand, (inland), INLAND RUSH. Tufted perennial 15–80 cm tall, without obvious rhizomes; perianth 3–4.5 mm long; capsule 3–4.7 mm long. Chiefly low ground, in open woods or prairies; widespread nearly throughout TX; sc Canada and c U.S. s to TX. Late Apr–Jul.

Juncus marginatus Rostk., (margined), GRASS-LEAF RUSH, TWO-FLOWER RUSH, NEEDLE-POINT RUSH. Perennial 15–90(–130) cm tall, with swollen stem bases, usually inconspicuously short-rhizomatous, sometimes tufted; inflorescence compact, of many small clusters of 2–12 flowers each; to avoid keying errors, this species, which has thin flat leaves that are neither equitant nor nodulose and which does not have the flowers subtended by bracteoles, can be reached either way in the key beginning at dichotomy 6; perianth 1.8–3.3(–3.5) mm long; capsule 1.8–2.9 mm long. Sandy old fields, roadsides, and moist areas; widespread in e 1/2 of TX, also Trans-Pecos; se Canada and e U.S. w to SD and TX, also CA, CO, and OR. May–Jul, occasionally to Aug. [*J. setosus* (Coville) Small] While var. *setosus* is sometimes recognized (e.g., Jones et al. 1997), we are following Correll and Johnston (1970), Churchill (1986a), and Brooks and Clemants (2000) in not recognizing infraspecific taxa in this species. According to Brooks and Clemants (2000), the characters used to separate infraspecific taxa vary independently.

Juncus nodatus Coville, (with nodes, knots, or swellings), JOINTED RUSH, GRASS-LEAF RUSH. Perennial with stems 40–120 cm tall, forming loose clumps from knotty base, without obvious rhizomes; inflorescence rather dense; similar to *J. marginatus* but with nodose leaves and more elongate inflorescences; perianth 1.2–2.2 mm long; capsule 1.9–2.5(–2.8) mm long. Damp sandy ground or shallow water; widespread in East TX; also n Gulf Prairies and Marshes, Wichita Co. in Red River drainage (Mahler 1988), and Mason Co. (Turner et al. 2003) in the e Edwards Plateau; IN s to FL w to KS and TX. Jun–Jul, rarely to Nov. The specific epithet is from the ring-like bands that are often conspicuously visible externally on the leaves where there are internal cross-partitions.

Juncus polycephalus Michx., (many-headed), FLAT-LEAF RUSH, MANY-HEAD RUSH. Tufted perennial from subrhizomatous base; similar to *J. validus*, but with smaller heads; plant 50–100 cm tall; stems mostly crushed flat in herbarium specimens; perianth 3–4 mm long; capsule 4–5 mm long. Wet areas, usually mucky or peaty substrates; scattered in Pineywoods and s Post Oak Savannah; also n Gulf Prairies and Marshes and e Edwards Plateau; se U.S. from MD s to FL w to TX. Summer.

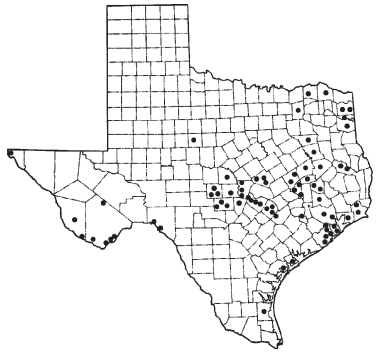
Juncus repens Michx., (creeping), CREEPING RUSH, LESSER CREEPING RUSH. Perennial with vegetative stems arching, often creeping and rooting at the nodes, sometimes floating or growing submersed along bottom, often forming extensive mats in shallow water; flowering stems 30 cm or less tall; to avoid keying errors, this species, which has thin flat leaves that are neither equitant nor nodulose and which does not have the flowers subtended by bracteoles, can be reached either way in the key beginning at dichotomy 6; perianth 5–7(–9) mm long; capsule 3.5–5.5 mm long. Lake and pond margins, ditches; Pineywoods and Post Oak Savannah; also n Gulf Prairies and Marshes; se U.S. from MD s to FL w to OK and TX. Summer–fall.

Juncus roemerianus Scheele, (for Ferdinand Roemer, 1818–1891, geologist, paleontologist, and explorer of TX), ROEMER'S RUSH. Perennial 50–150(–230) cm tall; rhizomes long and scaly; inflorescence appearing lateral; flowers perfect or pistillate (Eleuterius 1975, 1978); perianth 2.5–3.3 mm long; capsule (1.7–)2–3 mm long. Usually near the coast in salt marshes or other brackish situations; Milam and Montgomery (Turner et al. 2003) cos.; also the range map in Brooks and Clemants (2000) shows an isolated inland occurrence (county not specified) in the se part of East TX; mainly Gulf Prairies and Marshes; mainly coastal in se U.S. from DE s to FL w to TX. In some parts of its range this species forms large, nearly pure stands (Snogerup 1993).

Juncus scirpoides Lam., (*Scirpus*-like), NEEDLE-POD RUSH, SEDGE RUSH. Rhizomatous perennial very similar to *J. brachycarpus* except for capsules; perianth 2–3.2(–3.5) mm long; capsule 2.9–4



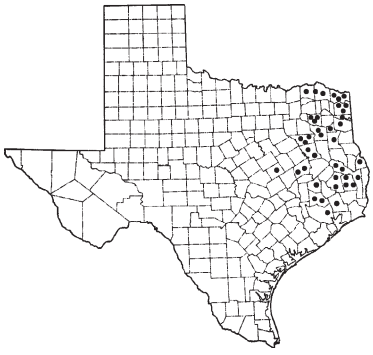
Juncus brachyphyllus



Juncus bufonius



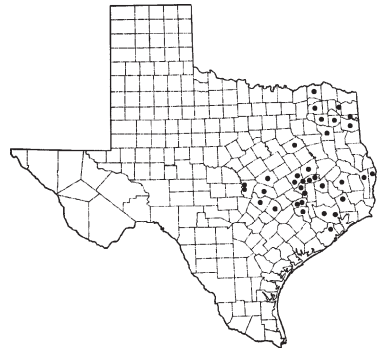
Juncus capitatus



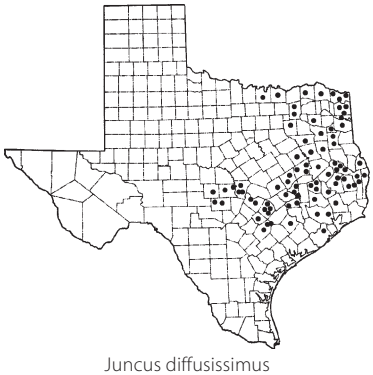
Juncus coriaceus



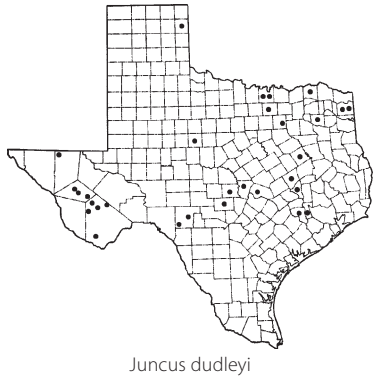
Juncus debilis



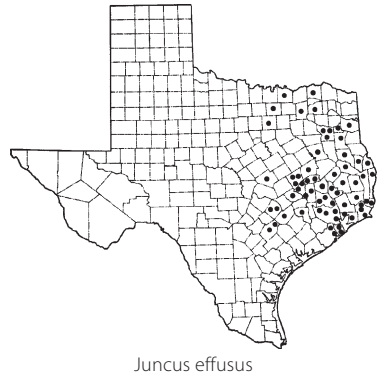
Juncus dichotomus



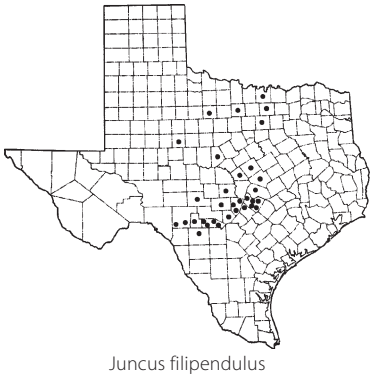
Juncus diffusissimus



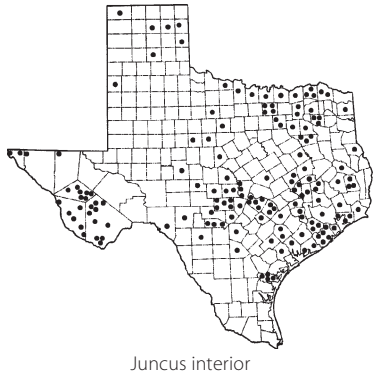
Juncus dudleyi



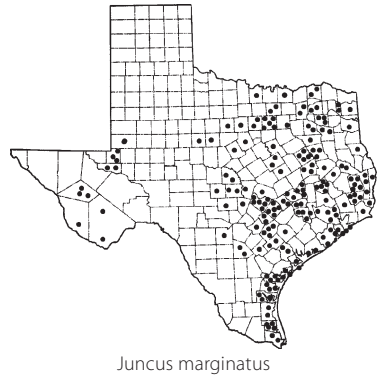
Juncus effusus



Juncus filipendulus



Juncus interior



Juncus marginatus

mm long. Damp sandy ground; widespread in East TX; also Gulf Prairies and Marshes and scattered to the w; e U.S. from NY s to FL w to NE and TX. Late May–Aug.

Juncus tenuis Willd., (slender), SLENDER RUSH, POVERTY RUSH, PATH RUSH. Tufted perennial 8–30(–50) cm tall, with basal offshoots but without obvious rhizomes; panicle 3–6(–9) cm long, ca. 1/4–1/5 the total height of plant (in contrast to the sometimes similar *J. bufonius*); internodes of inflorescence usually less than 5 mm long; perianth 3.3–5.5 mm long; anthers 0.1–0.2 mm long (shorter than in the similar *J. anthelatus*); capsule (3.3–)3.8–4.7 mm long. Moist sand in woods, often in disturbed areas or places with compacted soils (e.g., along paths or trails); Pineywoods and Post Oak Savannah w in Red River drainage to Grayson Co. (BRIT); also n Gulf Prairies and Marshes; throughout most of the U.S. and Canada. Spring, rarely summer.

Juncus texanus (Engelm.) Coville, (of Texas), TEXAS RUSH. Slender perennial 20–80 cm tall, freely rhizomatous, the elongate rhizomes thin (ca. 1 mm in diam.), with swollen nodes; perianth (3.5–)3.9–5.4 mm long; capsule 5.2–6.5(–8) mm long, with slender, prolonged, exserted tip. Low ground; in East TX mainly in the Blackland Prairie and to the e in Houston Co. (BRIT); also Cross Timbers and Prairies and e Edwards Plateau; endemic to TX (Brooks & Clemants 2000) or nearly so (possibly present in adjacent OK—Kartesz 1999; Carr 2002b). Jun–Jul. ?

Juncus torreyi Coville, (for John Torrey, 1796–1873, coauthor with Asa Gray of "The Flora of North America"), TORREY'S RUSH. Perennial 30–110 cm tall, rhizomatous, the rhizomes elongate, 1–3 mm in diam., often with swollen nodes, light-colored; heads 8–10(–11) mm thick, closely crowded; perianth 3.4–6 mm long; capsule (4.3–)4.5–5.7 mm long. Damp or wet ground; widespread in TX; throughout most of the U.S. and s Canada. Jun–Jul, sporadically to Oct.

Juncus trigonocarpus Steud., (three-cornered fruit), RED-POD RUSH. Perennial often in large clumps, coarse, rigid, 50–90(–120) cm tall; perianth 2.5–3.5 mm long; capsule 3.5–5 mm long, sharply 3-angled; seeds caudate (= with tails ± as long as body of seed). Seeps and bogs on sandy soils; scattered in the Pineywoods and Post Oak Savannah; Brooks and Clemants (2000) also mapped an outlying location (county unspecified) in the nw part of East TX; se U.S. from NC s to FL w to TX. Sep–Nov. [*J. caudatus* Chapm.]

Juncus validus Coville, (vigorous). Perennial resembling *J. torreyi* but heads well-separated; stems 30–100 cm tall; rhizomes often very short or absent, without tuberous thickenings; perianth usually 3.4–4.2(–5) mm long; capsule 4–5.5 mm long. Damp or wet ground. Jun–Oct.

1. Inflorescences mostly 2–5 cm long, of 6–15 heads; capsules tardily dehiscent (valves of capsules united at tips even after dehiscence) _____ var. **fascinatus**
1. Inflorescences 5–30 cm long, of (12–)15–76 heads; capsules promptly completely dehiscent (valves of capsules separate at tips after dehiscence) _____ var. **validus**

var. **fascinatus** M.C. Johnst., (fascinating). Bastrop, Caldwell, DeWitt, Guadalupe, Travis (Johnston 1964b), and Grayson (Turner et al. 2003) cos.; w margin of East TX w to Cross Timbers and Prairies and e Edwards Plateau (Johnston 1964b); also Gulf Prairies & Marshes; endemic to TX (Kartesz 1999; Brooks & Clemants 2000; Carr 2002c).

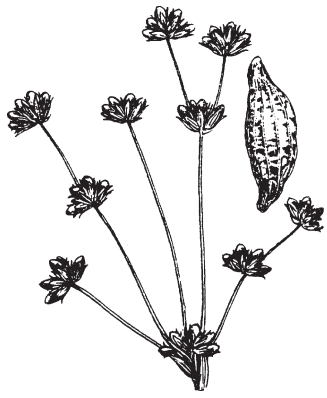
var. **validus**, ROUND-HEAD RUSH. Widespread in e 1/2 of TX; se U.S. from NC s to FL w to KS and TX. According to Brooks and Clemants (2000), "*Juncus validus* var. *validus* closely resembles *J. polycephalus* but differs in having complete septa, long-exserted capsules, and terete stems."

LUZULA DC. WOODRUSH

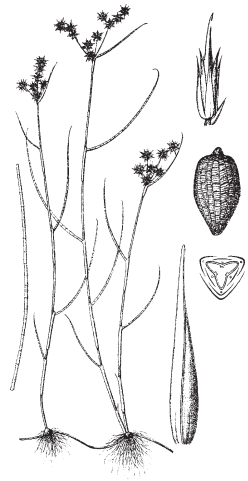
Perennials with stems in tufts or solitary; leaf blades flat, grass-like, with pubescence; leaf sheaths closed; inflorescences terminal, of 5–10(–13) usually simple branches, with 1–3 leaf-like bracts; flowers (in East TX species) in few-flowered glomerules; capsules obovoid to subglobose,



Juncus polycephalus [GWO]

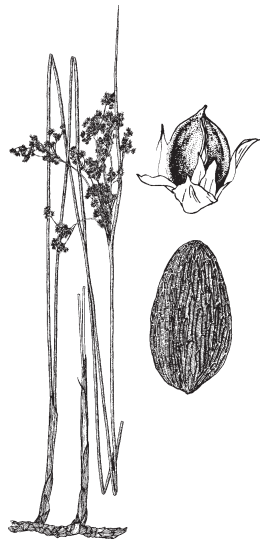


Juncus nodatus [GR3]

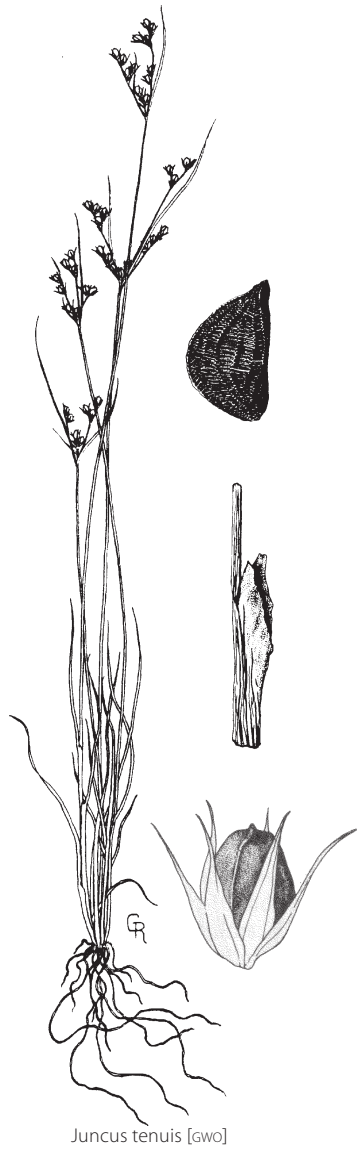


Juncus texanus [EN1]





Juncus roemerianus [GWO]





Juncus repens [GWO]



Juncus scirpoides [GWO]

Juncus tenuis [GWO]

1-celled; seeds 3 per capsule, 0.9–1.6 mm long, with whitish elaiosomes or caruncles (= appendages used in dispersal by ants or other insects), ca. 1/3–2/3 length of seed.

A genus of ca. 108 species (Swab 2000), nearly cosmopolitan in distribution but especially in temperate Eurasia. Handel (1978) and Beattie and Culver (1981) presented experimental evidence that the seeds of some species are dispersed by ants. The two TX taxa are sometimes treated as varieties of a single variable species complex, *L. campestre* (e.g., Yatskievych 1999). (Derivation uncertain; possibly either from Italian, *lucciola*, to shine or sparkle, or from Latin, *gramen luzulae*, or *luxulae*, diminutive of Latin *lux*, light, a name given because hairs of several species appear shiny when covered with dew—Swab 2000)
REFERENCE: Swab 2000.

1. Small bulb-like whitish structures (= swollen, reduced storage leaves) usually present on the rhizomes; glomerules (= flower clusters) cylindric; perianth ± equal to or shorter than capsule; inflorescence branches usually erect or ascending _____ **L. bulbosa**
1. Small bulb-like structures not present on the rhizomes (but base of plant can be swollen); glomerules subglobose or ovoid; perianth usually conspicuously longer than capsule; some of the inflorescence branches usually divergent, sometimes to right angles _____ **L. echinata**

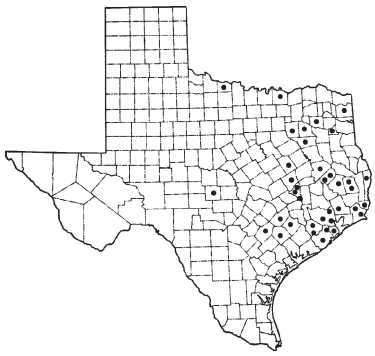
Luzula bulbosa (A.W. Wood) Smyth, (bulbose), BULB WOODRUSH. Stems in tufts or solitary, to 45 cm tall; rhizomes slender with whitish, swollen, bulb-like structures (= reduced storage leaves) ca. 2–4 mm thick; leaves few, to 17 cm long, 2–7 mm wide, long-hairy marginally; perianth segments (= tepals) 2–3 mm long, with shining chestnut centers and clear margins and apex; anthers 1–2 times as long as filaments; stigmas 3–4 times as long as styles. Sandy soils in forests, sometimes in more open areas; Pineywoods and Post Oak Savannah w to Fannin Co. in Red River drainage (Talbot property—BRIT); Turner et al. (2003) also mapped Hays Co. at w margin of East TX and Tarrant Co. in the Cross Timbers and Prairies; e U.S. from CT s to GA w to KS and TX. Spring. [*L. campestris* (L.) DC. var. *bulbosa* A.W. Wood]

Luzula echinata (Small) F.J. Herm., (prickly), HEDGEHOG WOODRUSH. Similar to *L. bulbosa* but more densely tufted; rhizomes knotty and base of plant sometimes swollen, but rhizomes without bulb-like structures; perianth segments (2.8–)3.5–4 mm long, greenish to pale or dark brown, usually with clear margins and apex; anthers 2–5 times as long as filaments; stigmas 2–3 times as long as styles. Sandy soils; Pineywoods and Post Oak Savannah w to Lamar Co. (Carr 1994) in Red River drainage; e U.S. w to IA and TX. Spring. [*L. campestris* (L.) DC. var. *echinata* (Small) Fernald & Wiegand, *L. echinata* var. *mesochorea* F.J. Herm.]

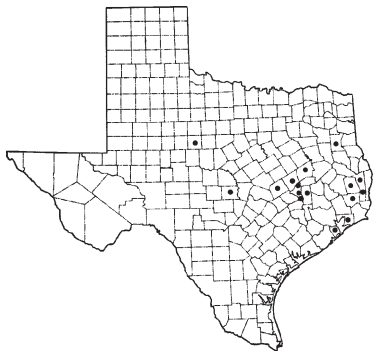
LEMNACEAE Gray
DUCKWEED FAMILY

Very small or minute annual or perennial aquatic plants, floating free on or in the water, each reduced to a small, green, flat or solid body (called thallus, frond, or joint) a few mm or less across, not differentiated into stems and leaves, solitary or in small clusters; new plants (= daughter fronds) chiefly produced asexually by budding, often remaining attached to the parent frond by a short stipe; turions (= reduced, compact, starch-rich fronds, produced under unfavorable conditions and overwintering underwater) sometimes produced; roots absent or present and unbranched; flowering infrequent or at least infrequently observed; inflorescence with 1 or 2 flowers, produced in 2 lateral pouches at frond base (in *Lemna* and *Spirodela*) or in a cavity on frond surface (in *Wolffia* and *Wolffiella*); flowers minute, without perianth (a very minute bract may be present); fruit a follicle with 1–5 seeds.

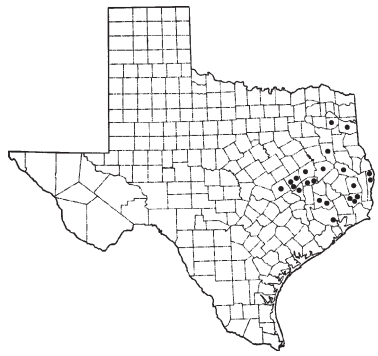
A small (37 species in 5 genera—Les & Crawford 1999; Landolt 2000) family of aquatic plants thought to be derived from the Araceae (JACK-IN-THE-PULPIT family). Members of the



Juncus nodatus



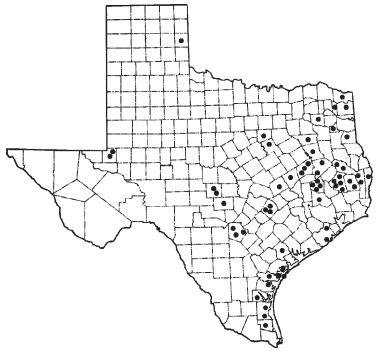
Juncus polycephalus



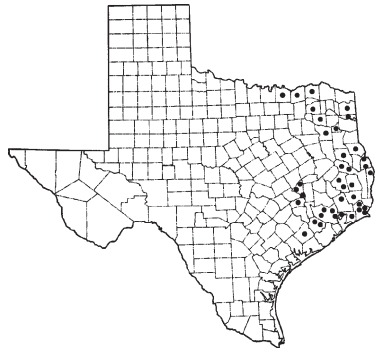
Juncus repens



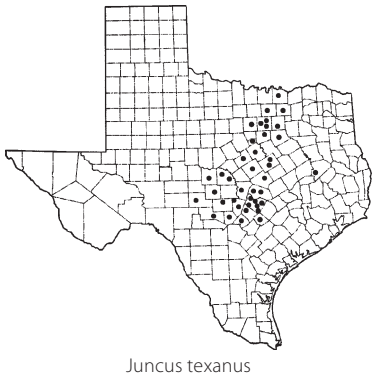
Juncus roemerianus



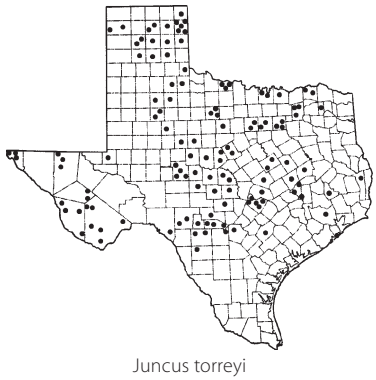
Juncus scirpoides



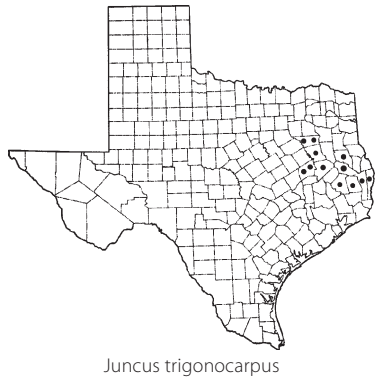
Juncus tenuis



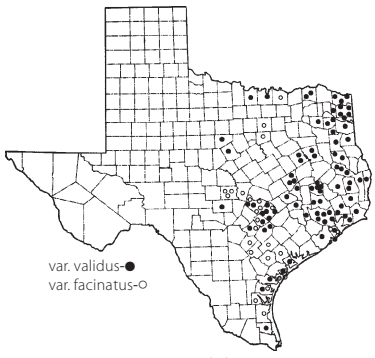
Juncus texanus



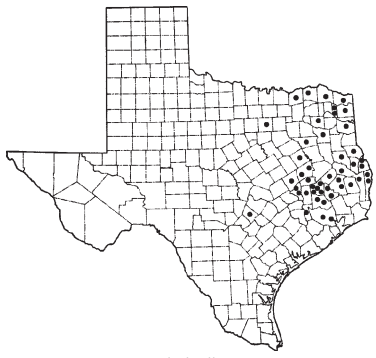
Juncus torreyi



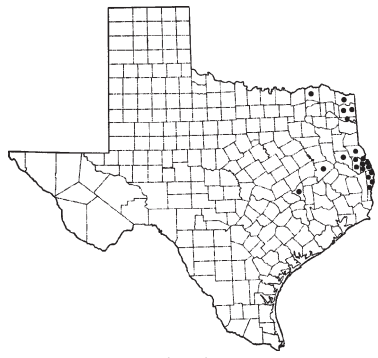
Juncus trigonocarpus



Juncus validus



Luzula bulbosa



Luzula echinata

Lemnaceae are tiny and extremely reduced morphologically, which made it difficult in the past to determine the phylogenetic relationships of the family. Kvacek (1995) suggested that the fossil genus *Limnobiophyllum* is a fossil link between the Araceae and the Lemnaceae, and Stockey et al. (1997), using a cladistic approach and material of *Limnobiophyllum,* concluded that *Pistia* (a free-floating aquatic member of the Araceae) plus *Limnobiophyllum* and Lemnaceae form a monophyletic group. Indeed, this linkage of Lemnaceae to Araceae goes back over 175 years (Hooker and Brown in Smith 1824; see discussion in Les et al. 2002). In addition, molecular studies have linked *Lemna* with *Pistia* (Araceae) (Duvall et al. 1993b) or more recently to Araceae subfamily Aroideae (French et al. 1995). In fact, the Lemnaceae is considered by many authorities to have evolved from within the Araceae by extreme reduction, and it has been suggested that the Lemnaceae be reduced to a subgroup within a more inclusive Araceae (Mayo et al. 1995, 1997, 1998; Stockey et al. 1997; APG II 2003). From a cladistic standpoint, the Araceae (without Lemnaceae) are thus paraphyletic and inappropriate for formal recognition. However, morphologically, the Lemnaceae is among the best defined groups in the angiosperms, and we are continuing to recognize it at the family level. Within the Lemnaceae it is thought that evolution has proceeded from complex ancestors (e.g., *Spirodela* and *Lemna*) to reduced taxa such as *Wolffiella* and *Wolffia,* and it is possible that a number of currently recognized genera (e.g., *Lemna, Spirodela,* and *Wolffiella*) are paraphyletic (Les et al. 1997).

Because of their huge numbers and rapid reproduction, DUCKWEEDS can have pronounced influences on aquatic habitats (Hicks 1937). They are important as food for waterfowl and fish, are easily dispersed by various mammals and birds, and can become pests. Vegetative reproduction is most important (flowering and fruiting are rare) and surprisingly efficient. According to Landolt (1998), "Under optimal conditions, the number of fronds may double within 24h, and one frond can easily develop into a population of over a million fronds within a month." Due to this prolific asexual reproduction, Lemnaceae are being studied by NASA as a possible food source for prolonged space voyages. Also, because of their small size, rapid reproduction, and ease of laboratory maintenance and manipulation (Jordan et al. 1996), duckweeds are potentially valuable subjects for a variety of laboratory experiments. Lemnaceae have also been used in wastewater treatment systems as biological filters, and the plants are sometimes harvested to make a high-protein feed for livestock (Tyrl et al. 1994). *Wolffia* fronds are used in se Asia as a vegetable, while *Lemna gibba* is used in Israel as a vegetable and salad (Landolt 2000).

If flowers are produced, the whole plant floating on the water appears to serve as a pollen carrier (Cox 1988)—this type of hydrophily (= water-mediated pollination) occurring at the water surface is known as epihydrophily (Philbrick 1993). Some workers (e.g., Cox 1988) further divide epihydrophily into a category in which pollen is transported just above the surface of the water (e.g., various Lemnaceae, *Vallisneria*—Hydrocharitaceae) and a category in which pollen is transported directly on the surface of the water (e.g., *Elodea*—Hydrocharitaceae).

The family is neither well-collected nor well-studied in East TX. All East TX species are found on lakes, ponds, swamps, marshes, or other standing water or stranded on mud. They are prominent chiefly in late summer and fall. According to Landolt (2000), "Generally, most Lemnaceae species have expanded during the last years because of the warming of the climate and eutrophication of the waters." This easily recognized family contains the smallest known flowering plants, members of the genus *Wolffia*. While generally easy to identify to genus, specific determination is often difficult, and definitive examination of some characters (e.g., vein number) requires the preparation of microscope slides; easily observed characters were used wherever possible in the following keys. Chromosome number is often quite variable within a species; for example, *Spirodela polyrhiza* has $2n$ = 30, 38, 40, 50, 80 (Urbanska-Worytkiewicz 1980; Landolt 2000). The following treatment relies heavily on works by Landolt (1980, 1986, 2000). (subclass Arecidae—Cronquist; order Alismatales—APG II)

FAMILY RECOGNITION IN THE FIELD: very small or minute aquatic plants (larger plants only a few mm in size) free-floating on or just below the water surface.



Juncus torreyi [GR3]



Juncus trigonocarpus [GWO]



Juncus validus var. fascinatus [HEA]



Juncus validus var. validus [GWO, SH3]



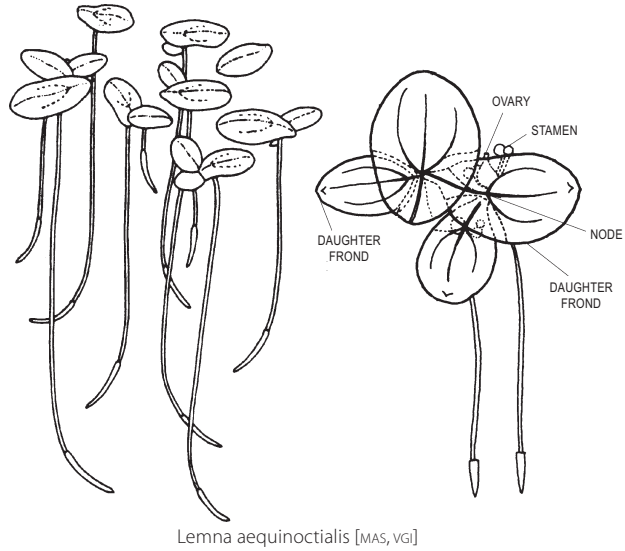
Luzula bulbosa [BT2, FNA, GR3]



Luzula echinata [GLE]



Landoltia punctata [MAS]



Lemna aequinoctialis [MAS, VGI]

REFERENCES: Thompson 1897; Hicks 1937; Maheshwari 1958; Wilson 1960; Harrison & Beal 1964; McClure & Alston 1966; Clark & Thieret 1968; den Hartog & van der Plas 1970; den Hartog 1975; Landolt 1980, 1986, 1997, 1998, 2000; Urbanska-Worytkiewicz 1980; Dahlgren et al. 1985; Landolt & Kandeler 1987; Kvacek 1995; Mayo et al. 1995, 1997, 1998; Jordan et al. 1996; Les et al. 1997, 2002; Stockey et al. 1997; Les & Crawford 1999; Yatskievych 1999; Bogner 2000; Lemon & Posluszny 2000b.

1. Roots 1 or more per frond; fronds 2 mm long or longer, oblong to elliptic, ovate, obovate, or orbicular, not long-tapered to apex, with 1 or more veins, usually floating on water surface.
   2. Each frond with 1 root; fronds 2–6.5 mm long; pigment cells absent (discrete brown dots not visible in dead fronds, but diffuse red pigmentation can be present) ____ **Lemna**
   2. Each frond with several roots; fronds 2.5–10 mm long; pigment cells present (visible in dead fronds as discrete brown dots; diffuse red pigmentation can also be present).
      3. Roots (4–)7–21 per frond; fronds only 1–1.5 times longer than wide (often almost as wide as long), 3–10 mm long, orbicular-obovate to nearly ovate, the upper surface often with a conspicuous red dot near center, conspicuously several-veined with 7–16(–21) veins; species widespread and abundant in East TX ____ **Spirodela**
      3. Roots 2–7(–12) per frond; fronds distinctly longer than wide (1.5–2 times longer than wide), 1.5–5(–8) mm long, oblong-ovate to somewhat elliptic-reniform, the upper surface usually without a conspicuous red dot, not conspicuously veined (with (3–)5–7 indistinct veins); species apparently rare in East TX ____ **Landoltia**
1. Roots absent; fronds EITHER < 1.6 mm long (pinhead size) OR fronds larger and ribbon-like to tongue- or sabre-shaped or ovate, sometimes distinctly long-tapered from a relatively broad base to a narrow apex, without veins, floating on water surface OR if not pinhead size, then usually submersed just below water surface.
   4. Fronds < 1.6 mm long, pinhead size, ± distinctly 3-dimensional, never flat except on the upper surface, unattached to one another or usually at most only two fronds attached together, usually floating on the water surface ____ **Wolffia**
   4. Fronds usually 2–10 mm long, flat in cross section, membranous, rarely solitary to 2–many attached together, usually floating just below the water surface ____ **Wolffiella**

LANDOLTIA Les & D.J. Crawford DOTTED DUCKMEAT

A monotypic genus (Les & Crawford 1999) previously included in *Spirodela*. However, based on morphological, anatomical, flavonoid, allozyme, and *rbc*L sequence data, *L. punctata* is "transitional between, but not a member of either *Lemna* or *Spirodela*" and "represents an isolated clade distinct from both *Spirodela* and *Lemna*" (Les & Crawford 1999). (Named for Elias Landolt, of Geobotanisches Institüt ETH, Zürich, Switzerland, a student of Lemnaceae for more than 45 years, and the recent contributor of Lemnaceae for *Flora of North America*)

REFERENCES: Saeger 1934; Crawford & Landolt 1993; Jordan et al. 1996; Les & Crawford 1999.

Landoltia punctata (G. Mey.) Les & D.J. Crawford, (punctate, dotted), DOTTED DUCKMEAT, LARGE DUCKWEED. Closely resembling some *Lemna* species in size and shape but easily distinguished by the presence of more than one root; fronds floating on water surface, solitary or in clusters of a few, oblong-ovate to somewhat elliptic-reniform, flat or gibbous, 1.5–5(–8) mm long, usually ca. 1–3 mm wide, 1.5–2 times longer than wide, with (3–)5–7 inconspicuous veins, the upper surface dark lustrous green, usually without a conspicuous red dot, often with small papillae, the lower surface usually reddish purple; roots usually 2–7(–12) per frond, to 7 cm long, all penetrating a small membranous scale (= prophyllum) enveloping base of frond; turions absent; vegetative reproductive pouches 2 per frond, these lateral near frond base; flowers 1(–2) per frond, but plants seldom flowering. Quiet waters; much less collected in East TX than *Spirodela polyrhiza*; Jasper (BRIT), Brazos, Gregg, Orange, Rusk, Shelby (Landolt 1986), Madison, Sabine (Turner et al. 2003 as *Spirodela punctata*), and Liberty (Brown et al. 2002) cos. in the

Pineywoods and Post Oak Savannah; also Denton Co. (mixed collection with *Lemna aequinoctialis*—BRIT) just w of East TX; also Gulf Prairies and Marshes; throughout much of the e U.S. from NY s to FL w to IL, OK, and TX, also in the w U.S. in AZ, CA, OR, and WA. [*Lemna punctata* G. Mey., *Spirodela oligorhiza* (Kurtz) Hegelm., *Spirodela punctata* (G. Mey.) C.H. Thomps.] Native to South America, se Asia, Australia, and probably also s Africa. Introduced to the U.S. as an aquarium plant (Godfrey & Wooten 1979) in the 1930s (Saeger 1934). *Landoltia punctata*, from five U.S. populations, was shown to have no infraspecific (= within species) variation in its chloroplast DNA (infraspecific variation has been observed in the majority of plants tested). Possible explanations include such factors as low levels of genetic diversity in the founding population (founder effect), clonal reproduction, and fluctuations in population size (and consequent loss of genetic variation) (Jordan et al. 1996).

LEMNA L. DUCKWEED

Fronds usually floating on water surface, lanceolate to ovate to nearly orbicular, flat or gibbous, solitary or in clusters of a few, pale green, yellow-green, or green, with 1–5(–7) veins, without pigment cells (but sometimes with reddish purple pigmentation); base (proximal end) of the single root surrounded by a tubular sheath, not covered by a membranous scale; 2 vegetative reproductive pouches per frond, these lateral near frond base; flowers 1(–2) per frond, but plants seldom flowering.

A cosmopolitan genus of 13 species (Landolt 2000); some authorities (e.g., Mabberley 1997) recognize as few as 7 species in the genus. *Lemna* species are eaten by waterfowl, and *L. minor* has been tried as a fodder for farm animals (Mabberley 1997). (Classical Greek name for a water plant)
REFERENCES: Landolt 1975; Reveal 1990; Crawford et al. 1996, 2001.

1. Plants usually submersed, forming dense colonies of 3–50 fronds connected by narrowed, conspicuous stalk-like bases; frond margins usually with at least some very minute teeth; species not documented for East TX _____ *L. trisulca*
1. Plants usually floating on water surface or, if stranded, forming mats on mud, the fronds single or 2–3 connected by inconspicuous small stalks that soon wither, the bases rounded; frond margins entire; including species widespread and abundant in East TX.
   2. Fronds with 3–5(–7) veins (use backlighting), with OR without anthocyanin (= red or purple pigmentation) present; upper (= dorsal) surface of fronds with or without prominent protuberances (= papillae); roots 1–6(–15) cm long; including species widespread and common in East TX.
      3. Fronds without any reddish purple pigmentation on either lower or upper surfaces; lower frond surface flat to slightly convex; root sheath with definite wings or appendages; roots < 3.5 cm long, the root tips usually sharp-pointed.
         4. Upper frond surface with only 1 papilla directly over the node (= point where root attaches on lower frond surface) and this one typically smaller than the papilla near the frond apex (= end of frond most distant from node); species widespread and common in East TX _____ **L. aequinoctialis**
         4. Upper frond surface very often with 2–3 prominent papillae over the node, these larger than the papilla near the frond apex; species apparently rare in East TX _____ **L. perpusilla**
      3. Fronds typically with reddish purple pigmentation, at least on lower surface; lower frond surface nearly flat to slightly or strongly convex or gibbous; root sheath without wings or appendages; roots sometimes > 3.5 cm long, the root tips mostly rounded.
         5. Fronds nearly flat beneath; upper frond surface with several papillae of ± equal size along the midline; forming small obovate to circular, rootless, dark green to brown turions (= compact, starch-rich fronds that are reduced in size and which overwinter underwater) under unfavorable conditions _____ **L. turionifera**

5. Fronds slightly to strongly convex or gibbous beneath; upper frond surface with papilla at apex bigger than others; not forming turions _____ **L. obscura**

2. Fronds with 1 vein (use backlighting), without red or purple pigmentation; upper surface of fronds flat, smooth or with obscure median papillae, without prominent papillae; roots 0.5–1.5 cm long; species rare in East TX.
   6. Fronds very asymmetrical at the base (= end of frond closest to attachment to other fronds and to where root arises), 1.3–3 times longer than wide, mostly (1–)2.5–5 mm long; vein reaching at least 3/4 of the distance from the node (= point where root attaches on lower frond surface) to the apex, usually distinct; plants sometimes submersed _____ **L. valdiviana**
   6. Fronds nearly symmetrical at the base, 1–2 times longer than wide, mostly 1–3(–4) mm long; vein reaching at most 2/3 of the distance from the node to the apex, sometimes indistinct; plants always floating on the surface _____ **L. minuta**

Lemna aequinoctialis Welw., (of equinoctial zone, from equatorial regions), DUCKWEED, LESSER DUCKWEED. Fronds floating, ovate to lanceolate, 1–6.5 mm long, 0.8–4.5 mm wide, 1–3 times longer than wide, never pointed, nearly symmetrical, light to medium green, with 3 veins; lower surface flat to slightly convex; distinct turions absent; roots 1–3 cm long, the wing of root sheath 1–2.5 times longer than wide. Widespread in e 1/2 of TX, also Trans-Pecos; throughout much of the s 2/3 of the U.S. [*L. trinervis* (Austin) Small] This is the common DUCKWEED in much of East TX.

Lemna minuta Kunth, (minute, very small), LEAST DUCKWEED. Fronds floating, ovate to lanceolate, 0.8–4 mm long, 0.5–2.5 mm wide, 1–2 times longer than wide, light green, with 1 vein; lower surface flat to slightly convex; turions absent; roots 0.5–1.5 cm long, the root sheath not winged. Bowie, Colorado, Dallas, Hays, Marion, Smith (Landolt 1986), Polk, and Travis (Turner et al. 2003) cos.; widely scattered in TX; widespread in the U.S., particularly in the sc and sw portions. [*L. minima* Phil. ex Hegelm., *L. minuscula* Herter, *L. valdiviana* Phil. var. *minima* Hegelm.] According to Landolt (1986), this species is sometimes difficult to distinguish from *L. valdiviana*; allozyme studies indicate that the two are "closely related and recently diverged sister species" (Crawford et al. 1996). These two species are considered the most morphologically reduced in the genus *Lemna* (Landolt 1986).

Lemna obscura (Austin) Daubs, (hidden), DUCKWEED, LITTLE DUCKWEED. Fronds floating, broadly ovate to suborbicular, 1–3.5 mm long, 0.8–3 mm wide, 1–1.5 times longer than wide; green to yellowish green, typically with reddish purple pigmentation, especially on lower surface; upper frond surface with a distinct papilla near apex and several smaller indistinct papillae along midline; lower frond surface slightly to strongly convex or gibbous; roots 1–4(–15) cm long, the root sheath not winged. Bowie, Fayette, Gonzales, Harris, Lamar, Titus, and Washington (BRIT—identified by Landolt), Bastrop (Johnston 1972), Angelina, Austin, Dallas, Freestone, and Orange (Turner et al. 2003) cos.; widespread in e 1/2 of TX; nearly throughout the e U.S. w to SD and TX. [*L. minor* L. var. *obscura* Austin, *L. minor* of TX authors, not L.] The *Lemma gibba–minor–obscura–turionifera* complex is quite confusing. However, according to Landolt (2000), *L. minor* is not known from TX and *L. gibba* occurs only to the w of East TX. The name *L. minor* has been misapplied to plants of *L. obscura* in TX in the past (e.g., Jones et al. 1997; Turner et al. 2003).

Lemna perpusilla Torr., (very weak and slender), DUCKWEED, MINUTE DUCKWEED. Fronds floating, ovate to lanceolate, 1–4 mm long, 0.8–3 mm wide, 1–1.7 times longer than wide, light green, with 3 veins; apical and central papillae prominent; distinct turions absent; roots 1–3.5 cm long, the wing of root sheath 2–3 times as long as wide. Dallas Co. (Landolt 1986); apparently rare in TX; Landolt (1986) gave only the Dallas locality, and the map in Landolt (2000) indicated that the species occurs only in the extreme ne part of East TX; ne U.S. s to NC and w to KS and TX. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

Lemna turionifera Landolt, (turion-bearing), DUCKWEED, TURION DUCKWEED. Fronds floating, ovate to nearly orbicular, 1.5–4 mm long, 1-1.5 times longer than wide, with 3 veins; plant producing small obovate to circular, rootless, dark green to brown turions (for overwintering); roots 1–6(–15) cm long, the root sheath not winged. Bowie Co. (Landolt 1986) in ne corner of East TX and Hays Co. (Landolt 1986) on the sw margin of East TX; also Aransas Co. in Gulf Prairies and Marshes, Donley, Hemphill, Lipscomb, and Oldham cos. in the Rolling Plains, Kerr Co. on the Edwards Plateau, El Paso Co. in the Trans-Pecos (Landolt 1986), and Real Co. (Turner et al. 2003) on the Edwards Plateau; widespread in Canada and most of the U.S. but rare in the se U.S.

Lemna valdiviana Phil., (of Valdivia, Chile), VALDIVIANA DUCKWEED, PALE DUCKWEED. Fronds floating or rarely submersed, ovate to lanceolate, somewhat falcate to symmetrical except for the oblique base, mostly (1–)2.5–5 mm long, 0.6–3 mm wide, 1.3–3 times longer than wide, occasionally somewhat pointed, light green, flat to slightly biconvex, with 1 vein; turions absent; roots 0.5–1.5 cm long, the root sheath not winged. Widely scattered in TX except in the nw and s parts of the state; widespread in the se U.S., scattered elsewhere. This species and *L. minuta* are considered the most morphologically reduced species in the genus *Lemna* (Landolt 1986).

Lemna trisulca L., (three-furrowed), STAR DUCKWEED, IVY DUCKWEED, IVY-LEAF DUCKWEED, was included for TX by Correll & Johnston (1970) with the comment "reported from Tex." It was also cited for the Pineywoods and Gulf Prairies and Marshes by Hatch et al. (1990). However, we have been unable to find any confirming specimens, and Landolt (1986, 2000) gave no citations for TX. While the species is thus probably not a member of the TX flora, it is mentioned here as a note to encourage collectors to look for it; it occurs widely in Canada, throughout most of the n 1/2 of the U.S., and is scattered further s. Plant submersed, usually forming tangled masses just below the water surface; fronds 3–15 mm long excluding conspicuous stalk-like bases, narrowly ovate to oblong, abruptly narrowed to the stalk-like bases, ± flat, often with reddish pigmentation, the margins usually minutely toothed near apex. Quiet, calcium rich waters, in cool-temperate regions (Landolt 2000).

SPIRODELA Schleid. DUCKMEAT, DUCKMEAL, BIG DUCKWEED

A cosmopolitan genus of 2 species (Les & Crawford 1999; Landolt 2000). *Landoltia punctata* was previously included in *Spirodela*; however, recent studies (see discussion under *Landoltia*) indicate that it should be recognized as a distinct genus. *Spirodela* is the least reduced genus in the family. It is sometimes grown, using dairy waste water, as a substitute for alfalfa in animal food. (Greek: *speira*, coil, twist, or spiral, and *delos*, evident, visible, or distinct, from the roots)
REFERENCES: Krajncic & Devidé 1979; Crawford & Landolt 1993; Les & Crawford 1999.

Spirodela polyrhiza (L.) Schleid., (many-rooted), COMMON DUCKMEAT, DUCKMEAT, GREATER DUCKWEED, BIG DUCKWEED. Fronds floating on water surface, solitary or in clusters of a few, orbicular-obovate to nearly ovate, flat or rarely gibbous, 3–10 mm long, usually 3–6 mm wide, 1–1.5 times longer than wide (often almost as wide as long), with 7–16(–21) conspicuous veins, the upper surface dark lustrous green, often with a conspicuous red dot near center, without distinct papillae, the lower surface usually reddish purple; roots (4–)7–21 per frond, 1–2(–3) perforating a membranous scale (= prophyllum); turions sometimes present; vegetative reproductive pouches 2 per frond, these lateral near frond base; flowers 1(–2) per frond, but seldom flowering. Quiet waters; widespread in TX but more common in the e 1/2 of the state; this species is more widespread and abundant in East TX than is the somewhat similar *Landoltia punctata*; widespread in s Canada and nearly throughout the U.S. This species is the largest of the surface-floating duckweeds.

WOLFFIA Horkel ex Schleid. WATER-MEAL

Fronds extremely tiny, about the size of a pinhead (0.4–1.6 mm long), ovoid, boat-shaped, or globular, distinctly 3-dimensional in appearance, solitary or paired, floating or submersed, without veins, with pigment cells (in some species) visible in dead fronds as brown dots, with a single terminal vegetative reproductive pouch where daughter fronds originate; roots absent; flower 1 per frond, but plants seldom flowering; on quiet waters; when present in large numbers the plants appear ± like green scum on the water surface.

A nearly worldwide genus of 11 species (Landolt 2000). *Wolffia* species are the smallest known and most morphologically reduced flowering plants. Concentrations of 1–2 million plants per square yard of water surface can occur (Hicks 1937). According to Crawford and Landolt (1995), "Species of *Wolffia* are much more divergent at allozyme loci than the majority of congeners of flowering plants. This suggests that the species are quite old and that the difficulties in distinguishing taxa morphologically are the result of reduction rather than lack of divergence due to recent speciation." Because of the relatively high phenotypic plasticity of *Wolffia* species, "it is extremely difficult to recognize various species within this group on morphological grounds only" (Landolt 1994). (Named for Johann Friedrich Wolff, 1778–1806, German botanist and physician who wrote on *Lemna* in 1801)

REFERENCES: Armstrong & Thorne 1984; Landolt 1994; Crawford & Landolt 1995.

1. Fronds usually ellipsoid or broadly ovoid (sometimes described as boat-shaped), 0.3–0.7 times as deep as wide, the upper surface flattened and often (but not always) with a raised conical papilla (= nipple-like projection) in the center; frond epidermis often (but not always) with brownish pigmented cells (seen in dried material); cells of fronds progressively smaller and less inflated from lower to upper surface and fronds thus appearing darker near upper surface when viewed laterally in transmitted light _____ **W. brasiliensis**

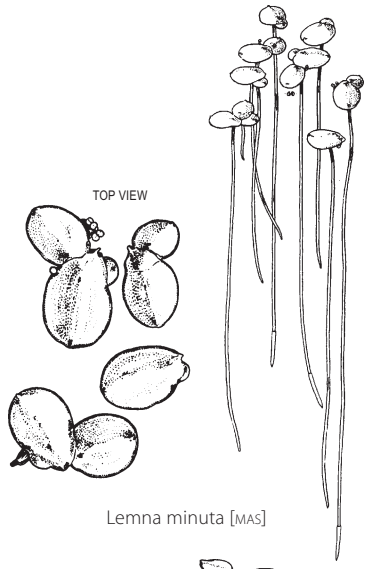
1. Fronds usually ± globular, rarely ellipsoid, 1–1.3 times as deep as wide, the upper surface strongly convex, not flattened and without a central papilla; frond epidermis without brownish pigmented cells; cells of fronds uniformly inflated and fronds thus ± uniformly green when viewed laterally in transmitted light _____ **W. columbiana**

Wolffia brasiliensis Wedd., (of Brazil). DOTTED WOLFFIA, POINTED WOLFFIA, BRAZILIAN WATER-MEAL. Fronds 0.5–1.6 mm long, often with a prominent papilla in center of upper surface, the upper surface intensely green; pigment cells present (visible in dead fronds as brown dots); seldom flowering. Widely scattered in the e 1/2 of TX; throughout most of the e U.S. w to KS and TX, scattered further w. Even though w of the previously known range of this species in East TX, many individuals from an isolated swamp/beaverpond complex near Telephone in Fannin Co. (L. Talbot property—BRIT) have definite epidermal pigmentation and papillae. [*W. papulifera* C.H. Thomps., *W. punctata* Griseb.]

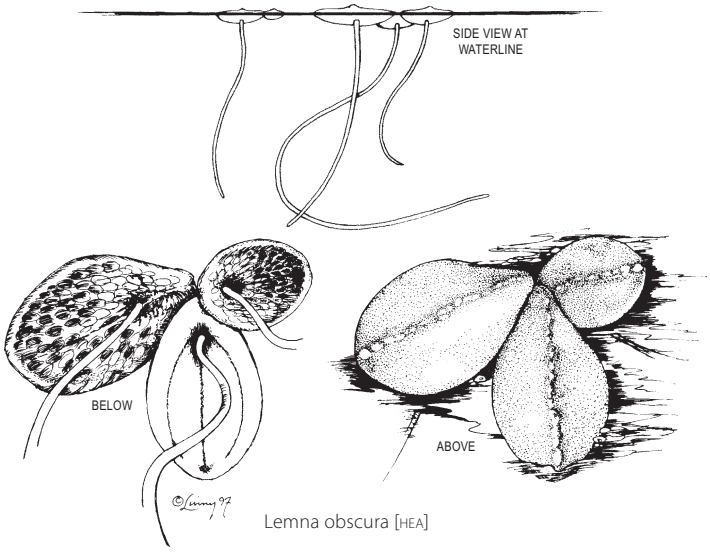
Wolffia columbiana H. Karst., (of Colombia), COLOMBIA WOLFFIA, COMMON WOLFFIA, COLOMBIAN WATER-MEAL. Fronds 0.1–1.4 mm long, usually with upper surface smooth or slightly roughened by a few minute papillae, these much smaller than the usually central papilla often seen in *W. brasiliensis*, the upper surface transparently green; pigment cells absent; seldom flowering. Widely scattered in the e 1/2 of TX; also Hemphill Co. (Turner et al. 2003) in the Panhandle; throughout e U.S. w to SD and TX, scattered further w and in s Canada.

WOLFFIELLA (Hegelm.) Hegelm. MUD-MIDGET, BOG-MAT

Fronds usually 2–10 mm long, ribbon-like to tongue- or saber-shaped or ovate, flat in appearance, 1 to 2–20+ together in star-shaped groups, submersed just below water surface or basal part of flowering or fruiting fronds emersed, without veins, with pigment cells visible in dead fronds as brown dots, with a single terminal vegetative reproductive pouch (where daughter



Lemna minuta [MAS]



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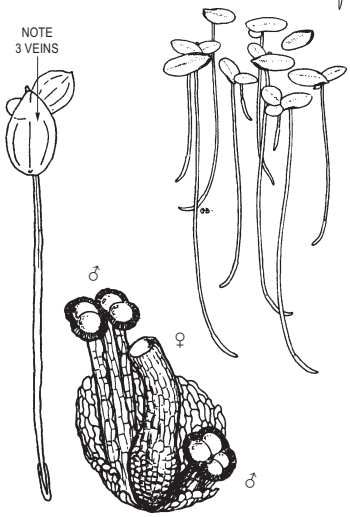
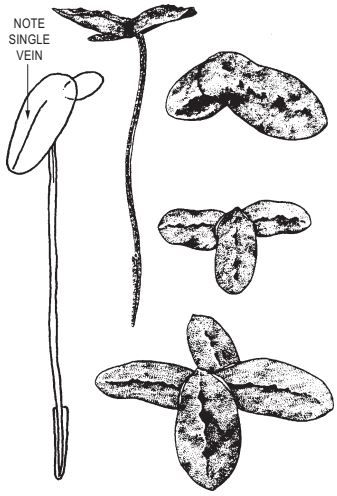
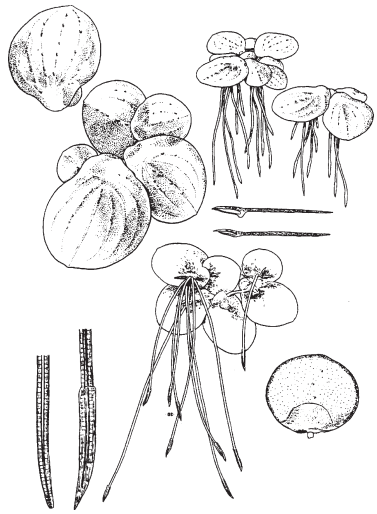


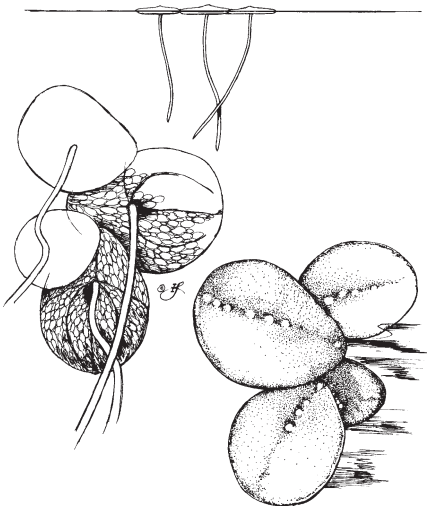
Lemma perpusilla [JEM, MAS]



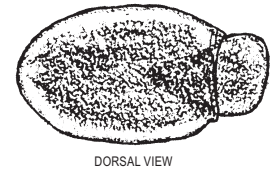
Lemna valdiviana [GWO, JEM]

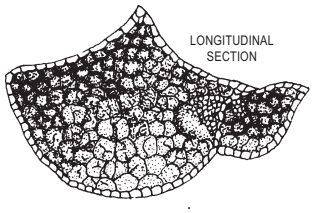


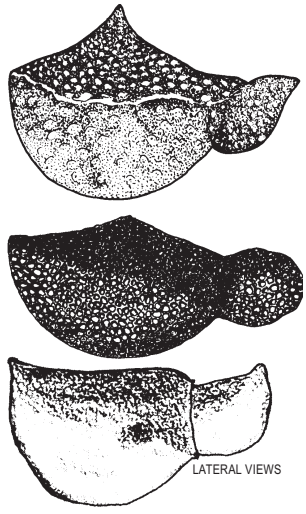
Spirodela polyrhiza [MAS]



Lemna turionifera [HEB]







Wolffia brasiliensis [GWO, MIB]

fronds originate); roots absent; flowers 1(–2) per frond, in cavity beside mid-line of upper surface of frond, but plants seldom flowering; in quiet waters.

A genus of 10 species (Landolt 2000), mostly of tropical and warm areas of the Americas and Africa. The following key is based on non-flowering material because "*Wolffiella* fronds change shape drastically when they are fertile ..." (Godfrey & Wooten 1979). (Name a diminutive of *Wolffia*)

REFERENCES: Landolt 1984; Crawford et al. 1997.

1. Fronds (4–)6–15(–20) times longer than wide, pointed at apex (= tip, the end opposite the end where the daughter fronds originate), narrowly sabre-shaped, long-tapered from a slightly broader base to the pointed apex; angle of vegetative reproductive pouch 25°–50° _____ **W. gladiata**
1. Fronds 1.5-8 times longer than wide, rounded or pointed at apex, tongue-shaped to ribbon-like or ovate, the sides ± parallel for much of their length or short-tapered; angle of vegetative reproductive pouch 45°–120°.
   2. Area of air spaces in tissue near base of frond usually no longer than wide, occupying basal 1/3 to 1/2 of frond; fronds 1.5–4 times longer than wide, usually curved downward at apex; angle of vegetative reproductive pouch 70°–120° _____ **W. lingulata**
   2. Area of air spaces in tissue near base of frond usually longer than wide, occupying basal 2/3 or more of frond; fronds 3–8 times longer than wide, usually flat; angle of vegetative reproductive pouch 45°–90° _____ **W. oblonga**

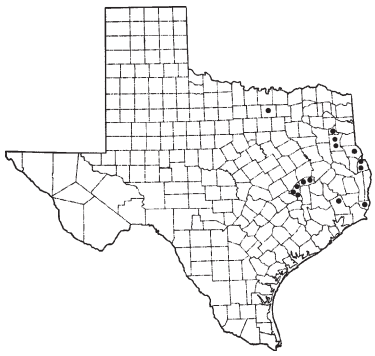
Wolffiella gladiata (Hegelm.) Hegelm., (sword-like), SWORD BOG-MAT. Fronds narrowly sabre-shaped, 4–9 mm long, ca. 0.5–1.4 mm wide at base, distinctly long-tapered from a slightly broader base to a pointed apex, often asymmetric near the apex with a curvature or an indentation on one side, rarely solitary to usually 2–many (to 20 or more) attached, forming star-like groups; area of air spaces within frond much longer than wide; seldom flowering. Scattered in East TX; also Gulf Prairies and Marshes.; throughout most of the e U.S. w to IL and TX, also WA. [*Wolffia gladiata* Hegelm., *Wolffia gladiata* var. *floridana* Donn. Sm., *Wolffiella floridana* (Donn. Sm.) C.H. Thomps.]

Wolffiella lingulata (Hegelm.) Hegelm., (strap-shaped), TONGUE-SHAPED BOG-MAT. Fronds tongue-shaped to widely so or ovate, 3–10 mm long, rounded at apex, ± symmetric to strongly curved, solitary to 2(–4) attached; seldom flowering. Harrison Co. (Evans & Brown 2002 based on *Nixon 16,133*, ASTC); also Brazoria Co. (Turner et al. 2003); also Landolt (2000) mapped it for the Gulf Prairies and Marshes just s of the Big Thicket; CA, FL, LA, MS, and TX. [*Wolffia lingulata* Hegelm.]

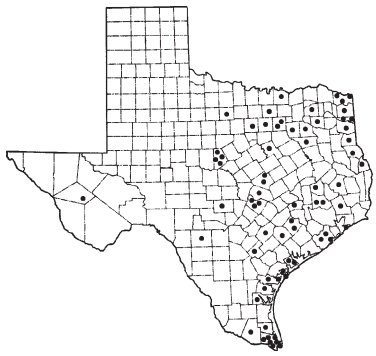
Wolffiella oblonga (Phil.) Hegelm., (elliptical with blunt ends), SABER BOG-MAT. Fronds narrowly tongue-shaped to ribbon-like, 1.2–7.5 mm long, rounded or pointed at apex, ± symmetric near the apex, solitary or 2–8 attached, forming star-like groups; seldom flowering. Jasper Co. (BRIT, *Diggs & George, s.n.*—B.A. Steinhagen Lake, mixed collection with *W. gladiata*), also range map in Landolt (2000) showing occurrence in s part of the Pineywoods (without specific county); also Gulf Prairies and Marshes (Landolt 2000); CA, FL, LA, MS, and TX. [*Lemna oblonga* Phil.] While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

LILIACEAE Juss.
LILY FAMILY

Perennial herbs from a bulb; leaves alternate or whorled along the stem or basal; flowers 1–few in a terminal umbel-like cluster or solitary at end of a naked scape; flowers conspicuous; tepals 6, distinct, all petaloid; stamens 6; ovary superior, 3-carpellate; style 1; fruit a capsule.



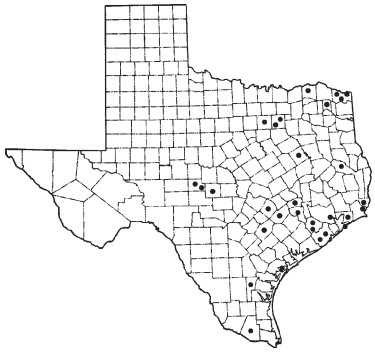
Landoltia punctata



Lemna aequinoctialis



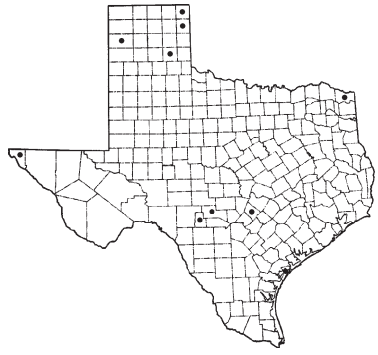
Lemna minuta



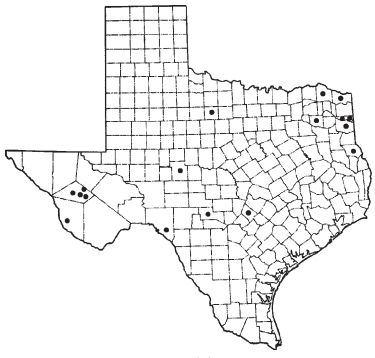
Lemna obscura



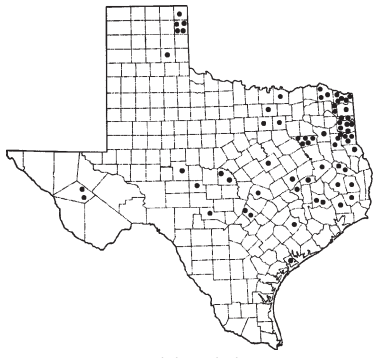
Lemma perpusilla



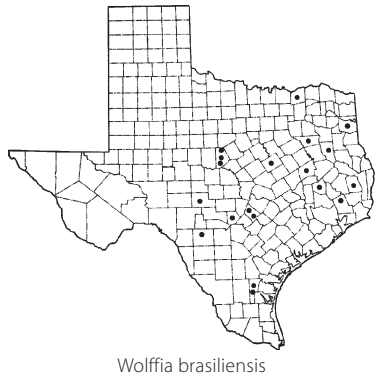
Lemna turionifera



Lemna valdiviana



Spirodela polyrhiza



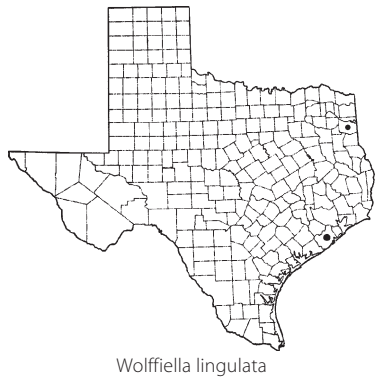
Wolffia brasiliensis



Wolffia columbiana



Wolffiella gladiata



Wolffiella lingulata

As treated here in a restricted sense, the Liliaceae is a medium-sized family of 11 genera and ca. 550 species (Tamura 1998a) of bulbose or rhizomatous perennial herbs widely distributed in the n hemisphere, but particularly abundant in temperate Eurasia. Molecular evidence indicates that the Liliaceae (in the narrow sense) is monophyletic (Patterson & Givnish 2002).

The Liliaceae "...has probably been used in a wider range of circumscriptions than any other family name" (Fay & Chase 2000). Indeed, taxonomically treating the species that have been considered to broadly fall within this family (4,950 species in 288 genera—Mabberley 1997) presents interesting problems. Many authors (e.g, Cronquist 1988) "placed most petaloid monocots with six-stamened flowers into a very broadly circumscribed—and obviously polyphyletic—Liliaceae" (Judd 1997). Other authorities separated them into two families, Liliaceae (species with superior ovaries) and Amaryllidaceae (species with inferior ovaries). However, in the words of Cochrane and Iltis (2000), such a restricted Liliaceae is "distinguished arbitrarily from the Amaryllidaceae." Still other systematists, following such works as Dahlgren et al. (1985), have divided the group into as many as 40 smaller families. "Recent studies have resulted in some exciting reevaluation of monocot phylogeny, particulary of the 'petaloid lilioid monocots'—so named because these plants have conspicuous petaloid tepals and, therefore, superficially resemble true lilies. ..." (Zomlefer 1999). In fact, recent molecular studies (e.g., Chase et al. 2000) have shown that species traditionally placed in the Liliaceae should be placed in numerous families in at least four orders, Liliales, Asparagales, Tofieldiales, and Nartheciales. Surprisingly, former Liliaceae such as *Allium*, *Asparagus*, *Hemerocallis*, *Hypoxis,* and *Polygonatum* are now thought to be more closely related to such families as Iridaceae and Orchidaceae (and other members of order Asparagales) than to *Lilium* (Chase et al. 1995a, 1995b, 1996, 2000; Fay et al. 2000). In the interest of nomenclatural stability, Diggs et al. (1999) followed Cronquist (1981, 1988, 1993), Kartesz (1994, 1999), and the then unpublished *Flora of North America* Volume 26 in treating the Liliaceae broadly to include plants now known to be in many different families. Recognizing the importance of nomenclatural stability, it is with some trepidation that we now divide up the Liliaceae (in the broad sense). However, it has become quite clear that parallel and convergent evolution in morphological characteristics (e.g., flower structure) have been significant factors in obscuring understanding of the actual relationships of "petaloid lilioid monocots." In particular, concerted convergence (= convergence in several different traits, favored by the same shared set of ecological conditions) has been important in hindering an understanding of phylogenetic relationships in the group (Patterson & Givnish 2002). The phylogeny of the Liliaceae (in the broad sense) now seems much more settled (e.g., Chase et al. 1995a, 2000; Judd 1997; Judd et al. 1999, 2002; Rudall et al. 2000b; Vinnersten & Bremer 2001), and to retain such a dramatically polyphyletic family would obscure our knowledge of the evolution of the moncots.

The Liliaceae is thus herein treated in a much less inclusive sense. East TX species that would traditionally have been included in a broadly considered Liliaceae are here recognized in 16 families in four orders: Asparagales (Alliaceae, Alstroemeriaceae, Amaryllidaceae, Anthericaceae, Asparagaceae, Convallariaceae, Hemerocallidaceae, Hyacinthaceae, Hypoxidaceae, Themidaceae), Liliales (Colchicaceae, Liliaceae, Melanthiaceae, Trilliaceae), Nartheciales (Nartheciaceae), and Tofieldiales (Tofieldiaceae). In order to assist in the identification of plants previously treated in the lily family in the broad sense, a chart and a key are provided below. The chart alphabetically lists all genera typically included in the lily family in the broad sense and indicates the families in which they are now recognized. The key allows identification to current family for all plants previously included in the broadly conceived lily family. In addition, two other families, Nolinaceae and Smilacaceae, considered by some authors a number of decades ago to be in the Liliaceae, are recognized as separate families here. It should be noted that nomenclature in the petaloid lilioid monocots is still far from settled, with different authorities drawing family boundaries quite differently. For example, the Angiosperm Phylogeny Group (APG II 2003) recently proposed combining numerous morphologically quite different groups (e.g., Agavaceae, Hyacinthaceae, Nolinaceae) into a very broadly conceived Asparagaceae.

The lily family (even in the restricted sense) is well known for its ornamentals including species of *Erythronium* (DOG-TOOTH-VIOLET), *Fritillaria* (FRITILLARY), *Lilium* (LILY), and *Tulipa* (TULIP). The Old World genus *Tulipa* has been cultivated since the 13th century in Iran; TULIPS were first introduced to Europe in 1554 and became extremely important economically in Holland, resulting eventually in "tulipomania," with great monetary speculation in the bulbs; there are now ca. 5,000 cultivars (Mabberley 1997; Tamura 1998a). *Fritillaria* (FRITILLARY) species, which contains many alkaloids, have been used medicinally for cough and fever in China since ancient times under the name BEI-MU (Tamura 1998a). (subclass Liliidae—Cronquist; order Liliales—APG II)

FAMILY RECOGNITION IN THE FIELD: bulbose perennials with EITHER erect leafy stems with numerous alternate or whorled leaves and 1–few, very large, showy flowers in an umbel-like cluster OR leaves only 1 or 2 at base of plant and flower solitary.

REFERENCES: Dahlgren et al. 1985; Conran 1989; Goldblatt 1995; Judd 1997; Tamura 1998a; Kosenko 1999; Zomlefer 1999; Fay & Chase 2000; Kelch 2000; Rudall et al. 2000b; Patterson & Givnish 2002.

GENERA PREVIOUSLY INCLUDED IN LILY FAMILY IN THE BROAD SENSE AND THEIR FAMILY TREATMENT IN THIS BOOK

Aletris (Nartheciaceae)	***Habranthus*** (Amaryllidaceae)	***Maianthemum*** (Convallariaceae)	***Stenanthium*** (Melanthiaceae)
Allium (Alliaceae)	***Hemerocallis*** (Hemerocallidaceae)	***Muscari*** (Hyacinthaceae)	***Toxicoscordion*** (Melanthiaceae)
Alstroemeria (Alstroemeriaceae)	***Hippeastrum*** (Amaryllidaceae)	***Narcissus*** (Amaryllidaceae)	***Triantha*** (Tofieldiaceae)
Androstephium (Themidaceae)	***Hyacinthus*** (Hyacinthaceae)	***Nothoscordum*** (Alliaceae)	***Trillium*** (Trilliaceae)
Asparagus (Asparagaceae)	***Hymenocallis*** (Amaryllidaceae)	***Ophiopogon*** (Convallariaceae)	***Uvularia*** (Colchicaceae)
Camassia (Hyacinthaceae)	***Hypoxis*** (Hypoxidaceae)	***Ornithogalum*** (Hyacinthaceae)	***Veratrum*** (Melanthiaceae)
Cooperia (Amaryllidaceae)	***Ipheion*** (Alliaceae)	***Polygonatum*** (Convallariaceae)	***Zephyranthes*** (Amaryllidaceae)
Crinum (Amaryllidaceae)	***Leucojum*** (Amaryllidaceae)	***Scilla*** (Hyacinthaceae)	***Zigadenus*** (Melanthiaceae)
Echeandia (Anthericaceae)	***Lilium*** (Liliaceae)	***Schoenocaulon*** (Melanthiaceae)	
Erythronium (Liliaceae)	***Lycoris*** (Amaryllidaceae)	***Schoenolirion*** (Hyacinthaceae)	

KEY TO PLANTS PREVIOUSLY INCLUDED IN A BROADLY CONCEIVED POLYPHYLETIC LILY FAMILY

1. Ovary inferior.
   2. Plants with leafy stems; flowers with perianth segments red to wine, spotted purplish brown, greenish apically, distinct _____ (*Alstroemeria*) **Alstroemeriaceae**
   2. Plants scapose, the leaves in a basal rosette; flowers with perianth segments variously white to pink, red, yellow, or orange-yellow, united only at base or united into a tube.
      3. Perianth usually pilose, yellow, 18 mm or less long; perianth segments united only at base; leaves narrowly linear, often pilose _____ (*Hypoxis*) **Hypoxidaceae**
      3. Perianth not pilose, white to pink, red, yellow, or orange-yellow, at least 20 mm long (usually much longer) OR with a corona OR perianth segments with yellowish green tips; perianth segments united only at base OR united into an often elongate conspicuous tube; leaves variously shaped, not pilose _____ **Amaryllidaceae**
1. Ovary superior (in a few cases only partly so).

4. Leaves (actually leaf-like bracts) in a single whorl of 3 at summit of the stem; flower 1 per plant _____ (*Trillium*) **Trilliaceae**
4. Leaves alternate or basal, or if whorled then in more than 1 whorl; flowers 1 to numerous per plant.
   5. Perianth very large, 55–180 mm long, orange to orange-red, yellow, or white.
      6. Leaves alternate or whorled along the stem; flowers 1–few in an umbel-like cluster at the end of a leafy stem, orange-red with purple spots OR white or mostly so _____ (*Lilium*) **Liliaceae**
      6. Leaves basal; flowers at the end of a naked scape, predominantly orange or yellow, sometimes with patterns but never spotted _____ (*Hemerocallis*) **Hemerocallidaceae**
   5. Perianth smaller, 40 mm or less long, variously colored.
      7. Inflorescence with a basal involucre of a sheathing bract or bracts; flowers solitary, umbellate, or in head-like inflorescences; plants sometimes with onion or garlic odor.
         8. Filaments separate; perianth white to yellowish, pink, or red, 12 mm or less long _____ **Alliaceae**
         8. Filaments united; perianth lavender-blue or white with pale blue tinge, 16–28 mm long.
            9. Flower(s) single, rarely 2, subtended by 2 partly or wholly united bracts; filaments without bifid apical appendages; perianth white with pale blue tinge, the lobes with a darker central line and brownish tinge on back; plant with onion or garlic odor _____ (*Ipheion*) **Alliaceae**
            9. Flowers 1–6(–9), the inflorescence subtended by 3 or 4 separate bracts; filaments with bifid apical appendages forming a crown between the anthers; perianth, including lobes, lavender-blue; plant without onion odor _____ (*Androstephium*) **Themidaceae**
      7. Inflorescence bractless or flowers individually bracted; flowers solitary, racemose, paniculate, or corymbose; plants without onion odor.
         10. Inflorescences axillary (= arising from axils of the leaves) or apparently so, with 1–9 (–15) flowers per inflorescence; plant with an erect-arching leafy stem OR stem with numerous finely dissected leaf-like branches.
            11. Leaves reduced to scales only; main stem with numerous finely dissected branches; fruit a red berry _____ (*Asparagus*) **Asparagaceae**
            11. Leaves well-developed, lanceolate-elliptic to broadly elliptic, to 15 cm long and 7 cm wide; main stem unbranched or once-forked into 2 branches; fruit a dehiscent capsule or a blue-black berry.
               12. Flowers solitary, apparently axillary; perianth parts free; fruit a deshiscent capsule _____ (*Uvularia*) **Colchicaceae**
               12. Flowers in (1–)2–9(–15)-flowered axillary inflorescences; perianth parts fused nearly to tips; fruit a blue-black berry _____ (*Polygonatum*) **Convallariaceae**
         10. Inflorescences at the tip of the aerial scape or stem, with 1–very numerous flowers per inflorescence; plant with leaves all basal or mostly so (except stems leafy in *Maianthemum,* which has flowers 50–250 per inflorescence).
            13. Flower solitary; leaves 2 _____ (*Erythronium*) **Liliaceae**
            13. Flowers in racemes, corymbs, or panicles; leaves more than 2.
               14. Tepals connate for ca. 1/2 or more of their length, forming a basal tube.
                  15. Perianth wrinkled and roughened externally (appearing mealy or farinose); plant from a short thick rhizome _____ (*Aletris*) **Nartheciaceae**
                  15. Perianth smooth externally; plant from a bulb _____ **Hyacinthaceae**
               14. Tepals separate or nearly so.
                  16. Stem leafy, the 5–13 conspicuous leaves alternate along most of the stem, the stems without a cluster of basal leaves; tepals < 2 mm long _____ (*Maianthemum*) **Convallariaceae**
                  16. Stem essentially without leaves, the leaves all basal or at least mostly so; tepals 2.3–17 mm long.
                     17. Tepals adnate in their lower portions to ovary; ovary with 1 style; leaves longer than to equaling the scape _____ (*Ophiopogon*) **Convallariaceae**

17. Tepals free from ovary; ovary with 1 OR 3 styles; leaves various.
    18. Ovary with 3 styles, these distinct (= separate to base) or connate basally (in 1 species); plants from rhizomes or bulbs.
        19. Pedicels each with 3 minute connate bracts just below the flower (and well above pedicel base); styles connate basally into column 1/4–2/3 their length; scape minutely glandular-pubescent below inflorescence _____ (*Triantha*) **Tofieldiaceae**
        19. Pedicels without 3 minute connate bracts just below the flower (bracts various, typically at pedicel base); styles distinct; scape not glandular pubescent (either glabrous or floccose pubescent) _____ **Melanthiaceae**
    18. Ovary with only 1 style (however, the stigma can be 3-lobed); plants from bulbs or corms but never rhizomes.
        20. Perianth yellow to yellow-orange, (7.5–)10–15(–17) mm long; plants from corms _____ (*Echeandia*) **Anthericaceae**
        20. Perianth white, greenish white, light blue, blue-violet, or yellow, but if yellow only 4.5–7 mm long; plants from bulbs _____ **Hyacinthaceae**

Key to Genera in Liliaceae in the Strict Sense

1. Leaves 1 or 2, at ground level; plant without evident stem (flower borne on a naked scape); flowers relatively small, 2–4 cm long, the perianth segments white or yellow, tinged with varying shades of blue, pink, red, lavender, purple, or orange on the outside _____ **Erythronium**
1. Leaves numerous, in whorls near middle of the stem or alternate along the stem; plant with erect stem 50–130 cm tall; flowers large, 5.5–25 cm long, the perianth segments either orange-red becoming yellowish in the throat and with purple spots on at least the proximal half OR white or mostly so _____ **Lilium**

Erythronium L. DOG-TOOTH-VIOLET, FAWN-LILY, TROUT-LILY

Perennials from deep bulb; underground runners (with bulb at tip) present or absent; leaves of flowering plants 2, of sterile plants 1; inflorescence usually a 1-flowered scape; perianth segments (tepals) 6, in ours white or yellow, tinged with varying shades of blue, pink, red, lavender, purple, or orange on the outside, 2–4 cm long; 3 inner tepals of white-flowered species with a yellow spot at base, stamens 6; ovary superior, 3-carpellate; capsule ellipsoid to obovoid.

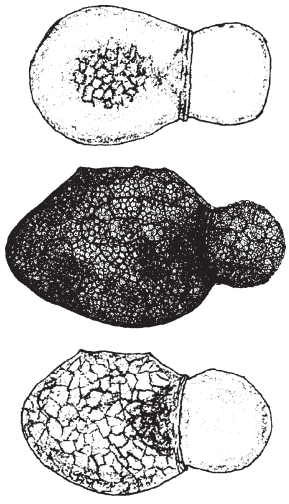
A mainly temperate area genus of ca. 27 species mostly of North America (23 species), with a few in Eurasia (e.g., Allen & Robertson 2002); some have edible corms and a number are cultivated as ornamentals. It is a "well-marked and distinctive genus closely related to *Tulipa*" (Allen & Robertson 2002). The genus is interesting biogeographically in that, "In North America, *Erythronium* consists of distinct eastern and western groups, the former clearly having an affinity with species of the Old World" (Allen & Robertson 2002). The following key is modified from Robertson (1966) and Allen and Robertson (2002). The seeds of many *Erythronium* species have oily white appendages (elaiosomes) and are ant-dispersed (see e.g., Handel et al. 1981; Ruhren & Dudash 1996). According to Gall (2000), the names TROUT-LILY and FAWN-LILY relate to "the speckling on the leaves, reminiscent of a speckled trout and a spotted fawn." The name DOG-TOOTH-VIOLET is probably the result of early European settlers applying names of familiar plants to American ones that superficially resembled them. Apparently, the European *Erythronium dens-canis* L. has "dog-toothed" roots and "violet"-colored flowers (Gall 2000). Mathew (1992), however, indicated that the shape of the bulb, pointed apically and rounded to blunt at base, is probably the reason for the common name DOG-TOOTH-VIOLET. Small solitary native bees (genus *Andrena*) are known to pollinate some *Erythronium* species

(Bernhardt 1977; Banks 1980). (Greek name for the pink- to purplish-flowered European species, *E. dens-canis*, from *erythros*, red)
REFERENCES: Harper 1945; Ireland 1957; Parks & Hardin 1963; Robertson 1966; Carr 1986; Takahashi 1987; Mathew 1992; McClain et al. 1999 [2000]; Allen & Robertson 2002; Allen et al. 2003.

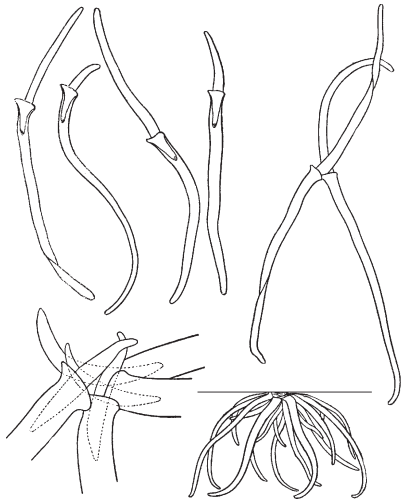
1. Flowers yellow on the inside (= adaxial side), held erect when open; inner 3 tepals with well-developed triangular auricles at base; lower (= abaxial) leaf surface not glaucous; capsule with a well-developed beak at apex _____ **E. rostratum**
1. Flowers predominantly white on the inside with a yellow area at center, not held erect when open, nodding; inner 3 tepals not auricled at base; lower leaf surface glaucous; capsule without a beak at apex, at most faintly apiculate.
   2. Tepals reflexed in full bloom; leaves mottled, flat to half-folded; mature fruits erect to nodding at maturity, held off ground; moist woods _____ **E. albidum**
   2. Tepals spreading to at most half-reflexed in full bloom; leaves usually not mottled, half-folded to conduplicate; mature fruits resting on ground; prairies, pastures, dry open woods ____ **E. mesochoreum**

Erythronium albidum Nutt., (white), WHITE DOG-TOOTH-VIOLET, WHITE FAWN-LILY, WHITE TROUT-LILY, TROUT-LILY. Leaves abruptly attenuated, mottled; non-flowering plants with long runners with a new bulb forming at runner tip; flowers predominantly white on the inside with a yellow area at center (can be tinged with varying shades of lavender to blue to pink on the outside); tepals 22–40 mm long; chromosome number $2n = 44$ (tetraploid). Usually moist woods; widespread in n part of East TX w to Cross Timbers and Prairies; se Canada (Ont.) and e U.S. w to SD and TX. Feb–Mar. Colonies of this species often have many more non-flowering, 1-leaved plants than flowering ones (Allen & Robertson 2002). The plants carry out their life cycle and disappear 6–8 weeks following emergence (McClain et al. 1999 [2000]). They are thus examples of "ephemeral" herbs that typically flower in early spring as soon as suitable temperatures permit and before the canopy closes (Schemske et al. 1978). 🏵/286

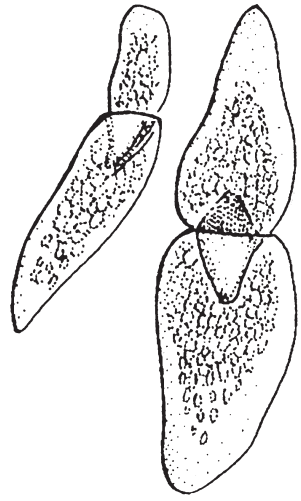
Erythronium mesochoreum Knerr, (midland), PRAIRIE TROUT-LILY, MIDLAND TROUT-LILY. Leaves gradually attenuated, usually not mottled; non-flowering plants usually without runners, a new bulb forming at base of old one; however, most plants flower; flower color as in *E. albidum*; tepals 15–30 mm long; chromosome number $2n = 22$ (diploid). Prairies and dry woods; K. Robertson (co-author of Flora of North America treatment of *Erythronium*) annotated BRIT specimens from Bell, Bosque, Coryell, Dallas, Grayson, Rockwall, Sabine, and Tarrant cos. as *E. mesochoreum*. Turner et al. (2003) additionally mapped Nacogdoches Co.; Allen and Robertson (2002) mapped the species as widespread in the n part of East TX; c U.S. from AR and TX n to IL, IN, and NE. (Jan–)Feb–Mar. [*E. albidum* var. *coloratum* Sterns, *E. albidum* var. *mesochoreum* (Knerr) Rickett] Most white-flowered East TX TROUT-LILIES we observed had mottled leaves; some of these had the mature fruits resting on the ground and some were from prairies; Robertson (1966) indicated that specimens from near Fort Worth were definitely *E. mesochoreum* and recently annotated a number of other TX specimens (listed above) as *E. mesochoreum*. Taylor and Taylor (1994) recognized the two white-flowered taxa as varieties of *E. albidum*. Further work on this complex is needed before specimens can be classified with confidence. We are not fully convinced there are actually two different species of white-flowered TROUT-LILIES in East TX. It is possible there is intergradation between these two taxa at the extreme sw margin of their ranges. However, McClain et al. (1999 [2000]) indicated that in Illinois *E. mesochoreum* is "readily distinguished" from *E. albidum* in the field by the prairie or open woodland habitat, earlier blooming period, narrow conduplicate leaves that usually lack mottling, a fruit that droops to the ground at maturity, and populations with relatively few sterile plants (versus *E. albidum* with a later blooming period, wider, flattish leaves that are strongly mottled, a fruit stalk that remains erect or slightly drooping, and populations with numerous sterile plants).



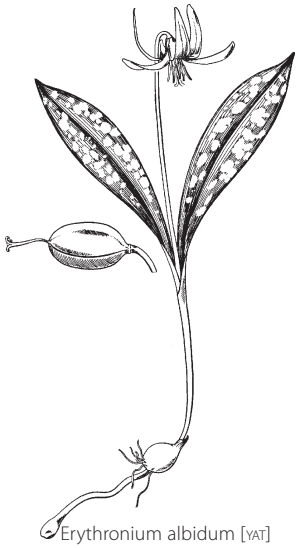
Wolffia columbiana [GWO, MIB]



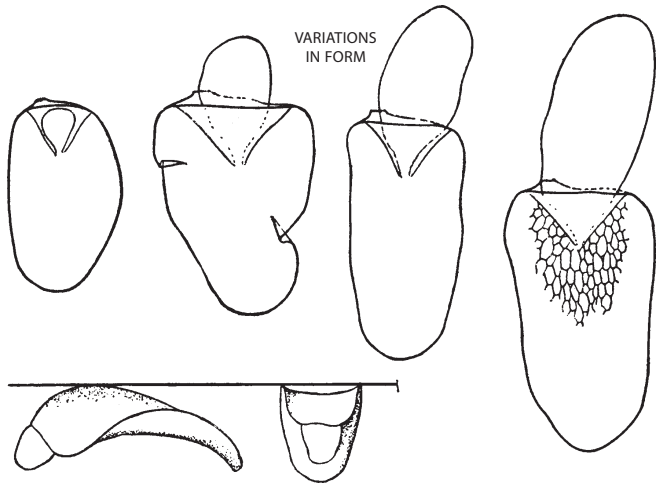
Wolffiella gladiata [ARM]



Wolffiella oblonga [FNA]



Erythronium albidum [YAT]



Wolffiella lingulata [ARM]



Erythronium mesochoreum [FNA]



Erythronium rostratum [YAT]



Lilium michauxii [GLE]

Likewise, K. Robertson (pers. comm.) notes that the two are distinct species over a wide geographic area. We are thus tentatively following McClain et al. (1999 [2000]) and Allen and Robertson (2002) in recognizing both species. *Erythronium mesochoreum* is apparently less common in East TX than *E. albidum*. The plants carry out their life cycle and disappear 6–8 weeks following emergence (McClain et al. 1999 [2000]). Churchill and Bloom in Churchill (1986b) indicated that ants eat the white oil body attached to the seeds and apparently act as dispersal agents. The species is reported to be well-adapted to prairie fires (Allen & Robertson 2002).

Erythronium rostratum W. Wolf, (beaked), YELLOW TROUT-LILY, BEAKED TROUT-LILY. Leaves irregularly mottled; non-flowering plants with runners; flowers yellow (can be tinged with shades of red to purple to orange on the outside), held erect (all other species of *Erythronium* have nodding flowers); tepals mostly spreading in full bloom, 20–34 mm long; inner 3 tepals with well-developed triangular auricles at base; anthers yellow; fruit usually erect at maturity, with a well-developed beak at apex; $2n = 24, 36$ (diploid or triploid) (Carr 1986). Beech-hardwood ravines; San Augustine (Kral 1966c), Sabine (MacRoberts & MacRoberts 1998a), and Polk (Turner et al. 2003) cos. in the Pineywoods; c U.S. from OH s to AL w to KS, OK, and TX. Spring. Colonies of this species often have many more non-flowering, 1-leaved plants than flowering ones (Allen & Robertson 2002). Some plants from the Ozarks are known to be triploid, an unusual condition in this typically diploid species (Carr 1986). While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠ ⚅/286

A second yellow-flowered species, *E. umbilicatum* C.R. Parks & Hardin (DIMPLED TROUT-LILY), has been apparently erroneously reported for the Pineywoods of TX (Hatch et al. 1990), but does not reach TX or immediately adjacent states (Allen & Robertson 2002). It can be distinguished using the following characters: inner tepals without auricles at base; anthers brown, purple, or infrequently yellow; fruits apically indented, with a depression, or rarely rounded.

LILIUM L. LILY

Bulbose perennial herbs; stems erect, unbranched, leafy; leaves alternate or whorled, entire, numerous; flowers terminal, 1–few in an umbel-like cluster, perfect, large and showy; perianth segments 6, free; stamens 6; pistil 3-carpellate; ovary superior; fruits capsules; seeds numerous, flat.

A genus of ca. 100 species (Skinner 2002) of bulbiferous herbs occurring mainly in temperate regions of the n hemisphere (ranging s in tropical mountains to India and the Philippines), and particularly abundant in e Asia (ca. 60 species) and North America (21 species) (Tamura 1998d; Skinner 2002). Many are cultivated and lilies are "of great commercial significance" and "are one of the mainstays of the worldwide horticultural bulb trade" (Skinner 2002). There are thousands of hybrids with ca. 6,000 registered (Skinner 2002). *Lilium candidum* L., MADONNA LILY, BOURBON LILY, has long been cultivated (since at least 1,500 B.C.) for its white flowers used in scent-making; it is figured in Cretan frescos 5,000 years old and is possibly the Rose of Sharon of the Bible. The bulbs of some species are eaten; Native Americans used them both as food and medicinally (Moerman 1998). *Hemerocallis* species, DAY-LILIES, in the Hemerocallidaceae, superficially resemble *Lilium* (true LILIES) "in habit and flower shape but are easily distinguished by rhizomes, septal nectaries, and the black, prismatic to rounded seeds (vs. the bulb, perigonal nectaries, and pale brown, flat seeds of *Lilium*)" (Zomlefer 1998). Most members of the genus are largely self-incompatible, and cross-pollination is necessary for seed production (Newell 1980; Skinner 2002). ☠ Some LILY species are known to be toxic to cats, causing renal failure and even death; ingestion of even a single flower can cause toxicity (Burrows & Tyrl 2001). (Latin form of Greek: *leirion*, name for the white Madonna lily—*Lilium candidum*)
REFERENCES: Woodcock & Stearn 1950; Ohwi 1965; Synge 1980; Adams & Dress 1982; Andersen 1986; Hayashi & Kawano 2000; Skinner 2002.

1. Perianth white or mostly so; leaves alternate; pollen yellow _____ **L. philippinense**
1. Perianth orange-red, with purple spots on at least the proximal half, becoming yellowish in the throat; leaves whorled mid-stem, sometimes alternate above or below; pollen reddish _____ **L. michauxii**

Lilium michauxii Poir., (for André Michaux, 1746–1803, French botanist and explorer of North America), CAROLINA LILY, TURK'S-CAP. Stems 50–130 cm tall; bulbs 1.5–4.4 cm wide (slightly wider than tall); leaves in 2–4(–5) whorls of (3–)4–7(–15) leaves each near middle of stem, sometimes with a few alternate leaves above and below, oblanceolate to narrowly obovate, (3.6–)6–12 cm long, 10–25(–38) mm wide, glaucous, somewhat fleshy; flowers 1–2(–4), nodding (buds erect), sweetly fragrant; perianth segments orange-red, with purple spots on at least the lower half, becoming yellowish in the throat, strongly recurved from near the middle in form of a "Turk's-cap", 5.5–8(–10) cm long, 10–20(–29) mm wide, not clawed; stamens long-exserted, 5.5–7.5 cm long; capsules (2.4–)3–5(–5.6) cm long, erect. Pine to oak or mesic hardwood forests, typically in well-drained soils; Cherokee, Nacogdoches, Newton, San Augustine, Tyler (BRIT), Angelina, Jasper, Sabine, Shelby (MacRoberts & MacRoberts (1998a), and Rusk (Turner et al. 2003) cos. in the Pineywoods; se U.S. from VA s to FL w to TX. Jul–Aug. [*L. canadense* L. var. *carolinianum* (Michx.) Baker, *L. carolinianum* Michx., not Bosc ex Lam., *L. fortunofulgidum* Roane & Henry, *L. superbum* L. var. *carolinianum* (Michx.) Chapm.] This species is reported to be pollinated by large swallowtail butterflies, including the eastern tiger swallowtail, *Papilio glaucus* L. (Skinner 2002). /291

Lilium philippinense Baker, (of the Philippines), PHILIPPINE LILY, PHILIPPINE ISLAND LILY. Stems 30–45(–100) cm tall; bulbs subglobose, to ca. 2.5–5 cm in diam.; leaves alternate, linear, to 15 cm long, 6 mm or less wide, with 1–3 veins; flowers 1–2(–6), fragrant; perianth funnelform, white (occasionally streaked with green and red basally), to 18–25 cm long, the segments basally papillose and spreading to slightly recurved at apex. Roadsides; Newton (*L. Brown 24438*, BRIT), Tyler (*C.M. Sanders s.n.*, BRIT; Brown & Elsik 2002), and Nacogdoches (R. George, pers. comm.) cos.; FL, KY, and TX. Jul–Aug. Native of the Philippines. This species, which was described as "common and conspicuous along roadsides," is one of the most recently reported introduced species for the East TX flora (Brown & Elsik 2002, reported as *L. longiflorum* Thunb.—L. Brown (pers. comm.) recently indicated that the specimens were actually *L. philippinense*). *Lilium philippinense* has the largest flowers in the genus (Skinner 2002). It is very similar to *L. longiflorum* (EASTER LILY), which is "the common white lily of the florist trade" and "is the most widely cultivated and commercially important lily" (Skinner 2002). However, *L. longiflorum* has leaves that are lanceolate, ca. 5–15 mm wide, and with 3–5 veins.

LIMNOCHARITACEAE Takht. ex Cronquist
WATER-POPPY FAMILY

A very small family (3 genera, 8 species) of tropical and subtropical regions (Haynes & Holm-Nielsen 1992; Haynes et al. 1998b; Haynes 2000a). Because of its flowers, with many separate carpels, numerous stamens, and laminar placentation, it is considered related to underived ("primitive") monocots (Haynes & Holm-Nielsen 1992). It has sometimes been combined with the Butomaceae (e.g., Correll & Johnston 1970; Godfrey & Wooten 1979) or Alismataceae (e.g., Mabberley 1997; Judd et al. 1999) and shares similarities with both of these families. While recent research indicates a closer relationship with Alismataceae (Dahlgren et al. 1985; Heywood 1993; Les & Haynes 1995), according to Cronquist (1981), Haynes and Holm-Nielsen (1992), Takhtajan (1997), and Haynes (2000a), it seems most appropriate to recognize it as a separate family. The Limnocharitaceae differs in having numerous ovules per carpel, laminar placentation, and dehiscent fruits (vs. 1–few ovules per carpel, basal placentation, and indehiscent fruits in Alismataceae) (Haynes et al. 1998b). Family name from *Limnocharis*, a tropical American

genus of 2 species. *Limnocharis flava* (L.) Buchenau is cultivated and naturalized in se Asia; it is eaten like spinach and also used as pig fodder. (Greek: *limne*, a marsh, and *charis*, delight) (subclass Alismatidae—Cronquist; order Alismatales—APG II)

FAMILY RECOGNITION IN THE FIELD: the only species occurring in TX is an introduced aquatic with long-petioled, broadly ovate to suborbicular leaves and long-stalked flowers held above the water, each with 3 showy yellowish petals.

REFERENCES: Dahlgren et al. 1985; Haynes & Holm-Nielsen 1992; Haynes et al. 1998b; Haynes 2000a.

HYDROCLEYS Rich. WATER-POPPY

A New World tropical genus of 5 species (Haynes 2000a) of aquatics with milky sap. The genus has sometimes been spelled "Hydrocleis" (Kenton 1981). (Greek: *hydro*, water, and *clavis*, club-shaped, presumably from shape of pistils—Haynes 2000a)

REFERENCES: Kaul 1968b; Sattler & Singh 1973; Kenton 1981.

Hydrocleys nymphoides (Willd.) Buchenau, (resembling *Nymphaea*, water-lily), WATER-POPPY. Rhizomatous, perennial, aquatic herb; rhizomes rooting at the nodes; leaves basal and borne with the flowers, long-petioled (petioles 1.5–40 cm long, sheathing at base); leaf blades usually floating, broadly ovate to suborbicular, typically cordate at base, apically rounded to slightly mucronate, usually 5–11.9 cm long, with 5–9 veins, marginally entire, glossy on adaxial (= upper) surface, sparsely pubescent on abaxial surface, with area along midrib ± spongy; inflorescences with 1–6 flowers, proliferating with leaves; flowers on pedicels 3.5–17.5 cm long, held well above the water, lasting only one day; sepals 3, persistent; petals 3, spreading, showy, light yellow to white with yellow base, obovate, 2.3–ca. 3 cm long; stamens numerous, the outer ones sterile (= staminodes); fertile anthers purple or violet; carpels (5–)6(–8), forming follicles, the follicles beaked, 10–14.5 mm long, 2–3.5 mm wide, each several-seeded; seeds sparsely glandular-pubescent. Ponds or other aquatic habitats; Hardin (Turner et al. 2003) and Harris (TEX; Turner et al. 2003) cos. near extreme s margin of East TX, also citation of Pineywoods by Hatch et al. (1990); in the U.S. known only from FL and TX Summer. Native of South America. This species is sometimes grown as an aquarium plant or cultivated in pools and ponds (Correll & Johnston 1970; Godfrey & Wooten 1979; Cronquist 1981) and persists following cultivation or dumping of aquaria (Haynes 2000a).

MARANTACEAE O. Peterson
ARROWROOT OR PRAYER PLANT FAMILY

A medium-sized (530 species in 31 genera—Kennedy 2000a) primarily tropical family of perennial rhizomatous herbs known for their elaborately patterned leaves. While 80% of the species are native to the New World (Kennedy 2000a), the generic distribution of the family is much more even—it is primarily the large genus *Calathea* that causes the high New World species percentage. Only two species of Marantaceae (both in the genus *Thalia*) are native to the U.S. There are a number of ornamentals, including species of *Calathea* and *Maranta*. According to Kennedy (2000a), the family can be recognized worldwide from a singe leaf—"leaf venation of broadly sigmoidally-curved (S-shaped) lateral veins with numerous, regular, parallel cross veinlets (attached at right angles) between them and the pulvinus at the base of the leaf blade." The joint-like pulvinus (also found in *Zingiber* of the related Zingiberaceae) is a region of specialized cells controlling leaf movement. The resulting ability of the leaf blades to change position (e.g., "fold up" at night), has given rise to the common name PRAYER PLANT. The stamens are also distinctive; all are sterile and modified into staminodes with the exception of one sometimes petal-like functional stamen. Marantaceae are unusual in having explosive secondary

pollen presentation—according to Kennedy (2000b), "Pollen is shed onto the back of the style behind the stigma during the evening prior to anthesis. When the style, held under tension, is released by the pollinator, the stigma moves forward scooping the pollen from the pollinator and, in the same motion, depositing its own pollen in the same place." The Marantaceae appears monophyletic and is most closely related to the Cannaceae (CANNA family), more distantly to the Zingiberaceae (GINGER family) and Costaceae (SPIRAL-FLAG family), and more distantly still to other Zingiberales families, including the Heliconiaceae (HELICONIA family), Musaceae (BANANA family), and Strelitziaceae (BIRD-OF-PARADISE family) (Smith et al. 1993; Chase et al. 2000; Kress et al. 2001). Family name from *Maranta*, ARROWROOT or PRAYER-PLANT, a tropical American genus of ca. 20 species. *Maranta arundinacea* L., WEST INDIAN ARROWROOT, has a starchy edible rhizome, the starch (arrowroot) being easily digested and used for infants and invalids. (Named for Bartolommeo Maranti, 16th century Venetian botanist and physician) (subclass Zingiberidae—Cronquist; order Zingiberales—APG II)

FAMILY RECOGNITION IN THE FIELD: the only East TX species is a large rhizomatous herb with broad, banana leaf-like leaves with a "joint" (pulvinus) where the long petiole and blade join; inflorescences usually white-powdery; flowers purple; androecium of a single fertile stamen and often staminodes.

REFERENCES: Andersson 1976, 1981b, 1998; Grootjen 1983; Kirchoff 1983, 1991; Rogers 1984; Dahlgren et al. 1985; Kress 1990; Kirchoff 1991; Smith et al. 1993; Kennedy 2000a, 2000b; Andersson & Chase 2001; Kress et al. 2001.

THALIA L. ALLIGATOR-FLAG

A mostly tropical American (1 in Africa, presumably naturalized from the New World) genus of 6 species of emergent aquatics (Kennedy 2000a). Fruit dispersal in *Thalia* is thought to be most commonly by water—an air-filled space between the fruit wall and seed is reported to make the fruit buoyant (Grootjen 1983; Kennedy 2000a). (Named either for Johann Thal, a German physician and naturalist who died in 1583 or possibly for Thalia, one of the nine Greek muses and the one who presided over comedy—Austin 2002)

REFERENCES: Davis 1987; Andersson 1981a.

Thalia dealbata Fraser ex Roscoe, (white-washed), POWDERY THALIA, POWDERED THALIA, POWDERY ALLIGATOR-FLAG. Perennial, emergent, aquatic herb 1–2.5 m tall from strong rhizomes, glabrous and with whitened surfaces; leaves 2–5, long-petioled, alternate, all basal, large, banana leaf-like; leaf blades 30–55 cm long, to 22 cm wide, ovate-lanceolate, pilose at very base on upper (= adaxial) surface, with prominent midrib and numerous, curved side veins parallel with each other, with a colored (yellowish brown to purple-brown to reddish) pulvinus at junction with petiole; petioles to 80 cm long, the base winged and clasping; inflorescence a rather small loose panicle, the axes zigzag in appearance, with whitish surfaces, with a prominent basal bract paired with a small one, the bracts typically with conspicuously whitened surfaces; flowers small, usually paired and enclosed by two bracts, sessile; sepals 3, 2.5 mm or less long; petals 3, unequal, purple, 5–10 mm long; fertile stamen 1; staminodes present, petal-like, purple, united, one with cupped, projecting apex exceeding the petals; pistil 1; ovary inferior; fruit a bluish purple, subglobose utricle 9–15 mm in diam. Shallow water, ditches, pond margins, or other wet areas; mainly Pineywoods, Post Oak Savannah, and n Gulf Prairies and Marshes w to Blackland Prairie (Dallas Co.—BRIT, Gonzales Co.—Turner et al. 2003); also escaping cultivation in Tarrant Co. (Fort Worth Botanic Garden—BRIT) in the Cross Timbers and Prairies; se U.S. from SC w to OK and TX, also IL and MO. May–Sep. This species is usually autogamous (= self-pollinating) (Kennedy 2000a). It is sometimes grown as an ornamental. According to Kennedy (2000a), this is "the only species of Marantaceae endemic to North America." /302

MAYACACEAE Kunth
BOG-MOSS FAMILY

A very small family (1 genus, 4 species) of freshwater, aquatic or wet area herbs occurring primarily in the Americas (se U.S. to Argentina and n Uruguay), with 1 species in Africa (Lourteig 1999; Faden 2000a). They are superficially moss-like or *Lycopodium*-like. According to some authors (e.g., Heywood 1993), the family is allied with the Commelinaceae but can be distinguished by its parietal placentation, anthers opening by pores or pore-like slits, and non-sheathing leaves. Other authorities suggest a closer relationship with Xyridaceae (e.g., Cronquist 1981; Stevenson & Loconte 1995; Takhtajan 1997). Recent molecular evidence places the family in order Poales with Xyridaceae, Juncaceae, and Cyperaceae (Davis et al. 2004). (subclass Commelinidae—Cronquist; order Poales—APG II)

FAMILY RECOGNITION IN THE FIELD: small, moss-like or club-moss-like, aquatic or wet area herbs with numerous, spirally arranged, ± linear leaves and solitary, stalked, radially symmetrical, whitish to pinkish or violet flowers.

REFERENCES: Thieret 1975; Stevenson 1983, 1998; Faden 1985, 2000a; Lourteig 1999.

MAYACA Aubl. BOG-MOSS

A genus of ca. 4 species (some authorities suggest up to 10), mostly of tropical to warm temperate America, with 1 species in tropical Africa (Angola, Zaire, Zambia) (Takhtajan 1997; Stevenson 1998; Faden 2000a). Some species are used as ornamental aquarium plants (Heywood 1993). (Derivation uncertain; possibly an aboriginal American name or perhaps related to the Mayaca or Mahica region of Brazil).

REFERENCE: Godfrey & Wooten 1979.

Mayaca fluviatilis Aubl., BOG-MOSS, STREAM BOG-MOSS, (growing in rivers or streams). Small, moss-like or club-moss-like, emersed or submersed, aquatic or wet area herbs with branched stems (these relatively longer in deep water forms); leaves spirally arranged, sessile, numerous, linear-lanceolate to narrowly linear, not sheathing, 2–8(–30) mm long, 0.5–1 mm wide, entire or apically 2-toothed; flowers perfect, radially symmetrical, solitary, apparently from the upper leaf axils, on pedicels to 2(–4) cm long (the pedicels varying from shorter than to much longer than the leaves, usually elongating with age); pedicels each subtended by a membranaceous, delicate, broadly ovate bract shorter than the leaves, the bract splitting longitudinally; sepals 3, acute to acuminate, 2–5 mm long; petals 3, whitish to pinkish or violet, ± obovate or broadly ovate, as long as or slightly longer than the sepals; stamens 3; anthers opening by terminal pore-like slits; ovary superior; fruit a capsule, 4–5 mm long, 3–4.5 mm broad; seeds 2–25 per capsule. Bogs, springs, seepage areas, marshes, streams, and other wet areas; Pineywoods and Post Oak Savannah; also n Gulf Prairies and Marshes; se U.S. from NC s to FL w to TX. May–Jul. [*M. aubletii* Michx.] This species can vary in habitat from on shore to deep water; some of the morphological variation associated with these habitat differences has been recognized in the past at the species level (*M. aubletii*); however, there is apparently only a single species involved (Godfrey & Wooten 1979; Faden 2000a).

MELANTHIACEAE Batsch ex Borkh.
DEATH-CAMAS OR BUNCHFLOWER FAMILY

Perennials from rhizomes or bulbs, scapose or subscapose with mostly basal leaves; flowers in racemes, panicles, or spikes, usually small; tepals 6, all ± alike, usually with nectary on adaxial surface; stamens 6; ovary superior to slightly inferior, 3-carpellate; styles 3, these usually distinct; fruit ventricidal capsules (= carpels separating and subsequently their ventral margins opening to release the seeds).

A small family (ca. 7–8 genera, ca. 68–93 species) of perennial herbs typically of woodland and alpine areas from subtropical to temperate and arctic regions of the n hemisphere. Many Melanthiaceae are characterized by having bulbs or rhizomes, an unusual type of anther dehiscence (opening as a peltate disk), and shared susceptibility to certain rust fungi (Zomlefer 1997a). The genera have been variously treated in terms of family affiliation. Some authorities have put them in a very broad and clearly polyphyletic (but practical) Liliaceae (e.g., Correll & Johnston 1970; Cronquist 1988; Diggs et al. 1999), while others have recognized a smaller but still rather inclusive polyphyletic Melanthiaceae, including only superficially similar genera now treated in Nartheciaceae and Tofieldiaceae (e.g., Dahlgren et al. 1985). Still others (e.g., Zomlefer 1997a; Tamura 1998b; Judd et al. 1999, 2002) recognized a more narrowly defined Melanthiaceae (ca. 10-11 genera, 77–119 species), excluding *Trillium* and related genera (recognized as the Trilliaceae). The circumscription here is slightly narrower, limited to the tribe Melanthieae of Zomlefer and Judd (2002), a monophyletic taxon. Some recent molecular and morphological analyses (e.g., Chase et al. 2000; Fuse & Tamura 2000; Rudall et al. 2000b) support the inclusion of *Trillium* and related genera in Melanthiaceae (a circumscription followed by the Angiosperm Phylogeny Group (APG II 2003). Such a treatment is, however, problematic for a flora in that it groups together plants of radically different morphologies. As a result, we are taking what we consider to be an intermediate, though practical, approach in recognizing the Melanthiaceae excluding the Trilliaceae. For a detailed discussion of the groups formerly treated as Liliaceae in the broad sense, see the family synopsis of the Liliaceae (here treated in a restricted sense) on page 726. ☠ *Veratrum* alkaloids (see further discussion under *Veratrum*), some highly toxic, are found in a number of genera, including *Amianthium*, *Schoenocaulon*, *Toxicoscordion*, *Veratrum*, and *Zigadenus*. *Amianthium muscitoxicum* (Walt.) A. Gray, FLY-POISON (a literal translation of the Latin specific epithet), of the se U.S., sometimes included in *Zigadenus*, historically yielded root extracts which were mixed with honey or molasses and used as an insecticide against houseflies (Zomlefer 1997a). An illegitimate orthographic variant "Melanthaceae," has been used by some authors in the past (Zomlefer 1997a). The key to genera is modified from Zomlefer (1997a) and Zomlefer and Judd (2002). Family name from *Melanthium*, a genus of 4 species of e North America, here treated as part of *Veratrum*. (Greek: *melas*, black or dark, and *anthos*, flower, in reference to the persistent flower parts becoming dark after flowering) (subclass Liliidae—Cronquist; order Liliales—APG II)

FAMILY RECOGNITION IN THE FIELD: plants scapose or subscapose herbs with numerous small flowers in racemes, panicles or spikes and ovaries with 3 styles.

REFERENCES: Kupchan et al. 1961; Johnson 1969; Zomlefer 1997a; Tamura 1998b; Frame et al. 1999; Fuse & Tamura 2000; Rudall et al. 2000b; Zomlefer et al. 2001; Zomlefer & Judd 2002; Zomlefer & Smith 2002.

1. Leaves (actually leaf-like bracts) in a single whorl of 3 at the summit of the stem; flower solitary; fruits fleshy, berry-like _____ **Trillium** (see Trilliaceae)
1. Leaves mostly basal, not in a single whorl of 3 at summit of stem; flowers numerous; fruits dry capsules.
   2. Inflorescence spicate (with sessile flowers); bulbs covered with dark fibers; tepals 2.3–4.7 mm long; seeds with a short terminal appendage _____ **Schoenocaulon**
   2. Inflorescence racemose to paniculate (with stalked flowers); bulbs, if present, not covered with dark fibers; tepals 3–16 mm long; seeds lacking terminal appendage.
      3. Rhizome present, sometimes terminated by a bulb; tepals each with 2 glands at base; inflorescence floccose pubescent OR glabrous.
         4. Rhizome terminated by a tunicate bulb; tepals greenish yellow, aging dark reddish purple; inflorescence floccose pubescent; seeds broadly winged; plants flowering May–Jul _____ **Veratrum**
         4. Rhizome without a terminal bulb; tepals white to cream colored; inflorescence glabrous; seeds angled but not winged; plants flowering mid-Jul–Sep _____ **Zigadenus**
      3. Rhizome absent, underground stem a bulb (this sometimes slender); tepals each with 1 gland at base or gland lacking; inflorescence glabrous.

5. Tepal bases not clawed, only gradually and slightly narrowed at base; gland at tepal bases lacking or obscure; bracts 2–5(–12) mm long; bulb slender, ± cylindrical; filaments slender their whole length or nearly so; plants of forests, forest margins, damp pinelands, and bogs _____ **Stenanthium**

5. Tepal bases (at least the inner ones) abruptly narrowed and claw-like at base; gland at tepal bases present; longest bracts usually 10–20 mm long; bulb ovoid; filaments widened at base; plants of prairies and open woods, often on calcareous substrates _____ **Toxicoscordion**

SCHOENOCAULON A. Gray
SABADILLA, FEATHER-SHANK, GREEN-LILY, CEBADILLA

Herbaceous, scapose perennials with a much reduced rhizome terminating in a fibrous-tunicate bulb (with dark scales and fibers); leaves all basal, grass-like, glabrous, marginally serrulate; scapes naked, erect, unbranched; inflorescences spicate, terminal, many-flowered (bottlebrush-like); flowers sessile or sub-sessile, perfect (staminate at apex of inflorescence), each subtended by a small bract; tepals 6, ± equal, essentially free, pale green or greenish white, persistent; stamens 6 in 2 whorls, 2–2.5 times as long as perianth; styles 3, distinct; ovary superior; fruit a 3-celled capsule, ca. 1–2 cm long.

A New World genus of 10–25 species (Frame 2002) native from the s U.S. to Peru, with most species endemic to Mexico (Frame 1989). It is distinguished from related genera by its spike-like, racemose inflorescence of small flowers with exserted stamens (Frame 2001). Delimitation of species has been difficult (Zomlefer 1997a), and the exact number of species has been variously estimated to be 10–25 (Frame 1989, 2002; Zomlefer 1997a; Tamura 1998b); Zomlefer and Judd (2002) estimated 24 species. Recent molecular as well as morphological evidence suggests the genus is monophyletic (Zomlefer et al. 2001). According to Frame (2002), "*Schoenocaulon* has rarely been collected in the United States in recent times; all three [U.S.] species are possibly threatened." However, Zomlefer (pers. comm.) notes that *S. dubium* (Michx.) Small of FL is common. Frame (1989) indicated that "... the perianth more or less i[e]ncloses the androecium at anthesis. After anthesis, the perianth opens and elongates somewhat, and the filaments elongate relatively more than the perianth." Some species have *Veratrum*-type cerveratrum alkaloids (e.g., sabadine and veratradine); *S. officinale* A. Gray (SABADILLA, CEVADILLA) has seeds that are insecticidal and have been used by humans (e.g., louse powder) and in veterinary medicine as a topical pesticide (Kupchan et al. 1961; Mabberley 1997; Zomlefer 1997a; Frame 2002). "An extract of sabadilla reportedly was one of the ingredients in the asphyxiating gases used by the Germans in chemical warfare of World War I" (Zomlefer 1997a). (Greek: *schoeno*, reed or rush-like, and *caulos*, a stalk, in reference to the naked scape—Frame 1989, or the rush-like appearance of the inflorescence of tiny flowers—Zomlefer 1997a)

REFERENCES: Brinker 1942; Frame 1989, 1990, 2001, 2002; Frame et al. 1999; Zomlefer et al. 2001.

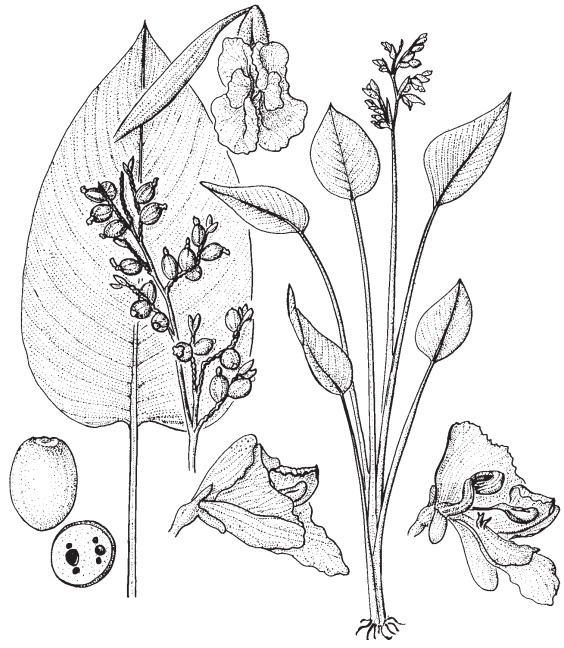
1. Plants usually (but not always) flowering in autumn (Sep–Oct); tepals usually elliptic to ovate-elliptic, submembranous to slightly fleshy, with thin crenulate to minutely denticulate margins; inflorescences 15–20 mm in diam. _____ **S. ghiesbreghtii**

1. Plants flowering in spring and summer (Mar–Jul, rarely later after unseasonable rainfall); tepals linear-oblong, fleshy-thickened or almost leathery, with thickish entire margins; inflorescences 10–15 mm in diam. _____ **S. texanum**

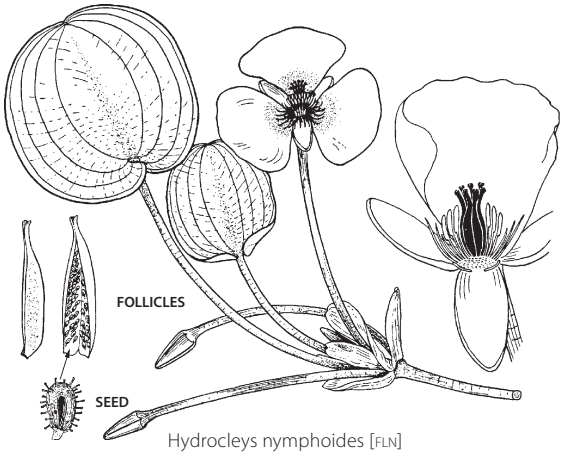
Schoenocaulon ghiesbreghtii Greenm., (for A.B. Ghiesbreght, 1810–1893, who collected the type in Chiapas, Mexico), GREEN-LILY, DRUMMOND'S SABADILLA, GREEN FEATHER-SHANK. Plant to ca. 90 cm tall; leaves to 50(–75) cm long, to 7(–11) mm wide; tepals ca. 2.5–4.7 mm long, pale green; $2n = 16$ (Frame 2002). Sandy or gravelly soils, roadsides, arroyos, prairies, forest margins, caliche; Bastrop, Colorado, Gonzales, Guadalupe (BRIT), Bexar, Caldwell, DeWitt, Fayette, and Wilson (Turner et al. 2003) cos. in s part of Post Oak Savannah; also Gulf Prairies and Marshes and



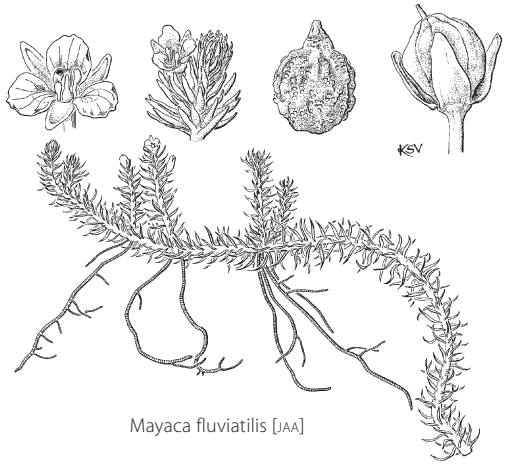
Lilium philippinense [GCH]



Thalia dealbata [FNA]



Hydrocleys nymphoides [FLN]



Mayaca fluviatilis [JAA]



Schoenocaulon ghiesbreghtii [HEB]

South TX Plains; in the U.S. this species is known only from TX. Sep–Oct (rarely in spring). This species has in TX long gone under the name *S. drummondii* A. Gray (e.g., Correll & Johnston 1970), which is now considered an illegitimate name (TROPICOS 2003). Frame (2002) treated this species as *S. ghiesbreghtii* Greenm. (also known from Mexico), but based on molecular work in preparation (W. Zomlefer, pers. comm.), the U.S. populations likely warrant recognition as a separate species. According to Frame (2002), in the U.S. this species "grows at or near sea level and almost exclusively on the Reyosa gravel formation of the Texas Gulf prairie. ... In the late 1930s and early 1940s, it was used in a series of transplantation experiments conducted by the Texas Agricultural Experiment Stations. This has led to some confusion with regard to its natural distribution." Until the nomenclature of this species is clarified, we are following the recent *Flora of North America* treatment (Frame 2002) in using the name *S. ghiesbreghtii* for the GREEN-LILY.

Schoenocaulon texanum Scheele, (of Texas), TEXAS SABADILLA, TEXAS FEATHER-SHANK. Plant to 55 cm tall; leaves to 60 cm long, mostly 4(–6) mm or less wide; tepals 2.3–4 mm long, greenish white; capsules 10–15(–19) mm long; $2n = 16$ (Frame 2002). Limestone soils, rocky grasslands and openings in juniper-oak woodlands; Bell, Hays, Travis (BRIT), Comal (ASTC), Bexar (Turner et al. 2003), and Williamson (Balcones Canyonlands Nat. Wildlife Refuge, C. Sexton, pers. comm.) cos.; w margin of East TX s to South TX Plains and w through Edwards Plateau to Trans-Pecos; NM and TX. Mar–Jul (–rarely later after unseasonable rainfall). According to Frame (2002), "The morphology of *Schoenocaulon texanum* is peculiarly dependent upon annual rainfall. Plants of small stature but average bulb size can be readily distinguished as the products of one or several seasons of lower than normal rainfall. The hallmarks of such plants are congested racemes, few flowers, these often appearing withered and brown, and ovaries that do not mature or have perhaps only one small locule ripening to produce a few seeds." ⊠/297

STENANTHIUM (A. Gray) Kunth FEATHER-BELLS, FEATHER-FLEECE

Perennial, subscapose, glabrous herbs from a slender bulb; leaves crowded near base; inflorescence a raceme or panicle; flowers perfect and/or staminate; tepals 6, all ± alike, greenish white to creamy white, cream, or yellowish, separate to base, not clawed, glandless or with an obscure gland at base of each; stamens 6; ovary usually superior or partly inferior; fruit a capsule.

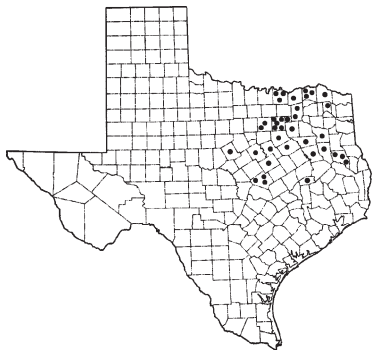
A genus of 2 or 3 species of the e U.S. (Zomlefer & Judd 2002; Zomlefer & Smith 2002). Recent chromosomal, molecular, and morphological studies (Zomlefer et al. 2001; Zomlefer & Judd 2002; Zomlefer & Smith 2002) have necessitated significant changes in generic circumscription of *Stenanthium*. Several species previously placed in *Stenanthium*, as well as several formerly in *Zigadenus*, have now been shown to belong in the genus *Anticlea* (Zomlefer et al. 2001; Zomlefer & Judd 2002; Zomlefer & Smith 2002). *Stenanthium gramineum* (the type species of the genus) has been shown to be most closely related to taxa (*S. densum*, *S. leimanthoides* if recognized) previously treated in *Zigadenus*. This is a clear example of new research requiring scientific names to be changed (despite some nomenclatural confusion). See further discussion and references under *Zigadenus*.

All species of *Stenanthium* have a chromosome number of $2n = 20$ (Zomlefer & Smith 2002). (Greek: *stenos*, narrow, and *anthos*, flower, in reference to the narrow inflorescences or tepals)
REFERENCES: Fernald 1946b; Zomlefer et al. 2001; Utech 2002b; Zomlefer & Judd 2002; Zomlefer & Smith 2002.

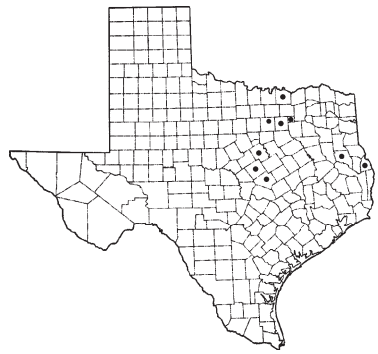
1. Tepals 3–5 mm long, each with an obscure gland near the base; inflorescence a raceme or panicle 5 cm or less wide; pedicels 10–20 mm long; capsules 10–20 mm long _____ **S. densum**
1. Tepals (4–)5–10 mm long, without glands; inflorescence a panicle often > 5 cm wide; pedicels 4–6 mm long; capsules 6–10 mm long _____ **S. gramineum**



Wolffiella oblonga



Erythronium albidum



Erythronium mesochoreum



Erythronium rostratum



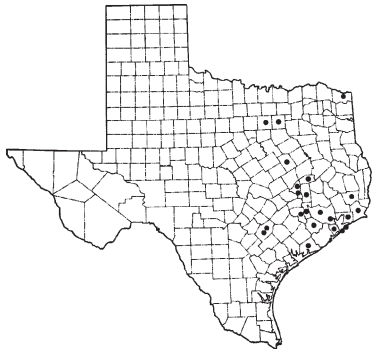
Lilium michauxii



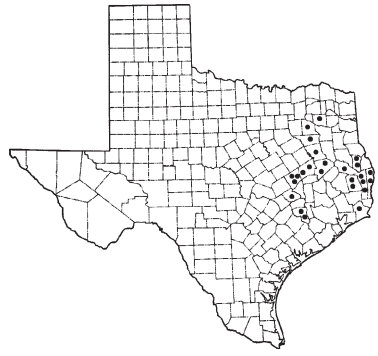
Lilium philippinense



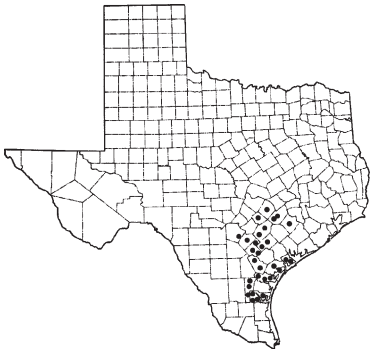
Hydrocleys nymphoides



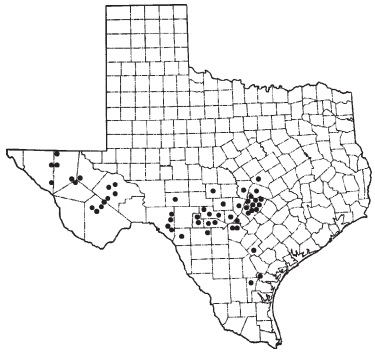
Thalia dealbata



Mayaca fluviatilis



Schoenocaulon ghiesbreghtii



Schoenocaulon texanum



Stenanthium densum

Stenanthium densum (Desr.) Zomlefer & Judd, (dense, crowded together), BLACK DEATH-CAMAS, CROW-POISON, BLACK-SNAKEROOT, PINE BARREN DEATH-CAMAS, COASTAL DEATH-CAMAS, OSCEOLA'S-PLUME. Subscapose, glabrous perennial to ca. 1.5(–2) m tall, bulbose, the bulbs rarely thickened (to only ca. 2 cm wide), with smooth coats or the outer bulb coats fibrous; leaves crowded near base, narrowly linear, to ca. 60 cm long, 2–12 mm wide; inflorescence usually a raceme or a panicle of racemes, with numerous flowers; bracts 2–5(–12) mm long, sometimes with a reddish tinge; pedicels 20 mm or less long; tepals 6, all ± alike, 3–5 mm long, greenish white to creamy white, cream, or yellowish, narrowed but not so abruptly as to be claw-like at base; with a usually obscure yellowish gland near the base; filaments slender their whole length; capsules usually 10–20 mm long. Wet areas, damp pinelands, and bogs; Anderson Co. in a "muck bog" in the Engeling Wildlife Management Area (BRIT; Bridges & Orzell 1989a; MacRoberts & MacRoberts 1998e; Singhurst et al. 2003b) and Henderson and Tyler (Turner et al. 2003) cos. in the Post Oak Savannah and Pineywoods; e U.S. from NY s to FL w to TX. Apr–Aug. [*Oceanorus leimanthoides* (A. Gray) Small, *Tracyanthus angustifolius* (Michx.) Small, *Zigadenus densus* (Desr.) Fernald, *Zigadenus leimanthoides* (A. Gray) A. Gray] *Zigedanus leimanthoides*, here included in *S. densum*, has often been segregated as a distinct species based on the paniculate (versus racemose for *S. densum*) inflorescence, and the "status of *S. leimanthoides* merits additional systematic study" (Zomlefer & Judd 2002). However, following Schwartz (2002), we are tentatively including *S. leimanthoides* in *S. densus* (even though Schwartz treated them in *Zigadenus*). According to McDearman (1984), Zomlefer (1997a), and Schwartz (2002), while distinct in some areas, the two entities intergrade (size, inflorescence morphology, flowering time) in the Gulf coast area. Plant size, which is determined by age and environment, appears to affect inflorescence morphology—smaller plants tend to have simple racemes, while larger plants develop panicles. Further research is needed to determine if recognition at the varietal level is appropriate. The bulb is reported to be "very poisonous" (Correll & Johnston 1970). While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠☠

Stenanthium gramineum (Ker Gawl.) Morong, (grass-like), FEATHER-BELLS, FEATHER-FLEECE. Erect, glabrous, perennial herb from a slender tunicate bulb; stems 0.3–1.5(–ca. 2) m tall, leafy in lower portion, the blades reduced upward; basal or near basal leaves also usually present and best developed; leaves numerous, linear, grass-like, to 70 cm long; inflorescence a panicle, 30–90 cm long; flowers numerous, perfect, and/or some staminate; tepals 6, whitish to greenish yellow, separate nearly to base, linear or narrowly lanceolate, (4–)5–10 mm long, glandless, persistent; stamens 6, much shorter than the perianth; ovary superior; capsule 6–15 mm long, erect. Forests, forest margins; widely scattered in the Pineywoods; e U.S. from PA s to FL w to MI and TX. Jun–Aug. [*S. angustifolium* (Pursh) Kunth, *S. robustum* S. Watson, *S. gramineum* var. *robustum* (S. Watson) Fernald] While some authorities (e.g., Kartesz 1999) recognize varieties in this species, we are not recognizing infraspecific taxa, following Utech (2002b), who said the varieties were "indistinct and sympatric." According to Yatskievych (1999), "Some authors do not consider this taxon [var. *robustum*] worthy of formal recognition, and intermediates between it and the typical phase have been documented." Likewise, Zomlefer (1997a) indicated that the varieties sometimes recognized in this species are "probably unworthy of taxonomic recognition." ⊠/302

TOXICOSCORDION Rydb.

DEATH-CAMAS, POISON-SEGO, STAR-LILY, ZYGADENE

A genus of ca. 8–10 species of the midwestern U.S. and w North America (Zomlefer et al. 2001; Zomlefer & Judd 2002; Zomlefer 2003). The species included here has traditionally been treated in *Zigadenus*. However, recent chromosomal, molecular, and morphological studies (Zomlefer et al. 2001; Zomlefer & Judd 2002; Zomlefer 2003) have necessitated significant changes in generic

circumscription of that genus (see *Zigadenus* for further discussion). ☠ Many species of *Toxicoscordion* (e.g., "DEATH CAMAS") are poisonous due to the presence of *Veratrum* alkaloids. Children have been poisoned from eating the bulbs or chewing the flowers, and deaths have been reported from eating the bulbs; all parts of the plant, fresh or dried, should be considered poisonous; toxins present include zygadenine, zygacine, and related alkaloids (Marsh et al. 1915; Kupchan et al. 1961; Schmutz & Hamilton 1979; Stephens 1980; Ajilvsgi 1984; Fuller & McClintock 1986; Foster & Caras 1994; Zomlefer 1997a; Burrows & Tyrl 2001; Schwartz 2002). According to Correll and Johnston (1970) (who treated the species in the genus *Zigadenus*), "When grazed, most of the species are usually fatal to sheep and some species even to cattle." Symptoms include muscle weakness, tremors, loss of motor coordination, foaming at the mouth and nostrils, and vomiting. While lacking the characteristic odor and having a bitter bulb, toxic *Toxicoscordion* species can be mistaken for wild onions (Weathers 1998; Bruneton 1999). They can also be confused with edible *Camassia* (WILD-HYACINTH) species, resulting in the common name DEATH-CAMAS (Burrows & Tyrl 2001). Native Americans used *Toxicoscordion* species medicinally in a variety of ways (Moerman 1998). (Latin: *toxicum*, poison, and Greek: *scordon*, garlic, presumably in reference to a similarity of the bulb to that of garlic)

REFERENCES: Preece 1956; Kupchan et al. 1961; McDearman 1984; Schwartz 1994; Zomlefer1997a; Frame et al. 1999; Zomlefer et al. 2001; Schwartz 2002; Zomlefer & Judd 2002; Zomlefer 2003.

Toxicoscordion nuttallii (A. Gray) Rydb., (for Sir Thomas Nuttall, 1786–1859, English-American botanist), NUTTALL'S DEATH-CAMAS, POISON-CAMAS, DEATH-CAMAS, MERRY-HEARTS, EASTER-CANDLE, POISON-HYACINTH. Perennial, subscapose, glabrous herb 30–75(–100) cm tall, bulbose, the outer bulb coats papery, not fibrous, the bulbs to ca. 4 cm wide; leaves crowded near base, with short, tubular basal sheath (closed but very thin down side opposite blade, easily splitting); inflorescence a raceme or a panicle with a few short branches near base, these flower-bearing nearly to base; longest bracts usually 10–20 mm long; pedicels becoming 10–25(–35) mm long; tepals all ± alike, separate to base, usually (5–)6–8(–9) mm long, whitish to cream, ovate, the inner (and sometimes outer as well) abruptly narrow and claw-like at base, each with a yellowish gland at base, withering persistent; stamens 6; filaments widened at base; ovary superior; fruit a 2-lobed capsule ca. 8–12(–16) mm long; $2n = 22$ (Zomlefer 2003, in contrast to incorrect literature reports of 32—e.g., Schwartz 2002). Prairies, open woods, often on calcareous substrates, in relatively dry habitats; widespread in East TX w to West Cross Timbers and e Edwards Plateau; AR, KS, MO, OK, and TX. Late Mar–early May. [*Amianthium nuttallii* A. Gray, *Toxicoscordion texense* Rydb., *Zigadenus texensis* (Rydb.) J.F. Macbr., *Zigadenus nuttallii* (A. Gray) S. Watson] All parts of the plant may be fatally poisonous to cattle, sheep, and horses due to complex steroidal alkaloids (Sperry et al. 1955; Ajilvsgi 1984; Blackwell 1990); *T. nuttallii* is considered the most toxic species in the genus (Burrows & Tyrl 2001). ☠ ⚅/303

VERATRUM L.
FALSE HELLEBORE, WHITE HELLEBORE, BUNCHFLOWER, SKUNK-CABBAGE, CORN-LILY

A n hemisphere genus of perhaps 29–34 species (Bodkin & Utech 2002; McNeal & Shaw 2002) of predominantly woodland and/or alpine perennial herbs (Zomlefer et al. 2003). Species limits within the group are unsettled, with some authorities giving a wider range (17–45) in the number of species (Zomlefer et al. 2003). The segregate genus *Melanthium* (4 species of e North America) has often been treated separately (e.g., Bodkin & Utech 2002) or variously submerged totally or in part into *Veratrum* (e.g., Zimmerman 1958; Kupchan et al. 1961; Zomlefer 1997a; Zomlefer et al. 2001; Zomlefer & Smith 2002). As recently as 2002, Bodkin and Utech noted that, "Resolution of the problematical *Melanthium–Veratrum* species series will require full molecular and phylogenetic analysis of the group, especially of the narrow-leaved Asian *Veratrum*, several of which approximate *Melanthium*." Recent work by Zomlefer et al. (2003)

addressed these issues, showing that *Melanthium* is derived from within *Veratrum,* and supporting the monophyly of *Veratrum* in the broad sense. Therefore, treatment of *Melanthium* within *Veratrum* now seems most appropriate. ☠ *Veratrum* (FALSE or WHITE HELLEBORE) species have long been important medicinally and as poisonous plants. They have been used medicinally since ancient times in Eurasian folk medicine, by various Native American tribes, and from the early 1800s until recently by medical doctors for the control of hypertension; they have also been used in sorcery, mystical rites, as crow poisons, and as insecticides (Kupchan et al. 1961; Zomlefer 1997a; Burrows & Tyrl 2001; Alm 2002). The hypotensive, teratogenic, and/or neurotoxic properties are the result of *Veratrum* alkaloids (e.g., veratradine, veratramine), a physiologically powerful group of very complex molecules. Approximately 100 of these compounds have been isolated, even though relatively few species have been thoroughly analyzed (Zomlefer et al. 2003). (Latin: *vere*, true, and *aater*, black, in reference to the black rhizomes found in some species—McNeal & Shaw 2002)

REFERENCES: Zimmerman 1958; Bodkin 1978, 1998; Zomlefer 1997a; Tamura 1998d; Zomlefer et al. 2001; Bodkin & Utech 2002; McNeal & Shaw 2002; Zomlefer et al. 2003.

Veratrum virginicum (L.) W.T. Aiton, (of Virginia), BUNCHFLOWER. Perennial, short rhizomatous herb lacking the odor of onion or garlic; stem base slightly bulbose, with brown fibers derived from old leaf bases; stem ± erect, 0.6–1.5(–2) m tall, downy or scurfy above; leaves mostly basal, those on the stem reduced and mostly bract-like; basal leaves 20–50(–80) cm long, 4–32 mm wide, broadly linear; inflorescence a terminal panicle; pedicels 4–22 mm long, subtended by small bracts, these densely floccose on margins and lower surfaces; flowers perfect or sometimes those near tip of inflorescence functionally staminate, numerous; tepals 6, 5–13 mm long, fused at the base, clawed, with a pair of yellow to greenish brown, nectariferous glands at base of ± ovate blade portion, whitish to pale yellow, turning greenish yellow or reddish purple; claw < 1/2 as long as blade; stamens 6, attached near or above middle of each claw; styles 3; ovary superior; fruit a 3-lobed capsule 10–18 mm long; seeds flat; $2n = 16$ (Bodkin & Utech 2002). Bogs, swales, savannahs, meadows, forest margins; Angelina, Jasper (ASTC), Anderson, Jefferson, and Milam (Turner et al. 2003) cos. in the Pineywoods and Post Oak Savannah; widespread in e U.S. w to KS, OK, and TX. May–Jul. [*Melanthium dispersum* Small, *Melanthium virginicum* L.] This species contains a number of poisonous alkaloids (Yatskievych 1999). ☠ ⚅/306

ZIGADENUS Michx.

DEATH-CAMAS, POISON-SEGO, STAR-LILY, ZYGADENE

☙ A monotypic genus of the se U.S. represented only by *Z. glaberrimus.* Recent chromosomal, molecular, and morphological studies (Zomlefer et al. 2001; Zomlefer & Judd 2002) have necessitated significant changes in generic circumscription of the tribe Melanthieae (which includes all East TX members of the family). In the past, *Zigadenus* has been variously circumscribed—Zomlefer (1997a) provisionally recognized 17 species, included the monotypic segregate *Amianthium,* and noted that the genus represents a "heterogeneous, non-monophyletic grouping" needing study. Tamura (1998b) circumscribed the genus more narrowly (ca. 10 species) and excluded *Amianthium.* Schwartz (2002) had a more inclusive view, recognizing 18–22 species. In all of these conceptions, the genus was a heterogeneous assemblage of only distantly related species. This is a clear example of new research requiring scientific names to be changed (despite some nomenclatural confusion). Extensive recent research (Zomlefer et al. 2001) has shown that *Z. glaberrimus* is an isolated taxon on a separate evolutionary branch from the rest of the tribe—it thus has to be recognized as a separate genus. Because *Z. glaberrimus* is the type species of *Zigadenus,* different generic names have to be used for the other groups of species previously recognized in the polyphyletic *Zigadenus* (Zomlefer & Judd 2002). For example, *Z. densus* and *Z. nuttallii* are now treated in *Stenanthium* and *Toxicoscordion* respectively. Previously sometimes spelled *Zygadenus,* an orthographic variant that does not have nomenclatural priority. (Greek: *zygos,* a yoke, and *aden,* a gland, referring to the glands on the tepals sometimes being in pairs)



Schoenocaulon texanum [HEA]



Stenanthium gramineum [BB1]



Stenanthium densum [GLE]



Zigadenus glaberrimus [GLE]



Veratrum virginicum [GLE]



Toxicoscordion nuttallii [BB2]

REFERENCES: Preece 1956; Kupchan et al. 1961; Zomlefer 1997a; Frame et al. 1999; Zomlefer et al. 2001; Schwartz 2002; Zomlefer & Judd 2002.

1. Plant from thickened, twisted rhizome; tepals (9–)10–16 mm long, each with 2 glands above base _____ **Z. glaberrimus**
1. Plant from a bulb (this sometimes slender); tepals 3–8(–9) mm long, each with 1 gland at base or gland lacking (species previously treated in *Zigadenus*)
   2. Tepals 3–5 mm long, narrowed but not so abruptly as to be claw-like at base; filaments slender their whole length; bracts 2–5(–12) mm long; plants of wet areas, damp pinelands, and bogs _____ see *Stenanthium densum*
   2. Tepals usually (5–)6–8(–9) mm long, at least the inner ones abruptly narrowed and claw-like at base; filaments widened at base; longest bracts usually 10–20 mm long; plants of drier habitats, prairies and open woods, often on calcareous substrates _____ see *Toxicoscordion nuttallii*

Zigadenus glaberrimus Michx., (very smooth, bare), SANDBOG DEATH-CAMAS, ATLANTIC DEATH-CAMAS, SNAKE-ROOT, was apparently erroneously reported for "Tex. (?)" by Correll and Johnston (1970) and for East TX (no county specified) by Nixon and Kell (1993). However, according to Schwartz (2002), this species of the far se U.S. occurs in neither TX nor any adjacent state, and she considers its closest occurrence to TX to be in MS. Likewise, we have seen no specimens from TX and thus do not consider it to be a member of the East TX flora. It is included here to clarify confusion and to alert collectors to its possible, but unlikely, occurrence in the state. Bogs, savannahs, sandy pinelands; AL, FL, GA, MS, NC, SC, VA. Mid-Jul–Sep. This species, now recognized as a monotypic genus, has long been recognized as unusual. For example, Radford et al. (1968) suggested that it was unusual in having rhizomes, was "perhaps generically distinct" from the other members of the genus, and was in "many respects very closely related to *Melanthium*." As with many other members of the Melanthiaceae, this species should be considered toxic (Burrows & Tyrl 2001). ☠

NARTHECIACEAE Fr. ex Bjurzon
BOG ASPHODEL FAMILY

A small family (4–5 genera, ca. 21–28 species) of perennial herbs, generally of temperate climates from e Asia and Indomalaysia to e North America and n South America; a few have been cultivated as ornamentals (Zomlefer 1997c; Caddick et al. 2002b). The genera have been variously treated in terms of family affiliation. Many authorities (e.g., Correll & Johnston 1970; Cronquist 1988; Diggs et al. 1999) have put them in a broadly defined and clearly polyphyletic (but practical) Liliaceae, based on superficial similarities in flower structure to the genus *Lilium*, while others have put them in a polyphyletic Melanthiaceae (e.g., Dahlgren et al. 1985). We are using a narrower and presumably monophyletic circumscription following Zomlefer (1997c) and Caddick et al. (2002b). Tamura (1998c) recognized the Nartheciaceae but treated the family more broadly (10 genera and ca. 72 species), including genera here considered to comprise the very distantly related Tofieldiaceae. Some authorities have recognized the family in the order Nartheciales (Reveal & Zomlefer 1998). Preliminary molecular/cladistic evidence suggested that the order Nartheciales (excluding the Tofieldiaceae) was in an isolated position and appeared to be the sister group of the Dioscoreales (Chase et al. 1995a; Zomlefer 1999; Fuse & Tamura 2000). Subsequently, a number of authorities (e.g., Caddick et al. 2000, 2002a, 2002b; Chase et al. 2000; APG II 2003) have placed the family in the Dioscoreales (the classification we are following here). However, a very recent molecular study (Davis et al. 2004) suggests that the Nartheciaceae is the sister group to the Pandanales. Whichever ordinal designation is chosen, members of the Nartheciaceae are not closely related to other taxa often put in a broadly defined Liliaceae. In addition, the Nartheciaceae are only distantly related to the

Tofieldiaceae, which are in a clade including Alismataceae and Araceae, near the base of the monocots (Chase et al. 2000; Fuse & Tamura 2000). For a detailed discussion of the groups formerly treated as Liliaceae in the broad sense, see the family synopsis of the Liliaceae (here treated in a restricted sense) on page 726. Family name from *Narthecium*, BOG ASPHODEL, a genus of 4–8 species of temperate North America, e Asia, and w Europe. (Name an anagram of *Anthericum* L.—Zomlefer 1997c, a genus previously treated in a broadly defined Liliaceae but now in the Anthericaceae—Mabberley 1997) (subclass Liliidae—Cronquist; order Dioscoreales—APG II)

FAMILY RECOGNITION IN THE FIELD: scapose perennials with small white to yellow flowers in a spike-like raceme, the tepals free only at their tips and *wrinkled and roughened externally* and appearing mealy.

REFERENCES: Dahlgren et al. 1985; Goldblatt 1995; Zomlefer 1997a, 1997c, 1999; Reveal & Zomlefer 1998; Tamura 1998c; Caddick et al. 2000, 2002a, 2002b; Fuse & Tamura 2000; Davis et al. 2004.

ALETRIS L. STAR-GRASS, COLIC-ROOT

Perennial, glabrous herbs from a short thick rhizome; leaves mostly in a basal rosette, sessile, linear-lanceolate to elliptic, flat; flowers in a spike-like raceme terminating a nearly naked scape (a few small remote bracts can be present); flowers perfect, each subtended by 2 subulate, unequal bracts; perianth tubular to campanulate, wrinkled and roughened externally (appearing mealy or farinose), the 6 segments (= tepals) free only at the apex (lobes); stamens 6, attached to perianth just below perianth lobes; style 1, with 3 stigmas; ovary superior to partly inferior; fruit a beaked capsule.

A genus of ca. 15–25 species of North America, the West Indies (Bahamas), and e Asia (Zomlefer 1997c; Sullivan 2002), including several cultivated as ornamentals. Some authors (e.g., Wen 1999) consider this genus an example of an e Asia-e North America disjunction; this distribution pattern is discussed under the genus *Brachyelytrum* (Poaceae). The rhizomes of some species (particularly *A. farinosa*) are rich in steroidal sapogenins and have been used medicinally, giving rise to such common names as COLIC-ROOT, AGUE-ROOT, BREAST-ROOT, BACKACHE-ROOT, and RHEUMATISM-ROOT (Cheatham et al. 1995; Zomlefer 1997c). (Greek: *aletris*, a female slave who ground corn, referring to the apparent mealiness of the perianth)

REFERENCES: Browne 1956, 1961; Sullivan 2002.

1. Perianth yellow to orange-yellow, ca. 6–7 mm long, the lobes ovate to triangular _____ **A. aurea**
1. Perianth white to creamy-white, usually (7–)8–10 mm long, the lobes lanceolate to lance-oblong _____ **A. farinosa**

Aletris aurea Walter, (golden), YELLOW STAR-GRASS, YELLOW COLIC-ROOT, GOLDEN COLIC-ROOT. Leaves flat, lanceolate, 2–8(–12) cm long, 10–20 mm wide, bright yellow green; scape 20–80 cm or more tall; pedicels 3 mm or less long; perianth yellow to orange-yellow (can fade upon drying), roughened on the outside; beak of fruit gradually narrowed. Savannahs, boggy areas, pine barrens; Pineywoods and Post Oak Savannah; also n Gulf Prairies and Marshes; se U.S. from MD s to FL w to AR, OK, and TX. May–Jul. /273

Aletris farinosa L., (mealy, powdery), UNICORN-ROOT, WHITE-TUBE STAR-GRASS, WHITE STAR-GRASS, SOUTHERN COLIC-ROOT, WHITE COLIC-ROOT. Leaves 4–15(–20) cm long, (5–)10–20(–26) mm wide, dark green; scape 40–100 cm tall; perianth white to creamy white, roughened on the outside; beak of fruit abruptly narrowed. Sandy soils, gravels, and peats; tentatively included based on citations for East TX by Correll and Johnston (1970) and for the ne corner of East TX (without county specified) by Sullivan (2002); no county distribution map is provided; se Canada and widespread in the e U.S. w to IL, AR, and TX. Late spring–mid-summer. /273

NOLINACEAE Nakai
BEAR-GRASS FAMILY

Dioecious or polygamo-dioecious, xerophytic perennials with a woody crown or short trunk; leaves numerous, clustered in a dense rosette, linear, smooth to prickly-margined; inflorescences many-flowered pedunculate panicles; flowers mostly unisexual (reduced parts of opposite sex present); perianth radially symmetrical, of 6 segments; stamens 6; ovary superior, with 1 or 3 cells; fruit a 3-winged samara or ± inflated 3-lobed capsule; seeds 1–3 per fruit.

A small family of 4 genera and ca. 50 species (Bogler 1998a) of perennial xerophytes with many adaptations related to water conservation. Growth forms vary from small and nearly trunkless to large and tree-like, but all share leaves in a terminal rosette. The family ranges from n Central America through Mexico to the s U.S. (Bogler 1998a; Irish & Irish 2000), with most species in Mexico. It includes the unusual *Beaucarnea*, a genus of tree-like species with often strikingly swollen stem bases. In the past, taxa included here in the Nolinaceae were sometimes included in a broadly conceived Liliaceae (e.g., Kartesz 1999) or often in the Agavaceae (e.g., Correll & Johnston 1970; Diggs et al. 1999; Verhoek & Hess 2002 following Cronquist 1988), based on certain morphological similarities. However, recent evidence suggests that the Agavaceae and Nolinaceae are not closely related and should be recognized separately (Dahlgren et al. 1985; Eguiarte et al. 1994; Bogler & Simpson 1995, 1996; Kubitzki et al. 1998; Chase et al. 2000). Molecular evidence indicates that the Nolinaceae is closely related to the Asparagaceae and Convallariaceae, and some studies (e.g., Chase et al. 1995a; Chase et al. 2000; Fay et al. 2000) suggest that the Nolinaceae should be included in the Convallariaceae. Following such preliminary studies, Judd et al. (1999) submerged the Nolinaceae into the Convallariaceae. On the other hand, Rudall et al. (2000a), Judd et al. (2002), and Judd (2003) included the Nolinaceae in a broadly interpreted Ruscaceae. More recently, the Angiosperm Phylogeny Group (APG II 2003) suggested placing them either in Ruscaceae or in a very broadly defined Asparagaceae (along with such families as Agavaceae). However, there has been disagreement in molecular analyses of the family and its presumed relatives (see e.g., Rudall et al. 2000a; Yamashita & Tamura 2000). Since the Nolinaceae appears to be a well-defined monophyletic group (Bogler & Simpson 1995, 1996), and until the phylogeny of this complex is clarified and the nomenclature more stable, we are recognizing it as a distinct family. Some species are used as ornamentals (e.g., *Beaucarnea*), while the leaves of others "have been used since prehistoric times for weaving baskets, sandals, sleeping mats, hats, and other household items" (Bogler 1998a). Pollination is primarily by small bees (Bogler 1998a). (subclass Liliidae—Cronquist; order Asparagales—APG II as part of Ruscaceae)

FAMILY RECOGNITION IN THE FIELD: dry-adapted, somewhat grass-like perennials with a rosette of numerous, linear, smooth to conspicuously prickly-margined leaves from a woody crown or short trunk; flowers small, white or greenish, numerous in a panicle.

REFERENCES: Dahlgren et al. 1985; Eguiarte et al. 1994; Bogler & Simpson 1995, 1996; García-Mendoza & Galván 1995; Bogler 1998a; Irish & Irish 2000; Yamashita & Tamura 2000; Walker 2001; Judd 2003.

1. Leaf margins with sharp, curved, spine-like prickles 1–3 mm long, the prickles visible at a glance; fruits 3-winged, with only one seed, 1-celled; inflorescences with branches so densely covered with flowers that they are finger-like _____ **Dasylirion**
1. Leaf margins smooth to strongly serrulate, but without spine-like prickles, the teeth much less than 1 mm long and visible only on close inspection; fruits unwinged (but dry and inflated), usually with more than one seed, 3-celled and 3-lobed; inflorescences relatively open, the branches not finger-like _____ **Nolina**

DASYLIRION Zucc. SOTOL, SHAGGY-LILY

A genus of ca. 17 species (Bogler 2002) of fibrous, prickly-leaved species of arid regions of the sw U.S. and Mexico; a number are cultivated in xerophyte gardens. The trunks of some species were used in construction and as fuel, and the leaves have been used for thatching, baskets, etc. The sugar-rich spongy interiors of the trunks and leaf bases have been used as a food for cattle (during droughts) and humans (Standley 1920). The leaves were trimmed and the remaining "heads" (including pith and leaf bases) were roasted in pits in the ground or otherwise cooked and were widely used as food in the desert southwest. A liquor known as sotol (with strong odor and peculiar taste) is made from *Dasylirion* in a process similar to mescal and tequila production from *Agave* (distilled from the baked and fermented "heads"); it was widely smuggled into the U.S. during prohibition (Standley 1920; Bogler 1998a, 2002). (Greek: *dasy*, thick, dense, or shaggy, and *lirion*, lily, in reference to the old leaves that hang on the trunk and give the plant a shaggy appearance—Starr 1999 or to the compact arrangement of flowers in the inflorescence—Bogler 2002)

REFERENCES: Trelease 1911; Bogler 1994, 1995, 1998b, 2002; Starr 1999.

Dasylirion texanum Scheele, (of Texas), TEXAS SOTOL, SOTOL. Perennial with short trunk often buried in the ground or to 0.5(–1.5) m tall; leaves numerous, in a rosette, (0.7–)0.9–1.3 m long, 8–14 mm wide (not including prickles), ± rigid, marginally armed with antrorse, curved, spine-like prickles 1–3 mm long, apically splitting into conspicuous fibers; flowering stem 2–4 m long, terminated by a narrow panicle 0.6–0.9 m long; flowers functionally unisexual (species partly dioecious); perianth ca. 1.5–2 mm long, whitish or greenish, the segments minutely toothed; fruit a 3-winged, 1-seeded, indehiscent samara, 5.5–7 mm long. Dry rocky areas; Bexar, Comal (Turner et al. 2003), and Travis (Carr 2002a) cos. near extreme w margin of East TX; mainly Edwards Plateau and Trans-Pecos; in the U.S. known only from TX, also Mexico. Jun–Jul. Cattle are reported to be able to feed on the "heads" if the leaves are burned off (Vines 1960).

NOLINA Michx. BEAR-GRASS

Polygamo-dioecious perennials with woody crowns; leaves numerous, in a basal rosette, linear, with margins smooth or serrulate; panicle stalked, held among or well above the leaves; perianth small, whitish to yellowish green, 1.8–3.5 mm long; fruit a ± inflated, 3-lobed capsule; seeds ± round, 2.6–4.2 mm in diam.

A primarily sw North American genus of 23–30 species, with species ranging from the se U.S. n to Colorado, w to California, and s into Mexico (Bogler 1998a; Irish & Irish 2000; Hess 2002); some are used as ornamentals. (Named for Abbé C.P. Nolin, an 18th century French agriculturalist, arboriculturist, and director of the royal nurseries—Hess 2002)

REFERENCES: Trelease 1911; Thorne 1965; Hess 2002; Judd 2003.

1. Leaves 4–12 mm wide, flattened in cross section, the margins strongly serrulate; inflorescence held well above the leaves; capsules 6–10 mm long _____ **N. lindheimeriana**
1. Leaves 2–4(–7) mm wide, roundish with one flattened side in cross section, the margins smooth to remotely toothed; inflorescence among the leaves; capsules 3–4 mm long _____ **N. texana**

Nolina lindheimeriana (Scheele) S. Watson, (for Ferdinand Jacob Lindheimer, 1809–1879, German-born TX collector), DEVIL'S-SHOESTRING, LINDHEIMER'S BEAR-GRASS, RIBBON-GRASS, LINDHEIMER'S NOLINA. Perennial 60–180 cm tall, with woody crown; leaves narrow and elongate, 30–100 cm long, flat, soft, with smooth surfaces and serrulate margins, the teeth directed forward; seeds loose in capsule. Limestone outcrops, in sun or shade; Bexar, Comal, Fayette, Travis, Williamson (Turner et al. 2003), and Bell (J. Stanford, pers. comm.) cos. near w margin of East TX; mainly Edwards Plateau; endemic to TX (Kartesz 1999; Carr 2002b, 2002c) or nearly so

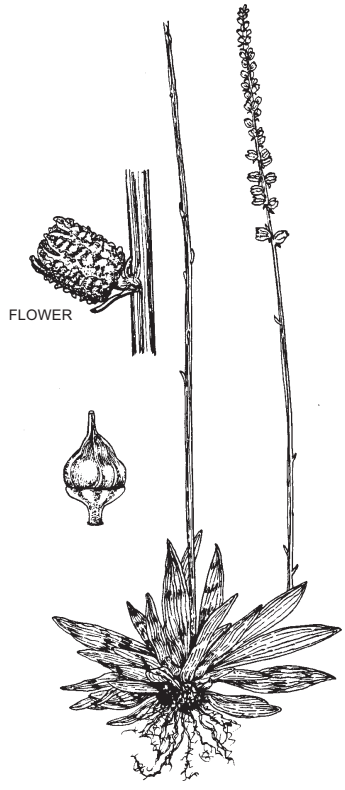
(Hess 2002). Apr–May. [*Dasylirion lindheimerianum* Scheele] Hess (2002) noted that this species is "quite infrequent and becoming more so as its habitat is destroyed through development or overgrazing."

Nolina texana S. Watson, (of Texas), TEXAS BEAR-GRASS, BEAR-GRASS, SACAHUISTA, TEXAS SACAHUISTA, BUNCH-GRASS. Perennial 30–60 cm tall; leaves narrow, elongate, 40–80 cm long, almost rounded-triangular in cross section, the margins smooth or with distant teeth; seeds bursting capsule walls as they expand. Rocky soils; Bell (BRIT), Bexar (BAYLU), Travis (TAMU), Comal, and Williamson (Turner et al. 2003) cos. near w margin of Blackland Prairie; mainly w 1/2 of TX; NM and TX. Late winter–spring(–early summer). [*N. texana* var. *compacta* (Trel.) I.M. Johnst.] The flowers, flower stalks, buds, and fruits are poisonous and potentially fatal to livestock. Liver-kidney toxicity and photosensitization (= increased sensitivity to light, thus easily sunburned) are involved, with poisoning caused by steroidal saponins as well as an unidentified volatile toxin. Symptoms include a swollen head and reddened, swollen ears, lips, and face—as a result, the condition is sometimes known as "bighead" (Sperry et al. 1955; Kingsbury 1964; Weathers 1998; Burrows & Tyrl 2001; Hart et al. 2001). This species is normally avoided by livestock but will be eaten if no other food is available (J. Stanford, pers. comm.). Hess (2002) noted that, "The dark, round seeds are quite distinct in the open fruit chambers on inflorescences hidden within the basal leaves." /292

ORCHIDACEAE Juss.
ORCHID FAMILY

East TX species perennial terrestrial herbs, some species rhizomatous or with swollen, bulbose bases, autotrophic and with green leaves or saprophytic/mycophytic and lacking chlorophyll; roots mycorrhizal (= obtaining nutrients from a symbiotic relationship with fungi in the soil), fleshy-fibrous or absent (*Corallorhiza*, *Hexalectris*); leaves when present basal or cauline, alternate or opposite (*Listera*) or spiral (*Platythelys*) or whorled (*Isotria*), with sheath or clasping petiolar base or not so (*Tipularia*); leaf blades with parallel or parallel convergent veins, or ribbed and net-veined, or rather fleshy and not evidently veined; flowers solitary or in spikes or racemes, usually bilaterally symmetrical (asymmetrical in *Tipularia*); sepals 3, green or colored and petal-like; petals 3, one (the lip or labellum, normally the lowest due to 180° twisting of the flower) slightly or very different from the others in shape or size and often elaborated into lobes, spurs, sacs, fringes, or grooves; nectaries usually present; stamen 1 (or 2 fertile stamens and 1 staminode in *Cypripedium*), united with pistil into a central knob-like or column-like structure (= column) with 1 inconspicuous sessile anther (or 2 in *Cypripedium*); pollen grains usually in pollinia (= sac-like waxy masses), with elongate tips terminating in a sticky pad (= viscidium) or granular (*Cypripedium*); ovary inferior, in most species twisted and the flower thus resupinate (= inverted 180°, making the lip the lowermost of the petals); placentation parietal; fruit (in ours) a dry dehiscent capsule; seeds very numerous (can number in the thousands or even millions), minute, dust-like, without endosperm.

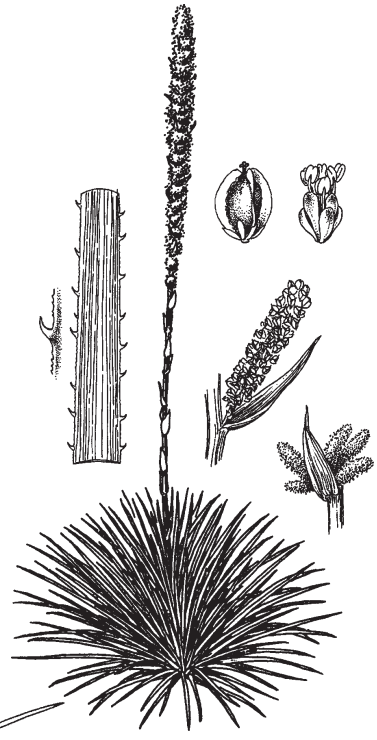
A huge family of ca. 800 genera and 22,000–35,000 species (Romero-González et al. 2002), more species than any other monocot family. The Orchidaceae is possibly larger even than the Asteraceae and thus possibly the largest family of flowering plants; it comprises ca. 40% of the monocots (Rasmussen 1985). Because of its size and the number of tropical (and thus poorly known) taxa, the number of genera and species has been difficult to determine. The family is cosmopolitan in occurrence, ranging from the tropics to polar regions. Based on recent molecular studies (e.g., Kores et al. 1997; Cameron et al. 1999; Cameron & Chase 2000; Freudenstein & Chase 2001), five subfamilies are now often recognized within the Orchidaceae: Apostasioideae, Cypripedioideae, Epidendroideae, Orchidoideae (including the previously recognized



Aletris aurea [CO1]



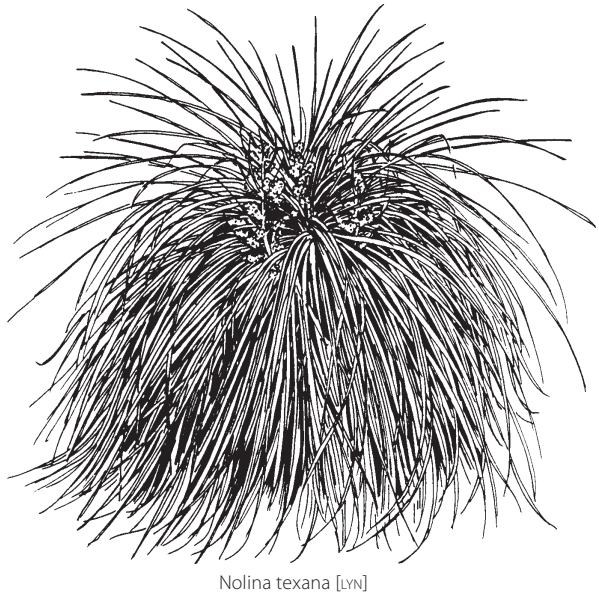
Nolina lindheimeriana [LYN]



Dasylirion texanum [POW]



Aletris farinosa [GLE]



Nolina texana [LYN]

Spiranthoideae), and Vanilloideae (Judd et al. 2002). Representatives of four of the subfamilies (all except the basal, Old World Apostasioideae) occur in East TX. The family has been variously considered to be in either Liliales or Asparagales, with recent molecular evidence suggesting that Orchidaceae are a monophyletic group in the Asparagales (a group containing Agavaceae, Amaryllidaceae, Iridaceae, Hypoxidaceae, etc.) (Chase et al. 1995b; Dressler & Chase 1995; Fay et al. 2000; Davis et al. 2004). "The extraordinary diversity of the orchids has only been fully realized during the last 150 years, yet orchids are mentioned in the earliest botanical literature as sources of wonderment or medicinal power. The well known belief in the powers of the testicle-like tubers of *Orchis* was described by Dioscorides in his *De Materia Medica* (c. AD 70). ..." (Rasmussen 1999). Even earlier, Theophrastus (327–285 BC) described orchids (in the genus *Orchis*) in his *Enquiry into Plants*. Orchids are particularly abundant in the tropics where many species are epiphytic. Atwood (1986) indicated epiphytes account for 73% of the family, and many of these have special swollen water and nutrient storage structures called pseudobulbs (modified stems)—a particularly important adaptation for the epiphytic habit.

The family is extremely important horticulturally for its beautiful and intricate flowers, and nearly 100,000 hybrids have been reported (Huxley et al. 1992), including numerous intergeneric hybrids. However, "most of the plants traded in the national and international market belong to a small number of species and their hybrids in only a few genera" (Romero-González et al. 2002). Orchid cultivation is very old, dating back over 2,500 years. Kung-fu-tzu (Confucius 551–479 BC) said "Acquaintance with good men is likened to entering a room full of Lan." "Lan gives the king's fragrance." *Lan* is the Chinese term for "fragrant Orchid" and refers to *Cymbidium ensifolium* (and *C. pumilum*), which had apparently been brought into cultivation long before the time of Kung-fu-tzu (L. Magrath, pers. comm.). Well known cultivated genera include *Cattleya* (CORSAGE ORCHID), *Cymbidium*, *Dendrobium*, *Epidendrum*, *Paphiopedilum* (SLIPPER ORCHID), and *Phalaenopsis* (MOTH ORCHID). In addition to hybridization, tissue culture and other sophisticated techniques are now used in orchid propagation and cultivation. The fruit of *Vanilla planifolia* Jackson, a tropical American spice used by the Aztecs and earlier Mexican cultures, is the source of the flavoring vanilla. While huge numerically and of great importance horticulturally (Cullen 1992), the Orchidaceae remains one of the least understood families of flowering plants (Pridgeon et al. 1999) for a variety of reasons (e.g., lack of good fossil record, size, largely tropical distribution).

Pollination mechanisms are often incredibly specialized (e.g., pseudocopulation in which the flower mimics a female insect and thus attracts males who carry out pollination while attempting to copulate with the flower); some species even imprison and intoxicate their pollinators. Other species offer no reward and attract pollinators by deceit (Neiland & Wilcock 2000). Pollinia are often attached by their sticky viscidia to particular body parts of insect visitors (e.g., compound eyes, head, proboscis) and subsequently transferred to the flowers of other individuals (see Catling & Catling 1991b for detailed information on orchid pollination). Special relationships with mycorrhizal fungi are necessary for seed germination, seedling growth, and nutrient uptake (see e.g., Clements 1988; Anderson 1991; Currah 1991), and mycotrophy (= obtaining food from decaying organic material via a special relationship with a symbiotic fungus) is either a primary (*Corallorhiza*, *Hexalectris*) or secondary source of nutrition. Orchidaceae are unique in having basidiomycete fungi involved in the mycorrhizal relationship (Currah 1991). A number of orchids have a low tolerance for environmental disturbance (probably in part due to their obligate relationships with mycorrhizal fungi and in most cases specific pollinators), and many species are now greatly reduced in number or extinct due to habitat destruction and modification. However, some species, particularly those of bogs and wetland pine savannahs, require natural disturbance such as fire. Finding orchids in the wild can sometimes be difficult. According to Yatskievych (1999), "Many species produce only vegetative growth some years and several regularly take breaks from aboveground life, persisting subterraneously for one or more years." Of the 55 species of orchids known for TX (Liggio & Liggio 1999; J. Liggio, pers. comm.),

45 occur in East TX including the federally endangered *Spiranthes parksii* and the newly described *Spiranthes eatonii* and *S. sylvatica* (Brown 1999, 2001). Luer (1972, 1975), Liggio and Liggio (1999), and Brown (2003) have excellent color photographs of the orchids of East TX; many photographs by Joe Liggio are included in this volume. An additional species that should be looked for in East TX is *Pteroglossaspis ecristata* (Fernald) Rofle (CRESTLESS PLUME ORCHID). This orchid, native to the se U.S. is known from Vernon Parish, LA, immediately adjacent to the TX border, and is likely to be found in East TX (E. Keith, pers. comm.). It is characterized by a raceme of flowers that are yellowish green to brown with purplish brown or deep purple markings. Family name from *Orchis*, a genus of 33 species native from the n temperate zone to sw China and India. (Greek: *orchis*, testicle, in reference to the shape of the tuberous roots of some European species in genera such as *Orchis*, *Ophrys*, and *Serapias*—Cribb 1999) (subclass Liliidae—Cronquist; order Asparagales—APG II)

FAMILY RECOGNITION IN THE FIELD: perennial herbs usually with alternate or basal leaves (but leaves can be spiral or opposite or whorled or reduced to inconspicuous bracts); reproductive parts united into a central *column*; flowers bilaterally symmetrical (or asymmetrical in *Tipularia*), with 3 sepals and 3 petals, 1 of the petals (the *lip*) usually being different from the other 2; fruit a capsule with very numerous nearly microscopic seeds.

REFERENCES: Correll 1937, 1947, 1950, 1961; Schultes & Pease 1963; Luer 1972, 1975; Magrath 1973, 2001a, 2001b; Dressler 1981, 1983, 1986, 1993; Williams & Williams 1983; Rasmussen 1985, 1999, 2000; Atwood 1986; Burns-Balogh & Funk 1986; Catling & Catling 1991b; Sheehan & Sheehan 1994; Dressler & Chase 1995; Neyland & Urbatsch 1995; Cameron 1999; Cameron et al. 1999; Chase 1999; Freudenstein & Rasmussen 1999; Liggio & Liggio 1999; Pridgeon et al. 1999, 2001; Cameron & Chase 2000; Freudenstein et al. 2000; Neiland & Wilcock 2000; Molvray et al. 2000; Chase 2001; Freudenstein & Chase 2001; McKeever 2001; Brown 2002a, 2003; Magrath et al. 2002; Romero-González et al. 2002.

1. Stems at flowering time without leaf blades (even at base), with sheaths or clasping bracts only; plants green and photosynthetic OR not green (yellowish to reddish, brownish, or purplish) and saprophytic/mycotrophic.
    2. Lip with a slender spur (10–)15–23 mm long; flowers asymmetrical, with one petal overlapping the dorsal sepal _____ **Tipularia**
    2. Lip without a spur; flowers bilaterally symmetrical.
        3. Plants green, photosynthetic; flowers sessile; perianth white to ivory, cream, or green, with or without green or yellow markings; lower floral bracts slightly longer than the ovaries they subtend _____ **Spiranthes**
        3. Plants not green, saprophytic/mycotrophic, the stems usually yellowish to reddish, brownish, or purplish; flowers short-pedicelled; perianth mottled or with markings, variously purple, pink, reddish brown, brown, yellow, or white (but at least some darker markings present); lower floral bracts shorter than or equal to the ovaries in length.
            4. Stem bracts elliptic-ovate, shorter to slightly longer than broad; floral bracts easily observed; lip 7–20 mm long, with 5–7 longitudinal ridges or crests, without 2 distinct basal lamellae; rhizomes with annular markings, not coral-like (not branched) _____ **Hexalectris**
            4. Stem with long, tubular sheaths much longer than broad; floral bracts minute, inconspicuous; lip 2.6–7.5 mm long, without ridges or crests, with 2 distinct basal lamellae; rhizomes lacking annular markings, coral-like (highly branched) _____ **Corallorhiza**

1. Stems at flowering time with 1 or more leaf blades; plants green and photosynthetic.
    5. Lip a conspicuous slipper-like pouch, cream to pale yellow, (4.1–)5.3–6.5 cm long; fertile anthers 2; pollen granular; flowers 1(–2) per plant _____ **Cypripedium**
    5. Lip various, but not a slipper-like pouch, variously colored, 1.1–33(–38.5) mm long; fertile anther 1; pollen in 1–6 sac-like waxy masses (= pollinia); flowers 1–many per plant.
        6. Flowers with a slender, slightly club-shaped or saccate spur 2.5–140 mm long; flower color

white, greenish white, green, yellow-green, yellow, or orange, without any pinkish, reddish, or purplish pigmentation.

7. Leaves short-petiolate, 3–8, spirally arranged, the sheaths inflated; spur saccate, ca. 2.5–3.5 mm long; species extremely rare or absent from East TX (not seen there since 1924) _____ **Platythelys**

7. Leaves not petiolate, 1–several, alternate, the sheaths not inflated, basally sheathing the stem; spur slender cylindrical to club-shaped, 4–140 mm long; including species widespread and common in East TX.

8. Lip 3-parted at least halfway to base.

9. Lip parted into 3 ± linear divisions, the divisions entire or nearly so _____ **Habenaria**

9. Lip parted into three divisions, the divisions themselves variously divided into thread-like segments _____ **Platanthera**

8. Lip not 3-parted, entire to lobed to conspicuously fringed _____ **Platanthera**

6. Flowers without a spur; flower color either white, ivory, cream, or green, sometimes with green or yellow markings OR if not so then variously colored with at least some pinkish to reddish or purplish pigmentation (but not orange).

10. Leaves not cauline, in a basal rosette.

11. Flowers resupinate (thus lip the lowermost of the petals), white to ivory, cream, or green, with or without green or yellow markings on the lip; inflorescence a spike; leaves present and green, or withered and brown, or absent _____ **Spiranthes**

11. Flowers NOT resupinate (thus lip the uppermost of the petals), greenish white, without green or yellow markings on the lip; inflorescence a raceme; leaves present at flowering time, green, not withered _____ **Ponthieva**

10. Leaves cauline or if basal, then not in a rosette.

12. Flowers not resupinate (thus lip the uppermost of the petals), pink to rose-pink, rose-purple, or rarely white; leaves 1(–3), basal, not cauline; column arcuate, persistent in fruit _____ **Calopogon**

12. Flowers resupinate (thus lip the lowermost of the petals), variously colored; leaves 1–several, cauline, not basal; column various, if arcuate, not obviously persistent in fruit.

13. Flowers white with the entire lip bright yellow; introduced species expected in such habitats as flower beds, lawns, and gardens; species currently documented in TX only from Brazos and Harris cos. _____ **Zeuxine**

13. Flowers variously colored but not as above; native species in various natural habitats; including species widespread in East TX.

14. Leaves 1(–2).

15. Inflorescence with 10–50(–160) flowers; petals green; lip minute, 1.1–2.3 mm long; base of stem swollen into a pseudobulb _____ **Malaxis**

15. Inflorescence with 1(–3) flowers; petals pink to rose or white; lip 12–33(–38.5) mm long; base of stem not swollen into a pseudobulb.

16. Sepals pink to rose or white; lip (12–)15–25 mm long, heavily bearded with a white-yellow beard; petals apices not recurved; species widespread in Pineywoods and Post Oak Savannah _____ **Pogonia**

16. Sepals olive-green, brown, or maroon; lip 21–33(–38.5) mm long, not bearded (but with a central yellowish crest); petals with recurved apices; species extremely rare or absent from East TX (not seen there since before middle of 20th century) _____ **Cleistes**

14. Leaves 2–several.

17. Leaves opposite or subopposite or whorled, at apex of stem (at base of inflorescence).

18. Leaves 2, opposite or subopposite; inflorescence a raceme of

5–25 flowers; lip 6–12 mm long, split in the distal 1/3–3/4 into two filamentous lobes (and thus appearing distinctly 2-pronged) _____ **Listera**

18. Leaves 5(–6 or 10) in a single whorl; inflorescence a solitary flower (rarely 2); lip 15–25 mm long, apically 3-lobed _____ **Isotria**

17. Leaves alternate, not at apex of stem.

19. Lip hinged, the protruding portion (= epichile) extremely mobile if touched or disturbed by wind; stems with 6–12 leaves below inflorescence; leaves large, 6–22 cm long, 2–7 cm wide, not at all grass-like; flowers greenish to brownish, yellowish, or pinkish, with purplish or reddish markings _____ **Epipactis**

19. Lip neither hinged nor mobile; stems with 1–6(–8) leaves below inflorescence; leaves large OR small, sometimes grass-like; flowers variously white to ivory, cream, pink, or green, sometimes with green or yellow markings.

20. Inflorescence a raceme of usually 1–6 (often 3) flowers, these alternating, neither in spirals nor ranks nor the inflorescence 1-sided; flowers white to pink, the lip with 3 parallel, bright green, papillose crests or lamellae _____ **Triphora**

20. Inflorescence a spike of usually numerous flowers, these not alternating, rather in spirals or ranks or the inflorescence 1-sided; flowers variously white to ivory, cream, or green, sometimes with green or yellow markings, but the lip without 3 parallel, bright green, papillose crests or lamellae _____ **Spiranthes**

CALOPOGON R. Br. GRASS-PINK, SWAMP-PINK

Erect, scapose herbs from corms; leaf 1(–3), grass-like, sheathing the stem near base; inflorescence a racemose spike with (1–)2–25 flowers; flower buds waxy; flowers showy, pink to rose-pink or rose-purple or rarely white, not resupinate (= the lip therefore the uppermost of the petals); lip ± fish tail-shaped, bearded with numerous pink or white, clavellate hairs with yellow tips; column slender, curved, terminally dilated, persistent; pollinia 4; capsules erect.

An e North American and West Indian genus of 5 species (1 described in 1995) (Goldman et al. 2002a, 2004); sometimes cultivated as ornamentals. The genus is apparently related to *Arethusa* (Goldman et al. 2001). According to Yatskievych (1999), the flowers are "pollinated by bees, which are apparently deceived by the beard of hairs ... that resembles anthers. The hinged lip, which is at the top of the flower, flexes downward when a bee lands on it, forcing the insect to pollinate the flower during its escape." The deceived bee receives no nutritional reward in return for pollinating the flower (Liggio & Liggio 1999), which is apparently mimicking in appearance flowers that do provide a reward (Luer 1975). According to Luer (1975), "They commonly grow in company with other flowers with pink petals and yellow stamens (*Geranium maculatum* and species of *Rhexia*, *Rosa*, and *Sabatia*), which provide nectar and pollen for food." This is an example of "naivete exploitation" in which inexperienced bees are tricked into providing pollination services without receiving a reward (Gregg 1989); it is also referred to as deceit pollination (e.g., Goldman et al. 2002a). (Greek: *kalos*, beautiful, and *pogon*, beard, from the colorful tuft of hairs on the lip which is characteristic of the genus)

REFERENCES: Thien 1973; Magrath 1989; Goldman 1995, 1998a, 2000; Goldman et al. 2001, 2002a, 2004; Lehmberg 2002; Trapnell et al. 2004.

1. Flowers all opening nearly simultaneously, fragrant; flower buds grooved longitudinally; corm elongate, forked; leaf nearly as long as or longer than inflorescence _____ **C. oklahomensis**

1. Flowers opening in slow succession up the raceme over a prolonged period OR (in *C. barbatus*

which is not thought to occur in TX) all opening nearly simultaneously, not fragrant or only slightly so; flower buds usually smooth; corm globose to elongate, not forked; leaf usually shorter than inflorescence.

2. Flowers opening in slow succession up the raceme over a prolonged period, spaced > 1 cm apart; leaf not closely appressed to inflorescence at flowering time, usually > 5 mm wide (varying from ca. 4–37 mm); lip 10–20(–23) mm long, the middle lobe with dilated end typically anvil-shaped (= broad and flat-topped), 5.5–21 mm wide; column usually 10–20(–25) mm long ____ **C. tuberosus**

2. Flowers all opening nearly simultaneously, closely spaced (< 1 cm apart); leaf closely appressed to inflorescence at flowering time, usually ca. 2 mm wide (varying from 1–5.5 mm); lip 7–13.5 mm long, the middle lobe with dilated end triangular to quadrangular, 7–11 mm wide; column (6–)7–8(–9) mm long ____ *C. barbatus*

Calopogon oklahomensis D.H. Goldman, (of Oklahoma). OKLAHOMA GRASS-PINK. Plant to 35 cm tall; leaf not closely appressed to inflorescence at flowering time, to 35 cm long, 5–15 mm wide; flowers 2–7(–11), spaced > 1 cm apart, opening in such rapid succession as to be nearly simultaneous, with citronella odor; lateral sepals grooved longitudinally, recurved; petals 11–20 mm long; lip 9–15(–17) mm long, the middle lobe with dilated apex triangular; disk of lip pinkish, the same color as most of flower, with a basal area of yellow hairs above which is an area of pinkish hairs; stigma flat against column surface; $2n = 114, 120$. Mesic to damp, acidic, sandy or loamy soils of oak woods, savannahs, or hillside seepage bogs, occurring sporadically (in abundance only after a fire—Liggio & Liggio 1999); Pineywoods and Post Oak Savannah; AL, AR, GA, IL, IN, IA, KS, LA, MS, MO, OK, SC, TN, TX, and WI, but now "nearly extirpated outside the south-central states" (Goldman et al. 2002a). Mar–early May. It has been suggested that this hexaploid species may be an alloploid, resulting from ancient hybridization between *C. barbatus* and *C. tuberosus* (Goldman 2000; Goldman et al. 2002a). More recent studies (Trapnell et al. 2004) suggest that *C. oklahomensis* is "the most genetically distinct species" in the genus, and it has been proposed that the distinctiveness "of this apparently ancient polyploid may be the result of its occupation of a separate glacial refugium west of the Mississippi [R]river." Goldman et al. (2004) utilized molecular and cytological techniques to attempt to elucidate the origin of *C. oklahomensis* and concluded that, while it is possible that the species is an ancient hybrid, the results are ambiguous and the exact origin of the species is still "enigmatic." (TOES 1993: IV; incorrectly referred to as *C. barbatus*) ⚠ 🏵/279

Calopogon tuberosus (L.) Britton, Sterns, & Poggenb., (tuberous), GRASS-PINK, TUBEROUS GRASS-PINK, SWAMP-PINK, ROSE-WINGS. Plant usually 20–80 cm tall; leaf to 50+ cm long; flowers usually more than 8 (varying from (1–)4–25); lateral sepals smooth, straight; sepals and petals usually 12–28 mm long; lip 10–20(–23) mm long; disk of lip white with basal area of white to yellow hairs above which is a region of white, yellow, or orange hairs; stigma usually perpendicular to column surface; $2n = 38, 40$. Bogs, marshes, wet pineland savannahs, edges of baygalls, other wet areas, acidic soils, often with carnivorous plants; mainly Pineywoods and Post Oak Savannah; also n edge of Gulf Prairies and Marshes; e Canada and throughout e U.S. w to MN, OK, and TX. May–early Jul. [*C. pulchellus* R. Br. ex W.T. Aiton] Little or no nectar is produced, and visiting insects are therefore deceived into providing pollination services for no reward (Thien & Marcks 1972; Catling & Catling 1991b); pollination is by bumblebees and leafcutter bees (Catling & Catling 1991b; Lehmberg 2002). Liggio and Liggio (1999) considered this the best-known orchid in East TX. It is "the most variable and widespread species in the genus" (Goldman et al. 2002a). 🏵/279

Calopogon barbatus (Walter) Ames, (barbed), BEARDED GRASS-PINK. Plant 15–34(–taller after flowering) cm tall; leaf 5–18(–22) cm long; pedicels 6–10 mm long; flowers usually (1–)2–5(–12), very closely spaced; lateral sepals grooved longitudinally, recurved; sepals and petals 11–20 mm

long; lip 7–13.5 mm long; disk of lip pink, the same color as most of flower; stigma flat against column surface; 2*n* = 38, 40. Apr–May. Bogs, marshes, other wet areas; cited by Correll and Johnston (1970) as occurring in Henderson Co.; supposedly Pineywoods and Post Oak Savannah (Hatch et al. 1990). However, Goldman (1995) indicated that all TX specimens previously identified as *C. barbatus* are actually small individuals of *C. oklahomensis*. In addition, Liggio and Liggio (1999) did not include the species for TX and commented, "*C. barbatus* does not grow in Texas." While we therefore do not consider *C. barbatus* to be a component of the TX flora, this discussion was added for clarity and the species is included in the above key for completeness; no county distribution map is provided. Se U.S. from NC s to FL w to w LA. According to Goldman et al. (2002a), "The type specimen for the basionym of *Calopogon barbatus*, *Ophrys barbata* Walter, is actually *C. multiflorus* (D.H. Goldman 1998a). The name *Ophrys barbata*, however, has been proposed for conservation (Goldman 1998a; Brummitt 2000), in which case no nomenclatural change will be necessary."

CLEISTES Rich. ex Lindl. SPREADING POGONIA, ROSEBUD ORCHID

A New World genus of ca. 25 species (Gregg & Catling 2002), with most in tropical and subtropical areas (primarily South America) and two species in the e U.S.; the genus has in the past frequently been considered to have considerably more species—e.g., 55–57 (Mabberley 1997; Liggio & Liggio 1999). *Cleistes* was previously included in the similar genus *Pogonia*, and some authors are once again placing it in *Pogonia* (J. Liggio, pers. comm.). The two e U.S. species can reproduce asexually by root shoots (Gregg & Catling 2002). Because no TX material is available, the following description is adapted from those in Catling and Gregg (1992) and Gregg and Catling (2002). (Greek: *cleistos*, closed, referring to the non-spreading petals which give the flowers a closed tubular appearance even when in full bloom—Schultes & Pease 1963)
REFERENCES: Ames 1922; Fernald 1946c; Baldwin & Speese 1957; Luer 1972, 1975; Gregg 1989; Catling & Gregg 1992; Gregg & Catling 2002.

Cleistes bifaria (Fernald) Catling & Gregg, ("two-fold; from the two areas of occurrence"—Fernald 1950a), SMALLER ROSEBUD ORCHID, SMALLER SPREADING POGONIA, ROSEBUD ORCHID, SPREADING POGONIA, ROSE ORCHID, LADY'S-ETTERCAP. Plant terrestrial, (12–)15–46(–64) cm tall, glabrous, bluish green, glaucous; roots numerous, slender, fibrous; stems rigidly erect; leaf solitary(–2), inserted near mid-stem, oblong-lanceolate to elliptic-oblong, (2.5–)4.5–14.5 cm long; inflorescence of 1(–3) large flower(s); floral bract leaf-like, narrowly lanceolate, 1.9–9 cm long; flower(s) resupinate; sepals olive-green, brown, or maroon, linear-lanceolate, 24–55 mm long, (2–)3–5 mm wide, ascending, spreading-ascending, or recurved; lateral petals rose-pink or pinkish white, acuminate or acute, with recurved apices, 21–36 mm long, 6–10(–12) mm wide, converging over the column and lip, making the flower appear tubular and closed except distally; lip rose-pink or pinkish-white with rose or purple veins, oblanceolate, slightly 3-lobed, 21–33(–38.5) mm long, 13–16 mm wide, marginally crenulate, with a conspicuous, yellowish, fleshy, longitudinal crest; column slender, 13–19 mm long; pollinia 2, yellow. Wetland pine savannahs, wet meadows, and woodlands, acidic soils; included based on a collection by E.J. Palmer (county not specified) cited by Correll (1944, 1961), presumably in the Pineywoods. This species has not been seen in TX since before the middle of the 20th century (Liggio & Liggio 1999) and the nearest known location is in e LA (Catling & Gregg 1992); no county distribution map is provided; se U.S. from VA s to FL w to LA and ?TX. Probably Apr–May in TX. [*C. divaricata* (L.) Ames var. *bifaria* Fernald, *Pogonia bifaria* (Fernald) P.M. Br. & Wunderlin] In TX, this species has long gone under the name *C. divaricata* (L.) Ames (e.g., Hatch et al. 1990); however, detailed study (Catling & Gregg 1992) indicated that *C. bifaria* is worthy of specific recognition. Its short column and the combination of the pink to pinkish white petals and olive-green, brown, or maroon, elongate, linear-lanceolate, ascending and often recurved sepals allow easy recognition. Pollination is reportedly by bees (Catling & Catling 1991b; Gregg 1989, 1991);

however, the flowers offer little or no reward for most pollinators (no nectar is produced, though pollen is sometimes gathered by bees), and the flowers mostly utilize "naivete exploitation," enticing inexperienced bees with a pollen-mimicking yellow labellar crest (Gregg 1989, 1991). ⚅/282

CORALLORHIZA Gagnebin CORALROOT

Inconspicuous terrestrial saprophytes/mycophytes lacking leaf blades (leaf sheaths present), variously yellow to brown or purple, sometimes somewhat greenish; roots absent; rhizomes coral-like, branched; inflorescence a small raceme of 2–25(–more) flowers; flowers resupinate, variously colored; lip entire to denticulate or slightly undulate, not fringed; pollinia 4; capsules ovoid, pendant at maturity.

A mostly n temperate genus of 11 (Magrath & Freudenstein 2002) leafless species seemingly lacking chlorophyll; except for 1 circumboreal species, the genus is limited to the New World (Freudenstein 1997). They are mycotrophic saprophytes (= having a symbiotic relationship with mycorrhizal fungi which break down decaying organic matter and provide nutrition to the orchid); a number of different genera of fungi are known to be associated with *Corallorhiza*. Some species are cultivated as ornamentals, but cultivation is difficult because of the fungal associations required for growth (Freudenstein 1997). The plants, which for much of the year live symbiotically with fungi entirely underground, sometimes seem to disappear from an area only to reappear years later (Luer 1975). Different color forms are known sporadically in all species, ranging "from plants with unspotted petals to completely yellow plants, apparently devoid of anthocyanin" (Magrath & Freudenstein 2002). The genus name has often been spelled *Corallorrhiza* (e.g., *Index Nominum Genericorum*—Farr et al. 1979), and authorship of the genus has been attributed to either Châtelin (Specim. Inaug. Corallorhiza: 6. 1760, as *Corallorhiza*) or to Gagnebin (Acta Helv. Phys.-Math 2:61. 1755, as *Corallorrhiza*). Freudenstein (1996) proposed that Gagnebin be accepted as the author, but that the more commonly used spelling (*Corallorhiza*) be conserved; this proposal was subsequently accepted (Brummitt 1999; Nicolson 1999). (Greek: *corallion*, coral, and *rhiza*, root, referring to the rhizome whose branching resembles that of coral)

REFERENCES: Brummitt 1999; Freudenstein 1994, 1996, 1997; Engel 1997; Magrath 1973; Magrath & Freudenstein 2002; Molvray et al. 2000; Nicolson 1999.

1. Flowers cleistogamous (= closed at maturity); plants flowering late summer–fall; stems conspicuously bulbose at base; dorsal sepal (can be described as the one opposite or most distant from the lip) 3–4.5 mm long, 1-nerved; lip 2.6–3.8(–4.6) mm long _____ **C. odontorhiza**
1. Flowers open at maturity; plants flowering in spring; stems not bulbose at base or only slightly so; dorsal sepal 4.5–10 mm long, 3-nerved; lip 4–7.5 mm long _____ **C. wisteriana**

Corallorhiza odontorhiza (Willd.) Poir., (tooth-rooted), AUTUMN CORALROOT, LATE CORALROOT, LATE SOUTHERN CORALROOT, FALL CORALROOT, SMALL-FLOWER CORALROOT. Plant very inconspicuous, 11–20(–46) cm tall, from irregular rhizomes; stems yellowish brown to brown or purple, with a conspicuous bulbose base; flowers 5–15(–more), essentially cleistogamous (in TX; chasmogamous forms occur elsewhere); perianth purple, brown, or yellow, with green; lip white, spotted with purple, entire or with a slightly undulate margin. Woods; n Red River Co. (*Magrath 12302*, OCLA—L. Magrath, pers. comm.; Turner et al. 2003) and Cass Co. (Liggio & Liggio 1999) in the ne corner of e TX; these are the only two TX locations of which we are aware; se Canada and throughout e U.S. w to MN and TX. Sep–Oct. [*C. micrantha* Chapm., *C. odontorhiza* (Willd.) Nutt.] Luer (1975) speculated that since most flowers open very little, self-fertilization must be effective; Freudenstein (1997) concurred. Individuals with chasmogamous flowers are known in some parts of the species range (Liggio & Liggio 1999), and both chasmogamous and cleistogamous plants sometimes occur in the same population (Magrath & Freudenstein 2002). Plants with cleistogamous flowers are recognized as var. *odontorhiza*,

while those with open perianths are treated as var. *pringlei* (Greenman) Freudenstein (the latter variety is not known from TX) (Magrath & Freudenstein 2002). Luer (1975) referred to this rather non-showy species as the "ugly duckling" of the genus. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠ 🏵/283

Corallorhiza wisteriana Conrad, (for its discoverer, Charles Jones Wister, 1782–1865), SPRING CORALROOT, WISTER'S CORALROOT, EARLY SOUTHERN CORALROOT. Plant very inconspicuous, 10–40(–55) cm tall, from irregular rhizomes; stems yellowish to reddish brown or purple, not bulbose-based or only slightly so; flowers 5–25(–more); perianth brownish, greenish yellow, or reddish brown with purple dots; lip white with purple to pink markings, entire or denticulate. In leaf mold of various forests, on limestone hills or on sandy soils, from dry to wet sites; widespread in e 1/2 of TX; throughout much of U.S. from PA s to FL w to WA and AZ. Mid-Feb–Apr. This species is reported to often prefer "richer habitats than other coral-roots" (Magrath & Freudenstein 2002). 🏵/283

CYPRIPEDIUM L. LADY'S-SLIPPER, MOCCASIN FLOWER

A mainly n temperate genus of ca. 45 species (Sheviak 2002a). *Cypripedium* and related genera form a distinctive group within the family (e.g., with 2 fertile anthers) and are sometimes segregated as a separate family, Cypripediaceae (e.g., Rasmussen 1985). However, they are clearly, if distantly, related to other orchids and we are following the general consensus among most recent authorities (e.g., Pridgeon et al. 1999; Chase 2001; Sheviak 2002a) and including them in the Orchidaceae. The sac-like or slipper-like, inflated lip has one opening which is functionally composed of a larger central entrance for pollinators and two posterior exits below the anthers. Colors and fragrance attract insects (deceptively, since no nutritional reward has been discovered), apparently primarily bees, which become temporarily trapped inside the inflated lip. Once inside, and unable to leave through the central entrance because of its infolded slippery margins, the insect must force its way out one of the two posterior exits/orifices below the anthers. To facilitate the insect's escape via this pathway, the lip has hairs on the inner surface that form a ladder to the small exits/orifices. In the process of escaping, the insect passes first by the stigma, onto which pollen grains from previously visited flowers may be scraped off, and finally below an anther where viscid pollen is attached to the insect's back (van der Pijl & Dodson 1966; Luer 1975; Davis 1986; Pridgeon et al. 1999). ☠ The shoots of some species have glands producing a contact irritant (cypripedin) (Mabberley 1997), while foliage hairs are reported to cause dermatitis in some people (Yatskievych 1999). The active ingredients appear to be a red quinone and related substances, possibly serving a protective function as antifungal agents (Pridgeon et al. 1999). LADY'S-SLIPPERS are difficult though not impossible to cultivate (Case 1987), and many "cypripediums" in cultivation are actually members of other genera (e.g., the Asiatic genus *Paphiopedilum*). As with many orchids, overcollecting from the wild is a serious threat to some populations. The common name LADY'S-SLIPPER was given by medieval botanists in reference to the Virgin Mary, with other old names including SOULIER DE NOTRE DAME ("Our Lady's shoe") (Durant 1976). (Greek: *Kypris*, Latinized as *Cypris*, goddess of love and beauty (Venus), supposed to have been born on Cyprus, and (according to Linnaeus) *podium*, little foot; actually from Latin *pes*, *pedis*, foot, or possibly Greek, *pedilon*, sandal or slipper—Luer 1975; in reference to the beautiful slipper shape of the lip)

REFERENCES: Soukup 1977; Reed 1981, 1982; Atwood 1984, 1985; Davis 1986; Sheviak 1992, 1994, 2002a; Case 1994; Brown 1995; Weldy et al. 1996; Cribb 1997; Case et al. 1998; Pridgeon et al. 1999; Cammack & Patrick 2000; Keenan 2000; Allen et al. 2004b.

Cypripedium kentuckiense C.F. Reed, (of Kentucky), SOUTHERN LADY'S-SLIPPER, YELLOW LADY'S-SLIPPER, RAFINESQUE'S LADY'S-SLIPPER, KENTUCKY LADY'S-SLIPPER, IVORY LADY'S-SLIPPER, PURLOINED-

SLIPPER. Herb with fibrous roots from a rhizome; stems to 0.7(–1) m tall; leaves borne along the stem, 3–5(–6), ± ovate to ovate-lanceolate; flowers 1–2, terminal, showy, resupinate, subtended by a foliaceous bract; lip expanded, in form of a slipper-like pouch, (4.1–)5.3–6.5 cm long, cream to pale yellow, the central opening (orifice) in lip 27–37 mm long, extending nearly to the toe of the slipper, the toe rather blunt; lateral petals and sepals ranging from deep maroon to yellow-green with maroon mottling; sepals 55–126 mm long; petals to 156 mm long, spirally twisted; anthers 2 (in contrast to all other East TX orchid species with 1 anther); pollen granular, but sticky (all other East TX orchids have pollen in sac-like waxy masses known as pollinia); capsules ellipsoid. Deciduous forests on wooded seepage areas, floodplains of streams, and mesic ravines; Pineywoods in Harrison, San Augustine (BRIT), Nacogdoches, Newton, Sabine, Tyler (TOES 1993), Shelby (Liggio & Liggio 1999), Newton (Poole et al. 2002), Cass, and Trinity (Turner et al. 2003) cos. and Red River Co. (Sanders 1994; Turner et al. 2003) in the Red River drainage; se US. from KY s to GA and w to OK and TX, also VA. Mar–May. [*C. calceolus* L. var. *pubescens* (Willd.) Correll in sense of Correll and Johnston (1970) in part, *C. daultonii* Soukup—without Latin diagnosis and therefore not validly published] The egg-sized lip makes this the largest *Cypripedium* in North America (Liggio & Liggio 1999). The central opening (orifice) in the lip is also quite distinctive. According to Sheviak (2002a), "In related species the orifice is a restricted opening *in* the adaxial surface of the lip; in *C. kentuckiense* the orifice *replaces* the basal portion of the adaxial surface, the sides of the lip terminating abruptly at the orifice without curving toward the horizontal. In herbarium specimens this detail is obscured, but the cavernous nature of the orifice is emphasized by the adaxial surface descending from the apical margin of the orifice toward the apex of the lip; the obovoid lip appears to hang from the margin of the orifice, and the lip is not particularly slipper-shaped**.** In contrast, in related species, the adaxial surface of the lip surrounds the orifice and extends forward toward the apex, forming a more convincing slipper." SOUTHERN LADY'S-SLIPPER is the largest, and in the opinion of some (e.g., Ajilvsgi 1979), the showiest orchid in East TX. This species, which is part of the *C. calceolus* L. complex, was described in 1981 by Reed. It is most similar to *C. parviflorum* Salisb. var. *pubescens* (Willd.) O.W. Knight [*C. pubescens* Willd.], a taxon occurring further n in the U.S. While it appears to be recently derived from *C. parviflorum* (in the broad sense) (Case 1994; Case et al. 1998; M. Case, pers. comm.), isozyme evidence supports its recognition at the species level (Case et al. 1998). *Cypripedium kentuckiense* can be distinguished from *C. pubescens* by its larger flower with a very deep, almost globular lip with a much flattened top resulting from the large opening (Atwood 1985). According to Weldy et al. (1996), "Currently, the global rank of *C. kentuckiense* indicates that it is threatened throughout its range (G3), while the federal ranking (C2) indicates that it is a likely candidate for the list of federal endangered and threatened species." While once frequent in beech forests in East TX, as of 2004, 17 populations and 146 individuals were known from the state (J. Singhurst, pers. comm.), and it is considered "state threatened" (TOES 1993). (TOES 1993: IV; RARE 2002a: G3S1SOC)⚠ ⚅/284

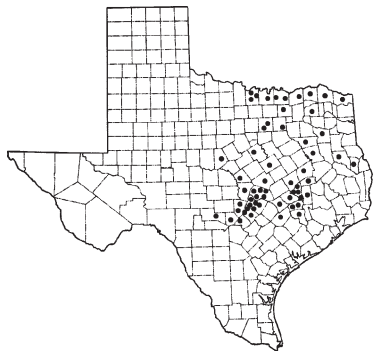
EPIPACTIS Zinn HELLEBORINE

A genus of ca. 25 (Brown & Argus 2002) species ranging from the n temperate zone to the tropics, mainly in Europe and Asia; only one species, *E. gigantea*, is native to North America. (Greek: *epipactis*, an ancient name applied by Theophrastus, ca. 350 B.C., to a plant used to curdle milk, possibly hellebore—Luer 1975)
REFERENCES: Luer 1975; Brown & Argus 2002.

Epipactis gigantea Douglas ex Hook., (gigantic), GIANT HELLEBORINE, STREAM ORCHIS, STREAM EPIPACTIS, CHATTERBOX. Plant terrestrial or sometimes semi-epiphytic (on cypress trees or floating logs), 20–80(–140) cm tall, rhizomatous; leaves clasping stem, broadly elliptic to linear-lanceolate, 6–22 cm long, 2–7 cm wide; inflorescence a lax terminal raceme, 2–8(–32)-flowered, prominently bracteate; flowers greenish to brownish, yellowish, and/or pinkish, with purplish



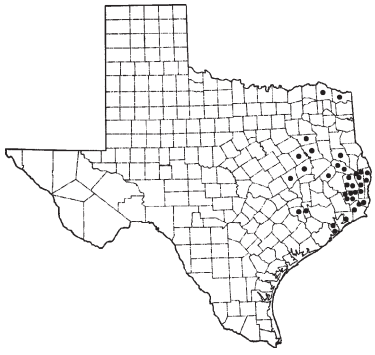
Stenanthium gramineum



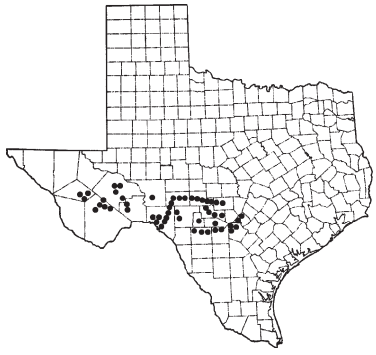
Toxicoscordion nuttallii



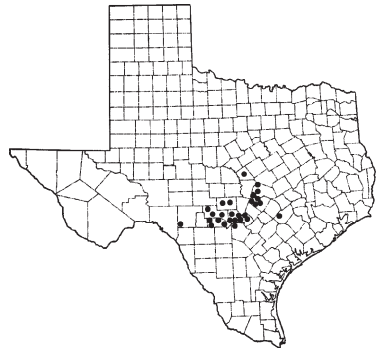
Veratrum virginicum



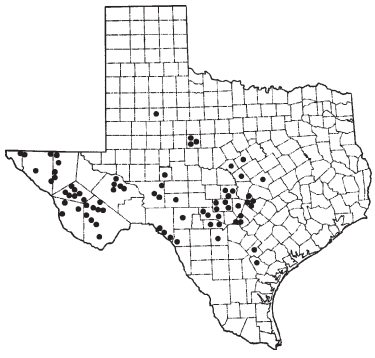
Aletris aurea



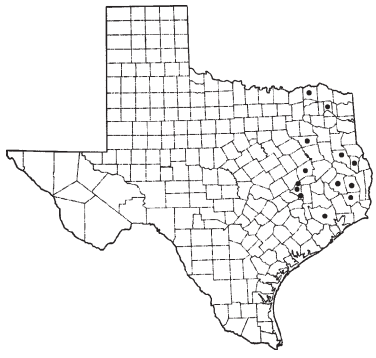
Dasylirion texanum



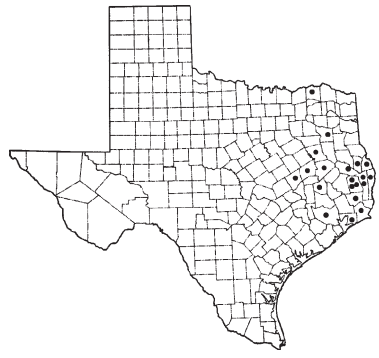
Nolina lindheimeriana



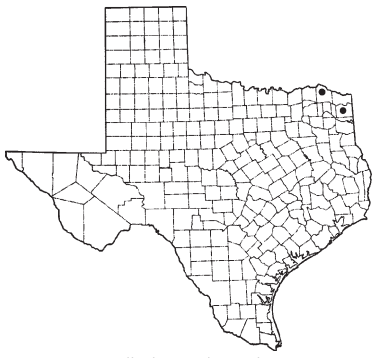
Nolina texana



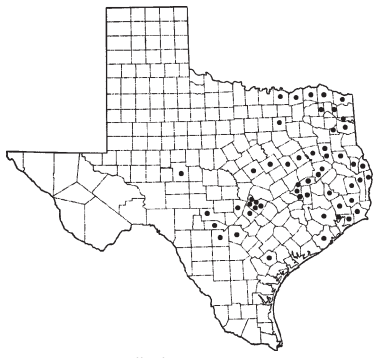
Calopogon oklahomensis



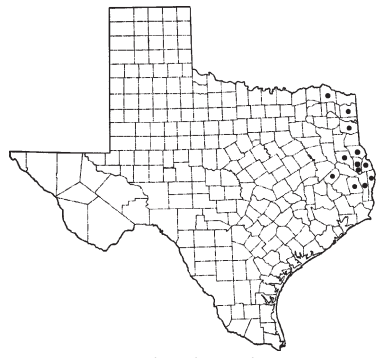
Calopogon tuberosus



Corallorhiza odontorhiza



Corallorhiza wisteriana



Cypripedium kentuckiense

or reddish markings, resupinate; sepals 15–25 mm long, lip 3-lobed, hinged, mobile, the protruding portion (= epichile) "when touched or stirred by a slight breeze, flaps rapidly like the jaw of an overly talkative person" (Liggio & Liggio 1999); capsules pendent, 2–2.5 cm long. Stream banks in woods, usually associated with limestone springs and seeps (in TX *Adiantum capillus-veneris*, VENUS'-HAIR FERN or SOUTHERN MAIDENHAIR FERN, is a common associate); Blackland Prairie in Hays and Travis (BRIT) cos. near w edge of East TX, also Austin, Dallas (Correll 1961), Gonzales (Liggio & Liggio 1999), and Washington (T. Kiphart, pers. comm.) cos.; also scattered in w 1/2 of TX; B.C. and throughout w U.S. e to MT and TX, also SD. Mar–Aug. According to Luer (1975), the common name CHATTERBOX is used "because the oscillating portion of the protruding lip from the bottom of the flower reminds one of a loquacious acquaintance." Pollination is reportedly by syrphid flies (Luer 1975). This species is considered to be of conservation concern in TX. (RARE 2002b: G3S3) ⚠ ⚅/286

HABENARIA Willd. FINGER ORCHID, FALSE REIN ORCHID, REIN ORCHID

Plants erect to ascending; roots both slender and tuberous, fleshy; tuberoids sometimes present at base of stem; leaves 3–8, sheathing the stem; inflorescences spicate racemes with few to many flowers; flowers white or green, resupinate; petals deeply 2-parted; lip deeply 3-parted, not fringed, with a spur; pollinia 2; capsules erect to semi-erect.

A pantropical and subtropical genus of ca. 600 species (Sheviak 2002c), the number depending on circumscription. A number of segregates are sometimes split out based on differences in flower structure and roots. For example, many species previously placed in *Habenaria* are now treated in *Platanthera* (see discussion under *Platanthera*). (Latin: *habena*, reins, thong, or strap, in allusion to the shape of the long, strap-like divisions of the lip of some species)
REFERENCES: Ames 1910; Luer 1972; Brown 2000b; Sheviak 2002c.

1. Petals (including lip) white; spur 5–8 cm long, much longer than the pedicellate ovary; lateral lobes of the lip 10–18 mm long _____ **H. quinqueseta**
1. Petals (including lip) green; spur 0.9–1.4 cm long, ca. as long as the pedicellate ovary; lateral lobes of the lip 5–11 mm long _____ **H. repens**

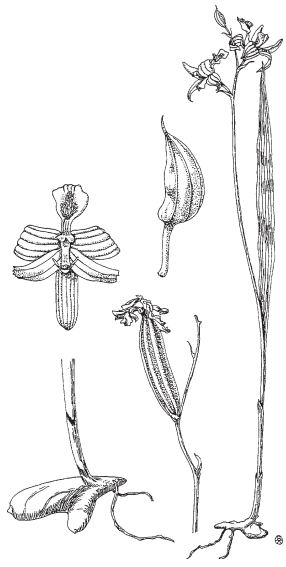
Habenaria quinqueseta (Michx.) Eaton, (five bristles, in reference to the five long narrow structures of the perianth—these being the lower division of each of the 2 petals and the 3 lobes of the lip), PINE HABENARIA, MICHAUX'S ORCHID. Plant 20–50(–60) cm tall; roots fibrous; ovoid tuberoid usually present at base of stem; leaves 3–7, ovate to lanceolate or oblanceolate, 5–20 cm long, 2–6 cm wide; inflorescences loosely-flowered, with 3–15 flowers; flowers fragrant; sepals green, oblong to ovate-oblong, 6–13 mm long; petals white, deeply 2-parted, the upper division linear-oblong, falcate, 4–9 mm long, ca. 2 mm wide (the upper divisions of the 2 petals converging in front of the upper sepal), the lower division filiform, recurved, 10–12 mm long, ca. 1 mm wide; lip deeply 3-parted, the lateral lobes filiform, 10–18 mm long, recurved, the middle lobe linear, 8–15 mm long; spur slender to slightly club-shaped, recurved, usually 5–8 cm long, much longer than the ovary; capsules 15–20 mm long. Pinelands, flatwoods, swamps; included for East TX based on range maps in Luer (1972) and Sheviak (2002c) showing occurrence in the se part of the Pineywoods; possibly also in the Gulf Prairies and Marshes; no county distribution map is provided. Correll (1961) cited a Charles Wright (who collected in TX in mid-1800s) collection of undetermined county (but probably in the Big Thicket—Liggio & Liggio 1999); according to Geiser (1937, based on Asa Gray's letters), Wright's collecting in deep East TX was in Angelina, Jasper, Newton, and Tyler counties. The current occurrence of this species in the state is questionable. As indicated by Liggio and Liggio (1999), "This orchid was undoubtedly a rare, disjunct species in Texas when Wright collected it. It was probably an isolated occurrence at the western limit of its range." Se U.S. from SC s to FL w to TX. Aug–Sep. [*Orchis quinqueseta* Michx.] This species has often been treated as including *H. macroceratitis* Willd. [*H. quinqueseta* var. *macroceratitis* (Willd.) Luer]; however, Brown (2000b) considered the two to be distinct species. ⚅/287



Calopogon tuberosus [FNA]



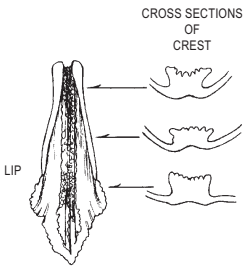
Cleistes bifaria [HEB]



Calopogon oklahomensis [LIN]



Corallorhiza odontorhiza [BB1]

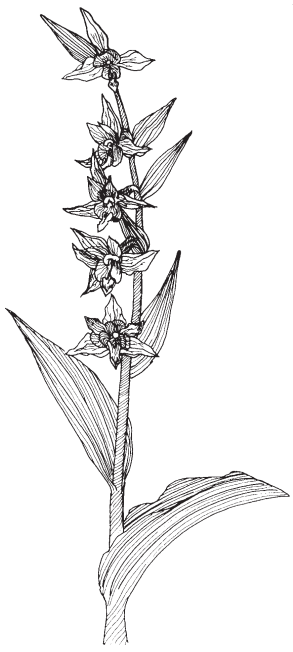




Corallorhiza wisteriana [FNA]



Cypripedium kentuckiense [RJG]



Epipactis gigantea [PMC]

Habenaria repens Nutt., (creeping), WATER SPIDER ORCHID, CREEPING ORCHID, CREEPING WATER SPIDER ORCHID, NUTTALL'S HABENARIA, FALSE REIN ORCHID, WATER ORCHID, FLOATING ORCHID. Plant glabrous, 10–50(–90) cm tall; roots fibrous, sometimes with tuberous swellings; leaves 3–8, 3-ribbed, linear-lanceolate, 5–20(–25) cm long, 0.4–2.5(–4.5) cm wide; racemes usually densely-flowered; flowers green; sepals ovate to oblong, 3–7 mm long; petals deeply 2-parted, the upper division oblong-lanceolate to lanceolate, erect, falcate, 3–7 mm long, the lower division filiform, falcate, longer than upper; lip deeply 3-parted, strongly deflexed, the lateral lobes filiform, 5–11 mm long, the middle lobe linear to linear-oblong, 4–7 mm long; spur slender, 0.9–1.4 cm long, ca. as long as the ovary; capsules 8–15 mm long. Pond margins, ditches, bogs, other wet areas, often in water; widely distributed in East TX; also Gulf Prairies and Marshes and s South TX Plains; se U.S. from NC s to FL w to OK and TX. Primarily May–frost. An inflorescence in full flower is thought by some to resemble a "tangled swarm of spindly spiders" (Luer 1972). According to Sheviak (2002c), this species "is remarkable in sometimes being truly aquatic. Often forming floating mats, the plants then are commonly decumbent, at least basally, and new shoots and slender roots arise abundantly from much of the length of the stem. A few spheroid tuberoids are sometimes produced from roots arising at wide intervals. Other roots bear new shoots some decimeters from the parent stem; the distal portion of the root then commonly enlarges into a slenderly lance-fusiform tuberoid." ▣/287

HEXALECTRIS Raf. CRESTED-CORALROOT

Plants saprophytic/mycotrophic, leafless; roots absent; rhizomes irregular, with stout annular markings; stems erect, pinkish to reddish or purplish; flowers resupinate, in a raceme; corolla lip 3-lobed, with 5–7 longitudinal crests down the middle of the disc; pollinia 8.

A genus of 7 species (Goldman et al. 2002b) of the s U.S. and Mexico. The plants are mycotrophic saprophytes (= having a symbiotic relationship with mycorrhizal fungi which break down decaying organic matter and provide nutrition to the orchid) (Luer 1975; Liggio & Liggio 1999). Some years large numbers of individuals will flower in a given area and the next year none, a phenomenon presumably correlated with variation in weather (Engel 1997). The genus name *Hexalectris* "was probably inappropriate because plants in the genus tend to have five or seven crests on the lip," rather than six (Goldman et al. 2002b). (Greek: *hex*, six, and *alectryon*, cock, referring to the usually 5–7 longitudinal crests—resembling a cock's comb—on the lip)
REFERENCES: Luer 1975; Engel 1987, 1997; Catling & Engel 1993; Goldman et al. 2002b; Collins et al. 2005.

1. Lip deeply 3-lobed (sinuses between lobes > 3 mm deep), with 5 conspicuous, longitudinal, yellow, wavy crests; lateral petals maroon or deep purple; anther red or maroon _____ **H. warnockii**
1. Lip shallowly 3-lobed (the sinuses between lobes < 2 mm deep), with 5–7 longitudinal, purple, non-wavy crests or striations; lateral petals yellow-tan to purplish brown or pinkish brown; anther white to yellow.
   2. Lip 11 mm or less long, the middle lobe bright purple to pink; sepals and lateral petals (7–)9–11(–13) mm long; lateral petals pinkish brown; column 6–8 mm long _____ **H. nitida**
   2. Lip 12–20 mm long, the middle lobe usually yellow to white or tan, with purple striations; sepals and lateral petals (12–)13–23 mm long; lateral petals yellow-tan to purplish brown, with brown or purple veins; column 11–18 mm long _____ **H. spicata**

Hexalectris nitida L.O. Williams, (shining), SHINING HEXALECTRIS, GLASS MOUNTAIN-CORALROOT, GLASS MOUNTAIN CRESTED-CORALROOT, SHINING COCK'S-COMB, SHINING-CORALROOT. Plant 15–32 cm tall; racemes with 6–20(–24) flowers; flower parts with shiny or polished appearance; sepals, petals, and lip (7–)9–11(–13) mm long; lateral petals pinkish brown; lip with middle lobe bright purple to pink, the lateral lobes white; anther yellow. In humus under juniper trees over limestone; Dallas (BRIT), Bexar, Comal, Hays, McLennan, and Travis (Turner et al. 2003) cos. on w margin of East TX; scattered further w; NM and TX. Jun–Aug, often after ample late-spring

rain. According to Goldman et al. (2002b), plants of this species "examined from the United States have been self-pollinating because of a reduced rostellum. In central Texas, in particular, flowers of this species are cleistogamous." Engel (1987) also noted that often the flowers do not open. A specimen (*Marsden et al. s.n.*, BRIT; Collins et al. in press) was recently collected at the Dallas Co. Cedar Ridge Preserve that was nearly lacking in pigmentation—it was very pale greenish yellow. While the lack of color makes identification to species more difficult, the 11 mm long sepals and lateral petals suggest *H. nitida*. (RARE 2001, 2002b: G3S3) ⚠/288

Hexalectris spicata (Walter) Barnhart, (with spikes), SPIKED CRESTED-CORALROOT, CRESTED-CORALROOT. Plant 15–80 cm tall; stem fleshy pink; racemes with 5–25 flowers; lateral petals yellow-tan to purplish brown, with brown or purple veins; middle lobe of lip usually yellow to white or tan, with purple striations; occasionally plants lack purple pigment—the sepals and lateral petals can then be mahogany brown with darker brown striations, and the lip is all white except for faint yellowish markings (Luer 1975). The following key to varieties is modified from Catling and Engel (1993).

1. Flowers usually not opening (typically auto-pollinating, but sometimes opening), the sepals and petals usually not recurved at tips; the 5 central veins of the lip with their highest keels raised 0.4–0.7 mm above the lip surface; column without a rostellar flap separating the pollen masses from the stigmatic surface; petals 14–16 mm long, 4–5 mm wide; usually flowering in East TX in Jun–Jul _____ var. **arizonica**
1. Flowers opening, the sepals and petals often with recurving tips; the 5 central veins of the lip with their highest keels raised (0.4–)0.7–1 mm above the lip surface; column with a rostellar flap separating the pollen masses from the stigmatic surface; petals 14–23 mm long, 5–9 mm wide; usually flowering in East TX in May–early Jun _____ var. **spicata**

var. **arizonica** (S. Watson) Catling & V.S. Engel, (of Arizona), ARIZONA CRESTED-CORALROOT. Flowers usually cleistogamous, reduced; rostellum (= structure on column that separates the anther from the stigma and prevents self-pollination) lacking (Liggio & Liggio 1999); anther whitish. In rotting wood or leaf litter in oak, pine, or juniper woods over limestone; Anderson, Dallas, and Travis (Catling & Engel 1993) cos. in East TX; also known from Palo Pinto Co. in the Cross Timbers and Prairies and Brewster and Culberson cos. in far w TX (Catling & Engel 1993); AZ, NM, and TX. (May–)Jun–Jul, typically later than var. *spicata*. [*Corallorhiza arizonica* S. Watson] Catling and Engel (1993) indicated that most plants seen in the Dallas area and all in Travis Co. have closed flowers that do not open and are apparently auto-pollinating. They suggested this taxon is an auto-pollinating race derived from var. *spicata*; alternatively, they suggested that var. *arizonica* might have a hybrid origin, possibly resulting from a cross between *H. nitida* and *H. spicata* var. *spicata*. The varietal epithet *arizonica* is taken from the state where the variety was first collected.

var. **spicata**, CRESTED-CORALROOT, BRUNETTA, BUFF-CREST, COCK'S-COMB, LEAFLESS ORCHID. Flowers chasmogamous; rostellum present; anther yellow. Oak, hickory, beech-magnolia, or conifer (often *Juniperus*) woods, calcareous sandy or organic soils; widespread in TX except nw and s parts of the state; according to Catling and Engel (1993), this taxon occurs at the same site (Dallas Co. Cedar Ridge Preserve) as *H. spicata* var. *arizonica* and *H. nitida*; e U.S. from VA s to FL w to KS and TX, also AZ and NM. (Apr–)May–early Jun. According to J. Stanford (pers. comm.), these delicate-appearing plants have massive underground rhizomes (ca. 10 cm in diam.). /288

Hexalectris warnockii Ames & Correll, (for Barton Holland Warnock, 1911–1998, Trans-Pecos TX botanist), TEXAS PURPLE-SPIKE, TEXAS CRESTED-CORALROOT. Plant to ca. 30(–40) cm tall; inflorescences with 3–10 flowers; sepals, petals, and lip ca. (12–)15–20 mm long; lateral petals (12–)15–20 mm long, maroon or deep purple; lip with middle lobe whitish, edged in purple, with 5 conspicuous yellow crests, 3 of which reach the apex, the lateral lobes of lip pale pink with

purple veins; anther red to maroon. Leaf litter and humus under juniper trees; Dallas (Mahler 1988; Engel 1997; Goldman et al. 2002b) and Hays (Liggio & Liggio 1999) cos.; also Edwards Plateau and Trans-Pecos; AZ and TX. Jun–Sep. Goldman et al. (2002b) considered this species to be of conservation concern. (RARE 2002a: G2S2SOC) ⚠ ⚅/288

ISOTRIA Raf. WHORLED-POGONIA, FIVE-LEAF ORCHID

A genus of 2 species of the e U.S. (Mehrhoff & Homoya 2002). The other species, *I. medeoloides* (Pursh) Raf., which does not reach TX, is currently listed as Threatened by the U.S. Fish and Wildlife Service under the federal Endangered Species Act (U.S. Fish & Wildlife Service 2003), and is considered by some to be one of the rarest orchids in temperate North America (Mehrhoff 1983). (Greek: *isos*, equal, and *tria*, three, in reference to the three sepals which are equal in size and shape)
REFERENCES: Luer 1972, 1975; Mehrhoff 1983; Mehrhoff & Homoya 2002.

Isotria verticillata (Willd.) Raf., (verticillate, whorled), WHORLED-POGONIA, WHORLED ISOTRIA, LARGE WHORLED-POGONIA, FIVE-LEAF ORCHID, PURPLE FIVE-LEAF ORCHID. Terrestrial herb 4–25 (–40) cm tall; roots numerous, unusually long (see illustration), pubescent (indicative of mycorrhizae), producing shoots developing into new plants; stems hollow, glabrous, usually purplish to brownish green, glaucous, the fruiting stalk of the previous year often persisting; leaves 5(–6 or 10) in a single whorl, at right angles to the stem, oblong to ovate or elliptic, 3–10 cm long, (1–) 2.5–5.3 cm wide, sessile, not glaucous; flower resupinate, solitary (rarely 2), erect on an elongate (12 mm or more long), slender pedicel (this elongating in fruit), tilting over the edge of the whorl of leaves after becoming pollinated (Luer 1975); sepals greenish white near base to bronze medially and purplish distally, 3.4–6.7 cm long, 2–3 times as long as the petals, ca. 3–4 (–7) mm wide, linear-lanceolate; lateral petals pale yellowish green, narrowly obovate, to 2 cm long and 6 mm wide, overlapping and forming a hood over the column; lip 1.5–2.5 cm long, 8–10 mm wide, with a yellowish median crest, 3-lobed apically, the central lobe whitish, the lateral lobes purplish; column 8–12 mm long; pollinia 2; capsule erect on peduncle, 2–3.5(–4.2) cm long, ellipsoid or cylindrical. Along streams, low woods, on hardwood forest slopes, margins of baygalls, moist, sandy, acidic soils; Pineywoods in Cass, Nacogdoches (BRIT), Jasper, Newton, Polk, Sabine, San Augustine, and Tyler (Liggio & Liggio 1999) cos.; se Canada (Ont.) and throughout e U.S. w to IL, OK, and TX. Mar–Apr. [*Pogonia verticillata* (Willd.) Nutt.] The plants appear sporadically, flowering heavily one season, and then apparently being absent for perhaps several years (Luer 1975); there can be "extensive colonies with hundreds of stems" (Mehrhoff & Homoya 2002). The flowers are sweetly fragrant (but lack nectar) (Mehrhoff & Homoya 2002), and pollination is by small solitary bees (Mehrhoff 1983; Catling & Catling 1991b). The only other species in the genus, *I. medeoloides* (SMALL WHORLED-POGONIA), is a scentless, self-pollinating species (Mehrhoff 1983) that does not (or perhaps only rarely) reproduce vegetatively. It can be distinguished from *I. verticillata* by its stem lacking purple coloration and by its glaucous leaves (the plant thus having a characteristic milky white appearance, at least when young) (D.M.E. Ware, pers. comm.). (TOES 1993: IV) ⚠ ⚅/290

LISTERA R. BR. TWAYBLADE

A genus of 25 species of cool temperate areas in both the n and s hemispheres (Magrath & Coleman 2002). All are small and inconspicuous and have only 2(–3) opposite or subopposite leaves, these located at apex of stem (Magrath & Coleman 2002). Pollination in the genus is unusual—a portion of the column splits explosively when touched and ejects a quick-drying, cement-like fluid which glues the pollinia to the visiting insect. The common name TWAYBLADE is from an archaic English word, *tway*, meaning two (related to twain) in reference to the two leaf blades. (Named for Martin Lister, 1638–1711, English physician, naturalist, and paleontologist)
REFERENCES: Luer 1972, 1975; Magrath & Coleman 2002.



Habenaria quinqueseta [LUN]



Habenaria repens [FNA]



Hexalectris nitida [PMC]



Hexalectris spicata var. arizonica [LIN]

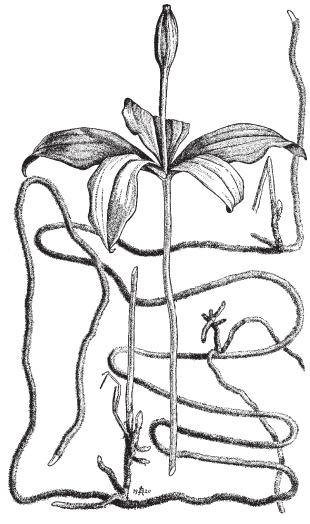


Hexalectris spicata var. spicata [GLE]



Hexalectris warnockii [FNA]





Isotria verticillata [LUN]

Listera australis Lindl., (southern), SOUTHERN TWAYBLADE, LONG-LIP TWAYBLADE. Inconspicuous delicate herb 8–20(–29) cm tall; roots few, fibrous; stems erect, purplish green, glabrous; leaves 2(–3), opposite or subopposite, borne at stem apex, sessile, ovate to elliptic-ovate, 1.3–3.5(–4) cm long; inflorescence a loose terminal raceme of 5–25 greenish purple or reddish purple, pedicelled flowers; peduncle and rachis ± glandular pubescent; bracts to 2 mm long and 1 mm wide; flowers resupinate; perianth parts persisting as capsules mature; sepals ovate, ca. 1.5 mm long and 1 mm wide; lateral petals oblong, obtuse, ca. 1.5 mm long and 0.5 mm wide, recurved; lip 6–12 mm long, linear, auricled on each side basally, split in the distal 1/3–3/4 into two filamentous lobes (and thus appearing distinctly 2-pronged); column minute, 0.5–1 mm long and wide; pollinia 2, yellow; capsules borne horizontally, ovoid, to 8 mm long and 5 mm wide. In humus and among mosses in dense shade of low woods and ravines, bogs, "usually in association with rhizomes of cinnamon fern (*Osmunda cinnamomea*) and royal fern (*O. regalis*)" (Magrath & Coleman 2002); J. Liggio (pers. comm.) has observed that the species is also found where no *Osmunda* is present; widespread in the Pineywoods; se Canada and e U.S. from VT s to FL w to OK and TX. Feb–Jun. [*Ophrys australis* (Lindl.) House] Leaves appear in late winter, allowing the plants to make use of the abundant sunlight reaching the forest floor before the deciduous trees of the canopy develop their leaves (Liggio & Liggio 1999). This species is inconspicuous and easily overlooked. ⚅/291

MALAXIS Sol. ex Sw. ADDER'S-MOUTH

A subcosmopolitan genus of ca. 250 species of usually small, delicate, terrestrial herbs, with greatest diversity in Asia and the East Indies (Catling & Magrath 2002). A portion of the column produces a microscopic droplet of sticky fluid which comes in contact with the pollinia. When a minute insect reaches behind the column for nectar, it touches the droplet and upon leaving, it withdraws the pollinia now glued to its head or proboscis. The pollinia are subsequently transferred to another flower (Luer 1975). Pollination of the tiny flowers of some species is by fungus gnats (Catling & Catling 1991b). The common name is derived from the apparently bifid lip, supposedly resembling the bared fangs of a tiny snake (Luer 1975). *Malaxis wendtii* Salazar, known from Mexico and Trans-Pecos TX, was named in 1993 honoring Dr. Tom Wendt, a student of Mexican phytogeography and floristics and botanist at the Univ. of TX at Austin (Salazar 1993). (Greek: *malaxis*, a softening, from *malaco*, soft or delicate, either in reference to the soft succulent consistency of the leaves or to the fragile nature of some members of the genus (Luer 1975; Summers 1987)

REFERENCES: Ames & Schweinfurth 1935; Luer 1972, 1975; Catling 1991; Catling & Magrath 2002.

Malaxis unifolia Michx., (single-leaved), GREEN ADDER'S-MOUTH, ONE-LEAF MALAXIS, ONE-LEAF ADDER'S-MOUTH, GREEN MALAXIS. Plant 3–30(–55) cm tall (usually shorter), glabrous; roots few, fibrous; stems swollen at base into a pseudobulb 0.5–2 cm in diam.; leaf solitary (rarely 2), bright green, ovate to ovate-lanceolate, 1.6–10 cm long and 0.5–5(–6.5) cm wide, keeled beneath, the base sheathing the stem; inflorescence a solitary terminal raceme with 10–50(–160) tiny flowers; floral bracts 1.4 mm or less long; flowers green, resupinate; sepals 1.1–1.9(–2.2) mm long; lateral petals thread-like, recurved, 0.8–1.7(–3) mm long 0.1–0.3 mm wide; lip 1.1–2.3 mm long, 1–2.2 mm wide, 3-toothed, the middle tooth short and the lip thus appearing bifid; column minute, 0.4–0.6 mm long; pollinia 4; capsules subglobose to ellipsoid, to 8 mm long and 4 mm wide. In humus on moist wooded slopes along streams, ravines, and in mixed pine-hardwood forests, also on margins of baygalls, acidic soils; Pineywoods and Red River Co. (Liggio & Liggio 1999) in Red River drainage; e Canada and throughout e U.S. w to MN, OK, and TX. Apr–Jun. [*Achroanthes unifolia* (Michx.) Raf., *Microstylis unifolia* (Michx.) Britton, Sterns & Poggenb.] ⚅/292

PLATANTHERA Rich. FINGER ORCHID, BUTTERFLY ORCHID, FRINGED ORCHID, BOG ORCHID, FRINGELESS ORCHID

Plants erect; leaves 1–5, sheathing the stem; spikes with few to many flowers; flowers white to bright yellow, yellow-green, orange, or pale green (or other colors outside East TX), resupinate or not resupinate in 1 species (*P. nivea*); petals not deeply 2-parted; lip entire to fringed or (in one species) deeply 3-parted with the divisions variously divided into thread-like segments, with an often conspicuous spur; pollinia 2; capsules horizontal to semi-erect.

A n hemisphere, primarily n temperate, genus of ca. 200 species (Sheviak 2002b). In the past this genus has often been included within *Habenaria*. East TX species of the two genera can be separated as in the generic key, and Luer (1975) distinguished the genera as follows: *Habenaria* species usually have tuberoids on the roots, the lip and petals usually divided into multiple linear parts, the stigma with a pair of fleshy projections at or below the entrance to the nectary, and are mainly tropical in distribution, with only 2 species north of Florida. In contrast, *Platanthera* species usually lack tuberoids on the roots, usually have the lip and petals not divided into multiple linear parts, lack fleshy projections from the stigma, and are widespread in the n hemisphere. Hybridization is known to occur between a number of *Platanthera* species (Luer 1975; Smith & Snow 1976; Folsom 1984; Brown 2002a, 2003). Pollination is by various insects, including butterflies, moths, bees, and mosquitoes (Smith & Snow 1976; Folsom 1984; Mabberley 1997; Argue 1999a, 1999b), but the genus is pollinated mainly by Lepidoptera (Pridgeon et al. 2001); spur length is apparently a critical factor in pollination (Pridgeon et al. 2001). (Greek: *platys*, broad or wide, and *anthera*, anther, in reference to the unusually wide anther)

REFERENCES: Ames 1910; Luer 1975; Smith & Snow 1976; Holmes 1983; Folsom 1984, 1995; Argue 1999a, 1999b; Sheviak 2002b, Brown 2004a.

1. Lip EITHER conspicuously fringed OR deeply divided at least halfway to base into 3 parts.
   2. Lip deeply divided at least halfway to base into 3 parts (these parts may be variously divided); flowers pale yellow-green to greenish white ____ **P. lacera**
   2. Lip conspicuously fringed, but not divided into 3 parts; flowers white or yellow to orange.
      3. Flowers white ____ **P. blephariglottis**
      3. Flowers yellow to orange.
         4. Spur longer than the ovary and pedicel combined, 20–35 mm long; lip ca. 8–12 mm long (not including fringe) ____ **P. ciliaris**
         4. Spur shorter than or equal to the ovary and pedicel combined, 4–14(–17) mm long; lip ca. 4–6 mm long (not including fringe).
            5. Spur 4–8(–10) mm long, ca. 1/2 the length of the ovary and pedicel combined; mouth of spur nearly triangular to keyhole-shaped ____ **P. cristata**
            5. Spur (8–)11–14(–17) mm long, ca. equal in length to the ovary and pedicel combined; mouth of spur nearly circular ____ **P. chapmanii**
1. Lip neither fringed nor deeply divided (can be crenulate or erose in *P. integra*).
   6. Flowers conspicuously white; lip the uppermost of the petals (flowers not resupinate) ____ **P. nivea**
   6. Flowers bright yellow to yellow-green or pale green; lip the lowermost of the petals (flowers resupinate).
      7. Flowers bright yellow; lip usually crenulate or erose apically ____ **P. integra**
      7. Flowers yellow-green or pale green; lip neither crenulate nor erose (can be obscurely 3-lobed apically in *P. clavellata*)
         8. Lip with a lobe or tooth on each side near the base; center of lip or lip base with a tubercle or growth (fin-like, rounded); apex of lip not at all lobed ____ **P. flava**
         8. Lip without lobes or teeth near base; center of lip or lip base without a tubercle or growth; apex of lip obscurely 3-lobed ____ **P. clavellata**

Platanthera blephariglottis (Willd.) Lindl. var. **conspicua** (Nash) Luer, (sp.: tongue like an eyelid or eyebrow, in reference to the fringed lip; var.: easily seen, conspicuous), LARGE WHITE FRINGED ORCHID, WHITE FRINGED ORCHID, WHITE FINGER ORCHID, PLUME OF NAVARRE. Plant to 35–110 cm tall; leaves 2–4, lanceolate, 5–35 cm long, keeled; spikes densely- or loosely-flowered, with 30–50 flowers; flowers white; sepals ovate; petals linear, 3–8 mm long; lip ovate, ca. 1–nearly 2 cm long (not including fringe), conspicuously fringed marginally, the fringe adding ca. another 1/2 cm in length; spur slender, 3–4(–5) cm long, as long as ovary or longer. Swamp margins, depressions in savannahs, hillside seepage bogs, margins of baygalls; included for East TX based on range map in Luer (1975) showing occurrence in the s part of the Pineywoods; however, a single Galveston Co. collection to the s of East TX in the Gulf Prairies and Marshes (Correll 1961) is the only definitive collection known for the state; also known less than 50 miles e of the TX/LA border in Vernon Parish, LA (MacRoberts & MacRoberts 1995a); se U.S. from NC s to FL w to TX. Aug–Sep. [*Blephariglottis conspicua* (Nash) Small, *Habenaria blephariglottis* (Willd.) Hook. var. *conspicua* (Nash) Ames, *P. conspicua* (Nash) P.M. Br.] Variety *conspicua* is sometimes recognized as a distinct species, *P. conspicua* (Brown 2002b). This taxon is morphologically similar to the orange-flowered *P. ciliaris*. Pollination by butterflies and moths has been reported (Luer 1975); Smith and Snow (1976) indicated that *P. blephariglottis* is pollinated mainly by moths. Hybrids are known between *P. blephariglottis* and *P. ciliaris*, *P. clavellata*, and *P. cristata* (Sheviak 2002b). The northern more widespread var. *blephariglottis* has smaller flowers with the spur < 2.6 cm long. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠ ▣/294

Platanthera chapmanii (Small) Luer, (for A.W. Chapman, 1809–1899, American botanist and author of *Flora of the Southern United States*), CHAPMAN'S FRINGED ORCHID, CHAPMAN'S FINGER ORCHID, CHAPMAN'S ORCHID. Plant 30–100 cm tall; leaves 1–2(–3), linear-lanceolate, 10–28 cm long, 1–3.5 cm wide; spikes densely-flowered (to 60 or more flowers); flowers orange; sepals suborbicular to oblong-elliptic; petals narrowly cuneate to oblong-cuneate, 3–4 mm long; lip (not including fringe) ca. 3–6 mm long, conspicuously fringed marginally; spur slender, (8–)11–14(–17) mm long. Wet woods, bogs, swamps, especially wetland pine savannahs, acidic soils; in the s part of the Pineywoods in Hardin, Jefferson (Correll 1961), Orange, and Tyler (Liggio & Liggio 1999) cos.; FL, GA, and TX. While once abundant in parts of the Big Thicket, habitat conversion for pine-plantations and residential development has destroyed most of this orchid's habitat (Liggio & Liggio 1999). Jul–Aug. [*Blephariglottis chapmanii* Small, *Habenaria* ×*chapmanii* (Small) Ames] This species is intermediate morphologically between *P. ciliaris* and *P. cristata* and has been considered by some to be a hybrid between these two species (Luer 1975). However, Folsom (1984, 1995) concluded that *P. chapmanii* is a distinct species, and Brown (2002a) noted that while it may have originated as a hybrid, it is a "stable, reproducing species." Most populations of these three "yellow-fringed orchids" are morphologically "pure," *P. chapmanii* grows true from seed, and in the area where *P. chapmanii* is most common (near Apalachicola, FL), *P. ciliaris* is absent (Folsom 1984). Brown (2004a) recently clarified the situation by emphasizing that *P. chapmanii* is a species with an ancestral hybrid origin, while ×*channellii* Folsom is a morphologically similar current hybrid with the same parentage (*P. ciliaris* × *P. cristata*). Pollination is by long-tongued butterflies as in *P. ciliaris*; however, the shorter spur of *P. chapmanii* results in the pollinia being attached to the butterfly's proboscis—rather than to the eyes as in the case of *P. ciliaris*. This pollination difference apparently acts as a reproductive isolating mechanism (Folsom 1984). Joe Liggio (pers. comm.) noted that this species is rare and geographically restricted to n FL, s GA, and East TX. Brown (2002a) indicated that more than 90 percent of all the known plants are in FL. Thus, even though not officially recognized as such (TOES 1993; Carr 2002d; Poole et al. 2002), because of its decreased abundance and limited occurrence we consider this species to be of conservation concern in TX. ⚠ ▣/294

Platanthera ciliaris (L.) Lindl., (ciliate, fringed), YELLOW FRINGED ORCHID, YELLOW FINGER ORCHID, ORANGE-FRINGE, ORANGE-PLUME, RATTLESNAKE'S-MASTER. Plant 24–100 cm tall; leaves 2–4, oblong lanceolate to lanceolate, 7–30(–40) cm long, 0.6–6 cm wide; spikes densely- or loosely-flowered, with 30–60 flowers; flowers very showy, bright to deep orange; sepals oblong-elliptic to ovate or nearly orbicular, 4–9 mm long; petals linear, 6–7 mm long; lip oblong, 8–12 mm long (not including fringe), conspicuously fringed marginally, the fringe adding ca. another cm or more in length (the fringe segments can themselves be branched); spur slender, 20–35 mm long, longer than the ovary. Low woods, near edge of water, moist areas, hillside seepage bogs, baygalls, and savannahs, acidic soils; mainly in the Pineywoods, but w to w margin of Post Oak Savannah in Henderson, Milam (Correll 1961), and Anderson (MacRoberts & MacRoberts 1998e) cos.; se Canada (Ont.) and e U.S. from NY s to FL w to IL, OK, and TX. Jun–Aug. [*Blephariglottis ciliaris* (L.) Rydb., *Habenaria ciliaris* (L.) R. Br. ex W.T. Aiton] Pollination is by long-tongued butterflies which get the pollinia attached to their compound eyes (Folsom 1984). Smith and Snow (1976) found that *Papilio troilus* (spicebush swallowtail) was the main pollinator. This is the most common summer-blooming orchid in East TX (Liggio & Liggio 1999). Hybrids are known between *P. ciliaris* and both *P. blephariglottis* and *P. cristata* (Sheviak 2002b); Brown (2002b) treated the hybrid between *P. ciliaris* and *P. conspicua* (*P. blephariglottis* var. *conspicua*) as *P.* ×*lueri* P.M. Br. ⚅/294

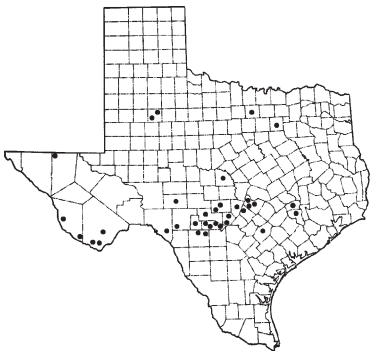
Platanthera clavellata (Michx.) Luer, (club-shaped, in reference to the spurs), LITTLE CLUB-SPUR ORCHID, SMALL WOOD ORCHID, GREEN WOODLAND ORCHID, GREEN WOOD ORCHID, SMALL GREEN WOOD ORCHID, FROG-SPIKE, GREEN REIN ORCHID, SOUTHERN REIN ORCHID, WOOD ORCHID. Plant 15–35(–47) cm tall; leaves 1(–2), oblanceolate to obovate-oblanceolate, 5–19 cm long, 1–3.5 cm wide; spikes usually with 3–15 flowers; flowers yellow-green to pale green, twisted ca. 45 degrees away from the vertical axis of the stem; sepals ovate, 4–5 mm long; petals ovate or obovate, 3–5 mm long; lip oblong, obscurely 3-lobed apically, 3–7 mm long; spur varying from slightly club-shaped to slender and cylindric, 8–13 mm long, longer than the ovary. At edge of water or in water, along streams, swamps, baygalls, and seeps, mucky saturated soils; widespread in the Pineywoods; e Canada and throughout e U.S. w to MN, OK, and TX. Jun–Jul. [*Gymnadeniopsis clavellata* (Michx.) Rydb., *Habenaria clavellata* (Michx.) Rydb.] In bud this species superficially resembles the adder's-tongue ferns—*Ophioglossum*. It is reportedly self-pollinated throughout much of its range (Catling & Catling 1991b). As in *P. integra* and *P. nivea*, the column of this species bears appendages (somewhat as in *Habenaria*); because of this, Sheviak (2002b) noted that it "appears that this species is inappropriately placed in *Platanthera*." However, hybrids are known between *P. clavellata* and *P. blephariglottis* (Sheviak 2002b). ⚅/294

Platanthera cristata (Michx.) Lindl., (crested), CRESTED FRINGED ORCHID, CRESTED FINGER ORCHID, ORANGE-CREST ORCHID, GOLDEN FRINGE ORCHID, ORANGE-CREST, CRESTED YELLOW ORCHID, YELLOW FRINGED ORCHID. Plant 18–90 cm tall; leaves 2–4, oblong-lanceolate to linear-lanceolate, 5–21 cm long; spikes usually densely-flowered, with up to ca. 80 flowers; flowers bright orange (resembling small versions of those of *P. ciliaris*); sepals oblong-elliptic to orbicular, 3–4.5 mm long; petals oblong-elliptic to obovate, 2–4 mm long; lip ovate, ca. 4–6 mm long (not including fringe), conspicuously fringed marginally, the fringe adding ca. 4 mm in length (the fringe segments can themselves be branched); spur slender, 4–8(–10) mm long, much shorter than the ovary. Bogs, baygalls, seeps, low meadows, and damp woods, moist, sandy, intensely acidic soils; Pineywoods, particularly the s portion; e U.S. from NY s to FL w to AR and TX. Jun–Jul. [*Blephariglottis cristata* (Michx.) Raf., *Habenaria cristata* (Michx.) R. Br. ex W.T. Aiton] This species is similar to *P. ciliaris* but "has a narrower, more compact and often proportionately longer raceme [spike] of flowers which are less than half the size of those of *P. ciliaris*" (Luer 1975). The species is also similar to *P. chapmanii*, but the triangular or keyhole-shaped mouth of the spur of *P. cristata* is distinctive and can be used to distinguish the species from *P. chapmanii* (mouth of spur

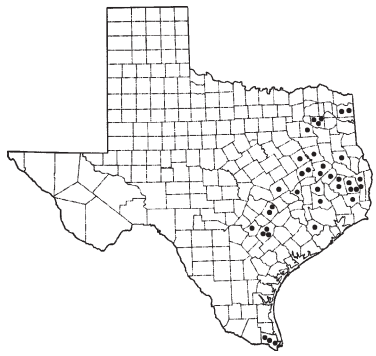
nearly circular) (Sheviak 2002b). While the flowers are visited by long-tongued butterflies (as in the similar *P. ciliaris* and *P. chapmanii*), pollination is by bees. The relatively short spur and the presence of floral fragrance are consistent with bee pollination. This pollination difference apparently functions as a reproductive isolating mechanism (Folsom 1984). Hybrids are known between *P. cristata* and *P. blephariglottis* (Sheviak 2002b); Brown (2002b) treated the hybrid between *P. cristata* and *P. conspicua* (*P. blephariglottis* var. *conspicua*) as *P.* ×*beckneri* P.M. Br. 🏵/294

Platanthera flava (L.) Lindl., (pale yellow), SOUTHERN REIN ORCHID, TUBERCLED FINGER ORCHID, PALE GREEN ORCHIS, SOUTHERN TUBERCLED ORCHID. Plant 11–65 cm tall; leaves 1–4, ovate-oblong to narrowly lanceolate, 5–23(–35) cm long, 1–5(–7) cm wide; spikes usually rather loosely-flowered, slender, with 10–40 flowers; floral bracts mostly shorter than flowers; flowers yellow-green; sepals ovate-oblong to suborbicular, 2–4 mm long; petals ovate to oblong or suborbicular, 2–5 mm long; lip variable, broadly oblong to suborbicular, 2.2–6 mm long, unfringed, with a triangular lobe or tooth on each side near base, with a tubercle or growth (fin-like, rounded) in the center of the lip at or near lip base; spur slender (rarely slightly club-shaped), 4–11 mm long. Wet habitats including stream beds, bogs, baygalls, swamps, floodplains, and wet savannahs, often in standing water where it can form extensive linear colonies from the stoloniferous rhizomes (L. Magrath, pers. comm.); Harrison (BRIT), Jasper, Rusk, Sabine (Liggio & Liggio 1999), Harris, and Upshur (Correll 1961) cos. in the Pineywoods; also n margin of Gulf Prairies and Marshes (se Harris Co.—collected by Larry Brown in an area invaded by Chinese tallow trees—Liggio & Liggio 1999); e U.S. from NJ s to FL w to IL, OK, and TX. Jun–Jul. [*Habenaria flava* (L.) R. Br., *Perularia bidentata* (Elliott) Small, *Perularia scutellata* (Nutt.) Small] Visitation of the flowers by mosquitoes, moths, and butterflies has been reported (Luer 1975; Catling & Catling 1991b). According to Liggio and Liggio (1999), "The base of the lip has a fin-like knobby projection that partially obstructs the entrance to the nectar-containing spur. When an insect tries to reach this nectar, it is 'reined' into contact with the sticky area that contains the pollinia. This probably explains the common name, 'rein orchid'...." Plants from the n U.S. with denser, stouter inflorescences and floral bracts longer than the flowers are recognized as var. *herbiola* (R. Br.) Luer (e.g., Sheviak 2002b). 🏵/294

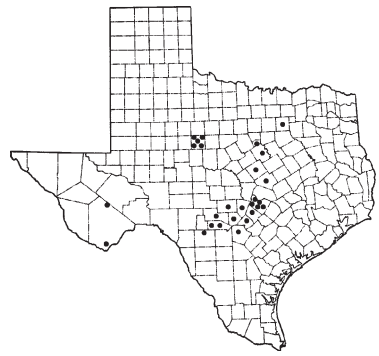
Platanthera integra (Nutt.) A. Gray ex L.C. Beck, (whole, entire), YELLOW FRINGELESS ORCHID, GOLDEN FROG-ARROW, SMALL SOUTHERN YELLOW ORCHIS, FROG-ARROW, GOLDEN FRET-LIP, ORANGE REIN ORCHID. Plant 30–62(–72) cm tall; leaves 1–2(–3), oblong-lanceolate to narrowly lanceolate, 10–20(–32) cm long, 1–3 cm wide; spikes densely-flowered, with 30–60 flowers; flowers bright yellow; sepals ovate-orbicular to orbicular, 3–5 mm long; petals narrowly oblong to elliptic, 3–4 mm long; lip ovate-elliptic to obovate, (3–)4–5 mm long, crenulate or erose apically or rarely nearly entire; spur slender, 5–6(–10) mm long. Hillside seepage bogs and wet pineland savannahs; extremely rare in TX; Jasper (BRIT), Angelina, Hardin (Bridges & Orzell 1989a; Liggio & Liggio 1999; Carr 2001), and Newton (J. Singhurst, pers. comm.) cos. in the s part of the Pineywoods, typically on the Catahoula geologic formation (Bridges & Orzell 1989a); e U.S. from NJ s to FL w to TX. Jul–Sep. [*Gymnadeniopsis integra* (Nutt.) Rydb., *Habenaria integra* (Nutt.) Spreng.] Pollination by bumble bees has been reported (Luer 1975). This species is distinguished from other orange and yellow *Platanthera* species by the unfringed lip. Until the 1980s, the only documented occurrence of this species in TX was a Drummond collection from the 1800s. Holmes (1983), however, discovered that the Drummond specimen was misidentified and thus that the species apparently was unknown from the state. Bridges and Orzell (1989a) reported that a TEX sheet collected by Mrs. J.L. Hooks from Hardin Co. in 1950 was *P. integra* and further, that they had found two extant populations in hillside seepage bogs in Angelina and Jasper counties. As in *P. clavellata* and *P. nivea*, the column of *P. integra* bears 2 pairs of lateral appendages; according to Sheviak (2002b), these 3 species "evidently form a group apart from *Platanthera*." (RARE 2001, 2002b: G3G4S1) ⚠ 🏵/295



Epipactis gigantea



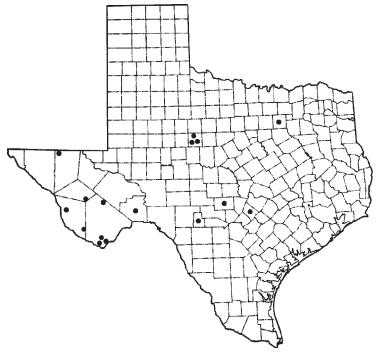
Habenaria repens



Hexalectris nitida



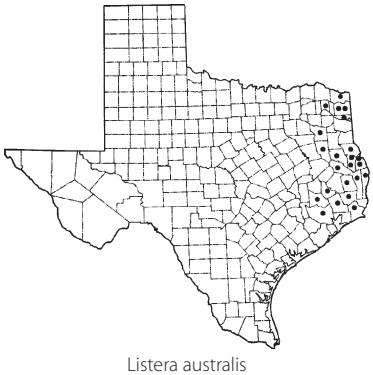
Hexalectris spicata
(both vars.)



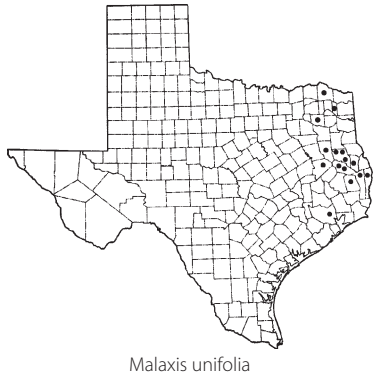
Hexalectris warnockii



Isotria verticillata



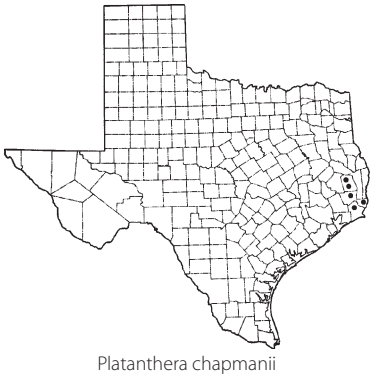
Listera australis



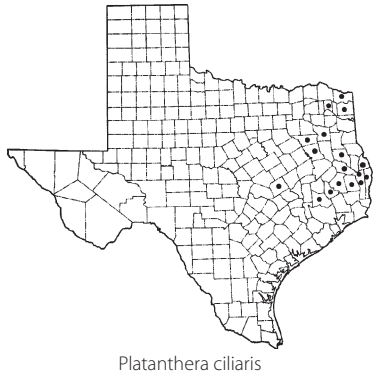
Malaxis unifolia



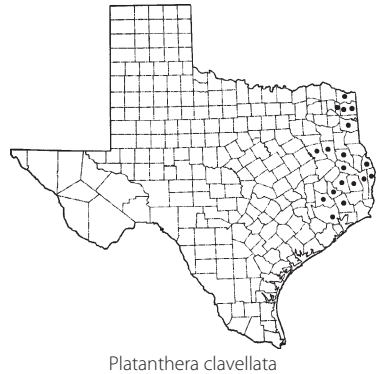
Platanthera blephariglottis



Platanthera chapmanii



Platanthera ciliaris



Platanthera clavellata

Platanthera lacera (Michx.) G. Don, (torn, in reference to the deeply fringed lip), GREEN FRINGED ORCHID, RAGGED FRINGED ORCHID, RAGGED ORCHID. Plant 25–80 cm tall; leaves 1–5, elliptic to lanceolate, 7–25 cm long, 1.5–5 cm wide; spikes densely to loosely-flowered, with 20–40 flowers; flowers pale yellow-green to greenish white; sepals oblong to ovate, 4–6(–8) mm long; petals linear-oblong, 5–8 mm long; lip deeply divided at least halfway to base into 3 parts (these parts may be variously divided into thread-like segments), 10–17 mm long; spur slender or slightly club-shaped, to 23 mm long, as long as or longer than the ovary. Along wooded streams, marshes, wet meadows, moist to wet, sandy, acidic soils; in TX known only from Bowie Co. (BRIT) in the extreme ne corner of the state. Until relocated by J. Singhurst and M. White in 2000 (J. Liggio, pers. comm.), this species was known in TX only from a collection by D. and H. Correll in 1946 (Liggio & Liggio 1999); e Canada and throughout e U.S. w to MN, OK, and TX. May–Jul. [*Blephariglottis lacera* (Michx.) Farw., *Habenaria lacera* (Michx.) R. Br.] Pollination by moths has been reported (Luer 1975); more specifically, the flowers produce a sweet fragrance which attracts day-flying sphinx moths (Catling & Catling 1991b; Yatskievych 1999). (TOES 1993: IV) ⚠ ֍/295

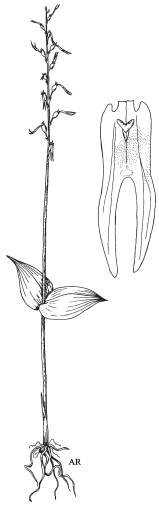
Platanthera nivea (Nutt.) Luer, (snowy, white as snow), SNOWY ORCHID, SOUTHERN SMALL WHITE ORCHIS, BOG-TORCH, SHOWY ORCHIS, SNOWY HABENARIA, FROG-ARROW, WHITE FROG-ARROW, FROG-SPEAR, SAVANNAH ORCHID, WHITE REIN ORCHID. Plant 20–60(–90) cm tall; leaves (1–)2–3, linear-lanceolate, 5–27(–31) cm long; spikes densely-flowered, with 20–50 flowers; flowers intensely white; sepals oblong to ovate, 2–6 mm long, the lateral ones falcate; petals oblong to elliptic, somewhat falcate; lip uppermost (flowers not resupinate, in contrast to all other East TX *Platanthera* species), linear-oblong to linear-elliptic, 3–8 mm long, bent backward at the center; spur slender, 10–16(–18) mm long. Bogs, wet meadows, savannahs, moist pinelands; Hardin, Jasper (BRIT), Jefferson, Newton, Sabine, and Tyler (Liggio & Liggio 1999) cos. in the Pineywoods; also Gulf Prairies and Marshes; e U.S. from NJ s to FL w to AR and TX. May–Jul. [*Gymnadeniopsis nivea* (Nutt.) Rydb., *Habenaria nivea* (Nutt.) Spreng.] While once common in the pine savannahs of the Big Thicket, habitat destruction has made this species rare in TX (Liggio & Liggio 1999). Luer (1975) noted that the intensely white flowers with a touch of yellow in the center (the column) make the inflorescence look like popcorn. This species can be abundant after fire (G. Watson, pers. comm.). Sheviak (2002b) noted that several characters, including the unusual column (with 2 pairs of appendages) and non-resupinate flowers, "suggest that this species should not be included in *Platanthera*." (TOES 1993: IV) ⚠ ֍/295

PLATYTHELYS Garay JUG ORCHID

A genus of 9 species of warm areas of the Americas (Ackerman 2002a); previously included in the genus *Erythrodes*. Garay (1977) distinguished *Platythelys* based on its distinctive rostellum (= an extension from the upper edge of the stigma). (Greek: *platy*, broad, and *thely*, female, in reference to the broad flat rostellum)

REFERENCES: Luer 1972; Garay 1977; Ackerman 2002a.

Platythelys querceticola (Lindl.) Garay, (inhabitant of oak woods), LOW ERYTHRODES, JUG ORCHID, LOW GROUND ORCHID. Plant to ca. 40 cm tall, glabrous; stems leafy, ascending to erect from a prostrate, stoloniferous base with fibrous roots at the nodes; leaves 3–8, ovate to lanceolate or elliptic-lanceolate, 2–6.5(–8) cm long, 1–2(–3) cm wide, reticulate-veined, short-petiolate; petioles with bases expanded and clasping the stem; inflorescence a terminal spicate raceme of 4–25+ small flowers (superficially reminiscent of a *Spiranthes* inflorescence); floral bracts ovate, acuminate, to ca. 6 mm long; flowers subsessile, whitish or greenish, sometimes faintly marked with pink, resupinate; flower parts not widely spreading; sepals elliptic, 3.5–4.5 mm long and 1.5–2.5 mm wide; lateral petals lanceolate, 3–4.5 mm long and 1–1.3 mm wide, connivent (= adjacent but not fused to) with the uppermost sepal; lip 3–4 mm long (not including spur), elongated basally into a saccate spur 2.5–3.5 mm long, apically 3-lobed, the lateral lobes rounded, the



Listera australis [GLE]



Malaxis unifolia [FNA]



Platanthera blephariglottis var. conspicua [PMB]



Platanthera chapmanii [PMB]



Platanthera ciliaris [PMB]



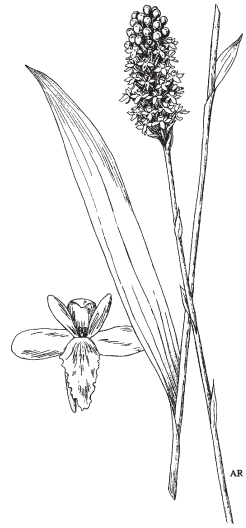
Platanthera clavellata [FNA]



Platanthera cristata [GLE]



Platanthera flava [GLE]



Platanthera integra [GLE]

middle lobe apiculate, recurved; column ca. 1.5 mm long and wide; pollinia 2, yellow; capsules to ca. 7 mm long. In humus, swamps, springs, and creek banks in moist woods; Ames (1924) reported the species from TX based on a sight observation, a range map in Luer (1972) showed occurrence in the Pineywoods, and Hatch et al. (1990) cited the Pineywoods; however, neither Correll (1961), Correll and Johnston (1970), Liggio and Liggio (1999), nor Ackerman (2002a) located any TX specimens; Johnston (1990) excluded it from his list of TX plants; therefore, it is highly possible that this species does not presently occur in TX; no county distribution map is provided; FL, LA, and possibly TX. Flowering dates are not available for TX; however, in n FL the species flowers from Jul–Sep (Luer 1972; Brown 2002a). [*Erythrodes querceticola* (Lindl.) Ames, *Physurus querceticola* Lindl., *Physurus sagraeanus* A. Rich.] This species was treated in the genus *Erythrodes* by Correll (1961), Correll and Johnston (1970), and Luer (1972).

POGONIA Juss. SNAKE-MOUTH, BEARD-FLOWER

A genus of 3 species of North America and e Asia (Sheviak & Catling 2002). (Greek: *pogonias*, bearded, referring to the bearded lip)
REFERENCES: Teuscher 1978; Sheviak & Catling 2002.

Pogonia ophioglossoides (L.) Ker Gawl., (resembling *Ophioglossum*–adder's-tongue fern, in reference to the single leaf), ROSE POGONIA, SNAKE-MOUTH ORCHID, ADDER'S-MOUTH, ADDER'S-TONGUE-LEAVED POGONIA, BEARD-FLOWER, ROSE-CRESTED ORCHID. Plant 20–40(–70) cm tall, from fibrous roots scattered along slender rootstock; stems rigidly erect; leaf usually 1, ovate to ovate-lanceolate, 2–12 cm long, ca. 1–3 cm wide; inflorescence terminal, of 1(–3) flower(s); flower rose-pink to white, occasionally fragrant, resupinate (the lip therefore the lowermost of the petals), subtended by a leaf-like bract; lip heavily white-yellow bearded, (12–)15–25 mm long; capsule 2–3 cm long. Seepage slopes, wetland pine savannah, bogs, marshy areas, other wet areas, often with PITCHER PLANTS, frequently growing on mats of *Sphagnum* moss; Pineywoods and Post Oak Savannah; also n margin of Gulf Prairies and Marshes; e Canada and through e U.S. w to MN, OK, and TX. Apr–Jul. This species is pollinated by bees, which are apparently deceived. The insects are attracted by a fragrance and by the appearance of the beard of yellow-white hairs on the lip which mimics stamens; little or no nectar is produced (Catling & Catling 1991b). This is an example of "naivete exploitation" in which inexperienced bees are tricked into providing pollination services without receiving a reward (Gregg 1989). /295

PONTHIEVA R. Br. PONTHIEU'S ORCHID, SHADOW-WITCH

A genus of 25 terrestrial or rarely epiphytic species of tropical and warm areas of the Americas (Ackerman 2002c); it has sometimes been considered to consist of up to 53 species (Mabberley 1997). (Named for Henri de Ponthieu, a French West Indian merchant, who sent new collections of plants to Sir Joseph Banks in 1778—Luer 1972)
REFERENCES: Luer 1972; Ackerman 1995, 2002c.

Ponthieva racemosa (Walter) C. Mohr, (with a raceme type inflorescence), SHADOW-WITCH, HAIRY SHADOW-WITCH, PONTHIEU'S ORCHID, GLANDULAR NEOTTIA. Terrestrial scapose herb; roots numerous, stout; stems 13–30(–60) cm tall, pubescent, usually with reddish brown pigmentation; leaves 3–6(–8), in a basal rosette, rich green above, with a silvery luster beneath, elliptic to oblanceolate or obovate, 3–17 cm long, 1–5.5 cm wide, subsessile to broadly petioled, reduced to narrow bracts on the stem, ± succulent when fresh, thin and papery upon drying; inflorescence an unbranched terminal raceme with 20–30(–35) widely spreading flowers that face ± upward; floral bracts lanceolate, 8–10 mm long and 2 mm wide; flowers not resupinate, the lip thus uppermost; middle sepal whitish green, with bright green veins, 4–7 mm long and 2–3 mm wide; lateral sepals whitish green, 4.3–6.5 mm long and 2.5–3.5 mm wide; lateral petals white, with bright green veins, noticeably obliquely triangular, clawed, 4–6 mm long and 3.5–5

mm wide, adherent apically with apex of middle sepal; lip white with a green conspicuously concave center, clawed, suborbiculate, with a long, pointed apex, 5–7 mm long and 4–7 mm wide (when flattened); column 4–5 mm long; pollinia 4, yellow; capsules ellipsoid, 8–13 mm long, ca. 5 mm wide. Along wooded streams and around sloughs and ponds, usually near limestone outcrops or in calcareous soils (e.g., Fleming Formation at Davis Hill State Park in Liberty Co.—Liggio 2002); Jasper, Liberty (BRIT), and San Jacinto (SHSU) cos. in s part of Pineywoods; se U.S. from VA s to FL w to TX. Sep–Oct. [*Arethusa racemosa* Walter] The combination of oblique lateral petals and non-resupinate lip is distinctive. In Florida, the species is self-compatible but not autogamous; natural fruit set was 35% in one population (Ackerman 1995). Small halictid bees have been observed visiting the flowers (Luer 1972). While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠ ▣/296

SPIRANTHES Rich. LADIES'-TRESSES, PEARL-TWIST

Roots fleshy, tuberous-thickened; stems unbranched, with few, mostly basal leaves or none persisting until flowering time; flowers resupinate, in a slender, often twisted or spiraled spike; perianth narrow, almost tubular, white to ivory, cream, or green, with or without green or yellow markings; pollinia 2.

A genus of 45 species of North America, South America, Eurasia, and Australia (Sheviak & Brown 2002), but mainly n temperate. A number of species are cultivated as ornamentals. While some species of *Spiranthes* are among the most common orchids in East TX, others are very rare (e.g., *S. parksii, S. brevilabris*). Pollination in some is by long-tongued bees which transfer pollinia attached to their tongues; other species reproduce via agamospermy (= the production of seeds by asexual means) (Catling & Catling 1991b). The spiral arrangement of the flowers is thought to be an adaptation to bee pollination, with the spiral functioning somewhat like a ladder (Catling & Catling 1991b; Yatskievych 1999). The characteristic spiraling of the inflorescence varies greatly, with inflorescences ranging from scarcely coiled to so tightly coiled that the spiral aspect is lost (Sheviak 1982); in the key below, it is necessary to distinguish "flowers single-ranked" from "flowers multi-ranked." The term multi-ranked describes the situation in which coiling is so tight that the flowers appear to be arranged in several vertical rows or ranks in the inflorescence. For clear examples of flowers single-ranked, see the illustrations of *S. lacera* var. *gracilis*, *S. praecox*, or *S. tuberos*a. For clear examples of flowers multi-ranked, see the illustrations of *S. cernua* or *S. magnicamporum*. In the key and descriptions below, the color of the perianth is usually described exclusive of the lip; lip color is usually described separately. The common name LADIES'-TRESSES is derived from an old meaing of the word tress (a braid) and refers to the braided appearance of the inflorescence; the derivation is through Latin, *tricia*, plait, which comes from Greek, *tricha*, three-fold, in reference to the three strands of plaits or braids (Durant 1976). (Greek: *speira*, a coil or spiral, and *anthos*, flower, from the spiraled inflorescence)

REFERENCES: Correll 1947; Catling & McIntosh 1979; Garay 1980; Catling 1981, 1982, 1983a, 1983b; Sheviak 1982, 1991; MacRoberts et al. 1997; Brown 1999, 2001; Sheviak & Brown 2002.

1. Axis of inflorescence glabrous or essentially so (as seen under magnification); leaves (if present at flowering time) all basal.
   2. Perianth 5.5–11 mm long; leaves (if present) mostly 5 mm or less wide, erect or ascending, without a petiole, the lower portion sheathing the stem, linear to narrowly lanceolate or oblong-elliptic.
      3. Lip tapering from broad base to narrow obtuse apex, yellowish or yellowish green, not marked or veined with green; inflorescence often 1-sided (rarely slightly spiraled); leaves usually withering and dried by flowering time; plants flowering Nov–Dec _____ **S. longilabris**

3. Lip usually widest near apex, white or creamy green to green, usually marked or veined with green (usually with distinctive diverging green lines); inflorescence tightly to loosely spiraled to 1-sided; leaves usually present at flowering time; plants flowering Apr–Jun.
   4. Perianth 5.5–8.5(–11) mm long, white, the lip usually with green veins near apex _____ **S. praecox**
   4. Perianth 10–16.5 mm long, creamy green to green, the lip with darker green veins near apex _____ **S. sylvatica**

2. Perianth 2.5–5 mm long; leaves (if present) 6–25 mm wide, spreading, the ± short broad blades with a distinct petiole, ovate to ovate-lanceolate.
   5. Lip pure white; root 1(–2); perianth 2.5–3(–5) mm long, gaping from near middle; plant flowering Jun–Sep _____ **S. tuberosa**
   5. Lip with a yellow to green center; roots several, in a fascicle; perianth 3–5 mm long, gaping closer to apex (ca. 2/3 or 3/4 distance from base); plant flowering either Feb–May or Sep–Nov.
      6. Leaves usually not persisting until flowering time; plant usually flowering relatively later, mostly Sep–Nov _____ **S. lacera**
      6. Leaves usually present at flowering time; plants flowering relatively earlier, mostly in spring, Feb–May.
         7. Lip white with green center; sepals and petals white with green basal portion; leaves oblanceolate _____ **S. eatonii**
         7. Lip cream to yellowish white to yellowish green with yellow center; sepals and petals cream to yellowish white or yellowish green, without green basal portion; leaves ovate _____ **S. floridana**

1. Axis of inflorescence pubescent (as seen under magnification—use 10X hand lens), the pubescence blunt to capitate (= end enlarged) or pointed; leaves (if present at flowering time) cauline and/or basal.
   8. Inflorescence with flowers single-ranked (= inflorescence with a single discernable vertical row or rank of flowers spiraling one to many times up the inflorescence, the inflorescence sometimes scarcely coiled and thus secund or 1-sided).
      9. Leaves absent at flowering time; plants flowering (late Aug–)Oct–Nov.
         10. Lateral petals ± obovate, distinctly narrowest at base; lip (when flattened) narrowest in basal 1/3, oval, not constricted at middle, 5–7 mm long; in side view the sepals extending further (appearing longer) than the petals; species endemic to a few counties in the s part of the Post Oak Savannah and one in the Pineywoods _____ **S. parksii**
         10. Lateral petals lanceolate, not distinctly narrowest at base; lip (when flattened) widest basally, usually slightly to distinctly constricted near the middle and then slightly widened at the apex, 6–12 mm long; in side view all perianth parts extending about the same distance; species widespread throughout East TX _____ **S. cernua**
      9. Leaves present at flowering time (may be withered and dry); plants flowering Feb–Jul.
         11. Leaves ovate, 2–6 cm long; upper surface of lip with a patch or tuft of pubescence; plants flowering Feb–May _____ **S. brevilabris**
         11. Leaves linear-lanceolate to linear-oblanceolate, 5–35(–40) cm long; upper surface of lip without a patch of pubescence; plants flowering Apr–Jul.
            12. Lip usually widest near base, often fleshy-thickened, white with yellow or greenish yellow center.
               13. Pubescence of inflorescence pointed (use hand lens); tuberosities at base of lip not incurved, not prominent, much less than one-fifth as long as lip; species common and widespread in East TX _____ **S. vernalis**
               13. Pubescence of inflorescence capitate; tuberosities at base of lip distinctly incurved, prominent, ca. one-fifth as long as lip; species rare in East TX, known only from the Pineywoods _____ **S. laciniata**

12. Lip usually widest near apex or the lateral margins parallel, thin and membranous, white, usually marked or veined with green (usually with distinctive diverging green lines) _____ **S. praecox**

8. Inflorescence with flowers multi-ranked (= inflorescence with the flowers so densely spiraled as to produce the appearance of 2–4 vertical rows or ranks of flowers spiraling up the inflorescence).
14. Flowers remaining unopened in all stages; perianth pale yellowish _____ **S. cernua** (peloric form)
14. Flowers opening in normal manner; perianth white to ivory or cream, the lip often with yellowish to greenish center or markings.
15. Lateral petals ± obovate to ovate or suborbicular, distinctly narrowest at base, with a central green stripe (strip rarely absent); lip 5–7 mm long; in side view the sepals extending further (appearing longer) than the petals; rare endangered species endemic to a few counties in the s part of the Post Oak Savannah and one in the Pineywoods _____ **S. parksii**
15. Lateral petals linear to lanceolate, elliptic-lanceolate, or lance-oblong, not distinctly narrowest at base, without a central green stripe; lip 5–16 mm long; in side view all perianth parts extending about the same distance; including species common and widespread throughout East TX.
16. Perianth 5–6.1 mm long, pure white, including lip; plants delicate, slender, 5–40 cm tall; leaves present at flowering time; spike 15 mm or less in diam.; flowers unscented _____ **S. ovalis**
16. Perianth 5–15(–18) mm long, white to ivory, cream, creamy green, or green, the lip with a yellow, greenish yellow, or yellow-green center or marked with green veins; plants often large and stout (for a *Spiranthes*), 7–100+ cm tall; leaves present OR absent at flowering time; spike usually much > 15 mm in diam.; flowers unscented or scented.
17. Lip usually widest near apex or the lateral margins parallel, thin and membranous, white or creamy green to green, usually marked or veined with green (usually with distinctive diverging green lines); plants flowering Apr–Jun.
18. Perianth 5.5–8.5(–11) mm long, white, the lip usually with green veins near apex _____ **S. praecox**
18. Perianth 10–16.5 mm long, creamy green to green, the lip with darker green veins near apex _____ **S. sylvatica**
17. Lip usually widest near base, often fleshy-thickened, white with a yellow, greenish yellow, or yellow-green center; plants flowering (late Aug–)Oct–Dec(–Jan).
19. Lateral sepals spreading, the tips arching upward and angled away from the rest of the perianth; flowers slender, not inflated, strongly fragrant; leaves usually absent at flowering time; lip not constricted near the middle, with small basal tuberosities (± short conical knobs); plants typically in calcareous, slightly alkaline soils, usually in grasslands _____ **S. magnicamporum**
19. Lateral sepals appressed, oriented parallel to the rest of the perianth; flowers appearing inflated, strongly fragrant OR not so; leaves present OR absent at flowering time; lip not constricted OR slightly to distinctly constricted near the middle, often with prominent basal tuberosities (usually somewhat inward-curving); plants often in sandy soils or very wet situations, in various habitats.
20. Leaves all basal or 1–2 near very base of stem, usually not persisting until flowering time; petioles less than 6 mm wide; flowers scentless or only faintly fragrant; lip (when flattened) widest basally, usually slightly to distinctly constricted near the middle and then slightly widened at the apex; in various habitats throughout East TX _____ **S. cernua**

20. Leaves often extending well up the stem and sometimes merging gradually with the bracts below the inflorescence, present at flowering time; petioles more than 7 mm wide; flowers strongly fragrant; lip (when flattened) not constricted or only slightly so, ± tapering from wider base to apex; often in swamps or wet forested sites primarily in the Pineywoods _____ **S. odorata**

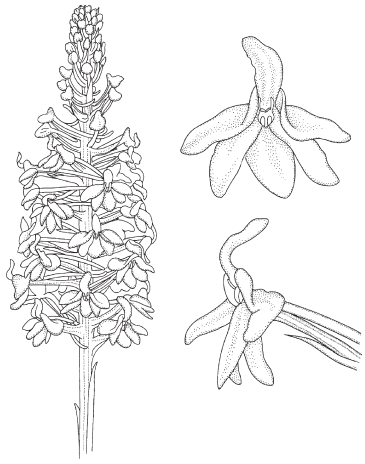
Spiranthes brevilabris Lindl., (short-lipped), TEXAS LADIES'-TRESSES. Plant (including inflorescence and flowers) densely pubescent with capitate hairs, 7–40 cm tall; leaves 3–5, basal, usually present at flowering time, withering after flowering, ovate, 2–6 cm long, 1–2 cm wide; spike with flowers loosely spiraled, single-ranked, frequently 1-sided; perianth ca. 5 mm long, creamy white to yellowish white; lip with yellow center sometimes marked with green, recurved, finely lacerate at apex, the upper surface with a tuft or patch of hairs. Meadows and pinelands; Cass and Tyler (Liggio & Liggio 1999) cos. in the Pineywoods; also Galveston and Harris (Liggio & Liggio 1999) cos. in the Gulf Prairies and Marshes; se U.S. from AL s to FL w to TX. Feb–May. [*Spiranthes gracilis* (Bigelow) L.C. Beck var. *brevilabris* (Lindl.) Correll] While this species and *S. floridana* were treated as varieties of *S. gracilis* [= *S. lacera* var. *gracilis*] by Correll (e.g., 1961), they flower earlier, have leaves persisting through flowering time, differ from *S. gracilis* in lip characters, and in *S. brevilabris,* can be distinguished by the dense pubescence (Luer 1972). This species has often been considered to include *S. floridana* as a variety (e.g., Hatch et al. 1990; Liggio & Liggio 1999); see further discussion under *S. floridana*. Only a few collections of the rare *S. brevilabris* have ever been made in TX (J. Liggio, pers. comm.). According to Sheviak and Brown (2002), *S. brevilabris* "has dramatically declined, with only a single extant population known in 1998–2000." The species is thus obviously of conservation concern. ⚠ ֍/300

Spiranthes cernua (L.) Rich., (drooping, nodding, in reference to the somewhat nodding position of the flowers), NODDING LADIES'-TRESSES, COMMON LADIES'-TRESSES, LADIES'-TRESSES, WHITE NODDING LADIES'-TRESSES. Plant glabrous below, pubescent above with some capitate hairs, 10–60 cm tall; roots fleshy, wide-spreading; leaves all basal or 1–2 near very base of stem, linear to lanceolate, 5–26 cm long and 0.5–2.5 cm wide, usually not persisting until flowering; spike pubescent, 1.5–2 cm thick, usually with flowers multi-ranked or rarely single-ranked; flowers sometimes scentless or only faintly fragrant; perianth white to ivory or cream, rarely pale yellowish, 6–12 mm long; lip thick, with yellow center, usually slightly to distinctly constricted near the middle, apically recurved and undulate or crenulate; column 3–7 mm long; $2n = 45, 60$ (Sheviak 1982; Sheviak & Brown 2002). Prairies, open woodlands, wetland pine savannahs, even lawns, often on sandy soils; widespread in e 1/2 of TX; se Canada and throughout e U.S. w to MN and TX. (Late Aug–)Oct–Nov. A form with all closed flowers is known from the Post Oak Savannah; while the flowering spike is similar to normal *S. cernua*, the closed flowers are pointed in form and are pale yellowish. These flowers, typically with the lip scarcely different from the lateral petals, are sometimes referred to as peloric, a term used to describe various abnormal floral morphologies and technically meaning an abnormal regularity occurring in normally irregular flowers (Challis 2002); in these plants reproduction is vegetative through apomixis (Liggio & Liggio 1999). As discussed by Liggio and Liggio (1999), there is considerable confusion in distinguishing the three TX members of the *S. cernua* complex (*S. cernua, S. odorata, S. magnicamporum*). Sheviak and Brown (2002) also noted that determination of species in this complex is "often challenging." This is partly due to significant morphological variability, hybridization, morphological abnormalities, and the fact that *S. cernua* is a polyploid facultatively apomictic compilospecies receiving genes from the related diploids (Sheviak 1982,1991). Using characters (in the key above) such as presence of leaves at flowering time, floral fragrance, and habitat helps in making definitive identifications. ֍/300

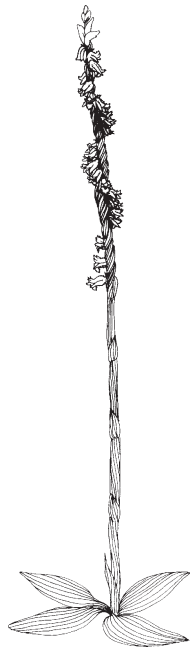
Spiranthes eatonii Ames ex P.M. Br., (for A.A. Eaton, 1865–1908, who collected the species during a Florida trip for Oakes Ames), EATON'S LADIES'-TRESSES. Plant 15–55 cm tall; leaves all basal, usually



Platanthera lacera [YAT]



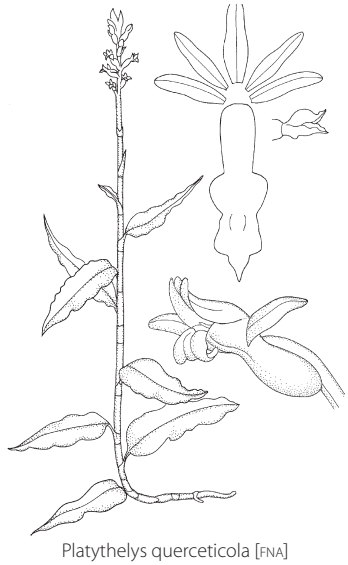
Platanthera nivea [FNA]



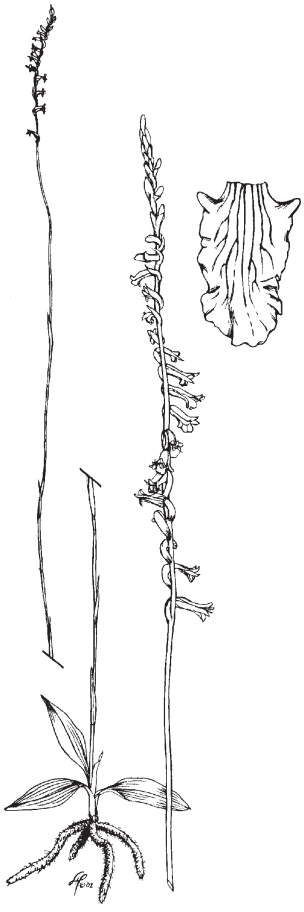
Spiranthes brevilabris [PMB]



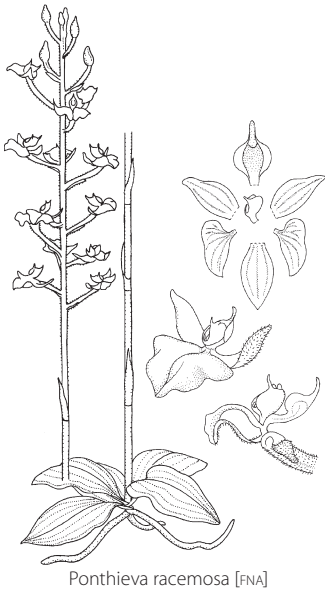
Pogonia ophioglossoides [LUN]



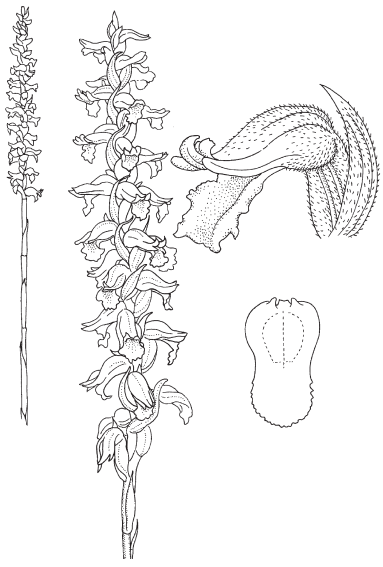
Platythelys querceticola [FNA]



Spiranthes eatonii [HEB]



Ponthieva racemosa [FNA]



Spiranthes cernua [FNA]

persisting until flowering but sometimes withering, usually short-petioled; leaf blades oblanceolate, 1–5.5 cm long, 0.75–1 cm wide; inflorescence with flowers single-ranked (sometimes 1-sided) to tightly spiraled and multi-ranked, essentially glabrous (when viewed with a hand lens; when a dissecting scope is used, sparse, scattered capitate glands can be seen); perianth white, 3–5 mm long; lip white with green center, without lacerate apex. Dry sandy pine barrens, roadsides, cemeteries, dry pine flatwoods; Jefferson Co. (BRIT) near s margin of the Pineywoods; se VA s to FL w to TX. Feb–May. This species was recently described as a new species by Brown (1999) and, as such, is one of the more recent additions to the flora of East TX. According to Sheviak and Brown (2002), this "is the only white-flowered, basal-leaved *Spiranthes* within its range to bloom at that time of year [late winter to spring]." The "narrow oblanceolate leaves" are also "distinctive." Known from only one county in TX, this species is of conservation concern. ⚠ ֍/300

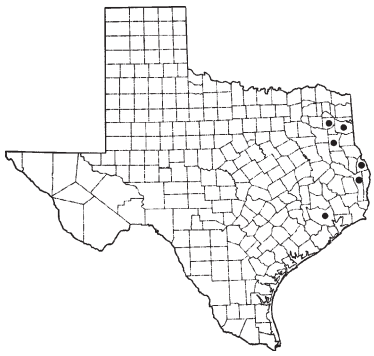
Spiranthes floridana (Wherry) Cory, (of Florida), FLORIDA LADIES'-TRESSES. Plant similar to *S. brevilabris*, 7–40 cm tall; leaves 3–5, basal, present at flowering time; leaf blades usually ovate, 2–6 cm long; inflorescence 1-sided (= secund) to loosely spiraled, glabrous or with only sparse hairs; perianth cream to yellowish white or yellowish green, to ca. 5 mm long; lip with yellow center. Open pinelands and meadows; Hardin, Jefferson, and Tyler (Liggio & Liggio 1999) cos. in the Pineywoods; also Harris Co. (Liggio & Liggio 1999) in the Gulf Prairies and Marshes; Liggio and Liggio (1999) indicated that this taxon is known from only five herbarium collections from TX; AL, FL, GA, MS, NC, SC, and TX. Feb–May. [*Imbidium floridanum* Wherry, *S. brevilabris* Lindl. var. *floridana* (Wherry) Luer, *S. gracilis* (Bigelow) L.C. Beck var. *floridana* (Wherry) Correll] This species has sometimes been treated as a variety of *S. brevilabris* (e.g., Hatch et al. 1990; Liggio & Liggio 1999) or not recognized as distinct from that species (Turner et al. 2003), and the two "are often and easily confused, although the degree of pubescence is an excellent diagnostic tool in the field" (Sheviak & Brown 2002)—*S. brevilabris* has the inflorescence densely pubescent, while in *S. floridana* it is glabrous or with only sparse pubescence. While we are following Sheviak and Brown (2002) in treating this taxon as a distinct species, further research is warranted to determine the most appropriate rank at which to recognize the variation present. As with *S. brevilabris*, Sheviak and Brown (2002) reported that "This species has become very uncommon, with only a single extant population known in 1998–2000." However, J. Liggio (pers. comm.) is aware of populations in two units of the Big Thicket National Preserve. Nevertheless, while not officially recognized as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), we consider this rare species to be of conservation concern. ⚠ ֍/300

Spiranthes lacera (Raf.) Raf. var. **gracilis** (Bigelow) Luer, (sp.: torn; var.: graceful), SOUTHERN SLENDER LADIES'-TRESSES, SLENDER LADIES'-TRESSES, GREEN-LIP LADIES'-TRESSES, AUTUMN TRESSES. Plant essentially glabrous, 20–60 cm tall; leaves all basal, usually not persisting until flowering, short petioled; leaf blades ovate, 1.5–6.5 cm long, 10–25 mm wide; inflorescence with flowers single-ranked, 1-sided to loosely or ± densely spiraled; perianth white, ca. 5 mm long; lip white marked with broad green or yellow-green stripe or spot in center, the apex finely lacerate. Sandy woods, prairies, often as a "pioneer" species in abandoned farmland and old fields (Liggio & Liggio 1999); widespread in East TX; also Denton Co. (Liggio & Liggio 1999) in the East Cross Timbers and n Gulf Prairies and Marshes; se Canada (Ont.) and throughout e U.S. w to MI and TX. Sep–Nov. [*S. gracilis* (Bigelow) L.C. Beck] Hybrids are known between this taxon and *S. vernalis* (Sheviak & Brown 2002). The more n *S. lacera* var. *lacera*, which does not reach TX, can be distinguished by the inflorescence with capitate pubescence and the leaves usually persisting through flowering time (Sheviak & Brown 2002). ֍/300

Spiranthes laciniata (Small) Ames, (laciniate, torn, in reference to the edge of the lip), LACE-LIP LADIES'-TRESSES, FRINGE-LIP LADIES'-TRESSES, LACE-LIP SPIRAL ORCHID. Plant 20–60(–100) cm tall; leaves persisting through flowering time, linear-lanceolate, 5–25(–40) cm long, to 1(–1.7) cm wide; inflorescence pubescent with capitate hairs, the flowers single-ranked, loosely spiraled to



Platanthera cristata



Platanthera flava



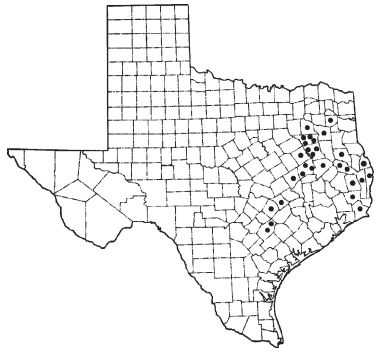
Platanthera integra



Platanthera lacera



Platanthera nivea



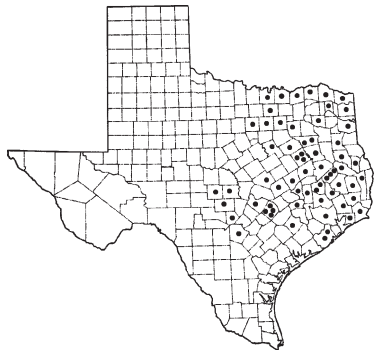
Pogonia ophioglossoides



Ponthieva racemosa



Spiranthes brevilabris



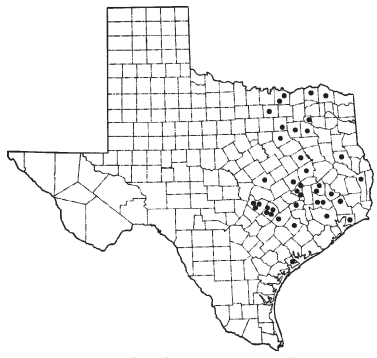
Spiranthes cernua



Spiranthes eatonii



Spiranthes floridana

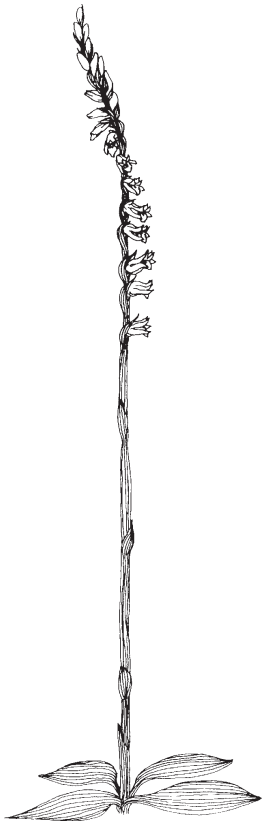


Spiranthes lacera var. gracilis

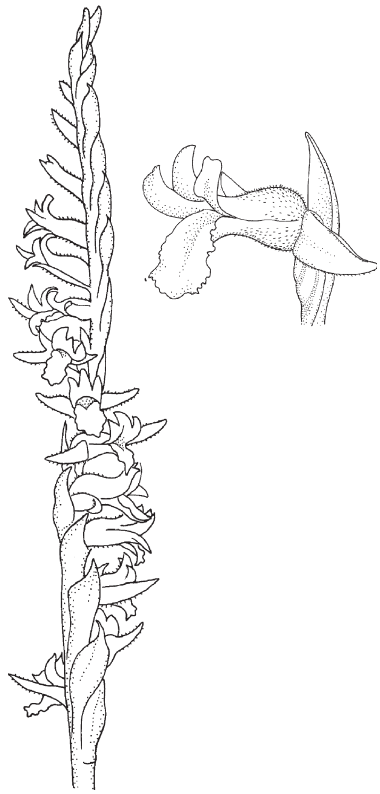
nearly secund (= 1-sided); perianth white to cream, 6–10 mm long; lip with yellow center, recurved, crenulate margined, with conspicuous incurved basal tuberosities. Marshes, shallow water, boggy depressions in savannahs and prairies, roadside ditches, often in areas flooded part of the year; Bowie (BRIT), Angelina, Hardin, Jasper, and Polk (Liggio & Liggio 1999) cos. in the Pineywoods; also Harris and Matagorda (Liggio & Liggio 1999) cos. in the Gulf Prairies and Marshes; this species is much less common in TX than the similar *S. vernalis*; e U.S. from NJ and MD s to FL w to TX. May–Jul. [*Imbidium laciniatum* (Small) House] Correll and Johnston (1970) considered this species to be a hybrid between *S. praecox* and *S. vernalis*. However, it flowers later in the season than *S. vernalis*, to which it is most similar morphologically, differing mainly in the different type of hairs on the inflorescence (Luer 1972) and in the tuberosities at the base of the lip (Liggio & Liggio 1999). According to Sheviak and Brown (2002), *S. laciniata* only "superficially resembles" *S. vernalis*. The actual hybrid between *S. praecox* and *S. vernalis* is very rare and has been named *S.* ×*meridionalis* P.M. Br. (Brown 2000c). ⚅/300

Spiranthes longilabris Lindl., (long-lipped), GIANT SPIRAL ORCHID, LONG-LIP LADIES'-TRESSES, GIANT SPIRAL LADIES'-TRESSES. Plant ± glabrous throughout (some tiny capitate hairs may be present), 12–60 cm tall; leaves when present basal (usually withering and dried before flowering time), 3–10(–15) cm long, mostly < 5 mm wide; spike with flowers projecting horizontally, single-ranked, not spiraled to slightly spiraled, but usually not more than 180°; perianth white or white tinged with cream, conspicuously open, 8–11 mm long; lip yellowish green or yellowish, 3–5.5 mm wide near base (which is widest portion), recurved apically, crenate. Wetland pine savannahs; Hardin and Newton (BRIT) cos. in the s Pineywoods; a citation for the Blackland Prairie by Hatch et al. (1990) is apparently an error. Luer (1972) mapped the species as occurring w across the coastal plain of the se U.S. to the very e part of the Pineywoods of TX, and Liggio and Liggio (1999) documented only the 2 counties given above; se U.S. from NC s to FL w to TX. Nov–Dec. The species is easily distinguished from other East TX *Spiranthes* species by the not spiraling or barely spiraling spike of large flowers blooming in late fall (Liggio & Liggio 1999). Known from only 2 counties in TX, this species is of conservation concern. Hybrids between *S. longilabris* and *S. odorata* are known and have been named S. ×folsomii P.M. Br. (Brown 2000a; Sheviak & Brown 2002). (RARE 2001, 2002b: without rank) ⚠ ⚅/301

Spiranthes magnicamporum Sheviak, (great field or great plains), GREAT PLAINS LADIES'-TRESSES, PRAIRIE LADIES'-TRESSES. Plant pubescent, 7–60 cm tall; roots tuberously thickened, abruptly descending; leaves all basal, linear-lanceolate, to 16 cm long and ca. 1(–1.5) cm wide, usually not persisting until flowering (see note below); inflorescence pubescent, with flowers tightly spiraled, multi-ranked; flowers fragrant, often with strong odor similar to vanilla or coumarin; perianth white to ivory, 5–14 mm long; lip with center yellowish and fleshy, slightly crisped apically; column 3 mm long; $2n = 30$ (Sheviak 1982). Upland, calcareous, slightly alkaline soils, prairies, moist or seeping limestone and calcareous rock outcrops, roadsides, most abundant in open situations; Comal, Fannin, Grayson (BRIT), Travis (Liggio & Liggio 1999), and Williamson (Turner et al. 2003) cos. in the Blackland Prairie on w margin of East TX and Brazos, Grimes, Limestone (Liggio & Liggio 1999), Robertson (Turner et al. 2003), and Washington (J. Liggio, pers. comm.) cos. in the Post Oak Savannah; also e Cross Timbers and Prairies and e Edwards Plateau; se Canada and in much of the e U.S. w to ND and NM. Nov–Dec(–Jan). This species is similar to and often confused with *S. cernua* and is part of the *S. cernua* complex; see further discussion under that species. The strongly scented flowers appear slender and with spreading sepals as compared to *S. cernua* with inflated, tubular, usually ± unscented flowers and appressed sepals. Unfortunately, these characters are often not observable in herbarium specimens (Sheviak 1982). Sheviak (1982) recognized them both at the specific level, indicating that while introgression occurs between the two, they differ in chromosome number, are partially genetically isolated and have different ecological requirements. According to Sheviak and Brown (2002), "Leaves typically senesce some weeks before anthesis, usually before the inflorescence



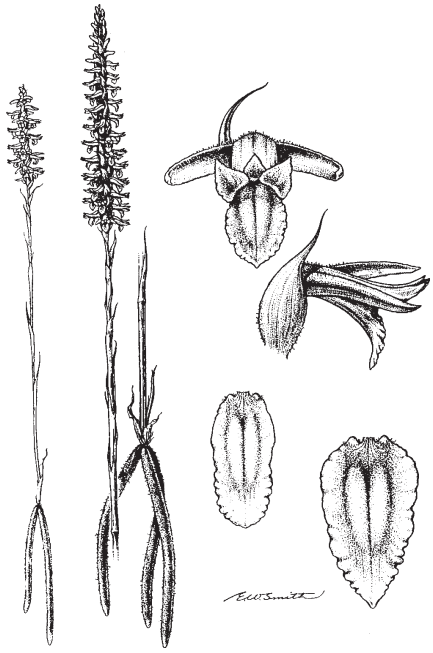
Spiranthes floridana [PMB]



Spiranthes longilabris [FNA]



Spiranthes lacera var. gracilis [PMC]



Spiranthes magnicamporum [BML]



Spiranthes laciniata [PMB]



Spiranthes odorata [FNA]

appears. Occasionally at the northern and western range limits of the species, however, especially in wetter habitats, they may persist into anthesis." 🏵/301

Spiranthes odorata (Nutt.) Lindl., (with an odor), FRAGRANT LADIES'-TRESSES, FRAGRANT TRESSES, SWAMP TRESSES, MARSH LADIES'-TRESSES, SWEET LADIES'-TRESSES, TIDAL TRESSES. Similar to and sometimes described as a luxuriant form of *S. cernua*; often taller, 18–100+ cm tall (this is the largest species of *Spiranthes* in East TX); leaves present at flowering (unlike most fall-flowering species), to 38(–52) cm long and 2.5(–4) cm wide; inflorescence with flowers tightly spiraled, multi-ranked; flowers with a strong scent (sometimes described as of vanilla or vanilla and jasmine); perianth 5–15(–18) mm long, usually white, varying to ivory or cream; lip ovate, tapering to the apex, not or only slightly constricted near the middle, yellow or greenish centrally; $2n$ = 30 (Sheviak 1982). Wet forested habitats, often in seasonally inundated areas, sometimes in standing water, clayey soils of wet pinelands, edges of rivers and lakes; Pineywoods and Post Oak Savannah; also Gulf Prairies and Marshes; e U.S. from NJ and MD s to FL w to TX. Oct–Nov. [*S. cernua* (L.) L.C. Rich. var. *odorata* (Nutt.) Correll] According to Luer (1972), "the most notable characteristic [of this species] is its strong scent, which we are unable to compare with that of anything else." This species is part of the *S. cernua* complex (see discussion under that species), and Correll (e.g., 1961) and Luer (1972) treated it as a variety of *S. cernua*. However, Sheviak's (1982) biosystematic study of the *S. cernua* complex gives strong justification for recognition of *S. odorata* at the specific level and most authorities now recognize it (e.g., Sheviak & Brown 2002; Brown 2002a). According to Sheviak and Brown (2002), "The very long, wide-spreading roots produce vegetative offshoots often 30 cm from the parent shoot, giving rise to extensive clonal colonies." 🏵/301

Spiranthes ovalis Lindl., (oval), OCTOBER LADIES'-TRESSES, OVAL LADIES'-TRESSES, LESSER LADIES'-TRESSES, LITTLE-ELEPHANTS. Plant glabrous below, pubescent above with some hairs capitate, ± delicate, to only 35(–40) cm tall; leaves 2–4, basal or low on stem, 3–15(–27) cm long, 6–15 mm wide, present at flowering time (unlike most fall-flowering species); spike with flowers tightly spiraled, in 2 or 3 ranks; flowers small; perianth pure white, 5–6.1 mm long; lip recurved apically, wavy-crenate. Wooded areas; sparsely scattered in East TX; also n Gulf Prairies and Marshes; se Canada (Ont.) and e U.S. from PA s to FL w to WI and TX. Sep–Nov. [*S. cernua* (L.) Rich. var. *parviflora* Chapm.] This is the only small-flowered species of *Spiranthes* in East TX with the flowers so densely spiraled as to produce the appearance of 2 or more vertical rows or ranks of flowers spiraling up the inflorescence. Except for its minute stature, *S. ovalis* resembles *S. cernua* (Luer 1975; Liggio & Liggio 1999). *Spiranthes ovalis* is reported to be quite shade tolerant (Liggio & Liggio 1999). While we are not recognizing infraspecific taxa in this species, Sheviak and Brown (2002) recognized 2 varieties, var. *ovalis* and var. *erostellata* Catling, and mapped both as occurring in East TX. The two can be separated using the following characters. The lack of a rostellum results in var. *erostellata* being autogamous (self-pollinating) (Catling 1983). 🏵/301

1. Rostellum (= portion of stigma separating pollinia and receptive surface of stigma) and viscidium (= sticky pad attached to pollinium) present; flowers fully opening and the ovaries swelling progressively _____ var. *ovalis*
1. Rostellum and viscidium absent; flowers never quite fully open and the ovaries on all flowers swelling simultaneously _____ var. *erostellata*

Spiranthes parksii Correll, (for the late Dr. H.B. Parks, Curator of the S.M. Tracy Herbarium (TAES, Texas A&M Univ.), who collected the type in 1945), NAVASOTA LADIES'-TRESSES, PARKS' LADIES'-TRESSES. Plant 20–33 cm tall; stems glabrous below, glandular-pubescent above; leaves basal, absent at flowering time; spike with flowers single-ranked or sometimes appearing multi-ranked, glandular-pubescent; floral bracts with white tips; perianth 5–8 mm long, white to light yellow-green, scarcely gaping, the segments with midveins slightly greenish to darker green; lateral sepals often with apices upturned; lateral petals rounded, ± obovate, distinctly

narrowest at base, 4.5–6.7 mm long, much shorter than the sepals; lip oval, narrowest in basal 1/3, distally truncate, erose-margined, 5–7 mm long, the central portion of lip varying from yellow to yellow-white and yellow-green; 2*n* = 60 (Sheviak & Brown 2002). "Margins of post oak woodlands in sandy loams along intermittent tributaries of the Brazos and Navasota Rivers, often in areas where edaphic (such as high aluminum content of soil) or hydrologic (such as a perched water table) factors limit competing vegetation in herbaceous layer" (TOES 1993), also barrens (rocky sandstone outcrops), first collected along the Navasota River in Brazos Co. in the Post Oak Savannah (Correll 1947; Correll & Johnston 1970; Luer 1975), also Burleson, Freestone, Grimes, Jasper, Leon, Madison, Robertson, Washington (Bridges & Orzell 1989a; TOES 1993), Fayette, Milam (Poole et al. 2002), and Bastrop (C. Sheviak, pers. comm.) cos.; endemic to East TX (Carr 2002b). Primarily Post Oak Savannah, with one outlying locality in an open woodland on Catahoula sandstone barrens in Jasper Co. in the Pineywoods (Liggio & Liggio 1999). Oct–Nov (usually flowering 2–4, typically 3 weeks after the much more common *S. lacera* var. *gracilis*). This species was first collected by Correll (1947) and not rediscovered until 1978 (Catling & MacIntosh 1979). In 1982, it was listed as federally endangered (Poole & Riskind 1987). MacRoberts et al. (1997) discussed the status of this species in TX. Luer (1975) considered this species to be similar to *S. lacera* var. *gracilis,* possibly being a polyploid form of that species or a hybrid. However, subsequent discoveries of a number of populations (e.g., Catling & McIntosh 1979; Bridges & Orzell 1989a) support its recognition as a separate species. Correll and Johnston (1970) indicated that, "The characteristically obovate petals and oval lip are distinctive and conveniently separate this species from all other species of *Spiranthes* found in TX." However, *S. parksii* cannot be distinguished from the similar and co-occurring *S. cernua* in the rosette stage, and flowering specimens must be seen for accurate specific identification. The tetraploid chromosome number and development of polyembryonic seeds (both shared with *S. cernua*) led Sheviak and Brown (2002) to suggest that this species is derived from *S. cernua*. Further, "The broad petals with central green stripe, several veins (instead of the three typical of the group), and erose-emarginate apical margin furthermore evidently represent partial peloria" [common in *S. cernua*] (Sheviak & Brown 2002). See discussion of peloria under *S. cernua*. Additional information is available from Texas Parks and Wildlife (1997, 2003a). (TOES 1993: I; RARE 2002a: G3S3LEE) ⚠ /301

Spiranthes praecox (Walter) S. Watson, (precocious, very early, in reference to the spring blooming time), GREEN-VEIN LADIES'-TRESSES, GRASS-LEAF LADIES'-TRESSES, GIANT LADIES'-TRESSES. Plant often glabrous throughout (sometimes axis of inflorescence with some pubescence), 20–75 cm tall; leaves usually 5–7, mostly basal, narrowly linear to filiform, 10–25 cm long, 1–5 cm wide, persisting through flowering time; inflorescence with flowers single- or multi-ranked, sometimes nearly 1-sided; perianth typically stark white, usually marked with green, 5.5–8.5(–11) mm long; lip thin, white, usually marked or veined with green (usually with distinctive diverging green lines), 2–6 mm wide near apex (which is widest portion), apically mostly wavy and slightly crenate. Low woods, wet open areas, roadsides; primarily in the Pineywoods, also Post Oak Savannah and n part of Gulf Prairies and Marshes; se U.S. from VA s to FL w to TX. Apr–May. According to Sheviak and Brown (2002), "Typical plants are easily recognized by the stark white flowers with green venation of the lip. In forma *albolabia* P. M. Brown & C. McCartney, the lip appears pure white but the raised veins are actually a pale yellow." *Spiranthes praecox* shares the distinctive diverging green lines on the lip with the newly described *S. sylvatica* (Brown 2001). That species has larger, creamy green to green flowers usually in tight spirals. *Spiranthes praecox* is known to hybridize with *S. vernalis* to produce *S.* ×*meridionalis* P.M. Br. (Brown 2000c; Sheviak & Brown 2002). /301

Spiranthes sylvatica P.M. Br., (of woodlands, forest-loving), WOODLAND LADIES'-TRESSES. Plant 20–80 cm tall, sparsely pubescent with capitate hairs; roots numerous, slender; leaves 3–5, basal and on lower third of stem, 10–35 cm long, 0.8–1.5 cm wide, persisting through flowering time;

inflorescence with flowers in a tight spiral, multi-ranked; perianth creamy green to green, 10–16.5 mm long; lip creamy green to green with darker green veining, 5–10(–14) mm long. Roadside banks, forest margins, shady old fields, and oak-pine woodlands, typically in shaded habitats, usually in drier soils than *S. praecox*; Jasper (*Lundell & Lundell 10554*, AMES) and Sabine (*Correll et al. 22233*, AMES) cos. (Brown 2001); since this species was added after map pages for the flora were completed, no county distribution map is provided; se U.S. from VA s to FL w to AR and TX. Apr–Jun. This species is similar to and has long been confused with *S. praceox*. It differs in its creamy-green to green, larger flowers and woodland habitat (Brown 2001). Further research is needed on these taxa. *Spiranthes sylvatica* is one of the most recently described species in the flora of East TX. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠ ⊞/302

Spiranthes tuberosa Raf., (tuberous), LITTLE LADIES'-TRESSES, GRAY'S LADIES'-TRESSES, LITTLE PEARL-TWIST, WHITE SPIRAL ORCHID, BECK'S LADIES'-TRESSES. Plant glabrous, 5–30 cm tall; root 1(–2), tuberous; leaves 2–3(–5), usually not present at flowering time, all basal, ovate, 2.5–5(–6.5) cm long, 6–15(–20) mm wide; inflorescence with flowers single-ranked, usually in a ± loose spiral; perianth white, gaping from near the middle, small, 2.5–3(–5) mm long; lip snow white, 2.5–3(–5) mm long, 1.5–2.5 mm wide, the apex crisped, barely erose. Open, dry, sandy woods, openings, savannahs; primarily Pineywoods and Post Oak Savannah; also n Gulf Prairies and Marshes; e U.S. from NY s to FL w to KS and TX. Jun–Sep. [*S. grayi* Ames, *S. tuberosa* var. *grayi* (Ames) Fernald] This species has the smallest flowers of all North American *Spiranthes* (Liggio & Liggio 1999). It is similar to *S. lacera* var. *gracilis* except that species has the lip white marked with a broad green or yellow-green stripe or spot in center, blooms Sep–Nov, and is larger in size. The tuberous root of *S. tuberosa* is distinctive. According to Sheviak and Brown (2002), "This species is easily recognized by its pure white flowers, broad crisped lip, and fugacious [= soon withering] leaves." ⊞/302

Spiranthes vernalis Engelm. & A. Gray, (of spring), SPRING LADIES'-TRESSES, TWISTED LADIES'-TRESSES, UPLAND LADIES'-TRESSES, SPRING TRESSES. Plant 10–60(–65) cm tall; leaves 4–5, persisting through flowering time, linear-lanceolate, 5–25 cm long, to ca. 1 cm wide; spike about 1.6 cm thick, with up to 50 flowers in a single rank that is usually rather tightly coiled (but can be loose to nearly 1-sided), the rachis and ovaries with reddish or whitish pointed hairs (use hand lens); perianth 6–10 mm long, usually white; lip with yellow or greenish yellow center, fleshy, recurved, apically crenulate, with stout, short, cone-shaped basal tuberosities; $2n = 30$ (Sheviak & Brown 2002). Sandy woods and prairies, roadsides, pastures, wetland pine savannahs, moist areas; widespread and common in e 1/3 of TX; also outliers in the Cross Timbers and Prairies (Cooke Co.), the Edwards Plateau (Mason Co.), and the Rolling Plains (Hemphill Co.) (Liggio & Liggio 1999); widespread in the e U.S. w to NE and TX. Late Apr–Jul. [*S. reverchonii* (Small) Cory] Liggio and Liggio (1999) commented that, "The spring ladies tresses is undoubtedly the most common orchid in Texas." Sheviak and Brown (2002) noted that this is a variable species and that the "most consistent diagnostic character is the presence in inflorescences of copious articulate, pointed trichomes that readily distinguish *S. vernalis* from similar species." Hybrids are known between this species and both *S. lacera* var. *gracilis* (Sheviak & Catling 2002) and *S. praecox* (Brown 2000b). ⊞/302

TIPULARIA Nutt. CRANE-FLY

A genus of 3 similar species of woodlands of e North America and Asia (Catling & Sheviak 2002). The genus is thought to have been more widespread in the past, based on its three widely separated species: *T. josephi* Rchb. f. ex Lindl. in the Himalayan Mts., *T. japonica* Matsum. in Japan, and *T. discolor* in the e U.S. (Luer 1975). Some authors (e.g., Wen 1999) consider this genus

an example of an e Asia-e North America disjunction; this distribution pattern is discussed under the genus *Brachyelytrum* (Poaceae). (Latin: *tippula*, water-spider, from *Tipula*, the genus of insects including crane-flies, in reference to the resemblance of the flowers to crippled crane-flies in flight—Luer 1975)
REFERENCES: Luer 1972, 1975; Stoutamire 1978; Whigham & McWethy 1980; Snow & Whigham 1989; Catling & Catling 1991a; Catling & Sheviak 2002.

Tipularia discolor (Pursh) Nutt., (of different colors, reportedly because of the differing colors of the two leaf surfaces—Brown 2002a), CRANE-FLY ORCHID, CRIPPLED CRANE-FLY, ELFIN-SPUR. Scapose, terrestrial, glabrous herb 10–60(–65) cm tall; scape arising from end of a series of horizontally oriented corms, brownish or purplish green; leaf solitary, produced in fall and overwintering, green, often blotched with purple above, strikingly purple beneath, the whole leaf turning dull red before being lost in late spring, distinctly petiolate, the blade cordate to ovate-elliptic, 5–10.5 cm long, 2.5–7 cm wide, the petiole 5–11 cm long; inflorescence a loose raceme of 10–40(–55) flowers, produced in summer after loss of leaf; floral bracts absent; flowers watery purple-green (pale green, tinged or mottled with purple), resupinate, asymmetrical, with one petal overlapping the dorsal sepal; sepals and lateral petals 4–8 mm long, 1–3 mm wide; lip 3-lobed, the lateral lobes basal, the slender central lobe much longer (5–8 mm), with a slender, basal, ± horizontal spur (10–)15–23 mm long; column (2.5–)3–4 mm long; pollinia 4 (in 2 pairs), yellow; capsules narrowly ellipsoid, 9–12 mm long. In humus of rich woods, along streams, floodplains, and on wooded slopes, "often in depressions under sweet gum" (Catling & Sheviak 2002); widespread in the Pineywoods; e U.S. from MA s to FL w to IL and TX. Jul–Sep. [*T. unifolia* Britton, Sterns & Poggenb.] This species is usually found closely associated with beech trees (Ajilvsgi 1979). Out of a large number of plants producing leaves, only a small percentage will produce inflorescences in a given year (Luer 1975). This is the only North American orchid whose flowers are not bilaterally symmetrical (Stoutamire 1978; Homoya 1993), and this lack of symmetry can be explained as "... part of a character complex adapting the flowers to pollinarium attachment off the visitor midline. ..." (Stoutamire 1978). According to Catling and Sheviak (2002), pollination is "... by noctuid moths [family Noctuidae], the pollinaria attaching to either the left or right compound eye depending on whether the column of a particular flower is slightly twisted to the left or to the right." Anther caps surrounding the pollen masses are retained for a brief period of time (ca. 8–40 minutes before shriveling and falling off) after removal of the pollen masses by pollinating moths. The anther caps apparently prevent the pollen masses from attaching to stigmatic surfaces. The time delay is thought to allow the moth ample time to arrive at a different plant and thus maximize cross-pollination (Stoutamire 1978; Catling & Catling 1991a, 1991b). ⊞/303

TRIPHORA Nutt. THREE-BIRDS ORCHIDS, NODDING-CAPS

A New World genus of 25 (Medley 2002) terrestrial woodland species formerly included in the genus *Pogonia*. However, the somewhat erect mature anther of *Triphora* would be atypical in *Pogonia* (Dressler 1981), and the two genera differ in chromosome number (Baldwin & Speese 1957). *Triphora* and several related genera comprise a difficult to place relict group with no close allies, and *Triphora* and *Pogonia* are now considered to be in different subtribes, tribes, or possibly even subfamilies (Dressler 1981, 1993). According to Medley (2002), "Most species of *Triphora* exist in small, scattered populations and exhibit synchronous, ephemeral flowering; flowers last only one day. Synchrony enhances the chances for fertilization. Isolated flowers are rarely fertilized." (Greek: *tri*, three, and *phoros*, bearing, in reference to the small number of flowers (often three), or to the three crests on a three-lobed lip—Luer 1975)
REFERENCES: Luer 1972, 1975; Medley 1979, 2002; Keenan 1988, 1992.

Triphora trianthophora (Sw.) Rydb., (three flower-bearing), THREE-BIRDS ORCHID, NODDING-POGONIA, BROODING-POGONIA. Erect terrestrial herb 8–25(–30) cm tall, with cylindrical to nearly

spheroid, tuber-like swellings to 3 cm long and 15 mm in width which give rise to new plants; stem tinged with purple; leaves 2–8, bract-like, tinged with purple, broadly ovate to cordate, 10–15(–20) mm long, 2–15 mm wide, clasping; inflorescence racemose, with 1–6(–rarely more), but often 3, pedicellate, white to pink flowers borne from the leaf axils; flowers resupinate, usually lasting only a single day; sepals oblanceolate, 11–15 mm long, 3–4 mm wide; lateral petals oblanceolate, 11–14 mm long, ca. same width as sepals, arched over the column; lip white with three parallel, bright green, papillose crests, 10–15(–20) mm long, 6–10 mm wide, with slender claw, 3-lobed, the lateral lobes ± ovate, curved upward, the middle lobe ovate to orbicular, with a sinuate margin; column ca. 10 mm long, white; pollinia 2, purplish; capsules erect, to 15 mm long; 2*n* = 44 (Sheviak & Brown 2002). Leaf mold of hardwood forests, rich sandy soils near streams; Nacogdoches, Smith (BRIT), Anderson, Jefferson, and San Jacinto (Liggio & Liggio 1999) cos. in the Pineywoods; se Canada (Ont.) and throughout e U.S. w to NE and TX. Jul–Oct (flowering synchronous and ephemeral). [*Pogonia trianthophora* (Sw.) Britton, Sterns & Poggenb., *T. trianthophora* var. *schaffneri* Camp] Flowering is unpredictable: in some seasons many plants in a colony will appear above ground while in other seasons scarcely any will appear (Luer 1975). The roots exist saprophytically below ground in symbiosis with a fungus (Luer 1975) and can exist for years without sending up a flower stalk (Summers 1987). Mass flowering of a colony (all mature buds opening at the same time on the same day), apparently based on temperature or other environmental cues, has been reported (Luer 1975; Keenan 1988, 1992). Typically a plant will have one or two flowers open at a time, and the individual flowers are usually open for only a single day (Keenan 1988, 1992), but sometimes 2–4 days near the w limit of the species (Medley 2002). The common name NODDING-POGONIA results from the pedicels not rigidly supporting the weight of the flowers (Luer 1975). Pollination is by small, often halictid, bees (Medley 1979; Catling & Catling 1991b). ⊠/306

ZEUXINE Lindl. SOLDIER'S ORCHID

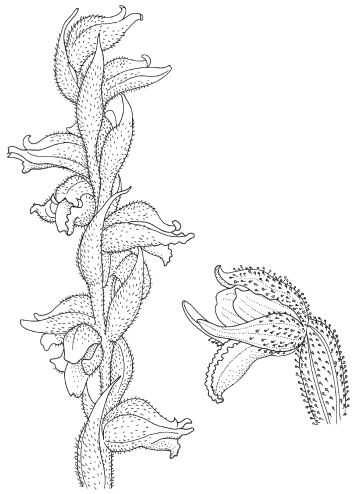
A genus of 30 species (Ackerman 2002b) of tropical and warm areas of the Old World; some species are cultivated as ornamentals. (Greek: *zeuxis*, yoking or joining, probably in reference to the partial fusion of the lip and column, or possibly from the pollinia growing together in some species—Sheehan & Sheehan 1995)

REFERENCES: Ames 1938; Luer 1972; Sheehan & Sheehan 1995; Liggio & Liggio 1999; Ackerman 2002b.

Zeuxine strateumatica (L.) Schltr., (band, company, or army, probably in reference to the resemblance of a number of the erect plants to a company of soldiers—Luer 1972), ZEUXINE ORCHID, SOLDIER'S ORCHID. Erect terrestrial herb 4–25 cm tall, perennial, but can act as an annual, rhizomatous, with new plants forming from buds on the rhizomes; stems often purplish; leaves 5–12, sheathing the stem, linear-lanceolate, to 8(–9) cm long, 3–8 mm wide, keeled; inflorescence a densely-flowered terminal spike with up to 50 flowers (tiny plants may have only 1 or 2 flowers); flowers white except for bright yellow to orangish lip; sepals and lateral petals similar, ovate to ovate-lanceolate, 4–7 mm long, 1.5–3 mm wide, the dorsal sepal and lateral petals converging to form a hood; lip ca. 4 mm long and 3 mm wide, rounded and dilated apically, adnate at base to base of column; column ca. 1.5 mm long and wide; pollinia yellow; capsules semi-erect, ca. 7 mm long and 6 mm wide; 2*n* = 22–64, 30–56, 50, 100 (Sheviak & Brown 2002). Weed in such habitats as flower beds, lawns, and gardens; Brazos (H. Wilson, pers. comm.) and Harris (TAMU; Liggio & Liggio 1999) cos.; a report of a Montgomery Co. locality (Liggio & Liggio 1999) is apparently incorrect (L. Brown, pers. comm.); AL, FL, GA, LA, MS, SC and TX. Dec–Jan. Native of Asia. This species is thought to have first arrived in North America (FL) in a shipment of centipede grass (*Eremochloa ophiuroides*) seed in 1927 (Sheehan & Sheehan 1995); it is now widespread in peninsular Florida and into Georgia, and it was first discovered in TX in 1988 growing in a mulched flower bed (Brown & Gandhi 1989; Liggio & Liggio 1999). Liggio (pers. comm.) has heard of other unconfirmed reports and suggests that the species will possibly become more



Spiranthes ovalis [GLE]



Spiranthes parksii [FNA]



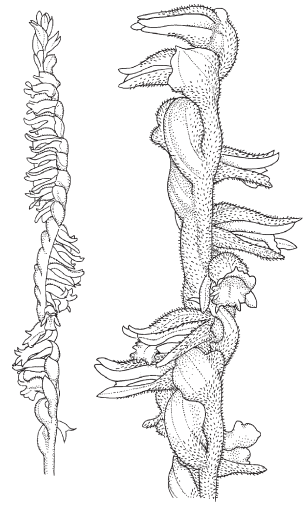
Spiranthes praecox [GLE]



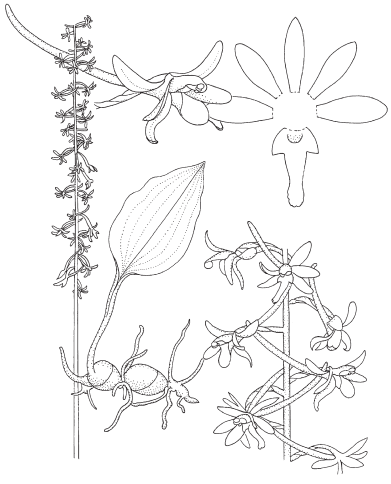
Spiranthes sylvatica [PMB]



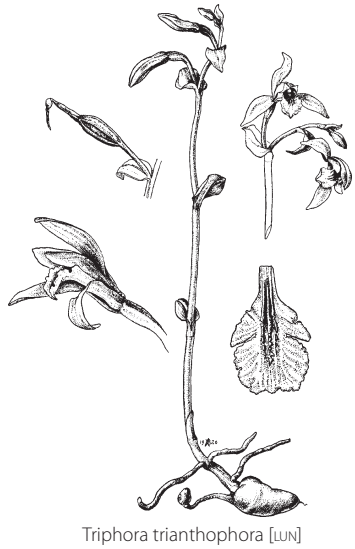
Spiranthes tuberosa [GLE]



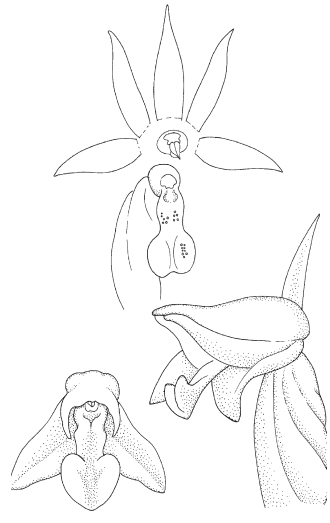
Spiranthes vernalis [FNA]



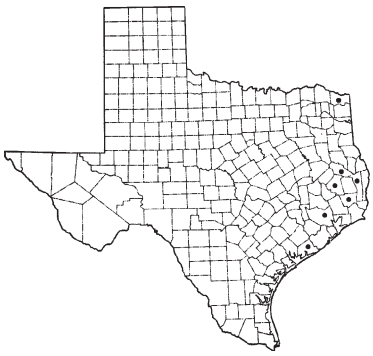
Tipularia discolor [FNA]



Triphora trianthophora [LUN]



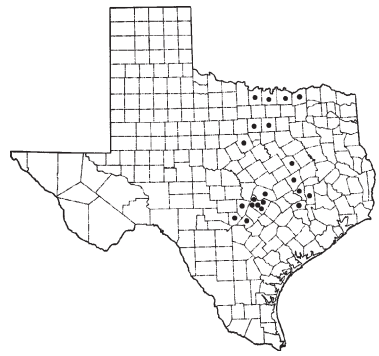
Zeuxine strateumatica [FNA]



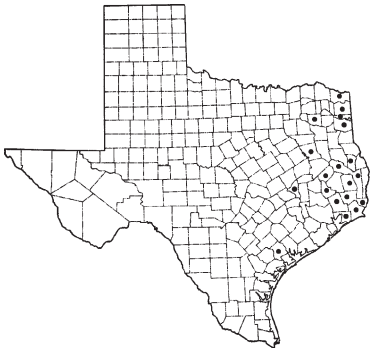
Spiranthes laciniata



Spiranthes longilabris



Spiranthes magnicamporum



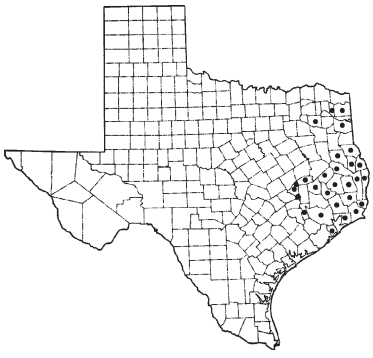
Spiranthes odorata



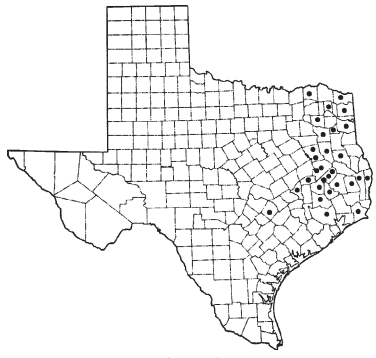
Spiranthes ovalis



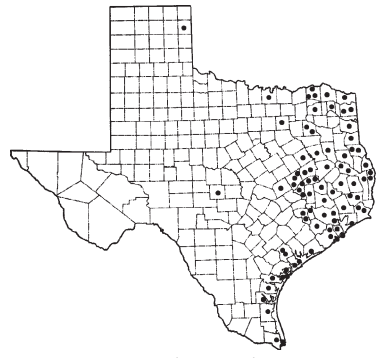
Spiranthes parksii



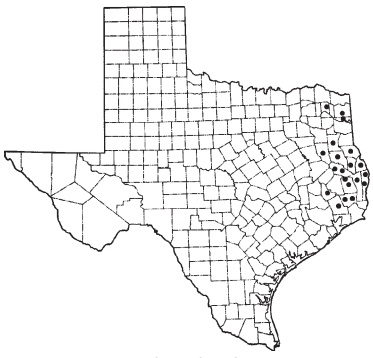
Spiranthes praecox



Spiranthes tuberosa



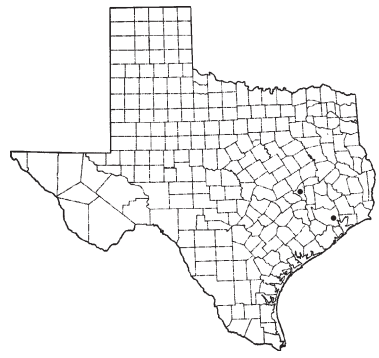
Spiranthes vernalis



Tipularia discolor



Triphora trianthophora



Zeuxine strateumatica

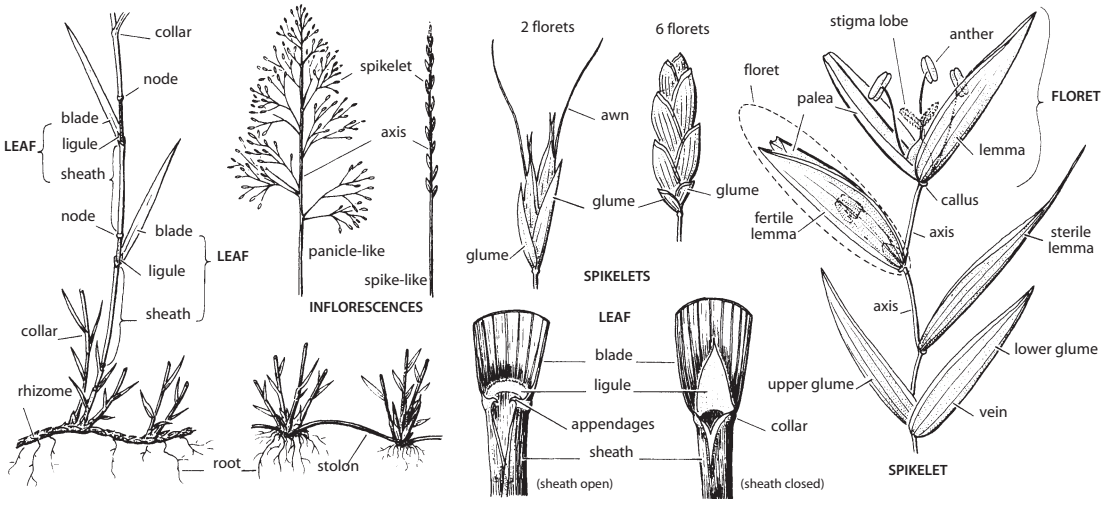
widespread in TX. [*Orchis strateumatica* L.] Luer (1972) indicated that while small flies have been observed visiting the flowers, the species is probably self-pollinated. Similarly, Ackerman (2002b) suggested the species is probably autogamous or apomictic, based on the apparently high fruit set, spontaneous reproduction in greenhouses, and its weedy nature. /308

POACEAE Barnhart (GRAMINEAE Juss.) GRASS FAMILY

Ours herbaceous or woody (in bamboos), annuals or perennials; roots fibrous; culms (= stems) usually rounded, with prominent, swollen or constricted, solid nodes, the internodes hollow or solid, and with intercalary meristem at base allowing continued elongation; tillers (= basal branches), stolons (= above ground horizontal stems or "runners"), or rhizomes (= underground horizontal stems) often present; leaves alternate, with tubular basal sheath enclosing the culm and usually split to base down one side opposite the blade and a short or elongate, usually linear, flattened or involute (= inrolled) blade, usually with a ligule (= row of hairs, a scaly membrane, or a ciliated membrane) at junction of blade and sheath on adaxial (inner, upper) side, often with intercalary meristem near the ligule; inflorescences made up of very reduced branches called spikelets, which are the basic units of the grass inflorescence and which are arranged in various ways (e.g., spikes, spicate racemes, racemes, panicles); spikelets composed of (0–)2 empty scale-like bracts (= glumes) at base (in some, glumes none or reduced to awns), 1–numerous flowers, associated scale-like bracts (each flower and its subtending (1–)2 scale-like bracts are collectively called a floret), and a short axis; florets 2-ranked, borne one above another, alternating along the usually concealed axis (= rachilla), each usually with 2 alternate, overlapping scale-like bracts (lemma—the outer or lower; palea—the inner or upper, usually smaller and more delicate, sometimes absent or not visible); flowers perfect or imperfect, without true perianth (perianth apparently represented in some species by 2(–3) minute lodicules which function by swelling and opening the floret), typically open only for a short time (usually during morning) or not at all, wind- or self-pollinated; stamens (1–)3(–6), the anthers often dangling outside the floret at anthesis to allow the pollen to be carried away but sometimes retained within the floret; pistil 1, the typically 2(–3) stigmas usually feathery, with increased surface area to catch wind-blown pollen; fruit a grain or caryopsis (= 1-seeded fruit with ovary wall adnate to the seed coat), rarely an achene.

This is a huge cosmopolitan family with 9,500–12,000 species in 668 (Mabberley 1997) to as many as 785 genera (Watson & Dallwitz 1992). The family follows only Asteraceae, Orchidaceae, and Fabaceae in number of species. Species range from tiny annuals 2–3 cm tall

GENERAL CHARACTERISTICS OF THE POACEAE (GRAMINEAE) FAMILY [JEP]



to huge bamboos 40 m (ca. 130 feet) tall. On a worldwide basis, the Poaceae is ecologically the most dominant vascular plant family, occurring over vast areas of prairie, plain, steepe, and pampas. It is estimated that 20–24% (Judd et al. 1999) of the world's vegetational cover is made up of grasses. The family is also economically the most important, containing all the cereal crops including *Avena sativa* (OATS), *Hordeum vulgare* (BARLEY), *Oryza sativa* (RICE), *Secale cereale,* (RYE), *Sorghum bicolor* (SORGHUM), *Triticum aestivum* (WHEAT), and *Zea mays* (CORN), as well as *Saccharum officinarum* (SUGARCANE). Cereals are among the oldest types of plants cultivated by humans, with some being brought into cultivation at least 10,000 years ago (Judd et al. 1999); most major civilizations have been based on the food value of the triploid endosperm of grasses. More than 70% of farmland worldwide is devoted to cereals, which provide humans with more than 50% of all calories (Heiser 1990). Just three plants, WHEAT, RICE, and CORN, provide ca. 45–50% of total human caloric intake (Chrispeels & Sadava 1977; Mabberley 1997). Most grasses are extremely well-adapted to fire, grazing, trampling, and mowing. This is due in part to the presence of intercalary meristems (located in the culms just above the nodes and in the leaves near the ligule, thus allowing growth from the base even if terminal parts are damaged), the large amount of below ground biomass, and the tendency to branch ("tiller") or produce stolons or rhizomes near or below ground level. The Poaceae, which includes some species with C_3 and some with C_4 photosynthesis, is one of only two monocot families (the other is the Cyperaceae) with the typical C_4 photosynthetic pathway (Soros & Bruhl 2000). C_4 plants are better able to capture CO_2, and so are able to get the CO_2 they need for photosynthesis while keeping their stomata open less (and thus reducing water loss) in comparison to C_3 plants. The resulting increase in water use efficiency is an advantage in arid environments. Grasses are mostly wind-pollinated and shed large amounts of pollen, a major source of allergic reactions (e.g., hay fever) in humans. The family is well known for polyploidy, with at least 80% of the species thought to be of polyploid ancestry (e.g, *Triticum aestivum*, WHEAT, is a hexaploid—6 sets of chromosomes). Recent phylogenetic analyses (e.g., Hahn et al. 1995; Kellogg & Linder 1995; Linder & Kellogg 1995; Chase et al. 2000; Kellogg 2000b; Soltis et al. 2000; Grass Phylogeny Working Group 2001) indicate that Poaceae is a monophyletic group most closely related to Joinvilleaceae (a very small family of forest-margin plants of se Asia and the s Pacific) and more distantly related to other members of a "graminoid" clade including a number of small e Asia and s hemisphere families, including Anarthriaceae, Centrolepidaceae, Ecdeiocoleaceae, Flagellariaceae, and Restionaceae. More distant still are other members of the Poales, including Bromeliaceae, Cyperaceae, Juncaceae, Mayacaceae, Typhaceae, and Xyridaceae (Chase et al. 2000; Kellogg 2000b). The most recent large-scale work on the family (Grass Phylogeny Working Group 2001) divides the family into 12 subfamilies, 9 of which occur in East TX (see Appendix 4). The Poaceae is a particularly important part of the East TX flora; the 410 species present represent slightly more than 12% of the total species known for the region and make the Poaceae the largest family in East TX (the Asteraceae is a close second).

Turner et al. (2003) mapped a number of additional exotic species for East TX, based on specimens erroneously entered into the Digital Flora of Texas Herbarium Specimen Browser (2002). These specimens were either cultivated or associated with agricultural research facilities: *Blepharoneuron tricholepis* (Torr.) Nash, *Eleusine tristachya* (Lam.) Lam., *Eragrostis spicata* Vasey, *Hyparrhenia hirta* (Nees) Stapf, *Melinis repens* (Willd.) Zizka, *Pappophorum vaginatum* Buckley, *Paspalum unispicatum* (Scribn. & Merr.) Nash, *Pennisetum nervosum* (Nees) Trin., *Pennisetum setosum* (Sw.) Rich., *Phalaris aquatica* L., *Pleuraphis* (*Hilaria*) *jamesii* Torr., *Pleuraphis* (*Hilaria*) *mutica* Buckley, *Urochloa brizantha* (C. Hochstetter ex A. Rich.) R. Webster, *Urochloa mosambicensis* (Hack.) Dandy, and *Vetiveria zizanioides* (L.) Nash ex Small. We do not consider these species to be members of the East TX flora. A number of additional species of ornamental grasses are cultivated and long persist in East TX, including *Pennisetum* species and a variety of bamboos.

Dissection is usually necessary to see the parts of the grass spikelet, and because of the small size of the structures involved (e.g., lemmas, paleas), a dissecting scope or at minimum a hand lens is often necessary for definitive identification. In the keys, measurements of glumes, lemmas, or spikelets do not include awns (= hair-like or bristle-like appendages) if these are present. (subclass Commelinidae—Cronquist; order Poales—APG II)

FAMILY RECOGNITION IN THE FIELD: mostly herbs with 2-ranked leaves having sheathing bases, free blades, and ligules; culms round, with hollow or solid internodes; flowers small, inconspicuous, reduced to stamens and pistils, subtended by 2 scale-like bracts each, and arranged in very reduced spikes called *spikelets*; fruit a caryopsis; the ± similar Cyperaceae (SEDGES) have 3-ranked leaves, often 3-sided culms with solid internodes, each flower subtended by 1 scale-like bract, and fruit an achene; the ± similar Juncaceae (RUSHES) have flowers with a small 6-parted perianth and capsular fruit.

REFERENCES: Nash 1909, 1912; Nash & Hitchcock 1915; Hitchcock 1931–1939, 1935, 1951; Silveus 1933; Tharp 1952a; Shinners 1954; Gould 1957b, 1968a, 1968b, 1973, 1975b, 1978; Box & Gould 1959; deWet 1981; Stebbins 1981a, 1982, 1985; Estes et al. 1982; Gould & Shaw 1983; McVaugh 1983; Campbell 1985; Coughenour 1985; Dahlgren et al. 1985; Redmann 1985; Clayton & Renvoize 1986; Soderstrom et al. 1987; Hignight et al. 1988; Tucker 1988, 1990, 1996; Crins 1991; Allen 1992b, 2004a; Watson & Dallwitz 1992; Powell 1994; Barker et al. 1995, 1998[1999]; Clark et al. 1995; Kellogg & Linder 1995; Kellogg et al. 1996; Petersen & Seberg 1997; Peterson et al. 1997; Hsaio et al. 1998; Kucera 1998; Soreng & Davis 1998, 2000; Hatch et al. 1999; Grass Phylogeny Working Group 2000, 2001; Hilu 2000; Hilu & Alice 2000, 2001; Jacobs & Everett 2000; Judziewicz et al. 2000; Kellogg 2000a, 2000b; Spangler 2000; Zuloaga et al. 2000; Mohlenbrock 2001; Hatch 2002; Mathews et al. 2002; Soreng et al. 2003; Zuloaga et al. 2003; Coffey & Stevens 2004; Sánchez-Moreiras et al. 2004.

KEY TO GENERA OF POACEAE

1. Culms woody, persisting for more than 1 season (bamboos).
   2. Culms terete (= rounded); upper nodes often puberulent; base of midvein on lower leaf surface without short hairs; branches 3–6 per node; plants of moist woods or low areas, native in e part of East TX _____ **Arundinaria**
   2. Culms flattened above node on 1 side; upper nodes glabrous; base of midvein on lower leaf surface often with short hairs along one side; branches usually 2(–3) per node; plants introduced in East TX, persisting and spreading from cultivation _____ **Phyllostachys**
1. Culms not woody, lasting 1 season only (sometimes lasting 2 seasons and somewhat woody in *Arundo*).
   3. Plants typically 2–7 m tall, often reed-like; inflorescences typically large, sometimes plumose panicles up to 60(–130) cm long _____ **Key A** (page /798)
   3. Plants usually < 2(–3+) m tall, not reed-like; inflorescences various.
      4. Leaves with blades less than 1(–1.5) cm long, in clusters; inflorescences very inconspicuous and obscured by the leaves, typically reduced to a single(–few) spikelet _____ **Monanthochloe**
      4. Leaves with blades more than 1.5 cm long, usually not in clusters; inflorescences usually conspicuous.
         5. Spikelets fused with or closely fitted into the axis of the inflorescence or inflorescence branches, forming a solid cylindrical or flattened spike _____ **Key B** (page /799)
         5. Spikelets neither fused with nor closely fitted into the axis of the inflorescence or inflorescence branches (but may be sessile and appressed).
            6. Spikelets unisexual, the staminate and pistillate spikelets conspicuously different to the naked eye _____ **Key C** (page /799)
            6. Spikelets perfect, or if unisexual, not conspicuously different to the naked eye.
               7. Spikelets with 2–many perfect florets and thus usually 2–many fruits forming per spikelet.

8. Spikelets pedicelled (pedicels may be short); inflorescence typically an open or contracted panicle or a raceme with pedicelled spikelets _____ **KEY D** (page /800)
8. Spikelets sessile, or nearly sessile and so densely crowded as to conceal the short pedicels; inflorescence typically a spike, spicate raceme, or panicle with spicate branches _____ **KEY E** (page /804)

7. Spikelets with 1 perfect floret (staminate or reduced rudimentary florets sometimes present) and thus only a single fruit forming per spikelet.
9. Spikelets in pairs (1 sessile or nearly so and 1 pedicelled, sometimes both pedicelled, especially at branch tips), the pedicelled spikelet similar to sessile spikelet or usually reduced (in some cases to only a bristle) or sometimes absent (often represented by an empty pedicel); glumes thicker than lemmas of fertile florets, often subequal; pedicels often flattened and with long-ciliate margins _____ **Key F** (page /806)
9. Spikelets in pairs or not, but usually not in sessile-pedicelled pairs, when spikelets paired, the glumes thinner than lemmas of fertile florets; lower glume usually shorter than the upper, sometimes missing; pedicels glabrous or evenly pubescent on all sides, or pedicels absent _____ **Key G** (page /808)

KEY A

Plants typically 2–7 m tall but not woody, often reed-like; inflorescence typically large, sometimes plumose panicles up to 60(–130) cm long

1. Leaves mostly at the base of the plant; inflorescences often silvery-white, pinkish, or violet; creeping rhizomes absent; culms clumped but plants not forming extensive colonies _____ **Cortaderia**
1. Leaves distributed along much of the length of the culm; inflorescences variously colored; stout creeping rhizomes present or absent; plants in extensive dense colonies or not so.
2. Staminate and pistillate spikelets in separate inflorescences; pistillate spikelets on large "cobs"; whole pistillate inflorescence covered by large, leaf-like, modified leaves or bracts (= shucks or husks) _____ **Zea**
2. Staminate and pistillate spikelets in the same inflorescence OR flowers perfect; spikelets not on "cobs;" whole inflorescence not covered by leaf-like shucks.
3. Spikelets in pairs of 1 pedicelled and 1 sessile (rarely both spikelets of a pair are pedicelled but markedly unequal in length); plants not in dense extensive colonies (but culms can be clumped).
4. Inflorescence a subdigitate panicle of (1–)2–3(–4) spike-like racemes; flowers unisexual, the lower portion of the inflorescence pistillate, the upper portion staminate; pistillate spikelets appressed to and appearing sunken into the axis, becoming very hard; spikelets awnless _____ **Tripsacum**
4. Inflorescence a much-branched and rebranched panicle; flowers bisexual; spikelets not sunken into the axis, not becoming hard; spikelets awnless or awned.
5. Spikelets with a tuft of long hairs ca. as long as spikelets below glumes; sessile and pedicellate spikelets both fertile, alike morphologically; awn of lemmas 5–25 mm long (awn absent in *Saccharum officinarum*).
6. Awn of lemma 10–26 mm long OR awn absent; 1 spikelet of each pair sessile, 1 pedicelled; inflorescence branches disarticulating (breaking into sections) at maturity, the pedicels falling with the sessile spikelets _____ **Saccharum**
6. Awn of lemma 5–12 mm long; both spikelets of a pair pedicelled, the pedicels 1–6 mm long, unequal, one much shorter; inflorescence branches not disarticulating, the spikelets falling from the pedicels at maturity _____ **Miscanthus**
5. Spikelets without a tuft of long hairs below glumes; sessile spikelets fertile, pedicellate spikelets staminate or neuter and morphologically different, conspicuously nar-

rower and often differently awned; awn of lemmas often much shorter (can be up to 15 mm long) or absent ____ **Sorghum**

3. Spikelets not in pairs; plants sometimes in extensive dense colonies.
   7. Spikelets each subtended by 1 or 2 bristles; panicles densely cylindrical, spike-like ____ **Setaria** (*S. magna*)
   7. Spikelets not subtended by bristles; panicles neither densely cylindrical nor spike-like.
      8. Panicle of 5–75 spike-like, ± appressed branches ____ **Spartina**
      8. Panicle branches neither spike-like nor appressed.
         9. Spikelets 2.8–5 mm long, glabrous; florets 2 per spikelet (upper perfect, lower staminate); leaf blades 0.3–1.5 cm wide ____ **Panicum** (*P. virgatum*)
         9. Spikelets 10–15 mm long, with either rachilla or lemmas hairy; florets 2–10 per spikelet; leaf blades mostly 1.5–7 cm wide.
            10. Lemmas glabrous; rachilla hairy; glumes 3–8(–10) mm long, shorter than the lowest lemma ____ **Phragmites**
            10. Lemmas hairy; rachilla glabrous; glumes 10–15 mm long, as long as entire spikelet ____ **Arundo**

KEY B

Spikelets fused with or closely fitted into the axis of the inflorescence or inflorescence branches, forming a solid cylindrical or flattened spike

1. Inflorescences as long as or longer than the leafy portion of the culm, with (3–)4–12 branches ____ **Schedonnardus**
1. Inflorescences shorter than the leafy portion of the culm, unbranched or with up to 3 branches.
   2. Spikelets (at least upper) awned ____ **Aegilops**
   2. Spikelets awnless.
      3. Spikelets apparently, but not actually fused with nor closely fitted into the inflorescence axis, actually only very closely appressed forming a very slender, cylindrical raceme 1.5–2.5 mm in diam. (superficially resembling *Coelorachis*) ____ **Eremochloa**
      3. Spikelets actually fused with or closely fitted into the inflorescence axis.
         4. Plants tufted annuals; spikelets not in pairs; floret 1 per spikelet; inflorescence usually curved ____ **Parapholis**
         4. Plants perennials, often rhizomatous or stoloniferous; spikelets usually in pairs; florets 2 per spikelet; inflorescence usually not curved.
            5. Spike-like inflorescences flattened plants creeping, with flowering branches only 10–30 cm tall ____ **Stenotaphrum**
            5. Spike-like inflorescences (or if branched, the spike-like branches) not flattened or flattened only on one side; plants not creeping, 30–300 cm or more tall.
               6. Unbranched inflorescences 2–3 mm thick; leaf blades 1.5–8 mm wide ____ **Coelorachis**
               6. Unbranched inflorescences or each of the 2–3(–4) branches 5–8 mm thick; leaf blades usually 10–25 mm wide ____ **Tripsacum**

KEY C

Spikelets unisexual, the staminate and pistillate spikelets conspicuously different to the naked eye

1. Spikelets in pairs, one sterile and one fertile, dissimilar, the sterile obscuring the fertile [this taxon with bisexual spikelets is placed here in the key in case of confusion resulting from the two different spikelet forms]; inflorescence a dense, ovoid to oblong, head-like, sometimes interrupted panicle 1–4(–7) cm long; lemmas of fertile florets with awn usually 6–17 mm long ____ **Cynosurus**
1. Spikelets not in sterile-fertile pairs; inflorescences various; lemmas of fertile florets awnless or variously awned.

2. Spikelets with 16–40(–60) florets _____ **Eragrostis** (*E. reptans*)
2. Spikelets with 1–6(–10) florets.
   3. Spikelets with 3–6(–10) florets, conspicuously long-hairy (pistillate) or inconspicuously long-hairy (staminate); plants 20–60(–85) cm tall _____ **Poa** (*P. arachnifera*)
   3. Spikelets with 1–2 florets, glabrous or nearly so; plants either 30 cm or less tall or 30 cm–4(–5) m tall/long.
      4. Plants low, 30 cm or less tall, mat-forming, usually dioecious (= staminate and pistillate spikelets on different plants) _____ **Buchloe**
      4. Plants usually much larger, not mat-forming, usually monoecious (= staminate and pistillate spikelets on the same plant).
         5. Pistillate spikelets enclosed within a nearly globose, hard, bead-like involucre, with the staminate portion of the inflorescence extending beyond the apical opening of the involucre _____ **Coix**
         5. Pistillate spikelets not within a globose involucre.
            6. Staminate and pistillate spikelets in separate inflorescences; pistillate spikelets in large "cobs"; whole pistillate inflorescence covered by large, leaf-like, modified leaves or bracts (= shucks or husks) _____ **Zea**
            6. Staminate and pistillate spikelets in the same inflorescence; whole inflorescence not covered by leaf-like shucks.
               7. Leaf blades 4 mm or less wide; glumes absent; inflorescence 7 cm or less long, inconspicuous, with 1–few spikelets _____ **Luziola**
               7. Leaf blades (5–)10–80 mm wide; glumes present; inflorescence 10 cm or more long, often much more, conspicuous, with numerous spikelets.
                  8. Inflorescence unbranched and spike-like or with 2–3(–4) spike-like branches; pistillate spikelets becoming very hard; plants terrestrial _____ **Tripsacum**
                  8. Inflorescence a much-branched panicle; pistillate spikelets not becoming hard; plants usually growing in shallow water.
                     9. Staminate and pistillate spikelets on different branches, the staminate on lower branches, the pistillate on upper branches; pistillate spikelets 7–25 mm long; culms completely submersed OR emergent from water; species rare in East TX, confirmed only for Hays Co. _____ **Zizania**
                     9. Staminate and pistillate spikelets on the same branches, the pistillate terminal, the staminate below; pistillate spikelets 4–8 mm long; culms emergent from water; species widespread in East TX _____ **Zizaniopsis**

KEY D

Spikelets with 2–many perfect florets and thus usually 2–many fruits forming per spikelet; spikelets pedicelled (pedicels may be short)

1. Lemmas 1-awned from the back (not from their apex).
   2. Spikelets (excluding awns) 2.5 mm long or shorter _____ **Aira**
   2. Spikelets (excluding awns) 3 mm long or longer (often much longer).
      3. Glumes 1.5–5 mm long, ca. as long as the individual lemmas (excluding awns) _____ **Trisetum**
      3. Glumes 18–32 mm long, longer than the individual lemmas (excluding awns) and usually exceeding all of the lemmas _____ **Avena**
1. Lemmas awnless or awned from their apex (awn can arise between apical teeth).
   4. Glumes conspicuously longer than individual lemmas (excluding awns) and usually exceeding all of the lemmas.
      5. Spikelets 18–32 mm long (excluding awns); lemmas 14–19 mm long _____ **Avena**
      5. Spikelets 4–18(–20) mm long (excluding awns); lemmas 2–9 mm long.
         6. Lemmas awnless (but with minute mucros < 1 mm long); spikelets 4–7 mm long; inflorescences 10–36 cm long _____ **Tridens** (*strictus*)

6. Lemmas awned, the twisted and geniculate awns usually (3–)5–12(–17) mm long; spikelets 7–18(–20) mm long; inflorescences 12 cm or less long _____ **Danthonia**

4. Glumes not conspicuously longer than individual lemmas.
7. Lemmas with 11–15 awns _____ **Pappophorum**
7. Lemmas awnless or with a single awn.
8. Spikelets in several very dense, ± 1-sided clusters at the ends of branches, the branches bare of spikelets in their lower portions; rare introduced species _____ **Dactylis**
8. Spikelets not borne as above; including common native and introduced species.
9. Lemmas 3-veined, the veins often prominent.
10. Veins of lemmas pubescent or puberulent OR base of lemmas with long hairs; lemmas with midvein usually exserted as a short awn or mucro.
11. Plants annual; spikelets usually with (2–)3–4 florets; inflorescence a panicle 3–11 cm long with a few rebranched primary branches, the lower branches bare of spikelets on the lower 1/3–1/2; nerves of paleas with long hairs on upper half _____ **Triplasis**
11. Plants perennial; spikelets with 3–12 florets; inflorescences various, but often quite different from above; nerves of paleas without long hairs on upper half.
12. Inflorescences 5–40 cm long; culms with several nodes above base; leaf margins green, not thickened _____ **Tridens**
12. Inflorescences 2–4(–6) cm long; culms with one node above base; leaf margins white, thickened (visible with a hand lens) _____ **Erioneuron**
10. Veins of lemmas not hairy; base of lemmas without long hairs; lemmas awnless.
13. Lower 1(–2) floret(s) sterile; stamen 1 per floret; spikelets flat, 4–9 mm long, (2–)3–5(–6) mm wide _____ **Chasmanthium** (*C. laxum*)
13. Lower florets fertile; stamens 2–3 per floret; spikelets variously shaped and sized.
14. Lemmas 4.6–10.8 mm long; upper glume with 3–5 veins; caryopsis (= fruit) beaked, conspicuously exserted from the lemma and palea at maturity; species rare in East TX, documented only from Dallas Co. _____ **Diarrhena**
14. Lemmas 0.7–5 mm long; upper glume with 1 vein; caryopsis neither beaked nor conspicuously exserted; including species widespread and abundant in East TX.
15. Lemmas white, often purplish distally, the spikelets thus often appearing banded; inflorescence contracted, 1.5 cm or less wide, densely-flowered, the branches usually with spikelets nearly to base or apparently so (branches usually tightly appressed at base); spikelets 4–10 mm long _____ **Tridens** (*T. albescens*)
15. Lemmas variously colored; inflorescences variously shaped; spikelets of various sizes _____ **Eragrostis**
9. Lemmas 5–many-veined, the veins prominent or sometimes so obscure as to be almost unnoticeable.
16. Lemmas awned.
17. Spikelets usually (10–)15–50 mm long, if spikelets at the lower end of this size range, then lemmas 2-toothed or minutely notched at apex _____ **Bromus**
17. Spikelets 15.5(–18) mm or less long (often much less), if spikelets at the upper end of this size range, then lemmas neither 2-toothed nor notched at apex.
18. Lemmas awned from (or just below) a conspicuously 2-toothed apex, the awn geniculate _____ **Trisetum**
18. Lemmas awned from an entire or minutely and indistinctly notched apex, the awn straight.
19. Inflorescences dense, spike-like, uninterrupted panicles; lemmas keeled on back; awns 1–3 mm long _____ **Rostraria**

19. Inflorescences open to contracted, sometimes rather dense panicles or racemes, but if dense, these typically interrupted; lemmas rounded on back; awns various, but sometimes much longer than 3 mm.
    20. Leaf blades 0.1–2.5(–3) mm wide; plants annual, usually small, 5–75 cm tall; stamen usually 1 per floret, infrequently 3 _____ **Vulpia**
    20. Leaf blades 2–12 mm wide; plants perennial, often relatively large, 50–120(–200) cm tall; stamens 3 per floret _____ **Festuca**

16. Lemmas awnless.
    21. Spikelets conspicuously broad, 6–20 mm wide.
        22. Spikelets many times longer than wide; lemmas appressed _____ **Bromus**
        22. Spikelets at most only twice as long as wide; lemmas conspicuously spreading.
            23. Spikelets with 2 fertile florets; upper florets sterile, together much reduced to a small "rudiment" that is usually broadest near apex _____ **Melica** (*M. mutica*)
            23. Spikelets with 3–numerous fertile florets; upper florets fertile or sterile, if sterile not broadest near apex.
                24. Inflorescence branches and pedicels erect or nearly so.
                    25. Spikelets usually with 3–7 florets, the lower 1–2 florets sterile; glumes 1.2–3 mm long; spikelets disarticulating above the glumes and between the florets _____ **Chasmanthium**
                    25. Spikelets usually with ca. 15 florets, the lower florets fertile; glumes 3–4.5 mm long; spikelets disarticulating below the glumes _____ **Eragrostis** (*E. superba*)
                24. Inflorescence branches and/or pedicels drooping.
                    26. Spikelets usually more than 12 per inflorescence, often many more, each with 1–4 sterile lemmas below the lowest fertile one; glumes and lemmas sharply keeled; leaf blades 8–20 (–30) mm wide; wide-spread and abundant native species _____ **Chasmanthium** (*C. latifolium*)
                    26. Spikelets 1–6(–12) per inflorescence, without sterile lemmas below the lowest fertile one; glumes and lemmas ± rounded on back; leaf blades 2–8 mm wide; rare introduced species _____ **Briza** (*B. maxima*)
    21. Spikelets usually much narrower, 6 mm or less wide.
        27. Lemmas as wide as long, spreading at right angles, inflated with the margins outspread _____ **Briza** (*B. minor*)
        27. Lemmas longer than wide, not spreading at right angles, not inflated, the margins clasping the paleas.
            28. Lemmas rounded on back, without prominent keel or raised midvein except near apex.
                29. Upper florets together much reduced to a small "rudiment" that is usually broadest near apex; glumes thin, papery at least on margins and apices; leaf sheaths with margins united except at summit _____ **Melica**
                29. Upper florets ± like the lower florest; glumes not thin and papery; leaf sheaths open down one side (edges may overlap) except in *Glyceria* which has sheath margins united.
                    30. Lemma veins (usually 7) strongly and uniformly developed and equally spaced; leaf sheaths with margins united except at summit _____ **Glyceria**

30. Lemma veins none to several on each side, indistinct; leaf sheaths open down one side (edges may overlap).
    31. Plants perennial, usually 50–120(–200) cm tall; spikelets 8–15.5(–20) mm long OR if smaller, then lower panicle branches bare of spikelets in their lower 1/3–1/2 _____ **Festuca**
    31. Plants annual, to only 30(–60) cm tall; spikelets (4–)5–7(–10) mm long; panicle branches with spikelets nearly to base _____ **Desmazeria**
28. Lemmas keeled or with prominent midvein from tip to base.
    32. Plants strongly rhizomatous, of alkaline or alkaline-saline habitats; leaves conspicuously 2-ranked with sheaths obviously overlapping; spikelets unisexual, the staminate and pistillate inflorescences similar but on separate plants; spikelets usually 5–20-flowered, 6–18(–28) mm long _____ **Distichlis**
    32. Plants usually not rhizomatous or only inconspicuously so, of various habitats; leaves not as above; spikelets various.
        33. Spikelets (10–)15–35 mm long _____ **Bromus**
        33. Spikelets 1.5–11(–12) mm long.
            34. Panicles 1–3(–4.5) cm long, overtopped by the leaves; lemmas obtuse, with 5(–7) prominent, raised, almost parallel veins; culms to only 15(–30) cm long _____ **Sclerochloa**
            34. Panicles 2–70 cm long, exserted above the foliage; lemmas acute to obtuse, without 5 prominent, raised, almost parallel veins; culms of variable length, often much more than 15 cm long.
                35. Inflorescence an elongate, narrow, stiffly erect, spike-like panicle with a few widely spaced, usually short side branches; lower 1–2 florets in each spikelet sterile _____ **Chasmanthium**
                35. Inflorescences various, but quite different from above; lower florets in each spikelet fertile.
                    36. Lemmas often puberulent, the base of lemma often with long, kinky hairs; upper glume only slightly wider than lower glume (much less than 2 times as wide); panicle variable, open to contracted, but usually not conspicuously dense and spike-like _____ **Poa**
                    36. Lemmas glabrous or merely scabrous, the base of lemma lacking hairs; upper glume much wider than lower (often twice as wide or wider); panicle dense, narrow, almost spike-like.
                        37. Upper glume widest near middle, gradually narrowing to an acute apex; disarticulation above glumes and between florets _____ **Koeleria**
                        37. Upper glume widest near apex, abruptly narrowing to a broadly acute to rounded apex; disarticulation below glumes _____ **Sphenopholis**

KEY E

Spikelets with 2–many perfect florets and thus usually 2–many fruits forming per spikelet; spikelets sessile, or nearly sessile and so densely crowded as to conceal the short pedicels

1. Spikelets borne on opposite sides of the zigzag, usually flattened, main axis of the inflorescence; inflorescence unbranched, consisting of a solitary, 2-sided spike or spike-like raceme.
   2. Glumes usually 3.6 mm or more wide _____ **Triticum**
   2. Glumes 1–3.5 mm wide.
      3. Lemmas minutely spiny-ciliate on keel and margins (the hairs visible with the naked eye and obvious with a hand lens) _____ **Secale**
      3. Lemmas not minutely spiny-ciliate on keel and margins.
         4. Spikelets solitary at each node of the inflorescence.
            5. Glume 1 per spikelet; spikelets oriented with edge (back of lemmas) facing inflorescence axis _____ **Lolium**
            5. Glumes 2 per spikelet; spikelets oriented with side facing inflorescence axis _____ **Elymus**
         4. Spikelets 2–3 at each node of the inflorescence.
            6. Lemmas awnless (glumes can have awns up to 5 mm long); plants 35 cm or less tall; leaf blades 3 mm or less wide; inflorescences 2–3.5(–4) cm long; perfect florets at most 1 per spikelet [included here since there can appear to be 2] _____ **Hilaria**
            6. Lemmas conspicuously awned OR sometimes awnless; plants usually much > 35 cm tall; leaf blades usually much > 3 mm wide; inflorescences 3–21(–30) cm long; perfect florets at least 2 per spikelet _____ **Elymus**

1. Spikelets not on opposite sides of a main axis, rather borne all on 1 side or on all sides of the main axis or its branches; inflorescence usually branched, consisting of 2–many spikes, racemes, or panicles (condensed to open) OR if inflorescence unbranched, then not distinctly 2-sided.
   7. Spikelets in several very dense, 1-sided clusters at the end of branches bare of spikelets in their lower portions; rare introduced species _____ **Dactylis**
   7. Spikelets not borne as above; including common native and introduced species.
      8. Spikelets in pairs, one sterile and one fertile, dissimilar, the sterile obscuring the fertile; inflorescence a dense, ovoid to oblong, head-like, sometimes interrupted panicle 1–4(–7) cm long _____ **Cynosurus**
      8. Spikelets not in pairs; inflorescences various, but often more than 7 cm long OR with easily observed branches.
         9. Plants usually 5–30 cm tall; inflorescences usually 1–12 cm long and 19 mm or less wide.
            10. Spikelets usually with 3–4 florets, falling as a unit; inflorescences usually 1–3(–4.5) cm long, overtopped by the upper leaves; lemmas prominently 5(–7)-veined, the lowest lemma ca. 4.5–6 mm long _____ **Sclerochloa**
            10. Spikelets with (4–)5–14 florets, disarticulating above glumes and between florets; inflorescences usually 3–12 cm long, exserted beyond the upper leaves; lemmas 3-veined or obscurely veined, the lowest lemma ca. 2–3.1 mm long.
               11. Plants annual; leaf blades 1–3(–4) mm wide; inflorescences usually branched, 5–15 mm wide; introduced species of roadsides, railroads, and other disturbed areas _____ **Desmazeria**
               11. Plants perennial; leaf blades 0.2–1.1 mm wide; inflorescences unbranched, 1.5–2.5(–3.5) mm wide; native species of shallow soils on granite and other igneous outcrops or on limestone _____ **Tripogon**
         9. Plants usually much larger; inflorescences often much larger.
            12. Spikelets borne crowded on all sides of the inflorescence axis or on short, crowded branchlets, the whole inflorescence narrow, often a dense spike or spike-like or head-like.

13. Inflorescences narrow but not dense, the main axis clearly visible at a glance (spikelets crowded on well-separated short side branches); lowermost floret sterile, its lemma not very different from glumes in size or appearance _____ **Chasmanthium**
13. Inflorescences dense, the main axis often obscured by the numerous spikelets; lowermost floret perfect, its lemma sometimes quite different from glumes in size or appearance.
    14. Lemma veins pubescent, at least in lower portion, or base of lemma long-hairy; spikelets with 3–12 florets _____ **Tridens**
    14. Lemma veins and base of lemma glabrous or nearly so; spikelets with 2–6 florets.
        15. Upper glume widest near apex, abruptly narrowing to a broadly acute to rounded apex; disarticulation below glumes _____ **Sphenopholis**
        15. Upper glume widest near middle, gradually narrowing to an acute apex; disarticulation above glumes.
            16. Lemmas awnless; main inflorescence axis and branches puberulent; inflorescence dense, but interrupted at base; plants perennial _____ **Koeleria**
            16. Lemmas with awn 1–3 mm long arising from between two minute apical teeth; main inflorescence axis and branches glabrous or nearly so; inflorescence dense, not interrupted at base; plants annual _____ **Rostraria**

12. Spikelets borne on 1 side of the inflorescence axis or its branches, often in 2 distinct rows, the inflorescence with 2–many, distinct, short or long, digitately arranged or scattered, usually spike-like branches.
    17. Branches of inflorescence distributed (scattered) along main axis, usually only 1 arising per node, not crowded together.
        18. Panicles open to sometimes highly contracted, even spike-like in overall appearance, but distinct spike-like branches not present _____ **Eragrostis**
        18. Panicles of distinct spike-like branches.
            19. Spikelets not crowded on branches, the adjacent spikelets usually not overlapping _____ **Eragrostis**
            19. Spikelets often rather crowded, the adjacent spikelet usually overlapping.
                20. Lower glume distinctly longer than the lowest lemma, sometimes even exceeding the distal lemmas; lemmas of fertile florets ciliate on and adjacent to midsections of lateral veins, the hairs stiff _____ **Trichoneura**
                20. Lower glume shorter than to only slightly longer than the lowest lemma; lemmas glabrous or with pubescence, but not ciliate on and adjacent to lateral veins _____ **Leptochloa**
    17. Branches of inflorescence digitate (all arising together at very tip of flowering culm) or nearly so OR verticillate (in whorls).
        21. Lemmas and glumes awnless _____ **Eleusine**
        21. Lemmas and/or glumes with awns.
            22. Axis of each spicate inflorescence branch projecting as a stiff point beyond terminal spikelet; spikelets with 3–5 perfect florets _____ **Dactyloctenium**
            22. Axis of each spicate inflorescence branch not projecting as a stiff point beyond terminal spikelet; spikelets with 1–2 perfect florets.
                23. Lemma of perfect floret(s) with 3 awns, the central awn 8–12 mm long, the lateral awns 1.5 mm or less long _____ **Trichloris**
                23. Lemma of perfect floret(s) with a single awn _____ **Chloris**

KEY F

Spikelets in pairs (1 sessile or nearly so and 1 pedicelled, both sometimes pedicelled, especially at branch tips), the pedicelled spikelet similar to sessile spikelet or usually reduced (in some cases to only a bristle) or sometimes absent (often represented by an empty pedicel); fertile spikelets with 1 perfect floret; glumes thicker than lemmas of fertile florets, often subequal; pedicels often flattened and with long-ciliate margins

1. Spikelets sessile and apparently solitary, the pedicellate spikelet absent (actually so reduced as to be represented only by a pedicel).
   2. Inflorescence a solitary, terminal, spike-like raceme ca. 2–6 cm long and ca. 1.5–2.5 mm wide (pencil-like but much smaller in diam.) _____ **Eremochloa**
   2. Inflorescence of 2–several digitately arranged branches OR a panicle.
      3. Leaf blades cordate-clasping at base; plants low annuals creeping and rooting at lower nodes _____ **Arthraxon**
      3. Leaf blades not cordate-clasping at base; plants usually erect perennials or annuals.
         4. Inflorescences both terminal and axillary, of digitate clusters of 2–5 branches (the clusters sometimes clustered); peduncles each subtended by, and often partly enclosed by, a sometimes sheathing bract _____ **Andropogon**
         4. Inflorescence terminal only, a long-exserted and elongate panicle of numerous branches; peduncles not subtended by a bract _____ **Sorghastrum**
1. Spikelets in pairs, the pedicelled spikelet similar to sessile or shorter-pedicelled spikelet OR reduced, but usually not so reduced as to be represented by a pedicel only.
   5. Inflorescence a solitary (1 per peduncle), straight, elongate, very narrow, spike-like raceme (due to the pedicels being closely appressed to branch axis); sessile spikelets awnless or awned.
      6. Awns absent.
         7. Infloresence axis pilose; sessile spikelet 6–8 mm long; pedicelled spikelet similar in size to sessile one; plant tufted, not mat-forming, with erect culms 60–100(–120) cm tall _____ **Elionurus**
         7. Inflorescence axis glabrous; sessile spikelet 3–4 mm long; pedicelled spikelet usually much reduced; plant mat-forming, the culms 35 cm or less tall _____ **Eremochloa**
      6. Awns present on some spikelets, the awns 4–12(–15) cm long.
         8. Awned spikelet sessile; glumes and awn of awned spikelet dark brown at maturity; inflorescence axis disarticulating at maturity _____ **Heteropogon**
         8. Awned spikelet short-pedicelled; glumes and awn of awned spikelet light-colored at maturity; inflorescence axis remaining intact at maturity _____ **Trachypogon**
   5. Inflorescence not as above, often branched, and usually not narrowly elongate and spike-like (but sometimes a narrowly cylindrical panicle); sessile spikelets usually awned.
      9. Sessile (or nearly so) and pedicellate spikelets both fertile, alike morphologically.
         10. Plants annual; culms creeping at base and rooting at the lower nodes; inflorescences of (1–)2–5(–6) usually subdigitately arranged spike-like racemes; spikelets without a conspicuous tuft of long hairs at base (= without callus hairs) _____ **Microstegium**
         10. Plants perennial; culms neither creeping nor rooting at the nodes; inflorescences panicles, either large and with numerous branches terminating in numerous racemes OR narrowly cylindrical; spikelets often, but not always, with a conspicuous tuft of long callus hairs (= whorl of hairs attached directly below spikelet).
            11. Spikelets in pairs of 1 sessile, 1 pedicelled; inflorescence branches disarticulating (breaking into sections) at maturity, the pedicels falling with the sessile spikelets _____ **Saccharum**
            11. Spikelets in pairs of 1 long-pedicelled, 1 short-pedicelled; pedicels 1–6 mm long; inflorescence branches not disarticulating, the spikelets falling from pedicels at maturity.
               12. Lemma with awn 5–12 mm long; inflorescence branches 8–15(–30) cm long _____ **Miscanthus**

12. Lemma awnless; inflorescence branches 1–3.2(–7) cm long _____ **Imperata**

9. Sessile and pedicellate spikelets different, the sessile ones fertile, the pedicellate ones staminate or neuter and morphologically different, typically shorter, narrower, or differently awned, often rudimentary or vestigial.
13. Spikelets awnless.
14. Leaf blades 3–6(–8) mm wide; sessile spikelets 2.5–4 mm long; pedicels and internodes of inflorescence branches with a central translucent groove, densely villous with hairs 4–6 mm long, the hairs obscuring the spikelets and obvious at a glance. _____ **Bothriochloa** (*B. exaristata*)

14. Leaf blades 8–60 mm wide; sessile spikelets 3.5–5.5(–9) mm long; pedicels and internodes of inflorescence branches without a translucent groove, variously pubescent, but without dense long hairs 4 mm or more long, the spikelets not obscured _____ **Sorghum**

13. Spikelets with awns.
15. Inflorescences ± triangular clusters (of 1-several short, almost spikelet-like racemes) from the upper nodes (many clusters per culm), often drooping, the clusters each subtended by a reddish spathe-like sheath, each cluster subunit (raceme) with 2 pairs of sterile or staminate, sessile, awnless spikelets at base, forming what appears to be a loose involucre below the rest of the raceme (which consists of sessile fertile and pedicellate sterile or staminate spikelets); introduced species known in East TX only from one collection in Travis Co. _____ **Themeda**

15. Inflorescences not as above; including species widespread in East TX.
16. Inflorescence a single spike-like raceme per peduncle (each terminal branchlet with a single raceme above the uppermost leaf, these sometimes crowded together and sometimes appearing axillary due to the shortness of the branches of the flowering stem) _____ **Schizachyrium**

16. Inflorescence a panicle or of 2 or more racemes or spikes per peduncle (each terminal branchlet with 2–many inflorescence branches, racemes, or spikes above the uppermost leaf).
17. Pedicelled spikelets ca. the same size as the sessile spikelets or only slightly smaller.
18. Pedicelled spikelet broadly rounded or obtuse at apex; sessile spikelets 2.5–5 mm long; inflorescences mostly terminal, the axillary inflorescences few or absent _____ **Dichanthium**

18. Pedicelled spikelet tapering to a narrow apex; sessile spikelets 7–11 mm long; inflorescences usually both terminal and axillary _____ **Andropogon** (*A. gerardii*)

17. Pedicelled spikelets clearly smaller (either shorter or narrower, usually rudimentary or vestigial) than the sessile spikelets.
19. Leaf blades cordate-clasping at base; plants low annuals creeping and rooting at lower nodes _____ **Arthraxon**

19. Leaf blades not cordate-clasping at base; plants usually erect perennials or annuals.
20. Pedicels and usually upper internodes of inflorescence branches strongly flattened and grooved on both sides, the central portion thus thin to membranous, often easily ruptured with a probe ____ **Bothriochloa**

20. Pedicels and internodes of inflorescence branches neither strongly flattened nor grooved on both sides (can be slightly flattened or grooved on one side), the central portion thus neither thin nor membranous.
21. Inflorescence appearing digitate and often pinkish purple when seen in mass, typically well-exserted above uppermost

bract/leaf; leaf blades 2–4.5 mm wide; pedicelled spikelet about as long as sessile spikelet (though narrower) _____ **Bothriochloa** (*B. ischaemum*)

21. Inflorescence appearing digitate or paniculate, variously colored, closely subtended by a bract/leaf or exserted; leaf blades 0.8–60 mm wide; pedicelled spikelet ranging from about as long as sessile spikelet to much shorter or represented by the pedicel only.
    22. Inflorescences of 2–7 digitately arranged branches per peduncle (there can be numerous axillary as well as terminal inflorescences); leaf blades 0.8–10 mm wide _____ **Andropogon**
    22. Inflorescences of numerous paniculately arranged branches per peduncle (the inflorescence can be open or compact); leaf blades 8–60 mm wide _____ **Sorghum**

KEY G

Spikelets in pairs or not, but usually not in sessile-pedicelled pairs, when spikelets paired, the glumes thinner than lemmas of fertile florets; fertile spikelets with 1 perfect floret; lower glume usually shorter than the upper, sometimes missing; pedicels glabrous or evenly pubescent on all sides, or pedicels absent

1. Upper glume with 3–5 rows of stout hooked prickles _____ **Tragus**
1. Upper glume without stout hooked prickles.
    2. Spikelets surrounded by a bur-like involucre of prickly spines OR smooth scales OR subtended by an involucre of 1–many bristles.
        3. Involucre of spines or scales that are flattened at least at base (except not flattened in *Cenchrus myosuroides*), these sharply prickly (except in *Buchloe*); spines and bristles, if present, usually retrorsely barbed.
            4. Involucres smooth, neither prickly nor painful to the touch, usually hidden within leafy portion of plant _____ **Buchloe**
            4. Involucres sharply prickly, very painful to the touch (SANDBURS), usually conspicuous in spike-like inflorescence, not hidden in leafy portion of plant _____ **Cenchrus**
        3. Involucre of 1–many bristles (not flattened), these not sharply prickly; bristles often antrorsely barbed, sometimes long ciliate to plumose.
            5. Bristles remaining with the inflorescence axis when the spikelets fall; disarticulation below the individual spikelets, the spikelets falling separately (but spikelets can be very crowded) _____ **Setaria**
            5. Bristles falling with the spikelets; disarticulation below reduced panicle branches (fascicles), the 1–12 spikelets of a fascicle falling together _____ **Pennisetum**
    2. Spikelets without a well-developed involucre of spines, scales, or bristles (but may have a minute collar-like or cup-like structure just under the spikelet).
        6. Terminal spikelet on each branch immediately subtended by a single bristle, a few other spikelets sometimes subtended by a single bristle _____ **Setaria** (*S. reverchonii*)
        6. None of the spikelets subtended by a bristle.
            7. Reduced floret or florets present below the perfect floret (the reduced ones staminate or sterile, sometimes represented only by a sterile lemma).
                8. Lemma of lowermost sterile floret with ear-like appendages at base; species a rare introduction in East TX, known only from Falls Co. _____ **Ehrharta**
                8. Lemma of sterile floret without ear-like appendages at base; including species widespread and common in East TX.
                    9. Upper glume with awn 3.5–4 mm long divergent ± at right angle to glume body;

inflorescence solitary, curved, 1-sided, dense, spike-like, 5–15 cm long; reduced sterile florets present both below and above fertile floret _____ **Ctenium**

9. Upper glume without awn divergent at right angle to glume body; inflorescence various; reduced sterile floret(s) present only below fertile floret.
   10. Glumes equal; lemma of fertile floret strongly compressed, sharply keeled; reduced florets 2 per spikelet, rudimentary or scale-like, their lemmas not similar to the upper glume; inflorescence a very dense, tightly contracted, spike-like panicle; disarticulation above glumes _____ **Phalaris**
   10. Glumes usually unequal; lemma of fertile floret not as above; reduced floret 1 per spikelet (except 2 in *Anthoxanthum*), its lemma similar to the upper glume; inflorescences various, spike-like to very different; disarticulation below glumes (except above glumes in *Anthoxanthum*).
      11. Reduced florets 2 per spikelet, these both awned; disarticulation above glumes; plants with a sweet, vanilla-like fragrance (due to coumarin) _____ **Anthoxanthum**
      11. Reduced floret 1 per spikelet, awned OR unawned; disarticulation below glumes; plants without fragrance as described above _____ **Key H** (page /811)

7. Reduced floret absent below the perfect floret (reduced florets found above the perfect or absent or seemingly so).
   12. Inflorescences unbranched or seemingly so (e.g. spikes or spike-like racemes).
      13. Spikelets in clusters of 3 per node (the two lateral ones often reduced, staminate or sterile), sessile.
         14. Lemmas awned; inflorescence axis usually disarticulating at maturity, the sections falling with the spikelets; spikes usually 4–10 cm long _____ **Hordeum**
         14. Lemmas awnless; inflorescence axis not disarticulating, a cluster of 3 spikelets falling as a unit from the inflorescence axis; spikes 2–3.5 cm long _____ **Hilaria**
      13. Spikelets not 3 per node, sessile OR on pedicels.
         15. Lemma with 3 awns _____ **Aristida**
         15. Lemma with 1 awn or awnless.
            16. Inflorescence a narrow spike or spike-like raceme, with few spikelets.
               17. Spikelets 4.5–7(–8) mm long; glumes subequal; ligule a membrane 1.5 mm or less long; disarticulation at nodes of inflorescence axis; plants tufted annuals _____ **Parapholis**
               17. Spikelets 2.1–3.4 mm long; lower glume absent; ligule of hairs 0.3 mm or less long; disarticulation below the glume(s) or not occurring; plants rhizomatous mat-forming perennials _____ **Zoysia**
            16. Inflorescence extremely dense, ± cylindric, with numerous crowded spikelets (actually very dense panicles).
               18. Glumes awnless; lemma with awn 3–8+ mm long arising on back below middle _____ **Alopecurus**
               18. Glumes awned; lemma awnless or with an awn to ca. 1 mm long arising from the apex.
                  19. Awn of glumes 0.8–1.5(–2) mm long, abrupt from unnotched apex; inflorescences 5–9(–10) mm wide; lemma awnless _____ **Phleum**
                  19. Awn of glumes 4–10 mm long, from apical notch; inflorescences 10–30 mm wide; lemma with a delicate awn usually 0.5–1 mm long _____ **Polypogon**
   12. Inflorescences branched (sometimes so dense that the branching is difficult to see).
      20. Spikelets not borne along 1 side of the inflorescence branches; inflorescences usually without distinct spike-like branches having spikelets to very base (branches, however, can be so crowded as to make the whole inflorescence appear spike-like); spikelets sessile or pedicelled _____ **Key I** (page /813)

20. Spikelets usually borne along 1 side of the often flattened inflorescence branches, usually in 2 rows, AND/OR inflorescences of distinct spike-like branches bearing sessile spikelets to very base; spikelets sessile or nearly so.
    21. Branches of inflorescence digitate (all arising together at very tip of flowering culm) or nearly so or branches verticillate (in whorls).
        22. Spikelets without rudimentary floret or rudiment present only as a minute scale; spikelets awnless; inflorescence branches usually (2–)3–5(–9) _____ **Cynodon**
        22. Spikelets with rudimentary floret or florets present above perfect floret; spikelets usually awned (can be awnless in *Eustachys*); inflorescence branches (2–)3–20.
            23. Lemma of perfect floret awnless, sometimes mucronate or minutely aristate; upper (second) glume bilobed or truncate (can have a minute awn from between the lobes) _____ **Eustachys**
            23. Lemma of perfect floret awned, the awns usually conspicuous; upper glume acute to acuminate.
                24. Lemma of perfect floret with 3 awns, the central awn 8–12 mm long, the lateral awns 1.5 mm or less long _____ **Trichloris**
                24. Lemma of perfect floret with a single awn.
                    25. Spikelets laterally compressed; lemma of fertile floret < 4.5 mm long; sterile florets linear to conspicuously widened apically, 0.2–1.8 mm wide; plants without underground cleistogamous spikelets; including species widespread and common in East TX _____ **Chloris**
                    25. Spikelets dorsally compressed; lemma of fertile floret 4.5–7.5 mm long; sterile florets very small, linear, only ca. 0.3 mm wide; plants with underground cleistogamous spikelets at the tips of rhizomes; species rare in East TX (only confirmed East TX record is Brazos Co.) _____ **Enteropogon**
    21. Branches of inflorescence distributed along flowering culm, usually only one arising per node.
        26. Plants dwarf, mat-forming, to only ca. 30 cm tall; inflorescence branches 1–4, usually 6–14 mm long; plants usually dioecious, the male and female flowers on different plants; spikelets awnless or nearly so _____ **Buchloe**
        26. Plants often larger; inflorescence branches 1–80, 8–150 mm long; plants not dioecious, each spikelet with 1 perfect floret; spikelets awned or awnless.
            27. Inflorescence branches appressed to inflorescence axis or nearly so.
                28. Culms 20–40 cm tall; spikelets 3.5–5 mm long, awnless; leaf blades 1–3 mm wide; plants of open or bare areas _____ **Willkommia**
                28. Culms 60–250 cm tall; spikelets 5–25 mm long, awnless or awned; leaf blades 1.5–15 mm wide; plants of low moist areas, wet prairies, swales, coastal flats, and marshes _____ **Spartina**
            27. Inflorescence branches (these sometimes with only a few spikelets) spreading at an angle from inflorescence axis, often nearly perpendicular.
                29. Spikelets usually very densely arranged, either on a few comb-like side branches or in numerous, short, spikelet-like side branches; fertile spikelets with 1–several rudimentary or staminate florets above the perfect floret; inflorescence branches 6 cm or less long _____ **Bouteloua**

29. Spikelets loosely arranged on elongate side branches; fertile spikelets with only 1 floret (staminate or rudimentary florets absent or, if present, consisting only of an awn); inflorescence branches 2–24 cm long.
    30. Spikelets awned; leaf blades 2–13(–18) mm wide, rather broad in appearance for a grass, abruptly narrowed at base; inflorescences mostly ca. as wide as long or wider _____ **Gymnopogon**
    30. Spikelets awnless; leaf blades 1–3 mm wide, not abruptly narrowed at base; inflorescences longer than wide _____ **Schedonnardus**

KEY H

Spikelets with 1 perfect fertile floret; one reduced floret present below the fertile floret; lemma of fertile floret cartilaginous to hard (*Panicum* and many of its relatives)

1. Lower glume usually absent or much reduced, the spikelets thus usually with only 2 well-developed, scale-like bracts: lemma of sterile floret and upper glume (the lemma and palea of the fertile floret are often tough or hard and grain-like rather than scale-like); 3rd scale-like bract (lower glume), if present, much reduced, less than 1/4 as long or 1/2 as wide as the others.
    2. Spikelets long-pedicelled (pedicels 2–many times as long as spikelets), widely separated in a very open panicle (species previously segregated into *Leptoloma*) _____ **Digitaria**
    2. Spikelets sessile or short-pedicelled (but these can be well-developed), the inflorescence or its branches with ± closely spaced spikelets, the spikelets often overlapping one another or nearly so.
        3. Pedicels with a minute (< 0.5 mm long, but obvious with a hand lens) collar-like or cup-like structure just under the spikelet _____ **Eriochloa**
        3. Pedicels without collar-like or cup-like structure.
            4. Spikelets all with well-developed short pedicels, or some spikelets nearly sessile and some pedicelled.
                5. Inflorescence branches usually few, digitately arranged or along a short axis (shorter than the branches), the individual branches spike-like; lemmas sometimes with silky hairs longer than the spikelet _____ **Digitaria**
                5. Inflorescence a many-branched panicle with an elongate axis (much longer than the branches), the individual branches not spike-like; lemmas hairy, but the hairs not longer than the spikelet _____ **Anthenantia**
            4. Spikelets all sessile or subsessile.
                6. Spikelets narrowly lanceolate to narrowly elliptic, acute, (2–)2.5–4 times as long as wide; inflorescence branches digitately arranged or scattered along a short main inflorescence axis, never only 2 apically; lemma of fertile floret with margins thin and flat, not inrolled over the palea _____ **Digitaria**
                6. Spikelets lanceolate to oblong or suborbicular, obtuse or acute, 0.8–2.5 times as long as wide; inflorescence branches either only 2 apically or scattered along main inflorescence axis, not digitately arranged; lemma of fertile floret with margins relatively thick, inrolled over edges of the palea.
                    7. Rounded back of lemma of fertile floret facing the axis of the inflorescence branch; spikelets closely packed and often paired, in 2 or 4 rows; inflorescence with (1–)2–many branches; species widespread throughout East TX _____ **Paspalum**
                    7. Rounded back of lemma of fertile floret facing away from the axis of the inflorescence branch; spikelets more widely spaced (only slightly overlapping), not in pairs, in 2 rows; inflorescence with 2–7 branches; species known primarily from s and e portions of East TX _____ **Axonopus**
1. Lower glume well-developed, the spikelets thus with 3 or 4 well-developed, scale-like bracts: lemma and sometimes palea of sterile floret, upper glume, lower glume; 3rd or 4th scale-like bract (lower glume) may be much shorter than rest, but nearly as wide.

8. Inflorescence disarticulating so that sessile spikelet falls with section of the inflorescence branch; plants low annuals with cordate-clasping leaf bases _____ **Arthraxon**
8. Inflorescence disarticulating just below glumes; plants annuals or perennials without cordate-clasping leaf bases.
   9. One of the glumes and/or the lemma of lower floret awned.
      10. Lower glume unawned to minutely awn-tipped; lower lemma awnless to very long-awned (awn to 60 mm long) _____ **Echinochloa**
      10. Lower glume conspicuously awned, the awn 4–10 mm long, exceeding the rest of the floret; lemma of lower floret with awn 1.2 mm or less long _____ **Oplismenus**
   9. Glumes and lemma of lower floret unawned.
      11. Palea of lower (sterile) floret enlarged and indurate at maturity, much larger than the lemma of the lower floret, giving the spikelets an expanded appearance (spikelets at maturity gaping open at apex) (species previously in *Panicum* subgenus *Steinchisma*) _____ **Steinchisma**
      11. Palea of lower floret neither enlarged nor indurate, much smaller than the lemma of the lower floret, the spikelets neither with an expanded appearance nor gaping open (except spikelets gaping open in *Panicum virgatum* which does not have an enlarged palea).
         12. Inflorescence with an easily discernable central axis bearing relatively few (1–ca. 30) discrete, unbranched, 1-sided, spike-like racemes, these racemes usually discernable at a glance.
            13. Inflorescence branches terminating in a ± inconspicuous bristle 2.5–4 mm long _____ **Paspalidium**
            13. Inflorescence branches terminating in a spikelet, a terminal bristle absent.
               14. Ligules absent (if rarely present on lower leaves, then the ligule is of hairs only) _____ **Echinochloa**
               14. Ligules of either a membrane or hairs present on all leaves.
                  15. Rounded back of lemma of fertile floret and upper glume facing away from the axis of the inflorescence branch; lemma of fertile floret roughened-rugose _____ **Urochloa**
                  15. Rounded back of lemma of fertile floret and upper glume facing the axis of the inflorescence branch; lemma of fertile floret smooth or nearly so OR roughened-rugose.
                     16. Lemma of fertile floret smooth or nearly so _____ **Paspalum**
                     16. Lemma of fertile floret roughened-rugose _____ **Urochloa**
         12. Inflorescence without a conspicuous central axis, or if so, the branches usually rebranched; discrete spike-like racemes not easily discernable.
            17. Spikelets asymmetric at base, the upper glume with a pouch- or sac-like swelling at base; inflorescences dense spike-like panicles, the spikelets so densely arranged that at least the distal 1/2 of the inflorescence axis is concealed _____ **Sacciolepis**
            17. Spikelets variously shaped, but not as above; inflorescences ± open panicles, the inflorescence axis not concealed.
               18. Lemma of fertile floret roughened-rugose; panicle branches at the lower nodes verticillate _____ **Urochloa** (*U. maxima*)
               18. Lemma of fertile floret usually smooth, if roughened, then the panicle branches not verticillate.
                  19. Lemma of fertile floret with tip pointed, often abruptly so; palea of fertile floret with tip not enclosed by lemma; ligules absent (if present on lower leaves, then the ligule is of hairs only) _____ **Echinochloa**
                  19. Lemma of fertile floret with tip usually rounded, not pointed; palea of fertile floret with tip enclosed by lemma; ligules of either a membrane or hairs present on all leaves.

20. Basal leaves usually different from those of the culm, usually forming a basal rosette; small axillary panicles on reduced lateral shoots present in fall; branches typically developing at lower and middle stem nodes in summer, these branches often rebranching by fall; plants perennial (sometimes treated as *Panicum* subgenus *Dichanthelium*) _____ **Dichanthelium**

20. Basal leaves usually similar to those of the culm but smaller, a basal rosette absent; small axillary panicles absent in fall; branches usually not developing at lower and middle stem nodes or, if present, rarely rebranched; plants annual or perennial _____ **Panicum**

KEY I

Spikelets with 1 fertile floret; reduced floret below fertile floret absent; spikelets not borne along 1 side of the inflorescence branches; inflorescences usually without distinct spike-like branches having spikelets to very base

1. Glumes absent, the caryopsis (= fruit) thus subtended by only 2 scale-like bracts (lemma and palea); inflorescence a panicle with spreading branches.
   2. Lemmas awnless; spikelets strongly laterally compressed, 1.3–5.5 mm long, bisexual _____ **Leersia**
   2. Lemmas awned; spikelets not strongly laterally compressed, 4–25 mm long, unisexual, the staminate and pistillate either on different branches or in different places on the same branch.
      3. Staminate and pistillate spikelets on different branches, the staminate on lower branches, the pistillate on upper branches; pistillate spikelets 7–25 mm long; culms completely submersed OR emergent from water; species rare in East TX, confirmed only for Hays Co. _____ **Zizania**
      3. Staminate and pistillate spikelets on the same branches, the pistillate terminal, the staminate below; pistillate spikelets 4–8 mm long; culms emergent from water; species widespread and common in East TX _____ **Zizaniopsis**
1. Glume(s) present, the caryopsis thus subtended by more than 2 scale-like bracts (lemma, palea, glume(s)); inflorescence various.
   4. Spikelets 7–11 mm long, 2–4 mm wide, strongly flattened, oblong-ovate; glumes much smaller than lemmas, at most 3 mm long _____ **Oryza**
   4. Spikelets not as above; glumes various.
      5. Lemma hard, permanently enclosing caryopsis, narrowly fusiform-cylindrical (shaped like a fat needle broadest near middle), with a sharp-pointed callus at base, with either 1 very long (3.5–10 cm) awn OR 3 awns.
         6. Lemma with 3 awns; base of awns without ring of hairs _____ **Aristida**
         6. Lemma with 1 awn; base of awn with ring of hairs.
            7. Lemma margins strongly overlapping; lemma apex with smooth white neck (= crown) ca. 0.6–1(–2) mm long; ligule 1 mm or less long _____ **Nassella**
            7. Lemma margins involute, not overlapping (though abutting); lemma apex without white neck; ligule (0.4–)1.5–4.5 mm long _____ **Piptochaetium**
      5. Lemma neither hard nor permanently enclosing caryopsis, variously shaped, but not as above, usually without a sharp-pointed callus, with a single awn less than 3.5 cm long or awnless.
         8. Glumes usually 25–30 mm long _____ **Avena** (*A. sativa*)
         8. Glumes 10 mm or less long.
            9. Glumes and lemmas both awnless.
               10. Glumes both as long as or longer than lemma.
                  11. Panicles open, not spike-like, 2–25 cm wide _____ **Agrostis**
                  11. Panicles dense, almost spike-like, 3 cm or less wide.

12. Inflorescence so dense that its central axis is usually not visible; spikelets with 2 easily overlooked, reduced or scale-like sterile lemmas below the fertile floret _____ **Phalaris**
12. Inflorescence dense, but not so dense that its central axis is not visible; spikelets with only 1 floret, no reduced lemmas present.
13. Inflorescence branches dense, but not in whorls; ligule 0.5–1.5(–1.7) mm long _____ **Muhlenbergia**
13. Inflorescence branches in whorls; ligule 2–7 mm long.
14. Lemmas 1.4–2 mm long; spikelets disarticulating above the glumes; plants usually stoloniferous, the stolons rooting at the nodes and often forming a dense mat _____ **Agrostis** (*A. stolonifera*)
14. Lemmas ca. 1 mm long; spikelets disarticulating below the glumes; plants not stoloniferous _____ **Polypogon** (*P. viridis*)

10. Glumes, at least the first, shorter than lemma.
15. Spikelets extremely small, 1–2 mm long; glumes deciduous; inflorescences open, very delicate in appearance; pedicels much longer than spikelets, 2.4–11 mm long; introduced species rare in East TX, known in the area only from Brazos Co. _____ **Eragrostis** (*E. airoides*)
15. Spikelets variable in length, 1.3–7(–10) mm long; glumes persistent (except in *Cinna* which has spikelets 3.5 mm or more long); inflorescences and pedicels various; including native and introduced species widespread in East TX.
16. Spikelets disarticulating below glumes; stamen 1 per floret _____ **Cinna**
16. Spikelets disarticulating above glumes; stamens 3 per floret.
17. Lemma usually 1-veined (3-veined in two annual species); plants annual or perennial; fruit dropping from lemma and palea at maturity; seed loose, not fused to ovary wall; ligule a minute ring of hairs with membranous base _____ **Sporobolus**
17. Lemma 3-veined, the lateral veins sometimes faint; plants perennial; fruit enclosed in lemma and palea at maturity; seed fused to ovary wall; ligule a short membrane, usually without hairs _____ **Muhlenbergia**

9. Glumes AND/OR lemmas awned.
18. Inflorescence an extremely dense, spike-like panicle.
19. Inflorescences (8–)15–54(–60) cm long; glumes unawned; lemma with awn 3(–4) mm or less long _____ **Muhlenbergia**
19. Inflorescences 1–15(–18) cm long; EITHER glumes awned OR lemmas with awn 3 mm or more long.
20. Glumes awnless; lemma with awn 3–8+ mm long arising below middle of back of lemma _____ **Alopecurus**
20. Glumes awned, the awns 0.8–10 mm long; lemma awnless or with an awn to ca. 1 mm long arising from the apex of the lemma.
21. Awn of glume 0.8–1.5(–2) mm long, abruptly arising from unnotched apex; inflorescences 5–9(–10) mm wide; lemma awnless _____ **Phleum**
21. Awn of glume 4–10 mm long, arising from an apical notch; inflorescences 10–30 mm wide; lemma with a delicate awn 0.5–1 mm long _____ **Polypogon** (*P. monspeliensis*)

18. Inflorescence usually an open or sometimes contracted panicle, but not extremely dense and spike-like.
22. Lemmas either awnless OR awned from an entire or very minutely cleft apex; glumes, at least the first, usually shorter than lemma, awnless or awned.
23. Spikelets disarticulating below glumes; stamen 1 per floret; lemma with an awn 0.2–1.5 mm long; inflorescence a contracted panicle _____ **Cinna**

23. Spikelets disarticulating above glumes; stamens 3 per floret; lemma awnless or with an awn up to 25(–30) mm long; inflorescence an open to contracted panicle.
    24. Spikelets 8–13 mm long (excluding awns); lemma with awn 12–25 (–30) mm long; lower (first) glume absent or rudimentary _____ **Brachyelytrum**
    24. Spikelets 1.4–5 mm long; lemma awnless or with an awn to 15(–18) mm long; lower glume present _____ **Muhlenbergia**
22. Lemma awned from back, the awn arising anywhere from just below tip to near middle; glumes equaling or exceeding lemma, awnless.
    25. Awn of lemma 1–2 mm long, curled or hooked at tip; culms and leaves densely soft-hairy, velvety to the touch _____ **Holcus**
    25. Awn of lemma of various lengths, but neither curled nor hooked at tip; culms and leaves glabrous or with pubescence, but not velvety.
        26. Panicles contracted, dense, narrow, usually 15(–20) mm or less wide, the branches bearing spikelets nearly to the base; spikelets 3–4 mm long (excluding awns) _____ **Limnodea**
        26. Panicles open, very diffuse, > 15 mm wide, the branches usually naked of spikelets below the middle; spikelets 1.2–3.3(–3.5) mm long (excluding awns).
            27. Awn arising near middle of back of lemma, ca. 2–4 mm long; florets 2 per spikelet (though only 1 with awned lemma and spikelet thus appearing as if there is only 1 floret) _____ **Aira**
            27. Awn arising just below tip of lemma, 4–10 mm long; floret 1 per spikelet _____ **Agrostis** (*A. elliottiana*)

AEGILOPS L. GOAT GRASS

A variable C_3 genus of ca. 23 species (Saufferer ined.) native from the Canary Islands and the Mediterranean to c Asia and Pakistan. They are typically xerophytic species of open habitats (Watson & Dallwitz 1992) and are generally considered weedy. *Aegilops* is related to *Triticum* and is thought to have possibly contributed one or more genomes to polyploid WHEAT (e.g., An et al. 1985). Because species of *Aegilops* can sometimes hybridize with *Triticum* species, *Aegilops* is potentially an important source of genetic variation (e.g., disease resistance genes) for wheat breeders (Tucker 1996). While sometimes included in *Triticum* (e.g., Gould 1975b; Hatch 2002), *Aegilops* appears to be morphologically and phylogenetically distinct (van Slageren 1994) and is widely recognized as a separate genus (e.g., Yatskievych 1999; Saufferer ined.). (Classical Latin name for wheat or a kind of wild oat, possibly from Greek: *aigilops*, desired by the goat; or from *aig*, goat, and *ops*, eye, thus goat's eye; or from *aegilos*, an herb liked by goats, and *ops*, similar to, hence resembling an herb liked by goats—Saufferer ined.) (subfamily Pooideae, tribe Triticeae)

REFERENCES: Bowden 1959; Baum 1978, 1982, 1983; Waines et al. 1982; Witcombe 1983; Löve 1984; An et al. 1985; Gupta & Baum 1986, 1989; Waines & Barnhart 1992; van Slageren 1994; Tucker 1996; Barkworth 2000; Mason-Gamer & Kellogg 2000; Saufferer ined.

Aegilops cylindrica Host, (cylindrical), JOINTED GOAT GRASS, BEARDED GOAT GRASS. Annual 35–50(–75) cm tall; leaf sheaths glabrous except on margins; ligule a membrane < 1 mm long; leaf blades with flaring base projecting to form small, sometimes indistinct auricles; inflorescence a slender, cylindrical, pencil-like spike, the spikelets closely fitted into niches in the unbranched, flattened, bilateral axis of the inflorescence; disarticulation usually first in lowest node of inflorescence axis, the spike falling whole; spikelets solitary per node, sessile, 2–5-flowered, the upper florets reduced and sterile; glumes rounded, asymmetrical; glumes and lemmas of upper spikelets long-awned, the awns ca. 3–6(–8) cm long, the awns of lower spikelets much shorter,

0.5 cm or less long. Roadsides and disturbed sites, limestone areas; Dallas, Denton, Grayson, McLennan, Travis (BRIT), Angelina, and Bell (Turner et al. 2003) cos.; widespread in the state, but mainly w 2/3 of TX; sw Canada (B.C.) and throughout most of the U.S. except the extreme se. Apr–Jun. Native of Mediterranean region and adjacent Asia. [*Triticum cylindricum* (Host) Ces., Pass. & Gibson] This species can be a troublesome weed, particularly in winter wheat (Kappler et al. 2002). It is considered noxious in many w states including OK (Kartesz 1999). Sterile hybrids between *A. cylindrica* and *Triticum aestivum* (WHEAT) are known (Saufferer ined.) ⊘ ☞

AGROSTIS L. BENT GRASS

Glabrous annuals or perennials; ligule a membrane 1–6 mm long; inflorescence an open panicle (or contracted in *A. stolonifera*), the branches strongly ascending to spreading; spikelets 1-flowered; disarticulation above glumes; glumes usually longer than the lemma; paleas short or absent (except in *A stolonifera*); lemmas awned or awnless; stamens usually 3 (1 in *A. elliottiana*).

A cosmopolitan but especially n temperate C_3 genus of 150–200 species (Harvey ined.); a number are important for use in lawns (in cool climates) and pastures, and a few are agricultural weeds. Some species tolerant of toxic metals have been used for reclaiming contaminated land. (Old Greek name for grass from *agros*, a field or pasture) (subfamily Pooideae, tribe Poeae) REFERENCES: Hitchcock 1905; Tucker 1996; Harvey ined.

1. Lemmas with awns 4–10 mm long; plants annual; anther 1 per floret _____ **A. elliottiana**
1. Lemmas awnless (awns 3 mm or less long rarely present in *A. scabra*); plants perennial; anthers usually 3 per floret.
   2. Spikelets 1.2–2.1 mm long; lemmas 0.8–1.2 mm long _____ **A. hyemalis**
   2. Spikelets (at least some) (2–)2.2–3.2+ mm long; lemmas 1.3–2 mm long.
      3. Plants typically with creeping stolons; paleas present and well-developed, ca. 1/2–2/3 as long as lemmas, 2-veined; panicles contracted except at anthesis, with all or some of the main branches bearing spikelets all the way to the base; species known in East TX only from Cass Co. in the ne Pineywoods _____ **A. stolonifera**
      3. Plants without stolons; paleas absent or merely veinless scales 0.5 mm or less long; panicles open, usually without spikelets near base of main panicle branches; species widespread or scattered in East TX.
         4. Panicles with main branches (at least some) usually 5–15 cm or more long, rebranched only toward the tips, the spikelets clustered near the tips; species mainly of w TX, rarely introduced elsewhere; plants spring flowering except in w TX _____ **A. scabra**
         4. Panicles with main branches usually 5 cm or less long, infrequently longer, rebranched near or below the middle, the spikelets not clustered near the tips; species of Pineywoods and Post Oak Savannah w to Lamar Co.; plants usually flowering in fall _____ **A. perennans**

Agrostis elliottiana Schult., (for Stephen Elliott, 1771–1830, Carolinian botanist), ELLIOTT'S BENT GRASS, ANNUAL TICKLE GRASS. Annual 10–45 cm tall; leaf blades 0.5–1(–1.6) mm wide; panicles delicate, becoming very open, the main panicle branches rebranched near the middle; spikelets 1.2–2.2 mm long; lemma 1.1–2 mm long, with awn 4–10 mm long from just below apex, rarely awnless; anther 1. Sandy soils, disturbed sites; Pineywoods and Gulf Prairies and Marshes w to East Cross Timbers, also e Edwards Plateau; according to Harvey (ined.), "*Agrostis elliottiana* has a disjunct distribution, occurring in eastern North America from Kansas to Maryland, Georgia, and eastern Texas, in the Sacramento Valley, California, and in Yucatan, Mexico." Apr–May. Reeder and Reeder (1986) and Yatskievych (1999) indicated that this species has spikelets with a single, tiny, unusual anther made up of two nearly separate pollen sacs, and further, that the spikelets might be cleistogamous; East TX specimens also appear to have the tiny anthers.

Agrostis hyemalis (Walter) Britton, Sterns, & Poggenb., (of winter), TICKLE GRASS, SPRING BENT GRASS, WINTER BENT GRASS, FLY-AWAY GRASS. Tufted perennial 15–75(–80) cm tall; leaf blades 0.5–2(–3) mm wide; panicles narrow at start of flowering, later becoming very open; main panicle branches in whorls, at least some 5–15 cm or more long, rebranched only toward the tips, the spikelets clustered near the tips. Open areas, usually sandy soils throughout much of TX; se Canada and widespread in the e 1/2 of the U.S. Late Apr–early Jun. Rabinowitz and Rapp (1979) found that while some seeds fall from the inflorescence while it is attached to the plant, the "remaining seeds are dispersed when the panicle breaks from the parent and rolls in the wind (long-distance tumble dispersal)." The inflorescences are thus acting as "tumbleweeds." We are tentatively following Gould (1975b), Sutherland (1986), Kartesz (1994, 1999), and Harvey (ined.—*Flora of North America* treatment) in recognizing the similar *A. scabra* (ROUGH BENT GRASS) as a distinct species. However, Jones et al. (1997), Hatch (2002), and Turner et al. (2003) synonymized *A. scabra* with *A. hyemalis*, while Yatskievych (1999) treated it as a variety of *A. hyemalis*. Harvey (ined.) noted *A. hyemalis* differs in "its smaller spikelets and anthers, more conspicuous culm leaves, and perceptibly more clustered spikelets." Further study will be needed to determine the appropriate rank at which to recognize this variation. Harvey (ined.) separateed the two species as follows:

1. Lemma 0.8–1.2 mm long; anthers 0.2–0.3 mm long _____ *A. hyemalis*
1. Lemma 1.4–2 mm long; anthers 0.4–0.7 mm long _____ *A. scabra*

Agrostis perennans (Walter) Tuck., (perennial), AUTUMN BENT GRASS, UPLAND BENT GRASS, PERENNIAL BENT GRASS. Clumped perennial 30–80(–100) cm tall; basal leaves usually withering by flowering; leaf blades (1–)2–6 mm wide; spikelets 1.8–3.2 mm long. Moist sand along wooded streams, open oak woods; Pineywoods and Post Oak Savannah w to Henderson (BRIT) and Robertson (Turner et al. 2003) cos. and in Red River drainage to Lamar Co. (BRIT); also n Gulf Prairies and Marshes; throughout e Canada and the e U.S. w to ND and TX, also CA, OR, and WA. Aug–Oct, occasionally in spring. [*A. perennans* var. *aestivalis* Vasey]

Agrostis scabra Willd., (rough to the touch), ROUGH BENT GRASS, TICKLE GRASS. Clumped perennial usually 30–90 cm tall, similar to *A. hyemalis*; leaves mostly basal, these usually persisting; leaf blades 1–2 mm wide; panicles becoming very open, with main branches rebranched only toward the tips, the spikelets clustered near the tips; spikelets (at least some) (2–)2.2–3(–3.2+) mm long, often purplish. Waste areas, roadsides; Bowie, Lavaca (BRIT), Dallas, Hardin, and Harris (Correll & Johnston 1970) cos.; also Jeff Davis Co. (BRIT) in the Trans-Pecos; native in the w part of the state, but apparently introduced in East TX; widespread in Canada and the U.S. In East TX flowering in spring. [*A. hyemalis* var. *scabra* (Willd.) H.L. Blomq.] This species has often been synonymized with *A. hyemalis*—see discussion under that species. At maturity the inflorescence tends to break off at its base and can function as a tumbleweed (Yatskievych 1999; Harvey ined.). According to Harvey (ined.), awned and unawned individuals occur together, the "difference presumably being caused by a single gene." Harvey (ined.) also noted that the "species is variable in size, with the extremes consisting of a widespread, lowland, more weedy form, capable of producing very large panicles (this form is introduced into the southern United States) and a dwarf form of poorer soils and mountainous regions."

Agrostis stolonifera L., (stolon-bearing), CREEPING BENT GRASS, RED-TOP BENT GRASS. Mat-forming or turf-forming perennial, typically stoloniferous; culms decumbent or spreading at base, sometimes rooting at nodes, 30–100 cm long; leaf blades (1–)2–6 mm wide; panicles contracted, densely-flowered (open at anthesis, but becoming contracted after flowering), the main panicle branches rebranched below the middle; spikelets 1.6–3 mm long. Moist areas, pastures, and disturbed places, often temporarily flooded areas; Cass Co. (Turner et al. 2003) in the Pineywoods; known from a few widely scattered counties in TX; nearly throughout the U.S. and Canada.

Late spring–early summer. Native of Eurasia, but Harvey (ined.) suggested "some northern salt marsh and lakeside populations may be native." [*A. alba* L. var. *stolonifera* (L.) J.G. Sm., *A. maritima* Lam., *A. palustris* Huds., *A. stolonifera* var. *compacta* Hartm., *A. stolonifera* var. *palustris* (Huds.) Farw.] This species is sometimes cultivated as a turf grass for lawns (Yatskievych 1999). According to Barkworth (ined.), "In Europe, *P.* [*Polypogon*] *monspeliensis* hybridizes with *Agrostis stolonifera*, producing the sterile ×*Agropogon littoralis* (With.) C.E. Hubb. ..." However, the hybrid has not been reported from North America (Barkworth ined.).

AIRA L. HAIR GRASS, SILVER HAIR GRASS

A C_3 genus of 8–10 species (Tucker 1996; Mabberley 1997; Wipff ined.) of small annuals of Europe and the Mediterranean region to Iran; also widely distributed as weeds. Members of this genus have some of the most open, delicate-appearing inflorescences found among East TX grasses; the plants are small and easily overlooked. (An ancient Greek name for some grass, perhaps darnel—*Lolium temulentum* L.) (subfamily Pooideae, tribe Poeae)
REFERENCES: Brown & Peterson 1984; Tucker 1996; Wipff ined.

Aira caryophyllea L., (like *Caryophyllus* or *Dianthus*, Caryophyllaceae, from the tufts of slender leaves—Fernald 1950a), ANNUAL HAIR GRASS. Delicate tufted annual to ca. 35(–55) cm tall; ligule 1.5–4(–8) mm long, white, membranous; leaf blades usually 0.5(–2.5) mm or less wide; panicles delicate, very open and diffuse, 4–15 cm long; spikelets 2-flowered, 1.7–3.3(–3.5) mm long excluding awns; glumes 1.8–3 mm long, longer than the lemmas; lemmas 1.3–2.3(–2.6) mm long, one or both lemmas with a bent or twisted awn attached near the middle of the back, the awn ca. 2–4 mm long; paleas shorter than lemmas. Sandy open areas. Gould (1975b), Kartesz (1994, 1999), and Yatskievych (1999) treated var. *capillaris* as *A. elegans*. More recently, Hatch (2002) and Turner et al. (2003) recognized no varieties within *A. caryophyllea* (which they treated as including var. *capillaris*). However, we are following Jones et al. (1997) and the forthcoming treatment by Wipff (ined.) in recognizing the variation present at the varietal level. The county distribution map does not distinguish varieties.

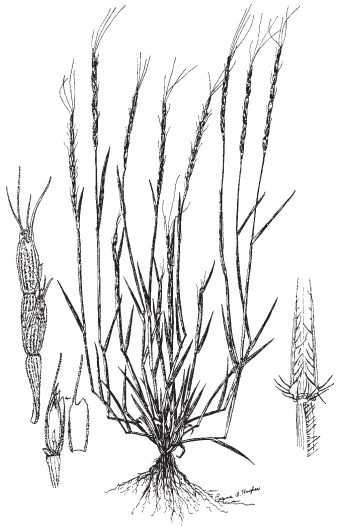
1. Lower floret with lemma often awnless (thus usually only one lemma per spikelet awned); pedicels usually 2–5(–8) times as long as the spikelets; spikelets 1.7–2.5 mm long _____ var. **capillaris**
1. Lower floret with lemma having an awn ca. 2 mm long from near middle of its back (thus both lemmas of a spikelet awned); pedicels 1–2.5 times as long as the spikelets; spikelets 2–3.3(–3.5) mm long _____ var. **caryophyllea**

var. **capillaris** Mutel, (resembling hair, very slender), ANNUAL HAIR GRASS, ANNUAL SILVER HAIR GRASS. Sandy open areas; Pineywoods and Post Oak Savannah and w in Red River drainage to Grayson Co. (BRIT); also East Cross Timbers; se U.S. from VA to FL w to NM, also CA, OR, and WA; Apr–Jun. Native of Europe. [*A. capillaris* Host, *A. elegans* Willd. ex Kunth, *A. elegantissima* Schur]

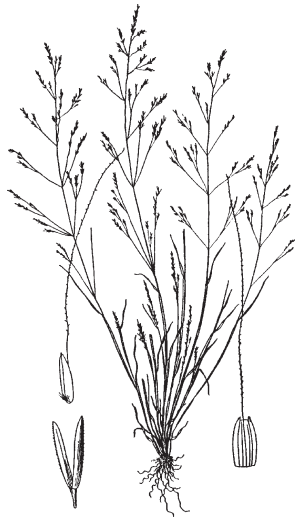
var. **caryophyllea**, COMMON SILVER HAIR GRASS. Similar to var. *capillaris* except as noted in the key. Sandy soils; Gregg, San Jacinto (BRIT), and Lamar (Carr 1994) cos.; reportedly first found in TX in San Jacinto Co. in 1981 (Brown & Peterson 1984); however, a Gregg Co. collection (*Shinners 20040*, BRIT) was made in 1955; e U.S. from NH to GA w to MO and TX, also scattered in w Canada and w U.S. Apr–May. Native of Europe.

ALOPECURUS L. FOXTAIL, MEADOW FOXTAIL

Glabrous tufted annuals; ligule membranous, 1.5–7 mm long; leaf blades flat; inflorescence a dense cylindrical spike-like panicle; spikelets 1-flowered, compressed, disarticulating below glumes and falling as a unit; glumes equal, awnless; lemmas awned on back below middle, the awn geniculate; paleas usually absent.



Aegilops cylindrica [REE]



Agrostis elliottiana [USB]



Agrostis hyemalis [HI1]



Agrostis perennans [USB]



Agrostis scabra [GO3]



Agrostis stolonifera [YAT]



Aira caryophyllea var. capillaris [SIL]



Aira caryophyllea var. caryophyllea [USB]

A C_3 genus of 29–36 species of temperate and subtropical areas of both hemispheres and tropical mountains, with its main distribution in sw Asia (Dogan 1999; Crins ined.). Some are important fodder plants while others are weeds. It is unusual in lacking both paleas and lodicules (Tucker 1996). (Greek: *alopex*, fox, and *oura*, tail, in reference to the appearance of the inflorescence) (subfamily Pooideae, tribe Poeae)
REFERENCES: Naylor 1972; Tucker 1996; Dogan 1997 [1998], 1999; Crins ined.

1. Spikelets 1.8–2.5(–3.1) mm long; glumes hispid-ciliate on midvein from base to apex; awn of lemma 3–5 mm long; anthers less than 1 mm long; species widespread in East TX _____ **A. carolinianus**
1. Spikelets 4.5–7 mm long; glumes with cilia on midvein only near base; awn of lemma 5–8+ mm long; anthers 2–4 mm long; species rare, if present, in East TX _____ **A. myosuroides**

Alopecurus carolinianus Walter, (of Carolina), CAROLINA FOXTAIL, TUFTED MEADOW FOXTAIL, COMMON FOXTAIL, TUFTED FOXTAIL. Culms 7–35(–60) cm tall; inflorescence 2–7 cm long and 4–6 mm in diam.; glume keels not winged. Ditches and other moist open areas; widespread in e 1/2 of TX; widespread in the U.S., particularly the southeast, also sw Canada. Mar–Jun.

Alopecurus myosuroides Huds., (resembling a mouse-tail), MOUSE FOXTAIL, SILM-SPIKE FOXTAIL, SLENDER MEADOW FOXTAIL, BLACK-TWITCH. Culms 40–70(–85) cm tall; inflorescence 3–10(–14) cm long, 4–8 mm in diam.; glume keels winged. Moist areas; included based on citation for Pineywoods by Hatch (2002), Hatch et al. (1990), and for "e. Tex." by Correll and Johnston (1970); however, no East TX specimens have been located (e.g., BRIT, TAES, TEX), and this species is only questionably included as a member of the East TX flora; no county distribution map is provided; also Gulf Prairies and Marshes (Hatch 2002); scattered in e U.S. from ME to SC w to KS and NM, also CA, OR, and sc Canada. Mar–Jun. Native of Eurasia. Apparently brought in with hay and occurring "only as a waif" (Correll & Johnston 1970). This species is a serious weed of grain fields in Europe (Naylor 1972; Tucker 1996; Holm et al. 1997) and is considered noxious in NC and WA (Kartesz 1999).

ANDROPOGON L. BLUESTEM, BEARD GRASS

Perennials; culms stiffly erect; ligule membranous; leaf blades 10 mm or less wide; inflorescences terminal and axillary, sometimes appearing paniculately arranged, each inflorescence of 2–several racemose, digitately arranged branches, the peduncle subtended by, and often partly enclosed by, a sometimes sheathing bract; spikelets in pairs: one sessile and perfect, the other pedicellate and staminate or neuter, well-developed to rudimentary or absent (represented by pedicel only); disarticulation so that sessile spikelet falls with associated pedicel and section of the inflorescence branch; lower glume large, firm, tightly clasping or enclosing upper glume; perfect spikelet with 2 florets, the lower neuter, often vestigial; lemma of perfect (upper) floret awned or awnless.

A genus of ca. 120 species (Campbell 2003) of tropical and warm areas of the world; it is considered one of the dominant savannah genera (Clayton & Renvoize 1986). A number of species are significant weeds, while others are valued as fodder or as native pasture grasses (Watson & Dallwitz 1992). It has sometimes been circumscribed more broadly to include such genera as *Bothriochloa*, *Dichanthium*, and *Schizachyrium*. Like all members of the Andropogoneae, it is characterized by C_4 photosynthesis (Kellogg 2000a). As is the case with many other warm season C_4 perennial grass species, symbiotic relationships between *Andropogon* species and mycorrhizal fungi are often very important (Wilson & Hartnett 1998). The bluish tinge of the foliage of some flowering individuals is the source of the common name BLUESTEM; at other times of the year, the foliage can be variously colored. Members of the *A. virginicus* complex (including *A. glomeratus*, *A. gyrans*, and *A. virginicus*) often have cleistogamous (= unopened, self-pollinated) flowers with only a single anther. These self-fertilizing forms are often very successful at

colonizing early successional or permanently disturbed sites (Campbell 1982). (Greek: *aner* (*andr*), man, and *pogon*, beard, referring to the hairy pedicels of the staminate spikelets) (subfamily Panicoideae, tribe Andropogoneae)

REFERENCES: Gould 1957a, 1967; Campbell 1982, 1983a, 1986; Barnes 1986; Wipff 1996b; Gustafson et al. 1999; Campbell 2003.

1. Sessile spikelets 7–11 mm long; terminal inflorescence conspicuously exserted beyond bracts, not woolly in appearance; pedicelled spikelets large, well-developed, similar to sessile spikelets except awnless ____ **A. gerardii**
1. Sessile spikelets 7 mm or less long; inflorescences either not conspicuously exserted beyond bracts OR if exserted then appearing woolly; pedicelled spikelets rudimentary, vestigial, or represented by the pedicel only.
   2. Inflorescence with 2 relatively stiff and usually straight branches, the spikelets and hairs usually so dense that the branch axes are not easily visible; sessile spikelets 5–7 mm long; inflorescences often conspicuously exserted beyond bracts ____ **A. ternarius**
   2. Inflorescence with 2–5 slender, delicate and flexuous branches, the spikelets and hairs often not as dense, the branch axes thus often visible, sometimes easily so; sessile spikelets 5 mm long or less; inflorescences usually not conspicuously exserted OR sometimes exserted in *A. gyrans*.
      3. Upper sheathing bract of inflorescence conspicuously inflated and spathe-like; lemma awns with a loose spiral twist near base; leaf blades 0.8–5 mm wide (typically ca. 2.5 mm); culms with tufts of long hairs just below sheathing bract of inflorescence; species rare in East TX ____ **A. gyrans**
      3. Upper sheathing bract of inflorescence not inflated; lemma awns straight or nearly so; leaf blades 1.7–9.5 mm wide (usually > 3 mm); culms glabrous OR with tufts of long hairs just below sheathing bract of inflorescence; species extremely widespread and abundant in East TX.
         4. Inflorescences crowded apically, together appearing broom-like; culms with tuft of long hairs below sheathing bract of inflorescence; leaf sheaths usually scabrous, sometimes smooth; leaf blades 13–109 cm long; ligule 0.6–2.2 mm long ____ **A. glomeratus**
         4. Inflorescences numerous but not clustered apically, not broom-like; culms glabrous below sheathing bract of inflorescence; leaf sheaths usually smooth, rarely scabrous; leaf blades 11–52 cm long; ligule 0.2–1 mm long ____ **A. virginicus**

Andropogon gerardii Vitman, (for Louis Gérard, 1733–1819, French botanist). Plant to 2 m tall, essentially glabrous, often glaucous; inflorescences of 2–7 digitately arranged branches, the branches 4–11 cm long; sessile spikelets usually scabrous, often glaucous; upper lemma of sessile spikelet awned (sometimes awnless in subsp. *hallii*); pedicellate spikelets about as large as sessile, awnless. Aug–Nov. This polyploid species has chromosome numbers of both $2n = 6x = 60$ and $2n = 9x = 90$; the plants are virtually indistinguishable morphologically (Norrmann et al. 1997). Hybridization between these two main cytotypes is possible, with the resulting individuals having a range of chromosome numbers (Norrmann & Keeler 2003). The reproductive biology of this species was studied by McKone et al. (1998) and was found to be very unusual in allocating more resources to male reproduction (pollen production) than to female reproduction (seed production). The following key to subspecies is modified from Sutherland (1986) and Wipff (1996b).

1. Upper lemma of sessile spikelet with an awn (7.5–)10–25 mm long; rhizomes short or absent, with internodes usually 2 mm or less in length; anthers usually < 3.8 mm long; ligule 0.4–2.5 mm long ____ subsp. **gerardii**
1. Upper lemma of sessile spikelet awnless or with an awn to 8(–11) mm long; rhizomes well-developed, creeping, with internodes often exceeding 20 mm in length; anthers usually > 3.8 mm long; ligule (0.9–)3–4.5 mm long ____ subsp. *hallii*

subsp. **gerardii**, BIG BLUESTEM, TURKEYFOOT. In relatively undisturbed areas and often an indicator of prairie remnants; throughout TX; throughout e 2/3 of the U.S. and s Canada w to AZ, MO, and Sask. BIG BLUESTEM was one of the dominants in the original tall grass prairie and is "one of the most important native grasses in North America" (Campbell 2003). It is considered one of the "big four" tall grasses along with *Panicum virgatum, Schizachyrium scoparium*, and *Sorghastrum nutans*. ⊞/275

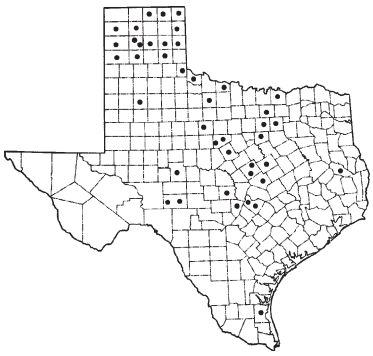
subsp. *hallii* (Hack.) Wipff, (presumably named for E.A. Hall who collected the type in Nebraska in 1862), SAND BLUESTEM. Sandy soils, apparently more drought tolerant than subsp. *gerardii* (Campbell 2003); a Montague Co. (Cross Timbers and Prairies) collection (*Garnett, s.n.*, BRIT), apparently of this subspecies, is the closest known occurrence to East TX; this subspecies is included here as a note because of past confusion over the two subspecies of *A. gerardii* and the hybrid between them. In TX this subspecies is generally found in the Rolling Plains, High Plains, and Trans-Pecos; c Canada and c U.S. [*A. gerardii* var. *paucipilus* (Nash) Fernald, *A. hallii* Hack., *A. paucipilus* Nash] This taxon has been variously treated. Turner et al. (2003) included it within an undivided *A. gerardii*, while Hatch (2002) treated it as *A. gerardii* var. *paucipilus*. However, Kartesz (1999) and Campbell (2003) recognized it as a distinct species (*A. hallii* Hack.). We are following Wipff (1996b) in recognizing the variation at the subspecific level. The 2 subspecies of *A. gerardii* sometimes hybridize (Barnes 1986), with the hybrids named *A. gerardii* subsp. ×*chrysocomus* (Nash) Wipff (Wipff 1996b).

Andropogon glomeratus (Walter) Britton, Sterns, & Poggenb., (clustered), BUSHY BLUESTEM, BUSHY BEARD GRASS. Plant 0.75–1.5 m tall; inflorescences much-branched, crowded, together appearing broom-like; inflorescence branches 1.5–3 cm long; sheaths of terminal branchlets of inflorescences reddish brown, not inflated, narrow, usually less than ca. 4 mm wide; sessile spikelets 3–4.5 mm long; pedicellate spikelets rudimentary or absent. Roadsides, low moist areas; widespread in TX; e U.S. from NY s to FL w to IL, OK, and TX and w U.S. from CA e to NM. Sep–Nov. [*A. glomeratus* var. *glaucopsis* (Elliott) C. Mohr, *A. glomeratus* var. *hirsutior* (Hack.) C. Mohr, *A. glomeratus* var. *pumilus* Vasey] Varieties are sometimes recognized in *A. glomeratus* (e.g., Campbell 1983a, 2003; Kartesz 1999), and according to Campbell (1983a), only var. *pumilus* occurs in TX. However, we are following Hatch (2002) in not recognizing infraspecific taxa. This species is reported to hybridize with *A. virginicus* (Campbell 2003); see note under *A. virginicus*. ⊞/275

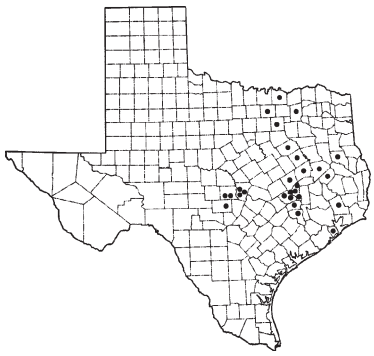
Andropogon gyrans Ashe, (going around in circles, concentrically twisted and plaited backward and forward; the significance of the name unclear, not given in the type description), ELLIOTT'S BLUESTEM, ELLIOTT'S BLUE GRASS. Plant 0.3–0.8(–1.4) m tall; inflorescences not broom-like; inflorescence branches 3–4(–5) cm long; upper sheathing bract of inflorescence inflated and spathe-like, ca. 4–15+ cm long, ca. 3–10 mm broad; sessile spikelets 3–5 mm long, with awns 10–15(–20) mm long, each with a loose spiral twist near base; pedicellate spikelets rudimentary or nearly so. Usually in partial shade. Late summer–fall. While some authorities (e.g., Hatch 2002) do not recognize infraspecific taxa, we are following Campbell's treatment (1983a, 2003) of the variation in this species at the varietal level. The county distribution map does not distinguish varieties.

1. Ligule usually less than 0.8(–1.1) mm long; inflorescences usually hidden in inflated sheathing bracts at maturity; plants of well-drained soils, rarely of poorly drained soils _____ var. **gyrans**
1. Ligule (0.8–)1.1(–1.5) mm long; inflorescences usually exposed at maturity; plants of bogs and ditches _____ var. **stenophyllus**

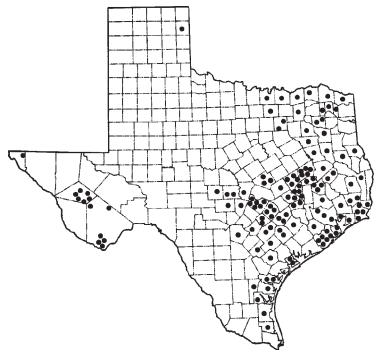
var. **gyrans**. Brazos, Robertson, and Walker (Campbell 1983a) cos.; also Erath Co. in Cross Timbers and Prairies and Galveston Co. in Gulf Prairies and Marshes (Campbell 1983a); NJ s to FL w to OK and TX. [*A. elliottii* of authors, not Chapm.] This taxon has long incorrectly gone under the name *A. elliottii* (Campbell 1983a).



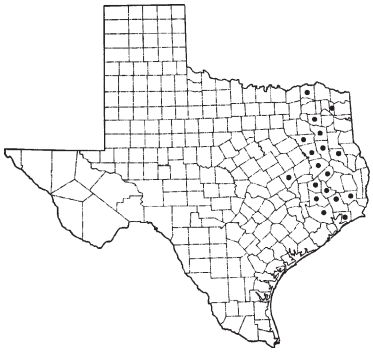
Aegilops cylindrica



Agrostis elliottiana



Agrostis hyemalis



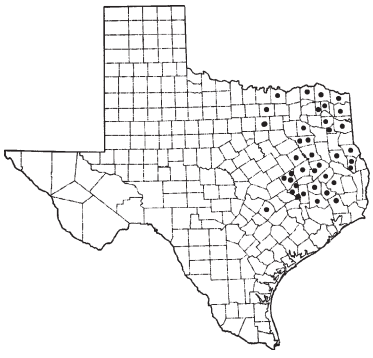
Agrostis perennans



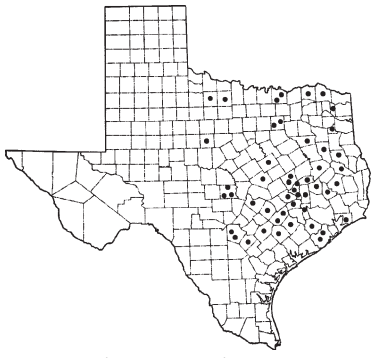
Agrostis scabra



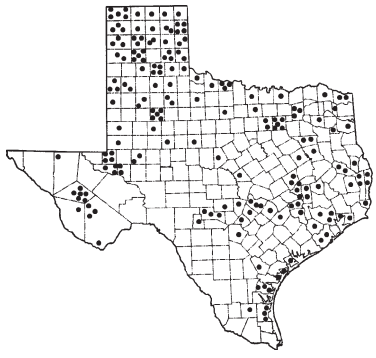
Agrostis stolonifera



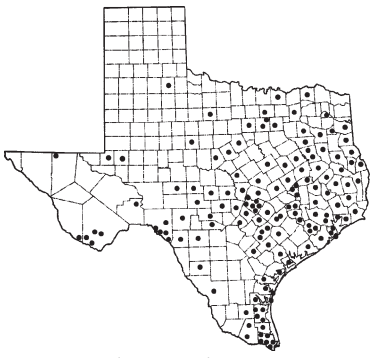
Aira caryophyllea
(both vars.)



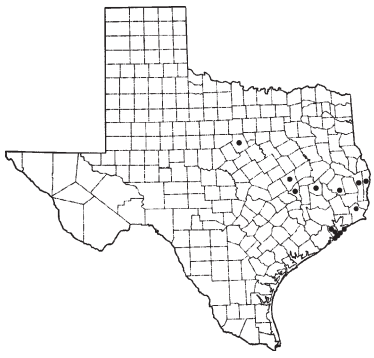
Alopecurus carolinianus



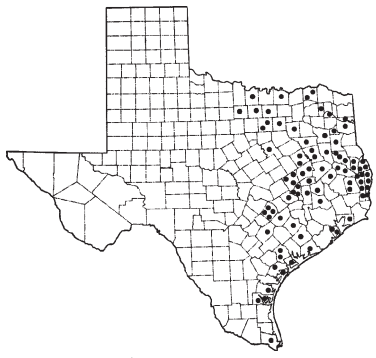
Andropogon gerardii
(both subsp.)



Andropogon glomeratus



Andropogon gyrans
(both vars.)



Andropogon ternarius

var. **stenophyllus** (Hackel) C.S. Campb., (narrow-leaved). Jasper (*Singhurst & Bridges 11979*, BAYLU), Newton (*Singhurst 11331*, BAYLU), and Robertson (Campbell 1983a) cos.; also Galveston Co. in Gulf Prairies and Marshes (Campbell 1983a); se U.S. from VA s to FL w to TX. [*A. virginicus* var. *stenophyllus* (Hackel) Fernald & Griscom, *A. perangustatus* Nash]

Andropogon ternarius Michx., (in threes), SPLIT-BEARD BLUESTEM, SPLIT-BEARD BEARD GRASS, SPLIT BLUESTEM, FEATHER BLUESTEM, SILVERY BEARD GRASS. Plant 0.7–1.2 m tall; culms glabrous or with a tuft of long hairs below bract-bearing node; inflorescences on lateral shoots at all upper nodes; inflorescence branches paired, 3–6 cm long; sessile spikelets glabrous, awned; pedicellate spikelets slender, awnless, rudimentary, 2 mm or less long, not wider than pedicel. Sandy soils, woodlands or woodland pastures; widespread in e 1/2 of TX; e U.S. from NJ s to FL w to KS, OK, and TX. Sep–Nov. The common name, SPLIT-BEARD BLUESTEM, is derived from each inflorescence having (being split into) 2 obviously hairy branches. The species is sometimes used as an ornamental and for erosion control (Campbell 2003). ⊞/275

Andropogon virginicus L., (of Virginia), BROOMSEDGE BLUESTEM, BROOMSEDGE, VIRGINIA BLUESTEM, YELLOWSEDGE BLUESTEM. Plant 0.5–1.5 m tall; culm nodes glabrous; inflorescences branched, not densely clustered; sheathing bracts of inflorescence usually straw-colored, not inflated, usually 3.8 mm or less wide; inflorescence branches 2–3 cm long; sessile spikelets with awned lemma; pedicellate spikelets rudimentary or absent. Sandy soils; moist areas or slopes; widespread in e 1/2 of TX; se Canada and e U.S. from NY to FL w to IA and TX, also CA. Sep–Nov. [*A. virginicus* L. var. *glaucus* Hackel] This species was inadvertently introduced to the Hawaiian Islands in 1932 and is considered one of the most threatening alien species there, as it is a serious invader of native communities and alters the fire and hydrology regimes (Cronk & Fuller 1995). It is considered a state noxious weed in HI (Kartesz 1999). Rice (1972) noted that this species is often able to persist in almost pure stands and found that it had allelopathic chemicals (= those causing harmful effects on other plants). This species is "taxonomically complex" (Campbell 2003) and quite variable, with some authorities (e.g., Campbell 2003) recognizing 3 varieties. According to Campbell (1983a), only var. *glaucus* occurs in TX. However, we are following Hatch (2002) in not recognizing infraspecific taxa in this species. A Jasper Co. specimen (*Shinners 31669*, BRIT), originally identified as *A. virginicus*, was annotated as *A. glaucopsis* Elliott, COASTAL BLUESTEM, by B.A. Sorrie (Jan. 2001) and labelled as a state record for TX. The most recent detailed study of the group (Campbell 1983a, 2003) treated the COASTAL BLUESTEM as *A. glomeratus* var. *glaucopsis* Mohr and gave its distribution as limited to the se U.S. extending w only to MS. This taxon has also been treated as *A. virginicus* L. var. *glaucopsis* (Elliott) Hitchc. or submerged in *A. virginicus* (e.g., Radford et al. 1968). The Jasper Co. specimen is labelled as having the "new leaves glaucous." However, both *A. glomeratus and A. virginicus* can at times have glaucous foliage. While the specimen otherwise resembles *A. virginicus* and we are treating it as such, it is mentioned here for completeness.

ANTHENANTIA P. Beauv. SILKYSCALE

Perennials from short rhizomes; culms stiffly erect; ligule a ciliate membrane or fringe of hairs or nearly obsolete, 1.5 mm or less long; leaf blades flat to involute; inflorescence a narrow panicle, the branches erect to ascending; spikelets short-pedicelled, obovoid, awnless, with 2 florets, the lower staminate or neuter, the upper perfect; disarticulation at base of spikelets; lower glume absent; upper glume and lemma of sterile floret subequal, densely cloaked with hairs 1–2 mm long, these giving the inflorescence a fuzzy appearance; stamens 3.

A C_4 genus of 3 species endemic to the se U.S. (Clayton & Renvoize 1986; Wipff 2003g; Kral 2004). Other authorities (e.g., McVaugh 1983) include the morphologically similar genus *Leptocoryphium*, which has 1–2 species ranging from Mexico to Argentina. Alternate spellings have included "Anthenanthia" and "Anthaenantia." However, *Anthenantia* has been determined

to be the etymologically correct version of the three alternate spellings used by Palisot de Beauvois, the author of the genus (Clayton & Renvoize 1986; Wipff 2003g). The following key and descriptions are modified from Kral (2004). (Greek: *anthos*, flower, and *enantios*, contrary, "the spikelet having given Palisot de Beauvois some problems in interpretation"—Wipff 2003g) (subfamily Panicoideae, tribe Paniceae)

REFERENCES: Webster 1988; López-Ferrari & Espejo 2000; Wipff 2003g; Kral 2004.

1. Adaxial (upper) surface of leaf blades with erect or variously directed hairs; principal leaves with blades shallowly auricled, only slightly angled outward from their sheaths; longer main panicle branches 1/3–1/2 as long as whole panicle, usually naked-based; glume and lower lemma often with longitudinal reddish bands _____ **A. texana**
1. Adaxial surface of leaf blades lacking hairs, though sometimes scabrid; principal leaves EITHER strongly auricled and angled outward from their sheaths OR lacking auricles and erect to gradually bowed outward; lower main panicle branches less than 1/3 panicle length OR branching near base; glume and lower lemma with OR without red longitudinal bands.
   2. Principal leaves with blades strongly auriculate and diverging at a definite angle from their sheaths, marginally ciliate basally; leaves, spikelets, and spikelet hairs with little or no red pigmentation; anthers brown at flowering; lemma and palea of fertile floret brown _____ **A. villosa**
   2. Principal leaves with blades weakly, if at all, auriculate and gradually flowing or continuing in ± the same plane as their sheaths, marginally ciliate basally OR lacking cilia basally; leaves, spikelets, and spikelet hairs variously reddish or purplish; anthers dark brown at flowering; lemma and palea of fertile floret darker red-brown to nearly black _____ *A. rufa*

Anthenantia texana R. Kral, (of Texas), TEXAS SILKYSCALE. Perennial (45–)60–100(–120) cm tall; leaves (15–)20–40(–60) cm long, the blades lance-linear, 4–7(–10) mm wide; ligule (0.5–)1(–1.5) mm long; panicle 7–15(–20) cm long; spikelets 3–4 mm long, reddish and green at anthesis, with red to pale pink or purple hairs. Sands, sandy clay loam, sandy peat, or silts of pine flatwoods, pine-oak barrens, bog margins, ditch banks and clearings (Kral 2004); Angelina, Freestone, Jasper, Liberty, Newton, Robertson, Tyler (BRIT), Hardin (VDB), Houston (VDB—Type), and Austin (TEX) cos. in the se part of East TX; also Aransas, Calhoun, Nueces (TEX), Jackson (BRIT), and Harris (Kral 2004) cos. in the Gulf Prairies and Marshes; w of the Mississippi Embayment in AR, LA, and TX. Mid-Jul–Oct. This is the most recently described new species in the East TX flora (Kral 2004). It has in the past typically been treated as part of *A. villosa*. Where Kral (2004) observed *A. texana* and *A. villosa* occurring together, *A. villosa* tended to occupy sandier, slightly higher areas, with *A. texana* in close proximity on slightly moister substrates.

Anthenantia villosa (Michx.) P. Beauv., (softly hairy), GREEN SILKYSCALE. Similar to *A. texana*; perennial (50–)60–130 cm tall; leaves 15–40 cm long; leaf blades 4–9(–15) mm wide; inflorescence (5–)10–20(–25) cm long; spikelets 3–4 mm long, green or pale green at anthesis, with silvery or pale hairs. Pinelands, pine-oak areas, bog margins, ditch banks, savannahs, roadsides, and sandy clearings, sometimes in relatively dry situations; Jasper, Newton (BRIT), and Hardin (TAES) cos. in the s Pineywoods; se U.S. from NC s to FL w to TX. Mid-Jul–Nov. This species in the past has been considered to occur broadly in the s part of East TX and the Gulf Prairies and Marshes (e.g., Turner et al. 2003), primarily because of confusion with the recently described *A. texana*. While additional TX collections will probably be made, since the species is currently known from the state from only three counties (Kral 2004), we are considering it of conservation concern in TX. ⚠

Anthenantia rufa (Nutt.) Schult., (red), PURPLE SILKYSCALE. Though this species has in the past been widely reported for TX (e.g., Turner et al. 2003), no definitive TX specimens are known (Kral 2004). However, Kral noted that it is "possibly" in East TX. The taxon is thus included in the key to species and here as a note for completeness and to alert collectors. Wet habitats (wet pine flatwoods and savannahs, sphagnous streamheads, and pitcher plant bogs); se U.S. from NC s to

FL w to LA and possibly TX. Mid-Jul–Oct. In parts of its range, PURPLE SILKYSCALE is considered to be an important native pasture species by some authorities (e.g., Watson & Dallwitz 1992).

ANTHOXANTHUM L. VERNAL GRASS

Tufted annuals or perennials, fragrant; leaves cauline; inflorescence a dense spike-like panicle, becoming yellowish or yellowish-brown; spikelets with 3 florets, the 2 proximal ones incomplete and reduced to dorsally awned lemmas exceeding the unawned, fertile, distal floret; disarticulation above the glumes, the florets falling together as a unit; glumes unequal, the lower glume ca. 1/2 as long as the upper, longer than the florets; awn of first lemma straight or nearly so, that of second lemma longer, geniculate, twisted; anthers 2.

A C_3 genus of 18–20 species (Clayton & Renvoize 1986; Allred ined.) of n temperate areas and mountains of tropical Africa and Asia. "The tissues contain coumarin, which gives the plants a sweet, vanilla-like fragrance. Coumarin is metabolized by *Aspergillus* fungi to produce dicoumarol, which induces vitamin K deficiency and a susceptibility to hemorrhaging in wounded animals. Because of this, moldy hay containing *Anthoxanthum* can be dangerous to grazing animals" (Allred ined.). Based on anatomy, the genus appears related to *Phalaris* and *Hierochloe* (Pizzolato 1984). Both of the following species are considered significant weeds by some authorities (Clayton & Renvoize 1986). The following treatment draws heavily on Allred (ined.). (Greek: *anthos*, flower, and *xanthos*, yellow, in reference to the color of the panicle after flowering—Watson & Dallwitz 1999) (subfamily Pooideae, tribe Poeae)
REFERENCES: Radford et al. 1968; Schouten & Veldkamp 1985; Hedberg 1990; Allred ined.

1. Plants annual; inflorescence 0.8–3(–4) cm long; ligule 1–2 mm long, obtuse to acute; leaf blades 1–3(–5) mm wide ____ **A. aristatum**
1. Plants perennial; inflorescence usually 5–8(–14) cm long; ligule 3–7 mm long, truncate; leaf blades 3–10 mm wide ____ **A. odoratum**

Anthoxanthum aristatum Boiss., (with a stiff awn or bristle), VERNAL GRASS, SMALL SWEET VERNAL GRASS. Annual 5–60 cm tall; inflorescence relatively looser than in *A. odoratum*; spikelets (excluding awns) (4–)5–9 mm long; awn of second lemma to 8 mm long; $2n = 10, 20$ (Allred ined.). Roadsides, weedy areas; included based on report of occurrence in East TX by S. Hatch (pers. comm.), inclusion in his 2002 checklist (Hatch 2002), and mapped location (Lee Co.) by Barkworth et al. (2002). However, we have seen no TX material of this species and only tentatively include it as a member of the East TX flora; no county distribution map is provided; widely scattered in Canada and U.S. except Great Plains and desert sw. Spring. Native to Europe.

Anthoxanthum odoratum L., (fragrant), SWEET VERNAL GRASS, LARGE SWEET VERNAL GRASS, SPRING GRASS. Perennial (10–)25–60(–100) cm tall; spikelets (excluding awns) 6–10 mm long; awn of second lemma to 9 mm long; $2n = 10, 20$ (Hedberg 1990; Allred ined.). Roadsides, weedy areas; Bowie (*Holmes & Singhurst 10002*—BAYLU) and Nacogdoches (*McCrary 73*—ASTC) cos.; widespread in Canada and U.S. except Great Plains and desert sw. Spring. Native to s Europe. This species has a strong sweet odor, due to coumarin (Watson & Dallwitz 1992; Mabberley 1997). It "was often included in hay and pasture mixes to give fragrance to the hay, but this practice is waning. The aroma is released upon wilting or drying. By itself, the species is unpalatable because of the bitter-tasting coumarin" (Allred ined.). While Burrows and Tyrl (2001) indicated that this species is potentially toxic, they noted that because of its scarcity, unpalatability, and low dicoumarol potential, it is not a major problem in North America. Both diploids and tetraploids are known (Hedberg 1990), but they cannot be distinguished morphologically.

ARISTIDA L. THREEAWN

Annuals or perennials; panicles open or contracted; spikelets 1-flowered, usually relatively long; glumes 1(–3)-veined; lemmas hardened, terete, linear, with a sharp-pointed callus at base, 3-awned; awn column present or absent; caryopsis permanently enclosed within the lemma.



Alopecurus carolinianus [HI1]



Alopecurus myosuroides [GLE, HI1]



Andropogon gerardii subsp. gerardii [GO1]



Andropogon glomeratus [USB]



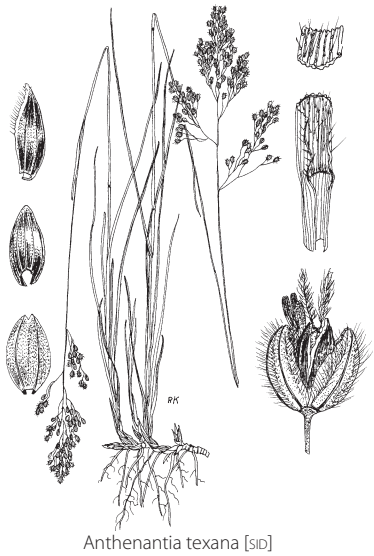
Andropogon gyrans var. gyrans [USB]



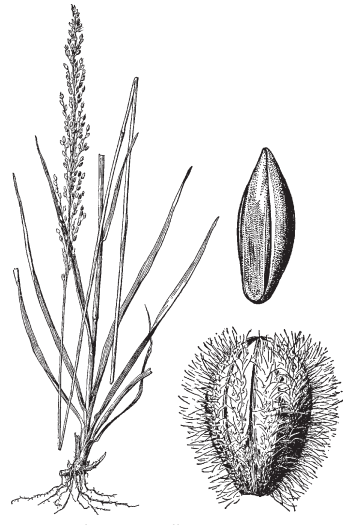
Andropogon ternarius [HI1]



Andropogon virginicus [REE]



Anthenantia texana [SID]



Anthenantia villosa [HI1]

A large homogeneous genus of 250–300 species found nearly throughout the world, but particularly frequent in warm, semi-arid environments (Allred & Valdés-Reyes 1995; Allred 2003d). The species are characterized by C_4 photosynthesis (Watson & Dallwitz 1992). "The divergent awns aid in wind and animal transportation of the florets and, by holding the florets and the caryopses they contain at an angle to the ground, in establishment" (Allred 2003d). However, according to Yatskievych (1999), the long awns reduce the value of the species as forage and can cause injuries to the noses, eyes, mouths, and intestines of grazers. In addition, the sharp calluses can be problematic for livestock and are irritating when in shoes and socks. *Aristida* species are "notorious for their taxonomic difficulty" (Allred & Valdés-Reyes 1995). (Latin: *arista*, a beard or awn) (subfamily Aristidoideae, tribe Aristideae)

REFERENCES: Hitchcock 1924, 1935; Holmgren & Holmgren 1977; Allred 1984a, 1984b, 1985a, 1985b, 1986, 2003d; Sutherland 1986; Tucker 1990; Allred & Valdés-Reyes 1995.

1. Lateral awns of lemma much reduced, 1–2(–4) mm long, erect; central awn of lemma 3–8 mm long, deflexed, with a spiral coil at base like a corkscrew _____ **A. dichotoma**
1. Lateral awns of lemma usually well-developed, (2–)4 mm or more long (often much longer), erect to spreading, horizontal, or even deflexed; central awn of lemma (5–)10–36 mm long, deflexed to erect, without a spiral coil at base (but may have a semicircular bend) OR in 1 rare species (*A. basiramea*) with a spiral coil at base.
   2. Awns of lemma, at least central one, spirally coiled at base like a corkscrew OR with a distinct semicircular bend at base.
      3. Lemma (8–)14–25 mm long (to base of awn); lower glume 3–7-veined, 11–20 mm long, the upper glume longer, usually 16–25 mm long (including awn); lateral awns of lemma very short, 0–7 mm long _____ **A. ramosissima**
      3. Lemma 4–10 mm long (to base of awn); lower glume 1-veined, the glumes ± equal, 17 mm or less long (including awn); lateral awns of lemma 4–30(–35) mm long.
         4. Central and lateral awns of lemma ca. equal, 20–30(–35) mm long, the central awn with a semicircular bend at base; awn column with a well-defined joint at base, separating at the joint at maturity (check mature spikelets); glumes 10–17 mm long; culms (30–)45–80 cm tall _____ **A. desmantha**
         4. Central and lateral awns of lemma different in length, the lateral awns 4–10 mm long, the central awn 9–15 mm long, spirally coiled at base like a corkscrew; awn column not jointed basally and not separating at maturity; glumes ca. 8–12 mm long; culms 45 cm or less tall _____ **A. basiramea**
   2. Awns of lemma nearly straight or curved, but neither spirally coiled basally nor with a distinct semicircular bend.
      5. Lemma usually 16–28 mm long to base of awn; central and lateral awns ca. equal (laterals at least 3/4 as long as central); lower glume 3–7-veined _____ **A. oligantha**
      5. Lemma 15 mm or less long to base of awn; central and lateral awns ca. equal OR not so; lower glume 1–2-veined.
         6. Leaf sheaths (at least lower ones) lanate, the hairs cobwebby, kinked, and intertwined _____ **A. lanosa**
         6. Leaf sheaths not lanate, varying from glabrous to pilose, the hairs, if present, ± straight, not cobwebby, and usually appressed.
            7. Panicles open, at least the lower branches spreading.
               8. Awns of lemma 4–10+ cm long; upper glume usually 14–25 mm long; lemma 12–16 mm long (to base of awns) _____ **A. purpurea** var. **longiseta**
               8. Awns of lemma 3–4.5 cm long; upper glume usually 15 mm or less long; lemma usually 10–12 mm long (to base of awns) _____ **A. purpurea** var. **purpurea**
            7. Panicles contracted, the branches usually all stiffly appressed along the main axis.
               9. Lemma narrowing into a slender twisted awn column (sometimes called a beak) ca. 0.1 mm wide and 1–4 mm long _____ **A. purpurea** var. **nealleyi**

9. Lemma thick to base of awns (from 0.2 to 0.8 mm wide); awn column absent.
   10. Awns 4–10+ cm long _____ **A. purpurea** var. **longiseta**
   10. Awns 3.5 cm or less long.
      11. Plants annual, often much-branched basally, but base neither knotty nor thickened; leaf blades usually 0.5–1 mm wide; glumes about equal; central awn (1–)5–27(–36) mm long; lemma 2.5–10 mm long; lateral awns sometimes reduced and 1/2 or less the length of the central awn OR well-developed _____ **A. longespica**
      11. Plants perennial, from a knotty thickened base; leaf blades usually 1–3 mm wide (however, they can be involute and thus appear narrower); glumes about equal OR lower glume half to three-fourths as long as upper; central awn 15–40 mm long; lemma 5–15.5 mm long; lateral awns well-developed, at least 1/2 the length of the central awn.
         12. Lemma 11–15.5 mm long (to base of awns); lower glume 1/2–3/4 as long as the upper glume; species of dry calcareous habitats, known in East TX only from the Blackland Prairie _____ **A. purpurea** var. **wrightii**
         12. Lemma 5–9.2 mm long; lower glume slightly shorter to longer than the upper glume; species of sandy or moist habitats, widespread in East TX.
            13. Upper glume 5–8 mm long; lower glume 1-keeled (1–2 veined, but if 2-veined without a flat area between the keel and the second vein); anthers 1–1.5 mm long; species widespread in East TX _____ **A. purpurascens**
            13. Upper glume (7.5–)9–13.5 mm long; lower glume prominently 2-keeled (with a flat area between the 2 keels/veins); anthers ca. 3 mm long; species known in East TX only from Hardin, Newton, and Tyler cos. in the s part of the Pineywoods _____ **A. palustris**

Aristida basiramea Engelm. ex Vasey, (branching from base), FORK-TIP THREEAWN, FORKED THREEAWN. Annual to 45 cm tall; panicles contracted; glumes about equal, to 12 mm long including awn; lemma 8–9 mm long, the central awn 9–15 mm long, conspicuously spirally coiled, the lateral awns spreading, 4–10 mm long. Sandy soils; Dallas (BRIT), Bastrop, and Red River (Gould 1975b) cos., apparently known in TX only from these three counties (Gould 1975b); se Canada (Ont.) and c U.S., scattered further e. Aug–Oct. According to Allred (1986), this species is similar to *A. dichotoma* and could be treated as a variety of that species. The two are distinguished by *A. basiramea* having spreading lateral awns usually 4–10 mm long (vs. lateral awns erect, 1–2 mm long in *A. dichotoma*). While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

Aristida desmantha Trin. & Rupr., (with clustered flowers), CURLY THREEAWN, WESTERN TRIPLEAWN, WESTERN THREEAWN, SAND THREEAWN. Annual; leaf sheaths glabrous to lanate pubescent; panicles loosely contracted, 8–20 cm long; spikelets light yellowish or golden-brown; glumes 1-veined, awn-tipped, about equal, 10–17 mm long (including awn); lemma 7–10 mm long, the awns about equal, 2–3(–3.5) cm long, spreading; awn column jointed basally, well-defined. Sandy soils; widespread in e 1/2 of TX; also Trans-Pecos; AR, IL, LA, MO, NE, OK, and TX. Sep–Nov.

Aristida dichotoma Michx., (2-parted or forked), CHURCH-MOUSE THREEAWN, POVERTY GRASS, PIGBUTT THREEAWN. Annual 15–60(–75) cm tall; inflorescence a contracted panicle or spike-like raceme; glumes about equal or the upper glume longer; lemma 4–6 mm long, rarely longer; central lemma awn 3–8 mm long, spirally coiled basally; lateral lemma awns 1–2(–4) mm long, erect. Sandy soils; Bastrop, Dallas, Grayson, Lamar (BRIT), Bowie, Brazos, Freestone, Red River, St. Augustine, and Travis (Turner et al. 2003) cos.; also e Edwards Plateau and Brazoria Co.

(Turner et al. 2003) in the Gulf Prairies and Marshes; se Canada (s Ont.) and widespread in the e 1/2 of the U.S. Aug–Nov.

Aristida lanosa Muhl. ex Elliott, (woolly), WOOLLY-SHEATH THREEAWN, WOOLLY TRIPLEAWN GRASS, WOOLLY THREEAWN. Perennial to ca. 1.2(–1.5) m tall; leaf sheaths (at least lower ones) lanate, the hairs cobwebby, kinked, and intertwined; panicles with appressed or somewhat spreading branches, the nodes lanate; glumes subequal, 9–15(–18) mm long including the awn when present; lemma (6.5–)8–9(–10) mm long, without a well-defined awn column; lemma awns only curved below, the central awn 12–28(–32) mm long, the lateral awns 7–17 mm long. Openings in woods, often in sandy soils; widespread in Pineywoods and Post Oak Savannah w to Montague (BRIT) (in Cross Timbers and Prairies) and Bastrop (Turner et al. 2003) cos.; se U.S. from NJ s to FL w to MO, OK, and TX. Late Aug–Nov. This species is similar in appearance to *A. desmantha,* which also has lanate leaf sheaths. However, *A. desmantha* has lemma awns with a semicircular bend and a distinct awn column well-differentiated from the lemma. Wipff (2003f) indicated that *A. lanosa* "is sometimes confused with *A. palustris*, but differs in several reproductive, vegetative, and habitat characteristics"—e.g., *A. palustris* has glabrous leaf sheaths and glabrous inflorescence nodes and typically occurs in bogs or other moist to wet areas.

Aristida longespica Poir., (long-spiked), SLIM-SPIKE THREEAWN, RED THREEAWN. Annual; culms slender, often geniculate (= bent abruptly) at base, to 65 cm long; leaves not in a conspicuous basal tuft; panicles contracted, narrow and spike-like; glumes about equal, (3–)4–9(–11) mm long; central lemma awn erect to reflexed. Two varieties, not always easily distinguished, occur in East TX; Allred (1986) noted that intermediates between the 2 are not uncommon, but since the extremes are so strikingly different, distinction at the varietal level seems appropriate. Sandy open areas. Late Aug–Dec.

1. Lemma usually (3.5–)7–10 mm long; central lemma awn usually (8–)12–27(–36) mm long; lateral awns usually 2/3–3/4 as long as central, usually 6–18 mm long _____ var. **geniculata**
1. Lemma usually 2.5–7 mm long; central lemma awn usually (1–)5–10(–15) mm long; lateral awns much shorter, usually 1/3–slightly more than 1/2 as long as central, usually (0–)2–5(–8) mm long _____ var. **longespica**

var. **geniculata** (Raf.) Fernald, (jointed), KEARNEY'S THREEAWN, PLAINS THREEAWN. Widespread in e 1/2 of TX; se Canada (Ont.) and e 1/2 U.S. from NH to FL w to SD and TX. Aug–Dec. [*A. intermedia* Scribn. & C.R. Ball]

var. **longespica**. SLIM-SPIKE THREEAWN, SLENDER THREEAWN. Pineywoods and Gulf Prairies and Marshes w to West Cross Timbers; se Canada (Ont.) and e 1/2 U.S. from NY to FL w to MN and TX, also AZ and WA.

Aristida oligantha Michx., (few-flowered), OLDFIELD THREEAWN, PRAIRIE THREEAWN, FEW-FLOWER ARISTIDA. Annual; inflorescence few-flowered, spicate or less often paniculate; glumes subequal, 18–25 mm long, the second with an awn to 1 cm long; lemma usually 16–28 mm long, the awns about equal, usually 3–7 cm long. Calcareous or sandy soils, fields, wasteplaces, and roadsides; widespread in e 1/2 of TX; Hatch (2002) cited all 10 vegetational areas; widespread in e 1/2 of U.S., scattered in w U.S. and s Canada. Jun–Nov. This species apparently has allelopathic effects on other plants. It is also often seen growing on seed harvester ant mounds (J. Stanford, pers. comm.).

Aristida palustris (Chapm.) Vasey., (marsh-loving), LONG-LEAF THREEAWN. Tufted perennial similar to *A. lanosa* but with glabrous leaf sheaths; culms 0.75–1.5 m tall; panicles narrow; glumes (7.5–)9–13.5 mm long, slightly unequal, the second very slightly longer than the first, the awns only 1–2 mm long; lemma 6–9.2 mm long, the awns unequal, the central awn 1.5–4 cm long, the lateral awns (0.8–)1–3.5 cm long. Margins of marshes, seeps, bogs, and other moist to wet areas; the only East TX records known to us are from Hardin (*McRoberts & McRoberts 3664*,

BRIT), Newton (*Carr 18418*, BRIT), and Tyler (MacRoberts et al. 2002a) cos. in the s part of the Pineywoods; se U.S. from VA s to FL w to e TX. [*A. affinis* of authors, not (Schultes) Kunth] While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

Aristida purpurascens Poir., (purplish or turning purple), ARROW-FEATHER THREEAWN, BROOM-SEDGE, ARROW GRASS. Tufted perennial from a knotty, thickened base, buds and short curving-erect rhizomes usually present; culms to 2(–4) mm in diam., to 1 m tall; basal leaves persistent after drying, often curly; panicles narrow, contracted; lemma 5–8 mm long, purple or mottled with purple at maturity, with central awn 15–30 mm long, more spreading than the lateral awns; lateral awns 2–10 mm shorter than central. Similar to *A. longespica* except *A. purpurascens* is perennial. The county distribution map does not distinguish varieties. The following key is adapted from Allred (1986).

1. Central and lateral lemma awns spreading, straight or slightly contorted but not reflexed, all about the same thickness at the base; glumes usually of different lengths, the lower usually longer than the upper, 6–10 mm long, the upper glume 5–8 mm long _____ var. **purpurascens**
1. Central lemma awn divaricate (= very widely spreading) to reflexed, about twice as thick at the base as the erect lateral awns; glumes ± equal or the lower slightly longer, both 6–7 mm long ___ var. **virgata**

var. **purpurascens**. Woods openings, borders, and prairies, usually on sandy soils; Pineywoods and Gulf Prairies and Marshes w to Blackland Prairie, also e Edwards Plateau; se Canada (Ont.) and e U.S. from NY to FL w to NE and TX. Aug–Nov.

var. **virgata** (Trin.) Allred, (wand-like). Sandy prairies, openings in sandy pinelands, bogs, or waste places, generally in moist or wet areas; Angelina (*Brown 9410*, BRIT), Hardin, and Jasper (SBSC) cos. in the Pineywoods; a Titus Co. collection (*Smith 710*, BRIT) may be var. *virgata* but is ambiguous; also Gulf Prairies and Marshes; e U.S. from NJ s to FL w to TX. This taxon has sometimes been recognized as a distinct species (e.g., Correll & Johnston 1970; Hatch et al. 1990), while some authorities (e.g., Gould 1975b; Hatch 2002) submerged it into an undivided *A. purpurascens*. Allred (1984a) indicated that when compared with *A. purpurascens*, there is significant morphological intergradation and only one species is involved. He later (1986) recognized *A. virgata* as a variety. However, the two varieties intergrade (Allred 2003d) and are difficult to distinguish. Allred (1984a), for example, indicated that sometimes an individual of *A. purpurascens* may have spikelets corresponding to more than one variety. While we are following Allred (1984a, 1986, 2003d) and Kartesz (1999) in recognizing var. *virgata*, it is possible that this variety does not deserve formal recognition.

Aristida purpurea Nutt., (purple), PURPLE THREEAWN. Perennial; panicles open or contracted. A highly variable species, with a number of the varieties having been treated as separate species in the past. Turner et al. (2003) recognized two species in this complex (*A. purpurea* including var. *longiseta* and *A. glauca* [our var. *nealleyi*] including var. *wrightii*). Because of extensive intergradation, we are following most recent authors (e.g., Holmgren & Holmgren 1977; Allred 1984b, 2003d; Sutherland 1986; Kartesz 1994, 1999; Hatch 2002) in treating the taxa as varieties of *A. purpurea*. Most plants may be separated by the characters given in the key to species and varieties. This is the most widespread and probably the most abundant *Aristida* species in TX. The county distribution map does not distinguish varieties.

var. **longiseta** (Steud.) Vasey, (long-bristled), RED THREEAWN, DOGTOWN GRASS, LONG-AWNED ARISTIDA, LONG-AWNED THREEAWN. Panicles contracted or open; glumes unequal, the first 0.5–0.6 the length of the second, the second 14–25 mm long; lemma 12–16 mm long, 0.3–0.8 mm wide at apex; lemma awns about equal, very long, 4–10 cm long, rarely longer. Disturbed sites; mainly Blackland Prairie s and w through w 3/4 of TX; sw Canada and w 1/2 of U.S. e to MN and LA. Mar–Dec. [*A. longiseta* Steud., *A. reverchonii* Vasey] This is the most variable variety of

A. purpurea; however, "the length of its glumes, the width of its lemma apex, and the length and thickness of its awns distinguish it from all the other varieties" (Allred 2003d). Allred (2003d) noted that the callus and awns are particularly problematic for sheep and cattle.

var. **nealleyi** (Vasey) Allred, (for Greenleaf Alley Nealley, 1864–1896, botanist), BLUE THREEAWN, NEALLEY'S THREEAWN. Panicles contracted; glumes unequal, the lower glume about half as long as upper; lemma 7–12(–13) mm long, usually slightly (1–3 mm) longer than upper glume, narrowing to ca. 0.1 mm wide, the lemma apex twisted into awn column 1–4 mm long; lemma awns slightly unequal, 15–20(–30) mm long. Grasslands on rocky, usually limestone soils; Travis Co. (BRIT; Carr 2002a**)** near w margin of East TX; w 2/3 of TX; mainly sw U.S. from KS and TX w to CA, also IL and VT. May–Oct. [*A. glauca* (Nees) Walp.] Turner et al. (2003) combined this taxon and *A. purpurea* var. *wrightii* and treated them as *A. glauca*. However, we are following the recent treatment in *Flora of North America* (Allred 2003d) in recognizing them as varieties of *A. purpurea*. According to Allred (2003d), "Although var. *nealleyi* is more distinct than the other varieties, having tight tufts of foliage exceeded by narrow, straw-colored panicles, it grades into var. *purpurea*, and the panicles resemble those of var. *wrightii*."

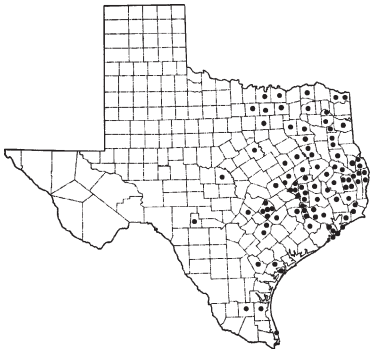
var. **purpurea**, (purple), PURPLE THREEAWN, PURPLE NEEDLE GRASS. Panicles open, curving, the branches flexuous; glumes unequal, the second 11–15 mm long, to twice the length of the first; lemma usually 10–12 mm long, narrowing to 0.1–0.3 mm wide at apex; lemma awns about equal, 3–4.5 cm long. Sandy or rocky soils; Post Oak Savannah s and w through much of w 3/4 of TX; sw U.S. from AR and LA w to CA. Apr–Oct.

var. **wrightii** (Nash) Allred, (for Charles Wright, 1811–1885, TX plant collector), WRIGHT'S THREEAWN, WRIGHT'S TRIPLEAWN GRASS. Panicles contracted; glumes unequal, the second 11–15 mm long, the first 0.5–0.75 as long as second; lemma equaling or exceeding upper glume, usually 11–15.5 mm long, narrowing to 0.2–0.3 mm wide at apex; lemma awns about equal, 15–30 mm long, the central occasionally longer than laterals. Calcareous soils; Blackland Prairie s and w through much of w 3/4 of TX; sw U.S. from OK and TX w to CA. May–Oct. [*A. wrightii* Nash] According to Allred (2003d), "It is the most robust variety of *A. purpurea*, and has dark, stout awns and long panicles. It may be confused with var. *nealleyi*, which has narrower lemmas and awns and a light-colored panicle, but it also intergrades with var. *purpurea* ..."

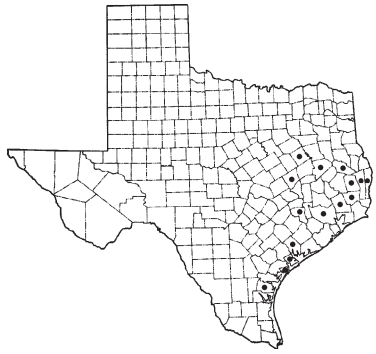
Aristida ramosissima Engelm. ex A. Gray, (much-branched), S-CURVE THREEAWN. Annual, much-branched, similar to *A. oligantha* (inflorescence few-flowered; spikelets large); lower glume 11–20 mm long, upper glume usually 16–25 mm long, including 3–7 mm long awn; lemma (8–)14–25 mm long; central lemma awn 9–28 mm long, with a semicircular bend at base; lateral lemma awns very short, 0–7 mm long, erect or nearly so. Sandy soils; roadsides, fields, open dry areas; Robertson, Van Zandt (BRIT), and Freestone (Turner et al. 2003) cos. in the Post Oak Savannah; rare in TX (e.g., Gould 1975 indicated that he had seen no TX collections); also reported for the Pineywoods and Edwards Plateau by Hatch (2002); c U.S. from IN to IA s to LA and TX. Late summer–fall. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

ARTHRAXON P. Beauv. CARP GRASS

A genus of 7 species (Thieret 2003c) of small grasses native to tropical and subtropical areas of the Old World. Like all members of the Andropogoneae, it is characterized by C_4 photosyn thesis (Watson & Dallwitz 1999; Kellogg 2000a). While monophyletic, delimitation of species within the genus is "quite difficult" (van Welzen 1993). "The spikelets break off easily and remain stuck to clothes and hair..." (van Welzen 1993). (Greek: *arthron*, joint, and *axon*, axis, in reference to the jointed inflorescence axis) (subfamily Panicoideae, tribe Andropogoneae)
REFERENCES: Kiger 1971; van Welzen 1981, 1993; Brown & Schultz 1991; Thieret 2003c.



Andropogon virginicus



Anthenantia texana



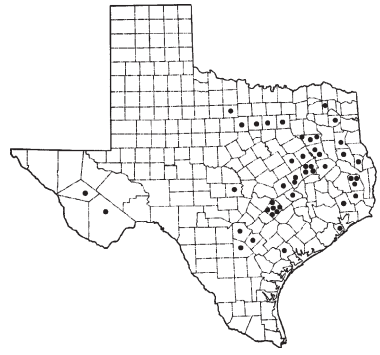
Anthenantia villosa



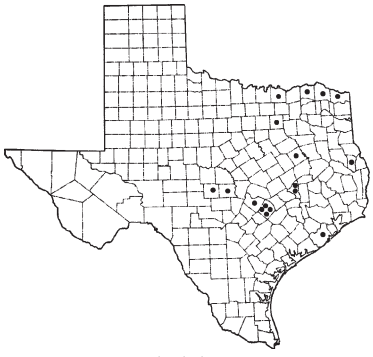
Anthoxanthum odoratum



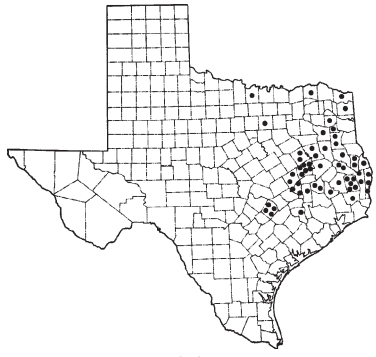
Aristida basiramea



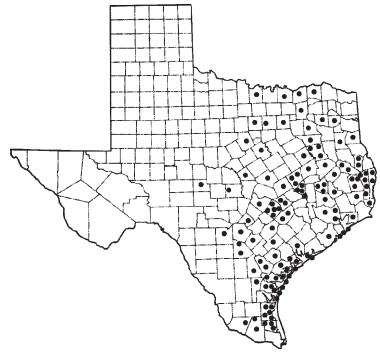
Aristida desmantha



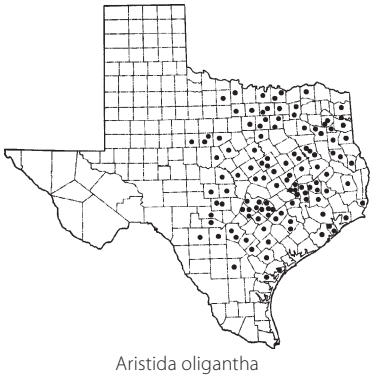
Aristida dichotoma



Aristida lanosa



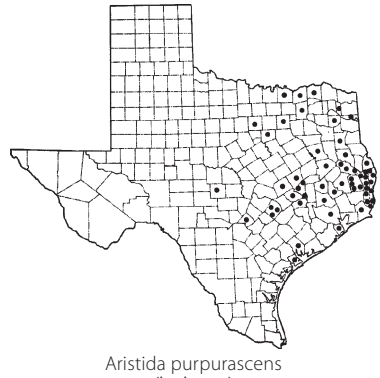
Aristida longespica
(both vars.)



Aristida oligantha



Aristida palustris



Aristida purpurascens
(both vars.)

Arthraxon hispidus (Thunb.) Makino, (hairy, bristly), SMALL CARP GRASS, JOINT-HEAD. Low annual; culms to 80(–100) cm long (rarely longer), creeping and rooting at lower nodes, glabrous; leaf blades lanceolate to ovate, 4–15(–20) mm wide, cordate-clasping; leaf sheaths hispid; ligule ciliate, ca. 1–3 mm long; racemes ca. 2–7 cm long, spike-like, usually 2–11(–15) in a digitate cluster; spikelets sessile, perfect, solitary (or in pairs—if pedicellate spikelet present, this sterile or reduced to a pedicel); disarticulation so that sessile spikelet falls with associated pedicel (if present) and section of the inflorescence branch; sessile spikelets 2–5 mm long, with 2 florets; glumes 2, equal, coarser in texture than membranous lemmas; lower floret sterile, awnless; upper (fertile) lemma awnless or with an awn to 7(–10) mm long, the awn attached anywhere from near the midpoint to the base of the midvein; palea absent. Moist areas, ditches, open places; Cass Co. (Brown & Schultz 1991—the first collection reported for TX); e U.S. from NY s to FL w to KS and TX; first collected in the U.S. in PA in 1877 (Kiger 1971). Fall. Native of Asia. [*A. ciliaris* P. Beauv., *A. cryptatherus* var. *ciliaris* (P. Beauv.) Koidz., *A. hispidus* subsp. *ciliaris* (P. Beauv.) Masam. & Yanagih.] According to Thieret (2003c), plants in the U.S. belong to var. *hispidus*, "the most widespread and variable of the four varieties." This species is used medicinally in China, and it is the source of a yellow dye (Mabberley 1997).

ARUNDINARIA Michx. CANE

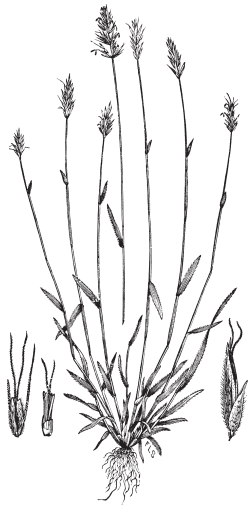
A C_3 n temperate genus of ca. 50 species (Tucker 1988; Watson & Dallwitz 1992) of BAMBOOS ranging from n India to China and Japan, with only 1 species native to the New World—*A. gigantea*, endemic to the se U.S. However, there is considerable disagreement over which Asian species should be included (Clark ined.), and therefore uncertainty in the number of species in the genus. Some species are used for fishing rods, umbrella shafts, and furniture, while others are cultivated as ornamentals or used in bonsai (Watson & Dallwitz 1992). (Latin: *arundo*, a reed) (subfamily Bambusoideae, tribe Bambuseae)

REFERENCES: McClure 1963, 1973; Haubrich 1980; Tucker 1988; Platt & Brantley 1997; Judziewicz et al. 1999; Grass Phylogeny Working Group 2000; Clark ined.

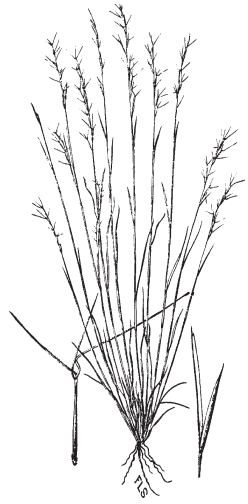
Arundinaria gigantea (Walter) Muhl., (gigantic), GIANT CANE, SOUTHERN CANE, SWITCH CANE, BAMBOO. Much-branched, woody, evergreen perennial (0.5–)2–5(–8) m or more tall from a usually solid rhizome; culms rounded, to ca. 3 cm in diam., the upper nodes often puberulent; branches 3–6 per node; leaves variable, the lower often reduced; ligule a firm membrane 1.5 mm or less long; leaf blades abruptly narrowed to a joint-like connection to the leaf sheaths; upper leaf blades usually 15–25(–30) cm long, 2–4(–5.5) cm wide; inflorescences racemose or narrowly paniculate; spikelets 1–few, large, 4–7(–8) cm long, ca. 8 mm broad, with 6–12(–13) florets, greenish or brownish; lemmas (10–)15–25 mm long, usually with pubescence. Moist woods or low areas, can form dense, nearly monocultural stands known as canebrakes (previously sometimes spelled canebreaks); Pineywoods and Post Oak Savannah w to Robertson Co. (Turner et al. 2003) and to at least Lamar Co. (BRIT) in Red River drainage; Turner et al. (2003) also mapped a Grayson Co. location even further w in Red River drainage; also n Gulf Prairies and Marshes; Hatch (2002) also cited the Edwards Plateau and Trans-Pecos; e U.S. from OH to FL w to KS and TX. Mostly Apr–May. This is the only native bamboo species in TX. It was used by Native Americans and others for such things as construction material, baskets, mats, pipestems, weapons, fishing poles, and food (cooked young shoots and fruits) (Platt & Brantley 1997; Yatskievych 1999). According to Yatskievych (1999), "The species is propagated mostly by rhizome fragments that are transported by water. ... Reports of the species' life cycle are conflicting, ranging from an annual flowering cycle to flowering every 30–40 years, and from mortality of the plant following flowering, to none of the die-off that is typical of most bamboos. Plants cultivated in St. Louis County [MO] flowered annually from 1993 to 1996 with no evidence of decline of existing stems." Gould (1975b), however, reported that the plants flower only at intervals of 4–6 years. Canebrakes were once extensive in alluvial floodplains, were a dominant



Anthoxanthum aristatum [BB2]



Anthoxanthum odoratum [USB]



Aristida basiramea [USB]



Aristida desmantha [USB]



Aristida dichotoma [USB]



Aristida lanosa [USB]



Aristida longespica var. geniculata [GO1]



Aristida longespica var. longespica [HI1]



Aristida oligantha [USB]

feature of the frontier landscape, and were valued by settlers for livestock grazing (Holley 1836; Ikin 1841; Kennedy 1841; Platt & Brantley 1997). GIANT CANE "formerly covered many square miles in east and southeast Texas but with the introduction of domestic stock it has almost disappeared. ..." (Correll & Johnston 1970). According to Holley (1836), "The cane-brakes are of immense extent, especially on Cane-brake creek. On this creek there is an uninterrupted canebrake, seventy-five miles long, and from one to three miles wide." It has been suggested that such large canebrakes "probably originated when Indian agriculture was greatly curtailed following population declines caused by introduced European diseases" and that floodplain fields abandoned by Indians were probably rapidly invaded by giant cane (Platt & Brantley 1997). The species is considered to have two subspecies which "represent opposite extremes of variation within a single, polymorphic species, with much intermediate variation" (Clark ined.). Texas plants belong to subsp. *gigantea*, versus the more easterly subsp. *tecta* (Walter) McClure. Subspecies *tecta* can be distinguished using the following characters: rhizomes with hollow centers, spikelets 3–5 cm long, usually somewhat reddish-purple, and lemmas glabrous or nearly so (Clark ined.). ⊠/276

ARUNDO L. GIANT REED

A C_3 genus of 3 species (Allred 2003b) native from the Mediterranean to Taiwan and widely introduced elsewhere. (Latin: *arundo*, a reed) (subfamily Arundinoideae, tribe Arundineae)
REFERENCES: Tucker 1990; Allred 2003b.

Arundo donax L., (classical name), GIANT REED. Perennial, rhizomatous; extremely large, the culms 2–6+ m tall, usually unbranched; ligule 1 mm or less long; leaf blades usually 4–7 cm wide on main culms, somewhat auricled and ± clasping, with a wedge-shaped brown area at base; panicles 30–60 cm long; branchlets and rachilla joints essentially glabrous; spikelets usually with 2–4 florets, 10–15 mm long; rachilla glabrous; glumes glabrous, subequal, as long as entire spikelet; lemmas densely hairy. Ditches, roadsides, and field margins, typically in wet areas, usually tight, clay soils; apparently not setting fertile seed in TX, spreading vegetatively (by pieces of rhizome scattered by road equipment, water, etc.) and sometimes forming large, dense, conspicuous colonies; widely scattered in TX, particularly in the e and s portions of the state; s 1/2 of the U.S. from MD to FL w to CA. Mostly Sep–Nov. Native to Mediterranean region. This is the "reed" of the Bible and has been used for 5,000 years for musical instruments (Mabberley 1987). The stems are the source of the reeds of woodwind instruments, and in its native range it is used for building materials, mats, lattice-work, screens, stakes, walking sticks, fishing poles, and paper pulp (Clayton & Renvoize 1986; Yatskievych 1999; Allred 2003b). It can, however, be a significant weed species. It is sometimes confused with *Arundinaria gigantea* (GIANT CANE), which can be distinguished vegetatively by its much-branched stems and leaf blades abruptly narrowed to a joint-like connection to the leaf sheath. *Arundo* is also similar to *Phragmites*, but *Phragmites* lacks the wedge-shaped, light to dark brown area at the base of the blades seen in *Arundo* (Allred 2003b). *Arundo* also usually has panicles erect even with age, while those of *Phragmites* often droop. The culms of *Arundo* die back to the ground if winter weather is cold; however, during mild winters they can survive in East TX. There are cultivars with striped or very wide leaves (Allred 2003b). ☜

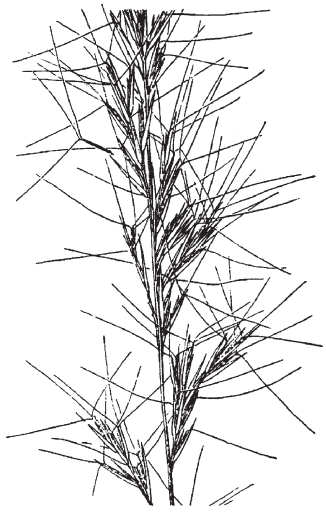
AVENA L. OAT

Erect annuals 30–120(–160) cm tall; ligule a whitish membrane 2–4 mm long; inflorescence an open panicle of ca. 8–30 large, pendulous spikelets; spikelets (1–)2(–4)-flowered; glumes 18–32 mm long, longer than the lemmas, acute to acuminate; lemmas 14–19 mm long, awned from near middle of the back or awnless.

A mainly temperate Old World C_3 genus of 29 species (Baum ined.) ranging from Europe to North Africa and c Asia. Polyploidy is important in the genus, with tetraploids and hexaploids



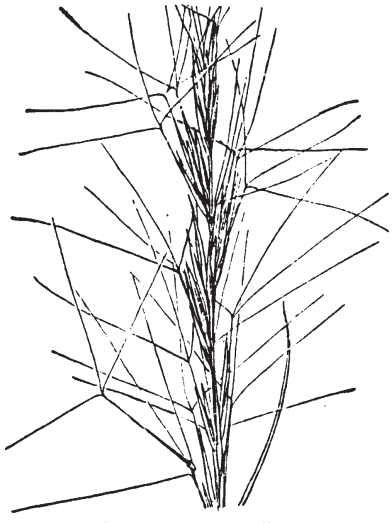
Aristida palustris [USB]



Aristida purpurascens var. virgata [HI1]



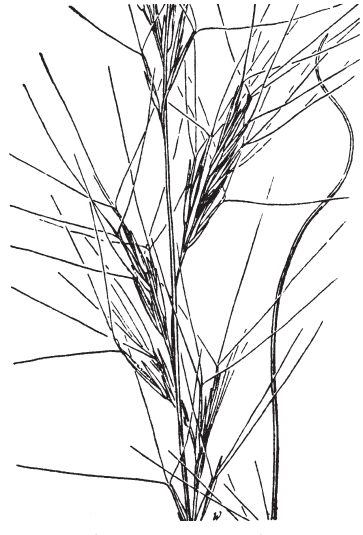
Aristida purpurea var. longiseta [GO1]



Aristida purpurea var. nealleyi [GO1]



Aristida purpurea var. purpurea [GO1]



Aristida purpurea var. wrightii [HI1]



Aristida ramosissima [HI1]



Arthraxon hispidus [HI1, RAD]



Arundinaria gigantea [SCB]

being common (Coffman 1977). A number of species are significant weeds, while OAT (*A. sativa*) is important as a grain and as animal fodder (Tucker 1996). ⊘ *Avena sterilis* L., ANIMATED OAT, native to Europe and introduced into the U.S. in CA, OR, and PA, is considered a U.S. federal noxious weed (Kartesz 1999; USDA Natural Resources Conservation Service 2002). (Classical Latin name, *avena*, oat, possibly from Latin: *aveo*, to desire, as in a forage desired by many animals—Coffman 1977) (subfamily Pooideae, tribe Poeae)

REFERENCES: Stanton 1952; Sampson 1954; Baum 1968a, 1968b, 1969, 1977, ined.; Coffman 1977; Sharma & Vanden Born 1978; Zohary & Hopf 1994; Tucker 1996.

1. Awn of lemmas geniculate, mostly 2.5–4.2 cm long; lemmas with stiff, usually reddish brown hairs on dorsal surface; florets disarticulating from the glumes _____ **A. fatua**
1. Awn of lemmas usually not geniculate, irregularly developed, < 3 cm long or absent; lemmas usually glabrous or nearly so; florets not disarticulating from the glumes, even at maturity _____ **A. sativa**

Avena fatua L., (false or foolish, without value). WILD OAT, OAT GRASS, POOR OAT. Spikelets 18–32 mm long; florets usually 2(–4), if more than 2, then the uppermost typically reduced and sterile lemma awns conspicuous and geniculate, those of the upper and lower florets subequal. Roadsides and other disturbed areas, abundant in some places; Brazos and Nacogdoches (BRIT) cos.; scattered in e 1/2 of TX; throughout most of Canada and most of the U.S. Mostly Apr–May. Native to Europe and c Asia. The pointed callus of the fruit is reported to cause mechanical injuries to livestock (Burlage 1968). This taxon is considered by some sources to be among the world's worst weeds (e.g., Holm et al. 1977). It is referred to as "the most serious annual weed of cultivated fields in the prairie provinces of Canada" (Sharma & Vanden Born 1978) and is considered to be a noxious weed in OK (Kartesz 1999). However, in other areas it is used for hay, as a range grass, and in animal feed. It is thought to have been "introduced into North America by early European settlers as impurities in seeds and feed" (Sharma & Vanden Born 1978). Material of *A. fatua* was found in a California mission in an adobe brick thought to have been made about 1805–1813, thus showing its introduction by early Spaniards (Hendry & Kelly 1925). This species hybridizes with *A. sativa*. According to Baum (ined.), the "hybrids resemble *A. sativa*, but differ in having the *fatua*-type lodicule; some also have a weak awn on the first lemma." The taxonomy of this and the following species is controversial. The two have been treated as either varieties of *A. fatua* (e.g., Correll & Johnston 1970; Jones et al. 1997; Yatskievych 1999; Hatch 2002) or separate species (Sampson 1954; Diggs et al. 1999; Kartesz 1999; Baum ined.), and the level at which to recognize them seems somewhat arbitrary. It can be argued that since *A. fatua* is apparently involved in the ancestry of *A. sativa* (Zohary & Hopf 1994), recognition at the level of variety or subspecies is most appropriate. However, there is little agreement among taxonomists about the appropriate rank to use in the case of cultivated species and their ancestors—some authorities use varieties, others subspecies, yet others species. We are following Baum (ined., in the forthcoming *Flora of North America* treatment), the recognized North American authority on the genus, in treating the two *Avena* taxa at the rank of species. ⊘

Avena sativa L., (cultivated), COMMON OAT, CULTIVATED OAT. Spikelets usually ca. 25–30 mm long; florets usually (1–)2(–3); lemma awns often absent, if present, < 3 cm long and the awn of the upper floret much shorter than that of the lower floret or lacking. Commonly cultivated for grain, often planted to prevent erosion on newly graded roadsides, also naturalized and common as a weed on roadsides and other disturbed areas; scattered throughout TX; throughout most of Canada and the U.S. Mostly Mar–Jun. Native of Eurasia, where it has long been a cultivated cereal crop. [*A. byzantina* K. Koch, *A. fatua* L. var. *sativa* (L.) Hausskn.] OAT is thought to be a later domesticate than WHEAT. This hexaploid probably evolved from weeds invading the fields of early WHEAT and BARLEY farmers (Heiser 1990; Zohary & Hopf 1994). In the archaeological record, it first appears as a weed in the Middle East; however, it is well-adapted to the colder damp climate of nw Europe, and as agriculture spread northward it was domesticated there ca. 2,000 BC (Sampson 1954; Clayton & Renvoize 1986). The species was probably intro-

duced to the U.S. by the Spanish (as food for their horses) ca. 400 years ago (Coffman 1977). It is one of the most nutritious of the cereals, having a high protein content. The use of oat in various forms (e.g., oatmeal, granola) increased in the 1980s based on information that eating oat bran reduces cholesterol levels in humans (Heiser 1990). It was considered in the past by some authorities to be the world's fourth most important cereal crop (Stanton 1953; Sampson 1954). Photosensitization, nitrate intoxication (resulting from high nitrate concentrations), and fungal contamination can result in the loss of cattle and horses upon ingesting OAT hay (Lewis & Elvin-Lewis 1977; Burrows & Tyrl 2001).

AXONOPUS P. Beauv. CARPET GRASS

Stoloniferous or cespitose perennials (our species), often forming carpets; culms compressed; ligule a minute membrane (1 mm or less long) or nearly absent; leaves essentially glabrous, the blades usually obtuse or rounded apically; inflorescence of 2–7 slender, spike-like branches, the terminal two paired; spikelets solitary at the nodes, nearly sessile, in two rows on a ± triangular-flattened, slightly winged axis, oblong-elliptic, dorsally compressed, oriented so that back of lemma of fertile floret is away from axis (adaxial orientation—see discussion below), disarticulating below the glumes; florets awnless, 2 per spikelet, the lower floret sterile or staminate, the upper floret perfect; lower (first) glume absent; upper glume and lemma of sterile floret ± equal; lemma of fertile floret firm with inrolled margins; palea of sterile floret absent.

A genus of ca. 100 species (Barkworth 2003h) characterized by C_4 photosynthesis. It is predominantly found in the American tropics, with a few species extending into the American subtropics and the Old World tropics (Davidse 1987b); the center of diversity is in central Brazil (Hickenbick et al. 1975). "All the species tend to grow in open habitats, often where the soil is somewhat impermeable and slightly flooded in the rainy season" (Barkworth 2003h). The genus is very similar to *Paspalum*, differing primarily in the orientation of the spikelets relative to the inflorescence axis (abaxial in *Paspalum*, adaxial in *Axonopus*—i.e., with the back of the upper glume facing away from the inflorescence axis) (Davidse 1987b; Crins 1991). *Axonopus* is also superficially similar to *Digitaria* but differs in spikelet orientation and in having a single spikelet (vs. paired in *Digitaria*) at each node of the inflorescence (Pohl 1980; Crins 1991). This member of the tribe Paniceae is further characterized by having spikelets lacking the lower glume as well as the palea of the lower floret (Davidse 1987b). Extensive polyploidy is known in the genus (Hickenbick et al. 1975). (Greek: *axon*, axis, and *pous*, foot, presumably from the creeping, carpet-forming habit) (subfamily Panicoideae, tribe Paniceae)

REFERENCES: Chase 1938; Black 1963; Hickenbick et al. 1975; Davidse 1987b; Crins 1991; Barkworth 2003h.

1. Spikelets (3.5–)4–5(–6) mm long, ca. 1.5 mm wide, glabrous; upper (only glume since lower glume is absent in *Axonopus*) glume and lemma of sterile floret with mid-vein usually visible at 10x magnification; culms near plant base ca. 2–4 mm wide in widest dimension _____ **A. furcatus**
1. Spikelets 1.7–3(–3.5) mm long, 0.7–1.1 mm wide, often with appressed silky hairs; upper glume and lemma of sterile floret with mid-vein usually inconspicuous even at 10x magnification; culms near plant base ca. 2 mm or less wide in widest dimension.
   2. Spikelets (2.2–)2.5–3(–3.5) mm long, 0.9–1.1 mm wide, apically pointed, the lemma of sterile floret and upper glume extending beyond the fertile floret, forming the ± distinct point; leaf blades 3–10(–20) mm wide _____ **A. compressus**
   2. Spikelets 1.7–2.2(–2.6) mm long, 0.7–0.9 mm wide, apically rather blunt, the lemma of sterile floret and glume usually not pointed beyond the fertile floret or only slightly so; leaf blades 1.5–6 mm wide _____ **A. fissifolius**

Axonopus compressus (Sw.) Beauv., (flattened), BROAD-LEAF CARPET GRASS, CARPET GRASS, COMMON CARPET GRASS, TROPICAL CARPET GRASS. Perennial, forming carpets but the flower-bearing culms erect; culms 20–50(–80) cm long, the nodes appressed-pubescent; leaf blades to ca. 25 cm

long, shorter on stolons, 3–10(–20) mm wide; inflorescence branches 1–13 cm long; spikelets (2.2–)2.5–3(–3.5) mm long, acuminate. Moist sandy areas, disturbed places; scattered in s 1/2 of East TX in Anderson, Bastrop, Brazos, Gonzales, Grimes, Milam, Montgomery, Newton (TAES—annotated by S. Hatch), and Robertson (Turner et al. 2003) cos.; also n Gulf Prairies and Marshes; se U.S. from SC s to FL w to TX. May–Nov. [*Anastrophus compressus* (Sw.) Schltdl. ex Döll, *Milium compressum* Sw.] This species is used for lawns in the humid tropics (Clayton & Renvoize 1986) and is also sometimes cultivated as a fodder. In other circumstances, it is considered a significant weed (Watson & Dallwitz 1992), and it is included by some authorities among the world's worst weeds (Holm et al. 1977).

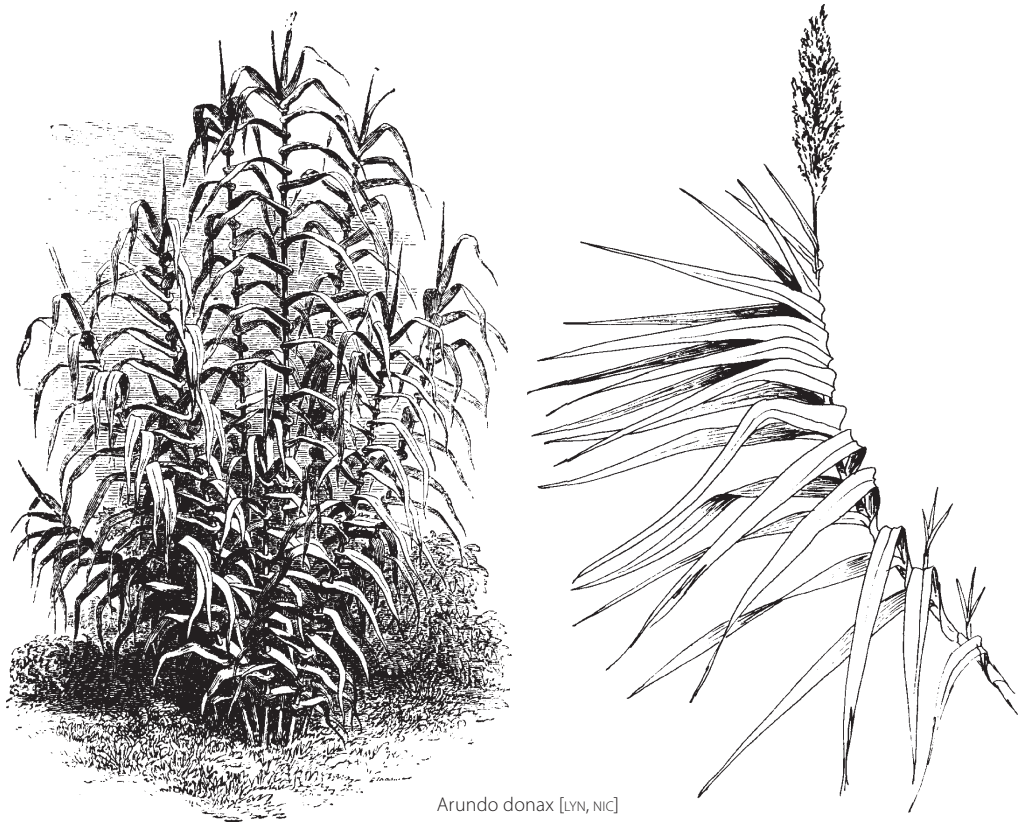
Axonopus fissifolius (Raddi) Kuhlm., (split-leaved), COMMON CARPET GRASS, NARROW-LEAF CARPET GRASS. Perennial, forming carpets but the flower-bearing culms erect to ascending; culms 20–35(–75) cm long, the nodes glabrous or minutely puberulent; leaf blades 6–17(–28) cm long, usually 1.5–6 mm wide, flat, blunt; inflorescence branches ca. 2.5–8(–12) cm long; spikelets 1.7–2.2(–2.6) mm long. Moist sandy woods, margins of wet areas, roadsides; widespread in s and e portions of East TX; also Gulf Prairies and Marshes; Turner et al. (2003) also mapped a disjunct site in Sutton Co. on the Edwards Plateau; se U.S. from VA s to FL w to OK and TX. (Feb–)May–Nov(–Dec). [*A. affinis* Chase] This species is sometimes used as a lawn or pasture grass, but it can be weedy (Barkworth 2003h). It is closely related to *A. compressus* (Crins 1991). Chase (1938) noted regarding this species [as *A. affinis*] that the difference from *A. compressus* "is slight and there are intergrades, but on the whole specimens may be segregated with relatively few intermediates."

Axonopus furcatus (Flüggé) Hitchc., (forked, furcate), BIG CARPET GRASS, FLAT CRAB GRASS. Perennial; culms to 100 cm long; leaf blades to 15(–30) cm long, 3–10(–15) mm wide; inflorescence branches 3.5–10(–15) cm long; spikelets (3.5–)4–5(–6) mm long, apically acuminate; lemma of sterile floret and single glume pointed and extending beyond the fertile floret for 1.5–2 mm. Moist sandy areas, ditches, pond margins; widespread in the Pineywoods and Post Oak Savannah; also n Gulf Prairies and Marshes; se U.S. from VA s to FL w to OK and TX. May–Nov. [*Anastrophus furcatus* (Flüggé) Nash, *Panicum furcatum* Flüggé]

BOTHRIOCHLOA Kuntze BLUESTEM, BEARD GRASS

Perennials; ligule membranous; inflorescences paniculate with racemose branches; pedicels and upper internodes of inflorescence branches with a central groove, furrow, or broad membranous area (this sometimes obscure), often densely villous; spikelets in pairs, one sessile, one pedicelled; disarticulation at base of sessile spikelet so that associated pedicel and section of inflorescence branch fall with the sessile spikelet; sessile spikelets 2-flowered, the lower floret sterile, the upper floret fertile; lower glume dorsally flattened, not enclosing the upper glume; upper glume with a rounded median keel; lemma of upper floret usually awned, the awn geniculate; pedicellate spikelets well-developed but often much smaller and narrower than sessile spikelets, neuter or staminate, awnless.

A genus of ca. 35 species of tropical to warm-temperate areas of the world (Allred 2003g). A number of species are strikingly amphitropical in distribution, occurring in both North and South America (Allred 1981). Some are cultivated for fodder while others are significant weeds. The genus was formerly treated in a more inclusive *Andropogon* and appears related to *Dichanthium* (Clayton & Renvoize 1986; Kellogg 2000a). Intergeneric hybrids are known with *Dichanthium* (de Wet & Harlan 1966, 1970b; Watson & Dallwitz 1992), and some authorities have suggested combining the two genera (e.g., de Wet & Harlan 1968). Like all members of the Andropogoneae, *Bothriochloa* is characterized by C_4 photosynthesis (Kellogg 2000a). Allred (2003g) noted that polyploidy has been "an important mechanism of speciation" in *Bothriochloa*. (Greek: *bothrion*, a shallow pit or trench, and *chloa*, grass, in reference to the grooved pedicels or pitted glumes of some species) (subfamily Panicoideae, tribe Andropogoneae)



Arundo donax [LYN, NIC]



Avena fatua [HI1]



Avena sativa [NVE]

REFERENCES: Gould 1953, 1957a, 1959b, 1967; Shinners 1956b; Celarier & Harlan 1958; Heslop-Harrison 1961; de Wet 1968; de Wet & Harlan 1966, 1970b; Allred 1981, 2003g; Allred & Gould 1983; Vega 2000.

1. Inflorescences usually pinkish purple or brownish at maturity; pedicelled spikelets about as long as sessile spikelets.
   2. Inflorescence axis shorter than branches, the inflorescence thus appearing nearly digitate; lower glume of sessile spikelets without a glandular pit; species a pernicious weed overly abundant in much of East TX _____ **B. ischaemum**
   2. Inflorescence axis usually longer than branches, the inflorescence thus not appearing digitate; lower glume of sessile spikelets with OR without a conspicuous glandular pit; species rare in East TX _____ **B. bladhii**
1. Inflorescences usually whitish silvery or light tan (or in one species rare in East TX purplish or brownish); pedicelled spikelets conspicuously shorter than sessile spikelets.
   3. Sessile spikelets 4.5–7.5 mm long; awn of lemma 18–30(–35) mm or more long; lower glume of sessile spikelet with OR without a glandular pit; culm nodes with OR without a conspicuous ring of spreading to ascending, white hairs; species limited to the w and s margins of East TX.
      4. Inflorescence axis 5–15+ cm long; inflorescences usually with 9 or more branches; culm nodes with a conspicuous ring of spreading to ascending, white hairs 1–4 mm long _____ **B. barbinodis**
      4. Inflorescence axis 0.6–4.5 cm long; inflorescences usually with 3–8 branches; culm nodes glabrous or minutely puberulent _____ **B. hybrida**
   3. Sessile spikelets < 4.5 mm long; awn of lemma 18 mm or less long; lower glume of sessile spikelet usually without a glandular pit (except in the rare *B. bladhii*); culm nodes without a conspicuous ring of spreading to ascending, white hairs; including species widespread throughout East TX.
      5. Sessile spikelets awnless or with awns 6 mm or less long _____ **B. exaristata**
      5. Sessile spikelets with awns 8–18 mm long.
         6. Inflorescences purplish or brownish; hairs subtending sessile spikelets only about 1/4 as long as the spikelets, so sparse as to not obscure the spikelets _____ **B. bladhii**
         6. Inflorescences usually whitish silvery or light tan; hairs subtending sessile spikelets at least 1/2 as long as the spikelets, abundant enough to somewhat obscure the spikelets.
            7. Panicles 4–12(–14) cm long; sessile spikelets ovate; glumes blunt; leaves often clustered at the base of the culms; culms usually less than 2 mm thick _____ **B. laguroides**
            7. Panicles 9–20 cm long; sessile spikelets narrowly ovate to lanceolate; glumes acute; leaves evenly distributed on the culms; culms 2–4 mm thick _____ **B. longipaniculata**

Bothriochloa barbinodis (Lag.) Herter, (bearded at nodes), CANE BEARD GRASS. Culms usually 60–120 cm tall; inflorescences included to long-exserted, usually with numerous branches, the main inflorescence axis usually longer than branches; sessile spikelets 4.5–7.5 mm long, the lower glume pitted or unpitted; lemma awn of sessile spikelet 20–30(–35) mm long. Sandy or rocky limestone soils. Mostly May–Oct. Turner et al. (2003) cited Bell, Bexar, Caldwell, Guadalupe, Hays, and Travis cos. on the w margin of East TX and Brazos Co. (cultivated?) further e (they did not recognize varieties); w part of East TX s and w throughout the w 2/3 of TX; w U.S. from CA e to OK and TX, also FL and SC. The county distribution map does not distinguish varieties. This species has an interesting amphitropical distribution, being found in both North America and s South America (Allred 1981). While some authorities (e.g., Kartesz 1999; Allred 2003g) do not recognize varieties, we are following Hatch (2002) in recognizing the variation at the varietal level based on the usually distinct morphology.

1. Lower glume of most sessile spikelets without a glandular pit or depression _____ var. **barbinodis**
1. Lower glume of most sessile spikelets with a glandular pit or depression (like a conspicuous "pin-hole" in the surface of the glume) _____ var. **perforata**

var. **barbinodis**, CANE BLUESTEM, CANE BEARD GRASS, BRISTLE-JOINT BLUESTEM. Apparently differing from var. *perforata* only in the distinctive glume character (Allred 2003g). Hays (BRIT) and McLennan (TAES) cos.; w 2/3 of TX.

var. **perforata** (Trin. ex E. Fourn.) Gould, (perforated), PINHOLE BLUESTEM, PINHOLE BEARD GRASS, PERFORATED BLUESTEM. Bexar, Guadalupe, Hays, and Travis (TAES) cos.; w 2/3 of TX. Heslop-Harrison (1961) suggested (for a different species of *Bothriochloa*) that the glume pit (actually its complementary swelling on the inner side of the glume) functions in preventing the emergence of the anther from the floret and thus controls cleistogamy (and hence, causes self-fertilization), which can be an advantage under certain conditions.

Bothriochloa bladhii (Retz.) S.T. Blake, (for P.J. Bladh, 1746–1816, Finnish employee of the Swedish East India Company who collected plants in Asia), AUSTRALIAN BLUESTEM, AUSTRALIAN BEARD GRASS. Similar to *B. ischaemum* var. *songarica*; culms usually 50–110(–150) cm tall, with nodes glabrous or with appressed hairs; inflorescences often with numerous branches, the main axis usually longer than branches; sessile spikelets 3.5–4 mm long, usually at least some with a conspicuous glandular pit on the lower glume; lemma awn of sessile spikelet 10–17 mm long; pedicellate spikelets either about the same size and shape as the sessile spikelets or about 1/2 their size. Roadsides, waste places, disturbed areas, and pastures; Fayette, Polk (BRIT), Brazos, and Grimes (Turner et al. 2003) cos. in Pineywoods and Post Oak Savannah, also Bexar Co. (Turner et al. 2003) at sw margin of East TX; sparsely scattered in a few other locations in the state; c U.S. from CO and NE s to TX and LA, also FL. Summer. Native of tropical Asia and Africa. [*Andropogon bladhii* Retz., *Andropogon intermedius* R. Br., *B. intermedia* (R. Br.) A. Camus] This species was introduced as "an experimental forage-grass in Tex." (Correll & Johnston 1970). It is known to hybridize with *B. ischaemum* and also with species in the genera *Capillipedium* and *Dichanthium* (de Wet & Harlan 1966, 1970b; Allred 2003g).

Bothriochloa exaristata (Nash) Henrard, (without an awn), AWNLESS BLUESTEM. Culms 40–130 (–150) cm tall; leaf blades 3–6(–8) mm wide; inflorescences with numerous branches, the inflorescence axis longer than branches; sessile spikelets 2.5–4 mm long, unpitted, awnless or with an awn to 4(–6) mm long. Roadsides, ditches, disturbed places, often on calcareous soils; Houston and Waller cos. (Allred 2003g); also n Gulf Prairies and Marshes; CA, LA, TX. Late spring–fall. [*Andropogon exaristatus* (Nash) Hitchc., *Andropogon hassleri* Hack., *B. hassleri* (Hack.) Henrard]

Bothriochloa hybrida (Gould) Gould, (hybrid), HYBRID BLUESTEM, HYBRID BEARD GRASS. Culms 30–80 cm tall; inflorescences with 3–8 branches; sessile spikelets 4.5–6.5 mm long, with a glandular pit above the middle of the lower glume; lemma awn of sessile spikelet 18–25 mm long. Roadsides, fields, often in heavy clay soils; Travis, Williamson (BRIT), Bastrop, Bexar, Gonzales, Guadalupe, and Wilson (Turner et al. 2003) cos.; also Gulf Prairies and Marshes, South TX Plains, Edwards Plateau, and reported from Jack Co. (Turner et al. 2003) in the Cross Timbers and Prairies; LA and TX. Mainly Apr–Oct, but nearly throughout the year under good conditions. [*Andropogon hybridus* Gould] The epithet reflects Gould's (1957a) opinion that the species "appears to have arisen from one or more hybrids" between the taxa now known as *Bothriochloa edwardsiana* Gould (known from the Edwards Plateau) and *Bothriochloa laguroides* subsp. *torreyana*.

Bothriochloa ischaemum (L.) Keng var. **songarica** (Rupr. ex Fisch. & C.A. Mey.) Celerier & Harlan, (sp.: from Greek: *ischaemos*, blood-restraining, from supposed styptic properties; var.: of Dzungaria, central Asia), KING RANCH BLUESTEM, KR BLUESTEM. Plant becoming rhizomatous or stoloniferous with mowing or grazing; culms 30–50(–100) cm tall; leaf blades 2–4.5 mm wide; inflorescences with 2–8 branches; sessile spikelets 3–4.5 mm long, unpitted; lemma awn of sessile spikelet 9–15(–17) mm long. Roadsides and fields; throughout TX; across much of the s 1/2 of the U.S. from FL w to CA. Mostly May–Nov. Native of s Europe and Asia. Introduced for

erosion control and livestock forage (Allred 2003g), this is a pernicious weed which crowds out native species. Unfortunately, this invasive exotic is now one of the most common grasses on many East TX roadsides. When seen in mass, its inflorescences produce a pinkish purple color clearly visible along many highways. According to Allred (2003g), var. *songarica* differs from var. *ischaemum* (glabrous nodes) in having pubescent (short hirsute) nodes. East TX plants all seem to be var. *songarica*.

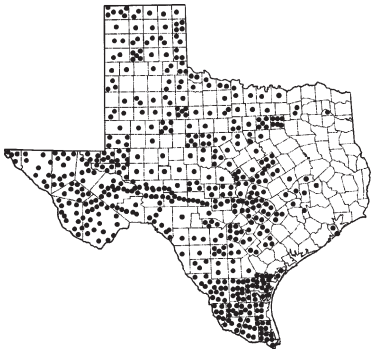
Bothriochloa laguroides (DC.) Herter. subsp. **torreyana** (Steud.) Allred & Gould, (sp.: like *Lagurus*—hare's-tail grass; subsp.: for John Torrey, 1796–1873, botanist and physician, co-author with Asa Gray, described many w American plants), SILVER BLUESTEM, SILVER BEARD GRASS. Culms 50–130 cm tall, the nodes often with pubescence; leaves typically clustered at culm base; inflorescences usually exserted, often with numerous branches, the main inflorescence axis usually longer than branches; sessile spikelets unpitted, ca. 4 mm long; lemma awn of sessile spikelet 8–18 mm long. Dry, often sandy soils or on limestone, increasing under disturbance, extremely common along roadsides; widespread throughout most of TX; across most of the s 1/2 of the U.S. from KY s to FL w to CA. Mostly May–Nov. [*B. saccharoides* (Sw.) Rydb. var. *torreyana* (Steud.) Gould] This species has often been confused with *Bothriochloa saccharoides* Rydb., a species that extends from the West Indies through Central America to adjacent South America (Allred 2003g). While the plants recognized here as *B. laguroides* subsp. *torreyana* have been treated in a variety of ways in the past, we are following Jones et al. (1997), Hatch (2002), and Allred (2003g) in recognizing them as a subspecies of *B. laguroides*. Long-panicled forms have been variously treated as a distinct species (*B. longipaniculata*—e.g., Kartesz 1999; Vega 2000; Allred 2003g), as a separate variety (*B. saccharoides* var. *longipaniculata*—Gould 1975b), or submerged within *B. laguroides* subsp. *torreyana* (Hatch 2002). Until further research is done on the group, we are following the recent treatment by Allred (2003g) in recognizing these forms as a distinct species. Further research may show that one of the other approaches is more appropriate. The couplet in the key to species (above) separating the two species is from Allred (2003g).

Bothriochloa longipaniculata (Gould) Allred & Gould., (long-panicled), LONG-SPIKE SILVER BLUESTEM, LONG-SPIKE BEARD GRASS. Culms to 150(–200) cm tall; leaves ± evenly distributed along culm; inflorescences usually exserted, 9–20 cm long, often with numerous branches, the main inflorescence axis usually longer than branches; sessile spikelets unpitted, ca. 4 mm long; lemma awn of sessile spikelet 9–14 mm long. Roadsides, grassy areas, openings in woods; widespread in East TX, particularly the s part; also Gulf Prairies and Marshes and South TX Plains; LA and TX. May–Nov. [*Andropogon saccharoides* Sw. var. *longipaniculatus* Gould, *B. saccharoides* (Sw.) Rydb. var. *longipaniculata* (Gould) Gould] This species is sometimes submerged within *B. laguroides* (see discussion under that species), but it is recognized here at the specific level following Allred (2003g).

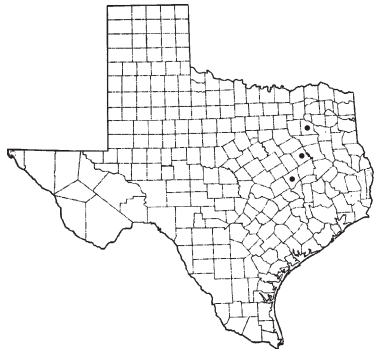
BOUTELOUA Lag. GRAMA GRASS

Perennials or annuals (*B. aristidoides* and *B. barbata*); culms erect, tufted; rhizomes present or absent; leaves mostly basal; ligule a fringe of hairs; leaf blades usually flat, involute apically; inflorescences of 1–many short, spike-like or spikelet-like branches; disarticulation at branch bases or above glumes; spikelets sessile, with 1 perfect floret and 1 or more staminate or neuter florets above; glumes 1-veined; lemmas 3-veined, often short-awned.

An American genus of ca. 40 species (Watson & Dallwitz 1992; Wipff 2003d) of open habitats ranging from Canada to Argentina, with the center of diversity in Mexico. It includes a number of valuable native forage grasses; some are also used as ornamentals. All species are C_4 plants with typical Kranz leaf anatomy (Gould 1979). These adaptations allow more effective capture of carbon dioxide and thus reduced loss of water through transpiration (since stomata



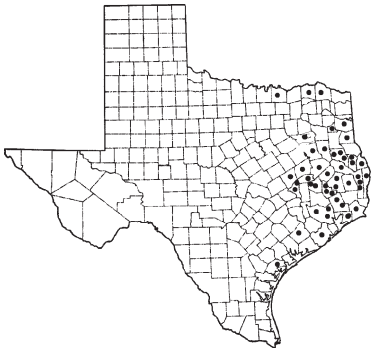
Aristida purpurea
(all vars.)



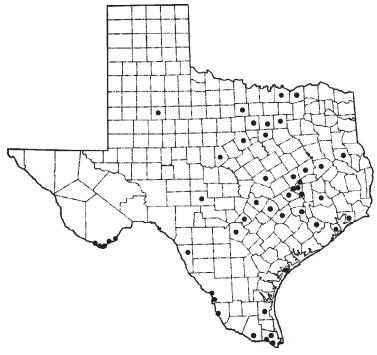
Aristida ramosissima



Arthraxon hispidus



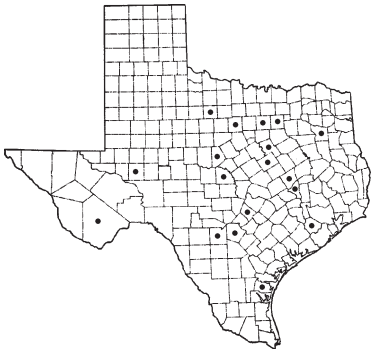
Arundinaria gigantea



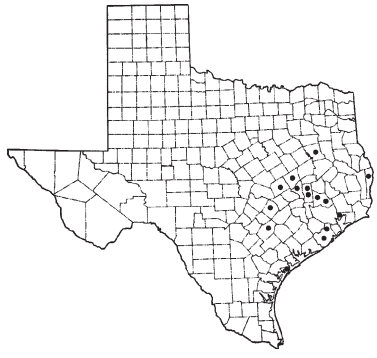
Arundo donax



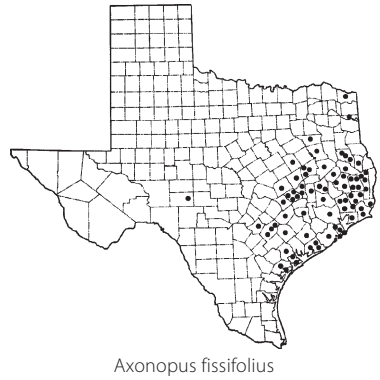
Avena fatua



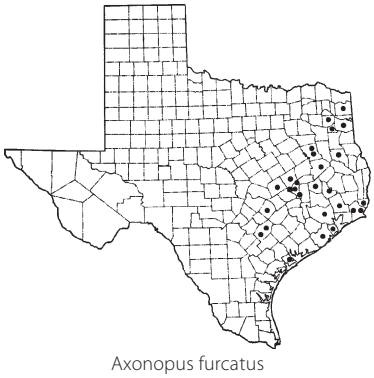
Avena sativa



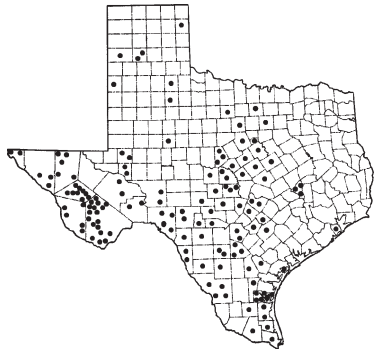
Axonopus compressus



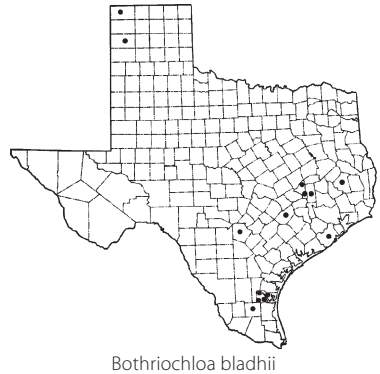
Axonopus fissifolius



Axonopus furcatus



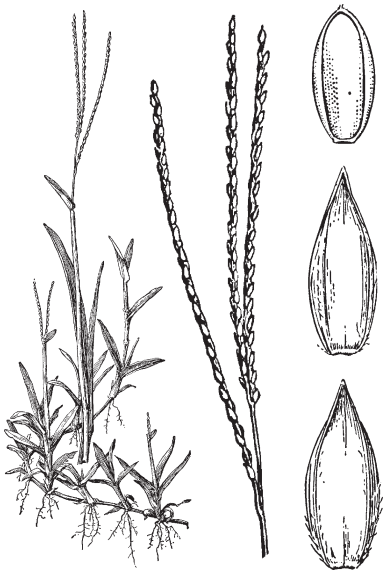
Bothriochloa barbinodis
(both vars.)



Bothriochloa bladhii

do not have to be as open for gas exchange), an advantage in arid environments. The genus has traditionally been divided into two subgenera (see key and synonymy below), *Bouteloua* (ca. 24 species) and *Chondrosum* (ca. 14 species), these sometimes treated as sections or as distinct genera (e.g., Clayton 1982; Clayton & Renvoize 1986; Pohl 1994b). However, recent molecular and morphological evidence (Columbus et al. 1998, 2000; Columbus 1999a, 1999b) suggests that neither *Bouteloua* nor its two subgenera are monophyletic and that the circumscripton of *Bouteloua* should be expanded to include species in a number of small satellite genera including *Buchloe*, BUFFALO GRASS. However, until confirming evidence is available, we are maintaining *Buchloe* as a distinct monotypic genus. While GRAMA GRASSES are very valuable as forage, ☠ hydrogen cyanide production in new growth after rains is known in a few species, posing a potential threat to grazing animals (Hilsenbeck in Powell 1994). The grains are eaten by native birds, including turkey, quail, and dove (Stubbendieck et al. 1997). The common name, *grama*, is derived from a Spanish word for a type of grass. (Named for Claudio Boutelou, 1774–1842, a Spanish writer on floriculture and agriculture) (subfamily Chloridoideae, tribe Cynodonteae)
REFERENCES: Griffiths 1912; Featherly 1931; Gould & Kapadia 1962, 1964; Kapadia & Gould 1964a, 1964b; Roy & Gould 1971; Gould 1979; Clayton 1982; Esparza Sandoval & Herrera-Arrieta 1996; Wipff & Jones 1996; Columbus et al. 1998, 2000; Allen et al. 1999, 2004; Columbus 1999a, 1999b; Wipff 2003d.

1. Spikelets usually 8–90 per inflorescence branch, with a striking pectinate (= comb-like) arrangement on inflorescence branches; inflorescence branches 1–6 cm long, not falling as a unit, the glumes persisting on the branches after the florets have fallen (subgenus *Chondrosum*).
   2. Lower internodes densely white-woolly; species primarily of w TX, known only from sw margin of East TX _____ **B. eriopoda**
   2. Lower internodes glabrous or with slight pubescence; including species widespread in East TX.
      3. Plants tufted annuals; inflorescence branches 1–3 cm long (usually averaging ca. 2 cm), usually < 3 mm wide including awns of spikelets _____ **B. barbata**
      3. Plants perennials; inflorescence branches 1.5–6 cm long (typically > 3 cm except in *B. trifida*), usually 3 mm or more wide including awns of spikelets.
         4. Each inflorescence branch ending with a naked extension of branch axis or axis-like rudimentary spikelet extended well beyond the terminal normal spikelet, the branch thus with a conspicuous, elongated, sharp point (this definitely different from awns); including species widespread in East TX.
            5. Lowermost rudimentary floret of each spikelet with a tuft of hairs present at base; culms 35–75 cm tall, strictly erect, unbranched, usually with three nodes; anthers ca. 3 mm long; inflorescences 25–40 cm long (above uppermost leaf); inflorescence branch ending with axis-like rudimentary spikelet extending beyond normal spikelets _____ **B. pectinata**
            5. Lowermost rudimentary floret of each spikelet without a tuft of hairs at base; culms 15–40 cm tall, decumbent at base, usually branched, with 4–6 nodes; anthers 2–2.5 mm long; inflorescences 10–30 cm long (above uppermost leaf); inflorescence branch ending with a naked extension of branch axis extended well beyond the terminal normal spikelet _____ **B. hirsuta**
         4. Each inflorescence branch ending in a spikelet (this spikelet can be reduced and pointed), without a conspicuous, long, sharp point (however, the spikelets can have pointed awns); species known in East TX only from extreme w margin of area.
            6. Inflorescence branches usually 1–3(–4) per main inflorescence axis, spreading, 1.5–6 cm long (usually at least some > 3 cm long); central awn of lemma arising between two minute membranous lobes _____ **B. gracilis**
            6. Inflorescence branches 3–8 per main inflorescence axis, usually appressed to axis, < 2(–2.5) cm long; central awn of lemma not arising between two minute membranous lobes _____ **B. trifida**



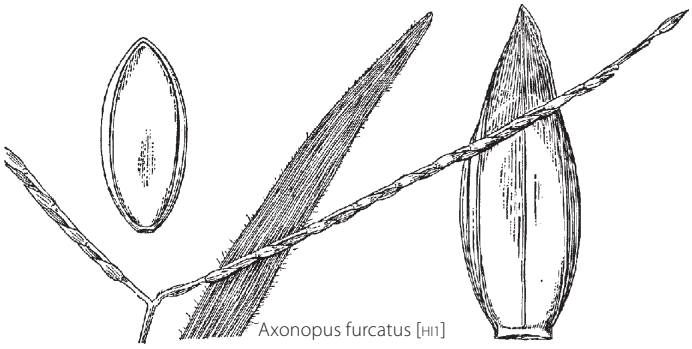
Axonopus compressus [HI1]



Axonopus fissifolius [GO1]



Bothriochloa barbinodis var. barbinodis [HI1]



Axonopus furcatus [HI1]



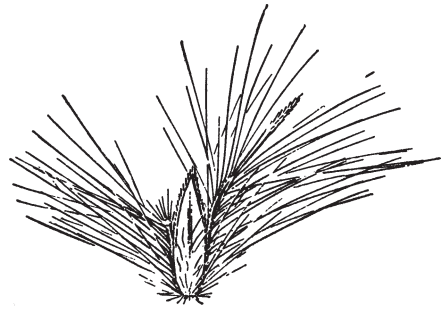
Bothriochloa barbinodis var. perforata [HI1]



Bothriochloa bladhii [GO1]



Bothriochloa hybrida [GO1]



Bothriochloa exaristata [HI1]

1. Spikelets usually 1–8 per inflorescence branch, not pectinately arranged on inflorescence branches; inflorescence branches usually 2 cm or less long, each falling as a separate unit (subgenus *Bouteloua*).
   7. Spikelets 1(–2) per inflorescence branch; inflorescence branches (5–)7–9 mm long; species rare in East TX _____ **B. uniflora**
   7. Spikelets (1–)2–7 per inflorescence branch, always averaging more than 1; inflorescence branches usually 8–20 mm long; including species widespread and abundant in East TX.
      8. Inflorescence branches 25 to many per inflorescence _____ **B. curtipendula**
      8. Inflorescence branches 16 or fewer per inflorescence.
         9. Inflorescence branches with spikelets in a wedge-shaped arrangement, all the spikelets of a single branch arising at ± the same point; branch axis 4–8 mm long; species widespread in Blackland Prairie and Post Oak Savannah _____ **B. rigidiseta**
         9. Inflorescence branches with spikelets not in a wedge-shaped arrangement, the spikelets arising at distinctly different locations along the branch axis (this visible with the naked eye); branch axis ca. 10–20 mm long (including portion extending beyond most distal spikelet); species known in East TX only from Bexar and Travis cos. near extreme w margin of area.
            10. Plants annual; inflorescence branches with (1–)2–4(–5) spikelets; rudimentary floret of each spikelet absent or reduced to an awn column and awns; branch axis (at least at base) and glumes with pubescence; lower glumes 1.5–3.5 mm long; anthers of lower (perfect) floret ca. 2.5 mm long _____ **B. aristidoides**
            10. Plants perennial; inflorescence branches with (2–)4–8 spikelets; rudimentary floret of each spikelet well-developed, usually staminate; branch axis and glumes glabrous or nearly so (inconspicuous hairs can be present on angles of axis or on keels of glumes); lower glumes 4–7 mm long; anthers of lower (perfect) floret 3–5.5 mm long _____ **B. repens**

Bouteloua aristidoides (Kunth) Griseb., (resembling *Aristida*—threeawn grass), NEEDLE GRAMA, SIXWEEKS GRAMA, SIXWEEKS GRASS. Tufted annual; culms 6–50+ cm tall, the lateral ones often ± decumbent basally; inflorescence branches 4–16 per main axis; branch axis ca. 13–22 mm long, extending for 5–11 mm beyond attachment point of terminal spikelet, this extension flattened, curved, and needle-like; spikelets with rudimentary floret reduced to an awn column and awns. Travis Co. (Turner et al. 2003) on w margin of East TX; mainly South TX Plains, Edwards Plateau, and Trans-Pecos; sw U.S. from TX w to CA. (May–)Aug–Oct(–Nov). Reported to be detrimental to sheep ranching because the inflorescence branches get into wool and reduce its value (Powell 1994).

Bouteloua barbata Lag., (barbed), SIXWEEKS GRAMA. Tufted annual; culms to 35 cm tall; inflorescence branches usually (2–)4–9 per main axis; axis of inflorescence branch not extended beyond spikelets, the axis terminating in a well-developed spikelet. Dry grasslands, roadsides, and waste places, typically sandy soils; Brazos Co. (Turner et al. 2003); the next closest location to East TX that we are aware of is Fort Worth (Tarrant Co.—BRIT), where the species occurs as a city weed in such places as the cracks in sidewalks; mainly w 2/3 of TX; w U.S. from KS and TX w to CA, also MT. Apr–Nov. [*Chondrosum barbatum* (Lagasca) Clayton] According to Wipff (2003d), this species "is often confused with juvenile plants of the perennial *B. trifida*, but in *B. barbata* the central awn [of the lemma] is flanked by two membranous lobes," versus *B. trifida* in which the central awn of the lemma is not flanked by membranous lobes.

Bouteloua curtipendula (Michx.) Torr., (short-hanging), SIDE-OATS GRAMA. **State grass of Texas.** Rhizomatous perennial; inflorescence branches arranged along 1 elongate main axis terminating a leafy culm, usually 25–80, reflexed, usually to ca. 1.5(–2) cm long; lemma of fertile floret awnless. Jun–Nov. This species is extremely variable morphologically, ecologically, and in terms of chromosome number; it often reproduces apomictically (Gould 1959a). It was adopted as the

state grass by the 62nd Texas Legislature in 1971 (Jones et al. 1997). It is an excellent native forage species and is considered one of the most important and widespread range grasses in the Great Plains (Yatskievych 1999). It is well-adapted to dry conditions, possibly explaining "its regional dominance in advanced succession communities" (Yoder et al. 1995).

1. Plants without creeping rhizomes (base can sometimes be knotty); culms in large or small clumps, stiffly erect _____ var. **caespitosa**
1. Plants with creeping rhizomes; culms not in large clumps, decumbent or stiffly erect _____ var. **curtipendula**

var. **caespitosa** Gould & Kapadia, (tufted). Mostly on loose, limey soils; Bexar, Hays, and Williamson (TEX—Digital Flora of Texas Herbarium Specimen Browser 2002) cos. on sw margin of East TX; mainly Cross Timbers and Prairies s and w to w TX; w U.S. from CO and TX w to CA.

var. **curtipendula**. On better soils and little disturbed areas including native prairies; throughout TX. This is the predominant variety throughout East TX; se Canada and throughout most of the U.S. ⊞/278

Bouteloua eriopoda (Torr.) Torr., (woolly-footed), BLACK GRAMA, WOOLLY-FOOT GRAMA. Perennial; culms to 60 cm long; inflorescence branches 3–8, to 5 cm long; axis of inflorescence branches densely white-woolly basally, slightly extended apically beyond attachment of terminal spikelet (apical rudimentary spikelet absent); spikelets with upper (sterile) floret reduced to an awn column bearing 3 awns. Dry, often rocky slopes and other arid areas, often in shrubby habitats; Bexar and Gonzales (Turner et al. 2003) cos. near sw margin of East TX; primarily w 1/2 of TX; w U.S. from KS and TX w to CA. Jun–Oct. [*Chondrosum eriopodum* Torr.] According to Wipff (2003d), "Once a dominant in much of its range, under heavy grazing *B. eriopoda* persists only where protected by shrubs or cacti because it is highly palatable."

Bouteloua gracilis (Willd. ex Kunth) Lag. ex Griffiths, (graceful), BLUE GRAMA, EYELASH GRASS. Perennial; culms to 60(–70) cm long; inflorescence branches usually 1–3(–4) per main axis, to ca. 6 cm long, curved; axis of inflorescence branches terminating in a normal spikelet—neither extending beyond spikelet apices (in contrast to *B. hirsuta*) nor with terminal, rudimentary, axis-like spikelet (in contrast to *B. pectinata*). Grasslands, usually on clay or rocky soils; Bell, Bexar, Brazos, Ellis, and Williamson (Turner et al. 2003) cos., mainly near w margin of East TX; primarily w 1/2 of TX; sc Canada and w U.S. from WI and TX w to CA, scattered further e. Jul–Oct. [*Chondrosum gracile* Willd. ex Kunth] Where common, this species is an important native forage (Wipff 2003d). There are nomenclatural problems regarding the name *B. gracilis*. However, a proposal to conserve the name has been made (Gandhi et al. 2001), and we are thus continuing to use the traditional name for this species until the issue is resolved.

Bouteloua hirsuta Lag., (hairy), HAIRY GRAMA. Perennial; inflorescence branches 1–4 per main axis, usually 2.3–4 cm long (including branch axis tip), straight to curved; axis of inflorescence branches extending conspicuously beyond spikelet apices, usually scabrous; chromosome number quite variable, $2n = 20–60$ (Roy 1968). Grasslands and a variety of other habitats, typically on well-drained, often rocky soils; throughout TX; mainly c U.S. from WI s to MS w to NV, scattered to the e. Jun–Nov. Vegetative apomixis (= the production of asexual plantlets) in the inflorescence has been reported (Hill 1982). [*Chondrosum hirsutum* (Lag.) Kunth] ⊞/278

Bouteloua pectinata Feath., (comb-like), TALL GRAMA. Perennial; inflorescence branches usually 3–5 per main axis, 2.5–4.5 cm long, straight to slightly curved; axis of inflorescence branches not extended but with axis-like rudimentary spikelet extending beyond spikelet apices; axis-like rudimentary spikelet usually hairy at base, its apex usually visibly bifid under magnification; $2n = 20$. Limestone outcrops, hilltops, well-drained calcareous soils; Bell, Grayson, Hays, Travis, Williamson (BRIT), Bexar, and Comal (Turner et al. 2003) cos. on w margin of East TX; also Cross Timbers and Prairies, e Edwards Plateau, and South TX Plains; endemic to TX and

OK. Mostly Jul–Aug, with a much shorter flowering period than *B. hirsuta*. [*B. hirsuta* var. *pectinata* (Feath.) Cory, *B. hirsuta* subsp. *pectinata* (Feath.) Wipff & S.D. Jones, *Chondrosum pectinatum* (Feath.) Clayton] While Wipff and Jones (1996), Jones et al. (1997), and Wipff (2003d) recognized this taxon at the subspecific level and Kartesz (1999) recognized it as a variety, we are following Roy and Gould (1971), whose biosystematic investigation supports its recognition as a separate species. Hatch (2002) also treated *B. pectinata* as a distinct species. Even though hybridization can occur where the two grow together (Wipff 2003d), they differ in numerous morphological characters and are usually easily distinguished in the field. According to Gould (1979), "... the morphological uniformity of this species [*B. pectinata*] contrasts strikingly with the variability observed in populations of plants of *B. hirsuta*." Further, molecular evidence (e.g., Columbus et al. 2000) does not support combining the two species. ⚅/278

Bouteloua repens (Kunth) Scribn. & Merr., (creeping), SLENDER GRAMA. Perennial; culms to 65 cm long, erect to decumbent, sometimes rooting at lower nodes; inflorescence branches usually 4–9(–12), ca. 9–20 mm long, along 1 main axis terminating a leafy culm; branch axis extending 2–6 mm beyond attachment point of terminal spikelet, but not beyond the terminal spikelet apex; lemma of fertile floret mucronate or short-awned; single rudimentary floret usually well-developed, usually staminate. Grasslands and open brushy areas; Bexar (TAES) and Travis (Carr 2002a) cos. near sw margin of East TX; mainly South TX Plains; AZ, NM, and TX. Apr–Dec. The single known Travis Co. collection (*Sexton, s.n.*, COA) was from a degraded Blackland Prairie site and represents the northern limit of this species (Carr 2002a).

Bouteloua rigidiseta (Steud.) Hitchc., (stiff-awned), TEXAS GRAMA, MESQUITE GRASS. Perennial 50 cm or less tall; inflorescence branches 6–8(–10), ca. 0.8–1.6 cm long (to end of spikelets), along 1 main axis terminating a leafy culm; branch axis 4–8 mm long, forked or trifurcate at apex, extending slightly beyond base of terminal spikelet but not extending needle-like beyond the spikelet apex; lemma of fertile floret 3-awned; rudimentary floret(s) reduced, sometimes to an awn column, 3-awned. Grasslands; widespread in TX; AR, LA, OK, and TX. Mar–Oct; reported to be one of the earliest warm season grasses to flower (Wipff 2003d). Details of the life history and population biology of this species were studied by Miller and Fowler (1994) and Miller et al. (1995). According to Wipff (2003d), while sometimes abundant, this species "has little value as a forage grass." ⚅/278

Bouteloua trifida Thurb., (three-parted), RED GRAMA, THREEAWN GRAMA. Perennial to 40 cm tall; inflorescence branches 3–8 per main axis, to 2(–2.5) cm long, slender and usually appressed to main axis; axis of inflorescence branches not extending beyond spikelets, ending in a spikelet but without terminal, rudimentary, axis-like spikelet. Grasslands, typically in relatively dry areas; Bell, Bexar, Hays, Travis (BRIT), Brazos, and Comal (Turner et al. 2003) cos. in the w part of East TX; mainly w 2/3 of TX; sw U.S. from TX w to CA. Apr–Nov. [*Chondrosum trifidum* (Feath.) Clayton] This species is drought resistant. It is sometimes mistaken for an *Aristida* "because of its delicate cespitose growth habit and purplish, 2-awned spikelets" (Wipff 2003d).

Bouteloua uniflora Vasey, (one-flowered), NEALLEY'S GRAMA, ONE-FLOWER GRAMA. Perennial to 60 cm tall; inflorescence branches usually 15–70(–83) per main axis, (5–)7–9 mm long, with 1 (–2) spikelet; branch axis extending ca. 3–5 mm beyond attachment point of spikelet but not beyond the spikelet apex. Rocky calcareous soils; Bexar and Goliad (TAES) cos. near s margin of East TX, also disjunct to Grimes Co. (*S.U. Smith 60*, 1996, TAES) to the n; scattered mainly in w 1/2 of TX; in the U.S. known only from TX and one collection from Utah (Wipff 2003d); also Coahuila, Mexico. Jul–Nov.

BRACHYELYTRUM P. Beauv. SHORT HUSK

A C_3 genus of three species (Saarela et al. 2003) of woodland grasses, two in e North America and one in e Asia. Species limits in the genus have been controversial, with some authorities



Bothriochloa ischaemum var. songarica [GO1]



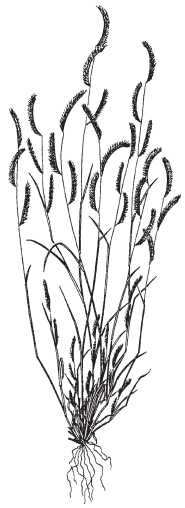
Bothriochloa laguroides subsp. torreyana [GO1, HEA]



Bothriochloa longipaniculata [GO1]



Bouteloua aristidoides [GO3, HI1]



Bouteloua barbata [GO3]



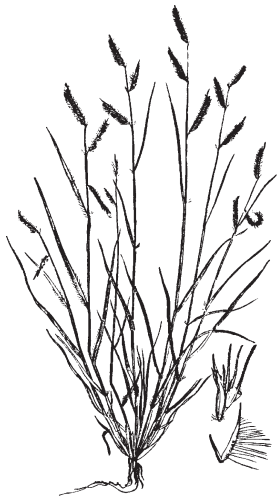
Bouteloua curtipendula var. curtipendula [USB]



Bouteloua eriopoda [HI1, USB]



Bouteloua gracilis [FNA]



Bouteloua hirsuta [USB]

(e.g., Stephenson ined.) treating all three taxa as parts of a single species and others considering them worthy of recognition as separate species (Stephenson 1971; Tucker 1988; Kartesz 1999). We are following a recent revision of the genus (Saarela et al. 2003), based on morphological and molecular data, in recognizing the variation at the specific level.

The disjunct e Asia–e North America distribution pattern exhibited by this and other genera has complex origins and is of interest to plant geographers. In the geologic past, dispersal between the Eurasian and North American continents was possible across both the Bering and North Atlantic land bridges, and the combined area is considered a single "Holarctic" biogeographic region. The fossil record shows that many plants had extensive distributions across the Northern Hemisphere—for example, temperate forests with tropical elements occurred very broadly and reached their maximum extension in the mid-Tertiary (the Tertiary extended from 65 million years ago to 1.8 mya). This widespread flora has been referred to as the Arcto-Tertiary flora, the Tertiaro-mesophytic flora, the boreotropical flora, or a mixed mesophytic forest. Geohistorical events from the mid-Tertiary to the present have included alterations in the shapes of the northern land masses, fluctuations in sea levels, plate tectonic movements, mountain building, glaciation, and other changes in the climate. As a result, there have been great changes in both the composition and the disposition of the flora, and the ranges of many plants have been greatly restricted (e.g., eliminated from Europe and w North America). A significant number of plants that were once much more widespread now survive in only two areas, e North America and e Asia. Though this disjunct distribution pattern has complex and multiple origins, with similar present day distributions differing in time and manner of origin, the consensus is that the e Asia–e North America pattern is in general a relict of the maximum development of Northern Hemisphere temperate forests (with tropical elements) in the Tertiary, with greater survival in e Asia and e North America and higher rates of extinction in Europe and w North America. According to Wen (1999), ca. 65 genera of seed plants have this disjunct distribution. The genus *Brachyelytrum* is an example (other East TX examples include, but are not limited to, *Aletris*, *Ampelopsis*, *Apios*, *Campsis*, *Carya*, *Diarrhena*, *Halesia*, *Hamamelis*, *Lindera*, *Lyonia*, *Menispermum*, *Nyssa*, *Parthenocissus*, *Penthorum*, *Phryma*, *Podophyllum*, *Sassafras*, *Saururus*, *Stewartia*, *Tipularia*, *Trachelospermum*, *Triosteum*, and *Zizania*) (Li 1952; Little 1970; Graham 1972; Boufford & Spongberg 1983; Hamilton 1983; Hsü 1983; Wu 1983; Ying 1983; Tiffney 1985a, 1985b; Cox & Moore 1993; Graham 1993a, 1999; Xiang et al. 1998; Wen 1999, 2001; Dilcher 2000; Donoghue et al. 2001; Xiang & Soltis 2001).

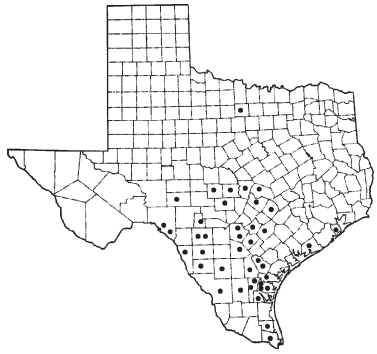
This genus has been variously thought to be in either the Pooideae (Festucoideae) (e.g., Hitchcock 1951) or Bambusoideae (e.g., Campbell et al. 1986; Tucker 1988), but recent evidence confirms its place in the Pooideae (Grass Phylogeny Working Group 2001). (Greek: *brachys*, short, and *elytron*, cover, husk, sheath, presumably in reference to the small glumes) (subfamily Pooideae, tribe Brachyelytreae)

REFERENCES: Babel 1943; Koyama & Kawano 1964; Stephenson 1971, ined.; Macfarlane & Watson 1980; Nixon et al. 1980a; Campbell 1983b; Campbell et al. 1986; Tucker 1988; Saarela et al. 2003.

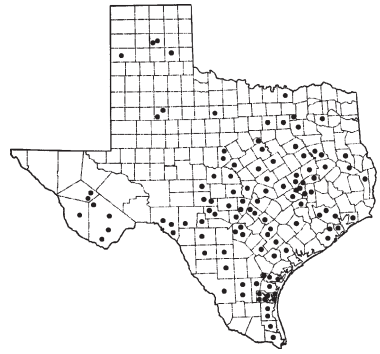
Brachyelytrum erectum (Schreb.) P. Beauv., (upright), BEARDED SHORT HUSK, LONG-AWNED WOOD GRASS. Perennial with short knotty rhizomes; culms 50–90(–100) cm tall, erect to ascending, usually with retrorse pubescence near the nodes; leaves cauline, 2–6; ligule a scale 1–3.5 mm long; leaf blades 8–17.5 cm long, 5–20 mm wide, flat; inflorescence a narrow panicle, often appearing racemose, 7–17 cm long; spikelets 8–13 mm long (excluding awns), with 1 fertile floret, disarticulating above the glumes; lower (first) glume absent or rudimentary (< 1 mm long); upper glume 1–4(–8) mm long; lemma 8–13 mm long, strongly antrorsely hispid, tapering into an awn 12–25(–30) mm long; palea slightly shorter than lemma; rachilla prolonged beyond palea as a slender awn-like bristle 5–8 mm long; stamens 3, the anthers ca. 5–6 mm long. Mesic forests, beech-hardwood slopes; Nacogdoches, Sabine (BRIT), San Augustine, Shelby (TOES 1993), Polk, Rusk, Tyler (Turner et al. 2003), and Jasper (J. Singhurst, pers. comm.) cos. in the Pineywoods; se Canada and e U.S. from ME s to FL w to MN and TX. May–Sep. This species was first reported for TX from Nacogdoches Co. by Nixon et al. (1980a). Vegetatively and in habitat preference, it superficially resembles two other woodland species, *Bromus pubescens* and *Chasmanthium latifolium*; however, *Brachyelytrum* can be easily distinguished by its spikelets with only 1 floret (versus 4–many florets). (TOES 1993: IV) ⚠



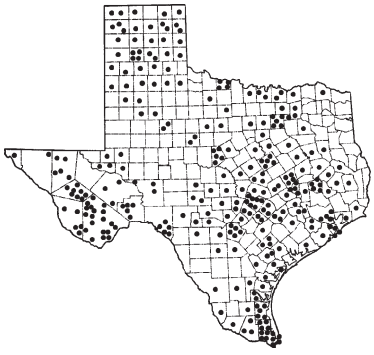
Bothriochloa exaristata



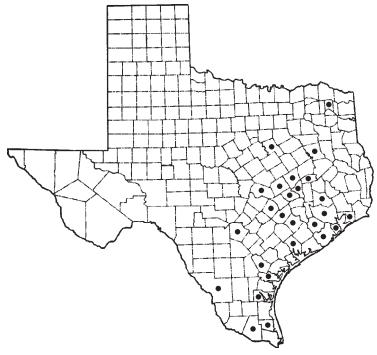
Bothriochloa hybrida



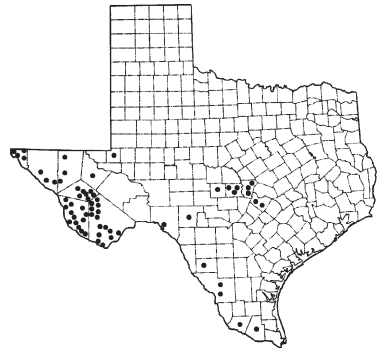
Bothriochloa ischaemum
(both vars.)



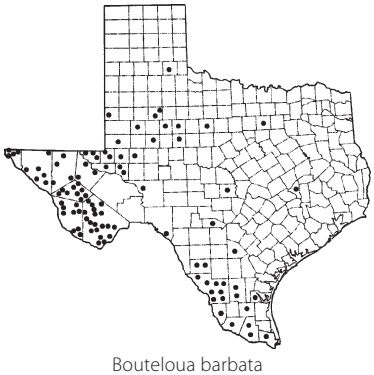
Bothriochloa laguroides subsp. torreyana



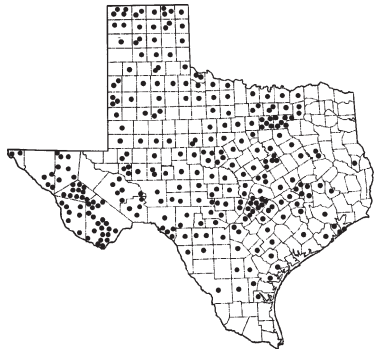
Bothriochloa longipaniculata



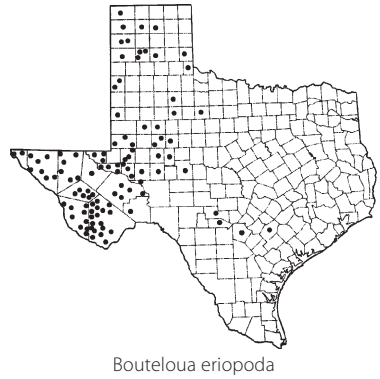
Bouteloua aristidoides



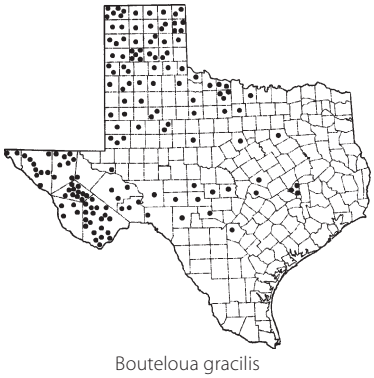
Bouteloua barbata



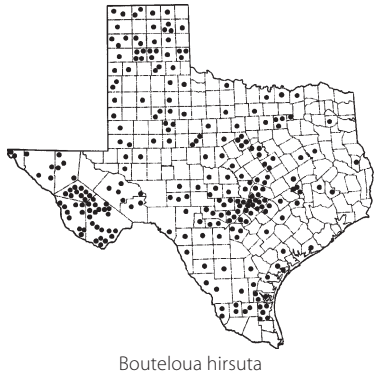
Bouteloua curtipendula
(both vars.)



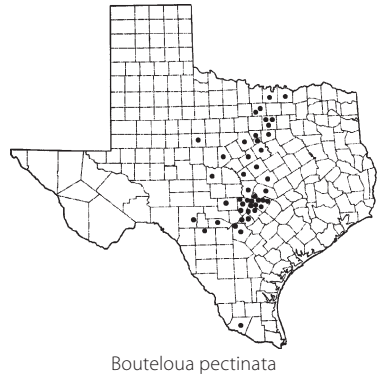
Bouteloua eriopoda



Bouteloua gracilis



Bouteloua hirsuta



Bouteloua pectinata

BRIZA L. QUAKING GRASS, SHAKING GRASS

Annuals (our species); ligule an unfringed membrane; leaf blades flat; inflorescences open panicles of awnless drooping spikelets on long pedicels; spikelets usually with 3–14(–20) florets, the florets crowded and widely spreading; disarticulation above glumes and between florets; lemmas usually broader than long, rounded apically; anthers 3.

A C_3 genus of ca. 20 species (Snow ined.) of temperate Eurasia and South America, including weeds as well as ornamentals cultivated for their showy inflorescences (e.g., *B. media* L., a Eurasian species with the interesting common names DODDERING-DILLIES and JIGGLE-JOGGLES, presumably in reference to the delicate, mobile/trembling spikelets). The group appears monophyletic and is characterized by dorsiventrally compressed, often globose and inflated spikelets (Bayón 1998). Some authorities (e.g., Nicora & Rúgolo 1981; Bayón 1998) recognize the *Briza* complex as having up to five segregate genera. (Greek: *brizein*, to nod—Snow ined.; apparently in reference to the often nodding spikelets) (subfamily Pooideae, tribe Poeae)
REFERENCES: Nicora & Rúgolo 1981; Tucker 1996; Bayón 1998; Mejía-Saulés & Bisby 2000; Snow ined.

1. Spikelets large, mostly (10–)12–25 mm long; inflorescences usually with only 1–6(–12 or more) spikelets; species rare in East TX ____ **B. maxima**
1. Spikelets small, usually 2–6 mm long; inflorescences with many spikelets; species widespread and abundant in East TX ____ **B. minor**

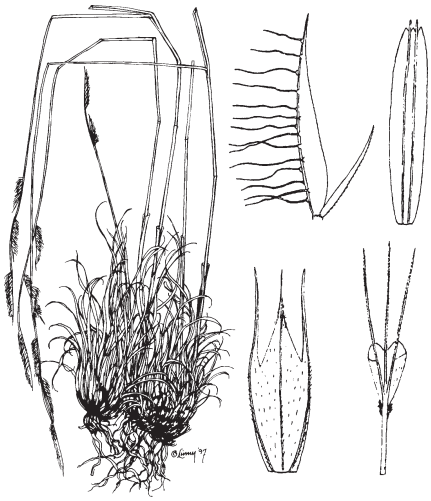
Briza maxima L., (largest), BIG QUAKING GRASS, GREATER QUAKING GRASS. Plant to ca. 60(–80) cm tall, glabrous or leaf blades minutely scabrous; ligule usually 2–7 mm long; leaf blades 2–8 mm wide; spikelets on long, slender, drooping pedicels, (10–)12–25 mm long, 8–12 mm wide, not markedly tapered, with 7–14(–20) florets; larger lemmas 7–9 mm long. Introduced as a garden ornamental; included based on citation for Pineywoods by Hatch et al. (1990) and Hatch (2002); however, we have seen no TX material; no county distribution map is provided; also reported for Gulf Prairies and Marshes (Hatch et al. 1990) and Cross Timbers and Prairies (Hignight et al. 1988); se U.S. from VA s to FL w to TX, scattered elsewhere in the U.S. (e.g., CA and OR) and s Canada. Apr–May. Native of the Mediterranean region.

Briza minor L., (smaller), LITTLE QUAKING GRASS, LESSER QUAKING GRASS. Plant to 7.5–50(–80) cm tall, glabrous or nearly so; ligule ca. 4–10(–13) mm long; leaf blades 2–8(–10) mm wide; spikelets pendulous on long, usually kinked pedicels, 2–6 mm long, ca. 2–6 mm wide, often almost triangular in shape, about as wide as long, markedly tapered toward apex, usually with 3–8 florets (rarely more); lemmas 1.5–2 mm long. Open areas in woods, fields, disturbed places, sandy areas; widespread throughout East TX; also known from n Gulf Prairies and Marshes and Tarrant (BRIT) and Burnet (Turner et al. 2003) cos. in the Cross Timbers and Prairies; e U.S. from VT and FL w to MO and TX, also CA, ID, and sw Canada (B.C.). Mostly Apr–May(–Jun). Native of the Mediterranean region. Reported to contain cyanide (Burlage 1968).

BROMUS L. BROME GRASS, CHESS

Plants annual or perennial; leaf sheaths closed except at summit; ligule a membrane, often prominent; inflorescence a usually ± 1-sided (barely so in *B. hordeaceus*) panicle or infrequently a raceme; spikelets pedicelled, with 4–numerous florets, disarticulating above glumes and between the florets; glumes 2, 1–9-veined; lemmas 5–13-veined, 2-toothed at apex (inconspicuously in *B. catharticus*), usually awned, with awn arising between the teeth, or awnless; paleas present, without awns.

A taxonomically complex C_3 genus of ca. 150 species (Tucker 1996; Planchuelo & Peterson 2000) of temperate and cool regions and tropical mountains. There is, however, disagreement about the number of taxa, with authorities recognizing anywhere from 100–400 species (Pavlick



Bouteloua pectinata [BOT, HEA]



Bouteloua repens [USH]



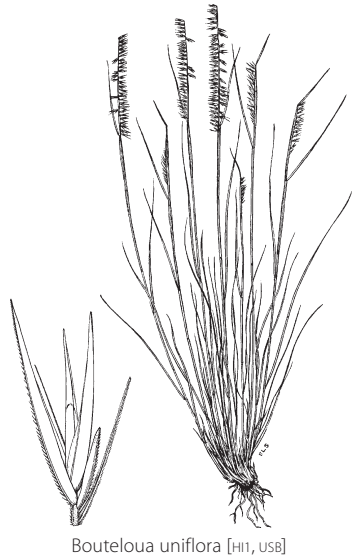
Bouteloua rigidiseta [HI1]



Bouteloua trifida [USB]



Briza maxima [LAM]



Bouteloua uniflora [HI1, USB]



Brachyelytrum erectum [HI1]



Briza minor [BB2]

ined.). A number of species are similar morphologically, hybridization is apparently common, and polyploidy is frequent (Smith 1972). Some are used as ornamentals and a number are utilized for forage. Other species are unpalatable, thus gaining the name CHEATGRASS, and the sharp pointed florets and long rough awns of some can even injure the eyes, noses, mouths, and digestive systems of livestock (Clayton & Renvoize 1986; Yatskievych 1999; Pavlick ined.). Unfortunately, a number of species have become problematic invaders of native habitats, and in some parts of the U.S., large areas of native grasses have been replaced by introduced members of the genus (Yatskievych 1999); many species are considered significant weeds (Watson & Dallwitz 1992). The awns serve to attach the fruits to animals, and it has been suggested that the curving of the awns (which increases upon drying) promotes dispersal by mechanically dislodging mature fruits by chance external friction (Ainouche et al. 1996). However, Peart (1979, 1981) argued that awns serve other purposes such as moving fruits across the soil surface to favorable microsites (in the case of awns that change shape upon drying) or orienting seeds in a position relative to the soil surface that maximizes water uptake for germination and establishment. The following treatment draws heavily on Yatskievych (1999). (An ancient Greek name for oats; from *broma*, food) (subfamily Pooideae, tribe Bromeae)

REFERENCES: Wagnon 1952; Raven 1960; Klemmedson & Smith 1964; Soderstrom & Beaman 1968; Smith 1970, 1972, 1981; Pinto-Escobar 1976, 1981; Krzakowa & Kraupe 1981; Stebbins 1981b; Novak et al. 1991, 1993; Smith & Sales 1993; Pavlick 1995, ined.; Pillay & Hilu 1995; Ainouche et al. 1996, 1999; Tucker 1996; Oja 1998; Oja & Jaaska 1998; Yatskievych 1999; Planchuelo & Peterson 2000; Bartlett et al. 2002.

1. Spikelets strongly flattened; glumes and lemmas sharply keeled; lemmas awnless or with a short awn 3.5 mm or less long _____ **B. catharticus**
1. Spikelets not strongly flattened; glumes and lemmas not sharply keeled; lemmas with awn 2–65 mm long (or in *B. inermis* which is rare in East TX, awnless or with an awn 3 mm or less long).
   2. Lower (first) glume with only 1 vein (rarely with 2 additional veins near base); upper glume usually with 3 veins (rarely with 2 additional faint marginal veins).
      3. Plants perennial; species EITHER with well-developed rhizomes OR of wooded habitats; awns absent or 0.5–8 mm long; leaf blades 5–10(–15) mm wide.
         4. Lemmas glabrous, with awn absent or 3 mm or less long; inflorescence branches stiffly ascending at maturity; rhizomes well-developed, creeping; plants in loose colonies, typically found in open or disturbed areas, rare in East TX, known only from Anderson and Robertson cos. _____ **B. inermis**
         4. Lemmas usually densely pubescent, with awn 2–8 mm long; inflorescence branches spreading or drooping at maturity; rhizomes absent or poorly developed; plants in tufts or clumps, typically found in wooded areas, widespread in East TX _____ **B. pubescens**
      3. Plants annual; species without rhizomes and usually (but not always) of open habitats; awns 6–65 mm long; leaf blades 2–7 mm wide.
         5. Spikelets large, (25–)30–40 mm long excluding awns; lemma bodies 18–30 mm long; awn of lemmas 30–50(–65) mm long _____ **B. diandrus**
         5. Spikelets much smaller, ca. 12–20 mm long excluding awns; lemma bodies 8–12 mm long; awn of lemmas 6–18 mm long.
            6. Awn of lemmas usually 10–18 mm long; apical teeth of lemmas often ± conspicuous, ca. 1–3(–5) mm long; species widespread in East TX, typically in open habitats _____ **B. tectorum**
            6. Awn of lemmas 6–10 mm long; apical teeth of lemmas inconspicuous, 0–0.5 mm long; species endemic to TX and known in East TX only from Bexar, Burleson, and Travis cos. near sw margin of area, typically in shady habitats _____ **B. texensis**
   2. Lower glume with 3–5 veins; upper glume with 5–7 veins.
      7. Awn of lemmas usually 15–50(–65) mm long; spikelets large, (20–)30–50 mm long at maturity excluding awns; species rare in East TX.

8. Lemmas and glumes conspicuously villous; awns of lemmas 15–22 mm long, curved; spikelets with 8–12 florets ____ **B. lanceolatus**
8. Lemmas and glumes glabrous or scabrous; awns of lemmas 30–50(–65) mm long, nearly straight; spikelets with 4–7 florets ____ **B. diandrus**

7. Awn of lemmas 13 mm or less long; spikelets smaller, usually 6–30 mm long at maturity excluding awns; species widespread and abundant in East TX.
9. Glumes and lemmas usually pubescent; inflorescences dense, the branches appressed-ascending; pedicels (= stalks) of spikelets shorter than spikelets ____ **B. hordeaceus**
9. Glumes and lemmas glabrous or slightly pubescent on veins or near apex; inflorescences more open, the branches ascending to spreading or drooping, but not appressed (except when very young); pedicels of spikelets usually as long as or longer than spikelets.
10. Mature lemmas with margins inrolled; basal leaf sheaths glabrous or densely pubescent; awn of lemmas usually 3–9 mm long; paleas from 0.8 mm shorter than lemmas to equaling or barely exceeding lemmas ____ **B. secalinus**
10. Mature lemmas with margins not inrolled; basal leaf sheaths often conspicuously (with a hand lens) shaggy-pilose; awn of lemmas usually 7–13 mm long; paleas 1–2 mm shorter than lemmas ____ **B. japonicus**

Bromus catharticus Vahl, (cathartic, purgative), RESCUE GRASS, RESCUE BROME, SCHRADER'S GRASS. Winter annual, in green growth from late fall to summer, usually 10–70 cm tall when in flower; leaf sheaths spreading-pilose, rarely glabrous; inflorescence usually an open drooping panicle; spikelets glabrous or with minute hairs along the keel, (10–)20–35 mm long, conspicuously flattened; lemmas awnless or with awn to 3.5 mm long. Roadsides, disturbed sites, lawns; throughout TX; se Canada (Nfld.) and throughout s 2/3 of the U.S., also NY, ND, PA, and SD. Mar–May. Native of s South America. [*B. willdenowii* Kunth, *B. unioloides* Kunth, *Festuca unioloides* Willd.] Following Raven (1960), Yatskievych (1999) used the name *B. willdenowii* for this taxon, explaining the taxonomic and nomenclatural problems. While *B. catharticus* is the oldest name for this South American complex, because of different interpretations, various authors have used either *B. unioloides* or *B. willdenowii*. Raven (1960) concluded that two species were involved, with RESCUE GRASS corresponding to the type specimen of *B. willdenowii*. He used the name *B. unioloides* for a similar, closely related species. Subsequently, Pinto-Escobar (1976) concluded that *B. catharticus* was an earlier name for the species referred to by Raven (1960) as *B. unioloides*. Further research on the complex (Pinto-Escobar 1981) indicated that only one species was involved, which because of nomenclatural priority had to be called *B. catharticus*. Until further study clarifies the situation, we are following the one species approach and using the name *B. catharticus*. Hatch (2002) noted that this is "one of the first grasses to appear in the spring."

Bromus diandrus Roth, (with two or twin stamens), RIPGUT GRASS, RIPGUT BROMUS, GREAT BROME. Annual, 20–90 cm tall; leaf sheaths with spreading pubescence; inflorescence with erect to spreading or drooping branches; spikelets glabrous, large, (25–)30–40 mm long (not counting awns); lemmas with awn 30–50(–65) mm long. Roadsides, field margins, and waste places; Brazos (BRIT), Cass, and Travis (Turner et al. 2003) cos.; also Burnet Co. (BRIT) just to the w of East TX and e Edwards Plateau; Gould (1975b) cited the Pineywoods, Post Oak Savannah, and Edwards Plateau, while Hatch (2002) cited these plus the Trans-Pecos; sw Canada (B.C.), CA, and TX. Spring. Native of Europe. [*B. rigidus* Roth] This species is considered a serious pest in semi-arid regions of the sw U.S. (Gould 1975b). "The stout, sharp-awned florets are injurious to stock, frequently working their way into the eyes and nostrils of grazing animals" (Gould 1975b). In TX, this species has long been treated as *B. diandrus* Roth (e.g., Gould 1975b; Hatch et al. 1990; Hatch 2002). However, Pavlick (1995, ined.) separated it from the similar *B. rigidus* Roth using a number of supposedly unambiguous morphological characters, and Kartesz (1999)

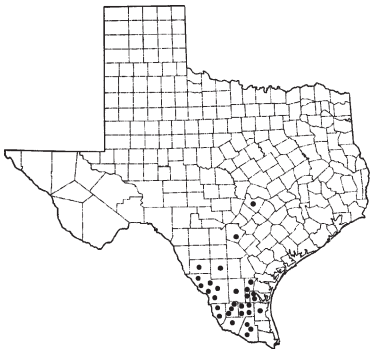
mapped only *B. rigidus* for TX. We have been unable to separate the two based on the material at hand and are tentatively following Hatch in including *B. rigidus* within *B. diandrus*. Further work may establish that *B. rigidus* is present in East TX and worthy of specific recognition. Pavlick (ined.) separates the two as follows:

1. Panicles loose; branches spreading or ascending; callus scar nearly circular _____ *B. diandrus*
1. Panicles usually dense; branches stiffly erect; callus scar more or less elliptical _____ *B. rigidus*

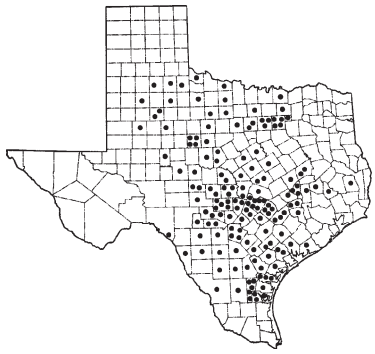
Bromus hordeaceus L., (like barley—*Hordeum*), SOFT CHESS, SOFT BROME, BALD BROME, LOP GRASS. Annual 10–60(–70) cm tall; lower leaf sheaths densely pilose, the upper glabrous; inflorescence dense, the branches appressed-ascending; spikelets 10–20(–25) mm long; lemmas usually densely pubescent, ca. 7–10 mm long, with awn usually 3–9 mm long. Disturbed areas; Limestone, McLennan (BRIT), Bexar, Brazos, and Robertson (Turner et al. 2003) cos.; also known as a weed from Denton Agricultural Experiment Station in May, 1947 (BRIT) and from Crockett Co. (Turner et al. 2003) in the w Edwards Plateau; throughout most of Canada and the U.S. except extreme se. Native of the Mediterranean region but now worldwide in distribution (Ainouche et al. 1999). [*B. hordeaceus* subsp. *divaricatus* (Bonnier & Layens) Kerguélen, *B. hordeaceus* subsp. *molliformis* (J. Lloyd) Maire & Weiller, *B. hordeaceus* subsp. *pseudothominei* (P.M. Sm.) H. Scholz, *B. mollis* L., *B. molliformis* J. Lloyd] Plants with lemma awns outcurved in fruit and ± flat near base have been recognized by some authorities as subsp. *molliformis* (e.g., Wilken & Painter 1993; Pavlick 1995; Kartesz 1999) or subsp. *divaricatus* (Pavlick ined.); plants with slightly smaller, sometimes glabrous lemmas have been recognized as subsp. *pseudothominei* (Pavlick ined.). Based on the small number of specimens seen for TX, we are not distinguishing infraspecific taxa; however, most TX material would apparently fall in subsp. *hordeaceus* on the basis of lemma size and awns. This species is a predominantly self-fertilizing tetraploid ($2n = 28$) (Ainouche et al. 1999).

Bromus inermis Leyss., (unarmed), SMOOTH BROME, HUNGARIAN BROME, BROMO. Perennial with creeping rhizomes; culms to 100(–130) cm tall; leaf sheaths glabrous; inflorescence dense to open, the branches stiffly ascending at maturity; spikelets 15–40 mm long; lemmas glabrous, with awn absent or up to 3 mm long. Disturbed sites, roadsides, and pastures; Anderson (TEX) and Robertson (Turner et al. 2003) cos.; also High Plains; nearly throughout Canada and the U.S. May–Jul. Native of Eurasia. [*Bromopsis inermis* (Leyss.) Houlb.] Even though it is widely planted as a forage and cover crop, Willson and Stubbendieck (2000) considered this an invasive and highly competitive weed. Armstrong (1981) discussed the evolution of this and related species. Kartesz (1999) considered *B. inermis* subsp. *inermis* (the form found in East TX) to be introduced, while subsp. *pumpellianus* (Scrib.) Wagnon (n and montane w U.S. and Canada) to be native. However, the most recent treatment of the group (Pavlick ined.) does not recognize infraspecific taxa. This species is apparently adapted to areas further n and may not persist in TX.

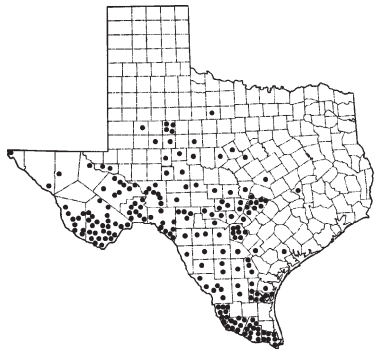
Bromus japonicus Thunb. ex Murray, (Japanese), JAPANESE BROME, JAPANESE CHESS, SPREADING BROME. Annual 20–80 cm tall; leaf sheaths often conspicuously (with a hand lens) shaggy-pilose or occasionally the uppermost glabrous; inflorescences with drooping or spreading branches; spikelets usually 15–30 mm long; lemmas glabrous, the awn usually 7–13 mm long, straight, curved, or abruptly bent out in age, often twisted. Roadsides, yards, and disturbed sites; nearly throughout TX; s Canada and nearly throughout the U.S. May–Jun. Native of Europe and Asia. [*B. commutatus* Schrad.] *Bromus commutatus* Schrad, HAIRY CHESS, MEADOW BROME, is recognized as a separate species by some authorities (e.g., Kartesz 1999; Yatskievych 1999; Planchuelo & Peterson 2000; Pavlick ined.) or included in *B. secalinus* (e.g., Hatch 2002) or *B. japonicus* (e.g., Jones et al. 1997). There is clearly confusion regarding this species complex—morphological characters separating *B. japonicus* and *B. commutatus* seem minor, and we are tentatively including *B. commutatus* in *B. japonicus* until the situation can be clarified. We have observed relatively few East TX specimens with curved or bent awns—Cherokee, Grimes, Hays, McLennan, Smith



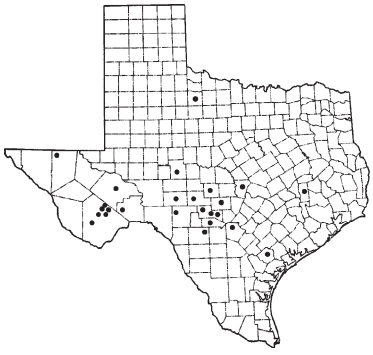
Bouteloua repens



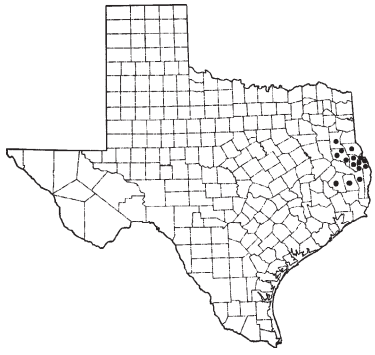
Bouteloua rigidiseta



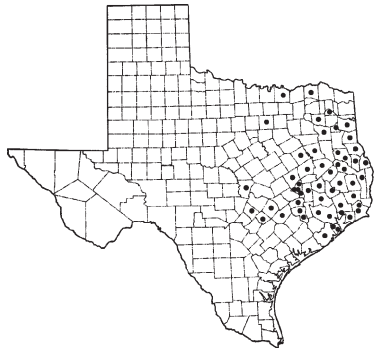
Bouteloua trifida



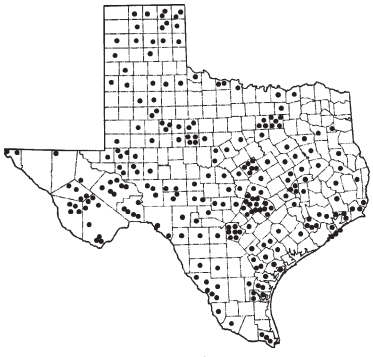
Bouteloua uniflora



Brachyelytrum erectum



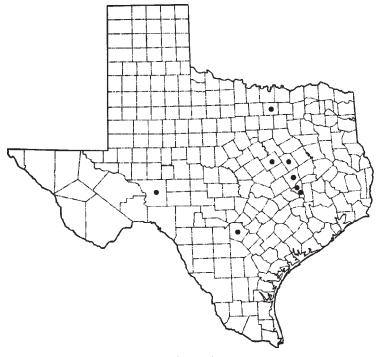
Briza minor



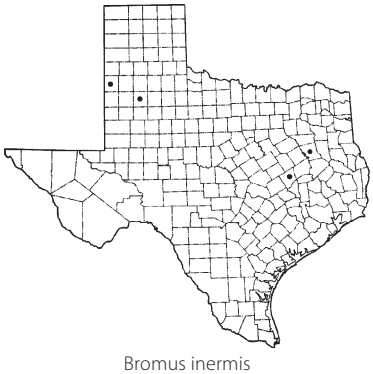
Bromus catharticus



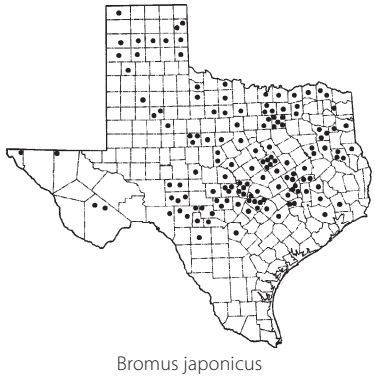
Bromus diandrus



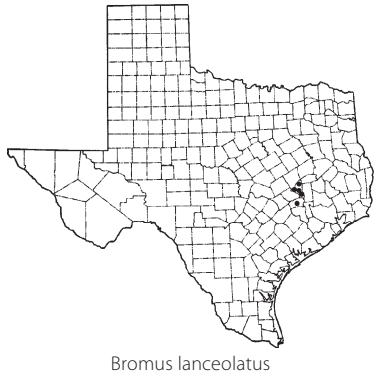
Bromus hordeaceus



Bromus inermis



Bromus japonicus



Bromus lanceolatus

(TAES), and Upshur (BRIT) cos. For those wishing to separate the two, Yatskievych (1999) and Planchuelo and Peterson (2000) distinguished them using the following characters:

1. Most of the lemmas (except sometimes the lowermost few of each spikelet) with awns noticeably curved, twisted, or abruptly bent outward, the tips mostly spreading; spikelets inflated, turgid; florets imbricate, the rachilla not evident at maturity _____ *B. japonicus*
1. Lemmas with awns straight or nearly so, ascending; spikelets neither inflated nor turgid, instead somewhat compressed; florets slightly imbricate, the rachilla evident at maturity _____ *B. commutatus*

Bromus lanceolatus Roth, (lanceolate, lance-shaped), MEDITERRANEAN BROME. Annual 26–60 cm tall; leaf sheaths hirsute; inflorescences open to loosely contracted, the branches ascending to erect; spikelets conspicuously villous, very large, (20–)30–50 mm long at maturity; lemmas with awn 15–22 mm long, conspicuously curved. Disturbed areas, roadside ditches; in TX known only from Brazos (BRIT—2 collections, one by F. Gould, TAES, TAMU) and Washington (ASTC, TAES) cos.; introduced to a few scattered locations in the U.S.—LA, NY, TX, and Washington, D.C. (Pavlick 1995; Kartesz 1999). Spring. Native of s Europe. [*B. macrostachys* Desf.] Gould (1975b) noted that the species (as *B. macrostachys)* was locally abundant and widespread in the area of College Station. The few TX specimens of this introduced species do not match the description of the species in three of the major treatments of *Bromus* (*Flora Europaea*—Smith 1980; *Bromus L. of North America*—Pavlick 1995; *Flora of North America*—Pavlick ined.). For example, in these treatments, the length of the lemma awns is given as 6–12 mm long, much shorter than awns seen in the TX material examined. In some ways the TX material more closely resembles *B. alopecurus* Poir., which is reported to have lemma awns up to 18 mm long (Wilken & Painter 1993). Texas material of this species is in need of detailed study. ☜

Bromus pubescens Muhl. ex Willd., (downy), HAIRY WOODLAND BROME, CANADA BROME. Perennial 70–120(–150) cm tall, forming small clumps or tufts; leaf sheaths spreading-pilose; inflorescences with spikelets drooping or spreading; spikelets densely pubescent, 18–35 mm long; lemmas with awn 2–8 mm long. Woods and thickets; Pineywoods w to East Cross Timbers and e Edwards Plateau; se Canada and throughout e U.S. w to ND and TX. Late Apr–early Jun. [*B. nottowayanus* Fernald, *B. purgans* L.—a rejected name (McNeill 1976)] Because of its wide leaf blades (5–10(–15) mm wide) and woodland habitat, without an inflorescence this species can be confused with *Chasmanthium latifolium*, WOOD-OATS; however, the conspicuously flat, glabrous spikelets of *C. latifolium* make that species instantly recognizable. We are tentatively following Gould (1975b) and Hatch (2002) in including *B. nottowayanus* in this species. *Bromus nottowayanus* was mapped for East TX by Wagnon (1952) and Pavlick (1995); the name has been applied to individuals with 5-veined upper glumes. According to Hatch (2002), "this character alone does not warrant recognition. ..." Barkworth et al. (2002) did not map *B. nottowayanus* for TX. Yatskievych (1999), however, recognized this species and separated it from the very similar *B. pubescens* as follows:

1. Leaf blades with the undersurface shiny (sometimes difficult to see when dried; also note that the shiny undersurface appears as the "upper" surface because the blade is twisted at the base); sheaths with a dense ring of hairs on the outer surface at the apex (on the side opposite the ligule); upper glume mostly 5-veined _____ *B. nottowayanus*
1. Leaf blades with the undersurface dull; sheaths lacking a well-defined ring of hairs at the apex, although the outer surface sometimes uniformly hairy; upper glume 3-veined _____ *B. pubescens*

Bromus secalinus L., (like rye—*Secale*), RYE BROME, CHEAT, CHESS. Annual 20–100(–120) cm tall; leaf sheaths glabrous or (especially lower ones) densely pubescent; inflorescences ± open, the branches spreading to ascending; spikelets usually glabrous or inconspicuously pubescent, (10–)15–25 mm long; lemmas with awn usually 3–9 mm long, straight or somewhat curved, but neither sharply twisted nor bent. Roadsides, fields, and disturbed sites; widespread in TX, par-

ticularly in the e 1/2 of the state; s Canada and throughout most of the U.S. Apr–Jun. Native of Europe. [*B. racemosus* of authors, not L., *B. secalinus* var. *velutinus* (Schrader) W.D.J. Koch] This species is similar to and possibly hybridizes with *B. japonicus*. Texas plants of *B. secalinus* have been treated as *B. racemosus* by some authors (e.g., Shinners 1958; Gould 1962, 1969). However, we are following Gould (1975b), Hatch et al. (1990), and Jones et al. (1997) in placing them in *B. secalinus*. Hatch (2002) treats *B. secalinus* as including *B. commutatus* (see discussion under *B. japonicus*). This species is considered to be a noxious weed in OK (Kartesz 1999).

Bromus tectorum L., (of houses, in recognition of its common habitat in 18th century Europe—the thatched roofs of dwellings—Leopold 1949), CHEATGRASS, EUROPEAN CHEATGRASS, CHEATGRASS BROME, DOWNY BROME, DOWNY CHESS, BRONCO GRASS, MORMON-OATS, JUNE GRASS. Annual 10–90 cm tall; lower leaf sheaths usually densely pubescent, the upper glabrous; inflorescence branches drooping to spreading; spikelets glabrous or pubescent, 12–20(–24) mm long; lemmas with apical teeth often ± conspicuous, ca. 1–3(–5) mm long, with awn usually 10–18 mm long. Roadsides, railroads, and disturbed sites; widely scattered in TX; s Canada and nearly throughout the U.S. Apr–May(–Jun). Native of Eurasia; apparently first introduced into the e U.S. ca. 1790, followed by multiple independent introductions in other parts of the country (Novak et al. 1993; Novak & Mack 2001; Bartlett et al. 2002); in TX since 1945 (Mahler 1988). [*B. tectorum* var. *glabratus* Senn.] The awns can cause mechanical injury to grazing livestock (Burlage 1968). In some parts of the w U.S., this species is a serious fire hazard—it matures early, dries out quickly, and burns readily (Klemmedson & Smith 1964). It has altered the fire ecology of some areas, resulting in a dramatic increase in fire frequency—consequently, there have been decreases in shrubs and other native vegetation and the formation of virtual monocultures of *B. tectorum* (Vitousek et al. 1996; Pimentel et al. 2000). Some authorities (e.g., Novak et al. 1993) suggest this species is now the most abundant vascular plant species in the Intermountain West, and it has been called a "devastating plant invader" (Bartlett et al. 2002). It is considered to be a noxious weed in CO (Kartesz 1999). Two varieties are sometimes recognized (e.g., Gould 1975b; Hatch et al. 1990) based on lemma pubescence (var. *glabratus* with lemmas glabrous or scabrous versus var. *tectorum* with lemmas soft pubescent). However, we are following Pavlick (1995, ined.), Kartesz (1999), and Hatch (2002) in not recognizing varieties.

Bromus texensis (Shear) Hitchc., (of Texas), TEXAS BROME. Annual 40–75 cm tall, short-lived; inflorescences narrow, the branches stiffly erect or widely spreading; spikelets ca. 20 mm long; lemmas with awn usually 6–10 mm long. In shade, thickets; Bexar (TAES), Burleson Co. (TAMU), and Travis (Gould 1975b) cos. near sw margin of East TX; also Gulf Prairies and Marshes, South TX Plains, and e Edwards Plateau; endemic to TX (Kartesz 1999; Carr 2002b, 2002c) or possibly also in n Mexico (Pavlick ined.). [*Bromopsis texensis* (Shear) Holub]

BUCHLOE Engelm. BUFFALO GRASS

A monotypic C_4 genus endemic to North America. Recent molecular evidence (Columbus et al. 1998, 2000; Columbus 1999) suggests that *Buchloe* and a number of other small satellite genera should be included within an expanded *Bouteloua* (otherwise, *Bouteloua* is paraphyletic). According to Snow (2003c), "Morphologically, the segregate genera differ from *Bouteloua* only in their pistillate panicles and spikelets and their reproductive mode, but not in their vegetative and staminate structures." However, until confirming evidence is available, we are following Hatch (2002) and Snow (2003c) in maintaining *Buchloe* as a distinct monotypic genus. Sex expression in BUFFALO GRASS appears to be environmentally influenced (e.g., light and nitrogen levels) (Quinn 2000). (Greek: *boubalos*, buffalo, and *chloë*, thus a contraction of *Bubalochloë*—Snow 2003c) (subfamily Chloridoideae, tribe Cynodonteae)

REFERENCES: Milby 1971[1972]; Quinn & Engel 1986; Columbus et al. 1998, 2000; Columbus 1999; Quinn 2000; Snow 2003c.

Buchloe dactyloides (Nutt.) Engelm., (finger-like), BUFFALO GRASS. Low perennial, 30 cm or less tall, stoloniferous, forming sod, dioecious or occasionally monoecious; culm nodes mostly glabrous; leaves usually with short, curly blades 1–2.5 mm wide; ligule a ciliate membrane ca. 0.5–1 mm long; staminate inflorescences elevated above the leaves, with 1–4 spike-like branches 6–14 mm long; staminate spikelets usually 6–12 per branch, sessile, pectinately arranged, 4–6 mm long, 2-flowered; glumes unequal, 1(–2)-veined; lemmas 3-veined; pistillate inflorescences usually hidden in leafy portion of plant, closely subtended by inflated leaf sheaths, the 2–3(–4) branches bur-like, the axes indurate, each usually with 3–5(–7) one-flowered spikelets, falling entire; upper glume indurate, yellowish, the apex 3-toothed; lemma 3-veined, 3-lobed. Grasslands; throughout TX, but more common from the Blackland Prairie westward; sc Canada and c U.S. from WI s to LA w to MT and NV, also GA and VA. Apr–Sep. [*Bouteloua dactyloides* (Nutt.) J.T. Columbus] This species is dominant over large areas of the short grass prairie of the Great Plains and is one of the most important grazing species of that area. It was used by settlers in making sod houses and is currently increasing in use as a drought resistant and low maintenance yard grass—because of its relatively low maximum height, little mowing is required. It has been suggested (Davidse 1987a) that the bur-like pistillate inflorescences may be animal dispersed.

CENCHRUS L. SANDBUR, GRASSBUR, SANDSPUR, BUR GRASS, HEDGEHOG GRASS, DEVIL'S-BUR, STICKERS, GOAT-HEADS

Annuals or perennials, largely glabrous; culms often geniculate; leaf sheaths compressed and keeled; ligule a short ciliate membrane; inflorescence spike-like, with zigzag, triangular-flattened axis; spikelets enclosed in bur-like involucres (1–several spikelets per involucre) with usually fused spines (flattened bristles) and bristles or (in *C. myosuroides*) only bristles; disarticulation at base of involucres; callus below involucre flared/swollen apically; spikelets of 2 florets, the lower floret sterile and with glume-like lemma, the upper floret fertile and with hardened grain-like lemma; glumes unequal, the lower smaller than the upper.

A genus of ca. 16 species (Stieber & Wipff 2003) of warm and dry regions of America, Africa, and India, characterized by C_4 photosynthesis. Other authorities, however, recognize more species—20 (Crins 1991) to 30 (Mabberley 1997). The bur-like spiny involucres are painful and injurious to both humans and other animals—they are frequently found on shoelaces, socks, and other clothing and on many animal species. The burs, which fall easily and serve as dispersal units, often become embedded between the toes of dogs, necessitating veterinary attention, and in various animals the burs are known to penetrate the mouth and tongue, causing serious problems (Ken Lawrence D.V.M., pers. comm.). They are particularly problematic in areas where sheep are raised and can damage the wool (Steyermark 1963). *Cenchrus* is closely related to *Pennisetum*; some species of the former closely resemble the latter morphologically (Chrtek & Osbornová 1996; Wipff & Veldkamp 1999), and the two have sometimes been combined (e.g., Correll & Johnston 1970). Recent molecular studies suggest *Pennisetum* is "probably paraphyletic" without the inclusion of *Cenchrus* (Gómez-Martínez & Culham 2000). However, "*Cenchrus* generally differs from *Pennisetum* in having retrorsely scabrous or strigose inner bristles that are usually fused to well above their bases" (Stieber & Wipff 2003), and until more information is available, we are following most recent authorities in maintaining *Cenchrus* as a separate genus. *Pennisetum ciliare* has been treated as a *Cenchrus* by some authorities (e.g., Gould 1975b; Webster 1988; Crins 1991; Watson & Dallwitz 1992; Yatskievych 1999). However, we are following other workers (e.g., Kartesz 1999; Hatch 2002; Wipff 2003j) in treating it in *Pennisetum*. While it seems more appropriately placed in *Pennisetum* (e.g., spikelets subtended only by an involucre of bristles, not spines; bristles antrorsely barbed; molecular evidence—Giussani et al. 2001; cytological evidence—S. Hatch, pers. comm.), it does exhibit some fusion of the involucre bristles (at least basally) as in species of *Cenchrus*, and it has the callus below the involucre flared/swollen apically—a character which is uniformly present in *Cenchrus*, but not



Bromus catharticus [USB]



Bromus diandrus [GO2, YAT]



Bromus hordeaceus [USB]



Bromus inermis [HI1]



Bromus japonicus [REE]



Bromus lanceolatus [RJG]



Bromus pubescens [YAT]



Bromus secalinus [REE]



Bromus tectorum [REE]

in *Pennisetum* (Webster 1988). (Modification of the old Greek name, *cenchros*, of *Setaria italica* (FOXTAIL-MILLET); alternatively, some authors suggest the Greek name was used for *Panicum miliaceum* L. (PROSO MILLET)—Chrtek & Osbornová 1996) (subfamily Panicoideae, tribe Paniceae) REFERENCES: Chase 1920b; Sohns 1955; DeLisle 1963; Webster 1988; Crins 1991; Chrtek & Osbornová 1996; Stieber & Wipff 2003.

1. Bristles subtending spikelets antrorsely barbed; spikelets subtended by bristles only, these not capable of penetrating skin; plants perennial _____ see **Pennisetum ciliare**
1. Bristles and spines subtending spikelets retrorsely barbed; spikelets enclosed in a bur-like involucre of bristles and flattened spines (without flattened spines in *C. myosuroides*), the spines capable of penetrating the skin and causing pain (less so in *C. myosuroides*); plants annual or perennial.
   2. Burs with terete bristles, their bases not flattened, the bristles fused only at very base; plants perennial; species rare in East TX _____ **C. myosuroides**
   2. Burs with spines with bases flattened, the spines variously fused above very base; plants annual or perennial; including species widespread and abundant in East TX.
      3. Burs with 1 whorl of united flattened spines confined to lower part of bur, these subtended by 1–several whorls of shorter, finer bristles _____ **C. echinatus**
      3. Burs with more than 1 whorl of flattened spines, the spines present irregularly over the body of the bur, these usually not subtended by whorls of bristles.
         4. Burs usually with 8–40 spines, the base of larger spines 1–2 mm wide, the base of bur usually without numerous, thin, down-pointing spines _____ **C. spinifex**
         4. Burs usually with 45–75 spines, the base of larger spines usually 1(–1.4) mm wide or less, the base of bur with numerous, thin, down-pointing spines _____ **C. longispinus**

Cenchrus echinatus L., (prickly), SOUTHERN SANDBUR, HEDGEHOG GRASS, CADILLO. Annual with geniculate or trailing culms to 85 cm long; bur short pubescent; spines and bristles retrorsely barbed. Disturbed areas; Bastrop, Bexar, Brazos, Dallas, Liberty, Montgomery, Nacogdoches, and Smith (Turner et al. 2003) cos.; widely scattered in e 1/2 of TX; across s U.S. from NC s to FL w to CA. Spring–fall. Considered to be a noxious weed in AZ and CA (Kartesz 1999) and ranked by some sources among the world's worst weeds (Holm et al. 1977). ⊘

Cenchrus longispinus (Hack.) Fernald, (long-spined), LONG-SPINE SANDBUR, INNOCENT-WEED. Annual; culms partly decumbent, 15–65 cm long; bur long-pubescent; spines retrorsely barbed. Sandy or gravelly sites, disturbed areas; Grayson, Van Zandt (BRIT), Liberty (SBSC), Leon, and McLennan (Turner et al. 2003) cos.; mainly n 1/2 of TX, particularly the Panhandle; scattered in s Canada and nearly throughout the U.S. Jun–Oct. [*C. carolinianus* Walter] Considered to be a noxious weed in CA, CO, NC, and WA (Kartesz 1999). ⊘

Cenchrus myosuroides Kunth, (resembling a mouse tail), BIG CENCHRUS, BIG SANDBUR, CADILLO. Coarse perennial to 2 m tall; culms ± woody; spines and bristles not flattened at base, retrorsely barbed. Ravines, ditches, near streams, disturbed areas; Brazos (TAES; Barkworth et al. 2002) and Bexar (Turner et al. 2003) cos.; scattered in the s 1/2 of TX; se U.S. from SC s to FL w to TX. May–Nov. [*Cenchropsis myosuroides* (Kunth) Nash] This species can be confused with *Pennisetum ciliare* but can be distinguished by the bristle barbs (retrorse in *C. myosuroides* versus antrorse in *P. ciliare*), bristle appearance (± straight, not purple in *C. myosuroides* versus wavy and purple in *P. ciliare*), and the bristle length (ca. 3–6 mm long in *C. myosuroides* versus ca. 4–14 mm long in *P. ciliare*).

Cenchrus spinifex Cav., (spiny), COMMON SANDBUR, GRASSBUR, COASTAL SANDBUR. Perennial but flowering the first year; culms partly decumbent, to 100 cm long; bur glabrous to short-pubescent; spines retrorsely barbed. Sandy or gravelly sites, disturbed areas; throughout TX, but more common in the w 1/2 of the state; widespread in s 1/2 of the U.S., scattered further n. May–Oct.

[*C. carolinianus* of authors, not Walter, *C. incertus* M.A. Curtis, *C. parviceps* Shinners, *C. pauciflorus* Benth.] We are following Jones et al. (1997), Kartesz (1999), and Stieber and Wipff (2003) for nomenclature of this species. It is considered to be a noxious weed in AZ, CA, and NV (Kartesz 1999). ⊘ ֍/282

CHASMANTHIUM Link WOOD-OATS

Perennials, ours rhizomatous; ligule in ours a minute ciliate membrane; leaf blades broad, flat; inflorescence an open or contracted panicle (rarely a raceme); spikelets (2–)3–many-flowered, laterally flattened, sometimes conspicuously so, disarticulating above the glumes and between the florets; glumes shorter than lemmas; lower 1–4 florets sterile.

A C_3 genus of 5 species (Sánchez-Ken & Clark 2003) endemic to North America; in the past it was recognized as part of the genus *Uniola*, which includes *U. paniculata* L., a coastal dune species known as SEA OATS. However, it is now recognized that *Chasmanthium* and *Uniola*, while superficially similar, belong in different subfamilies. *Chasmanthium* is the only genus of subfamily Centothecoideae that occurs in East TX. (Greek: *chasme*, gaping or yawn, and *anthus*, flower, presumably from the form of the spikelets—the lemmas and paleas gap and expose the grain at maturity) (subfamily Centothecoideae, tribe Centotheceae)
REFERENCES: Yates 1966a, 1966b; Brown & Smith 1974; Clark 1990; Tucker 1990; Wipff & Jones 1994 [1995]; Sánchez-Ken & Clark 2003.

1. Inflorescence branches drooping; pedicels 10–30 mm long; spikelets (10–)20–50 mm long, 6–17(–26)-flowered ____ **C. latifolium**
1. Inflorescence branches erect or ascending; pedicels at most 5 mm long, usually much less; spikelets 4–10(–18) mm long, 3–7-flowered.
   2. Leaf sheaths glabrous or nearly so; collar of leaf sheaths glabrous; culms 1 mm thick or less at the nodes; lemmas of fertile florets straight, with 3–7 veins ____ **C. laxum**
   2. Leaf sheaths (at least lower) usually long-pubescent or hirsute (rarely glabrous); collar of leaf sheaths pubescent; culms (1–)2–3.5 mm thick at the nodes; lemmas of fertile florets usually curved or irregularly contorted, with 7–9 veins ____ **C. sessiliflorum**

Chasmanthium latifolium (Michx.) H.O. Yates, (broad-leaved), WILD OATS, BROAD-LEAF WOOD-OATS, INLAND SEA-OATS, BROAD-LEAF CHASMANTHIUM, CREEK-OATS, INDIAN WOOD-OATS. Glabrous perennial, 0.4–1.5 m tall; culms leafy to 4/5 of their height; leaf blades 8–20(–30) mm wide; spikelets conspicuously flat, very wide (6–20 mm). Along streams and in moist woods, usually in shade; one of our most common woodland grasses; widespread in e 1/2 of TX; e U.S. from PA s to FL w to WI and TX. Jun–Sep. [*Uniola latifolia* Michx.] The large spikelets make this an excellent example to use in demonstrating spikelet structure to students; the dried inflorescences are also sometimes used ornamentally in dried flower arrangements. Because of its beauty and shade tolerance, this species is becoming increasingly used as an ornamental in native plant landscapes. According to Sánchez-Ken and Clark (2003), flowering is sometimes cleistogamous. ֍/282

Chasmanthium laxum (L.) H.O. Yates, (loose), SLENDER WOOD-OATS, SLENDER CHASMANTHIUM. Clumped, essentially glabrous perennial 40–130 cm tall; culms usually leafy for ca. 1/2 their height; leaf blades (8–)15–35(–40) cm long, usually 3–8(–11) mm wide; panicle branches appressed to ascending; spikelets flat, (2–)3–5(–6) mm wide, usually with 3–5 florets. Moist, usually sandy areas; Pineywoods and Post Oak Savannah; also n Gulf Prairies and Marshes; e U.S. from NY s to FL w to MO, OK, and TX; Jun–Nov. [*Uniola laxa* (L.) Britton, Sterns, & Poggenb.]

Chasmanthium sessiliflorum (Poir.) H.O. Yates, (sessile-flowered), NARROW-LEAF WOOD-OATS, LONG-LEAF WOOD-OATS, LONG-LEAF CHASMANTHIUM. Clumped perennial usually 0.7–1.5 m tall, usually with pubescence, similar to *C. laxum*; culms usually leafy for ca. 2/5 their height; leaf blades (15–)20–50 cm long, 4.5–12(–15) mm wide; panicle branches appressed to ascending to

divergent; spikelets flat, 4–7(–9) mm wide, usually with 4–7 florets. Moist forests, swamps, and prairie openings, sandy soils; Pineywoods and Post Oak Savannah, also Dallas Co. (Turner et al. 2003) to the w; also n Gulf Prairies and Marshes; se U.S. from VA s to FL w to OK and TX. Jun–Nov. [*C. laxum* subsp. *sessiliflorum* (Poir.) L.G. Clark, *C. laxum* var. *sessiliflorum* (Poir.) Wipff & S.D. Jones, *Uniola sessiliflora* Poir.] This taxon has been variously treated taxonomically. It has been recognized as a separate species (e.g., Kartesz 1999), as a subspecies of *C. laxum* (e.g., Clark 1990; Yatskievych 1999), as a variety of *C. laxum* (e.g., Wipff & Jones 1994 [1995]; Diggs et al. 1999), or as part of an undivided *C. laxum* (e.g., Hatch 2002). Clark (1990) indicated there is significant overlap between the two taxa in a number of morphological characters and that they are almost completely sympatric; he concluded that they are not worthy of recognition as species. Recently, Sánchez-Ken and Clark (2003) treated the two at the species level and gave a number of morphological characters (used in the key above) by which to distinguish them. Even though sympatric, the differences between them seem to be maintained. Additionally, Sánchez-Ken and Clark (2003) noted that, while growing in similar habitats, *C. sessiliflorum* extends "further into sphagnous stream heads, pine flatwoods, and pine savannahs." Because of these morphological and ecological differences, we are following Sánchez-Ken and Clark (2003) in treating *C. sessiliflorum* as a separate species.

CHLORIS Sw. WINDMILL GRASS

Annuals or perennials; leaf sheaths strongly compressed and sharply keeled; ligule a ciliate membrane; branches of inflorescence digitately or subdigitately arranged at tip of culm (apparently in 1 whorl) or else in several whorls; spikelets in 2 rows along 1 side of the branch axes, with 1(–2) perfect floret at base and 1 or more reduced ones above, laterally compressed, disarticulating above the glumes; glumes shorter than fertile floret; lemma of perfect floret usually awned, marginally often variously and sometimes conspicuously pubescent; reduced florets without paleas.

A C_4 genus of 55–60 species (Barkworth 2003b) of tropical and warm areas of the world (most abundant in the s hemisphere). The genus includes some fodder and pasture grasses, as well as a number of significant weeds (Watson & Dallwitz 1992). Recent molecular studies (Hilu & Alice 2000, 2001) raise questions about the monophyly of *Chloris* as traditionally delimited. *Enteropogon*, UMBRELLA GRASS, here treated as a separate genus following Barkworth (2003b), is sometimes included in *Chloris* (e.g., Correll & Johnston 1970; Gould 1975b; Hatch et al. 1990). The most reliable character in separating the two genera is compression of the spikelets: dorsally compressed in *Enteropogon* versus laterally compressed in *Chloris* (Jacobs & Highet 1988). Molecular data link *Chloris*, *Cynodon*, *Enteropogon*, and *Eustachys* but do not support combining the genera (Hilu & Alice 2000). Intergeneric hybrids of *Chloris* with *Cynodon* are known (Watson & Dallwitz 1992). The following treatment draws heavily on Gould (1975b). (Named for Chloris, Greek mother of Nestor, goddess of flowers) (subfamily Chloridoideae, tribe Cynodonteae)

REFERENCES: Nash 1898; Clayton 1967a, 1982; Lazarides 1972; Anderson 1974; Gould 1975b; Varadarajan & Gilmartin 1983a, 1983b; Jacobs & Highet 1988; Hilu & Alice 2000, 2001; Barkworth 2003b.

1. Branches of inflorescence in 2–5 whorls along a main axis usually 20 mm or more long; reduced (neuter or staminate) floret 1 per spikelet, truncate _____ **C. verticillata**
1. Branches of inflorescence usually in only 1 whorl, or appearing so (if in more than 1 whorl, then the whorls crowded along an axis less than 20 mm long); reduced floret(s) 1–4 per spikelet, truncate or not so.
   2. Reduced floret 1 per spikelet; including species widespread and common in East TX.
      3. Inflorescence branches bearing spikelets to very base; lowest spikelets of branch typically less than 3 mm apart.



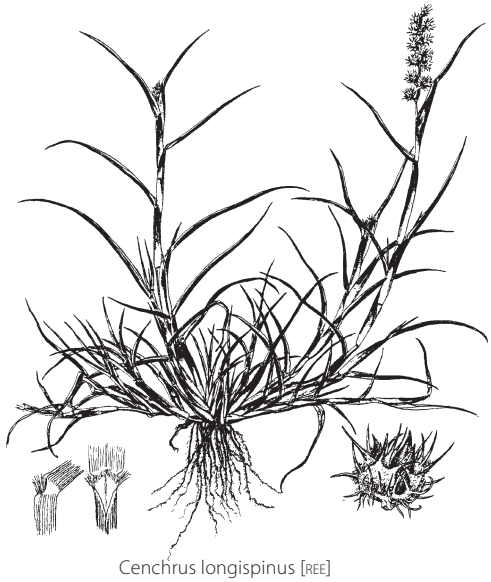
Bromus texensis [GO1]



Buchloe dactyloides [HI1]



Cenchrus echinatus [REE]



Cenchrus longispinus [REE]



Cenchrus spinifex [REE]



Cenchrus myosuroides [GO1, USB]



Chasmanthium latifolium [USB]



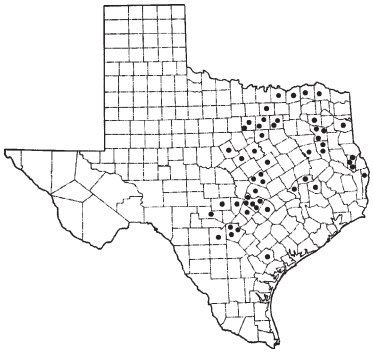
Chasmanthium laxum [USB]

4. Inflorescence branches short, 2–5 cm long; lemma of fertile floret 1.5–2 mm long, with awn usually 2 mm or less long _____ **C. cucullata**
4. Inflorescence branches usually longer, 3–17.6 cm long; lemma of fertile floret 2.2–4.2 mm long, with awn 2 mm or more long.
   5. Inflorescence appearing bristly-woolly at arm's length; awn of lemma of fertile floret 5–15 mm long; upper margins of lemma of fertile floret with a prominent tuft of hairs to ca. 2–3 mm long; plants annuals _____ **C. virgata**
   5. Inflorescence not appearing bristly-woolly at arm's length; awn of lemma of fertile floret 1.5–6.5 mm long; upper margins of lemma of fertile floret with OR without a tuft of hairs; plants stoloniferous perennials.
      6. Reduced floret(s) (1–)2–4, similar to perfect floret but smaller, often tapering to apex, much longer than wide; upper margins of lower lemmas often with a prominent tuft of hairs _____ **C. gayana**
      6. Reduced floret 1, usually distinctly different from perfect floret, often with a squared-off apex, often nearly as wide as long, sometimes triangular; upper margins of lower lemmas without a prominent tuft of hairs _____ **C. ×subdolichostachya**

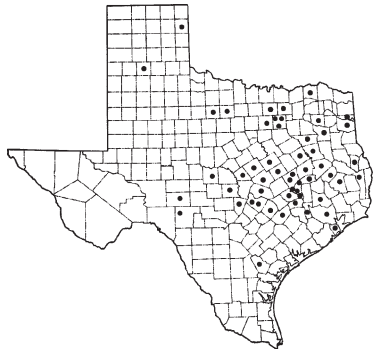
3. Inflorescence branches usually without spikelets near base (base of branches naked); lowest spikelets of branch typically 3 mm or more apart.
   7. Lemma of fertile floret 3.7–4.3 mm long, with awn 7–11 mm long; inflorescence branches bare of spikelets on lower one-fourth to one-third of their length; awn of reduced floret 4.5–6.5 mm long; species reported in East TX only from Brazos and Harris cos. _____ **C. texensis**
   7. Lemma of fertile floret 1.9–2.7 mm long, with awn 1.9–5.2 mm long; inflorescence branches bare of spikelets only at very base (lower 2–15 mm), bearing spikelets along most of their length; awn of reduced floret 2.5–3.5 mm long; species known from w and sw margins of East TX _____ **C. andropogonoides**

2. Reduced florets 2–4 per spikelet (Note: upper reduced florets are sometimes enclosed by the lowermost reduced floret; also, reduced florets usually lack paleas); species (except for *C. virgata*) rare in East TX and known only from s portion of area.
   8. Inflorescence appearing bristly-woolly at arm's length; awn of lemma of fertile floret 5–15 mm long; plants annuals _____ **C. virgata**
   8. Inflorescence not appearing bristly-woolly at arm's length; awn of lemma of fertile floret 0.5–5.5 mm long; plants tufted or stoloniferous perennials.
      9. Inflorescence with 9–30 branches; perennials usually with stolons; lowermost reduced floret 2.2–3.2 mm long _____ **C. gayana**
      9. Inflorescence with 3–7(–9) branches; tufted perennials scarcely if at all stoloniferous; lowermost reduced floret 1.1–1.8 mm long.
         10. Inflorescence branches 2–6(–7) cm long; lemma of fertile floret 1.8–2.8 mm long, with awn 0.9–1.4 mm long; lowermost reduced florets awnless or with awns 1.4 mm or less long _____ **C. ciliata**
         10. Inflorescence branches (4–)6–14 cm long; lemma of fertile floret usually 3–3.7 mm long, with awn 2.4–5.5 mm long; lowermost reduced florets with awns 1.5–3.5 mm long _____ **C. canterae**

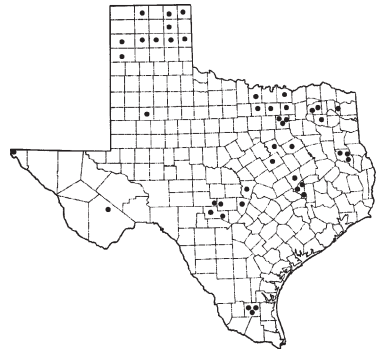
Chloris andropogonoides E. Fourn., (resembling *Andropogon*—bluestem), SLIM-SPIKE WINDMILL GRASS. Tufted perennial, 10–30(–40) cm tall, sometimes with short stolons; inflorescence branches 6–14, 3–15 cm long, usually in a single whorl, rarely with a second poorly developed whorl above first; lemma of fertile floret 1.9–2.7 mm long, glabrous or with inconspicuous appressed hairs; awn of lemma of fertile floret 1.9–5.2 mm long; reduced floret 0.9–1.7 mm long, obtuse apically but with awn 2.5–3.5 mm long. Prairies, open brushy areas, lawns, pastures, roadsides; Bexar, Caldwell, Fayette, Wilson (BRIT), DeWitt, Hays, and Travis (Turner et al. 2003) cos. in s part of East TX; also Gulf Prairies and Marshes, South TX Plains, and e Edwards Plateau;



Bromus pubescens



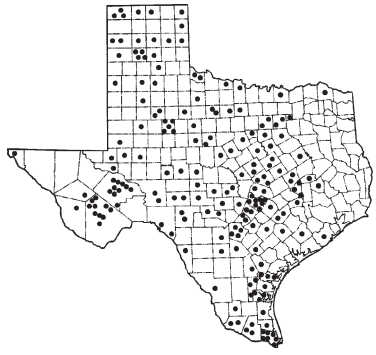
Bromus secalinus



Bromus tectorum



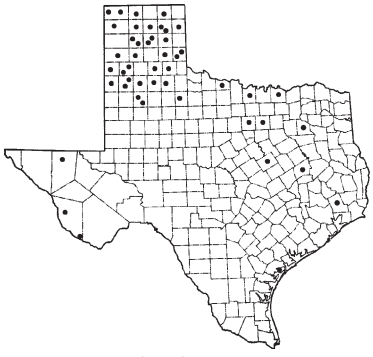
Bromus texensis



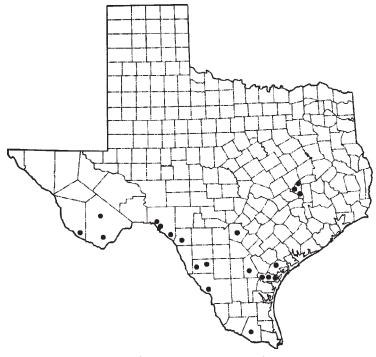
Buchloe dactyloides



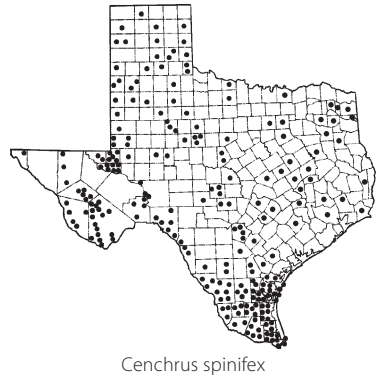
Cenchrus echinatus



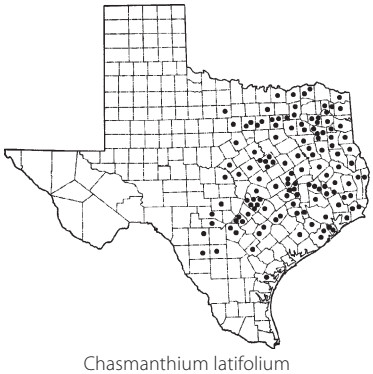
Cenchrus longispinus



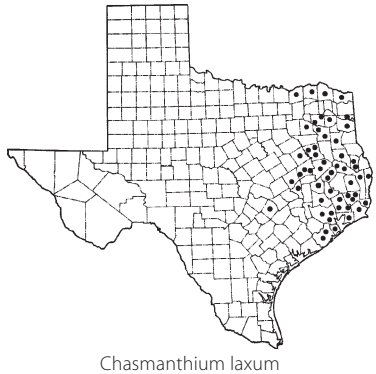
Cenchrus myosuroides



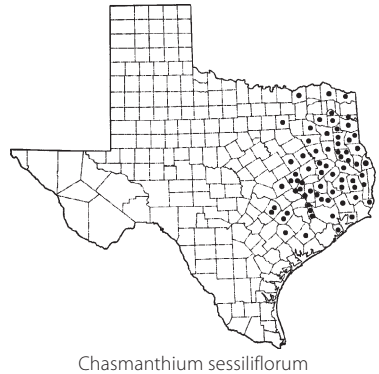
Cenchrus spinifex



Chasmanthium latifolium



Chasmanthium laxum



Chasmanthium sessiliflorum

in the U.S. known only from TX; also ne Mexico. May–Nov. This species is reported to hybridize with *C. cucullata* and *C. verticillata*, forming large populations that include morphological intermediates and introgressants (Anderson 1974; Gould 1975b; Barkworth 2003b). The species is reported to be poor forage (Hatch et al. 1999).

Chloris canterae Arechav., (for the collector, C.B. Cantera, who collected the type in South America), PARAGUAYAN WINDMILL GRASS. Tufted perennial to 100(–145) cm tall; inflorescence branches (2–)3–6(–9), 4–14 cm long, in a single whorl; lemma of fertile floret usually 3–3.7 mm long, the keel and margins with conspicuous cilia ca. 1–2(–3) mm long, with awn 2.4–5.5 mm long; reduced florets 2–3, the upper enclosed by the lowermost, the lowermost 1.1–1.8 mm long, turbinate, with awn 1.5–3.5 mm long. Roadsides; Burleson, Colorado, Harris, Milam (TAES), Bexar (Gould 1975b), Brazos, Lavaca (Turner et al. 2003), Montgomery, San Jacinto, and Walker (E. Keith, pers. comm.) cos.; mainly Gulf Prairies and Marshes and South TX Plains; LA and TX. Apr–Sep. [*C. carterae* var. *grandiflora* (Roseng. & Izag.) D.E. Anderson] Native of South America. The epithet is sometimes erroneously spelled "canterai" (e.g., Turner et al. 2003). While we are not recognizing infraspecific taxa (due to paucity of material to examine), Barkworth (2003b) recognized two varieties separated as follows and noted that both occur in LA and TX:

1. Leaves primarily cauline, 2.5–6 mm wide, flat; panicle branches 4–14 cm long _____ var. *canterae*
1. Leaves primarily basal, 1–1.5 mm wide, involute; panicle branches 3–6 cm long _____ var. *grandiflora*

Chloris ciliata Sw., (ciliate, fringed), FRINGED CHLORIS, FRINGED WINDMILL GRASS. Tufted perennial 25–60(–100) cm tall; inflorescence branches 3–5(–7), 2–6(–7) cm long, in a single whorl; lemma of fertile floret 1.8–2.8 mm long, the keel and margins with dense cilia ca. 0.5–1.3 mm long, with awn 0.9–1.4 mm long; reduced florets 2, the upper enclosed by the lower, the lower truncate, 1.3–1.8 mm long, awnless or with awn 1.4 mm or less long. Roadsides; Bexar Co. (TEX) at sw margin of East TX; mainly Gulf Prairies and Marshes and South TX Plains; NY (introduced) and TX (the species is mostly distributed in Latin America). Mar–Oct. [*C. ciliata* Sw. var. *texana* Vasey] This species has an interesting distribution—it is known from TX and Mexico through the Caribbean Islands and Central America, and then disjunct to Argentina (Barkworth 2003b).

Chloris cucullata Bisch., (hooded), HOODED WINDMILL GRASS, CROWFOOT GRASS, HOODED FINGER GRASS. Tufted perennial, 15–60(–90) cm tall; inflorescence branches 10–20, 2–5 cm long, in a single whorl (sometimes scattered over a distance of 2–5 mm); lemma of fertile floret broadly elliptic, 1.5–2 mm long, glabrous or with inconspicuous appressed pubescence, with awn usually 0.5–2 mm long; reduced floret conspicuously inflated, truncate, 1–1.5 mm long, awnless or with awn 1.5 mm or less long. Prairies, roadsides, open disturbed areas, often on sandy soils; widespread in sw part of East TX n to Limestone Co. (BRIT), also Nacogdoches Co. (Turner et al. 2003) in the Pineywoods; primarily w 2/3 of the state; sc U.S. in KS, NM, OK, and TX, and scattered to the e. Apr–Oct. Reported to be fair forage (Hatch et al. 1999). This species hybridizes with both *C. andropogonoides* and *C. verticillata* (Gould 1975b; Barkworth 2003b)—see *C. ×subdolichostachya*.

Chloris gayana Kunth, (for Jacques Etienne Gay, 1786–1864, French botanist), RHODES GRASS. Perennial 60–110(–300) cm tall, with stolons; inflorescence branches 9–30, 8–15(–20) cm long, usually in a single whorl, rarely with a second; spikelets rarely with a second fertile floret; lemma of fertile floret 2.5–4.2 mm long, somewhat gibbous (= swollen on 1 side), often with a tuft of hairs marginally near apex, sometimes merely inconspicuously appressed-pubescent, with awn 1.5–6.5 mm long; reduced florets (1–)2–4, similar to perfect floret but smaller, often tapering to apex, the lowermost 2.2–3.2 mm long and with awn 0.8–3.2 mm long. Cultivated as a forage grass, also in pastures and disturbed areas and escaping along roadsides; Limestone, Travis (BRIT), Harris, Williamson (TAES), Bexar, and Brazos (Turner et al. 2003) cos. in s part of

East TX; mainly Gulf Prairies and Marshes and South TX Plains; scattered mostly in the s 1/3 of the U.S. May–Dec. Probably native to e Africa. This species is reported to be a good forage (Hatch et al. 1999) and is important for this use in the tropics (Clayton & Renvoize 1986). It is "cultivated as a meadow grass in irrigated regions of the southwest" (Barkworth 2003b).

Chloris ×subdolichostachya Müll. Hal., (somewhat small-spiked), SHORT-SPIKE WINDMILL GRASS. Perennial, 30–70(–90) cm tall, stoloniferous; inflorescence branches 5–numerous, 3–17 cm long, in one whorl or apparently so (sometimes 2 very close together); lemma of fertile floret 2.2–2.9 mm long, not gibbous, with inconspicuous appressed pubescence, with awn 2–5 mm long; reduced floret variable, usually 0.5–1.4 mm wide, truncate, cuneate, or rounded apically. Disturbed sandy sites; scattered in much of e 2/3 of TX except Pineywoods; AZ, KS, LA, NM, and TX. May–Oct. [*Chloris latisquamea* Nash] While this taxon was previously recognized at the specific level as *C. subdolichostachya* (e.g., Gould 1970), we are following most recent authors (e.g., Jones et al. 1997; Kartesz 1999) who treated it as a hybrid: *C. ×subdolichostachya* [*C. cucullata* × *C. verticillata*]. It is widespread and reportedly highly fertile (Hatch et al. 1999). Barkworth (2003b) indicated that in s and c TX not only *C. cucullata* and *C. verticillata* but also *C. andropogonoides* hybridize and introgress. She suggested that the resulting plants "are best named as hybrids between their parents," rather than being treated as discrete taxonomic entities. However, for practical reasons we are continuing to recognize *C. ×subdolichostachya*. This taxon is reported to be fair to poor forage (Hatch et al. 1999).

Chloris texensis Nash, (of Texas), TEXAS WINDMILL GRASS. Tufted perennial, 30–45 cm tall, occasionally stoloniferous; inflorescence branches 8–10, to 20 cm long, in a single whorl; lemma of fertile floret 3.7–4.3 mm long, glabrous except for inconspicuous appressed pubescence marginally, with awn 7–11 mm long; reduced floret 2–2.5 mm long, acute, with awn 4.5–6.5 mm long. Rare on relatively bare areas in grassland remnants, roadsides, sandy to sandy loam soils; Harris (SBSC) and Brazos (TOES 1993; Carr 2002d noted that the Brazos report is "questionable") cos.; also Brazoria, Chambers, Galveston, Nueces, and Refugio cos. in the Gulf Prairies and Marshes, Hidalgo Co. in the South TX Plains (TOES 1993), and Jeff Davis Co. (Turner et al. 2003) in the Trans-Pecos; endemic to TX (Kartesz 1999; Carr 2002b, 2002c; Barkworth 2003b). Oct–Nov. Reported to be fair to poor forage (Hatch et al. 1999). Gould (1975b) indicated "Few specimens have been collected and most of these were collected over 30 years ago." (TOES 1993: V; RARE 2002a: G2S2SOC)

Chloris verticillata Nutt., (whorled), TUMBLE WINDMILL GRASS, WINDMILL FINGER GRASS. Tufted perennial to 40 cm tall; inflorescence branches 10–17+ per inflorescence, 5–15 cm long, in 2–5 whorls, the whorls typically separated by 5 mm or more; spikelets borne to base of inflorescence branches or nearly so (can be 3–5 mm from base); lemma of fertile floret 2–3.5 mm long, not gibbous, with only inconspicuous appressed marginal pubescence, with awn 4.8–9 mm long; reduced floret slightly inflated, truncate, 1.1–2.3 mm long, with awn 3.2–7 mm long. Disturbed clay or sandy sites, roadsides, waste places; widely scattered nearly throughout the state but more commonly on Blackland Prairie w through w 2/3 of the state; widespread in much of the U.S. except extreme se and nw. May–Oct. This species was a minor member of the original prairie. It increases under disturbance and serves as an indicator of overgrazed rangeland. It is reported to provide only fair to poor grazing (Powell 1994). The inflorescences detach basally and can act as "tumbleweeds" (Correll & Johnston 1970; Yatskievych 1999). *Chloris verticillata* hybridizes with *C. cucullata*, and forms extensive populations of intermediate plants (Gould 1975b)—see *C. ×subdolichostachya*.

Chloris virgata Sw., (wand-like), FEATHER FINGER GRASS, FEATHER WINDMILL GRASS, SHOWY CHLORIS. Annual, variable in size, 10–100+ cm tall; inflorescence branches 4–20, in a single whorl, 5–10 cm long; lemma of fertile floret 2.5–4.2 mm long, gibbous, appearing beaked apically, the keel and particularly the margins ciliate, the apical margins with abundant cilia

2–3 mm long (the inflorescences thus appearing bristly-woolly at arms length); lemma of fertile floret with awn 5–15 mm long; reduced floret 1(–2), similar to fertile except smaller, 1.4–2.9 mm long, with awn 3–9.5 mm long. Disturbed prairies, roadsides, waste places; widely scattered throughout TX; most of the s 2/3 of the U.S., scattered elsewhere. May–Nov. Reported to be fair to poor forage (Hatch et al. 1999) and "palatable to livestock" (Powell 1994).

CINNA L. WOOD REED

A C_3 genus of 4 species of the New World and temperate Eurasia, typically found in damp woods (Brandenburg ined.). The monotypic genus *Limnodea* is related to *Cinna* (from which it differs in various ways, including its annual habit, its smaller size, and its lemmas with long awns) and is sometimes treated in that genus (e.g., Tucker 1996; Yatskievych 1999). However, Brandenburg and Thieret (2000) stressed the differences between these genera and noted, "The inclusion of *Limnodea* in *Cinna* introduces a markedly discordant element into the latter small and well-circumscribed genus. The four currently recognized species of *Cinna* are quite similar to each other and all differ consistently from the monotypic *Limnodea* in several significant features....These genera are not congeneric." (Greek: *kinna*, old name for a grass—Hitchcock 1951 or Latin *cinna*, a grass from Cilicia—a Roman province in southeast Asia Minor, now part of Turkey—Brandenburg ined.) (subfamily Pooideae, tribe Poeae)

REFERENCES: Brandenburg 1980, ined.; Brandenburg et al. 1991c; Tucker 1996; Brandenburg & Thieret 2000.

Cinna arundinacea L., (resembling a reed), STOUT WOOD REED, WOOD REED, WOOD REED GRASS, SWEET WOOD GRASS. Tall perennial, somewhat bulbose basally; culms usually (0.3–)1–1.5(–1.8) m tall, glabrous; ligule a scale 2–11 mm long; leaf blades flat, 9–35 cm long, 3–19 mm wide; inflorescence a panicle 6.5–35(–55) cm long, loosely to densely-flowered, the branches ascending to spreading (sometimes drooping), with spikelets nearly to base; spikelets 1-flowered, flattened laterally, (3.5–)4–6(–7.5) mm long, disarticulating below glumes; lower glume shorter than lemma, 1-veined; upper glume equal to or slightly longer than lemma, 3-veined; lemma usually 3-veined, (2.7–)3.5–5(–6.4) mm long, with an awn 0.2–1.5 mm long (rarely absent) from minutely notched apex; palea 1-veined, shorter than lemma; stamen 1. Moist woodlands; Anderson, Harrison, Smith (BRIT), Grayson, and Henderson (J. Singhurst, pers. comm.) cos. in the n part of East TX, Brandenburg et al. (1991c) also mapped (without specific counties) the occurrence of this species in the ne part of East TX; se Canada and most of e U.S. w to ND and TX. Mostly Jul–Oct. [*C. arundinacea* var. *inexpansa* Fernald & Griscom] While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited and disjunct distribution in the state, we consider this species to be of conservation concern in TX. ⚠

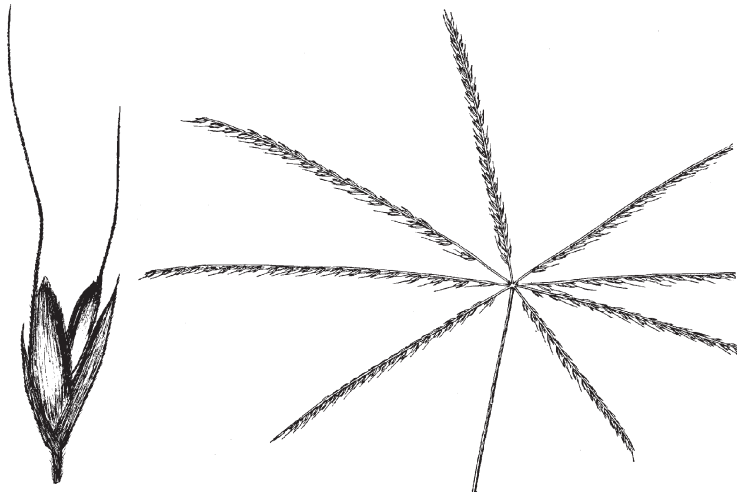
COELORACHIS Brongn. JOINT-TAIL

Perennials with or without rhizomes; ligule a short ciliate membrane; leaf blades flat, 8 mm or less wide; inflorescence a very slender, elongate, cylindrical, spike-like raceme (pencil-like but much smaller in diam.), breaking apart at the nodes of the inflorescence axis, the base of each internode with a niche on one side into which the spikelets fit closely; spikelets awnless, in pairs of 1 sessile and fertile and 1 pedicelled, reduced, and sterile; sessile spikelets with 2 florets, the lower sterile, the upper fertile; pedicels as broad as or broader than reduced spikelets.

A mainly tropical genus of ca. 20 species (Allen 2003b) related to *Rottboellia*, *Rhytachne* (Clayton & Renvoize 1986), and *Mnesithea* (Veldkamp et al. 1986). Generic boundaries among *Coelorachis* and its relatives have long been unsettled, and the species treated here have sometimes been put into *Manisuris* (e.g., Correll & Johnston 1970) or *Mnesithea* (e.g., Veldkamp et al. 1986; Jones et al. 1997; Hatch 2002; Turner et al. 2003). However, *Coelorachis* seems to be "sufficiently distinct to be maintained until more data are available" (Allen 2003b), and we are thus



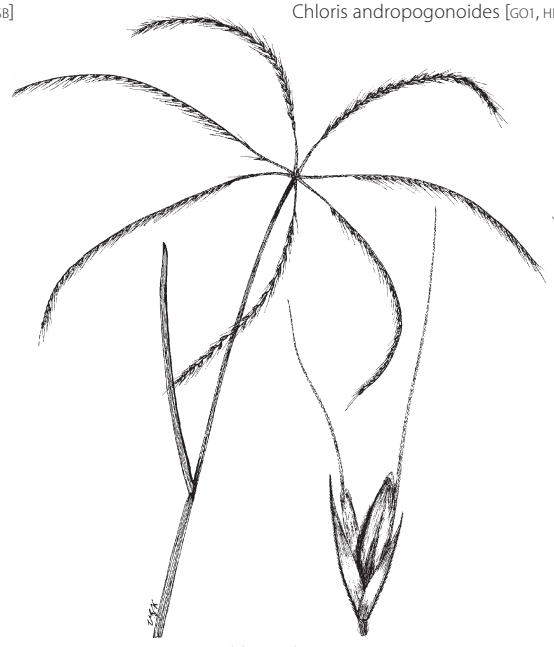
Chasmanthium sessiliflorum [USB]



Chloris andropogonoides [GO1, HI1]



Chloris canterae [GO1]



Chloris ciliata [USB]



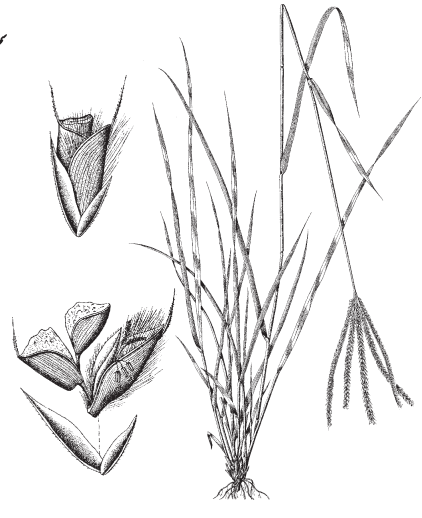
Chloris cucullata [USB]



Chloris gayana [GO1]



Chloris ×subdolichostachya [GO1]



Chloris texensis [GO1]

following J. Wipff (pers. comm.), Kartesz (1999), Yatskievych (1999), and Allen (2003b) in treating the species in *Coelorachis*. Like all members of the Andropogoneae, *Coelorachis* is characterized by C_4 photosynthesis (Kellogg 2000a). (Greek: *coelo*, hollow, and *rachis*, spine or backbone, possibly from the niches in the rachis (= inflorescence axis) into which the spikelets fit) (subfamily Panicoideae, tribe Andropogoneae)
REFERENCES: Clayton 1970; Veldkamp et al. 1986; Allen 2003b.

1. Leaf sheaths rounded or only slightly keeled; lower glume of sessile (fertile) spikelets ± pitted, the pits appearing ± as if in rows; sessile spikelets (4–)5–6 mm long _____ **C. cylindrica**
1. Leaf sheaths strongly keeled at least apically; lower glume of sessile (fertile) spikelets with irregular transverse ridges; sessile spikelets 3–4(–5) mm long _____ **C. rugosa**

Coelorachis cylindrica (Michx.) Nash, (cylindrical), CAROLINA JOINT-TAIL, JOINT GRASS. Glabrous perennial with hard-based, solitary or loosely clumped, erect to over-arched culms 25–100(–120) cm long; old plants with short, knotty rhizomes; ligule 0.5–1 mm long; leaf blades to 30 cm long, 1.5–4 mm wide; inflorescence 4–15 cm long, very slender (usually ca. 3 mm thick—sometimes to 6 mm wide if spikelets spreading); sessile spikelets (4–)5–6 mm long; pedicelled spikelets much smaller (1–2 mm long), rudimentary, less than half as long as pedicels; upper (fertile) lemmas of sessile spikelets 4–4.5 mm long. Prairies and open woods, sandy or clayey soils; widespread in e 1/2 of TX; se U.S. from NC s to FL w to KS and TX. Mostly May–Jul. An important component of certain native sandy prairies, including "mima mound" prairies. [*Manisuris cylindrica* (Michx.) Kuntze, *Mnesithea cylindrica* (Michx.) de Koning & Sosef] Jones et al. (1997) and Turner et al. (2003) treated this species as *Mnesithea cylindrica*.

Coelorachis rugosa (Nutt.) Nash, (wrinkled), WRINKLED JOINT-TAIL. Coarse perennial, glabrous; culms 75–130 cm tall, much-branched above, each branch terminating in an inflorescence; leaf blades to 35 cm long, 2–8 mm wide; inflorescence 4–8(–9.5) cm long, 2–2.5 mm thick (sometimes to ca. 3 mm wide if spikelets spreading); sessile spikelets 3–4(–5) mm long; pedicelled spikelets much reduced and rudimentary (1–3 mm long), shorter than pedicels; upper (fertile) lemmas of sessile spikelets 2–3 mm long. Moist soils, along streams, lakes, and other wet areas; Anderson (BRIT), Montgomery (TAES), Hardin, Harris, Tyler (SBSC); Angelina, Newton, Trinity (Turner et al. 2003), and Jasper (E. Keith, pers. comm., BAYLU, SBSC) cos. in the Pineywoods; also Galveston Co. (SBSC) in the Gulf Prairies and Marshes; se U.S. from NJ s to FL w to AR and TX. Mostly Jul–Oct. [*Manisuris rugosa* (Nutt.) Kuntze, *Mnesithea rugosa* (Nutt.) de Koning & Sosef] Jones et al. (1997) and Turner et al. (2003) treated this species as *Mnesithea rugosa*.

COIX L. JOB'S-TEARS

A genus of ca. 5 species of tropical Asia (Thieret 2003e). Like all members of the Andropogoneae, *Coix* is characterized by C_4 photosynthesis (Kellogg 2000a). Two of the species, primarily *C. lacryma-jobi*, are harvested for food in Asia. The position of *Coix* in the Andropogoneae is unclear; it has been variously linked with *Zea* and *Tripsacum* in phylogenetic studies using morphology (Kellogg & Watson 1993), or, using molecular data, either to a core group of Andropogoneae or to all other Andropogoneae as sister group (Mason-Gamer et al. 1998; Spangler et al. 1999; Kellogg 2000a). (Greek: *koix*, a kind of Egyptian palm, the name applied by Linnaeus to this genus) (subfamily Panicoideae, tribe Andropogoneae)
REFERENCES: Jain & Banerjee 1974; Cámara-Hernández & Gambino 1998; Thieret 2003e.

Coix lacryma-jobi L., (Job's-tears), JOB'S-TEARS. Large, branched, monoecious annual 1–1.5(–3) m tall; ligule membranous; leaf blades broad and flat, to 60(–75) cm long and 5(–6) cm wide; inflorescences numerous, long pedunculate from the axils of the upper leaves, each consisting of two parts: an ovoid to nearly globose, variously colored but often pearly-white or grayish, bead-like involucre (a modified sheathing bract) 6–13 mm long which contains the pistillate portion

of the inflorescence, and a staminate portion 2–4(–5) cm long which extends beyond the apical opening of the involucre; pistillate spikelets 3, 1 sessile and fertile and 2 pedicellate and sterile; staminate spikelets in pairs (or 3s) on the inflorescence axis, 1 of each group sessile, the other(s) pedicellate, each with 2 florets; awns absent; stamens 3. Cultivated ornamental, possibly escaping but probably only a yard weed; DeWitt (TAES) and Nacogdoches (Turner et al. 2003) cos.; CA, IA, LA, NM, PA, TN, and TX. Summer–fall. Native of se Asia, widely introduced in the tropics. Forms with the bead-like involucre or "false fruit" having a thin shell are used as food, especially in India and Burma, while forms having a hard shell are used as beads for jewelry and rosaries (Hitchcock 1951; Jain & Banerjee 1974; Mabberley 1997). The involucres "may be white, blue, pink, straw, gray, brown, or black, with the color being distributed evenly, irregularly, or in stripes" (Thieret 2003e). A cultivated form with yellow-striped leaf blades is known (Hitchcock 1951). This species is variously considered a significant weed, is cultivated as fodder, and is used for making flour (Watson & Dallwitz 1999).

CORTADERIA Stapf PAMPAS GRASS

Coarse perennials, dioecious, gynodioecious, or only pistillate; stems densely clumped, erect or nearly so, usually > 2 m tall; leaves mostly basal; ligule a tuft of hairs; inflorescence a large, showy, dense, plume-like panicle; spikelets compressed laterally, with 3–8 florets, the distal reduced and incomplete; disarticulation above glumes and between florets; glumes 2, awnless; lemmas awned to nearly awnless; stamens 3 in staminate florets.

A C_3 genus of 24–25 species (Astegiano et al. 1995; Allred 2003c) of coarse, clump-forming grasses mostly native to South America, with a few in New Zealand and New Guinea; it includes cultivated ornamentals and significant weeds. Recent molecular evidence (Barker et al. 2000) suggests that the genus as presently delimited may be polyphyletic and that the New and Old World species "represent different lineages, each of which merits generic recognition" (Allred 2003c). However, even if two genera are recognized, both species treated here would remain in *Cortaderia*. (From the Argentinian name, from Spanish: *cortada*, cutting, in reference to the sharply serrate blades—Allred 2003c) (subfamily Danthonioideae, tribe Danthonieae)
REFERENCES: Connor & Edgar 1974; Cowan 1976; Costas Lippmann 1977; Allred 1993a, 2003c; Astegiano et al. 1995; Barker et al. 2000; Linder & Barker 2000; Lambrinos 2001, 2002.

1. Leaf sheaths densely hairy; lemma awns 1 mm or less long; culm exceeding leaves, the inflorescence base usually well above the foliage; culm 4–5 times length of inflorescence _____ **C. jubata**
1. Leaf sheaths glabrous to sparsely hairy; lemma awns 2.5–5(–9) mm long; culm ± equaling the leaves, the inflorescence base only slightly, if at all, above the foliage; culm 2–4 times length of inflorescence _____ **C. selloana**

Cortaderia jubata (Lemoine) Stapf, (maned or crested, apparently in reference to inflorescence), PAMPAS GRASS, PURPLE PAMPAS GRASS. Plant 2–7 m tall, pistillate only, producing fruits asexually; leaf blades to 1 m or more long, with distal half not curved, the upper surface with pubescence basally; inflorescence 30–100 cm long; spikelets 14–16 mm long; stigmas included; $2n = 108$ (Allred 1993a). Open disturbed areas; included based on citation of Bexar, Brazos, Harris, and Hays cos. by Turner et al. (2003); also Cameron Co. (Turner et al. 2003) at s tip of TX; however, we have seen no naturalized TX material of this species; CA and TX. Native of Bolivia, Ecuador, and Peru. [*C. atacamensis* (Phil.) Pilg.] This species is capable of reproducing apomictically and invading open habitats (Allred 2003c.). It is considered a serious invasive weed in CA (Cowan 1976; Costas Lippmann 1977; Allred 2003c) and a noxious weed in HI (Kartesz 1999).

Cortaderia selloana (Schult. & Schult.f.) Asch. & Graebn., (for Friedrich Sellow, 1789–1831, German botanist who collected in South America), PAMPAS GRASS, URUGUAYAN PAMPAS GRASS. Dioecious or gynodioecious, coarse perennial to ca. 3(–4) m tall, forming large dense clumps to 2 m

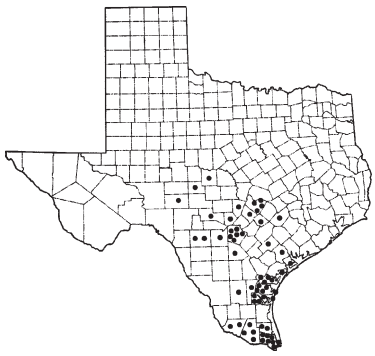
or more in diam.; leaf blades usually 0.6–1 m or more long, the distal half curved, with scabrous margins and midvein, the upper surface glabrous basally; inflorescence densely-flowered, conspicuously silvery-white, feathery, plume-like, 25–130 cm long; spikelets 15–17 mm long; pistillate lemmas with long silky hairs; staminate lemmas glabrous; stigmas exserted; $2n = 72$ (Allred 1993a). Allred (2003c) mapped several East TX localities; while we have seen no escaped East TX specimens, this species is widely cultivated throughout TX as an ornamental and long persists; Hatch et al. (1999) described it as "Relatively hardy but infrequent outside of cultivated areas" in the Gulf Prairies and Marshes; no county distribution map is provided; se Canada (Ont.) and scattered primarily in the s 1/2 of the U.S. Native to c South America. This species is considered a significant weed by some authorities (e.g., Watson & Dallwitz 1999), but there is little evidence of it becoming problematic in East TX. In 1977, Costas Lippmann noted that in CA it "shows few weedy tendencies." However, by 2001 Lambrinos found it to be capable of invading native plant communities in CA. Likewise, Allred (2003c) indicated that "It was thought that it would not become a weed problem because most plants sold as ornamentals are unisexual, but it is now considered an aggressive weed in California ..." ☞

CTENIUM Panz. TOOTHACHE GRASS

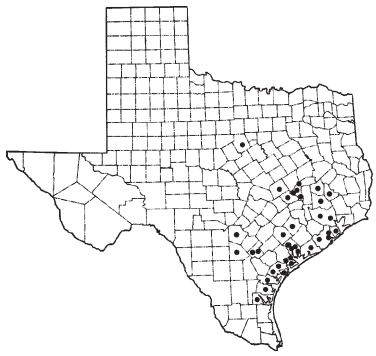
A C_4 genus of 17–20 species of tropical Africa, Madagascar, and tropical to subtropical areas of the New World. The species are typically found in savannah habitats (Barkworth 2003p). Barkworth (2003p) noted that the "awned upper glumes and the presence of sterile or staminate florets both below and above the fertile floret set it apart from other genera." (Greek: *ktenion*, a little comb, in reference to the comb-like inflorescence branches) (subfamily Chloridoideae, tribe Cynodonteae)

REFERENCES: Godfrey & Wooten 1979; MacRoberts & MacRoberts 1992; Barkworth 2003p.

Ctenium aromaticum (Walter) A.W. Wood, (fragrant), TOOTHACHE GRASS, ORANGE GRASS. Tufted perennial, typically with persisting, fibrous, old leaf bases; rhizomes lacking; tissues when fresh with a strong odor, variously described as turpentine-like or citrus-like; culms erect, to 120(–150) cm tall, the nodes glabrous, the internodes with minute pubescence; ligule a membrane 1–1.5 (–2.9) mm long; leaf blades to 46 cm long, 1–5 mm wide; inflorescence solitary, curved, dense, spike-like, 5–15 cm long, the axis extending slightly beyond the spikelets; spikelets sessile, in two rows, all conspicuously on one side of the inflorescence axis, at right angles to the axis, ca. 5–6 mm long excluding awns, the distal spikelets reduced; disarticulation above the glumes; glumes unequal, the upper much longer, ca. as long as spikelet, with glands adjacent to the midvein, with a conspicuously divergent (± at right angle to glume body) awn 3.5–4 mm long arising from the keel beyond its middle; lower 2 lemmas empty, awned; fertile floret solitary, the lemma pilose laterally, with a straight or divergent, subapical awn; 1–3 reduced lemmas also present distal to the fertile floret. Bogs, pine savannahs, and flatwoods; Newton Co. (*Singhurst 11,740*, BAYLU) at the e margin of East TX; no county distribution map is provided; se U.S. from VA s to FL w to TX. Summer–fall. [*Campulosus aromaticus* (Walter) Scribn.] TOOTHACHE GRASS is one of the native species most recently added to this volume. It was reported to us in Oct 2003 by J. Singhurst (pers. comm.). His find is an excellent example of targeted collecting—the species was long known from adjacent LA and thus expected from TX. A sustained search for the species in appropriate habitats resulted in this important addition to the TX flora. TOOTHACHE GRASS is reported to be highly fire-adapted, growing best in areas that burn on a 1–5 year cycle (MacRoberts & MacRoberts 1992; Barkworth 2003p); some authorities (Mabberley 1999) suggest that it flowers only after fire. The inflorescence branches "form curves, loops, and corkscrews, which are attractive in floral arrangements" (Barkworth 2003p). While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠



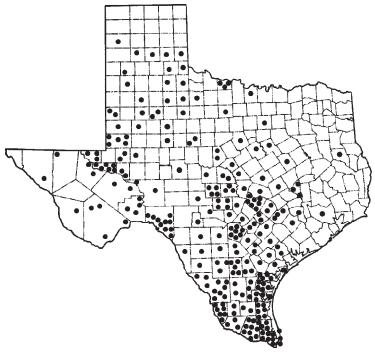
Chloris andropogonoides



Chloris canterae



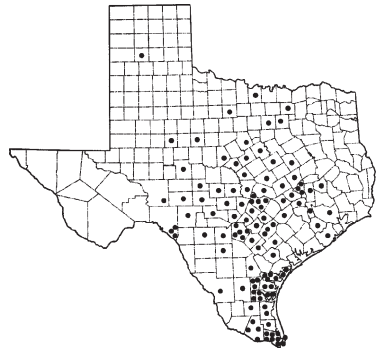
Chloris ciliata



Chloris cucullata



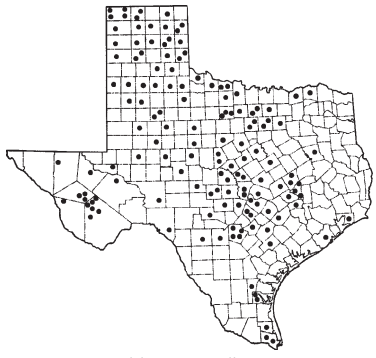
Chloris gayana



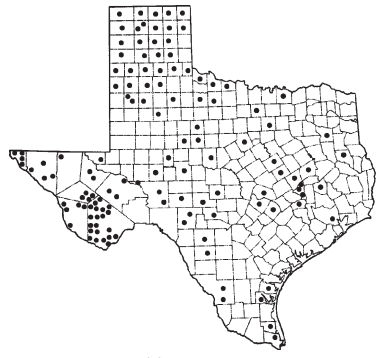
Chloris ×subdolichostachya



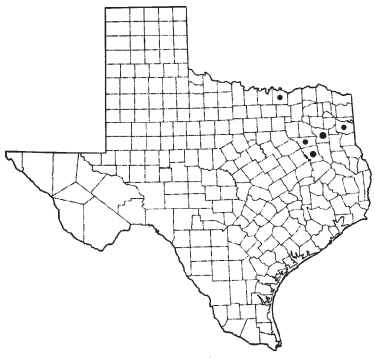
Chloris texensis



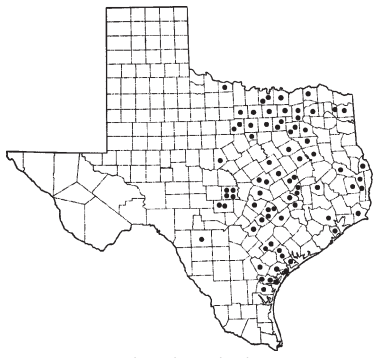
Chloris verticillata



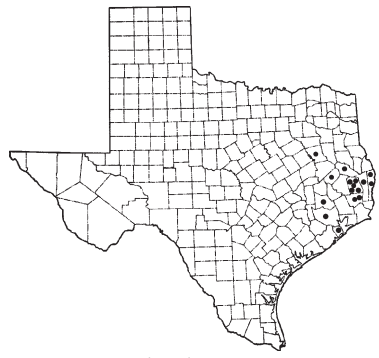
Chloris virgata



Cinna arundinacea



Coelorachis cylindrica



Coelorachis rugosa

CYNODON Rich. BERMUDA GRASS

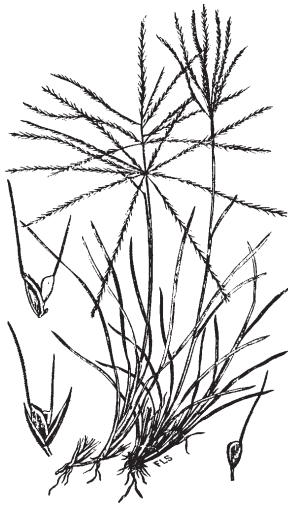
A C_4 genus of 9 species of tropical and warm areas of the Old World (Barkworth 2003e), which including pasture and lawn grasses and troublesome weeds. Recent molecular studies (Hilu & Alice 2000) indicate that *Cynodon* is related to *Chloris* and *Eustachys*. ☠ All species are reported to be potentially cyanogenic because of the glucoside dhurrin, which hydrolizes to hydrocyanic acid (HCN) in the rumen of livestock (Burrows & Tyrl 2001). At least some species of *Cynodon* have salt glands (= specialized epidermal structures for the excretion of excess salts from leaf tissue) and are halophytic (= tolerant of salty or alkaline conditions) (Oross & Thomson 1982). (Greek: *cyon*, dog, and *odous*, tooth, from the close rows of tooth-like spikelets or the hard scales on rhizomes) (subfamily Chloridoideae, tribe Cynodonteae)
REFERENCES: Harlan et al. 1969; de Wet & Harlan 1970a; Moreira 1984; Jones & Jones 1992; Barkworth 2003e.

Cynodon dactylon (L.) Pers., (fingered), BERMUDA GRASS, BAHAMA GRASS, STAR GRASS. Rhizomatous and stoloniferous, mat-forming perennial 10–40(–50) cm tall; culms mostly stoloniferous, with only inflorescence-bearing shoots erect; leaf blades 1–2(–5) mm wide; leaf sheaths compressed, keeled, with tufts of hairs at summit; lower leaf sheaths also pilose on back; ligule of hairs 0.2–0.5 mm long; branches of inflorescence (2–)3–5(–9), usually digitately arranged at tip of culm, 2–6(–8) cm long; spikelets with 1 perfect awnless floret, 1.7–2.5(–3.2) mm long, closely overlapping, in 2 rows on a flattened or triangular branch; disarticulation above the subequal glumes. Cultivated in TX since about 1882 for pasture and lawns (Mahler 1988), also a common weed throughout TX on roadsides, disturbed areas, gardens, and moist habitats; sw Canada (B.C.) and throughout most of the U.S. May–Oct. Native probably of Africa, but India has also been suggested (not from Bermuda, despite the common name). [*Capriola dactylon* (L.) Kuntze] This species was introduced to Georgia in 1751 and within 50 years was widespread in the e and se U.S. (Tellman 1997). It is an important cause of hay fever and is potentially poisonous to livestock due to the production of hydrocyanic acid under certain environmental conditions; it is also reported to cause photosensitization, staggers syndrome, and acute respiratory distress syndrome (ARDS) in livestock. The staggers syndrome (tremors, "head bob," head shaking, incoordination) may result from ergot-type alkaloids (see further discussion under *Paspalum*). ARDS (a pneumonia-like condition sometimes referred to as "fog fever") has affected cattle in East TX in spring and is apparently linked to a change in food (e.g., movement to a lush pasture) and an associated abrupt increase of l-tryptophan in the rumen of unaccustomed animals—this is converted to a toxin which causes pulmonary emphysema and edema (Lewis & Elvin-Lewis 1977; Fuller & McClintock 1986; Burrows & Tyrl 2001; Hart et al. 2001). BERMUDA GRASS is viewed as one of the world's worst weeds by some authorities (Holm et al. 1977) and affects a variety of crops including corn, cotton, and sugarcane (Holm et al. 1977; Moreira 1984). It is considered to be a noxious weed in AZ, CA, and UT (Kartesz 1999). However, BERMUDA GRASS is the most commonly used tropical lawn grass (Clayton & Renvoize 1986) and is one of the most important lawn and forage grasses in East TX. Improved hybrid strains are widely planted as pasture grasses; the species is salt- and alkali-tolerant (Hatch et al. 1999). ☠ ⊘ ☜

CYNOSURUS L. DOG-TAIL GRASS

An Old World C_3 genus of 8 species (Barkworth ined.) native to Europe, Asia, and Africa. Some species are used for pasture, hay, lawns, or playing fields; ⊘ others are considered serious weeds (Watson & Dallwitz 1999). (Greek: *cynos*, dog and *oura*, tail, referring to the shape of the panicle) (subfamily Pooideae, tribe Poeae)
REFERENCES: Tutin 1980; Tucker 1996; Yatskievych 1999; Thomas 2002; Barkworth ined.

Cynosurus echinatus L. (prickly), BRISTLY DOG-TAIL GRASS, SPINY DOG-TAIL GRASS, HEDGEHOG DOG-TAIL, ROUGH DOG-TAIL. Glabrous annual; flowering culms 30–60(–90) cm tall, ascending;



Chloris verticillata [USB]



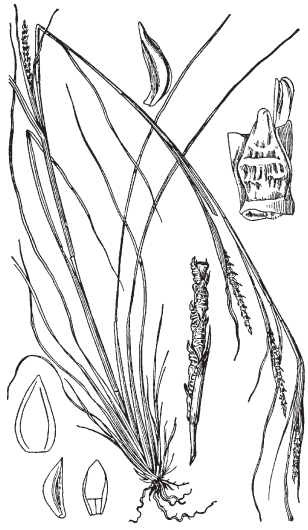
Chloris virgata [HI1]



Cinna arundinacea [USB]



Coelorachis cylindrica [HI1]



Coelorachis rugosa [HI1, USB]



Coix lacryma-jobi [HI1]



Cortaderia jubata [JEP]



Cortaderia selloana [EN2]



Ctenium aromaticum [HI1]

ligule membranous, 2.5–10(–13) mm long; leaf blades 3–6(–9 mm) wide; inflorescence a dense, ovoid to oblong, head-like, sometimes interrupted panicle 1–4(–7) cm long; spikelets in pairs, one sterile and one fertile, dissimilar (dimorphic), the sterile obscuring the fertile; sterile spikelets short-pedicelled, not disarticulating, with 8–14 florets, these composed solely of reduced lemmas, the lower lemmas often spreading and appearing well-separated; glumes and lemmas with bodies 1–3 mm long; lemma awn usually 4–10 mm long; fertile spikelets sessile, disarticulating above the glumes and between the florets, 7–10 mm long, with 2–3(–5) florets; glumes ± equal, slightly shorter than to nearly as long as the spikelet; lemmas with bodies 4–7 mm long; lemma awn usually 6–17 mm long; stamens 3. Cemeteries and other open disturbed areas; known in TX only from Walker Co. (*R.D. Thomas 129,383*, 1992, BRIT); most of the e U.S. w to MO, OK, and TX, also w coast of U.S. and Canada. May–Jun. Native of s Europe. This species was first collected in TX in 1992 and reported in the literature in 2002 (Thomas 2002); we know of no other TX collections. Some authorities consider this species to be a significant weed (e.g., Watson & Dallwitz 1999). ⊘ ☜

DACTYLIS L. ORCHARD GRASS

A C_3 Eurasian genus once considered to comprise 1–5 species, now typically treated as a variable monotypic genus (e.g., Tucker 1996; Allred ined.). Clayton and Renvoize (1986) considered the genus to be a segregate from *Poa*. (Greek: *dactylos*, finger; a name used by Pliny for a grass with digitate spikes or from the crowded spikelets at inflorescence tips) (subfamily Pooideae, tribe Poeae)

REFERENCES: Stebbins & Zohary 1959; Borrill 1961; Tucker 1996; Allred ined.

Dactylis glomerata L., (clustered), ORCHARD GRASS, COCK'S-FOOT. Erect, densely clumped perennial without rhizomes; culms to 1(–1.2) m tall; leaf sheaths closed for 1/2 or more of their length; ligule membranous, 2–7(–11) mm long; leaf blades 2–10 mm wide; panicles long-exserted, with few ascending or spreading branches, the spikelets nearly sessile in very dense head-like clusters at the ends of branches bare of spikelets in their lower portions (the spikelets in these clusters oriented ± to one side of the branch axis); spikelets usually with 2–5 flowers, ca. 5–9 mm long, disarticulating above the glumes and between the florets; glumes subequal to unequal; lemmas acuminate to short-awned; paleas shorter than lemmas; stamens 3. Roadsides, field margins, weedy yards; Grayson (first observed there in 1998—G. Diggs, pers. obs., BRIT), Harris (BRIT), Anderson, Brazos, Montgomery, Nacogdoches, and Travis (Turner et al. 2003) cos.; introduced as a forage grass, now a weed in scattered localities in TX; s Canada and nearly throughout the U.S. Spring–summer. Native to Eurasia and Africa. This species is now widely naturalized in cool temperate regions of the world and is an important cause of hay-fever. ORCHARD GRASS is considered a valuable pasture grass in temperate areas (Hatch et al. 1999), and numerous agricultural cultivars have been developed (Allred ined.). However, it is also considered by some to be a significant weed (Watson & Dallwitz 1992). It is complex genetically, including both diploid and tetraploid forms (Stebbins & Zohary 1959; Mabberley 1997). According to Allred (ined.), "Although several infraspecific taxa have been described, based generally on the size of the stomata and pollen, variation in pubescence, and panicle features, formal taxonomic recognition does not seem warranted." ☜

DACTYLOCTENIUM Willd. CROWFOOT

A primarily African and Australian C_4 genus of 10–13 species (Hatch 2003b), related to *Eleusine* (Werth et al. 1994). Most species grow on sandy soils, with some adapted to dune or saline habitats (Clayton & Renvoize 1986). (Greek *dactylos*, finger, and *ctenion*, a little comb, referring to the finger-like arrangement of the comb-like inflorescence branches) (subfamily Chloridoideae, tribe Cynodonteae)

REFERENCES: Peterson et al. 1997; Brandenburg 2003; Hatch 2003b.

Dactyloctenium aegyptium (L.) P. Beauv., (of Egypt), CROWFOOT, DURBAN CROWFOOT GRASS, EGYPTIAN CROWFOOT GRASS. Annual with culms mostly 10–60(–more) cm tall, often rooting at lower nodes; ligule a membrane usually 0.1–1 mm long, fringed with short hairs; leaf blades 2–9(–12) mm wide; inflorescences with 2–7(–more) digitately arranged branches usually 1.5–6 cm long; branch tip projecting 1–7 mm beyond terminal spikelets as a sharp point; spikelets sessile, very crowded, in 2 rows along one side of the narrow flattened branch, strongly laterally compressed, usually 3–4.5 mm long, with 3–5 perfect florets, disarticulating above the glumes; glumes 1.5–2 mm long; upper glume and lemmas usually with short awns 2.5 mm or less long; paleas ca. as large as lemmas. Usually sandy soils, moist areas, disturbed sites; widespread in s 1/2 of East TX; also Gulf Prairies and Marshes, South TX Plains, and e Edwards Plateau; widespread in the e and sw U.S. (Jul–)Sep–Dec. Native of the Old World tropics. This species is used in some parts of the world for lawns and playing fields, and in arid and semiarid areas it is considered an important pasture grass. It is also considered to be a significant weed (Watson & Dallwitz 1992) and is listed by some sources among the world's worst weeds (Holm et al. 1977). According to Hatch (2003b), "It is also considered a weed in southern Africa, but the seeds have been used for food and drink in times of famine. In addition, bruised young seeds have been used as a fish poison, and extracts are reputed to help kidney ailments and coughing (Koekemoer 1991)." Toxicity to human beings and livestock, resulting from the ingestion of seeds or leaves, has been reported (Holm et al. 1977), possibly due to the presence of cyanide (Burrows & Tyrl 2001). ?☠ ⊘ ☜

DANTHONIA DC. POVERTY-OATS, OAT GRASS, WILD OAT GRASS

Tufted perennials; leaves basal and on lower stem; ligule a short line of hairs ca. 1 mm or less long; leaf sheaths glabrous or with conspicuous pubescence, usually with a tuft of hairs on either side where blade attaches; inflorescence a small, usually narrow, almost spike-like raceme or few-branched panicle, the branches usually ascending; spikelets erect, with 3–8(–10) florets, disarticulating below the lowermost floret; glumes nearly equal, usually longer than rest of spikelet excluding lemma awns, 3- or 5- veined; lemmas usually sparsely hairy to villous, awned from between two acute or acuminate apical teeth, the awn flattened, geniculate, brownish, and spirally twisted near base.

☙ A C_3 genus of ca. 20 species of Europe, North Africa, and the Americas (Darbyshire 2003). Generic limits are controversial (Tomlinson 1985; Clayton & Renvoize 1986), with some authorities treating the genus much more broadly (e.g., 80–100 species—including *Rytidosperma*—e.g., Tucker 1990; Mabberley 1997). A number of species produce cleistogamous spikelets hidden in the leaf axils by the sheaths (Tucker 1990). (Named for Etienne Danthoine, an early 19th century French botanist of Marseilles) (subfamily Danthonioideae, tribe Danthonieae)
REFERENCES: Weatherwax 1928; Tomlinson 1985; Darbyshire & Cayouette 1989; Tucker 1990; Baeza 1996; Barker et al. 2000; Linder & Barker 2000; Darbyshire 2003.

1. Awn of lemma 10–12(–17) mm long; leaf sheath usually conspicuously pilose or villous; apical teeth of lemma 2–4(–5.5) mm long (awn arising between the teeth); lemma margins with hairs longest distally, the longest hairs 2.5–4 mm; glumes (10–)13–18(–20) mm long _____ **D. sericea**
1. Awn of lemma (3–)5–8 mm long; leaf sheath with tuft of hairs near junction with blade, otherwise glabrous or with inconspicuous hairs (sometimes pilose near base); apical teeth of lemma 0.5–2 mm long; lemma margins with hairs about equal in length proximally and distally, the longest hairs 2 mm or less long; glumes 7–13(–15) mm long _____ **D. spicata**

Danthonia sericea Nutt., (silky), DOWNY DANTHONIA, SILKY WILD OAT GRASS, DOWNY OAT GRASS. Tufted perennial to ca. 120 cm tall, similar to *D. spicata*; inflorescences usually 3.5–12 cm long; spikelets (10–)13–18(–20) mm long; lemmas usually 6–9 mm long including teeth, with margins densely long villous, the backs sometimes also villous. Sandy woods, roadsides; reported by Gould (1975b) in TX in the Pineywoods as "rare, in pine and mixed pine-hardwood forests."

The only TX record we know of is from Bowie Co. (*Cory 55951*, BRIT); se U.S. from NJ s to FL w to TX, and scattered in ne U.S. Apr–Jul. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

Danthonia spicata (L.) P. Beauv. ex Roem. & Schult., (with spikes), POVERTY-OATS, POVERTY DANTHONIA, POVERTY OAT GRASS, POVERTY WILD OAT GRASS, CURLY OAT GRASS. Tufted perennial 25–50(–100) cm tall, with crowded, mostly basal leaves; leaf blades persistent, 1–3(–4) mm wide, becoming dry and curling in age (making the rosettes recognizable even when flowers are not present); inflorescences usually short, 2–6.5 cm long, sometimes longer; spikelets 7–13(–15) mm long, on pedicels ca. 1–8 mm long; lemmas usually 3–7 mm long including teeth, sparsely villous on margins and back; spikelets with cleistogamous flowers are often hidden in the leaf axils (Weatherwax 1928; Yatskievych 1999). Sandy open woods; Angelina, Cherokee, Dallas, Grayson, Hunt, Lamar, Red River (BRIT), Bowie, Franklin, Freestone, Kaufman, Morris, and Van Zandt (Turner et al. 2003) cos. in n part of East TX; throughout most of Canada and most of the U.S. except extreme sw. May–Jul.

DESMAZERIA Dumort. FERN GRASS

A C_3 genus of 6–7 species (Barkworth & Campbell ined.) native to the Mediterranean region—Europe to n Africa and Iran; treated here as including *Catapodium*. Generic limits involving *Desmazeria* have been unsettled, and *Catapodium* (2 species) has sometimes been treated as a separate genus (e.g., Watson & Dallwitz 1992; Tucker 1996; Mabberley 1997). (Named for Jean Baptiste Henri Joseph Desmazières, 1786–1862, a French merchant, amateur botanist, and horticulturist—Barkworth & Campbell ined.) (subfamily Pooideae, tribe Poeae)
REFERENCES: Scholz 1974; Stace 1978, 1981; Brullo & Pavone 1985; Stace & Jarvis 1985; Tucker 1996; Barkworth & Campbell ined.

Desmazeria rigida (L.) Tutin, (rigid, stiff), FERN GRASS, Glabrous, tufted, small annual usually 10–30(–60) cm tall; ligule a membrane 1.5–4 mm long; leaf blades 1–3(–4) mm wide; panicles usually 3–12 cm long (rarely longer), narrow (5–15 mm wide), erect, dense, the branches with spikelets nearly to base, sometimes reduced to a raceme; spikelets (4–)5–9(–12)-flowered, (4–)5–7(–10) mm long, disarticulating above glumes and between florets; glumes and lemmas glabrous, awnless; glumes unequal; lemmas spreading, 2–3 mm long. Railroads, stock pens, roadsides, and disturbed areas; Brazos, Grimes, Hill, Jasper, Travis, Wilson (BRIT), Harris, Walker, Waller (SBSC), Bastrop, Fayette, Washington (Turner et al. 2003), and Ellis (Mahler 1988) cos.; scattered in e 1/2 of TX; scattered in the U.S., primarily in the se and far w. Apr–May. Native of Europe. Sometimes recognized in the genus *Catapodium* [as *C. rigidum* (L.) C.E. Hubb. ex Dony]. [*Poa rigida* L., *Scleropoa rigida* (L.) Griseb.] Some authorities consider this species to be a significant weed (e.g., Watson & Dallwitz 1992).

DIARRHENA P. Beauv. BEAKGRAIN

Rhizomatous perennials; culms arching; leaves basal and on lower stem; ligule a membrane; leaf blades flat; inflorescence a long-exserted, arching, narrow panicle with ascending branches; spikelets with 2–5(–7) florets, the terminal floret reduced and sterile, the florets often ± spreading at maturity; disarticulation above glumes and between florets; glumes 2, unequal, awnless; lemmas ± rounded on back, 3-veined, awnless, with a sharp cusp 1–2 mm long at apex; caryopsis (= fruit or grain) with a beak.

A C_3 genus of ca. 6 perennial species (Brandenburg ined.) of woodlands of e Asia and e North America, only 2 of the species are North American; this disjunct distribution pattern is discussed under the genus *Brachyelytrum* (Poaceae). Some authors, however, have treated the



Cynodon dactylon [REE]



Dactylis glomerata [HI1]



Dactyloctenium aegyptium [USB]



Cynosurus echinatus [YAT]



Danthonia sericea [USB]

Asian taxa in a separate genus, *Neomolinia* Honda (e.g., Tsvelev 1989, who recognized *Neomolinia* as having 5 species). Subfamilial classification of *Diarrhena* is problematic, with some authorities putting it in the Pooideae and others in the Bambusoideae (Brandenburg et al. 1991a); recent evidence suggests the appropriate placement is in the Pooideae (Grass Phylogeny Working Group 2001). The following key is from Brandenburg et al. (1991a). (Greek: *di,* two or twice, and *arrhen,* male, from the two stamens) (subfamily Pooideae, tribe Diarrheneae)
REFERENCES: Koyama & Kawano 1964; Macfarlane & Watson 1980; Tsvelev 1989; Brandenburg et al. 1991a; Brandenburg 2003, ined.

1. Callus on all mature lemmas except first [= lowest] pubescent; lemmas widest below the middle and gradually tapering into a cusp at apex, the lemma of first floret 7.1–10.8 mm long; mature fruits 1.3–1.8 mm broad, gradually tapering into a broad, blunt beak _____ **D. americana**
1. Callus on all mature lemmas glabrous; lemmas widest near or above the middle and ± abruptly contracted into cusp at apex, the lemma of first floret 4.6–7.5 mm long; mature fruits 1.8–2.5 mm broad, abruptly contracted into a bottlenose-shaped beak _____ **D. obovata**

Diarrhena americana P. Beauv., (of America), AMERICAN BEAKGRAIN. Culms ca. 0.6–1.3 m tall; leaf sheaths often hairy, sometimes only near summit; ligule a membranous collar 0.5–1.8 mm long; leaf blades 7–20 mm wide; inflorescences 9–30 cm long, with 4–23 spikelets; spikelets 10–20 mm long; lemmas usually 5.3–10.8 mm long, glabrous to minutely scabrous; anthers (1.7–)2–2.9(–3.5) mm long. Woodlands; this species has long been reported from TX based on a Reverchon collection from Dallas (Mahler 1988). However, the Dallas material is of the recently named, related species, *D. obovata* (Brandenburg et al. 1991a). Hatch et al. (1990) reported *D. americana* from the Pineywoods, but it is not known which species this citation represents; no county distribution map is provided. *Diarrhena americana*, native to the e U.S., is known from e OK but is unconfirmed for TX (Brandenburg et al. 1991a). It is included here to help clarify recent changes in the taxonomy of the genus. Summer–fall.

Diarrhena obovata (Gleason) Brandenburg, (obovate, inversely ovate), HAIRY BEAKGRAIN. Culms ca. 0.5–1.3 m tall; leaf sheaths usually glabrous; ligule 0.2–1 mm long; leaf blades 6–18 mm wide; inflorescences 5–30 cm long, with 4–33 spikelets; spikelets 7–17 mm long; lemmas 4.6–7.5 mm long, glabrous; anthers 1.4–2 mm long. Woodlands; Dallas Co. (Mahler 1988; Brandenburg et al. 1991a), collected by Reverchon in June 1874, in "rich woods, Buzzards Spring" (now in an e Dallas residential section), not found in TX since that time (Mahler 1988; cited as *D. americana*); the Dallas Co. location is the only one cited for TX by Brandenburg et al. (1991a); se Canada (Ont.) and e U.S. from NY s to VA w to SD and TX. Summer–fall. [*D. americana* var. *obovata* Gleason] While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

DICHANTHELIUM (Hitchc. & Chase) Gould
ROSETTE GRASS, PANIC GRASS

Annuals or perennials with or without rhizomes; plants with basal tuft or rosette of leaves present, these shorter and wider than those of the culms, produced from fall to spring and persistent; ligule usually a membrane, often ciliate or with a fringe of hairs; panicles terminal on mostly simple culms, produced in spring and early summer, a second crop of more numerous lateral or basal panicles (often of cleistogamous spikelets) produced in late summer or fall (descriptions are of spring phase only, autumnal phase often appears quite different); spikelets awnless, 2-flowered, the lower floret sterile or staminate, the upper floret perfect; glumes usually both present, the lower typically shorter; lemma of lower floret resembling upper glume; lemma of upper (perfect) floret firm to hardened, shiny and glabrous with margins inrolled.

A genus of approximately 72 (Freckmann & Lelong 2003a) to 120 (Watson & Dallwitz 1992) species of the Americas. They are morphologically similar to and often included in a broadly conceived *Panicum*. *Dichanthelium* has been recognized by Gould (1974), Gould and Clark (1978), Hatch (2002), and others on the basis of such characters as displaying an overwintering rosette of short broad leaves, uniformly having the C_3 photosynthetic pathway, and possessing spring chasmogamous inflorescences and small, axillary, autumnal or fall phase cleistogamous inflorescences. On the other hand, the overlap and blurring of these and other characters in *Panicum* and *Dichanthelium* in Central and South American taxa caused Zuloaga (1987) to question the generic recognition of *Dichanthelium*. However, it now seems clear based on cladistic analyses of molecular and morphological data (Gómez-Martínez & Culham 2000; Zuloaga et al. 2000; Giussani et al. 2001), that *Panicum* in the broad sense is not a monophyletic group, and that *Dichanthelium* should be recognized as a distinct genus. Without doubt, *Dichanthelium* is taxonomically one of the most difficult and complex genera of grasses in TX. Crins (1991) indicated that "Species distinctions are notoriously difficult..., mainly because of the confounding influences of autogamy and hybridization, which have led to the formation of many variants and morphological intermediates that usually breed true." The lack of agreement over specific and infraspecific concepts in the group is obvious when one considers the numerous differences between recent treatments by various experts (e.g., LeBlond 2001; Hatch 2002; Freckmann & Lelong 2003a). Because of the variation seen in some species in East TX and in order to facilitate proper identification, several will "key out" in more than one place in the key below. Some species are considered significant weeds (e.g., *D. clandestinum*—Watson & Dallwitz 1992). *Dichanthelium* and many related Paniceae have the fertile floret hardened and protected by the herbaceous glumes and sterile lemma—this has been suggested as a mechanism for internal dispersal by grazing animals (Davidse 1987a). (Greek: *di*, two or twice, and *anth*, flowering, in reference to the two flowering periods—Freckmann & Lelong 2003a) (subfamily Panicoideae, tribe Paniceae)

REFERENCES: Hitchcock & Chase 1910; Silveus 1942; Gould 1974, 1980; Clark & Gould 1975; Spellenberg 1975; Allred & Gould 1978; Gould & Clark 1978; Freckmann 1981a, 1981b; Lelong 1984, 1986; Zuloaga 1987; Hansen & Wunderlin 1988; Webster 1988, 1992; Webster et al. 1989; Crins 1991; Zuloaga et al. 1993, 2000; Wipff & Jones 1994 [1995]; Giussani et al. 2001; LeBlond 2001; Freckmann & Lelong 2003a.

1. Basal rosettes usually absent; bases of culms often hard, swollen, corm-like (less so in *D. nodatum*); spikelets 3.2–4.4 mm long, gradually tapering to a narrow base (= attenuate) and with papilla-based hairs (use dissecting scope).
   2. Leaf blades marginally papillose-ciliate to well beyond middle; lower glume appearing slightly separated from upper glume (due to narrowed base of upper glume); spikelets 3.5–4.4 mm long; plants of sandy soils _____ **D. nodatum**
   2. Leaf blades with only a few papilla-based hairs near base; lower glume not appearing separated from upper glume; spikelets (3.2–)3.5–3.9 mm long; plants of limey soils _____ **D. pedicellatum**
1. Basal rosettes usually present; bases of culms not corm-like; spikelets of various lengths, NOT BOTH tapering gradually to a narrow base AND with papilla-based hairs.
   3. Blades of basal and culm leaves usually all 15–40 times as long as wide, 1–5 mm wide; culms usually branched only near the base in the fall, with only 2–4 leaves above the basal rosette.
      4. Spikelets 1.7–2.1(–2.3) mm long; leaf blades soft, the margins usually ciliate, at least on the basal half; leaf sheaths pilose with widely spreading to slightly reflexed hairs _____ **D. laxiflorum**
      4. Spikelets 2.1–5 mm long; leaf blades stiff, the margins not ciliate; leaf sheaths glabrous or pilose with spreading to ascending hairs.
         5. Spikelets usually 3–4.8 mm long; upper (fertile) floret shorter than the ± beaked upper glume and lemma of lower floret _____ **D. depauperatum**

5. Spikelets usually 2.1–3 mm long; upper (fertile) floret as long as the beakless upper glume and lemma of lower floret _____ **D. linearifolium**

3. Blades of basal and lowest culm leaves 3–15 times as long as wide (blades of upper culm leaves up to 20 times), 2–40 mm wide; culms usually branched near the middle in the fall, with 3–14 leaves well-distributed along the culm above the basal rosette (except in *P. laxiflorum* and *P. strigosum* which have only 2–4 leaves).
6. Spikelets 2.4–5.2 mm long.
7. Nodes with a dense ring of widely spreading to reflexed hairs.
8. Spikelets 2.4–3.2 mm long.
9. Nodes with a broad, conspicuous, glabrous region just below a ring of hairs; culms usually 80–155 cm tall, stout (usually 2–5 mm thick); leaf blades (7–)9–25(–30) mm wide _____ **D. scoparium**
9. Nodes lacking a broad glabrous region; culms usually 20–80(–100) cm tall, slender (< 2 mm thick); leaf blades 13 mm or less wide.
10. Culm internodes and leaf sheaths (except margins) usually glabrous; spikelets 2.4(–2.6) mm or less long _____ **D. dichotomum**
10. Culm internodes and leaf sheaths with spreading to ascending or appressed hairs; spikelets 2.4–3 mm long.
11. Culm internodes with appressed to ascending hairs _____ **D. ovale**
11. Culm internodes with spreading hairs.
12. Hairs of culm internodes not papillose-based; leaf blades at mid-culm mostly 4–8 mm wide; spikelets attenuate basally _____ **D. consanguineum**
12. Hairs of culm internodes papillose-based; leaf blades at mid-culm mostly 8–12 mm wide; spikelets usually not attenuate basally, turgid _____ **D. malacophyllum**
8. Spikelets 3.6–5.2 mm long.
13. Leaf blades velvety-pubescent beneath, 8–16(–18) mm wide; ligule of hairs 2–4(–5) mm long; internodes with evident pubescence _____ **D. ravenelii**
13. Leaf blades not velvety-pubescent beneath, glabrous or with only scattered pubescence, 15–26(–40) mm wide; ligule essentially absent or to ca. 1 mm long; internodes glabrous OR sometimes with pubescence _____ **D. boscii**
7. Nodes glabrous OR with spreading to ascending hairs, but not a dense ring.
14. Leaf blades usually 13 mm or less wide.
15. Spikelets narrowly obovate, gradually tapering to a narrow base (= attenuate), 3.5–4.4 mm long _____ **D. nodatum**
15. Spikelets ovate, oblong, or slightly obovate, not tapering gradually to a narrow base, 2.4–4 mm long.
16. Hairs of ligule and adjacent hairs 2–6 mm long.
17. Spikelets usually 2.7–4 mm long; upper glume usually with an orange or purple spot at base _____ **D. oligosanthes**
17. Spikelets 2.4–3 mm long; upper glume usually without an orange or purple spot at base _____ **D. ovale**
16. Hairs of ligule absent or to 2 mm long.
18. Plants robust, the culms usually 90–150 cm tall; spikelets 2.4–2.9 mm long; leaf blades usually 15–25 cm long _____ **D. scabriusculum**
18. Plants relatively smaller, the culms 15–85 cm tall; spikelets 2.4–4 mm long; leaf blades usually 3–15(–20) cm long.
19. Leaf blades cordate-clasping at base; ligule ca. 0.3 mm long; spikelets 1.1–1.3 mm wide _____ **D. commutatum**
19. Leaf blades not cordate-clasping at base; ligule 0.5–2 mm long; spikelets 1.1–1.8 mm wide.

20. Internodes, particularly the lower ones, long-hairy, the hairs spreading to ascending or appressed; leaf blades with at least one surface pubescent; spikelets densely to sparsely pilose; upper glume usually without an orange or purple spot at base _____ **D. ovale**

20. Internodes glabrous to variously hairy; leaf blades glabrous or variously pubescent; spikelets glabrous to pubescent; upper glume with OR without an orange or purple spot at base.

21. Spikelets usually 2.7–4 mm long, 1.7–2.4 mm wide; lower glume similar to upper glume; upper glume usually with an orange or purple spot at base; leaf blades usually 4–12 (–15) mm wide _____ **D. oligosanthes**

21. Spikelets 2.4–2.8(–3) mm long, 1.2–1.8 mm wide; lower glume different than upper, usually thinner and more weakly veined; upper glume usually without an orange or purple spot at base; leaf blades usually 2–7(–8) mm wide _____ **D. aciculare**

14. Leaf blades (at least larger ones) usually 13–40 mm wide.

22. Leaf blades velvety-tomentose or puberulent beneath, glabrous or puberulent above; spikelets 2.4–2.8 mm long _____ **D. scoparium**

22. Leaf blades usually neither velvety-tomentose nor puberulent beneath (or if so, spikelets 3.4–4 mm long), often glabrous on both surfaces; spikelets 2.4–4 mm long.

23. Spikelets broadly elliptic to obovate, turgid, with heavy broad veins; leaf blades usually 4–12(–15) mm wide; upper glume usually with an orange or purple spot at base _____ **D. oligosanthes**

23. Spikelets narrowly elliptic to narrowly obovate, neither turgid nor strongly veined; leaf blades 8–40 mm wide; upper glume variable in color, yellowish green to greenish or purplish, but usually without an orange or purple spot at base.

24. Leaf sheaths, at least lower ones, papillose-hispid with spreading hairs, constricted at apex; culms with 5–10 cauline leaves _____ **D. clandestinum**

24. Leaf sheaths glabrous to puberulent or softly villous, not constricted apically; culms with 4–6 cauline leaves.

25. Spikelets 2.4–3.2 mm long, 1.1–1.3 mm wide; leaf blades usually < 10 cm long _____ **D. commutatum**

25. Spikelets (2.9–)3.3–3.9 mm long, 1.6–2 mm wide; leaf blades mostly 8–20 cm long _____ **D. latifolium**

6. Spikelets 0.8–2.4 mm long.

26. Leaf blades glabrous or nearly so, except near base or on margins.

27. Leaves mostly basal, the culms with only 2–4 leaves above the rosette, the basal leaves relatively similar to those of the culm; plants branched only at the base (culms unbranched).

28. Leaf sheaths glabrous or with ascending hairs 2 mm or less long; margins of leaf blades with papillose-based cilia _____ **D. strigosum**

28. Leaf sheaths pilose with widely spreading to slightly reflexed hairs 2–3.5 mm long; margins of leaf blades usually ciliate at least on the basal half but the cilia not papillose-based _____ **D. laxiflorum**

27. Leaves well-distributed along the culm (culms with 3–14 leaves), the basal ones different (shorter and/or wider) than those of the culm; plants often branched above the base.

29. Hairs of ligule and adjacent hairs (= pseudoligule), at least some, 2–6 mm long _____ **D. acuminatum**

29. Hairs of ligule 2 mm or less long.
    30. Plants robust, the culms usually 90–150 cm tall; spikelets 2.2–2.4 mm long; main inflorescences 10–21 cm long; leaf sheaths often mottled with pale spots _____ **D. scabriusculum**
    30. Plants relatively smaller, the culms 15–80 cm tall; spikelet length various but often less than 2.2 mm long; main inflorescences 2–12 cm long; leaf sheaths not mottled.
        31. Blades of larger culm leaves 6–30 mm wide, abruptly narrowed to subcordate or cordate basally, slightly auricled-clasping, with white cartilaginous margins.
            32. Leaf blades (at mid-culm) 15–30 mm wide, with evident veins, the uppermost leaf blades usually 10–15 cm or more long; culms erect or nearly so, usually with 4–7 cauline leaves; inflorescences < 1/2 as wide as long; species of the Pineywoods and Post Oak Savannah _____ **D. polyanthes**
            32. Leaf blades (at mid-culm) 6–13(–14) mm wide, with obscure veins, the uppermost leaf blades usually 3–9 cm long; culms decumbent or ascending, usually with 3–4(–6) cauline leaves; inflorescences > 1/2 as wide as long; species widespread in e 1/2 of TX and scattered to the w _____ **D. sphaerocarpon**
        31. Blades of larger culm leaves 3–10(–14) mm wide, narrowed or rounded basally, not auricled, without white cartilaginous margins (except with white margins in *D. tenue*).
            33. Spikelets 1–1.3 mm wide; leaf sheaths often (but not always) villous with long, spreading, sometimes papilla-based hairs; culm nodes not bearded _____ **D. aciculare**
            33. Spikelets 0.6–1 mm wide; leaf sheaths glabrous to pubescent, but without long spreading hairs; culm nodes bearded OR not so.
                34. Culm internodes and leaf sheaths usually puberulent, but sometimes glabrous; culm nodes not bearded; leaf blades 2.5–6(–8) mm wide; spikelets ± attenuate basally (= tapering to a narrow base) _____ **D. portoricense**
                34. Culm internodes and leaf sheaths (except the margins) glabrous; culm nodes often (but not always) with a beard of spreading hairs; leaf blades 5–15 mm wide; spikelets not attenuate basally.
                    35. Leaf blades of lower culm commonly more than 5 cm long or more than 4.5 mm wide; spikelets 1.5–2.4 mm long; culms (20–)40–80(–100) cm tall, usually > 1 mm thick __ **D. dichotomum**
                    35. Leaf blades of lower culm usually 5 cm or less long and 4.5(–6) mm or less wide; spikelets 1.1–1.7 mm long; culms to only 40(–55) cm tall, usually < 1 mm thick.
                        36. Margins of leaf blades thin, green; spikelets glabrous or sparsely puberulent; culms reclining or weakly erect, usually with 4–9 leaves _____ **D. ensifolium**
                        36. Margins of leaf blades with cartilaginous, usually whitish border; spikelets puberulent, often densely so; culms erect from geniculate base, with 3–4 leaves _____ **D. tenue**

26. Leaf blades sparsely to densely pubescent or pilose over one or both surfaces.
    37. Culms usually with only 2–4 leaves (most leaves at base of plant), unbranched; leaf blades with margins coarsely ciliate to beyond the middle _____ **D. strigosum**
    37. Culms with more than 3 leaves (most leaves not at base of plant), often branched; leaf blades with margins not ciliate to beyond the middle.
        38. Spikelets 0.8–2.1 mm long.
            39. Spikelets 0.8–1.1 mm long, puberulent to subglabrous; culms delicate, 0.3–0.8 mm thick; plants of bogs, wetland pine savannahs, and other wet habitats _____ **D. wrightianum**
            39. Spikelets 1.1–2.1 mm long, variously pubescent; culms delicate or not so; plants of wet to dry habitats.
                40. Spikelets 1.1–2.1 mm long; leaf sheaths glabrous or with hairs 3 mm or less long _____ **D. acuminatum**
                40. Spikelets 1.8–2.4 mm long; leaf sheaths with hairs usually more than 4 mm long _____ **D. ovale** subsp. **praecocious**
        38. Spikelets 2.1–2.4 mm long.
            41. Leaf sheaths with widely spreading or reflexed hairs 2–6 mm long _____ **D. ovale** subsp. **villosissimum**
            41. Leaf sheaths with appressed to ascending or spreading hairs ca. 2 mm long or less.
                42. Culm internodes glabrous or slightly hairy; culm nodes glabrous or slightly hairy _____ **D. scabriusculum**
                42. Culm internodes definitely hairy; culm nodes usually with a dense ring of hairs.
                    43. Culm nodes with a broad conspicuous glabrous region in addition to (below) a ring of hairs; culms usually 80–155 cm tall, stout (usually 2–5 mm thick) _____ **D. scoparium**
                    43. Culm nodes lacking a broad glabrous region; culms usually 80 cm or less tall, slender (< 2 mm thick)
                        44. Ligule (1–)1.5–6 mm long; spikelets not attenuate basally _____ **D. ovale**
                        44. Ligule absent or less than 1 mm long; spikelets ± attenuate basally _____ **D. consanguineum**

Dichanthelium aciculare (Desv. ex Poir.) Gould & C.A. Clark (bristle-like), NEEDLE-LEAF ROSETTE GRASS, NARROW-LEAF PANIC GRASS. Plant 15–75 cm tall; culms glabrous or variously hairy, but the nodes usually not bearded; leaves with lower sheaths usually sparsely to moderately villous, the upper sheaths and blades glabrous or variously hairy; leaf blades usually 2–7(–8) mm wide; panicles not contracted (and branches not appearing one-sided) or panicles contracted (and branches appearing one-sided); spikelets 1.7–2.8(–3) mm long. Sandy woods, prairies; e U.S. from MD s to FL w to MO, OK, and TX, also MN. Apr–Jun, also late summer–fall. Freckmann and Lelong (2003a) noted that this species can hybridize with *D. acuminatum*, *D. consanguineum*, *D. dichotomum*, *D. ovale*, and *D. portoricense*, which can "apparently lead to some intergradation with these species." This emphasizes the complexity encountered in *Dichanthelium*. According to Gould (1975b), relatively glabrous plants of *D. aciculare* [treated by him as *D. angustifolium*] resemble *D. dichotomum* (but *D. aciculare* in general has larger spikelets and more pubescent herbage). The variation within *D. aciculare* has variously been given no formal recognition (e.g., Allred & Gould 1978; Gould & Clark 1978) or recognized at the varietal, subspecific (Freckmann & Lelong 2003a), or specific levels (e.g., Lelong 1986). Because the variants are not well-separated geographically, we are following Wipff and Jones (1994 [1995]) and Hatch (2002) in recognizing varieties. Larry Brown (pers. comm.) notes that there are East TX plants intermediate between var. *aciculare* and var. *angustifolium*. Brown

(pers. comm.) also reports that some East TX specimens have the contracted panicles typical of the taxon recognized by Freckmann and Lelong (2003a) as *D. aciculare* subsp. *neuranthum* (Griseb.) Freckmann & Lelong. Even though this taxon has not been formally reported for TX (e.g., Hatch 2002), it is possible that it is a member of the East TX flora. The following key is modified from Lelong (1986) and Freckmann and Lelong (2003a):

1. Spikelets 1.7–2.3 mm long, blunt; leaf blades 3.5–6(–8) cm long and to 4 mm wide _____ var. **aciculare**
1. Spikelets 2.4–2.8(–3) mm long, often pointed or beaked; leaf blades (5–)6–16 cm long and to 7 (–8) mm wide _____ var. **angustifolium**

var. **aciculare**. Culms usually 35 cm or less tall. An Angelina Co. (BRIT) specimen is the only one for East TX we have seen that is var. *aciculare*; L. Brown (pers. comm.) notes that a Hardin Co. collection is also of this variety. [*Panicum aciculare* Desv. ex Poir., *Panicum ovinum* Scribn. & J.S. Sm.] While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this variety to be of conservation concern in TX. ⚠

var. **angustifolium** (Elliott) S.L. Hatch, (narrow-leaved). Culms usually 35–75 cm tall. Widespread in e 1/3 of TX, with a few locations scattered to the w; almost all East TX specimens of this species that we have seen are of var. *angustifolium*. [*D. angustifolium* (Elliott) Gould, *Panicum aciculare* Desv. ex Poir. var. *angustifolium* (Elliott) Wipff & S.D. Jones, *Panicum aciculare* var. *arenicoloides* (Ashe) Beetle, *Panicum angustifolium* Elliott, *Panicum arenicoloides* Ashe] The fruits are reportedly dispersed by ants, which are apparently attracted to a substance (possibly an oil) found under the first glume (Gaddy 1986).

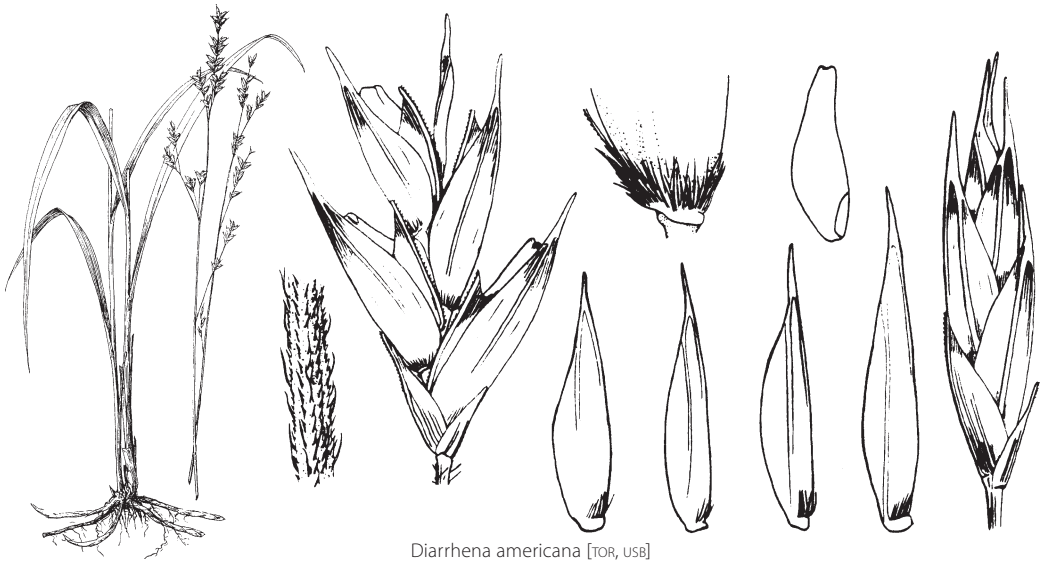
Dichanthelium acuminatum (Sw.) Gould & C.A. Clark (long-pointed, tapering to tip). Plant 10–70(–90) cm tall, ranging from densely villous to ±glabrous; hairs of ligule and adjacent hairs (= pseudoligule) usually 1.5–6 mm long, at least some usually 2 mm or more long (ligule length is often critical in distinguishing this from other species); leaf blades usually 3–12 mm wide; spikelets 1.1–2.1 mm long. Apr–Jun, again late summer–fall. According to Lelong (1986), *D. acuminatum* is "probably the most polymorphic and troublesome species in the genus." After examining numerous specimens of *D. acuminatum*, it is not clear what the best approach is for describing the variation seen in it and its relatives—different authors have taken radically different approaches. This is an excellent example of evolutionary processes resulting in a pattern of variation not easily divided into distinct taxa. Some authorities (e.g., Freckmann 1981a) recognized as distinct species some taxa that are here recognized as varieties (e.g., *D. longiligulatum*). Yatskievych (1999), on the other hand, submerged a number of taxa (including *D. ovale* var. *villosissimum*) into *Panicum acuminatum* var. *acuminatum*. Hatch (2002) treated *D. consanguineum* as *D. acuminatum* var. *consanguineum*. Freckmann and Lelong (2003a) took a still different approach and treated *D. acuminatum* as being composed of 10 subspecies. This species exhibits extensive geographic variation and has numerous local "microspecies" associated with autogamous reproduction (Freckmann 1981a). As a result, until a detailed study of the group throughout its range is carried out (hopefully using molecular techniques), it is highly likely that various state and regional floras will differ in the number of species and/or varieties recognized. We have attempted to give formal recognition to taxa that can be reasonably and consistently separated—having said this, we warn that intermediates are definitely to be expected. Several taxa sometimes treated as belonging to *D. acuminatum* are excluded from that species here. Because of its consistently small spikelet size (a critical character in *Dichanthelium* taxonomy), we are recognizing *D. wrightianum* as a distinct species. Also, based on recent work by Freckmann and Lelong (2003), we are treating the taxon that had previously been recognized as *D. acuminatum* var. *villosum* as *D. ovale* subsp. *villosissimum*—spikelet size supports this view. On the other hand, we are synonymizing several varieties (*fasciculatum*, *implicatum*, *thurowii*) with *D. acuminatum* var. *acuminatum*. Because of the intergrading patterns of variation, it seems most reasonable to recognize the following infraspe-



Danthonia spicata [USB]



Diarrhena obovata [TOR]



Diarrhena americana [TOR, USB]



Desmazeria rigida [BR2]



Dichanthelium aciculare [HI1]

cific taxa at the varietal level (these are not distinguished on the county distribution map). The following key to varieties is modified from Gould and Clark (1978).

1. Culms definitely hairy; sheaths of culm leaves, at least the lower ones, definitely hairy (pilose to villous), with ascending to spreading hairs; spikelets 1.2–2.1 mm long _____ var. **acuminatum**
1. Culms glabrous or the lower portions slightly hairy; sheaths of culm leaves glabrous or the lowermost sparsely hairy; spikelets 1.1–1.8 mm long.
   2. Spikelets 1.1–1.4 mm long _____ var. **longiligulatum**
   2. Spikelets 1.4–1.8 mm long.
      3. Panicle narrow, congested, 1/4–1/3 as broad as long, commonly 8–12 cm long _____ var. **densiflorum**
      3. Panicle broad, open, from 2/3 to nearly as broad as long, commonly 5–8 cm long _____ var. **lindheimeri**

var. **acuminatum**. WOOLLY ROSETTE GRASS, WOOLLY PANIC. Plant usually pilose to villous. Sandy open woods; most common in e 1/2 of TX but widespread in the state; s Canada and nearly throughout the U.S. [*D. acuminatum* (Sw.) Gould & C.A. Clark var. *fasciculatum* (Torr.) Freckmann, *D. acuminatum* subsp. *fasciculatum* (Torr.) Freckmann & Lelong, *D. acuminatum* var. *implicatum* (Scribn.) Gould & C.A. Clark, *D. acuminatum* var. *thurowii* (Scribn. & J.G. Sm.) Gould & C.A. Clark, *D. lanuginosum* (Elliott) Gould, *Panicum acuminatum* Sw., *Panicum acuminatum* var. *fasciculatum* (Torr.) Lelong, *Panicum auburne* Ashe, *Panicum huachucae* Ashe, *Panicum lanuginosum* Elliott, *Panicum tennesseense* Ashe, *Panicum thurowii* Scribn. & J.G. Sm.]

var. **densiflorum** (E.L. Rand & Redfield) Gould & C.A. Clark, (densely-flowered), EATON'S ROSETTE GRASS. Plant usually glabrous. Moist or wet areas such as bogs and pine savannahs; Houston, Liberty, and Upshur (BRIT) cos.; Pineywoods, also Gulf Prairies and Marshes; se Canada and e U.S. w to MI and TX. [*D. acuminatum* subsp. *spretum* (Schult.) Freckmann & Lelong, *Panicum nitidum* var. *densiflorum* E.L. Rand & Redfield, *Panicum spretum* Schultes] According to Freckmann and Lelong (2003), this taxon resembles *D. dichotomum* in size and overall habit.

var. **lindheimeri** (Nash) Gould & C.A. Clark, (for Ferdinand Jakob Lindheimer, 1801–1879, German born TX botanist), LINDHEIMER'S ROSETTE GRASS, LINDHEIMER'S PANIC. Plant nearly glabrous or with sparse pubescence. Sandy or rocky ground, in sun or shade; Pineywoods and Gulf Prairies and Marshes w to West Cross Timbers, also Edwards Plateau; se Canada and e 1/2 of the U.S., also CA, NM, and OR. [*D. lanuginosum* (Elliott) Gould var. *lindheimeri* (Nash) Fernald, *D. lindheimeri* (Nash) Gould, *Panicum acuminatum* Sw. var. *lindheimeri* (Nash) Lelong, *Panicum lanuginosum* (Elliott) Gould var. *lindheimeri* (Nash) Fernald, *Panicum lindheimeri* Nash] Similar to *D. dichotomum* (Gould 1975b) but differing in having a ligule ca. 1.5–6 mm long (versus 1 mm or less in *D. dichotomum*).

var. **longiligulatum** (Nash) Gould & C.A. Clark, (with long ligules), COASTAL PLAIN ROSETTE GRASS. Similar to var. *densiflorum* but panicles to 3/4 as broad as long and with smaller spikelets. Moist or wet areas such as bogs and pine savannahs; Panola Co. (BRIT) in the Pineywoods; se Canada and widespread in the e U.S. [*D. acuminatum* subsp. *longiligulatum* (Nash) Freckmann & Lelong, *D. longiligulatum* (Nash) Freckmann, *Panicum longiligulatum* Nash, *Panicum acuminatum* var. *longiligulatum* (Nash) Lelong] While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this variety to be of conservation concern in TX. ⚠

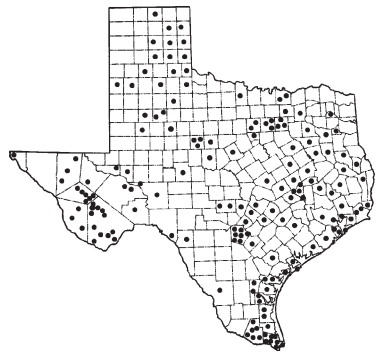
Dichanthelium boscii (Poir.) Gould & C.A. Clark (for its discoverer, Louis Augustin Guillaume Bosc, 1759–1828, French naturalist), BOSC'S PANIC GRASS. Plant ca. 40–75 cm tall; culm nodes densely bearded; leaf sheaths and blades glabrous or with only scattered pubescence; ligule essentially absent or to ca. 1 mm long; leaf blades 15–26(–40) mm wide; spikelets (3.7–)4–5.2 mm long. Wooded or low areas; widespread in Pineywoods and w in Red River drainage to Lamar Co. (Carr 1994); also n Gulf Prairies and Marshes; e U.S. from CT s to FL w to KS and TX. Apr–Jul, also fall. [*Panicum boscii* Poir.] The fruits are reportedly dispersed by ants, which are apparently attracted to a substance (possibly an oil) found under the first glume (Gaddy 1986).



Coix lacryma-jobi



Cortaderia jubata



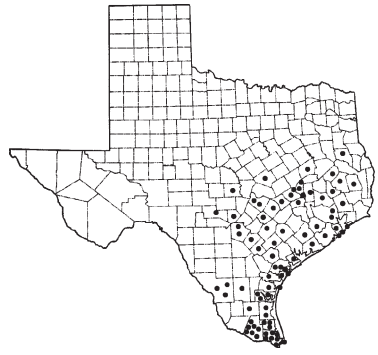
Cynodon dactylon



Cynosurus echinatus



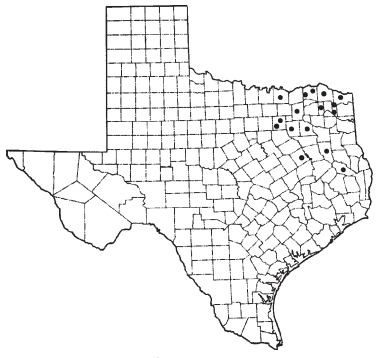
Dactylis glomerata



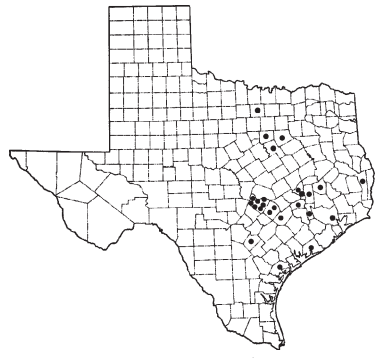
Dactyloctenium aegyptium



Danthonia sericea



Danthonia spicata



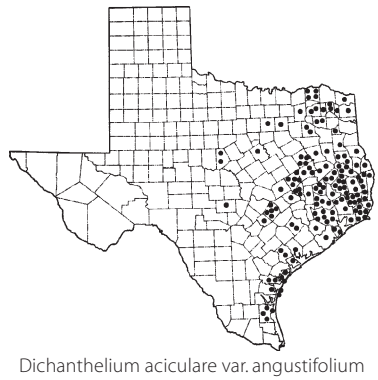
Desmazeria rigida



Diarrhena obovata



Dichanthelium aciculare var. aciculare



Dichanthelium aciculare var. angustifolium

Dichanthelium clandestinum (L.) Gould, (hidden), DEER-TONGUE, DEER-TONGUE ROSETTE GRASS. Plant 40–80(–140) cm tall; leaf blades usually (12–)15–30 mm wide; leaf sheaths, at least lower ones, papillose-hispid with spreading hairs; spikelets (2.3–)2.7–3.5(–4) mm long. Sandy woods; Bowie (BRIT) and Polk (Turner et al. 2003) cos., also collected at Dallas by Reverchon in 1875, not found there since (Mahler 1988), also reported for n portions of Pineywoods and Post Oak Savannah (Gould 1975b); se Canada and e U.S. w to IA and TX. Apr–Jun, again late summer–fall. [*Panicum clandestinum* L.] The stiff hairs of the leaf sheath are reported to be irritating to the skin (Gould & Clark 1978); L. Brown (pers. comm.) notes that this feature is lost on herbarium material. This species is similar to *D. latifolium* (Gould & Clark 1978), but it can be distinguished by its papillose-hispid leaf sheaths (versus glabrous or softly villous in *D. latifolium*). Hybrids with *D. dichotomum*, *D. scabriusculum*, and possibly *D. scoparium* are known (Freckmann & Lelong 2003a). While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

Dichanthelium commutatum (Schult.) Gould (variable, changing), VARIABLE ROSETTE GRASS. Culms (15–)40–75 cm tall; leaf sheaths glabrous or pubescent on the margins; larger leaf blades cordate-clasping at base, usually < 10 cm long, occasionally to 15 cm, 8–25 mm wide; spikelets usually 2.4–3.2 mm long, sometimes purplish. Moist areas or deep shade, sandy soils; widespread in East TX; also n Gulf Prairies and Marshes; widespread in the e U.S. w to MI and TX. Apr–Jun, again late summer–fall. [*D. commutatum* subsp. *ashei* (G. Pearson ex Ashe) Freckmann & Lelong, *D. commutatum* subsp. *equilaterale* (Scribn.) Freckmann & Lelong, *D. commutatum* subsp. *joorii* (Vasey) Freckmann & Lelong, *Panicum commutatum* Schult., *Panicum divergens* Kunth] Some authorities (e.g., Freckmann & Lelong 2003a) recognize infraspecific taxa in this species; they are reported to intergrade where they occur together.

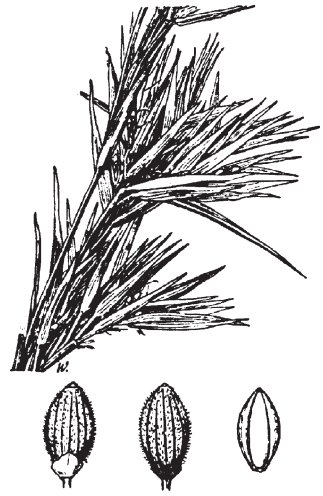
Dichanthelium consanguineum (Kunth) Gould & C.A. Clark, (related, close of kin), BLOOD ROSETTE GRASS, KUNTH'S PANIC GRASS. Culms 10–60 cm tall, the nodes bearded, the internodes villous; ligule absent or less than 1 mm long; leaf blades 4–8 mm wide; spikelets 2.4–3 mm long, densely pubescent, ± attenuate basally. Sandy soils, open woods; Angelina, Bastrop, Freestone, Hardin, Liberty, Nacogdoches, Newton (BRIT), Austin, Gonzales, Henderson, Leon, Montgomery, Polk, Robertson (TAES—annotated by S. Hatch), Harris, Jasper, and Jefferson (Turner et al. 2003) cos.; also n Gulf Prairies and Marshes; e U.S. from VA s to FL w to OK and TX. Apr–Jun, also summer–fall. [*Panicum consanguineum* Kunth] This species was treated as *D. acuminatum* var. *consanguineum* by Wipff and Jones (1994 [1995]) and Hatch (2002), and it indeed is similar to that species. However, its ligules are consistently shorter and its spikelets are typically larger than those of *D. acuminatum*. We are therefore following Gould and Clark (1978), Freckmann (1981a), Allen (1992b), and Freckmann and Lelong (2003a) in treating *D. consanguineum* as a separate species. According to Gould and Clark (1978), *D. consanguineum* is also similar to *D. ovale* Elliott, and Freckmann and Lelong (2003a) have suggested that hybridization occurs between *D. consanguineum* and both *D. aciculare* and *D. ovale*.

Dichanthelium depauperatum (Muhl.) Gould, (impoverished), STARVED ROSETTE GRASS, STARVED PANIC GRASS. Similar to *D. linearifolium* and intergrading with it; plant 20–60 cm tall; culms not branching above base; leaves mostly basal, pilose to hispid or nearly glabrous, the sheaths commonly thinly pilose, the blades often glabrous on upper surface; blades of basal and culm leaves all 15–40 times as long as wide, 1–5 mm wide; spikelets usually 3–4.8 mm long; upper (fertile) floret shorter than the ± beaked upper glume and lemma of lower floret. Woods, grassy areas, roadsides, particularly on sandy soils; widely scattered in East TX; se Canada and widespread in the e U.S. w to CO and TX. Apr–May, also summer. [*Panicum depauperatum* Muhl.] Hybridization with *D. linearifolium* is known (Freckmann & Lelong 2003a).

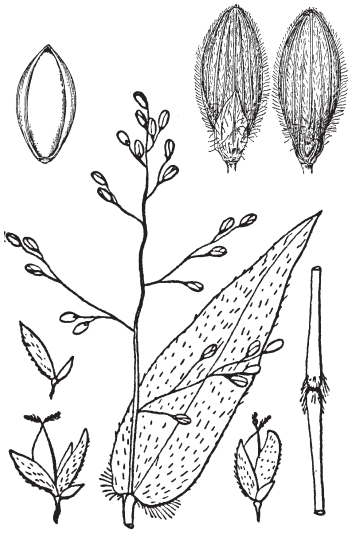
Dichanthelium dichotomum (L.) Gould, (2-forked or -parted), FORKED PANIC GRASS, CYPRESS ROSETTE GRASS. Plant usually (20–)40–80(–100) cm tall, often becoming much-branched with age,



Dichanthelium acuminatum var. acuminatum [HI1]



Dichanthelium acuminatum var. lindheimeri [HI1]



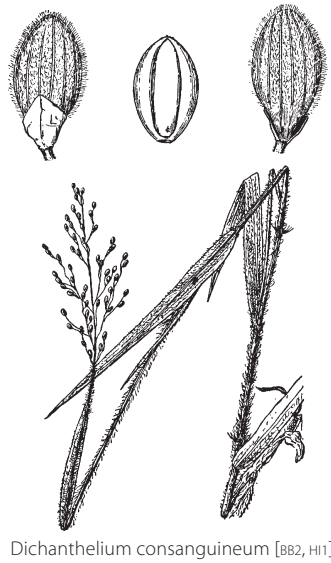
Dichanthelium boscii [BB2, HI1]



Dichanthelium commutatum [HI1]



Dichanthelium clandestinum [USB]



Dichanthelium consanguineum [BB2, HI1]



Dichanthelium depauperatum [USB]

glabrous except for nodes, summits of leaf sheaths, and margins of leaf blades near base; nodes glabrous or bearded with long spreading hairs; ligule absent or < 1 mm long; leaf blades usually 3–10(–15) mm wide; spikelets 1.5–2.4(–2.6) mm long. Often in low sandy woods, moist, or often boggy areas, less commonly in drier habitats; widespread in the e 1/2 of TX; se Canada and e 1/2 of the U.S. w to MI and TX, also AZ, CA, and OR. Apr–Jun, also late summer–fall. *Dichanthelium dichotomum* and its relatives comprise one of the most confusing species complexes known. Countless different approaches have been taken regarding their taxonomy, with the numerous intergrading morphological entities variously treated as varieties, subspecies, or distinct species, or not formally recognized (e.g., Diggs et al. 1999). Jones et al. (1997) and Hatch (2002) recognized five infraspecific taxa in TX, one of which is here treated as a separate species (*D. tenue*). Based on work by LeBlond (2001) and Freckmann and Lelong (2003a), we are tentatively recognizing six for the state. While we are following Freckmann and Lelong (2003a) in recognizing these taxa as subspecies, we would prefer to treat them at the varietal level as partially done by LeBlond (2001)—see Turner and Nesom (2000) for an explanation of infraspecific ranks. However, this would necessitate making new combinations which we cannot justify without a thorough study of the entire group. The following key to subspecies is slightly modified from Freckmann and Lelong (2003) and LeBlond (2001). However, there is substantial intergradation between these subspecies and difficulty should be anticipated when trying to separate them. The fruits are reportedly dispersed by ants, which are apparently attracted to a substance (possibly an oil) found under the first glume (Gaddy 1986).

1. Lower nodes hairy.
   2. Spikelets 1.5–1.8 mm long; upper floret 0.6–0.8 mm wide _____ subsp. **microcarpon**
   2. Spikelets usually 1.8–2.5 mm long; upper floret 0.7–1 mm wide.
      3. Spikelets usually glabrous; midculm leaf blades usually 5–7 mm wide _____ subsp. **dichotomum**
      3. Spikelets pubescent; midculm leaf blades usually 7–14 mm wide _____ subsp. **nitidum**
1. Lower nodes glabrous.
   4. Larger leaf blades more than (7–)10 mm wide; leaf sheaths often with pale glandular spots between the prominent veins; spikelets 1.9–2.6 mm long, acute to beaked _____ subsp. **yadkinense**
   4. Larger leaf blades less than 10 mm wide; leaf sheaths without glandular spots; spikelets 1.5–2.3 mm long, obtuse to subacute.
      5. Culms weak, ultimately reclining or sprawling over other plants, often flattened _____ subsp. **lucidum**
      5. Culms erect, terete.
         6. Leaf blades usually ascending or erect; spikelets broadly ellipsoid or obovoid, 1.5–1.8 (–2.1) mm long, often purplish at the base; plants of wet pine savannahs and open swamps _____ subsp. **roanokense**
         6. Leaf blades usually spreading; spikelets ellipsoid, 1.8–2.3 mm long, rarely purplish at the base; plants of wet-mesic to dry woods and thickets _____ subsp. **dichotomum**

subsp. **dichotomum**. Wet-mesic to dry, well-drained woodland sites, sandy soils; Henderson, Leon, and Limestone (BRIT) cos.; Hatch et al. (1990) cited regions 1, 2, 3, 4, and 5; se Canada and e 1/2 of the U.S. w to MI and TX. [*Panicum barbulatum* Michx., *Panicum dichotomum* L., *Panicum dichotomum* var. *barbulatum* (Michx.) A.W. Wood] This is a quite variable taxon (LeBlond 2001).

subsp. **lucidum** (Ashe) Freckmann & Lelong, (bright, shining, clear). Wet woods and other wet areas; Leon, Newton, Robertson, Rusk, and San Jacinto (TAES—annotated by S. Hatch) cos.; mainly se US from NJ s to FL w to TX. [*D. lucidum* (Ashe) LeBlond, *Panicum dichotomum* var. *lucidum* (Ashe) Lelong, *Panicum lucidum* Ashe] LeBlond (2001) recognized this taxon as a distinct species and noted that "the densely papillose fertile lemma and palea readily separate" it from all other members of the *D. dichotomum* complex.

subsp. **microcarpon** (Muhl. ex Elliott) Freckmann & Lelong, (small-fruited). Low or wet woods; Bowie, Camp, Cass, Hardin, Harrison, Houston, Jasper (BRIT), Angelina, Brazos, Leon, Liberty, Nacogdoches, Newton, Polk, Robertson, Rusk, Shelby, Smith (TAES—annotated by S. Hatch),

and Harris (SBSC) cos. in the Pineywoods and Post Oak Savannah; e U.S. w to MI and TX. [*Panicum microcarpon* Muhl. ex Elliott, *Panicum dichotomum* var. *ramulosum* (Torr.) Lelong, *Panicum nitidum* Lam. var. *ramulosum* Torr.]

subsp. **nitidum** (Lam.) Freckmann & Lelong, (shining). Moist to wet areas such as low pine woods; Jasper (BRIT) and Newton (TAES) cos.; also Harris Co. (near Houston, BRIT) in n Gulf Prairies and Marshes; se U.S. from VA s to FL w to TX. [*Panicum dichotomum* var. *nitidum* (Lam.) A.W. Wood, *Panicum nitidum* Lam.]

subsp. **roanokense** (Ashe) Freckmann & Lelong, (for Roanoke Island, NC, where the type was collected by W.W. Ashe). Wet pine savannahs and open swamps; Liberty Co. (BRIT; SBSC—Marysee Prairie), also cited for "southeastern Texas" (no specific county given) by Freckmann and Lelong (2003a); se U.S. from DE s to FL w to TX. [*Panicum dichotomum* var. *roanokense* (Ashe) Lelong, *Panicum roanokense* Ashe] This taxon is quite similar to subsp. *dichotomum* (LeBlond 2001). While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this subspecies to be of conservation concern in TX. ⚠

subsp. **yadkinense** (Ashe) Freckmann & Lelong, (seemingly from Yadkin River, NC, but cited originally as from Raleigh in the Neuse Valley—Fernald 1950a). Moist or wet woods; tentatively included based on citation for TX by LeBlond (2001); however, we have seen no TX specimens and Freckmann and Lelong (2003a) did not include TX in the range of this subspecies. [*Panicum dichotomum* var. *yadkinense* (Ashe) Lelong, *Panicum maculatum* Ashe, *Panicum yadkinense* Ashe] LeBlond (2001) noted that this taxon does not intergrade with any other *D. dichotomum* taxa and thus perhaps deserves recognition as a distinct species.

Dichanthelium ensifolium (Baldwin ex Elliott) Freckmann & Lelong, (with sword-shaped leaves), SWORD-LEAF PANIC GRASS. Culms to 40 cm tall, delicate, usually < 1 mm thick, reclining to weakly erect, with nodes usually glabrous; leaves 4–9; margins of leaf blades thin, green; spikelets 1.2–1.5 mm long, sometimes purplish. Moist to wet, often boggy areas, sandy acidic soils; Tyler (BRIT), Anderson, Angelina, Hardin, Jasper, Leon, Polk, and San Augustine (Freckmann & Lelong 2003a) cos.; Hatch et al. (1990) cited only the Pineywoods; se U.S. from NJ s to FL w to TX. Spring–fall. [*D. dichotomum* var. *ensifolium* (Baldwin ex Elliott) Gould & C.A. Clark, *D. ensifolium* subsp. *curtifolium* (Nash) Freckmann & Lelong, *Panicum dichotomum* var. *ensifolium* (Baldwin ex Elliott) C.F. Reed, *Panicum ensifolium* Baldwin ex Elliott, *Panicum nitidum* var. *ensifolium* (Baldwin ex Elliott) Vasey] This species has been variously treated taxonomically, recently most often as a variety of *D. dichotomum* or as a distinct species. Because of the paucity of available material and the lack of geographic separation of the variants, at this time we are not recognizing infraspecific taxa in this species. However, Freckmann and Lelong (2003a) recognized two sympatric subspecies which often can be found growing together at the same site. They separated the two as follows:

1. Sheaths sparsely spreading-pilose; ligule usually 1–1.8 mm long; blades sparsely pilose or glabrous on both surfaces _____ subsp. *curtifolium*
1. Sheaths glabrous; ligule 0.2–1 mm long; blades usually puberulent abaxially, usually glabrous, occasionally pubescent adaxially _____ subsp. *ensifolium*

Dichanthelium latifolium (L.) Gould & C.A. Clark, (broad-leaved), BROAD-LEAF ROSETTE GRASS, BROAD-LEAF PANIC GRASS. Culms 45–80(–110) cm tall, glabrous or with sparse pubescence; leaf sheaths glabrous or softly villous; leaf blades 8–20 cm long, 13–40 mm broad, glabrous, broadly cordate basally; spikelets (2.9–)3.3–3.9 mm long. Rich woods, shady areas; known in TX only from Harrison Co. (TAES; Freckmann & Lelong 2003a) in the ne Pineywoods; se Canada and widespread in the e U.S. w to MN and TX. Mostly May–Jun, also summer–fall. [*Panicum latifolium* L.] Gould and Clark (1978) suggested that this species appears to be closely related to both *D. clandestinum* and *D. commutatum*. While not officially designated as such (e.g., TOES

1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

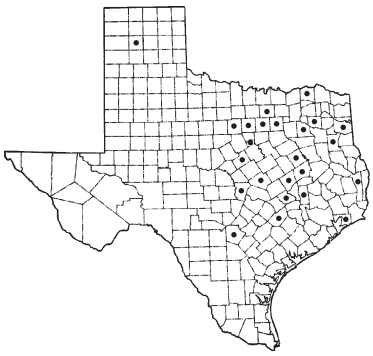
Dichanthelium laxiflorum (Lam.) Gould, (loosely-flowered), OPEN-FLOWER ROSETTE GRASS, OPEN-FLOWER PANIC, SOFT-TUFT PANIC GRASS. Plant 12–60 cm tall; culms not branching above the base; leaves mostly basal; leaf sheaths pilose with widely spreading to slightly reflexed hairs 2–3.5 mm long; leaf blades often pilose but sometimes varying to almost glabrous, the margins with conspicuous hairs, at least near base; spikelets usually 1.7–2.1(–2.3) mm long. Sandy woods, especially in low ground; widespread in East TX; also n Gulf Prairies and Marshes; e U.S. from PA s to FL w to MO, OK, and TX. Apr–Jun, again late summer–fall. [*Panicum laxiflorum* Lam.]

Dichanthelium linearifolium (Scribn. ex Nash) Gould, (linear-leaved), SLIM-LEAF ROSETTE GRASS, SLIM-LEAF PANIC, LINEAR-LEAF PANIC GRASS. Similar to *D. depauperatum* and perhaps intergrading with it; plant 15–50 cm tall; culms not branching above base, with only upper 2 internodes elongated; leaves mostly basal; leaf sheaths pilose or rarely glabrous; blades of basal and culm leaves similar, all 15–40 times as long as wide, 1–5 mm wide; spikelets usually 2.1–3 mm long; upper (fertile) floret as long as the beakless upper glume and lemma of lower floret. Dry sandy woods or open ground; widespread in East TX; also Cross Timbers and Prairies, e Edwards Plateau, and n Gulf Prairies and Marshes; se Canada and widespread in e U.S. w to WY and NM. Mar–Jun, again late summer–fall. [*Panicum linearifolium* Scribn. ex Nash]

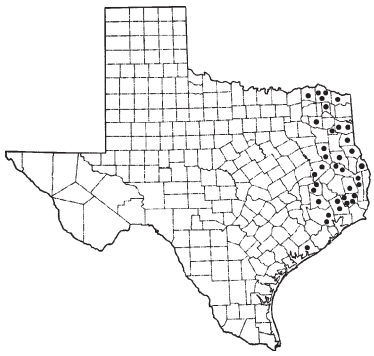
Dichanthelium malacophyllum (Nash) Gould, (soft-leaved), SOFT-LEAF ROSETTE GRASS, SOFT-LEAF PANIC GRASS. Plant 25–70 cm tall; culm nodes bearded; culm internodes with papillose-based hairs; leaf sheaths pilose; leaf blades densely soft-pubescent, at mid-culm mostly 8–12 mm wide; spikelets (2.5–)2.6–3.2 mm long; upper glume often purplish toward base. Sandy or rocky woods, usually on calcareous soils; Dallas, Lamar (BRIT), Brazos, Burleson, Grayson, Hardin, Kaufman, and McLennan (Turner et al. 2003) cos.; also e Cross Timbers and Prairies; c U.S. from KY and TN w to KS and TX, also SC. Apr–Jun, again late summer–fall. [*Panicum malacophyllum* Nash] This species intergrades and perhaps hybridizes with *D. oligosanthes* and *D. acuminatum* (Freckmann & Lelong 2003a).

Dichanthelium nodatum (Hitchc. & Chase) Gould, (apparently for the "numerous swollen nodes"—Hitchcock & Chase 1910), SARITA ROSETTE GRASS, SARITA DICHANTHELIUM, SARITA PANIC GRASS. Plant 20–50(–65) cm tall; basal rosettes usually absent; ligule of hairs, 2 mm or less long; leaf blades 4–7(–9) mm wide, marginally papillose-ciliate to well beyond middle; spikelets 3.5–4.4 mm long, narrowly obovate, gradually tapering to a narrow base; lower glume appearing slightly separated from upper glume due to narrowed base of upper glume. Sandy soils, grasslands, brushy areas, savannahs, and woods; sw part of East TX n to Bastrop, Colorado, and Robertson (Turner et al. 2003) cos.; also Gulf Prairies and Marshes and South TX Plains; Carr (2001) suggested that this species occurs only to the s of East TX. It has been reported as endemic to TX (Gould 1975b; Kartesz 1999; Carr 2002b, 2002c). However, Freckmann and Lelong (2003a) noted that it extends into ne Mexico. Apr–Jun, again late summer–fall. [*Panicum nodatum* Hitchc. & Chase] (RARE 2001: G3S3) ⚠?

Dichanthelium oligosanthes (Schult.) Gould, (few-flowered), FEW-FLOWER PANIC GRASS, HELLER'S ROSETTE GRASS. Culms spreading to erect, 15–85 cm tall, often branched and producing fascicles of reduced leaves, the nodes usually either glabrous or with sparse pubescence; ligule 0.1–4.2 mm long; leaf blades usually 4–12(–15) mm wide; spikelets usually 2.7–4 mm long; upper glume usually with an orange or purple spot at base. Open woods or open areas; e 1/2 of TX, scattered further w; varieties are not distinguished on the county distribution map. Apr–Jun, again late summer–fall. Variation within this species has been treated differently by various authorities: Hansen and Wunderlin (1988) indicated that the characters used to separate the varieties are unreliable and did not recognize varieties. On the other hand, Freckmann and Lelong (2003a) recognized the two entities as subspecies. Because of the lack of geographic



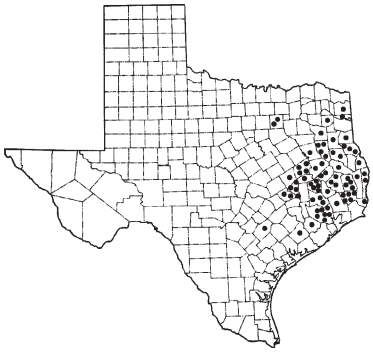
Dichanthelium acuminatum
(all vars.)



Dichanthelium boscii



Dichanthelium clandestinum



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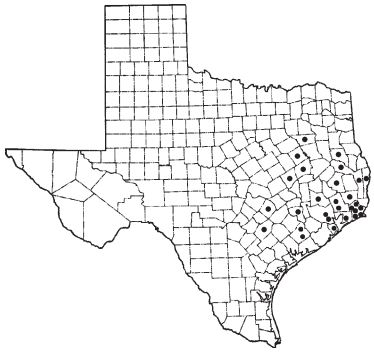

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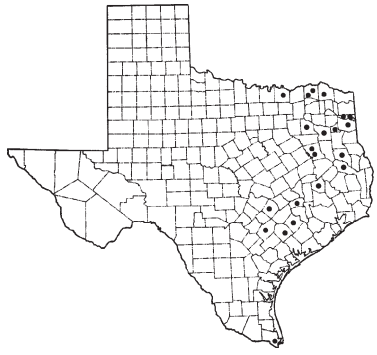
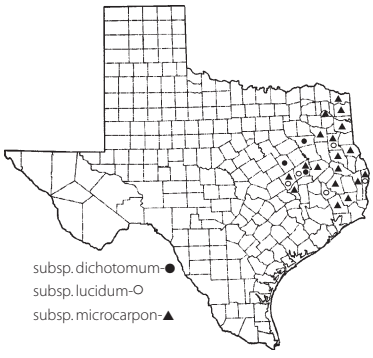
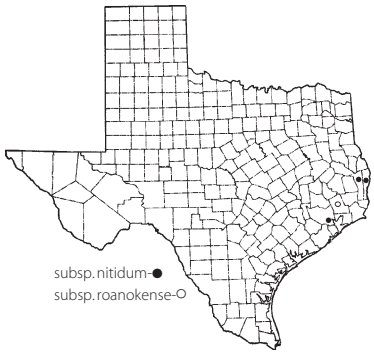


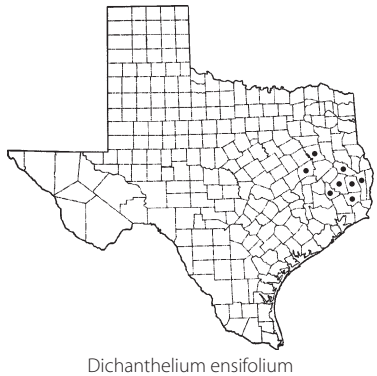
Dichanthelium depauperatum



Dichanthelium dichotomum



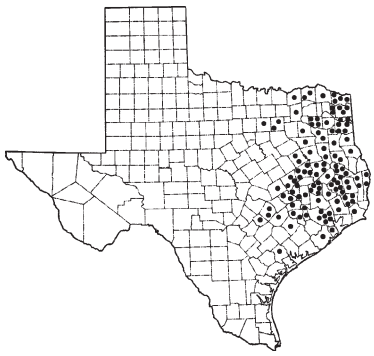
Dichanthelium dichotomum



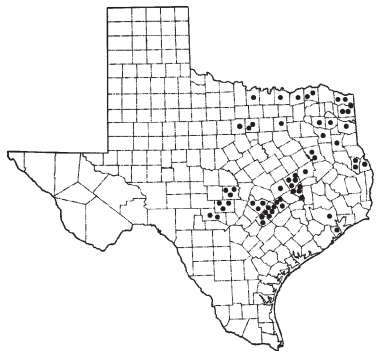
Dichanthelium ensifolium



Dichanthelium latifolium



Dichanthelium laxiflorum



Dichanthelium linearifolium

separation and the fact that they intergrade in areas of overlapping range (Freckmann & Lelong 2003a), we are following Hatch (2002) in treating the two entities as varieties. Apparent hybrids are known between *D. oligosanthes* and *D. acuminatum*, *D. malacophyllum*, and *D. ovale* (Freckmann & Lelong 2003a).

1. Lower leaf sheaths pilose with appressed or ascending hairs without swollen bases; spikelets usually 3.4–4 mm long, usually 2 mm or less wide, typically sparsely pubescent; ligule usually 1.6–4.2 mm long; leaf blades with lower surfaces tomentose or occasionally puberulent ___ var. **oligosanthes**
1. Lower leaf sheaths glabrous or pilose with ascending to spreading hairs from swollen bases; spikelets usually 2.7–3.6 mm long, 2–2.4 mm wide, typically glabrous; ligule usually 1–1.6 mm long; leaf blades with lower surfaces glabrous to puberulent, never tomentose _____ var. **scribnerianum**

var. **oligosanthes**. Leaf blades usually 4–8(–9) mm wide, > 10 times as long as wide, often somewhat involute. Sandy soils, woods or brushy areas; e 1/2 of TX; se Canada (Ont.) and widespread in the e U.S. w to MI and TX, also MT. [*D. oligosanthes* (Schult.) Gould subsp. *oligosanthes*, *Panicum oligosanthes* Schult.] Gould (1975b) noted that this taxon is similar to *D. ravenelii* but has smaller leaves and spikelets.

var. **scribnerianum** (Nash) Gould, (for Frank Lamson Scribner, 1851–1938, agrostologist, U.S. Dept. of Agriculture), SCRIBNER'S ROSETTE GRASS, SCRIBNER'S PANIC GRASS. Leaf blades usually 5–12(–15) mm wide, < 10 times as long as wide, not involute. Sandy to loamy or clayey soils, occasionally in limestone gravel, open or often brushy areas; nearly throughout TX; s Canada and nearly throughout the U.S. [*D. oligosanthes* subsp. *scribnerianum* (Nash) Freckmann & Lelong, *Panicum helleri* Nash, *Panicum oligosanthes* Schult. var. *scribnerianum* (Nash) Gould, *Panicum scribnerianum* Nash]

Dichanthelium ovale (Elliott) Gould & C.A. Clark, (oval or broadly elliptic in outline), EGG-LEAF ROSETTE GRASS, STIFF-LEAF PANIC GRASS. Culms 60 cm or less tall; nodes densely to sparsely bearded; internodes with appressed to ascending hairs; leaf sheaths pilose; ligule (1–)1.5–6 mm long; leaf blades 10 mm or less wide; spikelets 1.8–3 mm long. Dry, open, sandy or rocky areas; scattered in n part of East TX s to Austin Co.; also Cross Timbers and Prairies; se Canada (Ont.) and widespread in e 1/2 of the U.S. Spring, also late summer–fall. *Dichanthelium ovale* (excluding subsp. *villosissimum*) was not considered to occur in TX by Gould (1975b) or Hatch et al. (1990) or in LA by Allen (1992); however, Gould and Clark (1978) indicated that it did occur in TX. Hansen and Wunderlin (1988) submerged *D. consanguineum* into *D. ovale* since the two were based on only slight differences in pubescence—such a treatment may well be warranted. Individuals of *D. ovale* can sometimes resemble a number of other species including *D. acuminatum*, *D. commutatum*, *D. laxiflorum*, and *D. oligosanthes*. Freckmann and Lelong (2003a) recognized four subspecies of *D. ovale* (also recognized here), including subsp. *villosissimum*, which has often been considered part of *D. acuminatum*. They noted that these subspecies often intergrade. The following key is slightly modified from Freckmann and Lelong (2003a):

1. Lower leaf sheaths and lower culm internodes with soft, spreading or retrorse, papillose-based hairs, the longer hairs often longer than 4 mm long; spikelets 1.8–2.5 mm long.
   2. Spikelets 2.1–2.5 mm long; culms usually more than 1 mm thick, stiff; largest leaf blades usually 6–10 mm wide _____ subsp. **villosissimum**
   2. Spikelets 1.8–2.1 mm long; culms usually less than 1 mm thick, wiry; largest leaf blades usually 2–6 mm wide _____ subsp. **praecocius**
1. Lower leaf sheaths and lower culm internodes with ascending or appressed, non-papillose-based hairs shorter than 4 mm or else nearly glabrous; spikelets 2.1–3 mm long.
   3. Spikelets 2.5–3 mm long; basal leaf blades with long hairs on or near the margins and bases _____ subsp. **ovale**



Dichanthelium dichotomum [USB]



Dichanthelium ensifolium [BB2]



Dichanthelium latifolium [USB]



Dichanthelium laxiflorum [USB]



Dichanthelium linearifolium [USB]



Dichanthelium malacophyllum [USB]



Dichanthelium nodatum [HI1]



Dichanthelium oligosanthes var. scribnerianum [USB]

3. Spikelets 2.1–2.6 mm long; basal leaf blades usually without long hairs on or near the margins and bases _____ subsp. **pseudopubescens**

subsp. **ovale**. Tentatively included based on pers. comm. from Rob Evans of occurrence in the Pineywoods (no specific county given); no county distribution map is provided; in much of the e U.S. w to WI and TX. [*Panicum malacon* Nash, *Panicum ovale* Elliott]

subsp. **praecocius** (Hitchc. & Chase) Freckmann & Lelong, (appearing or developing early). Brazos, Dallas, and Leon (BRIT) cos.; also Denton, Montague, and Tarrant (BRIT) cos. in the Cross Timbers and Prairies. This subspecies is reported to intergrade with both subsp. *villosissimum* and *D. acuminatum*. While we are following Freckmann and Lelong (2003a) in recognizing this subspecies, with the limited material seen, we question its recognition as a separate entity. [*D. villosissimum* Nash var. *praecocius* (Hitchc. & Chase) Freckmann, *Panicum lanuginosum* Elliott var. *praecocius* (Hitchc. & Chase) Dore, *Panicum praecocius* Hitchc. & Chase]

subsp. **pseudopubescens** (Nash) Freckmann & Lelong, (mistaken for *Panicum pubescens*—a name no longer used). Tentatively included based on pers. comm. from Rob Evans of occurrence in the Pineywoods (as var. *addisonii*) (no specific county given); no county distribution map is provided; se Canada (Ont.) and widespread in the e 1/2 of the U.S. [*D. ovale* var. *addisonii* (Nash) Gould & C.A. Clark, *Panicum addisonii* Nash, *Panicum ovale* Elliott var. *addisonii* (Nash) C.F. Reed, *Panicum ovale* Elliott var. *pseudopubescens* (Nash) Lelong, *Panicum pseudopubescens* Nash, *Panicum villosissimum* Nash var. *pseudopubescens* (Nash) Fernald]

subsp. **villosissimum** (Nash) Freckmann & Lelong, (very long-hairy), WHITE-HAIRED ROSETTE GRASS, WHITE-HAIRED PANIC. Plant usually 20–60 cm tall; culms and leaf blades pilose; leaf sheaths with conspicuous, widely spreading or reflexed hairs 2–5 mm long; spikelets 2.1–2.5 mm long. Sandy woods; Austin, Bowie, Freestone, Grayson, Lamar, Robertson, and Titus (BRIT) cos.; also Cross Timbers and Prairies; se Canada (Ont.) and widespread in e 1/2 of the U.S. [*D. acuminatum* (Sw.) Gould & C.A. Clark var. *villosum* (A. Gray) Gould & C.A. Clark, *D. lanuginosum* (Elliott) Gould var. *villosissimum* (Nash) Gould, *D. ovale* subsp. *villosissimum* (Nash) Freckmann & Lelong, *D. villosissimum* (Nash) Freckmann, *Panicum acuminatum* Sw. var. *villosum* (A. Gray) Beetle, *Panicum dichotomum* L. var. *villosum* Vasey, *Panicum ovale* Elliott var. *villosum* (A. Gray) Lelong, *Panicum villosissimum* Nash] While this taxon has often been treated as a variety of *D. acuminatum* or as a distinct species, we are tentatively following Freckmann and Lelong (2003a) in recognizing it as a subspecies of *D. ovale*—spikelet length seems to support this conclusion. However, according to J. Wipff (pers. comm.), *D. acuminatum* var. *acuminatum* and *D. ovale* subsp. *villosissimum* are separated by only one weak character (amount and length of pubescence on the leaf sheaths and blades), which apparently intergrades completely; as a result, he suggests treating subsp. *villosissimum* as a synonym of *D. acuminatum* var. *acuminatum*. Additional research on this complex (hopefully involving molecular techniques) will be needed before a definitive understanding is reached. Further, we would prefer recognition of subsp. *villosissimum* at the varietal level, but since the appropriate combination has not yet been made, we are utilizing the subspecific rank.

Dichanthelium pedicellatum (Vasey) Gould, (stalked), CEDAR ROSETTE GRASS, CEDAR PANIC, CORM-BASED PANIC GRASS. Plant 25–70 cm tall; culm bases hard, swollen, corm-like; basal rosettes usually absent; lower leaf sheaths rather sparsely ascending-pilose, the upper sheaths pubescent or glabrous except on margins; leaf blades 3–7(–8) mm wide, pubescent on upper surface, glabrous or nearly so beneath, with only a few long, papilla-based, marginal hairs near base; spikelets (3.2–)3.5–3.9 mm long, narrowly obovate, gradually tapering to a narrow base; lower glume not appearing separated from upper glume, ca. 1/2 as long as spikelet, to ca. 2 mm long. Rocky limestone slopes, limey soils; Bell, Bexar, McLennan, Travis (BRIT), and Comal (Turner et al.



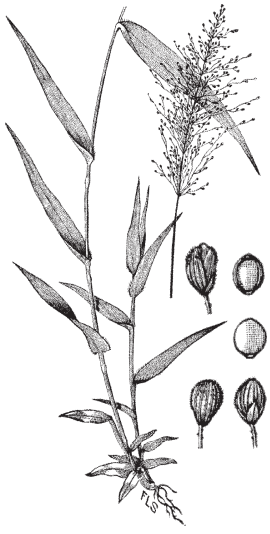
Dichanthelium ovale subsp. ovale [HI1, USB]



Dichanthelium ovale subsp. villosissimum [USB]



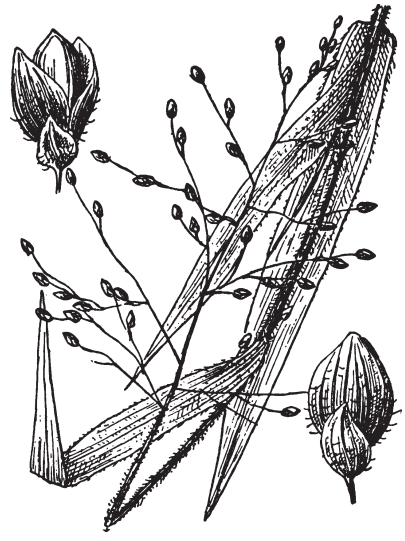
Dichanthelium pedicellatum [USB]



Dichanthelium polyanthes [USB]



Dichanthelium portoricense [YAT]



Dichanthelium ravenelii [BB2]



Dichanthelium scabriusculum [USB]



Dichanthelium scoparium [HI1]

2003) cos.; sw margin of East TX sw through Edwards Plateau and Trans-Pecos; in the U.S. known only from TX; also Mexico and Guatemala. Mar–Jun, occasionally again late summer–fall. [*Panicum pedicellatum* Vasey]

Dichanthelium polyanthes (Schult.) Mohlenbr., (many-flowered), MANY-FLOWER PANIC GRASS, LEAFY ROSETTE GRASS, LEAFY DICHANTHELIUM. Culms 30–80(–95) cm tall; ligule minute or apparently absent; blades of larger culm leaves 15–30 mm wide, cordate at base, ciliate only near the base, with white cartilaginous margins; inflorescence axis glabrous; spikelets 1.3–1.7 mm long. Wooded areas, near streams, roadside ditches; Angelina, Grimes, Hardin, Leon (BRIT), Liberty, Montgomery, San Jacinto, and Tyler (SBSC) cos. in the Pineywoods and Post Oak Savannah; e U.S. from VT s to GA w to MO, OK, and TX. Apr–Jun, again late summer–fall. [*D. sphaerocarpon* (Elliott) Gould var. *isophyllum* (Scribn.) Gould & C.A. Clark, *D. sphaerocarpon* var. *polyanthes* (Schult.) Gould, *Panicum microcarpon* Muhl., *Panicum microcarpon* var. *isophyllum* Scribn., *Panicum polyanthes* Schult., *Panicum sphaerocarpon* Elliott var. *isophyllum* (Scribn.) Angelo, *Panicum sphaerocarpon* var. *polyanthes* (Schult.) Sherif] This species sometimes hybridizes with *D. sphaerocarpon* (Freckmann & Lelong 2003a) and has often been treated as a variety of that species (e.g., Gould 1975b; Hatch 2002). Gould (1975b) indicated that the two taxa seem to completely intergrade.

Dichanthelium portoricense (Desv. ex Ham.) B.F. Hansen & Wunderlin, (of Porto [Puerto] Rico), HEMLOCK ROSETTE GRASS, BLUNT-GLUME PANIC GRASS. Culms 15–50 cm tall; culm internodes and usually leaf sheaths puberulent to short pilose but without long spreading hairs; leaf blades 2.5–6(–8) mm wide; spikelets 1.3–2.4(–2.6) mm long, attenuate at base. Low woods, bogs; Lee, Angelina (BRIT), Bastrop, Polk, and Sabine (Turner et al. 2003) cos.; also Gulf Prairies and Marshes; se Canada and widespread in the e U.S. w to IA and TX. May–Jun. [*D. portoricense* subsp. *patulum* (Scribn. & Merr.) Freckmann & Lelong, *D. sabulorum* (Lam.) Gould & C.A. Clark var. *patulum* (Scribn. & Merr.) Gould & C.A. Clark, *Panicum patulum* (Scribn. & Merr.) Hitchc., *Panicum portoricense* Desv. ex Ham., *Panicum sabulorum* Lam. var. *patulum* (Scribn. & Merr.) C.F. Reed] While this species has often been treated as *Dichanthelium* or *Panicum sabulorum* (e.g., Gould & Clark 1978; Kartesz 1999), Lelong (1984) and Hansen and Wunderlin (1988) indicated that *D. sabulorum* is a South American species that is not conspecific with the taxon here treated as *D. portoricense*. Yatskievych (1999—as *Panicum*) and Freckmann and Lelong (2003a) also used the name *D. portoricense*. Freckmann and Lelong (2003a) suggested that this species possibly hybridizes with *D. commutatum* and *D. sphaerocarpon*; they further noted that it can resemble *D. aciculare*. Some authorities (e.g., Freckmann & Lelong 2003a) recognize infraspecific taxa in this species; however, based on the limited material available to us, we are not recognizing varieties or subspecies. Likewise, Hatch (2002) did not formally treat infraspecific taxa. For those wishing to distinguish these, the following key from Freckmann and Lelong (2003a) may be helpful:

1. Spikelets 1.8–2.6 mm long, usually densely pubescent or puberulent (rarely glabrous); cauline blades 4–7 cm long, 3.5–8 mm wide _____ subsp. *patulum*
1. Spikelets 1.5–2.0 mm long, puberulent to nearly glabrous; cauline blades 2–5 cm long, 2.5–4.5 mm wide _____ subsp. portoricense

Dichanthelium ravenelii (Scribn. & Merr.) Gould (for Henry William Ravenel, 1814–1887, botanist and planter of South Carolina), RAVENEL'S PANIC GRASS. Culms 30–80 cm tall, stout, 2–3 mm thick, erect, with bearded nodes, with a glabrous ring below the beard; leaf sheaths short-pilose; ligule of hairs usually 2–4(–5) mm long; leaf blades 8–16(–18) mm wide, densely velvety-pubescent beneath, pilose toward base on upper surface and on margins, otherwise glabrous or nearly so; spikelets 3.7–4(–4.3) mm long, purplish at base. Sandy woods, dry areas; widespread in East TX; also n margin of Gulf Prairies and Marshes; e U.S. from MD s to FL w to MO, OK, and TX. Apr–Jun, again late summer–fall. [*Panicum ravenelii* Scribn. & Merr.] Gould (1975b) noted

that this species appears related to *D. oligosanthes* but differs in having wider leaf blades, larger spikelets, and bearded culm nodes.

Dichanthelium scabriusculum (Elliott) Gould & Clark, (somewhat rough), TALL SWAMP PANIC GRASS, WOOLLY ROSETTE GRASS. Culms usually 90–150 cm tall, the nodes neither swollen nor bearded, glabrous or only slightly hairy, often with a glandular band below the node; leaf sheaths glabrous or with some pubescence, but not velvety pubescent, narrowed at top, mottled with pale spots; leaf blades 7–15 mm wide, glabrous or with some pubescence on lower surface, but not velvety pubescent; spikelets 2.2–2.9 mm long. Low, wet, often shaded sites, sandy soils; scattered in East TX in Jasper (*Ajilvsgi 5921*, BRIT), Hardin, Leon, Tyler (TAES—annotated by S. Hatch), Anderson (SBSC), Austin, Bowie, and Robertson (Turner et al. 2003) cos.; e U.S. from NY s to FL w to TX. May(–Jul), also fall. [*Panicum scabriusculum* Elliott] This species is somewhat similar to *D. scoparium* but has leaf sheaths glabrous or at least without velvety pubescence and nodes not bearded. According to Freckmann and Lelong (2003a), *D. scabriusculum* possibly hybridizes with *D. clandestinum*, *D. dichotomum*, and *D. aciculare*.

Dichanthelium scoparium (Lam.) Gould, (broom-like), VELVET ROSETTE GRASS, VELVETY PANIC GRASS. Culms coarse, 80–155 cm tall, often conspicuously stout (usually 2–5 mm thick), the nodes often swollen, usually conspicuously bearded with a glabrous, glandular band below the beard; lower culm internodes and lower leaf sheaths and blades usually with velvety pubescence; leaf sheaths narrowed at top; leaf blades (7–)9–25(–30) mm wide; spikelets 2.2–2.8 mm long, often purplish at base. Sandy woods and low areas, often in disturbed sites; widespread in East TX, mainly in Pineywoods and Post Oak Savannah; also n Gulf Prairies and Marshes; e U.S. from NY s to FL w to KS and TX. May–Jun, also fall. [*Panicum scoparium* Lam.] If not for the velvety pubescence, this species would resemble *D. scabriusculum* (Gould 1975b). *Dichanthelium scoparium* possibly hybridizes with *D. acuminatum* and *D. dichotomum* (Freckmann & Lelong 2003a).

Dichanthelium sphaerocarpon (Elliott) Gould, (spherical-fruited), ROUND-SEED ROSETTE GRASS, ROUND-SEED PANIC, ROUND-SEED DICHANTHELIUM, ROUND-FRUIT PANIC GRASS. Culms 20–50 cm tall; ligule minute or apparently absent; blades of larger culm leaves 6–13(–14) mm wide, usually cordate at base, slightly auricled-clasping, ciliate only near the base, the margins white and cartilaginous; inflorescence axis glabrous; spikelets 1.4–1.8(–2) mm long. Sandy soils, shaded or open areas; widespread in e 1/2 of TX, scattered further w; se Canada (Ont.) and widespread in e U.S. w to KS and TX. Late Mar–Jun, again late summer–fall. [*Panicum sphaerocarpon* Elliott] The plants are similar to glabrous forms of *D. acuminatum* var. *lindheimeri* but differ in having a minute or absent ligule. This species also sometimes superficially resembles *D. strigosum*. It can, however, be distinguished by the glabrous inflorescence axis and leaf blades ciliate only near the base (versus inflorescence axis usually with spreading hairs and leaf blades ciliate to beyond the middle in *D. strigosum*). *Dichanthelium sphaerocarpon* hybridizes with several other species, including *D. acuminatum*, *D. laxiflorum*, and *D. polyanthes* (Gould & Clark 1978; Freckmann & Lelong 2003a). This species has sometimes been treated as including *D. polyanthes* as a variety (var. *isophyllum* or var. *polyanthes*); Gould (1975b) indicated that this and *D. polyanthes*, which he treated as *D. sphaerocarpon* var. *polyanthes*, seem to completely intergrade.

Dichanthelium strigosum (Muhl.) Freckmann, (strigose, with stiff bristles), ROUGH-HAIR ROSETTE GRASS, CUSHION-TUFTED PANIC GRASS. Culms ca. 45 cm or less tall, not branched above base; leaves mostly basal (only 2–4 leaves on culm); leaf sheaths glabrous or ascending pilose; leaf blades 3–8 mm wide, ciliate to beyond the middle; inflorescence axis with spreading hairs; spikelets 1.1–2.1 mm long, often purplish or brownish purple; glumes ca. 1/3–1/2 as long as spikelet. Moist pinelands, bogs, other low areas, sandy soils. The infraspecific taxa of this species have been variously treated as varieties, subspecies, or species (e.g., Turner et al. 2003). Until a thorough revision of the group is carried out, we are recognizing the infraspecific taxa at the

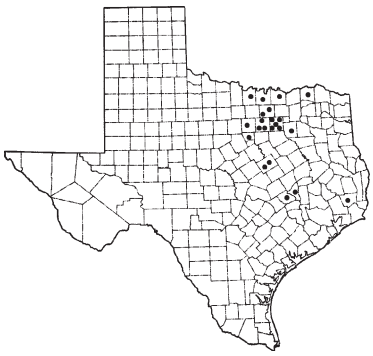
varietal level. While treating them as subspecies, Freckmann and Lelong (2003a) noted that the taxa "are mostly sympatric and sometimes grow together, with occasional intergradation." According to Freckmann and Lelong (2003a), "The primary panicles are briefly open-pollinated in April or May; the secondary panicles, which are produced from May through November, are cleistogamous."

1. Spikelets 1.6–2.1 mm long, pubescent; lower glume ca. 1/2 length of spikelet; leaf blades usually glabrous _____ var. **leucoblepharis**
1. Spikelets 1.1–1.6 mm long, glabrous; lower glume ca. 1/3 as long as spikelet; leaf blades pilose _____ var. **strigosum**

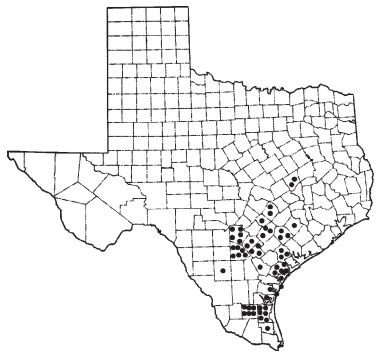
var. **leucoblepharis** (Trin.) Freckmann, (white-fringed, as with eyelashes). Culms usually 30 cm or less tall. Upshur (BRIT), Angelina, and Robertson (Turner et al. 2003, as *D. leucoblepharis*) cos., also cited for e TX by Freckmann and Lelong (2003a), and for TX by Gould and Clark (1978); se U.S. from NC s to FL w to TX. [*D. leucoblepharis* (Trin.) Gould & C.A. Clark, *D. strigosum* (Muhl.) Freckmann subsp. *leucoblepharis* (Trin.) Freckmann & Lelong, *Panicum ciliatum* Elliott, *Panicum leucoblepharis* Trin., *Panicum strigosum* Muhl. var. *leucoblepharis* (Trin.) Lelong, *Panicum strigosum* var. *puberula* C.F. Reed] The complicated nomenclatural history of this taxon was discussed by Veldkamp (1976) and Hansen and Wunderlin (1988). Turner et al. (2003) recognized this variety as a distinct species, *D. leucoblepharis*, while Freckmann and Lelong (2003) treated it as a subspecies of *D. strigosum*. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this variety to be of conservation concern in TX. ⚠

var. **strigosum**. Culms to 45 cm tall; leaf blades pilose. While we have seen no East TX specimens of this variety, it is included based on citation for Leon and Robertson cos. by Turner et al. (2003), for e TX by Freckmann and Lelong (2003a), and for TX by Gould and Clark (1978); se U.S. from VA s to FL w to TX. [*D. leucoblepharis* (Trin.) Gould & C.A. Clark var. *pubescens* (Vasey) Gould & C.A. Clark, *Panicum laxiflorum* Lam. var. *pubescens* Vasey, *Panicum strigosum* (Muhl. ex Elliott) Freckmann] While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this variety to be of conservation concern in TX. ⚠

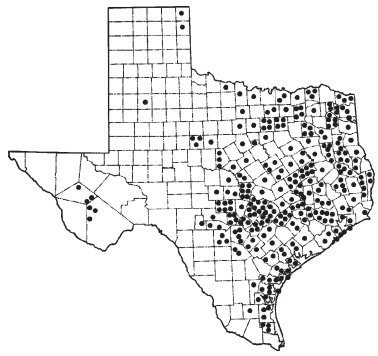
Dichanthelium tenue (Muhl.) Freckmann & Lelong, (slender, thin), SLENDER PANIC GRASS. Culms to only 40(–55) mm or less tall, delicate, < 1 mm thick, erect from geniculate base, with only 3–4 leaves; nodes glabrous; ligule < 1 mm long; leaf blades with white cartilaginous margins; spikelets 1.3–1.7 mm long. Wooded areas, savannahs, sandy soils; Hardin (BRIT), Liberty (BRIT, SBSC—Marysee Prairie), Angelina, Polk, San Augustine, and Tyler (TAES, annotated by S. Hatch as *D. dichotomum* var. *unciphyllum*) cos., also Freckmann and Lelong (2003a) mapped a number of localities in the s Pineywoods; se U.S. from MD s to FL w to TX. Spring, also fall. [*D. dichotomum* (L.) Gould var. *tenue* (Muhl.) Gould & C.A. Clark, *D. dichotomum* var. *unciphyllum* (Trin.) Davidse, *D. ensifolium* (Baldwin ex Elliott) Freckmann & Lelong var. *unciphyllum* (Trin.) B.F. Hansen & Wunderlin, *Panicum acuminatum* Sw. var. *unciphyllum* (Trin.) Lelong, *Panicum dichotomum* L. var. *tenue* (Muhl.) C.F. Reed, *Panicum dichotomum* var. *unciphyllum* (Trin.) Wipff & S.D. Jones, *Panicum tenue* Muhl., *Panicum trifolium* Nash, *Panicum unciphyllum* Trin.] This species has had a complex nomenclatural history. It has been variously recognized as a variety of several different species (e.g., Hatch 2002—*D. dichotomum* var. "uncephyllum") or as a distinct species. It is similar to *D. dichotomum* and *D. sphaerocarpon* and is closely related to and perhaps intergrades with *D. ensifolium* (Freckmann & Lelong 2003a). The pattern of variation within this group is so complex that the rank at which to recognize taxa seems almost arbitrary. Until further research can be done on the whole group, we are following the recent *Flora of North America* treatment (Freckmann & Lelong 2003a) in treating this taxon at the specific level.



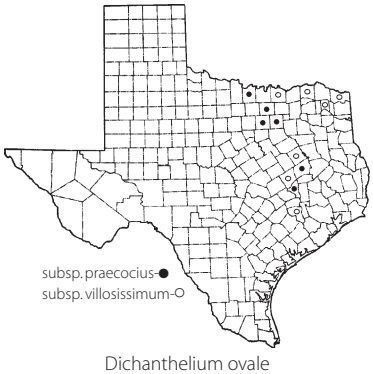
Dichanthelium malacophyllum



Dichanthelium nodatum



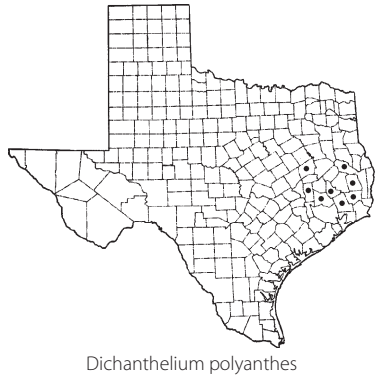
Dichanthelium oligosanthes
(both varieties)



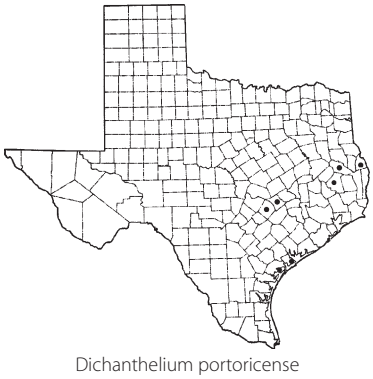
Dichanthelium ovale



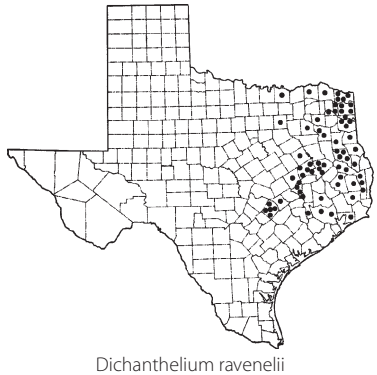
Dichanthelium pedicellatum



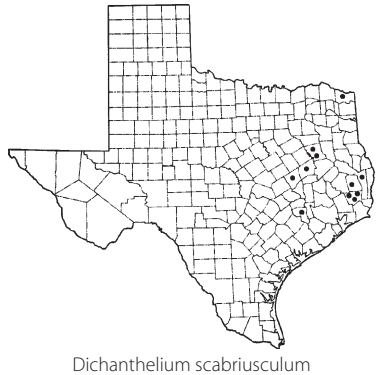
Dichanthelium polyanthes



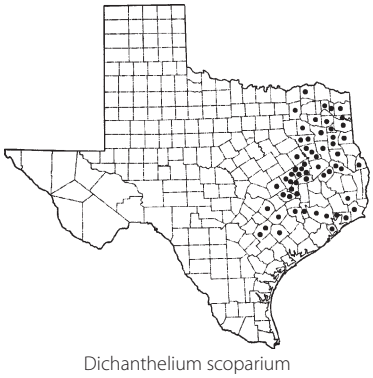
Dichanthelium portoricense



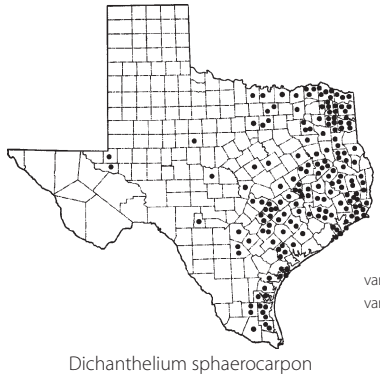
Dichanthelium ravenelii



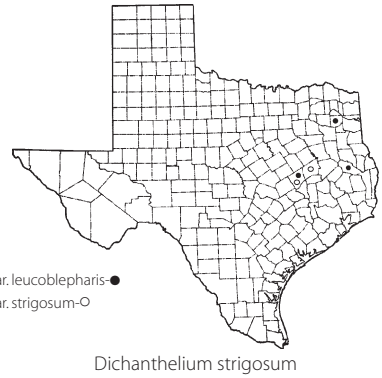
Dichanthelium scabriusculum



Dichanthelium scoparium



Dichanthelium sphaerocarpon



Dichanthelium strigosum

Dichanthelium wrightianum (Scribn.) Freckmann, (for its discoverer, Charles Wright, 1811–1885, TX collector), WRIGHT'S ROSETTE GRASS, WRIGHT'S PANIC GRASS. Culms 15–40(–50) cm tall, quite delicate, 0.3–0.8 mm thick; leaf sheaths glabrous or puberulent, with longer hairs on margins and at summit; ligule 1.5–3 mm long; leaf blades usually puberulent to pilose on upper and lower surfaces; spikelets very small, 0.8–1.1 mm long, puberulent to subglabrous, often purplish; lower glume 1/3 or less as long as spikelet. Sandy peat or muck, bogs, wet pine savannahs, swamps, lake shores, other wet areas; Anderson (*MacRoberts 3831*, Andrew's Pitcher Plant Bog), Hardin, Polk, and Tyler (SBSC) cos.; coastal states of the e U.S. from MA s to FL w to TX. (May–) Jul–Sep. [*D. acuminatum* (Sw.) Gould & C.A. Clark var. *wrightianum* (Scribn.) Gould & C.A. Clark, *Panicum acuminatum* Sw. var. *wrightianum* (Scribn.) C.F. Reed, *Panicum deminutivum* Peck, *Panicum minutulum* Desv., *Panicum strictum* Bosc ex Roem. & Schult., *Panicum wrightianum* Scribn.] Freckmann (1981a) noted that this taxon seems as closely related to *D. dichotomum* ("Ensifolia" group) as to *D. acuminatum*, under which it is often treated as a variety (e.g., Reed 1996). Freckmann and Lelong (2003a) noted that "some specimens suggest *Dichanthelium ensifolium*, and a few unusually robust specimens closely approach *D. acuminatum* subsp. *longiligulatum*." This species has the smallest spikelets of any *Dichanthelium* in TX.

DICHANTHIUM Willemet BLUESTEM

Perennials, tufted or stoloniferous; ligule a short membrane ca. 1–2 mm long; culm nodes bearded with a conspicuous ring of long white hairs (at least when young); inflorescences paniculate, of a few–several spicate branches, these sometimes rebranched; mostly terminal, the axillary inflorescences few or absent; pedicels and inflorescence branches flat or rounded (without a central groove or broad membranous area as seen in *Bothriochloa*); spikelets in pairs, one sessile, one pedicelled, the lowest pair of spikelets on the branches usually without awns and not producing seeds; disarticulation at base of sessile spikelet so that associated pedicel and section of inflorescence branch fall with the sessile spikelet; sessile spikelets 2-flowered, the lower floret sterile, the upper floret fertile; lemma of upper floret usually awned, the awn twisted, geniculate; pedicellate spikelets about as large as sessile spikelets, sterile or staminate, rounded or obtuse apically, awnless.

An Old World tropical genus (Asia and Australia) of 20 species (Barkworth 2003k), including important pasture species and significant weeds; it was formerly treated in a more inclusive *Andropogon*. It is considered to be closely related to *Bothriochloa* (Gould 1975b; Kellogg 2000a), intergeneric hybrids are known with that genus (de Wet & Harlan 1966, 1970b; Watson & Dallwitz 1992), and some authorities have suggested combining the two genera (e.g., de Wet & Harlan 1966, 1968). Like all members of the Andropogoneae, *Dichanthium* is characterized by C_4 photosynthesis (Kellogg 2000a). (Greek: *dicho*, in two, and *anthus*, flower, in reference to the paired spikelets) (subfamily Panicoideae, tribe Andropogoneae)

REFERENCES: Gould 1967; de Wet & Harlan 1968, 1970b; McKenzie et al. 1988; Barkworth 2003k.

1. Inflorescences appearing conspicuously silky-hairy at arm's length; lower glume of sessile spikelet (and often that of pedicelled spikelet as well) with an irregular line of long silky hairs across back near apex (the hairs also often on the margins near apex), the hairs typically 3–5 mm long; plants without stolons; pedicellate spikelets typically sterile _____ **D. sericeum**

1. Inflorescences not appearing silky-hairy at arm's length (however, the spikelets can have pubescence); lower glume of sessile spikelet (and that of pedicelled spikelet as well) without a line of hairs across back near apex, any hairs present on the glumes usually 2 mm or less long; plants usually with stolons; pedicellate spikelets typically staminate.
   2. Main axis and branches of inflorescence glabrous; sessile spikelets usually 2.5–3.5(–5) mm long, with lower glumes elliptic or oblong and ca. 1 mm wide _____ **D. annulatum**

2. Main axis and branches of inflorescence (where visible below spikelets) finely pubescent; sessile spikelets usually 4–5 mm long, with lower glumes obovate or nearly so and ca. 1.5–2 mm wide _____ **D. aristatum**

Dichanthium annulatum (Forssk.) Stapf, (ringed, ring-like), KLEBERG'S BLUESTEM, RINGED DICHANTHIUM. Perennial similar to *D. aristatum*; culms both erect and stoloniferous, the stoloniferous ones to 1+ m long; inflorescence with 2–9 spicate branches; lemma of sessile spikelets with awn 1.3–2.2 cm long. Introduced as a forage grass, disturbed areas; Brazos, Goliad, Fayette, Hays, and Travis (Turner et al. 2003) cos.; mainly Gulf Prairies and Marshes, scattered elsewhere; FL, OK, and TX (Barkworth 2003k). Flowering throughout the growing season. [*Andropogon annulatus* Forssk.] Native of se Asia. This species superficially resembles *Bothriochloa ischaemum* var. *songarica* (KING RANCH BLUESTEM) but has much longer and more conspicuous lemma awns. According to Gould (1975b), the inflorescence pubescence character used in the key to species above, "is the only consistent morphological difference between" *D. annulatum* and *D. aristatum*. KLEBERG'S BLUESTEM is regarded in some areas as a "highly esteemed forage grass, especially in India" (Barkworth 2003k), but it is reported by Hatch et al. (1999) to be poor forage for livestock and wildlife. It is also considered to be a significant weed (Watson & Dallwitz 1992).

Dichanthium aristatum (Poir.) C.E. Hubb., (with a stiff awn or bristle), ANGLETON'S BLUESTEM, AWNED DICHANTHIUM. Perennial; culms both erect and stoloniferous, the erect culms usually 70–100 cm tall, the stoloniferous ones often longer (2+ m); inflorescence with (2–)3–5(–8) spicate branches; lower glume of sessile spikelets with hairs, particularly near base and along margins, the hairs 2 mm or less long; awn of lemma of sessile spikelets ca. 1.5–2.5 cm long. Introduced as a forage grass, roadsides, disturbed areas, pastures; Goliad, Hays (BRIT), Austin, Bastrop, Bexar, Brazos, Fayette, Travis (TAES), Caldwell, and Wilson (Turner et al. 2003) cos. in s part of East TX; also Gulf Prairies and Marshes and South TX Plains; FL, LA, and TX. Sep–Dec. Native in tropical and subtropical regions from India to Indonesia, widely introduced elsewhere. [*Andropogon aristatum* Poir.] This species can be mistaken for *Bothriochloa ischaemum*, which does not always show the grooved pedicels typicial of *Bothriochloa*. The pubescent inflorescence axis and branches distinguish *D. aristatum*. It is reported to be poor forage for livestock and wildlife (Hatch et al. 1999). It is also sometimes used as a lawn grass (Barkworth 2003k), but is considered by some authorities to be a significant weed (Watson & Dallwitz 1992).

Dichanthium sericeum (R. Br.) A. Camus, (silky), SILKY BLUESTEM, QUEENSLAND BLUESTEM, QUEENSLAND BLUEGRASS. Tufted perennial; culms erect, usually 50–120 cm tall; inflorescence with 2–7 branches, the spikelets with so much silky pubescence that the inflorescences appear conspicuously silky-hairy at arm's length; sessile spikelets 2.5–4.5 mm long; lower glumes with hairs forming irregular line near tip, these hairs ca. 3–5 mm long and papilla-based; lemma of sessile spikelets with awn 2–3.5 cm long. Introduced to TX as a potential forage grass (Gould 1975b); Caldwell (TAES), Brazos, and Goliad (TAMU) cos.; mainly Gulf Prairies and Marshes and South TX Plains, also Kendall Co. (Turner et al. 2003) in e Edwards Plateau; FL and TX. May–Sep(–late fall). [*Andropogon sericeus* R. Br.] Native of Australia. Hatch et al. (1999) reported this species to be fair to poor forage for livestock and wildlife, while Watson and Dallwitz (1992) considered it to be an important pasture species.

DIGITARIA Haller CRAB GRASS, FINGER GRASS

Annuals or perennials; ligule membranous; inflorescence often digitate or nearly so, sometimes with branches along a short axis, the branches few to numerous, unbranched, spike-like, winged or unwinged, appearing 1-sided, the spikelets appressed in 2 rows along 1 side of the branch axis OR the inflorescences appearing very different in *D. cognata* which has an open, much-branched panicle with solitary long-pedicelled spikelets; spikelets sometimes in pairs (1

subsessile, the other short-pedicelled), 2-flowered, the lower floret staminate or neuter, the upper floret fertile; disarticulation below glumes; lower glume minute or absent; upper glume well-developed but usually shorter than lemmas; lemma of lower floret resembling a glume; lemma of fertile floret with margins thin and flat, not inrolled; stamens 3.

A C_4 genus of ca. 200 species of tropical to warm temperate areas of the world (Wipff 2003f). Many species are weedy, a number are important pasture grasses, and some are cultivated for food (grain) in Africa. As treated here, *Digitaria* includes *Leptoloma* (e.g., *D. cognata*), whose inflorescence appears quite different; see that species for discussion. Three East TX species (*D. californica, D. insularis, and D. patens*) were treated in the genus *Trichachne* by Correll and Johnston (1970). ⊘ *Digitaria velutina* (Forssk.) Beauv., VELVET CARPET GRASS, a federal noxious weed, was erroneously reported for TX by Kartesz (1999) (Wipff 2003f). (Latin: *digitus*, finger, from the finger-like arrangement of the inflorescence branches) (subfamily Panicoideae, tribe Paniceae)

REFERENCES: Henrard 1950; Ebinger 1962; Gould 1963; Veldkamp 1973; Webster & Hatch 1981a, 1981b, 1983, 1990; Webster & Shaw 1982; Webster 1987, 1988; Wipff & Hatch 1988, 1994; Crins 1991; Wipff 2001b, 2003f.

1. Spikelets long-pedicelled (pedicels 2–many times as long as spikelet); inflorescence a much-branched and rebranched, open panicle with spikelets far apart ____ **D. cognata**
1. Spikelets subsessile or on short, appressed pedicels; inflorescence of few to numerous, unbranched, spike-like branches (these digitately arranged or along a short axis), the spikelets close together.
   2. Inflorescence branches winged (wings often as wide as central part of branch); spikelets glabrous to short-pubescent.
      3. Spikelets 1.2–2.3 mm long; lemma of fertile floret dark brown to purplish black at maturity.
         4. Spikelets (1.7–)1.9–2.3 mm long ____ **D. ischaemum**
         4. Spikelets 1.2–1.7 mm long ____ **D. violascens**
      3. Spikelets 2.2–3.7 mm long; lemma of fertile floret light brown or grayish.
         5. Lemma of lower floret (lemma appearing glume-like because of minute or absent lower glume) of the nearly sessile spikelets with the 7 (sometimes apparently 5) veins ± equally spaced, often but not always densely villous marginally (note that spikelets are in pairs, one pedicelled and one nearly sessile); lower glume of nearly sessile spikelets rounded to truncate or bifid, usually 0.1–0.3 mm long ____ **D. bicornis**
         5. Lemma of lower floret of the nearly sessile spikelets with the 7 (sometimes apparently 5) veins not equally spaced, the lateral ones crowded at margins, glabrous or inconspicuously pubescent marginally; lower glume of nearly sessile spikelets obtuse or acute, often more than 0.3 mm long.
            6. Spikelets 2.2–3.3 mm long; upper glume 0.8–1.8 mm long; leaf blades usually densely pubescent, usually on both surfaces; lemma of lower floret minutely scabrous on lateral veins (as seen under a dissecting scope) ____ **D. sanguinalis**
            6. Spikelets 2.8–4.1 mm long; upper glume 1.5–2.7 mm long; leaf blades glabrous or sparsely pubescent, any hairs usually on upper surface only; lemma of lower floret smooth on lateral veins ____ **D. ciliaris**
   2. Inflorescence branches not winged or only minutely so; spikelets silky-pubescent with long white-, tan-, buff-, or purplish-silky hairs OR not so.
      7. Spikelets silky-pubescent, the inflorescences appearing conspicuously white-, tan-, buff-, or purplish-silky-pubescent at arm's length; spikelets 3–5.9 mm long.
         8. Back of lemma of lower, sterile floret usually with pubescence or apparently so (in addition to being conspicuously hirsute marginally); inflorescence usually tan- or buff-tinged due to conspicuous pubescence on spikelets ____ **D. insularis**
         8. Back (outer surface) of lemma of lower, sterile floret (lemma glume-like because of minute 1st glume) glabrous at least in a broad lengthwise band down the middle (but marginally densely hirsute); inflorescence usually white- or purplish-tinged due to conspicuous pubescence on spikelets.



Dichanthelium strigosum var. leucoblepharis [HI1]



Dichanthium annulatum [GO1]



Dichanthelium strigosum var. strigosum [GLE]



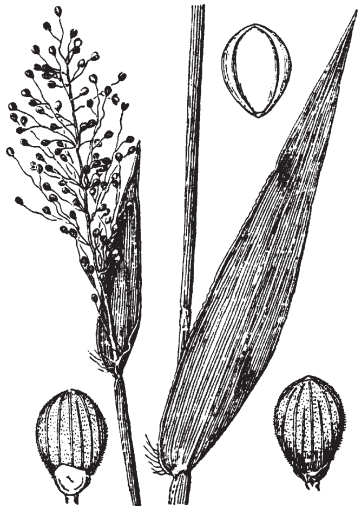
Dichanthelium tenue [GLE]



Dichanthium aristatum [HEB]



Dichanthium sericeum [GO1]



Dichanthelium sphaerocarpon [HI]



Dichanthelium wrightianum [USB]

9. Inflorescence branches appressed or ascending, the inflorescence contracted; spikelets crowded, overlapping; lemma of sterile, lower floret with hairs usually 2–5 mm long; terminal pedicels of branches 1.7–6(–7) mm long; caryopsis (= fruit) abruptly pointed _____ **D. californica**

9. Inflorescence branches stiffly spreading, the inflorescence open; spikelets widely-spaced, many of them not overlapping or only slightly so; lemma of sterile, lower floret usually with hairs ca. 2 mm or less long; terminal pedicels of branches 7.4–20 mm long; caryopsis tapering gradually to a point _____ **D. patens**

7. Spikelets not silky-pubescent, the inflorescences not appearing pubescent at arm's length; spikelets 1.5–2.8 mm long.

10. Plants perennial, the culms sometimes ± stoloniferous and rooting at the lower nodes; spikelets 2–2.6 mm long AND inflorescence branches 6–10(–13) cm long _____ **D. texana**

10. Plants annual, the culms neither stoloniferous nor rooting at the nodes; spikelets EITHER shorter than 2 mm OR inflorescence branches longer than 13 cm _____ **D. filiformis**

Digitaria bicornis (Lam.) Roem. & Schult., (two-horned), ASIAN CRAB GRASS. Annual similar to *D. ciliaris*, but yellow-green (Webster 1987); inflorescence branches digitately arranged or a few solitary below; culms decumbent and often rooting at the nodes; leaf blades mostly glabrous but with papilla-based hairs near ligule; spikelets (2.6–)2.8–3.6(–3.7) mm long; lemma of lower floret of nearly sessile spikelet often glabrous or nearly so (except often villous marginally); lemma of lower floret of pedicelled spikelet usually hairy; $2n = 72$ (Gould 1975b). Sandy or sandy loam soils; Bexar (BRIT), Austin, Grimes, Harris (SBSC), Angelina, Caldwell, Cass, Houston, Lee, Leon, Robertson, and Walker (Turner et al. 2003) cos.; Webster (1980) mapped the species as occurring widely in the Pineywoods and Post Oak Savannah of TX; also Gulf Prairies and Marshes and South TX Plains; se U.S. from VA s to FL w to TX, also CA. Jun–Nov. [*D. diversiflora* Swallen, *Paspalum bicorne* Lam.] There has been disagreement as to whether this species is native to the U.S. or not (e.g., the common name). Some authorities indicate it was introduced (e.g., Hatch et al. 1990). However, we are following recent sources who consider it native (e.g., Kartesz 1999; Wipff 2003f). According to Webster (1980), the species is "common and abundant on the sandy coastal plain of the southeastern states" and further, the "range of the species is now known to include ... eastern Texas." Wipff (2003f) considered it native from the se U.S. through Mexico to n South America and the West Indies. Webster and Shaw (1982) noted that *D. milanjiana* (Rendle) Stapf, MADAGASCAR CRAB GRASS, an introduced African perennial similar to *D. bicornis*, is known from s TX. It can be distinguished from *D. bicornis* (and the other similar annuals, *D. ciliaris* and *D. sanguinalis*) by its glabrous leaves (versus leaves with hairs at least in the region of the ligule in the other annual species).

Digitaria californica (Benth.) Henrard, (of California—reflecting that the first collection was made in Baja California—Wipff 2003f), CALIFORNIA COTTON-TOP, ARIZONA COTTON-TOP, CALIFORNIA CRAB GRASS. Tufted perennial from a knotty base; culms erect, ca. 50–100 cm tall; leaf blades glabrous or the upper surfaces villous; inflorescence usually silvery- or purple-tinged due to conspicuous pubescence, the branches digitately arranged or nearly so, usually appressed, densely-flowered; spikelets 3–4(–5.4) mm long (excluding hairs); upper glume and margins of lower lemma densely long-hairy, the hairs 2–5 mm long; $2n = 36$, 54, 70, and 72 (Gould 1975b). Disturbed grasslands; Travis (BRIT), Fayette (TAES), Bexar, Caldwell, and McLennan (Turner et al. 2003) cos. in sw part of East TX; widespread in w 2/3 of TX; AZ, CO, NM, OK, and TX. May–Nov. [*Trichachne californica* (Benth.) Chase]

Digitaria ciliaris (Retz.) Koeler, (ciliate, fringed), SOUTHERN CRAB GRASS. Annual; culms decumbent and rooting at lower nodes, the erect portion to ca. 60 cm tall; similar to *D. sanguinalis*, differing in characteristics as enumerated in the key; also similar to *D. bicornis* but usually dark green (Webster 1987); inflorescence branches digitately arranged or in whorls; leaf sheaths

with papilla-based hairs; leaf blades 3–9 mm wide, mostly glabrous but with papilla-based hairs near ligule or sparsely over whole upper surface; 2*n* = 54 (Gould 1975b). Common weed, open disturbed habitats; widespread in TX; throughout most of s 2/3 of US from NY s to FL w to CA. Jun–Nov. [*D. adscendens* (Kunth) Henrard, *D. sanguinalis* (L.) Scop. var. *ciliaris* (Retz.) Parl.] This species has sometimes been treated as a variety of *D. sanguinalis* (e.g., Steyermark 1963), but a detailed study by Webster (1987) indicated the two are distinct species; a sterile hybrid between them was reported by Gould (1963).

Digitaria cognata (Schult.) Pilg., (related to), FALL WITCHGRASS, CAROLINA CRAB GRASS. Clump-forming perennial to 70 cm tall; culms usually decumbent near base; lower leaf sheaths densely pubescent, the upper glabrous; ligule a membrane 1.5 mm or less long; panicle much-branched, open, with spikelets far apart; spikelets 2.2–3.3 mm long, long-pedicelled, obovate to narrowly or broadly elliptic; lower glume minute or absent; upper glume and lemma of sterile floret similar. Sandy, rocky, or gravelly soils; widespread in TX. Because its inflorescence is very different from those of most members of *Digitaria*, this species has sometimes been recognized in the genus *Leptoloma*. However, according to Wipff and Hatch (1994), the only character separating *Leptoloma* and *Digitaria* is inflorescence type, and that is unreliable. When examined worldwide, there is a transition between inflorescence types and thus no justification for separating the 2 genera (Veldkamp 1973; Webster 1988; Wipff & Hatch 1994; Yatskievych 1999). The inflorescence breaks off at the base and can act as a "tumbleweed" (Gould 1975b; Davidse 1987a). Two subspecies are found in East TX.

1. Lemma of lower, sterile floret 7-veined (rarely 6-), the veins not equally spaced; spikelets glabrous to pubescent; rhizomes absent; subspecies widespread throughout East TX _____ subsp. **cognata**
1. Lemma of lower, sterile floret 5-veined, the veins equally spaced; spikelets usually pubescent to densely pubescent; rhizomes present or absent; subspecies known in East TX only from w margin of area _____ subsp. **pubiflora**

subsp. **cognata**. Spikelets 2.2–3.1 mm long, usually broadly elliptic to obovate, glabrous to pubescent. In sandy soils, occasional in rocky or gravelly soils, open woods, fields, and disturbed sites; widespread in e 1/2 of TX; se Canada (Ont.) and e U.S. from NH s to FL w to MN and TX. (Feb–)May–Oct, but chiefly Aug–Oct. [*Leptoloma cognatum* (Schult.) Chase]

subsp. **pubiflora** (Vasey) Wipff, (with hairy flowers), WESTERN WITCH GRASS. Spikelets 2.3–3.3 mm long, usually narrowly elliptic, usually pubescent to densely pubescent but sometimes glabrous or nearly so. Dry areas, sandy or rocky soils; Bell, McLennan, Travis, Williamson (BRIT), Bexar, Caldwell, and Hays (Turner et al. 2003) cos. on the sw margin of East TX; widespread mainly in w 2/3 of TX; AZ, NM, OK, and TX. Spring–fall, but more commonly in the fall. [*Digitaria pubiflora* (Vasey) Wipff] This subspecies has variously been considered part of an undivided *D. cognata* (e.g., Gould 1975b), treated as a subspecies of it (Wipff & Hatch 1994; Turner et al. 2003), or recognized as a distinct species (Wipff 2001b, 2003f). Wipff (2001b) noted that the two are easily distinguished morphologically and that in the area of sympatry no hybrids were found. However, based on the morphological similarity and apparent overlap of characters, we are treating the variation at the subspecific level.

Digitaria filiformis (L.) Koeler, (thread-like), SLENDER CRAB GRASS, SLENDER FINGER GRASS. Tufted annual with erect culms usually 50–130(–150) cm or more tall; lowermost leaf sheaths sparsely to densely hairy; inflorescence branches digitately arranged or along a short main axis; upper glume usually 3/4 or more as long as lemma of fertile floret; lemma of fertile floret dark brown at maturity; 2*n* = 36 (Gould 1975b). Sandy fields or woods; widespread in e 1/2 of TX; e U.S. from NH s to FL w to IA and TX. Sep–Oct. There is disagreement over the taxonomy of this species. Turner et al. (2003) apparently submerged var. *villosa* into *D. filiformis*, not distinguishing it at any rank. Gould (1975b), Hatch et al. (1990), and Hatch (2002) recognized var. *villosa* as a dis-

tinct species. However, we have been unable to find sufficient differences in the material we have seen to warrant separation at the species level. Because of morphological overlap, we are therefore following Jones et al. (1997), Yatskievych (1999), and Wipff (2003f) in treating *D. villosa* as a variety of *D. filiformis*. Wipff (2003f) suggested that "Further study may show that the two varieties should be combined." We agree that additional study is needed to determine the appropriate taxonomic rank at which to recognize these entities. The county distribution map does not distinguish varieties.

1. Spikelets (1.3–)1.5–1.9(–2) mm long; inflorescence branches usually 8–13 cm long; lowermost leaf sheaths usually sparsely hairy, sometimes densely so; culms 80 cm or less tall _____ var. **filiformis**
1. Spikelets 2–2.8 mm long; inflorescence branches usually (10–)13–25 cm long; lowermost leaf sheaths densely hairy; culms usually 75–130(–150) cm tall _____ var. **villosa**

var. **filiformis.** Tufted annual with erect culms usually 50–80 cm tall, similar to var. *villosa*; 2*n* = 36 (Gould 1975b). Sandy fields or woods; Gould (1975b), Hatch et al. (1990), and Hatch (2002) cited the Pineywoods, Post Oak Savannah, and Gulf Prairies and Marshes; however, we have seen few East TX specimens that fall within this variety; e U.S. from NH s to FL w to IA and TX. Sep–Oct.

var. **villosa** (Walter) Fernald, (softly hairy), SHAGGY CRAB GRASS. Tufted annual with erect culms usually 75–130(–150) cm or more tall, much-branched at base; upper glume and lemma of fertile floret usually more pubescent than in var. *filiformis*; 2*n* = 36 (Gould 1975b). Disturbed sandy soils; widespread in e 1/2 of TX; se U.S. from VA s to FL w to MO, OK, and TX, also IL. Aug–Nov. [*Digitaria villosa* (Walter) Pers.]

Digitaria insularis (L.) Mez ex Ekman, (pertaining to or inhabiting an island), SOUR GRASS. Tufted perennial from a knotty base; culms erect, 35–100(–150) cm tall; leaf blades glabrous or nearly so; inflorescence usually tan- or buff-tinged due to conspicuous pubescence, the numerous branches appressed, densely-flowered; terminal pedicel of branches 2–5 mm long; spikelets 3.6–5.9 mm long (excluding hairs); upper glume and lemma of lower floret densely long-hairy, the hairs 2–4(–6) mm long; 2*n* = 36 (Gould 1975b). Ditches, moist areas; Bastrop, Bell, Bexar, and Caldwell (Turner et al. 2003) cos. in sw part of East TX; scattered in TX, but mainly Gulf Prairies and Marshes and South TX Plains; AZ, FL, and TX. Aug–Nov. [*Trichachne nutans* (L.) B.R. Baum, *Trichachne insularis* (L.) Nees]

Digitaria ischaemum (Schreb.) Muhl., (Greek: *ischaemos*, blood-restraining, from supposed styptic properties), SMOOTH CRAB GRASS. Tufted annual to ca. 50(–70) cm tall; leaf sheaths and blades usually glabrous or with sparse pubescence; inflorescence digitately arranged or nearly so (there can be a short main axis), the branches usually ca. 3–9(–11+) cm long; spikelets (1.7–)1.9–2.3 mm long; upper glume more than 3/4 as long as lemma of upper floret; 2*n* = 36 (Gould 1975b). Open woods, waste places; scattered in East TX w to Leon Co. (Turner et al. 2003); also n Gulf Prairies and Marshes; s Canada and nearly throughout the U.S. Aug–Nov. Native of Eurasia

Digitaria patens (Swallen) Henrard, (spreading, opening out), TEXAS COTTON-TOP. Tufted perennial similar to *D. californica*, but distinguished as in the key to species; culms 40–90 cm tall; inflorescence branches 4–10, stiffly spreading, the inflorescence open; spikelets widely-spaced, many of them not overlapping or only slightly so; lemma of sterile, lower floret usually with hairs ca. 2 mm or less long; 2*n* = 72 (Gould 1975b). Brushy areas, pastures, often in disturbed habitats, well-drained, usually sandy soils; Bexar and Caldwell (Turner et al. 2003) cos. on sw margin of East TX; mainly s Gulf Prairies and Marshes and South TX Plains, also e Edwards Plateau; endemic to TX and adjacent Mexico (Wipff 2003f). May–Nov. [*Trichachne patens* Swallen] Gould (1975b) indicated that this species "appears to be an octoploid derivative of *D. californica*."

Digitaria sanguinalis (L.) Scop., (of blood-red color, possibly due to the sometimes gray-brown to purple spikelets), HAIRY CRAB GRASS, LARGE CRAB GRASS. Annual similar to *D. ciliaris* but with



Digitaria bicornis [HEB]



Digitaria californica [GO3]



Digitaria ciliaris [GO4]



Digitaria cognata subsp. cognata [HI1]



Digitaria filiformis var. filiformis [HI1]



Digitaria filiformis var. villosa [GO2]

smaller spikelets and more densely pubescent leaf blades; culms weak, rooting at nodes; leaf sheaths and blades pubescent with papilla-based hairs; inflorescence usually with 4–9(–13) branches often 6–15 cm long, sometimes longer, these digitately arranged or nearly so (sometimes in 2–3 whorls along a short main axis); lemma of lower floret 7-veined (sometimes apparently 5-veined), the lateral veins minutely scabrous above; 2*n* = 36 (Gould 1975b). Open disturbed areas, much less common in East TX than *D. ciliaris*; widely scattered in TX; s Canada and throughout most of the U.S. Jul–Nov. Native of Eurasia. This species is considered a serious weed in some areas (Yatskievych 1999) and is listed by some sources among the world's worst weeds (Holm et al. 1977). ⊘ ☜

Digitaria texana Hitchc., (of Texas), TEXAS CRAB GRASS, TEXAS FINGER GRASS. Perennial; culms to 80 cm long, decumbent at base, often stoloniferous and rooting at the nodes; inflorescence branches usually 4–12, typically along a short axis; spikelets 2–2.6 mm long (not including coastal form with longer spikelets, mentioned below); upper glume and lemma of lower floret pubescent marginally and sometimes on back. Sandy soils, prairies, roadsides, sandy oak woods; tentatively included based on citation for the Big Thicket National Preserve (National Park Service 1995a, 1995b); no East TX specimen seen; found primarily to the s of East TX in the Gulf Prairies and Marshes and adjacent South TX Plains; according to Webster and Hatch (1990), the species occurs near the TX coast from Calhoun Co. to Cameron Co.; they also cited a Brazos Co. record (*Reeves 1040*, TAES) but suggested it "probably represents an incorrectly labeled specimen;" endemic to TX (Carr 2002b, 2002c) or possibly also in FL (Wipff 2003f); no county distribution map is provided. Sep–Nov. [*D. runyonii* Hitchc.] A form of this species occurring on coastal sand dunes has longer spikelets (ca. 2.8–3.3 mm long). It was previously recognized as *D. runyonii* (e.g., Gould 1975b), but subsequent research (Webster & Hatch 1990) found that vegetative characters overlap, intermediates are common, and "*D. runyonii* is best placed in synonymy under *D. texana*." ✦

Digitaria violascens Link, (becoming violet), VIOLET CRAB GRASS. Tufted annual to 60 cm tall; similar to *D. ischaemum*, except spikelets smaller (see key); upper glume from 1/2 to almost as long as lemma of upper floret; 2*n* = 36 (Gould 1975b). Partial shade, forest margins, openings in pine or mixed forests, disturbed areas; s part of the Pineywoods and Post Oak Savannah; also Denton Co. (Turner et al. 2003) in Cross Timbers and Prairies and n Gulf Prairies and Marshes; se U.S. from NC s to FL w to TX, also NY. (Jun–)Aug–Nov. Native of the Old World tropics. [*D. chinensis* (Nees) A. Camus, *D. ischaemum* (Schreb.) Muhl. var. *violascens* (Link) Radford] Some authors question whether this species is specifically distinct from *D. ischaemum* (e.g., Allen 1992b) or is a variety of that species (e.g., Radford et al. 1968). ☜

DISTICHLIS Raf. SALT GRASS, ALKALI GRASS

A genus of 5 species (Barkworth 2003a), 4 in the New World, 1 in Australia; typically of seashores and deserts. It is apparently related to *Monanthochloe*, and intergeneric hybrids between the two have been reported (Stephenson 1972). *Distichlis* species are halophytic (= adapted to grow in saline or alkali soils) and have salt glands, specialized epidermal structures for the excretion of excess salts from leaf tissue (Oross & Thomson 1982). They are also characterized by C_4 photosynthesis, an advantage in arid environments (Watson & Dallwitz 1992). (Greek: *distichos*, two-ranked) (subfamily Chloridoideae, tribe Cynodonteae)
REFERENCES: Beetle 1955; Peterson et al. 1997; Barkworth 2003a.

Distichlis spicata (L.) Greene, (with spikes), SALT GRASS, SPICATE SALT GRASS, INLAND SALT GRASS, DESERT SALT GRASS, COASTAL SALT GRASS, SPIKE GRASS, ALKALI GRASS. Low glabrous perennial 10–35(–70) cm tall from extensive scaly rhizomes, usually dioecious; flowering culms erect, the internodes short, with leaf sheaths conspicuously overlapping at least on lower portion of culm; leaves noticeably distichous (= 2-ranked); ligule a minute membrane < 0.5 mm long; leaf blades 2–20 cm long, 1–3 mm wide, often ± involute; inflorescence a contracted spike-like panicle or spike-like raceme 3–8 cm long; spikelets pedicellate, ± similar on male and female plants, usually



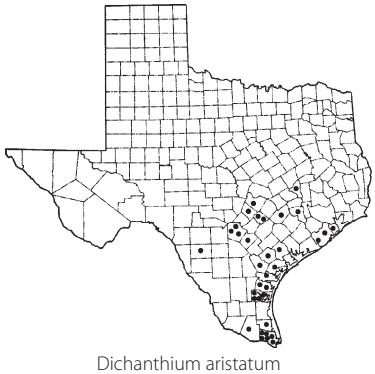
Dichanthelium tenue



Dichanthelium wrightianum



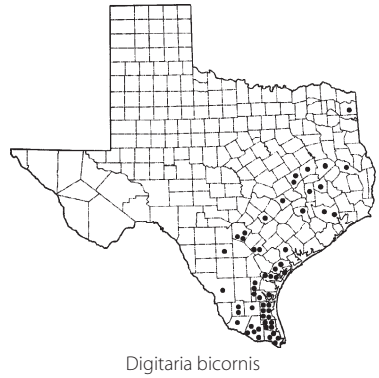
Dichanthium annulatum



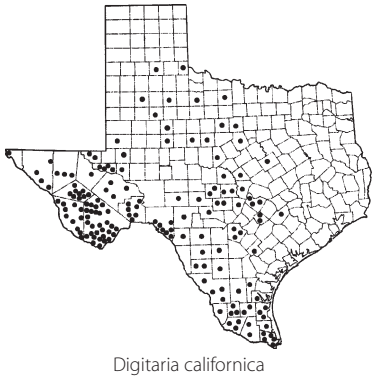
Dichanthium aristatum



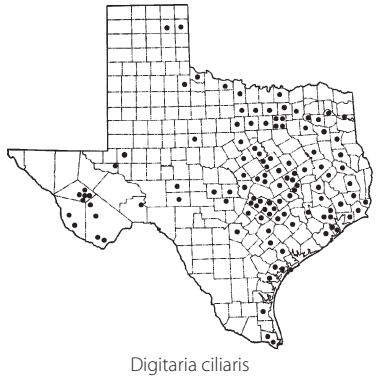
Dichanthium sericeum



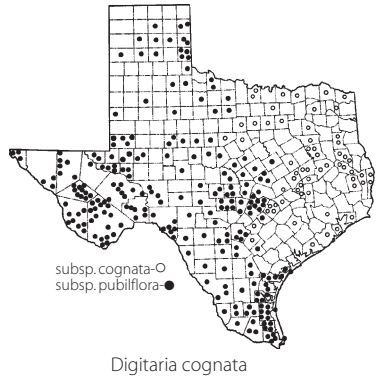
Digitaria bicornis



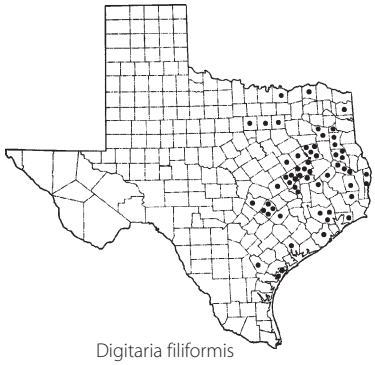
Digitaria californica



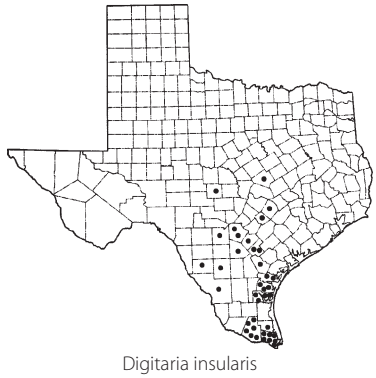
Digitaria ciliaris



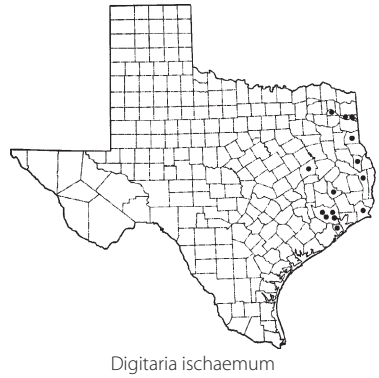
Digitaria cognata



Digitaria filiformis
(both vars.)



Digitaria insularis



Digitaria ischaemum

5–20-flowered, 6–18(–28) mm long, awnless; disarticulation above glumes and between florets; glumes slightly unequal; lemmas similar to glumes but longer and broader, 3–6 mm long, keeled; pistillate lemmas coriaceous, enclosing the caryopses; paleas as long as lemmas or nearly so. Widespread and often abundant in salt marshes and low flats along the coast, isolated inland populations occur widely in TX in moist, alkaline or salty areas—e.g. Van Zandt (BRIT, in salt marsh near Grand Saline—an area of considerable inland salt deposits associated with a salt dome), Anderson (TAES), and Bexar (Turner et al. 2003) cos.; mainly Gulf Prairies and Marshes but also widely scattered in the s and w parts of the state; s Canada and throughout most of the U.S. Summer–fall. [*Distichlis spicata* var. *stricta* (Torr.) Scribn.] While we are not recognizing it as a distinct variety, all East TX plants fall into var. *stricta*. According to Gould (1975b), this variety "appears to represent little more than a variable series of inland populations of *Distichlis spicata* growing under a wide range of soil and climatic conditions." This species is considered a significant weed by some authorities (e.g., Watson & Dallwitz 1992).

ECHINOCHLOA P. Beauv. BARNYARD GRASS, COCK-SPUR GRASS

Mostly annuals (*E. polystachya* perennial) with culms decumbent to spreading or erect; ligule usually absent; panicles dense, with spikelets crowded along one side of branches; spikelets of 2 florets (1 perfect), subsessile, glabrous, pubescent, or hispid, disarticulating below the glumes; lower glume present, much shorter than upper, unawned to minutely awn-tipped; upper glume and lemma of lower (sterile) floret similar; lemma of lower floret awnless to long-awned; lemma of upper (perfect) floret hardened, grain-like, smooth and shiny with inrolled margins, usually abruptly short-pointed at apex, the point often wrinkled.

A C_4 genus of 40–50 species of tropical to warm-temperate areas, usually associated with wet or damp places (Michael 2003). *Echinochloa* species are often extremely variable and intergrade, making absolute distinctions between taxa difficult. According to Michael (2003), "Some of the characters traditionally used for distinguishing taxa, e.g., awn length, are affected by the amount of moisture available; others reflect selection by cultivation, e.g., non-disarticulation in grain taxa, mimicry of rice as weeds of rice fields." In fact, some forms have evolved striking similarities in both vegetative and seed characters to rice—they are thus excellent examples of mimicry in plants (Barrett 1983). The genus includes a number of significant weeds and many important pasture species (Watson & Dallwitz 1992). There are two domesticated species, *E. esculenta* (A. Braun) H. Schotz [*E. utilis* Ohwi & Yabuno] (JAPANESE BARNYARD MILLET) and *E. frumentacea* Link (INDIAN-MILLET, SAWA-MILLET, BILLION-DOLLAR GRASS), apparently derived from *E. colona* and *E. crusgalli* respectively (Yabuno 1962; Michael 2003; but see Hilu 1994 for a different interpretation). *Echinochloa frumentacea* (sometimes treated as *E. crusgalli* var. *frumentacea* (Link) W. Wight) is cultivated for forage and grain (Yatskievych 1999) and in TX around ponds for waterfowl. This taxon apparently does not persist in TX without cultivation (Hatch et al. 1999). Hatch et al. (1999) noted that *Echinochloa* species are highly palatable to cattle, produce forage late in the hot summer period, and are important wetland plants for attracting birds. (Greek: *echinos*, hedgehog, and *chloa*, grass, referring to the bristling awns) (subfamily Panicoideae, tribe Paniceae)

REFERENCES: Hitchcock 1920b; Yabuno 1962, 1966; Gould et al. 1972; Barrett 1983; de Wet et al. 1983b; Maun & Barrett 1986; Crins 1991; Hilu 1994; Michael 2003.

1. Leaf sheaths hirsute or hispid; lemma of lower floret usually with awn 1.5–6 cm long (occasionally short-awned or awnless) ____ **E. walteri**
1. Leaf sheaths glabrous; lemma of lower floret awnless or variously awned.
   2 Palea of lower floret absent or vestigial; spikelets awnless or infrequently with awns to 1 cm long ____ **E. crus-pavonis**
   2. Palea of lower floret well-developed; spikelets awnless or with awns, these variable in length, to 6 cm long.



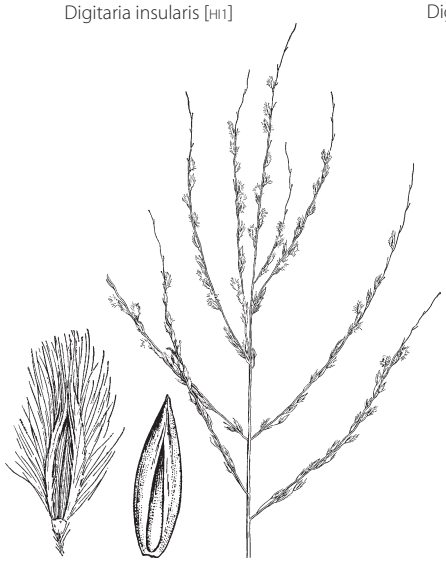
Digitaria insularis [HI1]



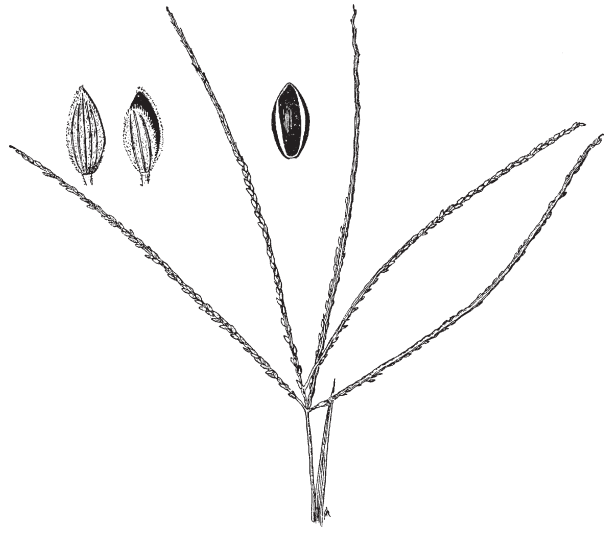
Digitaria ischaemum [REE]



Digitaria sanguinalis [REE]



Digitaria patens [HI1]



Digitaria violascens [HI2]



Digitaria texana [HI1]



Distichlis spicata [GO1]



Echinochloa colona [MAS]

3. Inflorescence branches 3–7, usually 2(–3) cm or less long, without secondary branches; spikelets 2–3 mm long, awnless, arranged in 4 regular rows, without papilla-based hairs; leaf blades 3–6(–9) mm wide _____ **E. colona**
3. Inflorescence and spikelets without the above combination of characters; inflorescence branches usually rebranched (but the secondary branches often short and inconspicuous), often longer than 2 cm; spikelets often longer than 3 mm, often awned, in regular rows or not so, sometimes with papilla-based hairs; leaf blades ca. 3–30 mm wide.
   4. Lemma of lower floret with awn usually 1.5–6 cm long; inflorescences usually very large, (10–)20–40 cm or more long and up to 10 cm thick; lemma of fertile (upper) floret without a line of minute hairs across the base of the tip (use dissecting scope); rare glabrous-sheathed form of this species _____ **E. walteri**
   4. Lemma of lower floret awnless or variously awned; inflorescences variable, often smaller; lemma of fertile floret with a line of minute hairs across the base of the tip (use dissecting scope); weedy species widespread and common in East TX.
      5. Lemma of fertile (upper) floret obtuse to broadly acute, with a sharply differentiated, withering, membranous tip; spikelets without papilla-based hairs _____ **E. crusgalli**
      5. Lemma of fertile floret acute to acuminate, tapering to a firm, stiff tip; spikelets usually with some stout, papilla-based hairs _____ **E. muricata**

Echinochloa colona (L.) Link, (farmer, colonist, to inhabit), JUNGLE-RICE, AWNLESS BARNYARD GRASS, SHAMA-MILLET. Culms 10–70 cm long; inflorescence branches not rebranched; spikelets 2–3 mm long, unawned, without papilla-based hairs. Low ground, disturbed areas; throughout TX; widespread in s 1/2 of U.S., scattered elsewhere. Jul–Nov. Native of Old World tropics. Because of disagreement over the Latin derivation, the specific epithet is sometimes spelled "colonum" (Yatskievych 1999). We are following Gould (1975b), Jones et al. (1997), Kartesz (1999), and Michael (2003) in using the spelling "colona." Michael (2003) indicated that this spelling reflects what was considered correct at the time of Linnaeus, who originally named the species. This species is an important weed of rice as well as a number of other crops, and it is considered by some sources to be among the world's worst weeds (Zimdahl 1989; Holm et al. 1977). According to Michael (2003), the "unbranched, rather widely-spaced panicle branches make this one of the easier species of *Echinochloa* to recognize."

Echinochloa crusgalli (L.) P. Beauv., (cockspur), BARNYARD GRASS, LARGE BARNYARD GRASS. Culms 30–100(–200) cm long; inflorescence axis erect or slightly drooping, the longer primary branches with short, inconspicuous, secondary branches; spikelets (2.5–)2.8–4.4 mm long, without papilla-based hairs; lemma of lower floret awnless or with an awn to over 5 cm long; lemma of fertile (upper) floret broadly ovate or broadly elliptic, apically obtuse to broadly acute, with a line of minute hairs across the base of the tip (use dissecting scope; this and *E. muricata* are the only two East TX *Echinochloa* species to display this distinctive but obscure character); $2n = 54$. Low ground, disturbed areas; throughout TX; s Canada and throughout the U.S. Jun–Oct. [*Panicum crusgalli* L.] While the specific epithet is often spelled "crus-galli," the correct spelling is without a hyphen (Michael 2003), following the original usage by Linnaeus (1753). This species is apparently introduced from the tropics and was reported from the U.S. by at least the early 1800s (Maun & Barrett 1986). It is a cosmopolitan weed which now ranges from 53° N to 40° S (Maun & Barrett 1986). Its success has been attributed to the production of large numbers of easily dispersed seeds, the ability to develop rapidly, the ability for its seeds to lie dormant for long periods, the capacity to flower under varying photoperiods, and relative resistance to herbicides (Maun & Barrett 1986). It adversely affects a variety of crops and is considered by some sources to be among the world's worst weeds (Holm et al. 1977). While this is a variable species (e.g., awn length), Michael (2003) did not consider the recognition of infraspecific taxa warranted.

Echinochloa crus-pavonis (Kunth) Schult. var. **macra** (Wiegand) Gould, (sp.: peacock spur; var.: soften), GULF COCK-SPUR GRASS. Culms 30–100(–150) cm long; inflorescence axis stiffly erect;

spikelets (2.5–)2.8–3.1(–3.4) mm long, without papilla-based hairs; lower lemma awnless or infrequently with an awn to 1 cm long; palea of lower floret absent or vestigial (unlike all other TX *Echinochloa* species); lemma of fertile (upper) floret narrowly elliptic, with a well-differentiated, early-withering tip. Disturbed areas; nearly throughout TX; w U.S. from OR and CA e to MO and MS. Jul–Nov. According to Michael (2003), the varietal epithet "is frequently spelled '*macera*', but '*macra*' is correct." Hatch et al. (1999) noted that this species is the most common *Echinochloa* in TX. Variety *crus-pavonis*, with the palea of the lower floret present and well-developed, lemma of lower floret usually with awns 2–9 mm long, and inflorescence axis curved or drooping, occurs to the s of East TX in the Gulf Prairies and Marshes. In the key above, it would come out with *E. crusgalli*, but it can be distinguished by a combination of spikelet size, awn length, shape of fertile floret, and curvature of the inflorescence.

Echinochloa muricata (P. Beauv.) Fernald, (with numerous minute short points, roughened), ROUGH BARNYARD GRASS, AMERICAN BARNYARD GRASS. Culms 80–150(–160) cm long; spikelets 2.3–5 mm long, green or purple, usually conspicuously echinate with stout, papilla-based hairs; lower lemma awnless or with an awn to 2.5 cm long; lemma of fertile floret apically acute to acuminate, with a line of minute hairs across the base of the tip (use dissecting scope; this and E. *crusgalli* are the only two East TX *Echinochloa* species to display this distinctive but obscure character); $2n = 36$. Low, moist, often disturbed areas; varieties are not distinguished on the county distribution map. Jul–Nov. This native species is sometimes treated as synonymous with the introduced *E. crusgalli*, but "differs consistently" (Michael 2003) in a number of characters. Further, *E. muricata* is tetraploid while *E. crusgalli* is hexaploid (Maun & Barrett 1986).

1. Spikelets 2.3–3.5(–3.8) mm long or shorter (excluding awn); awn of lemma of lower floret absent or to 6(–10) mm long _____ var. **microstachya**
1. Spikelets 3.5–5 mm long (excluding awn); awn of lemma of lower floret usually 6–25 mm long (rarely absent) _____ var. **muricata**

var. **microstachya** Wiegand, (small-spiked). Widely scattered in TX; s Canada and throughout the U.S. According to Michael (2003), this is the common variety in the w part of North America.

var. **muricata**. Widely scattered in TX; se Canada and e U.S. w to MN and NM, also CA, ID, and OR. According to Michael (2003), this is the common variety in the e part of North America.

Echinochloa walteri (Pursh) A. Heller, (for an early Carolinian botanist, Thomas Walter, ?1740–1789), LONG-AWN COCK-SPUR GRASS, COAST COCK-SPUR, COAST BARNYARD GRASS. Plant usually 1–2 m tall; leaf sheaths usually hirsute or hispid with papilla-based hairs, especially toward apex, rarely glabrous; inflorescence axis erect to curved or drooping; spikelets 3–5 mm long (excluding awns), with or without papilla-based hairs; lemma of lower floret with awn usually 1.5–6 cm long but occasionally short-awned or awnless. Low moist areas, sometimes in shallow water; widespread in e 1/2 of TX; se Canada and e U.S. from NH s to FL w to MN and TX. Jul–Nov.

Echinochloa polystachya (Kunth) Hitchc., (many-spiked), CREEPING RIVER GRASS, is known from Chambers (SBSC) and Jefferson (Turner et al. 2003) cos., just s of East TX. This species, which occurs in coastal marshes mainly along the lower Gulf coast (known from FL, LA, and TX), is distinguished from all *Echinochloa* species occurring in East TX by its coarse perennial habit (culms 1–2 m tall, leaf blades to 30 mm wide), lower leaves with a ligule (ring of yellow hairs), and large spikelets (4.5–6.5 mm long).

EHRHARTA Thunb. VELDT GRASS

An Old World C_3 genus of 25 species (Barkworth ined.) mostly native to s and tropical Africa but also known from the Mascarene Islands and Indonesia to New Zealand (Watson & Dallwitz 1999); Gibbs Russell and Ellis (1987) described it as having an "ancient Gond-wanaland distribution pattern." Some species are used as pasture or fodder grasses and a number are considered

significant weeds. The relationships of the genus have been difficult to determine, and it has been variously placed in the Arundinoideae, Bambusoideae, Festucoideae, or Oryzoideae (Gibbs Russell & Ellis 1987). Recent evidence suggests the appropriate placement is in the Ehrhartoideae (which also includes the Oryzeae). The following treatment draws heavily on Barkworth (ined.). (Named for Jakob Friedrich Ehrhart (1742-1795), a German botanist of Swiss origin who studied under Linnaeus—Barkworth ined.) (subfamily Ehrhartoideae, tribe Ehrharteae)
REFERENCES: Willemsse 1982; Gibbs Russell & Ellis 1987; Smith 1993; Barkworth ined.

Ehrharta calycina J.E. Smith, (calyx-like), PERENNIAL VELDT GRASS, VELDT GRASS. Clumped perennial, often with rhizomes; culms to 75 cm tall, glabrous; ligule a lacerate membrane ca. 1 mm long; leaf blades 3–5(–7) mm wide; inflorescence a narrow panicle 7–15(–22) cm long, sometimes partly within upper leaf sheath; spikelets with 3 florets (the lower 2 sterile, the upper floret fertile, ± concealed by the sterile florets), (4–)5–8(–9) mm long, purplish, disarticulating above the glumes, the florets falling as a unit; glumes nearly as long as the spikelets; sterile florets of lemmas only, these pubescent, pointed or with short awn; lower sterile lemma with earlike appendages at base; lemma of fertile floret becoming indurate, awnless. Weedy areas; in East TX known only from Falls Co. (*Sigut 29*, collected in 1950; TAES; Turner et al. 2003), also cited by Hatch (2002) for Post Oak Savannah and Blackland Prairie; CA, NV, and TX. Spring. Native of s Africa. This species is cultivated as fodder and also considered a significant weed (Watson & Dallwitz 1992).

ELEUSINE Gaertn. GOOSE GRASS

A C_4 genus of 9 species, all of which are African except for one species (*E. tristachya* (Lam.) Lam.), which is native to South America (Hilu 2003). The genus includes the tetraploid *E. coracana* (L.) Gaertn. subsp. *coracana* (FINGER-MILLET), an important grain crop cultivated in Africa for ca. 5,000 years and in India for ca. 3,000 years. It is considered to be one of the most ancient domesticated plants in Africa and is thought to have been domesticated in the highlands of East Africa (Hilu & de Wet 1976; Hilu et al. 1979; de Wet et al. 1984; Werth et al. 1994; Hilu & Johnson 1997; Hilu 2003). Other species are significant weeds (Watson & Dallwitz 1992). (Named from Eleusis, Greek town where Ceres or Demeter, the goddess of harvests, was worshiped) (subfamily Chloridoideae, tribe Cynodonteae)
REFERENCES: Phillips 1972; Hilu et al. 1979; Hilu 1980, 1988, 2003; Werth et al. 1994; Hilu & Johnson 1997; Peterson et al. 1997; Brandenburg 2003.

Eleusine indica (L.) Gaertn., (of India), GOOSE GRASS, INDIAN GOOSE GRASS, YARD GRASS, ZACATE GUAIMA. Annual with decumbent to erect culms 15–75(–90) cm long; leaf sheaths compressed, keeled, pilose on margins; ligule a short membrane 1 mm or less long; branches of inflorescence usually (1–)4–10(–rarely more), crowded at tip of culm, digitately arranged or often with 1–2 branches attached lower; spikelets sessile, crowded, overlapping, in two rows on one side of flattened winged branches, awnless, 3–6(–7.5) mm long, with (2–)5–7 florets, glabrous or nearly so, disarticulating above the glumes and between the florets. Common weed of gardens, lawns, and disturbed sites; widespread in TX, particularly in the e 1/2 of the state; se Canada and throughout most of the U.S. Late Jun–Oct. Native of Old World tropics. Molecular studies (e.g., Hilu 1988; Werth et al. 1994) support the hypothesis that this diploid species (2n = 18) is one of the ancestors of the cultivated tetraploid FINGER-MILLET. GOOSE GRASS is an important weed of a number of crops, and it is considered by some sources to be among the world's worst weeds (Holm et al. 1977; Zimdahl 1989).

Eleusine tristachya (Lam.) Lam., (with three spikes), THREE-SPIKE GOOSE GRASS. While not considered a member of the TX flora, this South American species is mentioned as a note since it was mapped by Turner et al. (2003) as occurring in Brazos County. However, the TAES sheet (*E.D. Liles 15*, 1962) is from "along fence in range management area" 2 miles sw of College Station.

Since this collection is associated with the research area at Texas A&M Univ., we do not consider the species to be a naturalized member of the TX flora. *Eleusine tristachya* can be distinguished by its inflorescences with only 1–3 branches, all of these in a single digitate cluster. According to Hilu (2003), "In the 1800s and early 1900s, *Eleusine tristachya* was found on ballast dumps at various ports and transportation centers in the United States. It has since been found as a weed in the Imperial Valley of California (Hilu 1980), but records of collections outside of California appear to be historical, with no populations persisting."

ELIONURUS Humb. & Bonpl. ex Willd. BALSAM-SCALE

A genus of 15 species (Barkworth 2003n) of the tropics and subtropics, with most of the species native to tropical Africa and America (Barkworth 2003n). The genus ranges from the se U.S. to South America, Africa to India, and New Guinea to Australia (Peterson et al. 1998). Molecular information indicates a relationship of the genus to *Tripsacum* and *Zea* (Mathews et al. 2002). The genus name has sometimes been spelled "*Elyonurus*" (e.g., Correll & Johnston 1970; Kartesz 1994). However, Peterson et al. (1998) proposed conservation of the spelling *Elionurus* because of confusion about the Greek derivation of the name (incorrectly thought to be from the Greek *elyo*, to curl or wind). The proposal has been recommended (Brummitt 2000), and the spelling *Elionurus* should therefore be used. Like all members of the Andropogoneae, *Elionurus* is characterized by C_4 photosynthesis (Watson & Dallwitz 1999; Kellogg 2000a). (Greek: *eluein*, mouse, and *oura*, tail, based on the common name, "rat-tail," used by the validating author, Willdenow, presumably in reference to the narrowly cylindrical, tail-like inflorescences) (subfamily Panicoideae, tribe Andropogoneae)

REFERENCES: Clayton 1966; Renvoize 1979; McVaugh 1983; Peterson et al. 1998; Brummitt 2000; Barkworth 2003n.

Elionurus tripsacoides Humb. & Bonpl. ex Willd., (resembling *Tripsacum*—gama grass), PAN-AMERICAN BALSAM-SCALE, BALSAM-SCALE. Tufted perennial, usually short rhizomatous; culms 60–100(–120) cm tall, branching above, glabrous; ligule a fringed membrane 1 mm or less long; leaf blades 1–2(–4) mm wide, flat or usually involute; inflorescence an erect, solitary, narrow, spicate raceme, 6–15 cm long, the inflorescence axis pilose and disarticulating so that each pair of spikelets falls with a section of the inflorescence axis; spikelets awnless, in pairs of 1 sessile and 1 pedicellate; sessile spikelet with 2 florets (the lower reduced and sterile, the upper perfect, fertile), appressed to axis, ca. 6–8 mm long, with 2 glumes, the first coriaceous, 2-toothed apically, usually glabrous on back, ciliate marginally toward tip, with a line of balsam-scented glands on the marginal veins, the lemmas thin, the paleas absent; pedicellate spikelet similar to the sessile one except staminate and slightly smaller; pedicel free, appressed, pilose at base. Sandy soils, grasslands and openings in woods; Bexar, Burleson, Colorado, DeWitt, Goliad, Lavaca (TAES), Austin, Harris (SBSC), Bastrop, Gonzales, and Guadalupe (Turner et al. 2003), cos. in s part of East TX; mainly Gulf Prairies and Marshes and South TX Plains; AL, FL, GA, MS, and TX. May–Nov.

ELYMUS L. WILD RYE, BOTTLEBRUSH GRASS

Ours perennials; culms solitary or few in small clumps or forming colonies, rhizomatous or not so; ligule a membrane; leaf blades auricled at base; inflorescence a dense, unbranched, 2-sided spike with 1–3 sessile spikelets per node, the inflorescence axis in our species remaining intact, disarticulation occurring above (usually) or below glumes and between florets; spikelets with 2–12 florets, oriented with side facing inflorescence axis; glumes 2, sometimes hardened or rounded basally; glumes and lemmas awned or awnless.

A n temperate, especially Asian, C_3 genus of ca. 100 (e.g., Tucker 1996) to ca. 300 species (e.g., Yatskievych 1999; Barkworth & Campbell ined.), depending on circumscription (currently

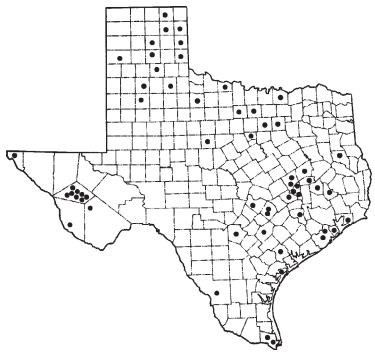
controversial and in flux). A narrow treatment would exclude species sometimes separated into genera such as *Elytrigia*, *Hystrix*, *Pascopyrum,* and *Sitanion*, while a broad view would include these. Because of a variety of genetic/molecular evidence (e.g., Jaaska 1998), we lean toward the broader view. The genus is complex and diverse—this diversity "probably stems from a combination of multiple origins involving different progenitors, introgression within the genus, hybridization with other members of the tribe, and plasticity. Little is known concerning the relative importance of these factors" (Barkworth & Campbell ined.). Recently, Helfgott and Mason-Gamer (2004) suggested that the genus is an allopolyploid derivative of *Pseudoroegneria* and *Hordeum*. It is an understatement to say there is a diversity of opinion about generic concepts in the Triticeae (*Elymus*, *Hordeum*, *Secale*, *Triticum,* and their relatives). Barkworth (2000) gave a detailed history of the changing views of generic relationships within the tribe. It is particularly important to realize that the Triticeae has an extremely complex evolutionary history involving hybridization, polyploidy, and reticulate evolution; even some of the diploid members of the tribe are apparently polyphyletic in origin (Barkworth 2000; Mason-Gamer & Kellogg 2000). This complexity is emphasized by the fact that different molecular studies give quite different and conflicting results (Mason-Gamer & Kellogg 2000). In fact, Barkworth (2000) said that "... I do not see there ever being complete agreement on the generic treatment of the tribe because of the complexity of the phylogenetic relationships within the tribe." Further, intergeneric hybrids are known between *Elymus* and *Triticum* (Watson & Dallwitz 1992), and one of the genomes in many polyploid species of *Elymus* is derived from *Hordeum* (Barkworth & Campbell ined.). While realizing these problems, we are nonetheless faced with choosing the best way to treat five East TX species. Three (*E. canadensis, E. villosa, E. virginiana*) belong to *Elymus* without controversy. *Elymus repens* has been variously treated in either *Agropyron*, *Elytrigia*, or *Elymus*, but based on genetic data (e.g., Assadi & Runemark 1995), we agree with Yatskievych (1999), Barkworth (2000), and Barkworth and Campbell (ined.) on treating it in *Elymus*. Finally, *E. smithii* (variously treated in *Agropyron*, *Elymus*, *Elytrigia*, or the monotypic genus *Pascopyrum*) appears to be a hybrid involving species considered by many authorities to be in *Elymus* (see further discussion under the species). It therefore seems most sensible to include it in *Elymus* as well. (Ancient Greek name for millet; from *elyo*, rolled up, from the caryopsis (= fruit) being tightly embraced by the lemma and palea) (subfamily Pooideae, tribe Triticeae)

REFERENCES: Pohl 1959; Gillett & Senn 1960; Bowden 1964; Church 1967; Runemark & Heneen 1968; Dewey 1975, 1982, 1983; Baum 1979; Davies 1980; Löve 1980; Estes & Tyrl 1982; Gabel 1984; Gupta & Baum 1989; Assadi & Runemark 1995; Campbell 1996; Tucker 1996; Jaaska 1998; Seberg & Petersen 1998; Barkworth 1997, 2000; Mason-Gamer & Kellogg 2000; Mason-Gamer 2001; Barkworth & Campbell ined.

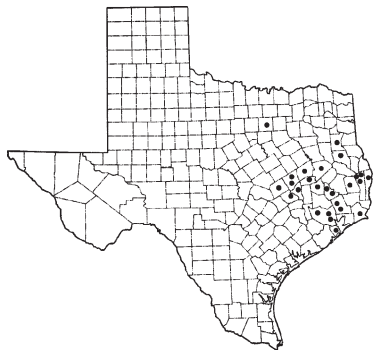
1. Spikelets usually 1 per node of inflorescence, sometimes 2 at middle and lower nodes of inflorescence; lemma awn absent or 10 mm or less long.
   2. Leaf blades usually involute (= the margins inrolled), stiff, the widest ones usually less than 5 mm wide (even when unrolled); foliage usually not glaucous, dark green to somewhat bluish green; glumes 2–3 mm wide, elliptic-lanceolate _____ **E. repens**
   2. Leaf blades flat, flexible, the widest ones 3–12(–18) mm wide; foliage glaucous, blue-green; glumes 0.5–1 mm wide, linear _____ **E. smithii**
1. Spikelets 2–3 per node of inflorescence; lemma awn 5–50 mm long.
   3. Glumes strongly 3–8-ribbed above base, 1–2.5 mm wide near middle, often strongly bowed out at base, often yellowish, hardened or rounded basally, with awn shorter than or equaling the body; lemma awns straight or slightly curved, 5–25 mm long _____ **E. virginicus**
   3. Glumes strongly 1–4-ribbed to base or nearly so, 0.2–1.5 mm wide near middle, not or only slightly bowed out at base, flat, neither yellowish, hardened, nor rounded basally, with awn equaling or exceeding the body; lemma awns usually curving outward at maturity, 15–50 mm long _____ **E. canadensis**



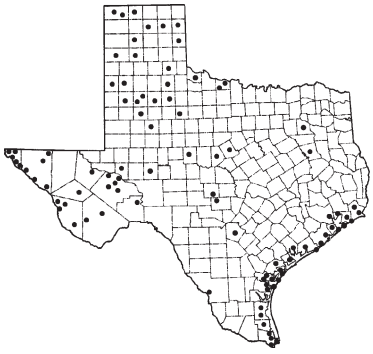
Digitaria patens



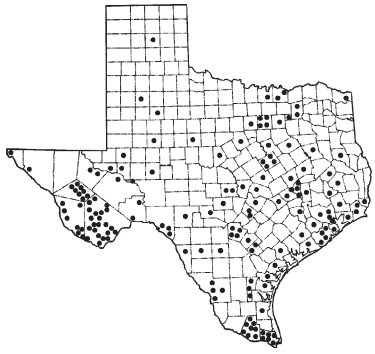
Digitaria sanguinalis



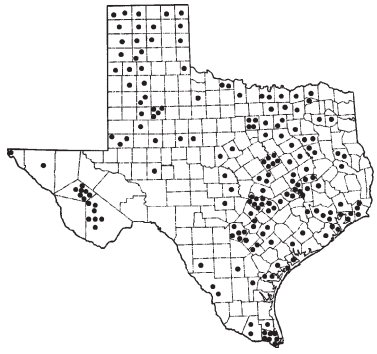
Digitaria violascens



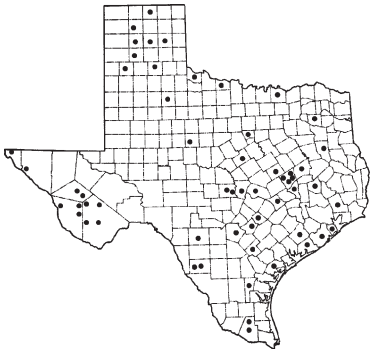
Distichlis spicata



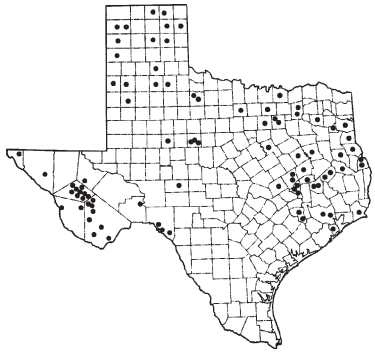
Echinochloa colona



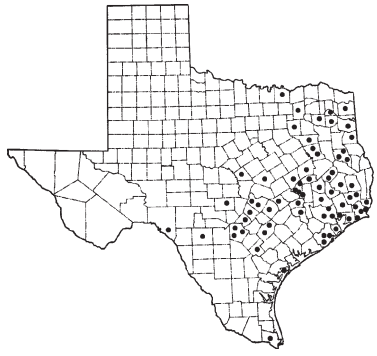
Echinochloa crusgalli



Echinochloa crus-pavonis var. macra



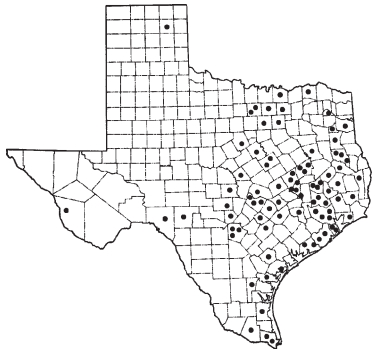
Echinochloa muricata
(both vars.)



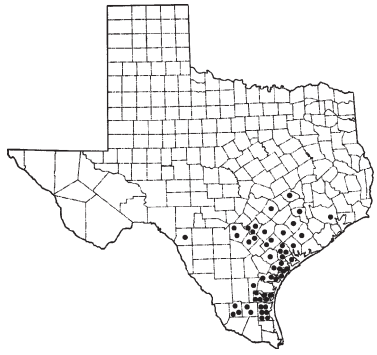
Echinochloa walteri



Ehrharta calycina



Eleusine indica



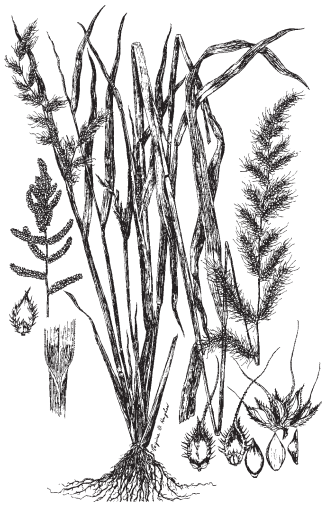
Elionurus tripsacoides

Elymus canadensis L., (of Canada), CANADA WILD RYE, NODDING WILD RYE. Perennial with rhizomes absent or very short; culms 40–160 cm tall; leaf sheaths usually glabrous; leaf blades mostly 4–12 mm wide, glabrous or roughened on upper surface; spike usually oblique or nodding, (4–)8–21 cm long and 6–18 mm thick (excluding awns); spikelets 2(–3) per node, 3–5-flowered, disarticulating above glumes and between the florets. Thickets and open woods; throughout most of TX; most of Canada and throughout the U.S. except the extreme se. (Mar–)late May–Jun. [*E. canadensis* L. var. *brachystachys* (Scribn. & C.R. Ball) Farw., *E. canadensis* L. var. *villosus* (Muhl.) Shinners, *E. villosus* Muhl. ex Willd.] *Elymus villosus*, HAIRY WILD RYE, is often recognized as a distinct species (e.g., Gabel 1984) and is reported for East TX by Brooks (1986) and for TX by Gabel (1984), Kartesz (1999), and Yatskievych (1999). However, because of a continuum in variation in TX material, this species (sometimes treated as *E. canadensis* L. var. *villosus*—Shinners 1954) is here tentatively submerged into *E. canadensis*, following Gould (1975b). In the words of Shinners (1954), "As I knew the plants in the Middle West, *E. villosus* and *E. canadensis* were quite distinct. In Texas it is another story altogether. In the local flora, some forms of var. *brachystachys* (Scribn. & Ball) Farwell are almost impossible to distinguish from var. *villosus*." Further, hybrids with *E. virginicus* are known (Pohl 1959), confusing the situation even more. Hatch (2002) also did not recognize *E. villosus* for TX. A detailed study of the variation within the TX species of *Elymus* is needed in order to clarify the number of species present. If one chooses to recognize *E. villosus*, the following key (modified from Gabel 1984, Brooks 1986, and Yatskievych 1999) may be helpful:

1. Leaf blades glabrous to roughened above; glumes 0.8–1.5 mm wide; paleas mostly 8.5–12.5 mm long; lemma awn usually curving outward at maturity; spike axis scabrous to sparsely pubescent _____ *E. canadensis*

1. Leaf blades usually hairy above; glumes 0.2–0.8 mm wide; paleas mostly 5.5–7 mm long; lemma awn straight or slightly curved; spike axis villous _____ *E. villosus*

Elymus repens (L.) Gould, (creeping), QUACK GRASS, CREEPING WILD RYE, DOG GRASS, WITCH GRASS. Rhizomatous, erect to decumbent perennial 50–110 cm tall; leaf sheaths glabrous to pilose, usually conspicuously auricled; leaf blades glabrous to pilose on upper surface; spikes slender, often dense, 4–19(–26) cm long, erect, the internodes of the spike axis flattened but often thick; spikelets in a zigzag arrangement on opposite sides of the spike axis, sessile, oriented so that their broadest dimension (not the keels of glumes) is toward the spike axis, awnless or short-awned, 1(–2) per node, 3–5(–8)-flowered, disarticulating below the glumes; $2n = 42$. Weedy and disturbed places, often moist areas; tentatively included based on citation for the Big Thicket National Preserve by the National Park Service (1995a, 1995b); while we have seen no East TX specimens, this species is widely introduced throughout most of the U.S. (including OK) and is not unexpected for East TX; no county distribution map is provided; Hatch (2002) indicated its occurrence in the High Plains and Trans-Pecos; most of Canada and throughout the U.S. except extreme se. May–Sep. Native of Europe and Asia. [*Agropyron repens* (L.) P. Beauv., *Agropyron repens* var. *subulatum* (Schreb.) Roem. & Schult., *Elytrigia repens* (L.) Desv. ex Nevski, *Elytrigia repens* var. *vaillantiana* (Wulfen & Schreb.) Prokudin, *Elytrigia vaillantiana* (Wulfen & Schreb.) Beetle, *Triticum repens* L., *Triticum vaillantianum* Wulfen & Schreb.] This species has most often in the past gone under the name *Agropyron repens*, but in recent treatments it has typically been treated in *Elymus* (e.g., Barkworth 2000). It is superficially similar to *Lolium perenne*, PERENNIAL RYE GRASS, (both with spikelets sessile, 1 per node), but is easily distinguished by the orientation of its spikelets with flat side against axis of inflorescence. In contrast, *Lolium* has the spikelets placed with the edge (keels of lemmas) against the axis of inflorescence. While useful for hay, forage, and erosion control, this species is reported to cause hay fever (Steyermark 1963), can be a difficult to eradicate pest (Yatskievych 1999), is considered noxious in many w states including OK (Kartesz 1999), and is noted by some sources to be among the world's worst weeds (Holm et al. 1977). ⊘ ☜



Echinochloa crus-gali [REE]



Echinochloa crus-pavonis var. macra [HI1]



Echinochloa muricata var. microstachya [GLE]



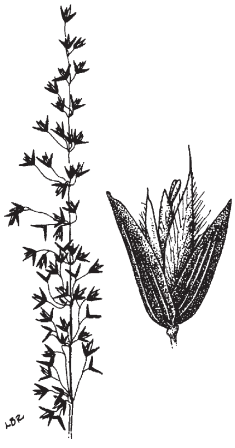
Echinochloa muricata var. muricata [GLE]



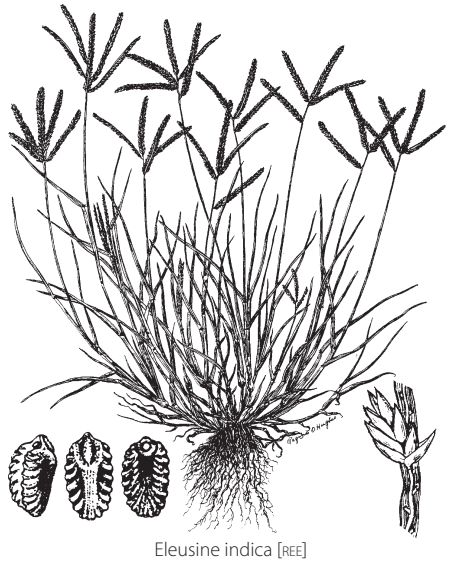
Echinochloa walteri [GO1]



Elionurus tripsacoides [VAS]



Ehrharta calycina [JEP]



Eleusine indica [REE]



Elymus canadensis [HI1]

Elymus smithii (Rydb.) Gould, (for its discoverer, Charles Eastwick Smith, 1820–1900), WESTERN WHEAT GRASS, BLUESTEM WHEAT GRASS. Rhizomatous, erect perennial 30–100 cm tall; leaf sheaths glabrous, usually conspicuously auricled at summit; ligule ca. 0.5 mm or less long; leaf blades noticeably scabrous on upper surface; spike slender, often dense, 6–20(–30) cm long, erect, the internodes of the spike axis flattened but thick; spikelets in a zigzag arrangement on opposite sides of the spike axis, sessile, oriented so that their broadest dimension (not the keels of glumes) is toward the spike axis, awnless or with awns 5 mm or less long, 1 or (at lower nodes) 2 per node, (2–)4–12-flowered, 12–26 mm long; disarticulation beneath florets; $2n = 56$. Prairies and roadsides, low areas; Lamar, Travis, and Trinity (Turner et al. 2003—as *Pascopyrum*) cos.; mainly w 1/2 of TX; s Canada and widespread in the U.S. except the se. May–Jul(–Sep). [*Agropyron smithii* Rydb., *Elytrigia smithii* (Rydb.) Nevski, *Pascopyrum smithii* (Rydb.) Á. Löve] This species has been variously treated in *Agropyron*, *Elymus*, *Elytrigia*, or the monotypic genus *Pascopyrum*. According to Dewey (1975), it is a fertile octoploid that probably originated through hybridization between *Elytrigia dasystachya* (Hook.) Scribn. & J.G. Sm. (now treated as *Elymus lanceolatus* (Scribn. & J.G. Sm.) Gould) and *Elymus triticoides* Buckley (often treated as *Leymus triticoides* (Buckley) Pilg.) with subsequent chromosome doubling. While Diggs et al. (1999) and Turner et al. (2003) recognized this species in *Pascopyrum*, because both *Elytrigia* and *Leymus* are now often considered to be part of a broadly viewed genus *Elymus*, it seems most reasonable to recognize *E. smithii* (of hybrid origin) as a member of *Elymus*. Even though many recent workers have followed this course of action (e.g., Yatskievych 1999; Hatch 2002), it should be stressed that not all agree (e.g., Barkworth ined.; Barkworth & Campbell ined.).

Elymus virginicus L., (of Virginia), VIRGINIA WILD RYE. Perennial without rhizomes; culms 30–140 cm tall; leaf sheaths glabrous, roughened, or hairy, at least the uppermost, sometimes all, inflated; leaf blades 5–15 mm wide, glabrous to roughened or hairy on upper surface; spike rather dense and stiff, usually erect, partly included to well-exserted, usually 3–15(–25) cm long; spikelets usually 2(–3) per node, 2–4(–6)-flowered, disarticulating below glumes and between florets. Thickets or open ground; in much of e 2/3 of TX; s Canada and e U.S. w to ND and NM, also AZ. (Apr–)May–Aug. [*E. australis* Scribn. & Ball, *E. glabriflorus* (Vasey) Scribn. & Ball, E. *glabriflorus* var. *australis* (Scribn. & C.R. Ball) J.J.N. Campb., *E. hirsutiglumis* Scribn., *E. jejunus* (Ramaley) Rydb., *E. macgregorii* R. Brooks & J.J.N. Campb., *E. strictus* Willd., *E. virginicus* L. var. *australis* (Scribn. & C.R. Ball) Hitchc., *E. virginicus* L. var. *glabriflorus* (Vasey) Bush; *E. virginicus* L. var. *jejunus* (Ramaley) Bush; *E. virginicus* L. var. *hirsutiglumis* (Scribn.) Hitchc., *E. virginicus* L. var. *intermedius* (Vasey) Bush] Hybrids with *E. canadensis* are known (Pohl 1959). *Elymus virginicus* "contains a confusing array of intergrading variants, many of which have been accorded taxonomic recognition in the past" (Yatskievych 1999). Some authorities (e.g., Barkworth & Campbell ined.) recognize a number of taxa (both species and varieties) of this complex as occurring in East TX. However, given the apparent morphological intergradation, and until the situation is clarified, we are following Hatch (2002) and Turner et al. (2003) in recognizing a broadly circumscribed *E. virginicus* for TX. For those wishing to recognize species in this complex, the following key, modified from Barkworth and Campbell (ined.) may be helpful:

1. Spike 1–2 cm wide (including the awns), exserted or sheathed; lemma awn 5–15(–20) mm long; leaf blades usually glabrous to scabridulous; plants flowering usually in mid-June–late July _____ *E. virginicus*
1. Spike 2.5–6 cm wide, exserted; lemma awn 15–40 mm long; leaf blades glabrous or villous; plants flowering usually mid-May–late July.
   2. Spike with 15–30 nodes, the internodes 3–5 mm long; leaf blades lax, or often ascending and involute, pale dull green, with basal auricles 0–2 mm long, brownish at maturity; plants flowering usually in mid-June–late July _____ *E. glabriflorus*
   2. Spike with 9–18 nodes, the internodes 4–7 mm long; leaf blades usually lax, dark glossy green under the glaucous bloom, with basal auricles 2–3 mm long, blackish at maturity; plants flowering usually in mid-May–mid-June _____ *E. macgregorii*

ENTEROPOGON Nees UMBRELLA GRASS

A C_4 genus of 17 species (Barkworth 2003c) found mainly in tropical savannahs. It is sometimes included in *Chloris* (e.g., Correll & Johnston 1970; Gould 1975b; Hatch et al. 1990). The most reliable character separating the two genera is compression of the spikelets: dorsally compressed in *Enteropogon* versus laterally compressed in *Chloris* (Jacobs & Highet 1988). Recent molecular studies link *Enteropogon* with *Chloris*, *Cynodon*, and *Eustachys*, but do not support combining the genus with any of them (Hilu & Alice 2000). Some species are considered important pasture grasses (Watson & Dallwitz 1992). (Greek: *enteron*, intestine, or Latin: *entero*, between, among, and Greek: *pogon*, a beard, the reference unclear) (subfamily Chloridoideae, tribe Cynodonteae)

REFERENCES: Clayton 1967a, 1982; Lazarides 1972; Anderson 1974; Nair et al. 1977; Jacobs & Highet 1988; Hilu & Alice 2000; Barkworth 2003c.

Enteropogon chlorideus (J. Presl) Clayton, (presumably for resemblance to *Chloris*—windmill grass), BURY-SEED CHLORIS, BURY-SEED UMBRELLA GRASS. Rhizomatous tufted perennial with subterranean cleistogamous spikelets at the tips of elongate rhizomes; culms erect, to 100 cm tall; leaf sheaths glabrous to occasionally sparsely long pilose apically; ligule a ciliate membrane on lower leaves or reduced to a short crown on upper leaves; leaf blades to 7(–10) mm wide; inflorescence a panicle; inflorescence branches spike-like, 3–11(–15), arising along the main axis, usually more than 1 per node, 6–10(–16) cm long, with spikelets nearly to base; spikelets appressed, overlapping but not crowded, with 1 perfect (lower) and 1(–2) reduced staminate (upper, stalked) floret, dorsally compressed, disarticulating above the glumes; glumes unequal; lower glume 1–2 mm long; upper glume 2–4 mm long; lemma of perfect floret 4.5–7.5 mm long, with a conspicuous awn to 15 mm long arising between two small setaceous teeth; lemma of reduced floret(s) very small, linear, only ca. 0.3 mm wide, usually with awn 2–8 mm long. Grasslands, old fields, brushy areas; Brazos Co. (TAES—Gould 1975b; Turner et al. 2003), Hatch (2002) also cited the Blackland Prairie; mainly to the s of East TX in Gulf Prairies and Marshes and South TX Plains; AZ and TX. Oct–Nov. This species is similar to various *Chloris* species but can be distinguished from East TX *Chloris* species by spikelet compression and by the lemma of lower (perfect) floret 4.5–7.5 mm long (versus < 4.5 mm long in *Chloris*), the usually longer lemma awns 6.5–15 mm long (often but not always less than 6.5 mm long in *Chloris*), and the presence of underground cleistogamous spikelets at the tips of rhizomes (not present in any East TX *Chloris* species). It was previously treated in *Chloris* [as *C. chloridea* (J. Presl) Hitchc.]. The common name is derived from the unusual underground cleistogamous spikelets.

ERAGROSTIS Wolf LOVE GRASS

Annuals or perennials; leaf sheaths glabrous except at summit in most species; ligule usually a ring of hairs; spikelets in very open to contracted panicles, 2–many-flowered, sometimes with a reddish purple color, often somewhat laterally compressed; disarticulation various; glumes unequal; lemmas obtuse, acute, or acuminate, awnless, rounded or keeled on back, 3-veined, the lateral veins sometimes obscure, usually glabrous; stamens 2 or 3.

A genus of ca. 350 species (Peterson 2003a) of temperate to subtropical and tropical areas of the world. Some are cultivated as ornamentals, for fodder, for use in revegetation, or for edible seeds, while others are considered significant weeds (Watson & Dallwitz 1992). *Eragrostis tef* (Zucc.) Trotter, TEFF, of ne Africa, is cultivated as a grain crop (a staple cereal in Ethiopia) and the straw is used in the manufacture of brick. This or other *Eragrostis* species were used in making bricks for Egyptian pyramids (3359 B.C.) (Costanza et al. 1980; Watson & Dallwitz 1992; Mabberley 1997). Some species have inflorescences which break off at maturity and disperse the seeds by acting as "tumbleweeds." All species are characterized by C_4 photosynthesis, with the "startling exception" of one species (Watson & Dallwitz 1992). Some of the East TX species

with few-flowered spikelets are extremely similar morphologically and difficult to distinguish (e.g., *E. intermedia*, *E. lugens*). According to Clayton and Renvoize (1986), some species are "very close" to *Sporobolus*. Recent studies (Hilu & Alice 2000, 2001; Van den Borre & Watson 2000) raise questions about the monophyly of *Eragrostis* as traditionally delimited; a number of small segregate genera need to be included for *Eragrostis* to be monophyletic (Ingram & Doyle 2004). (Derivation of name uncertain; according to Peterson (2003a), "Nathaniel Wolf (1776), the person who first named *Eragrostis*, made no statement concerning the origin of its name. Clifford (1996) provides three possible derivations: from *eros*, 'love', and *Agrostis*, the Greek name for an indeterminate herb; from the Greek *er*, 'early' and *agrostis*, 'wild,' referring to the fact that some species of *Eragrostis* are early invaders of arable land; or the Greek *eri-*, a prefix meaning 'very' or 'much,' suggesting that the name means many-flowered *Agrostis*. Many authors have stated that the first portion of the name is derived from *eros*, but none have explained the connection between *Eragrostis* and passionate expressions of love, the kind of love to which *eros* applies.") (subfamily Chloridoideae, tribe Cynodonteae)

REFERENCES: Nicora 1962; Koch 1974, 1978; Witherspoon 1977; Perry & McNeill 1986; Reeder 1986; Van den Borre & Watson 1994; Peterson et al. 1997; Poverene & Voigt 1997; Hilu & Alice 2000; Peterson 2003a; Ingram & Doyle 2004.

1. Culms definitely creeping, rooting at nodes; plants mat-forming annuals; flowering culms to only 25 cm tall (usually less).
   2. Plants dioecious (spikelets either all staminate or all pistillate); anthers 1.2–2.2 mm long; lemmas (1.8–)2.1–4 mm long, usually with short hairs along the veins; styles long-exserted from lemma and palea, often persistent and conspicuous (with a hand lens) as thread-like structures _____ **E. reptans**
   2. Plants with perfect florets; anthers 0.5 mm or less long; lemmas 1.5–2(–2.3) mm long, glabrous; styles not exserted _____ **E. hypnoides**
1. Culms erect or ascending, sometimes spreading at base, not rooting at the nodes (rarely rooting at lowest nodes); plants clump-forming annuals or perennials; flowering culms usually much more than 25 cm tall.
   3. Spikelets extremely small, 1–2 mm long, with 1(–3) floret; species introduced in Brazos Co. and known in East TX only from there _____ **E. airoides**
   3. Spikelets (1.5–)2 mm long or longer (often much longer), with 2–many florets; including species widespread in East TX.
      4. Main branches of inflorescence bearing spikelets to very base or nearly so; inflorescences usually relatively dense and narrow (but open in *E. sessilispica*).
         5. Spikelets sessile, widely spaced on long, widely spreading, unrebranched primary branches _____ **E. sessilispica**
         5. Spikelets nearly short-pedicelled or sessile, closely crowded on short or long branches (if long, then stiffly ascending).
            6. Spikelets 3–10 mm wide, usually < 2 times as long as wide, strongly flattened, disarticulating below the glumes, each spikelet falling as an intact unit; introduced species rare in East TX _____ **E. superba**
            6. Spikelets 5 mm or less wide (often much narrower), usually > 2 times as long as wide (often many times), usually slightly to strongly flattened, disarticulating internally, each spikelet not falling as an intact unit; including widespread and abundant native and introduced species.
               7. Spikelets (1.5–)2–3(–3.8) mm long, often so small and densely arranged that the individual spikelets are not discernible without close inspection.
                  8. Inflorescences 15 cm or more long, the main branches usually much longer than 3 cm, stiffly appressed to ascending, but the inflorescence obviously branched; palea keels glabrous or minutely scabrous, the scabrosities 0.2 mm or less long _____ **E. japonica**

8. Inflorescences 15 cm or less long, with main branches ca. 3 cm or less long, the branches either not easily discernible (because they are short and dense) OR ascending-spreading; palea keels ciliate, the cilia 0.2–0.8 mm long.
   9. Inflorescences so dense that they cannot be seen through; pedicels 0.1–1 mm long, usually shorter than the spikelets, straight; spikelets with 6–12 florets; anthers 2 _____ **E. ciliaris**
   9. Inflorescences dense, but generally able to be seen through; pedicels 1–4 (–7) mm long, usually as long as or longer than the spikelets, typically with a noticeable curvature; spikelets with 4–8 florets; anthers 3 _____ **E. amabilis**
7. Spikelets (4–)5–20 mm long, large enough or loosely arranged enough so that the individual spikelets are easily discernable at arm's length.
   10. Spikelets usually 1–1.5(–2) mm wide, almost as thick as wide, linear in outline _____ **E. barrelieri**
   10. Spikelets 2–5 mm wide, much wider than thick, ovate to lanceolate in outline.
      11. Plants annual; margins of leaf blades, culms just below nodes, and usually keels of lemmas and glumes glandular-dotted (use hand lens or dissecting scope); spikelets 2–4 mm wide, flattened but not strongly so; lemmas 2–2.8 mm long, apically obtuse to acute _____ **E. cilianensis**
      11. Plants perennial; margins of leaf blades, culms just below nodes, and lemmas and glumes not glandular-dotted; spikelets 3–5 mm wide, strongly flattened; lemmas 2.2–4 mm long, apically acuminate or nearly so _____ **E. secundiflora**

4. Main branches of inflorescence naked for a distance from base; inflorescences usually relatively open and broad with loosely ascending to widely spreading branches (inflorescence can be narrow in *E. secundiflora*, *E. superba*, and *E. curvula*).
   12. Pedicels longer than spikelets; spikelets widely spreading from branches.
      13. Spikelets 2–5(–6)-flowered, 2–4 mm long.
         14. Leaf sheaths glabrous (except on margins and at apex).
            15. Plants annual, with soft bases; leaf blades 1–4(–5) mm wide; lemmas 1.2–1.7 mm long, keeled; culms usually 50 cm or less tall _____ **E. capillaris**
            15. Plants perennial, with hardened bases; leaf blades 4–10 mm wide; lemmas 1.8–2.4 mm long, rounded on the back (sometimes slightly keeled near tip); culms usually 45–130 cm tall _____ **E. hirsuta**
         14. Leaf sheaths hairy on the surfaces (as well as at the margins and the apex).
            16. Culms usually 45–130 cm tall; leaves not crowded at base of culms; leaf blades (8–)25–40(–60) cm long; species widespread in East TX _____ **E. hirsuta**
            16. Culms usually less than 60 cm tall; leaves crowded at base of culms; leaf blades 8–12 cm long; species rarely, perhaps questionably, present in East TX _____ **E. polytricha**
      13. Spikelets (4–)5–30-flowered, 3–18 mm long.
         17. Spikelets very narrow, 1.5 mm or less wide; lemmas 1.2–1.8 mm long, rounded on the back OR keeled.
            18. Plants annual, with soft bases; spikelets disarticulating so that naked zigzag rachilla (= axis of spikelet) (and sometimes paleas) remains after lemmas and fruits have been shed.
               19. Closed spikelets (before lemmas spread open) 1 mm wide or less; lower glume 1/4–1/2 as long as adjacent lemma; lemmas 1.2–1.6 mm long; leaf blades 0.4–2.2(–3) mm wide; lower inflorescence branches hair-like, usually verticillate (in whorls of 3 or more branches) _____ **E. pilosa**
               19. Closed spikelets over 1 mm wide; lower glume 1/2–3/4 as long as adjacent lemma; lemmas more than 1.6 mm long; leaf blades 3–7 mm wide; lower inflorescence branches 1–3, usually not verticillate, if somewhat verticillate then not hair-like _____ **E. pectinacea**

18. Plants perennial, with hardened bases; spikelets disarticulating so that rachilla does not remain.
    20. Lemmas keeled, the lateral veins conspicuous.
        21. Lateral spikelets subsessile to short-pedicelled (peolicels on average < 1 cm long); leaf blades 3–8 mm wide; plants hardened and knotty at base and often with short rhizomes _____ **E. spectabilis**
        21. Lateral spikelets with long pedicels (on average > 1 cm long); leaf blades 2–4 mm wide; plants hardened at base but neither knotty nor with rhizomes _____ **E. elliottii**
    20. Lemmas usually rounded on back (midvein visible, but lemma not keeled), the lateral veins inconspicuous.
        22. Spikelets 1.3–1.5 (or more) mm wide; lemmas 1.6–1.8 (or more) mm long; fruits with a deep longitudinal groove; species widespread in East TX; flowering May–Oct _____ **E. intermedia**
        22. Spikelets 0.8–1.3 mm wide; lemmas 1.2–1.6 mm long; fruits ungrooved or with a shallow longitudinal groove; species apparently limited to Pineywoods in East TX; flowering mostly Nov–Jan (–spring) _____ **E. lugens**
17. Spikelets usually 1.5–10 mm wide; lemmas usually 1.8–4.4 mm long, keeled (in most species) OR rounded on the back (in *E. intermedia*).
    23. Lemmas rounded on back, the lateral veins inconspicuous; spikelets 4–6 (–7) mm long _____ **E. intermedia**
    23. Lemmas keeled, the lateral veins conspicuous; spikelets 4–18(–20) mm long.
        24. Spikelets 3–10 mm wide, usually < 2 times as long as wide, conspicuously flattened _____ **E. superba**
        24. Spikelets 3 mm or less wide, usually > 2 times as long as wide (often several times), usually only slightly to moderately flattened.
            25. Pedicels mixed, some longer and some shorter than the spikelets; plants annual, with soft bases; spikelets disarticulating so that naked zigzag rachilla (= axis of spikelet) and paleas remain after lemmas and fruits have been shed _____ **E. pectinacea**
            25. Pedicels (almost all) longer than the spikelets; plants perennial, with hardened bases; spikelets disarticulating so that rachilla does not remain.
                26. Main branches of inflorescence ± smooth to the touch; anthers 0.9–1.6 mm long; lemmas 2.4–3.8 mm long; spikelets lanceolate to ovate, usually with 10 or fewer florets; inflorescence relatively long and narrow (usually more than 1.5 times as long as wide) _____ **E. trichodes**
                26. Main branches of inflorescence scabrous to the touch; anthers 0.3–0.5 mm long; lemmas usually 1.4–2.3 mm long; spikelets oblong to linear, usually with 7–30 florets; inflorescences relatively short and broad (usually 1–1.5 times as long as wide).
                    27. Lateral spikelets subsessile to short-pedicelled, with pedicels averaging less than 1 cm long; leaf blades 3–8 mm wide; plants hardened and knotty at base and often with short rhizomes _____ **E. spectabilis**
                    27. Lateral spikelets with pedicels on average more than 1 cm long; leaf blades 2–4 mm wide; plants hardened at base but neither knotty nor with rhizomes _____ **E. elliottii**

12. Pedicels mostly shorter than spikelets (some pedicels, particularly those terminating branches, may be longer) or spikelets sessile; spikelets slightly spreading or appressed along the branches.
    28. Plants annual; culm bases neither hardened nor enlarged.
        29. Closed spikelets (before lemmas spread open) 1 mm wide or less; lower glume 1/4–1/2 as long as adjacent lemma; lemmas usually 1.2–1.6 mm long; leaf blades 0.4–2.2(–3) mm wide; lower inflorescence branches usually verticillate (in whorls of 3 or more branches), hair-like _____ **E. pilosa**
        29. Closed spikelets over 1 mm wide; lower glume 1/2–3/4 as long as adjacent lemma; lemmas usually 1.8–2.4 mm long; leaf blades 3–7 mm wide; lower inflorescence branches 1–3, usually not verticillate, if somewhat verticillate then not hair-like _____ **E. pectinacea**
    28. Plants perennial; culm bases hardened or enlarged.
        30. Spikelets 3–5 mm wide, densely arranged in conspicuously overlapping groups, often brown-red _____ **E. secundiflora**
        30. Spikelets 1–2 mm wide, less densely arranged, not in conspicuously overlapping groups, usually green to gray-green or straw-colored or sometimes with a reddish or purplish tinge.
            31. Spikelets 3–6 mm long, appressed; leaf sheaths and inflorescence branches usually sticky when fresh (a clear residue left when dry) _____ **E. curtipedicellata**
            31. Spikelets 5–20(–25) mm long, appressed to diverging; leaf sheaths and inflorescence branches not sticky.
                32. Pedicel subtending terminal spikelet of a branchlet (5–)10–25 mm long (lateral spikelets often sessile or nearly so); inflorescences 25–40 cm wide; spikelets with 9–30 florets; leaf blades usually 2–5 mm wide; stamens 2 per floret _____ **E. refracta**
                32. Pedicel subtending terminal spikelet of a branchlet 0.5–5 mm long; inflorescences 2–24 cm wide; spikelets with 3–12 florets; leaf blades 1–2(–3) mm wide; stamens 3 per floret.
                    33. Inflorescences (16–)18–40 cm long, (4–)8–24 cm wide; lemmas 1.8–3.5 mm long; leaf blades 12–50(–65) cm long; spikelets 1.2–1.6(–2) mm wide; plants large, the culms (60–)75–150 cm tall _____ **E. curvula**
                    33. Inflorescences 7–18 cm long, 2–8 cm wide; lemmas 1.5–1.7 mm long; leaf blades 2–10(–12) cm long; spikelets 0.8–1.2 mm wide; plants relatively smaller, the culms 80 cm or less tall _____ **E. lehmanniana**

Eragrostis airoides Nees, (presumably for its resemblance to *Aira*—hair grass), DARNEL LOVE GRASS. Tufted perennial; culms 30–100(–110) cm tall; inflorescences open, very delicate in appearance; pedicels much longer than spikelets, the pedicels 2.4–11 mm long; spikelets extremely small, 1–2 mm long, with 1(–3) floret; lemmas 0.8–1.3 mm long. Disturbed sites, sandy soils; Brazos Co. (Turner et al. 2003); this introduced species is apparently known in the U.S. only from Brazos Co. (Kartesz 1999; Turner et al. 2003; Peterson 2003a). Summer–fall; Native of South America. According to Peterson (2003a), this "is an enigmatic species, often treated as *Sporobolus brasiliensis* (Raddi) Hackel, which it resembles in its chromosome base number of $x = 9$ and caryopsis morphology, but its frequent possession of spikelets with more than 1 floret and its mode of spikelet disarticulation argue for its retention in *Eragrostis*."

Eragrostis amabilis (L.) Wight & Arn. ex Nees, (lovely), JAPANESE LOVE GRASS. Tufted annual to 40 cm tall; inflorescences with spikelets relatively crowded; pedicels as long or longer than the spikelets; spikelets usually 1.5–2.5 mm long, 0.9–1.4 mm wide, reddish purple to greenish, with 4–8 florets; lemmas 0.7–1.1 mm long. Weedy or disturbed areas; tentatively included based on

citation for Pineywoods by Hatch (2002); Hatch (2002) also reported Gulf Prairies and Marshes; however, we have seen no TX specimens and the species is not cited for TX by Turner et al. (2003) or by Peterson (2003a); we therefore only tentatively consider this species a member of the East TX flora; no county distribution map is provided; se U.S. from SC s to FL w to MS and ?TX. Native of the Old World. [*E. tenella* L.]

Eragrostis barrelieri Daveau, (for French botanist, Jacques Barrelier, d. 1673), MEDITERRANEAN LOVE GRASS. Low-spreading to erect, tufted annual 7–50(–60) cm tall; culms often with a ring of glandular dots just below each node, these sometimes fused; inflorescences relatively dense, the main branches with spikelets to base or nearly so; spikelets subsessile, (4–)5–11 mm long, 1–1.5 (–2) mm wide, almost as thick as wide, linear in outline, gray- or yellow-green to bronze or dark purple-red-brown, with 6–15+ florets; lemmas usually 1.4–2 mm long. Roadsides and disturbed sites; widespread nearly throughout TX except the Pineywoods; w U.S. from CA e to NE and TX, also scattered in s U.S. Apr–Nov. Native of s Europe.

Eragrostis capillaris (L.) Nees, (resembling hair, very slender), LACE GRASS, TINY LOVE GRASS. Tufted annual; culms usually 10–50 cm tall; inflorescences open, the main branches naked of spikelets at base; pedicels much longer than spikelets; spikelets ca. 2–3(–3.5) mm long, ca. 1–1.4 mm wide, with 2–5 florets; lemmas 1.2–1.7 mm long Open disturbed areas; scattered in s portion of East TX, also reported from Parker and Tarrant (Turner et al. 2003) cos. in Cross Timbers and Prairies; se Canada (Ont.) and e U.S. from ME s to GA w to NE and TX. May–summer.

Eragrostis cilianensis (All.) Vignalo ex Janch., (fringed with hairs), STINK GRASS. Tufted annual often with a strong disagreeable odor; culms 10–40(–60) cm tall, with a ring of glandular dots just below the nodes; margins of leaf blades usually resin-dotted; inflorescences dense, the main branches with spikelets to base or nearly so; pedicels mostly shorter than the spikelets; spikelets (4–)6–20(–25) mm long, 2–4 mm wide, with (5–)10–40 florets; lemmas 2–2.8 mm long, dull grayish green, with minute, raised, glandular dots on keel. Disturbed sites; throughout TX; s Canada and throughout the U.S. Mostly Aug–Oct. Native of Europe. This species is reportedly mildly toxic to livestock, and in some areas it proliferates in overgrazed pastures, presumably due to its unpalatability (Steyermark 1963; Yatskievych 1999). The odor of fresh plants has been compared to that of crushed cockroaches (Koch 1974; Yatskievych 1999).

Eragrostis ciliaris (L.) R. Br., (ciliate, fringed with hairs), GOPHER-TAIL LOVE GRASS. Tufted annual 55(–75) cm or less tall; inflorescences dense, spike-like, very narrow, usually only 2–10(–17) mm wide, the main branches with spikelets to the base; pedicels shorter than spikelets; spikelets 2–3 mm long, 1–2 mm wide, with 6–12 florets, often purplish; lemmas 0.8–1.3 mm long; paleas with conspicuous marginal cilia 0.4–0.8 mm long. Sandy soils, reported as introduced but not persistent (Gould 1975b); Polk (Turner et al. 2003), Waller, and Washington (Gould 1975b) cos.; also n Gulf Prairies and Marshes; se U.S. from GA s to FL w to NM. Fall–winter. Native of the Old World tropics. [*E. megastachya* (Koeler) Link] This species is considered native to the se U.S. by some authorities (e.g., Kartesz 1999), but the recent treatment by Peterson (2003a) indicated that it is introduced. The strikingly ciliate paleas and very narrow inflorescence are distinctive.

Eragrostis curtipedicellata Buckley, (short-stalked), GUMMY LOVE GRASS, SHORT-STALKED LOVE GRASS. Tufted, hard-based perennial with short knotty rhizomes; culms 15–75 cm tall; leaf sheaths usually sticky when fresh (a clear residue left when dry); inflorescences open, with sticky axis, the branches spreading, stiff, the main branches naked of spikelets at base, the entire inflorescence often breaking off in age and acting as a tumbleweed; spikelets subsessile, 3–6 mm long, 1–1.5(–2) mm wide, with 4–11 florets; lemmas ca. 1.5–2 mm long. Sandy oak woods, fields, roadsides, and open areas; nearly throughout TX, but less common in the Pineywoods; sc U.S. from MO s to LA w to CO and NM. May–Nov.

Eragrostis curvula (Schrad.) Nees, (curved), WEEPING LOVE GRASS. Large clump-forming perennial; culms (60–)75–150 cm tall; upper leaf sheaths usually glabrous, the lower pubescent with



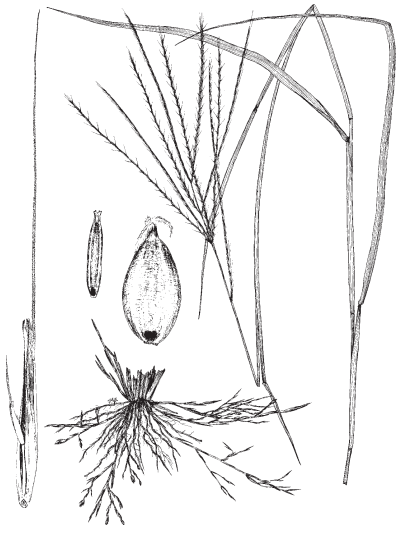
Elymus repens [HI1]



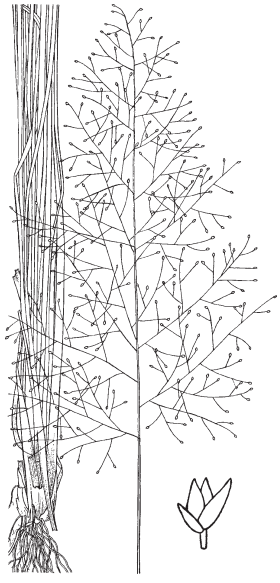
Elymus smithii [USB]



Elymus virginicus [USB]



Enteropogon chlorideus [GO1]



Eragrostis airoides [REN]



Eragrostis amabilis [HI1, SIL]



Eragrostis barrelieri [GO2]



Eragrostis capillaris [USB]



Eragrostis cilianensis [HI1]

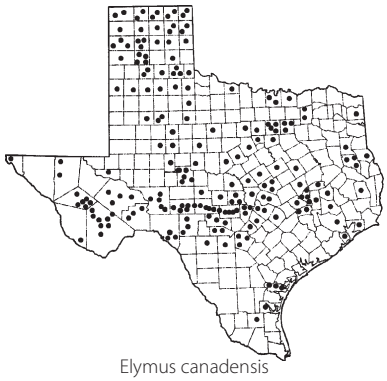
closely ascending hairs; inflorescences usually (4–)8–24 cm wide, ± drooping or open, the branches naked of spikelets at base; pedicels usually shorter than the spikelets; spikelets (4–)6–10 mm long, 1.2–1.6(–2) mm wide, usually with 3–12 flowers, dark gray to grayish green or purple; lemmas 1.8–3.5 mm long. Planted on sandy soils for erosion control and range improvement, but escaping easily (Peterson 2003a) into fields, roadsides, and weedy sites; now widespread in TX; widespread in U.S. except nc part. May–Jul. Native of s Africa. This species is considered to be a "highly polymorphic complex" that reproduces primarily by apomixis; polyploidy is also involved (Poverene & Voigt 1997). Cattle wait until more palatable species are gone before eating the rather coarse foliage; subsequently they will eat this species nearly to the ground. The hard stubble that remains will hurt their feet, making them "tender-footed" and hesitant to walk and properly feed. They have to be removed from such a pasture (J. Stanford, pers. comm.).

Eragrostis elliottii S. Watson, (possibly for Stephen Elliott, 1771–1830, Carolinian botanist and author of *A Sketch of the Botany of South-Carolina and Georgia*), ELLIOTT'S LOVE GRASS. Tufted perennial hardened at base but neither knotty nor with rhizomes; culms 25–75 cm tall; inflorescences very open, the main branches naked of spikelets at base; pedicels usually much longer than the spikelets; spikelets 4.5–18 mm long, 1.5–3 mm wide, with 6–30 florets, often reddish tinged; lemmas 1.8–4.4 mm long. Low pinelands, sandy soils; scattered in Pineywoods and Post Oak Savannah; also Gulf Prairies and Marshes and a few locations to the w; se U.S. from NC w to MO, OK, and TX. July–Fall.

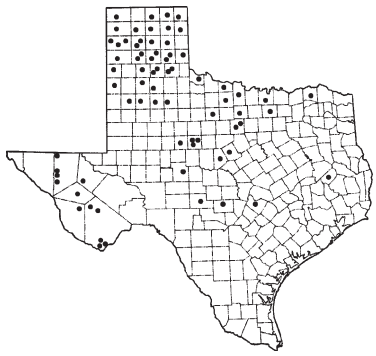
Eragrostis hirsuta (Michx.) Nees, (hairy), BIG-TOP LOVE GRASS, STOUT LOVE GRASS. Tufted perennial; culms usually 45–130 cm tall; leaf sheaths often hairy on the surfaces as well as at the margins and the apex, rarely glabrous; inflorescences very open, the main branches naked of spikelets at base; pedicels usually much longer than the spikelets; spikelets small, 2–4 mm long, 1–1.2(–1.7) mm wide, with only 2–4(–6) florets, greenish with purple tinges; lemmas 1.8–2.4 mm long. Sandy woods and river bottoms; widespread in e 1/3 of TX; much of the e U.S. (except extreme ne) w to MO, OK, and TX. Sep–Nov. [*E. hirsuta* var. *laevivaginata* Fernald]

Eragrostis hypnoides (Lam.) Britton, Sterns, & Poggenb., (like *Hypnum*—a genus of mosses, moss-like), TEAL LOVE GRASS, TEEL LOVE GRASS, SMOOTH CREEPING LOVE GRASS. Low annual; culms creeping, rooting at nodes, mat-forming, the flowering culms to only 15(–25) cm tall; in aspect similar to *E. reptans*; inflorescences usually dense but sometimes somewhat open, to only 5(–8) cm long; pedicels much shorter than the spikelets; spikelets (3–)5–12(–15) mm long, ca. 1–2(–2.5) mm wide, with (5–)8–22(–40) florets; lemmas 1.5–2(–2.3) mm long, glabrous. Mud and sand bars of streams, lakes; scattered in East TX primarily in the Pineywoods and Post Oak Savannah, also Gulf Prairies and Marshes; se Canada and throughout most of the U.S. Spring to fall, but mostly fall.

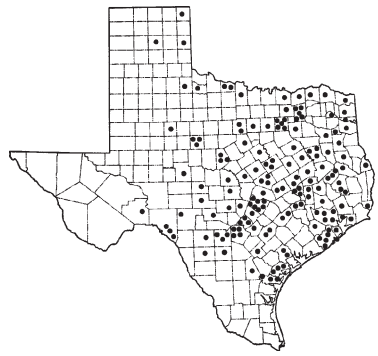
Eragrostis intermedia Hitchc., (intermediate), PLAINS LOVE GRASS. Tufted erect perennial with hardened bases; culms usually 50–100 cm tall; inflorescences very open, the main branches naked of spikelets at base; pedicels much longer than the spikelets; spikelets usually 4–6(–7) mm long, 1.3–2 mm wide, with 5–11 florets, olive green to lead gray or reddish purple; lemmas 1.6–2.2 mm long. Sandy woods or less often open ground; widespread in TX; much of the s 1/2 of the U.S. May–Oct. Many of the specimens included here in *E. intermedia* have been previously placed in *E. lugens* (Correll & Johnston 1970). The two species are extremely similar and difficult to distinguish (see key to species). However, Gould (1975b) indicated that they differ in flowering period. According to Peterson (2003a), "*Eragrostis intermedia* is similar to the more widespread *E. lugens*, but differs from that species in having wider spikelets, longer lemmas, and caryopses with a prominent adaxial groove." Witherspoon (1977) recognized 4 varieties of *E. intermedia*. East TX plants correspond to var. *intermedia*; the other 3 varieties occur in Mexico and Central America (Yatskievych 1999). Peterson (2003a) did not recognize varieties.



Elymus canadensis



Elymus smithii



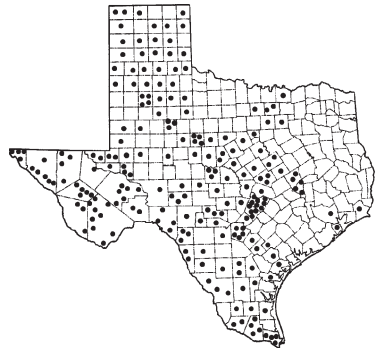
Elymus virginicus



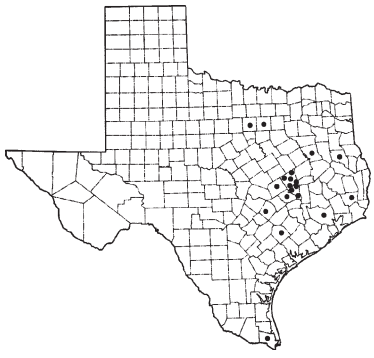
Enteropogon chlorideus



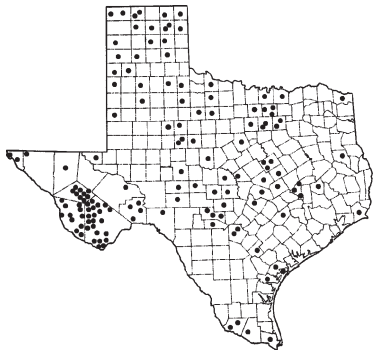
Eragrostis airoides



Eragrostis barrelieri



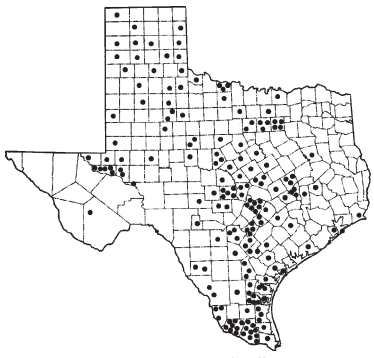
Eragrostis capillaris



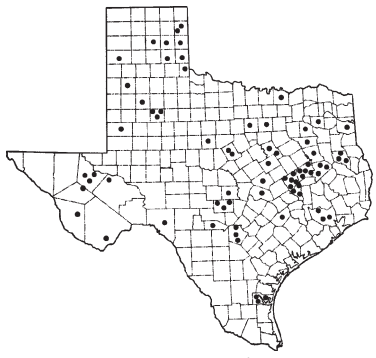
Eragrostis cilianensis



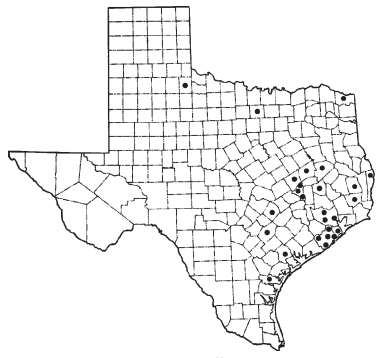
Eragrostis ciliaris



Eragrostis curtipedicellata



Eragrostis curvula



Eragrostis elliottii

Eragrostis japonica (Thunb.) Trin., (of Japan), POND LOVE GRASS, JAPANESE LOVE GRASS. Tufted annual; culms 80(–115) cm or less tall; inflorescences dense, 10–50 mm wide, with stiffly ascending branches, the main branches with spikelets to the base; spikelets subsessile, 2–3(–3.8) mm long, 0.6–1.3 mm wide, with (4–)6–8(–12) florets; lemmas 1–1.4 mm long. Roadside ditches, margins of lakes and streams, moist disturbed areas, typically in sandy soils; Red River (BRIT), Liberty, Nacogdoches, Newton, and Polk (Turner et al. 2003) cos.; se U.S. from GA s to FL w to MO, OK, and TX. Aug–Nov. Native of the Old World tropics (Peterson 2003a). [*Eragrostis glomerata* (Walter) L.H. Dewey] Some authorities (e.g., Correll & Johnston 1970; Hatch et al. 1990; Yatskievych 1999; Hatch 2002) treat this species as *E. glomerata* and consider it native to the U.S. However, we are following the recent *Flora of North America* treatment (Peterson 2003a) in considering it to be *E. japonica.* ☜

Eragrostis lehmanniana Nees (derivation not indicated by author, possibly for Johann G.C. Lehmann, 1792–1860, German botanist at Hamburg), LEHMANN'S LOVE GRASS. Tufted perennial; culms usually 40–80 cm tall, ± erect, sometimes rooting at lower nodes; inflorescences open; pedicels 4 mm or less long; spikelets 5–12(–14) mm long, 0.8–1.2 mm wide, with 4–12 florets; lemmas 1.5–1.7 mm long. Roadsides and disturbed areas; included based on citation of Gonzales and Madison (Turner et al. 2003) cos.; however, we have been unable to locate any non-cultivated East TX collections and only tentatively include it as a member of the flora; scattered primarily in s and w TX; sw U.S. from TX w to CA. (Mar–)Jul–Oct. Native of s Africa. This species was introduced into the s U.S. for erosion control, but unfortunately it displaces native species in some areas (Peterson 2003a). ☜

Eragrostis lugens Nees, (mournful, doleful), MOURNING LOVE GRASS. Tufted erect perennial with hardened bases; culms usually 35–70 cm tall; inflorescences very open, the main branches naked of spikelets at the base; pedicels much longer than the spikelets; spikelets usually 3–4.5 mm long, 0.8–1.3 mm wide, with 5–9 florets; lemmas 1.2–1.6 mm long. Sandy areas; Brazos (Gould 1958), Bell, Harris, Harrison, Nacogdoches, Smith (Turner et al. 2003), and Bastrop (E. Keith, pers. comm., SBSC) cos. This species is exceedingly similar to *E. intermedia* (see discussion under that species). We are following Gould (1975b) in recognizing *E. lugens* as restricted in TX primarily (but not exclusively) to vegetational areas 1 (Pineywoods) and 6 (South TX Plains), and (fide Hatch et al. 1999 and Turner et al. 2003) the Gulf Prairies and Marshes; se U.S. from NC s to FL w to OK and TX. Flowering mostly Nov–Jan(–spring).

Eragrostis pectinacea (Michx.) Nees ex Steud., (comb-like), PURPLE LOVE GRASS, TUFTED LOVE GRASS, CAROLINA LOVE GRASS. Low-spreading to erect annual; culms 10–60(–80) cm tall; inflorescences fairly open, the main branches naked of spikelets at the base; pedicels shorter than to longer than spikelets; spikelets 3.5–11 mm long, 1–2(–2.5) mm wide, usually with 6–14(–20) florets, grayish green; lemmas (1.6–)1.8–2.4 mm long. Sandy or clayey roadsides, disturbed areas. Spring–Nov. The characters used to distinguish the varieties given here are modified from Correll and Johnston (1970), who treated the taxa as species; however, the distinctions seem too weak for recognition at the specific level. Reeder (1986), Hatch (2002), and Peterson (2003a) treated them as varieties; Turner et al. (2003) did not indicate infraspecific taxa. The county distribution map does not distinguish varieties.

1. Pedicels not appressed, spreading from the inflorescence branches, 3–10 mm long, averaging > 4 mm _____ var. **miserrima**
1. Pedicels appressed to the inflorescence branches, 1–5 mm long, usually averaging < 4 mm _____ var. **pectinacea**

var. **miserrima** (E. Fourn.) Reeder, (possibly from Latin: *miser*, miserable, sickly, or wretched). Specimens from Grayson and Limestone (BRIT) cos. may be examples of var. *miserrima*; scattered in TX; se Canada (Ont.) and scattered in the U.S., primarily in the s 1/2. [*E. arida* Hitchc., *E. tephrosanthos* Schult.]



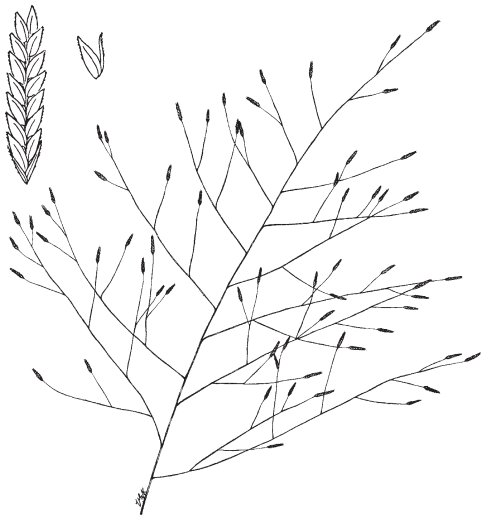
Eragrostis ciliaris [USB]



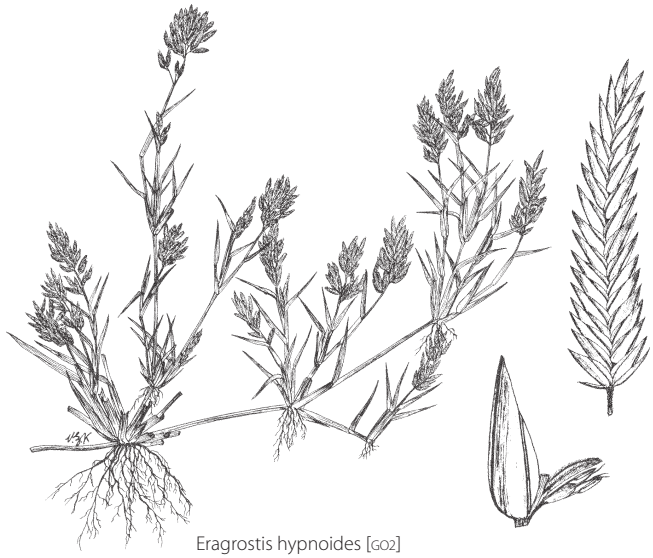
Eragrostis curtipedicellata [USB]



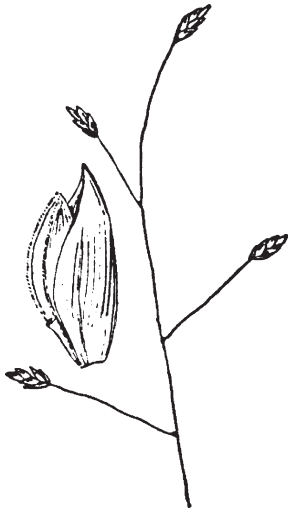
Eragrostis curvula [USD]



Eragrostis elliottii [GO2, SIL]



Eragrostis hypnoides [GO2]



Eragrostis hirsuta [HI1]



Eragrostis intermedia [HI1]

var. **pectinacea**, SPREADING LOVE GRASS. Widespread in TX; scattered in s Canada and throughout the U.S. This is the more common of the 2 varieties in TX. [*E. diffusa* Buckley]

Eragrostis pilosa (L.) P. Beauv., (pilose, with long soft hairs), INDIA LOVE GRASS. Tufted annual 15–55(–70) cm tall; inflorescences open, the main branches naked of spikelets at the base; pedicels usually longer than the spikelets; spikelets 2–7 mm long, when closed (before lemmas spread open) very narrow, 1 mm wide or less, when open to 1(–1.5) mm wide, usually with 4–11(–17) florets; lemmas usually 1.2–1.6 mm long, grayish green with reddish or purplish tips. Sandy or sandy clay roadsides, disturbed sites; Dallas, Fannin, Rains (BRIT), Grimes, Hopkins, McLennan, Robertson (Turner et al. 2003) and Walker (E. Keith, pers. comm., BAYLU, SBSC) cos.; Post Oak Savannah and Gulf Prairies and Marshes w to West Cross Timbers, also several localities in the Panhandle; scattered in s Canada and nearly throughout the U.S. Jun–Aug. Native of Eurasia (Peterson 2003a). [*E. multicaulis* Steud.] We are following a number of recent authorities (e.g., Hatch et al. 1990; Allen 1992; Weakley 2000; Hatch 2002; Peterson 2003a) in considering this species to be introduced; others (e.g., Kartesz 1999) consider it native to the U.S. Some workers (e.g., Hatch 2002; Peterson 2003a) recognize a variety, var. *perplexa* (L.H. Harv.) S.D. Koch, based on the presence of glandular pits scattered over the whole plant and slightly longer lemmas. However, all East TX material would appear to belong to the typical var. *pilosa* if varieties are recognized. ☜

Eragrostis polytricha Nees, (many-haired), HAIRY-SHEATH LOVE GRASS. Tufted perennial similar to *E. hirsuta* and *E. lugens*; culms usually 60 cm or less tall; leaf blades densely papillose-pilose at least 2/3 their length; inflorescences open, the main branches naked of spikelets at the base; spikelets ca. 3–4 mm long, ca. 1.5 mm wide, with 3–5 florets; lemmas 1.8 mm or less long. Sandy areas; Walker Co.—reported (as *E. trichocolea* var. *floridana*) "in sandy ground near Huntsville, Texas" by Witherspoon (1977) (no specimen cited) and listed (as *E. trichocolea* var. *floridana*) by Hatch et al. (1990) and Hatch (2002) for the Pineywoods and Post Oak Savannah; we have, however, seen no East TX material and only tentatively consider this species a member of the flora; no county distribution map is provided; FL and ?TX, but primarily Mexico to South America. Hatch et al. (1990) also cited *E. trichocolea* var. *trichocolea* for the Post Oak Savannah; however, according to Witherspoon (1977), var. *trichocolea* is found in South America (but not North America). Likewise, Kartesz (1999) did not list var. *trichocolea* for North America. Davidse (1994) and Peterson (2003a) synonymized *E. trichocolea* under *E. polytricha* Nees. Summer–fall. [*E. floridana* Hitchc., *E. trichocolea* Hack. & Arechav. var. *floridana* (Hitchc.) Witherspoon, *E. trichocolea* of authors, not (Nutt.) Wood] If this species is confirmed for TX, it should probably be considered of conservation concern for the state.

Eragrostis refracta (Muhl.) Scribn., (bent sharply back from the base), COASTAL LOVE GRASS, MEADOW LOVE GRASS. Tufted perennial; culms usually 80 cm or less tall; inflorescences very open, the main branches naked of spikelets at the base; pedicel subtending terminal spikelet of a branchlet (5–)10–25 mm long; lateral spikelets often sessile or subsessile, their pedicels frequently 2 mm long or less, often much less; spikelets 5–18 mm long, usually 1.4–2(–3) mm wide, with 9–30 florets, greenish or with reddish or purplish tinge; lemmas usually 1.4–2.2 mm long. Pine forests, sandy soils; widespread in Pineywoods and Post Oak Savannah and Dallas Co. (Turner et al. 2003) to the w; also n Gulf Prairies and Marshes; se U.S. from VA s to FL w to OK, and TX. Aug–Oct. [*E. campestris* Trin., *E. campestris* var. *refracta* (Muhl. ex Elliott) Chapm.]

Eragrostis reptans (Michx.) Nees, (creeping), CREEPING LOVE GRASS. Dioecious annual; culms creeping, rooting at nodes, mat-forming; flowering culms 5–10(–20) cm tall; inflorescences short (3 cm or less long), the pistillate ones often ± head-like, the staminate inflorescences somewhat more open; spikelets sessile or very short-pedicelled, crowded, usually 6–20(–26) mm long, usually 2–4 mm wide, ovate to lanceolate or linear, sometimes curved, with 16–40(–60) florets; lemmas (1.8–)2.1–4 mm long, usually with short hairs along the veins. Dry lake beds, stream bottoms, wet weedy areas; widespread in e 1/2 of TX, scattered to the w; widespread in ec U.S. from WV s to



Eragrostis japonica [USB]





Eragrostis lugens [GO1]



Eragrostis pectinacea var. miserrima [HI1]

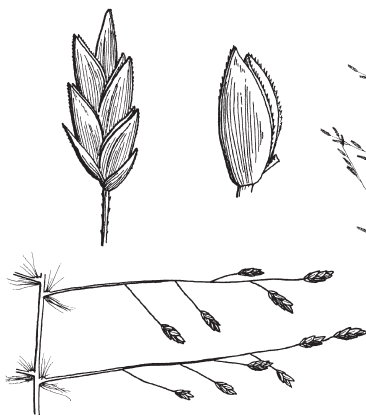
Eragrostis lehmanniana [FNA]



Eragrostis pectinacea var. pectinacea [USB]



Eragrostis pilosa [USB]



Eragrostis polytricha [FNA]



Eragrostis refracta [GLE, GO2]

AL w to SD and TX. Apr–Nov. This species is sometimes (e.g., Nicora 1962; Gould 1975b; Kartesz 1999) segregated into the genus *Neeragrostis* [as *N. reptans* (Michx.) Nicora]. However, Koch (1978) pointed out that the taxon is separated from *Eragrostis* only in being dioecious and concluded it is best treated as a somewhat morphologically unusual *Eragrostis*.

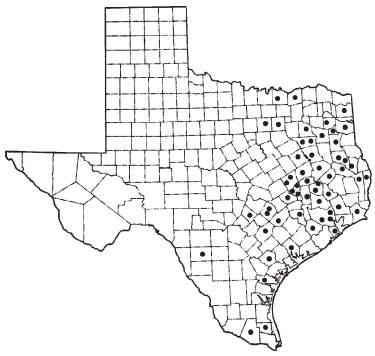
Eragrostis secundiflora J. Presl subsp. **oxylepis** (Torr.) S.D. Koch, (sp.: with flowers on one side of the stalk; subsp.: sharp-scaled), RED LOVE GRASS. Tufted perennial 15–90(–150) cm tall; inflorescences usually small and compact, occasionally with 1 or 2 long branches, the branches either with spikelets to the base or naked of spikelets at the base; spikelets subsessile, 5–15(–20) mm long, usually 3–5 mm wide, strongly flattened, with 9–24(–29) florets, glaucous or blue-gray to green, or brown-red; lemmas 2.2–4 mm long. Sandy woods or open ground, rarely in limestone gravel; nearly throughout TX but more common in the e 1/2; e U.S. from SC s to FL w to NE and NM, also CA. May–Nov. Koch (1978) and Peterson (2003a) indicated that subsp. *secundiflora* occurs from South America n to Mexico. We are following Koch (1978) for synonymy of this taxon. [*E. beyrichii* J.G. Sm., *E. oxylepis* (Torr.) Torr., *E. oxylepis* (Torr.) Torr. var. *beyrichii* (J.G. Sm.) Shinners]

Eragrostis sessilispica Buckley, (with sessile spikelets), TUMBLE LOVE GRASS. Tufted perennial 30–90 cm tall; inflorescences open, the main branches widely spreading, unrebranched, the sessile spikelets widely spaced and borne to the very base of branch, the entire inflorescence becoming loosely coiled and half prostrate, ultimately breaking off and acting as a tumbleweed; spikelets 5–12.5 mm long, 2–3 mm wide, with 5–12 florets, straw-colored to tinged with purplish; lemmas 3–5 mm long. Sandy prairies and oak openings; widespread in w part of East TX from Austin and Brazos (Turner et al. 2003) cos. w; widespread in w 2/3 of TX; KS, NM, OK, and TX. Apr–Sep.

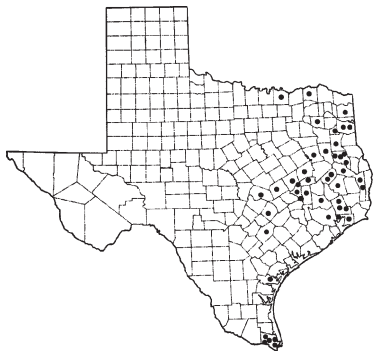
Eragrostis spectabilis (Pursh) Steud., (spectacular), PURPLE LOVE GRASS, PETTICOAT-CLIMBER. Perennial to 70(–85) cm tall, with base hardened and knotty, often with short rhizomes; inflorescences very open, main branches naked of spikelets at the base; lateral spikelets on pedicels averaging < 1 cm long; spikelets (4–)5–7 mm long, 1–2.5 mm wide, with 7–13 florets, reddish purple; lemmas 1.5–2.5 mm long. Sandy or disturbed sites; widespread in e 1/2 of TX and known from the Panhandle; se Canada and throughout e U.S. w to ND and NM. Aug–Oct. [*E. spectabilis* var. *sparsihirsuta* Farw.] This is a showy species sometimes used as an ornamental (Peterson 2003a).

Eragrostis superba Peyr., (superb), WILMANN'S LOVE GRASS, SAW-TOOTH LOVE GRASS. Perennial to nearly 100 cm tall; inflorescences narrow, dense, with relatively few, large spikelets, the main branches either with spikelets to base or naked of spikelets at the base; spikelets ca. (6–)10–16 mm long, 3–10 mm wide, conspicuously flattened, usually with ca. 15 florets, showy, disarticulating below the glumes, each spikelet falling as an intact unit; lemmas 3–5 mm long, strongly keeled. Drought resistant species planted as a range grass and for erosion control and revegetation, also persisting, and escaping; Bastrop (Turner et al. 2003) and Walker (E. Keith, pers. comm., SBSC) cos.; also Parker (R. O'Kennon, pers. obs.), Brewster, Gillespie, and Llano (Turner et al. 2003) cos. to the w of East TX and cited for vegetational areas 3, 4, 5, 6, and 7 by Hatch (2002); sw U.S. from TX w to AZ. Spring–fall. Introduced from Africa (where it is grown for hay). This species has exceptionally large, flattened spikelets and could be considered ornamental; the size of the spikelets also makes it a good candidate for teaching grass structure to students. Peterson (2003a) noted that the common name SAW-TOOTH LOVE GRASS appropriately describes the leaf blades. ☜

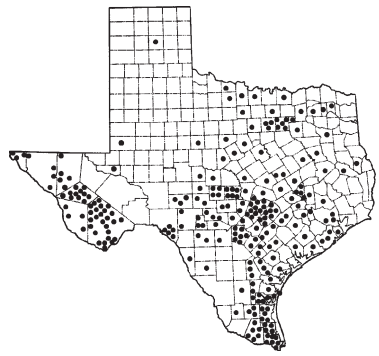
Eragrostis trichodes (Nutt.) A.W. Wood, (hair-like), SAND LOVE GRASS, THREAD LOVE GRASS. Tufted perennial; culms (30–)60–160 cm tall; inflorescences very open, the main branches naked of spikelets at the base; spikelets 4–10(–15) mm long, 1.5–3(–4) mm wide, usually with 4–10 florets (rarely more); lemmas 2.4–3.8 mm long, with reddish-tinged splotches. Sandy prairies;



Eragrostis hirsuta



Eragrostis hypnoides



Eragrostis intermedia



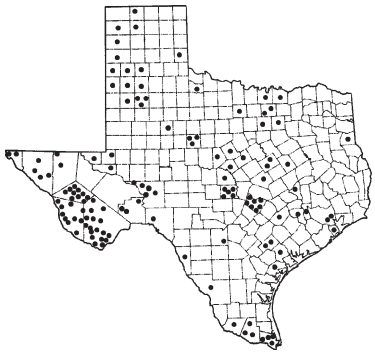
Eragrostis japonica



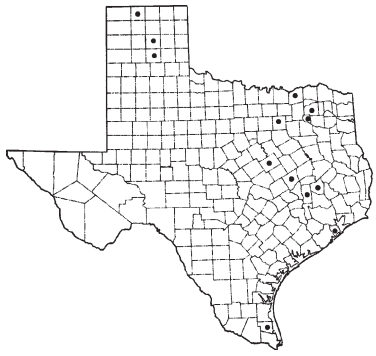
Eragrostis lehmanniana



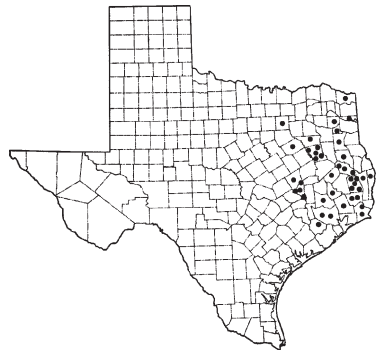
Eragrostis lugens



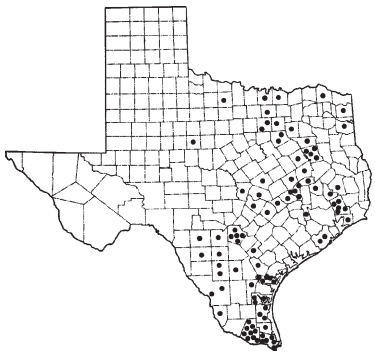
Eragrostis pectinacea
(both vars.)



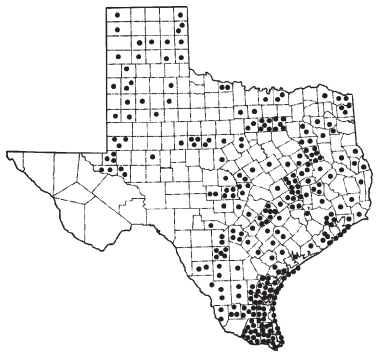
Eragrostis pilosa



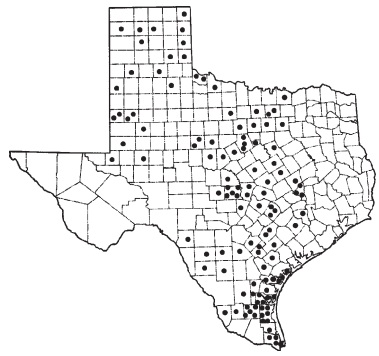
Eragrostis refracta



Eragrostis reptans



Eragrostis secundiflora subsp. oxylepis



Eragrostis sessilispica

widespread in TX; c U.S. from MI s to MS w to WY and NM, also NY and VT. Jul–Dec., sporadically in the spring. [*E. pilifera* Scheele, *E. trichodes* var. *pilifera* (Scheele) Fernald] Hatch (2002) recognized var. *pilifera*. However, we have not been able to find consistent differences and are thus following Correll and Johnston (1970), Gould (1975b), and Peterson (2003a) in not recognizing varieties. According to Peterson (2003), this species is sometimes used as an ornamental.

EREMOCHLOA Büse CENTIPEDE GRASS

A genus of 11 species (Buitenhuis & Veldkamp 2001; Thieret 2003d) native from Indomalesia (India to New Guinea) to Australia. It is considered by some authorities (e.g., Clayton & Renvoize 1986) to be related to *Coelorachis*. The solitary, terminal, 1-sided, spike-like raceme distinguishes this genus from all other members of the tribe Andropogoneae (Bor 1952b). Like all members of the Andropogoneae, *Eremochloa* is characterized by C_4 photosynthesis (Kellogg 2000a). (Greek: *eremos*, desert, and *chloa*, grass—Bor 1952b) (subfamily Panicoideae, tribe Andropogoneae)

REFERENCES: Bor 1952b; Buitenhuis & Veldkamp 2001; Thieret 2003d.

Eremochloa ophiuroides (Munro) Hack., (snake-tailed), CENTIPEDE GRASS. Mat-forming stoloniferous perennial; culms erect, to 35 cm tall; leaf sheaths sharply keeled; leaf blades (lower ones) 1–5 mm wide, the upper ones reduced or lacking; inflorescence a solitary, terminal, spike-like raceme ca. 2–6 cm long and ca. 1.5–2.5 mm wide (pencil-like but much smaller in diam.), the spikelets closely appressed and overlapping scale-fashion along 1 side; spikelets awnless, glabrous, in pairs, one sessile, one pedicellate; disarticulation at base of sessile spikelet so that associated pedicel and section of inflorescence axis fall with the sessile spikelet; pedicelled spikelet usually much reduced (represented by a bristle) or absent (only ± flattened pedicel remaining); sessile spikelets dorsally compressed, 3–4 mm long, 2-flowered, the lower floret staminate, the upper floret fertile; lower glume winged near apex, making the glume ± truncate apically, the keel with 1–several hook-like spines 0.2–0.3 mm long near base. Roadsides, parking lots, lawns; Cherokee (BRIT), Angelina, Liberty, Newton (SBSC), Leon (Gould 1975b), and Brazos (Turner et al. 2003) cos.; according to Gould (1975b) this species is an occasional escape from experimental plantings, but we are unaware of other TX localities; se U.S. from NC s to FL w to AR and TX, also MA. Mainly spring–fall. Native of e Asia. [*Ischaemum ophiuroides* Munro] This species is used for erosion control and as a lawn grass (Mabberley 1997), particularly in the tropics (Clayton & Renvoize 1986). Its use as a lawn grass in the southeastern United States dates from ca. 1920 (Thieret 2003d). The extremely slender, spike-like inflorescences superficially resemble those of *Coelorachis* (JOINT-TAIL). The common name is in reference to the appearance of the leafy stolons (Thieret 2003d).

ERIOCHLOA Kunth CUP GRASS

Annuals or perennials; ligule of hairs to 1–2 mm long; panicle slender, of erect, appressed, spike-like racemes along a main axis; spikelets each with a small (< 0.5 mm long) cup-like collar or ring (called the callus) just under the base, solitary or paired, 2-flowered, the lower staminate or neuter, the upper perfect; disarticulation at base of spikelets; lower glume absent (see note in synopsis below); upper glume and lemma of sterile floret similar.

A C_4 genus of 20–30 species of tropical and warm areas of the world (Shaw & Smeins 1981; Shaw et al. 2003). More than two-thirds of the taxa are found in the American southwest and in the central Andes (Shaw & Smeins 1981). Some species are important pasture grasses while others are considered significant weeds (Watson & Dallwitz 1992). The small cup-like structure below the spikelets, known as the callus, is quite unique and distinguishes the genus from all other members of its tribe (Shaw & Webster 1987). Its anatomical derivation has been studied in detail (Shaw & Smeins 1979, 1983; Thompson et al. 1990) with conflicting conclusions.

Shaw and Smeins (1983) concluded that it represents swollen or expanded internode tissue fused with the much-reduced lower glume. Thompson et al. (1990), however, found that it lacks vascular tissue, is formed entirely of parenchymatous tissue, and that glume tissue is not involved. They concluded that it is "formed by a proliferation of the ground tissue at the spikelet base." Davidse (1987a) suggested a possible function—the cup-shaped structure might contain lipids and function as an elaiosome to attract ants that would act as dispersal agents for the seeds. (Greek: *erion*, wool, and *chloa*, grass, in reference to the densely hairy pedicels and spikelets of the type species—Shaw & Webster 1981) (subfamily Panicoideae, tribe Paniceae)
REFERENCES: Shaw & Smeins 1979, 1981, 1983; Shaw & Webster 1987; Thompson et al. 1990; Crins 1991; Arriaga 2000; Shaw et al. 2003.

1. Pedicels with long silky hairs ca. half as long as the spikelets or longer; inflorescence branches (racemes) not or only scarcely overlapping each other; leaf blades 0.5–4 mm wide; lemma of perfect floret awnless or with a minute awn tip less than 0.4 mm long _____ **E. sericea**
1. Pedicels glabrous or with only very short pubescence; inflorescence branches overlapping each other; leaf blades 2–10(–13) mm wide; lemma of perfect floret with an awn 0.4–1.5 mm long.
   2. Leaf blades glabrous or scabrous on lower surface; plants perennial (but may flower first year and appear annual); spikelets (4–)4.5–5.7 mm long, typically paired (but becoming solitary toward tip of inflorescence branch); species known in East TX only from s portion of area _____ **E. punctata**
   2. Leaf blades pubescent on lower surface; plants annual; spikelets 3.5–4.5(–5) mm long, solitary (occasionally paired at base of inflorescence branch); species widespread in East TX _____ **E. contracta**

Eriochloa contracta Hitchc., (contracted), PRAIRIE CUP GRASS. Annual 15–75(–100) cm tall, often with many culms, forming bushy clumps; leaf sheaths and blades (at least the lower ones) often rather densely soft-pubescent; leaf blades 2–8 mm wide; lemma of perfect floret with awn 0.4–1.1 mm long; spikelets mostly solitary. Roadsides, ditches, disturbed areas; in East TX mainly Blackland Prairie, but widespread in TX; se Canada (Ont.) and sc and sw U.S., scattered elsewhere. May–Oct.

Eriochloa punctata (L.) Desv. ex Hamilton, (spotted), LOUISIANA CUP GRASS, EVERLASTING GRASS. Perennial, rhizomatous, 30–150 cm tall; leaf sheaths and blades usually glabrous or blades scabrous; leaf blades (2–)4–10(–13) mm wide; lemma of perfect floret with awn 0.6–1.5 mm long; spikelets mostly paired. Ditches and other moist areas; Brazos and Harris (TAES) cos.; mainly Gulf Prairies and Marshes and South TX Plains; LA and TX. Mar–Dec. [*Milium punctatum* L.] This species is the least common member of the genus in East TX. It is considered a significant weed in some areas (presumably where not native) by Watson and Dallwitz (1992).

Eriochloa sericea (Scheele) Munro ex Vasey, (silky), TEXAS CUP GRASS, SILKY CUP GRASS. Perennial with short rhizomes but tufted, 30–130 cm tall, rather densely soft-pubescent; spikelets 4–5 mm long, solitary; lemma of perfect floret awnless or with a minute awn tip less than 0.4 mm long. Prairies, open thickets, roadsides, calcareous clays or clay loams; widespread in w part of East TX from Leon (BRIT) and Grimes (Turner et al. 2003) cos. w; w portion of East TX w to Rolling Plains and s to Edwards Plateau, South TX Plains, and Gulf Prairies and Marshes; CO, KS, NE, OK, and TX. May–Oct. This is a secondary member of the original prairie. It is reported to be good forage but does not withstand grazing; it is said to persist in overgrazed pastures only under the protection of shrubs (Hatch et al. 1999).

ERIONEURON Nash WOOLLY GRASS, FLUFF GRASS

A New World C_4 genus of 3 species (Valdés-Reyna & Hatch 1997; Valdés-Reyna 2003b); similar to and previously included in *Tridens*. Seedlings "appear to have a shaggy, white-villous 'indumentum,' but this is composed of a myriad of small, water-soluble crystals" (Valdés-Reyna 2003b). The monotypic genus *Dasyochloa* of the sw U.S. and n Mexico has at times been

treated in *Erioneuron* (e.g., Gould 1975b; Mabberley 1997), but it is currently recognized as a distinct genus (Sánchez 1983; Valdés-Reyna 2003c). (Greek: *erion*, wool, and *neuro*, nerve, from hairs on nerves (veins) of lemmas and paleas) (subfamily Chloridoideae, tribe Cynodonteae)
REFERENCES: Tateoka 1961; Sánchez 1983; Valdés-Reyna 1985, 2003b; Valdés-Reyna & Hatch 1995, 1997; Peterson et al. 1997.

Erioneuron pilosum (Buckley) Nash, (pilose, with long soft hairs), HAIRY TRIDENS, HAIRY ERIONEURON, HAIRY WOOLLY GRASS. Tufted perennial; culms 10–30(–40) cm tall, usually with one node above the basal cluster of leaves; ligule of hairs ca. 0.5 mm long; leaf blades 2–8(–11) cm long, 1–2(–2.5) mm wide, with a thick white margin (visible with a hand lens); panicles or racemes contracted, 2–4(–6) cm long, 1.5–2 cm broad, of ca. 4–9(–12) large spikelets; spikelets usually 10–16 mm long, with ca. 6–18 closely imbricated florets; disarticulation above glumes and between florets; glumes 1-veined, glabrous; lemmas rounded on back, 3-veined, the veins and margins conspicuously long-hairy, with awn 0.5–2(–2.5) mm long from an entire or notched apex (teeth to 0.5 mm long). Disturbed sites, prairies; widespread on w margin of East TX, also Camp Co. (Turner et al. 2003) in the far ne part of East TX; nearly throughout w 2/3 of TX; w U.S. from CA e to KS and TX. Apr–Oct. [*Tridens pilosus* (Buckley) Hitchc.]

EUSTACHYS Desv. FINGER GRASS

Perennials; culms erect or geniculate basally; ligule a ciliate membrane 0.5 mm or less long; inflorescence of (2–)3–14 digitately arranged (or nearly so), spike-like branches; spikelets crowded, in 2 rows along 1 side of each branch, with 1 perfect floret below and usually 1 sterile (sometimes staminate) floret above; glumes unequal, the second (upper) longer, bilobed/bidentate, with a short (< 1 mm long) awn arising between the lobes/teeth; lemma of fertile floret truncate or nearly so, with margins strongly ciliate; lemma of sterile floret reduced, ± truncate.

A close-knit genus of ca. 12 species (Aulbach 2003) native mainly to tropical and subtropical America and Africa, with the greatest diversity (9 species—Molina 1996) in South America. The species are characterized by C_4 photosynthesis (Watson & Dallwitz 1992) and are often found in savannah habitats (Clayton & Renvoize 1986). *Eustachys* is similar to and has sometimes been treated as a section of *Chloris* (e.g., Hitchcock 1951). According to Gould (1975b), the "two genera differ most conspicuously in the bilobed short-aristate glumes of *Eustachys* as contrasted with the lanceolate or acuminate glumes of *Chloris*." Molina (1996) gave a detailed discussion of differences between the two genera, concluding that *Eustachys* warrants recognition. Recent molecular studies question the monophyly of both *Chloris* and *Eustachys*, but point to an alliance between some species of these two genera (Hilu & Alice 2000, 2001). Aulbach (2003) concluded that *Eustachys* is "morphologically similar to *Chloris*, with the placement of a few species being problematic." Aulbach further indicated that molecular data support the recognition of *Eustachys*, but that "the relationships between it, *Chloris sensu stricto*, and *Cynodon* are not clear." The following key is modified from Wipff and Hatch (1992) and Wipff et al. (1994). (Greek: *eu*, good or true, and *stachys*, spike, in reference to the spike-like inflorescence branches) (subfamily Chloridoideae, tribe Cynodonteae)
REFERENCES: McKenzie et al. 1987a; Jones & Wipff 1992b; Wipff & Hatch 1992; Wipff et al. 1994; Nowack 1995; Molina 1996; Hilu & Alice 2000, 2001; Aulbach 2003.

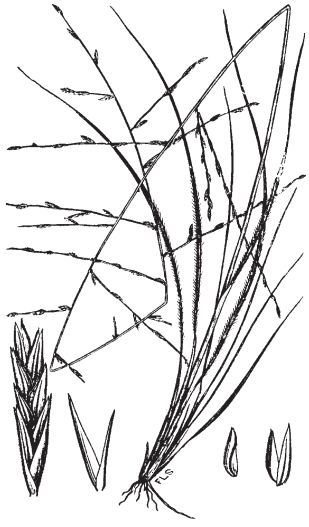
1. Lemma of lower (fertile) floret with keel (midvein) glabrous (note: the lemma margins are conspicuously ciliate) _____ **E. retusa**
1. Lemma of lower floret with keel ciliate (use a dissecting scope if possible since the hairs are often not obvious).
   2. Lemma of lower floret dark chocolate brown to black (light brown only when very immature); margins of lemma of lower floret glabrous on the lower 1/2–2/3 (the upper portion ciliate with short usually appressed hairs 0.1–0.4 mm long); lemma (sterile, reduced) of upper floret 0.8–1.0(–1.2) mm long _____ **E. petraea**



Eragrostis reptans [HI1]



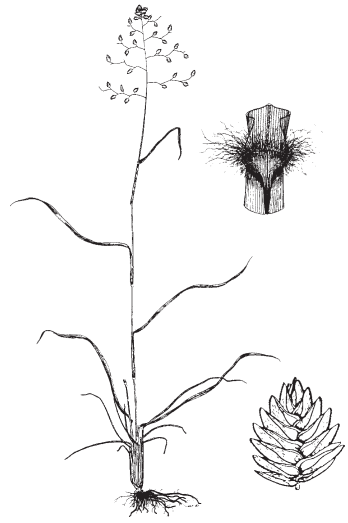
Eragrostis secundiflora subsp. oxylepis [USB]



Eragrostis sessilispica [USB]



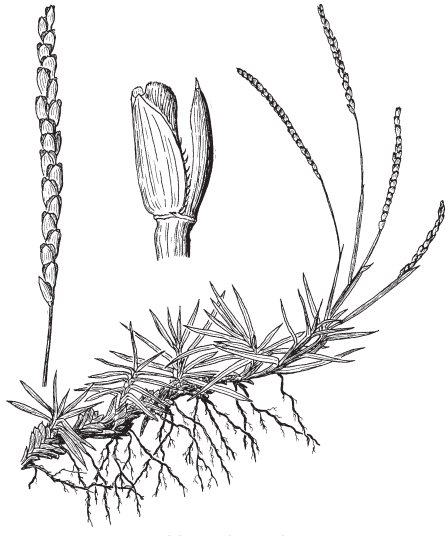
Eragrostis spectabilis [HI1]



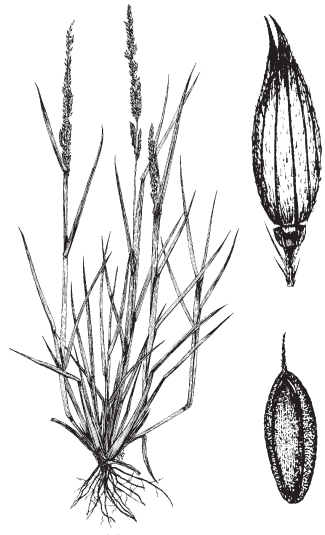
Eragrostis superba [HIG]



Eragrostis trichodes [USB]



Eremochloa ophiuroides [FNA]



Eriochloa contracta [GO1]

2. Lemma of lower floret pale to golden brown; margins of lemma of lower floret ciliate the entire length, the hairs appressed to spreading and more than 0.5 mm long; lemma of upper floret 1.2–1.5 mm long _____ **E. caribaea**

Eustachys caribaea (Spreng.) Herter, (of the Caribbean), CARIBBEAN FINGER GRASS, CHICKENFOOT GRASS. Tufted rhizomatous perennial; culms to 70 cm tall; leaf blades (4–)6–10 mm wide; inflorescence of 4–9(–10) digitately arranged, spike-like branches, the branches 4–9 cm long; spikelets 2–2.5 mm long; lowermost lemma with keel and margins ciliate, otherwise glabrous; lemma of sterile floret obconic-cylindrical, truncate. Roadsides, pastures, disturbed areas; Fayette (BRIT); Bexar, Brazos (TAES), Caldwell, and Gonzales (Wipff & Hatch 1992) cos.; also n Gulf Prairies and Marshes; GA, LA, MS, and TX. Apr–Sep. Native of Central and South America (the describing author, Sprengel, mistakenly thought it came from the Caribbean—Nowack 1995). [*Chloris bahiensis* Steud., *Chloris capensis* (Houtt.) Thell. var. *bahiensis* (Steud.) Parodi, *Chloris caribaea* Spreng., *E. paspaloides* (Vahl.) Lanza & Mattei subsp. *caribaea* (Spreng.) Nowack] First reported in the U.S. from LA by McKenzie et al. (1987a). The first TX report was by Wipff and Hatch (1992). This taxon is extremely closely related to *E. paspaloides* of Africa; Nowack (1995), upon examining both African and American material, concluded that the differences do not justify distinguishing separate species and recognized the African and American representatives at the subspecific level. While the African and New World taxa appear quite similar, we are following the recent treatment by Aulbach (2003) in recognizing *E. caribaea* at the specific level.

Eustachys petraea (Sw.) Desv., (growing on stony ground, rock-loving), PINEWOODS FINGER GRASS, STIFF-LEAF FINGER GRASS. Tufted to stoloniferous perennial with erect culms 20–90(–120) cm tall; leaf blades ca. 2.5–10 mm wide; inflorescence with (2–)4–8(–11) branches, the branches 4–12 cm long; spikelets ca. 1.8–2.5 mm long; lemma of sterile floret cylindrical, truncate. Sandy soils, open areas, open woods; Milam (BRIT), Hardin (ASTC), Colorado, Fayette, Harris, Lavaca, Liberty, Montgomery, and Trinity (Turner et al. 2003) cos. in se part of East TX; also Gulf Prairies and Marshes and South TX Plains; se U.S. from NC s to FL w to TX. Mar–Dec. [*Chloris petraea* Sw.]

Eustachys retusa (Lag.) Kunth, (retuse, notched slightly at apex), ARGENTINIAN FINGER GRASS. Tufted perennial with erect culms 25–90 cm tall; leaf blades 4–7(–12) mm wide; inflorescence of (3–)6–15 branches, the branches 4–10 cm long; spikelets ca. 1.9–2.4 mm long; lemma of fertile floret pale brown, the margins conspicuously ciliate, the hairs to ca. 1–2 mm long and often spreading at right angles to the lemma margin, otherwise lemmas glabrous; lemma of sterile floret ca. 1.1–1.2 mm long, cylindrical to narrowly obtriangular and truncate. Disturbed roadsides; Falls, Limestone, Robertson (BRIT), Kaufman (ASTC), Bastrop, Brazos, Houston, McLennan, Milam, and Walker (Turner et al. 2003) cos.; also Brazoria Co. (Turner et al. 2003) in the Gulf Prairies and Marshes; mainly TX, also FL, NY, and SC. May–Sep. Native to South America. [*Chloris argentina* (Hack.) Lillo & Parodi]

Eustachys distichophylla (Lag.) Nees, (with leaves arranged in two ranks), WEEPING FINGER GRASS, native to South America, has been reported for TX (e.g., Hitchcock 1951; McKenzie et al. 1987a), apparently based on misidentified material of *E. retusa* (Wipff & Hatch 1994); it is therefore not considered a member of the East TX flora. This species has the lemma of fertile floret with glabrous keel as in *E. retusa*, but the lemma of sterile floret acute to obtuse (rather than truncate as in *E. retusa*) and the lemma of fertile floret longer (2.4 mm or longer versus < 2.4 mm long in *E. retusa*).

FESTUCA L. FESCUE

Tufted perennials; culms erect or slightly decumbent basally; leaf sheaths open; ligule a membrane; leaf blades 2.5–12 mm wide; inflorescence a panicle, open or contracted; spikelets with



Eriochloa punctata [SID]



Eriochloa sericea [USB]



Erioneuron pilosum [BB2]



Eustachys caribaea [SID]



Eustachys petraea [USB]



Eustachys retusa [HEA]



Festuca arundinacea [USB]



Festuca paradoxa [GLE]

2–10 florets, glabrous or nearly so; disarticulation above glumes and between florets; glumes 2, unequal, the upper one longer, usually slightly shorter than lower lemma; lemmas usually rounded on back, not toothed at apex, awnless or with a short awn; stamens 3.

A C_3 genus of ca. 400–450 species (Mabberley 1997; Darbyshire & Pavlick ined.) of temperate, alpine, and polar areas of all continents except Antarctica, and in tropical mountains. Some are important as pasture and lawn grasses, while others are considered significant weeds (Watson & Dallwitz 1992). *Vulpia* (SIXWEEKS GRASS, ANNUAL FESCUE), treated here as a separate genus, has in the past sometimes been included in *Festuca*. A number of workers (e.g., Bulinska-Radomska & Lester 1988; Pasakinskiene et al. 1998) have noted similarities between the genera *Festuca*, *Lolium*, and *Vulpia*, and it now seems clear that *Lolium* is most closely related to some species of *Festuca* (Gaut et al. 2000). In addition, intergeneric hybrids between *Lolium* and *Festuca* are known (Terrell 1966; Watson & Dallwitz 1992). Darbyshire (1993) suggested that *Festuca* subgenus *Schedonorus*, the broad-leaved fescues (including *F. arundinacea* and *F. pratensis*), be shifted to *Lolium* based on a number of types of experimental evidence including hybridization. Tucker (1996) followed that classification. More recently (Darbyshire ined.) has recognized subgenus *Schedonorus* at the generic level and considers it to comprise 3 species native to Europe and temperate Asia. However, other recent studies (e.g., Aiken et al. 1997; Charmet et al. 1997; Gaut et al. 2000) suggest the situation is more complex. In fact, some molecular data (e.g., Charmet et al. 1997) indicate that *Lolium*, *Vulpia*, and possibly *Dactylis* are derived from within *Festuca* and even raise the possibility that *Festuca* might be polyphyletic. A more recent study (Torrecilla & Catalán 2000) suggests that only *Festuca* in the broad sense (including *Lolium* and *Vulpia*) is monophyletic. It is thus not yet clear what is the best arrangement of these genera (i.e., one large genus, a genus with subgenera, a number of smaller genera, etc.). We are therefore following such recent authors as Yatskievych (1999) in retaining subgenus *Schedonorus* in *Festuca*, at least for the present. As more information becomes available, a reassessment of generic boundaries may be necessary. Clayton and Renvoize (1986), while recognizing the similarities between *F. arundinacea* (and related species) and *Lolium*, said, "Nevertheless the two genera are so easily distinguished that it seems unrealistic to unite them." Indeed, the two genera are readily separated morphologically: *Lolium* has spicate inflorescences and spikelets with a single glume, while *Festuca* has paniculate inflorescences and spikelets with two glumes. The key below is in part modified from Aiken and Lefkovitch (1993). (Latin: *festuca*, stalk, stem, or straw; a name used by Pliny for a weed—Darbyshire & Pavlick ined.) (subfamily Pooideae, tribe Poeae)

REFERENCES: Piper 1906; Terrell 1966, 1967, 1968b; Bulinska-Radomska & Lester 1985b, 1988; Aiken & Darbyshire 1990; Darbyshire & Warwick 1992; Aiken & Lefkovitch 1993; Darbyshire 1993, ined.; Tucker 1996; Aiken et al. 1997, 1998; Charmet et al. 1997; Soreng & Terrell 1997; Thomas et al. 1997; Pasakinskiene et al. 1998; Gaut et al. 2000; Soreng et al. 2001; Torrecilla & Catalán 2002; Darbyshire & Pavlick ined.

1. Inflorescence contracted, at least above, with lower branches often bearing spikelets well below the middle; spikelets 8–15(–20) mm long, with 3–10 florets; lower lemmas 4–12 mm long; introduced species usually of roadsides, fields, and disturbed or open areas.
   2. Auricles at summit of leaf sheath usually with ciliate margins; spikelets usually with 3–6 florets; leaf sheaths with age pale straw-colored, often staying intact; leaf blades 3–12 mm wide; lemmas usually 6–12 mm long, usually minutely scabrous (use dissecting scope), with a short awn 0.3–2(–4) mm long, rarely awnless; rachilla scabrous; shortest branch (if more than one) at each main node of inflorescence usually with 3 or more spikelets; lowest inflorescence node with 2 or 3 branches _____ **F. arundinacea**
   2. Auricles at summit of leaf sheath with glabrous margins; spikelets usually with (4–)6–10 florets; leaf sheaths with age brown, breaking down to form fibers; leaf blades 2–7(–8) mm wide; lemmas usually 4–6(–8) mm long, usually glabrous or scabrous only at apex, usually awnless;

rachilla glabrous; shortest branch (if more than one) at each main node of inflorescence with only 1–2 spikelets; lowest inflorescence node with 1 or 2 branches _____ **F. pratensis**

1. Inflorescence open, with lower branches usually without spikelets below the middle; spikelets 4–9 mm long, with 2–5(–6) florets; lower lemmas 3–7(–8) mm long; native species of open woods, forest margins, or other partially shaded places.
   3. Lower lemmas 5–8 mm long, awnless or with minute awn to 1.5(–2) mm long; upper glume 4–7.5 mm long; species ranging from ne part of East TX south to e Edwards Plateau _____ **F. versuta**
   3. Lower lemmas 3–5 mm long, awnless; upper glume 2–5 mm long; species limited to the n and ne parts of East TX.
      4. Inflorescence branches reflexed or drooping at maturity; spikelets often widely separated on the lower inflorescence branches, sometimes overlapping slightly toward the ends of the branches; spikelets lanceolate in bud; upper glume usually shorter than the first lemma _____ **F. subverticillata**
      4. Inflorescence branches loosely ascending at maturity (can be drooping before maturity); spikelets clustered, consistently overlapping each other by 1/3 to 1/2 their length on the lower inflorescence branches; spikelets clavate in bud; upper glume almost as long as or longer than the first lemma _____ **F. paradoxa**

Festuca arundinacea Schreb., (reed-like), TALL FESCUE, ALTA FESCUE. Nearly glabrous perennial forming clumps, with short rhizomes; culms 60–150(–200) cm tall; ligule 0.2–1 mm long; leaf blades 3–12 mm wide, with veins prominent on adaxial (= upper) surface; panicle rather narrow and dense; spikelets 8–15(–20) mm long; some florets are reportedly replaced on occasion by vegetative bulbils (Yatskievych 1999); anthers 2.5–4 mm long; chromosome number variable—2*n* = 28, 42, 56, 63, 70 (Darbyshire ined.). In calcareous clay, roadsides, open or disturbed areas, also cultivated; widespread in East TX but more common in the ne part; widely scattered in TX; s Canada and nearly throughout the U.S. Mostly Apr–Jun. Native of temperate Eurasia and n Africa. [*F. elatior* L. var. *arundinacea* (Schreb.) Wimm., *F. elatior* L. subsp. *arundinacea* (Schreb.) Hack., *Lolium arundinaceum* (Schreb.) Darbysh., *Schedonorus arundinaceus* (Schreb.) Dumort., *Schedonorus phoenix* (Scop.) Holub] Darbyshire (1993) presented evidence that *Festuca* is polyphyletic and that this species is best treated in the genus *Lolium*; Jones et al. (1997) and Kartesz (1999) followed Darbyshire (1993). More recently, Darbyshire (ined.) has transferred the species to *Schedonorus* under the name *S. phoenix*. However, there is conflicting evidence (Aiken et al. 1997; Charmet et al. 1997; Gaut et al. 2000), and until the taxonomic situation is more stable, we are treating the species conservatively and continuing to recognize it in *Festuca* (see additional discussion in generic synopsis above).

This species, introduced as a cool-season hay/forage, is considered to be one of the most important cultivated pasture grasses in the U.S. It is now also used as a turf grass and for erosion control, and it is reported to occupy more acreage in the U.S. than any other introduced grass species (Ball et al. 1993). However, it can be a problematic invasive weed in native prairie remnants. Livestock can sometimes be poisoned by eating this species, with the resulting condition variously called "fescue toxicity," "gangrenous fescue poisoning," "fescue foot," "summer syndrome," "summer slump," "summer toxicosis," "fat necrosis," or "staggers and shivers." While the symptoms are similar to those produced by ingestion of ergot alkaloids (see discussion under genus *Secale*), a different endophytic (= growing within the plant tissue) fungus is at fault. The fungus infecting fescue has been identified as *Neotyphodium coenophialum* (Morgan-Jones & W. Gams) Glenn, C.W. Bacon & Hanlin (previously in genus *Acremonium*), a relative of ergot fungi. The fungus produces alkaloids (including ergot-like and pyrrolizidine) which cause a number of symptoms (e.g., low weight gain, reduced milk production, increased body temperature, intolerance to heat, abortion). A number of these symptoms are caused by vasoconstrictive action in small blood vessels, which reduces blood flow to the skin and extremities—even gangrene and loss of extremities (e.g., feet, tip of tail, tips of ears) can occur (Kingsbury 1964; Clay 1988; Hardin & Brownie 1993; Weathers 1998; Yatskievych 1999; Burrows & Tyrl 2001; Hart et al. 2001). According to Burrows and Tyrl (2001), "Diseases associated with fescues are probably the most important toxicologic problems of livestock in North America" and conservative estimates of livestock-related losses nationwide are between 1/2 and 1 billion dollars per year (Ball et al. 1993).

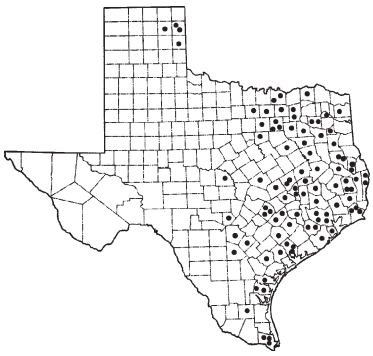
Interestingly, the relationship between fungus and plant appears to be the mutualistic—infected grass plants show many benefits in comparison to uninfected individuals—enhanced growth, more rapid germination, higher seed production, greater resistance to drought, and protection against herbivory. Infected plants thus grow better and are preferred for such uses as lawns and turf (Clay 1988; Ball et al. 1993). The fungus, on the other hand, grows within and receives nourishment from the plant and is even spread inside the host plant's seeds. However, ranchers and land managers should be aware of the dangers to their livestock of a diet containing significant amounts of infected *F. arundinacea*.

Festuca paradoxa Desv., (strange, unexpected), CLUSTERED FEATHER GRASS. Perennial 50–110(–120) cm tall, similar to *F. subverticillata* but distinguished by characters in the key; spikelets 4–8 mm long. Open woods, forest margins; Bowie, Red River, Wood (BRIT), San Jacinto (SBSC), and Upshur (Turner et al. 2003) cos. Aiken et al. (1997) mapped (without specific counties) its occurrence in the ne part of the Pineywoods and in the Red River drainage; in TX limited to the ne part of the state; throughout much of the e U.S. from PA s to GA w to MN and TX. Apr–Jun. [*F. nutans* Biehler, *F. shortii* Kunth ex A.W. Wood] While it has been suggested that this species intergrades with *F. subverticillata* and that the two may represent only a single taxon (Gould 1975b), studies by Aiken and Lefkovitch (1993) and Aiken et al. (1997) indicate that they are morphologically distinguishable and remain distinct in areas of sympatry, and hence are separate species. Darbyshire and Pavlick (ined.) note that, while similar to *F. subverticillata*, *F. paradoxa* has the "spikelets more distal and crowded on the inflorescence."

Festuca pratensis Huds., (of meadows). MEADOW FESCUE, ENGLISH BLUEGRASS. Perennial similar to *F. arundinacea* but usually smaller and less robust, to ca. 100(–130) cm tall; ligule < 0.5 mm long; leaf blades 2–7(–8) mm wide, the veins not prominent on adaxial (= upper) surface; spikelets 9–15.5 mm long; anthers 2–4.5 mm long. Disturbed grassy areas, roadsides, stream banks; included based on citation for TX by Kartesz (1999), because Tucker (1988) indicated that it is "probably present in all the Southeastern States," and to encourage collectors to look for it in East TX. The only definitive TX specimen we have seen is from Potter Co. (BRIT) in the Panhandle. However, this species is naturalized nearly throughout the continental U.S. and s Canada (Kartesz 1999) and is expected from East TX; no county distribution map is provided. Mostly Apr–Jul. Native of Europe and sw Asia. [*F. elatior* L., in part, *Lolium pratense* (Huds.) Darbysh., *Schedonorus pratensis* (Huds.) P. Beauv.] Darbyshire (ined.) separates this and two related species into the segregate genus *Schedonorus* (see discussion in generic synopsis). This species is related to *F. arundinacea*—the two overlap in most characters (Sutherland 1986), and Terrell (1968b) indicated that "some specimens will be more or less intermediate" between these two species. Yatskievych (1999) also noted the two overlap and that "misdeterminations are commonly encountered in the herbarium." Hatch (2002) synonymized *F. pratensis* with *F. arundinacea*. However, data from enzyme electrophoresis support the recognition of *F. arundinacea* and *F. pratensis* as distinct species (Bulinska-Radomska & Lester 1985b), and in his recent treatment, Darbyshire (ined.) recognized them at the specific level. Darbyshire (ined.) noted that while this species was in the past a popular forage grass in parts of North America, it is now only rarely used.

Festuca subverticillata (Pers.) E.B. Alexeev, (slightly whorled), NODDING FESCUE. Glabrous perennial 50–100(–150) tall, forming clumps, without rhizomes; panicle open; spikelets 2–5(–6)-flowered, 4–7 mm long; lemmas awnless, falling early; anthers 1–2.2 mm long. Low woods and thickets; Cherokee, Dallas, Grayson, Red River (BRIT), San Jacinto (*E. Keith 155*, SBSC—annotated L. Brown), Burleson, and Shelby (Turner et al. 2003) cos.; in TX limited primarily to the ne part of the state; se Canada and e U.S. w to ND and TX. Apr–Jun. [*F. obtusa* Biehler]

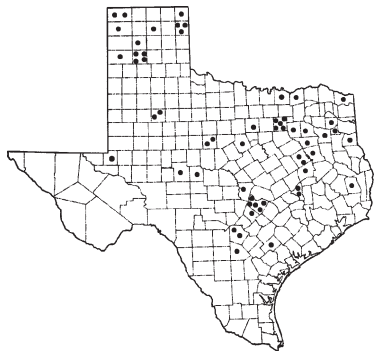
Festuca versuta Beal, (reversible), TEXAS FESCUE. Glabrous perennial 50–100 cm tall, forming clumps, without rhizomes; panicle open; spikelets 2–5-flowered, usually 6–9(–11) mm long; lemmas awnless or with a minute awn; anthers 2–3 mm long. Moist partially shaded areas,



Eragrostis spectabilis



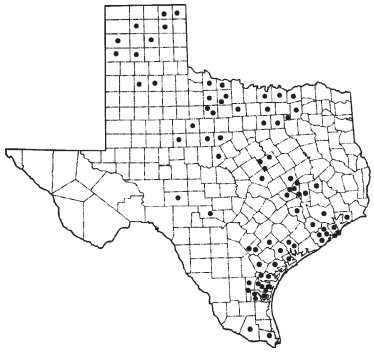
Eragrostis superba



Eragrostis trichodes



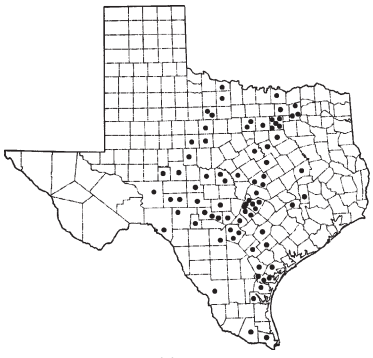
Eremochloa ophiuroides



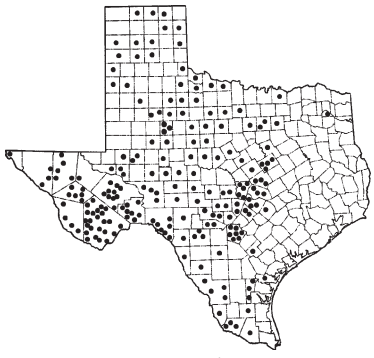
Eriochloa contracta



Eriochloa punctata



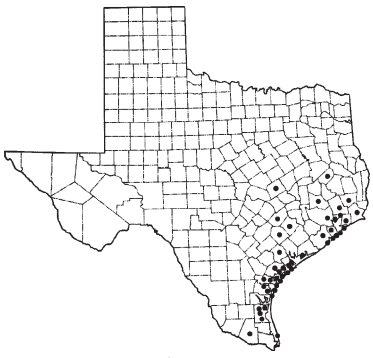
Eriochloa sericea



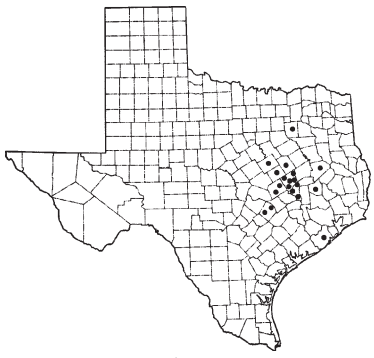
Erioneuron pilosum



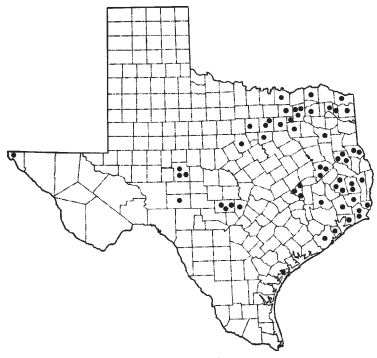
Eustachys caribaea



Eustachys petraea



Eustachys retusa



Festuca arundinacea

limestone-derived soils; Bexar, Travis (BRIT), Bell, Comal, Hays (Turner et al. 2003), and Fayette (Carr 2001) cos. in the sw part of East TX, also Aiken et al. (1997) mapped (without specific counties) its occurrence from ne TX (roughly in the vicinity of Hopkins Co.) s and w through the Post Oak Savannah and Blackland Prairie to e Edwards Plateau; also Blanco and Kendall (Carr 2001) cos. in e Edwards Plateau; endemic to TX, the Wichita Mts. of OK (Aiken et al. 1997), and AR (Darbyshire & Pavlick ined.). Darbyshire and Pavlick (ined.) indicate that this species is "rare." Mar–Jun. (RARE 2001, 2002b: G3S2S3)⚠

GLYCERIA R. Br. MANNA GRASS

Perennials, often with rhizomes or rooting at lower nodes; leaf sheaths closed for 3/4 or more of their length; ligule a membrane; inflorescence an open or contracted panicle (rarely a raceme); spikelets in ours with 3–14(–20) florets, awnless, disarticulating above glumes and between florets; glumes unequal; lemmas usually with 7 strong, parallel veins, rounded on back; paleas often as long or slightly longer than lemmas.

A cosmopolitan but particularly temperate North American C_3 genus of ca. 40 species (Barkworth ined.), typically of wet places or shallow water; a number are good pasture grasses. The genus resembles *Puccinellia,* and some species previously placed in *Glyceria* are now treated in *Puccinellia* and *Torreyochloa*. Native Americans formerly used the seeds of some, and in Europe, flour is made using the seeds of certain species (Yatskievych 1999). ☠ All species are palatable (Barkworth ined.), but under certain conditions *Glyceria* species are known to be poisonous to livestock, due to the presence of dhurrin, a cyanogenic glycoside which is enzymatically converted to hydrogen cyanide (Burrows & Tyrl 2001). (Greek: *glyceros*, sweet, referring to the taste of the seeds of the type species) (subfamily Pooideae, tribe Meliceae)
REFERENCES: Church 1949; Tucker 1996; de Esparza & Maze 1997; Mejía-Saulés & Bisby 2000; Barkworth ined.

1. Inflorescence branches usually short and stiffly erect or ascending (particularly at maturity), often with spikelets to base of branches or nearly so; spikelets 8–20(–30) mm long, with 7–14(–20) florets; lower glume ca. (1–)2–4 mm long; upper (longer glume) 2–5.1 mm long.
   2. Lemmas 2.5–3.5 mm long, with short pubescence visible with 10X hand lens; anthers < 1 mm long ____ **G. arkansana**
   2. Lemmas usually 3.5–5.5 mm long, minutely scabrous, the hairs hard to distinguish even with 10X hand lens; anthers 1–2 mm long ____ **G. septentrionalis**
1. Inflorescence branches (at least lower) long and flexuous, bare of spikelets on the lower 1/3–1/2; spikelets 2–4(–5) mm long, usually with 3–7 florets; lower glume <1(–1.4) mm long; upper glume 0.8–1.3(–2) mm long ____ **G. striata**

Glyceria arkansana Fernald, (of Arkansas), ARKANSAS MANNA GRASS. Perennial similar to *G. septentrionalis*, distinguished as in the key; leaf blades usually (3–)6–12 mm wide. Wet areas; Fannin (Talbot property, BRIT), Bowie (BAYLU, TAES, Nixon et al. 1987), Red River (BAYLU), and Lamar (Carr 1994) cos. in Red River drainage and Liberty (SBSC, TAES) and San Jacinto (SBSC) cos. further s; also Fort Bend Co. (L. Brown, pers. comm.) in the Gulf Prairies and Marshes; in TX primarily in the ne corner of the state; e U.S. from VA w to MO, OK, and TX. Mar–May. While Gould (1975b) recognized *G. arkansana*, he indicated that it "is close to and weakly differentiated from *G. septentrionalis* and probably should be treated as a variety of that species." Jones et al. (1997) treated it as a variety of *G. septentrionalis*, as did Yatskievych (1999) and Hatch (2002). However, Allen (1992b), Tucker (1996), Kartesz (1999) Weakley (2000), and Barkworth (ined.) recognize it at the species level. Until a detailed study can be carried out, we are treating the two as different species. [*G. septentrionalis* Hitchc. var. *arkansana* (Fernald) Steyerm. & Kucera]

Glyceria septentrionalis Hitchc., (northern), FLOATING MANNA GRASS, EASTERN MANNA GRASS, Plant glabrous; culms ca. 1–1.8 m tall, often rooting near base; ligule ca. 3–6(–10) mm long; leaf blades usually 4–10 mm wide; inflorescence usually 18–40(–50) cm long, the branches short and rigid. Wet areas, often in woods; Bowie, Brazos, Franklin, Trinity, and Robertson (TEX) cos.; also n Gulf Prairies and Marshes; se Canada and e U.S. w to MN and TX. Mar–Jun. [*Panicularia septentrionalis* (Hitchc.) E.P. Bicknell]

Glyceria striata (Lam.) Hitchc., (striated, striped), FOWL MANNA GRASS, NERVED MANNA GRASS. Plant glabrous, often with short rhizomes; culms 0.4–0.9(–1.5) m tall, usually erect from decumbent bases; ligule 1–4 mm long; leaf blades usually 2–8 mm wide, rarely wider; inflorescence 10–22(–25) cm long, typically with numerous slender, flexuous branches; spikelets ca. 2–4(–5) mm long; lemmas usually 1.3–2(–2.5) mm long, glabrous or nearly so, the 7 veins usually quite prominent; anthers 0.3–0.5(–0.9) mm long. Along streams, swamps, marshes, moist forest margins; Bowie (BAYLU) and Lamar (Carr 1994) cos. in Red River drainage, also Bell (TAES), Travis, and Washington (Turner et al. 2003) cos.; rare in e Edwards Plateau and Trans-Pecos; nearly throughout s Canada and the U.S., also disjunct to the mountains of Mexico (Tucker 1996). Apr–Aug. This species is variable morphologically, but the differences appear to be "a consequence of environmental, rather than genetic, factors" (Barkworth ined.). It is reported as potentially cyanogenic (Burlage 1968; Fuller & McClintock 1986).

GYMNOPOGON P. Beauv. BEARD GRASS, SKELETON GRASS

Clumped perennials from rhizomes; culms nearly erect to decumbent; leaves cauline, distichous (= 2-ranked), crowded; ligule minute, a fringed membrane or a rim of callus tissue, < 1 mm long; leaf blades flat, short, abruptly narrowed and ± cordate at base, (resembling those of some *Panicum* species); inflorescence a panicle, mostly ca. as wide as long or wider, with numerous widely spreading to reflexed, spike-like branches (these alternate along the main axis of the inflorescence), with small beards of hairs often present at base of inflorescence branches; spikelets usually not overlapping, appressed, in 2 rows on 1 side of the slender, slightly flattened branches, with 1(–2) perfect lower floret and 1 rudimentary upper floret (usually reduced to only a naked or awned pedicel); disarticulation above the glumes; glumes subequal (upper slightly longer), longer than the florets; lemma of fertile floret with an awn from the minutely notched apex; palea often slightly longer than lemma.

A C_4 genus of ca. 15 species mostly of warm areas of the Americas, with 1 species from India to Thailand (Smith 2003). The foliage is superficially similar to that of some *Panicum* species, while the inflorescence is reminiscent of *Chloris*. The genus is related to *Chloris*, but *Gymnopogon* can be distinguished by its 2-ranked leaves, alternate inflorescence branches, glumes longer than the florets, and the essentially obsolete upper floret (Clayton & Renvoize 1986; Yatskievych 1999). (Greek: *gymnus*, naked, and *pogon*, beard, referring to the reduction of the abortive flower to a bare awn, or to the naked prolongation of the rachilla in a number of species) (subfamily Chloridoideae, tribe Cynodonteae)
REFERENCES: Smith 1971, 2003.

1. Branches of inflorescence bearing scattered spikelets usually to the base (the very base with a spikelet); rudimentary floret with a distinct awn or sometimes reduced to only an awned pedicel; rhizomes short, knotty or plant merely with a knotty base; lemma of fertile floret with awn 4–8 (–12) mm long _____ **G. ambiguus**
1. Branches of inflorescence without spikelets in the basal 1/3 or more of their length (the very base without a spikelet); rudimentary floret awnless, reduced to only a naked pedicel; rhizomes elongate; lemma of fertile floret with awn 1–3(–4.5) mm long _____ **G. brevifolius**

Gymnopogon ambiguus (Michx.) Britton, Sterns, & Poggenb., (ambiguous), BEARDED SKELETON GRASS, BEARD GRASS. Culms 25–60(–100) cm long, nearly erect to spreading, with numerous short overlapping leaves; leaf blades spreading to deflexed, to 13(–18) mm wide; panicle usually broader than long, 10–25(–35) cm long, with 12–35 branches, these usually 10–24 cm long; glumes 4–7 mm long; lemma of fertile floret ca. 3–4(–6) mm long, with a 4–8(–12) mm awn; rudimentary floret varying from an awned pedicel to a minute awned vestige—when only an awned pedicel there is typically a discontinuity (bend or curvature) where the pedicel ends and the awn begins; awn of rudimentary floret 1–5(–6) mm long. Usually in sandy soils, typically in shade; widespread in East TX in appropriate habitats w to Grayson (BRIT) and Guadalupe (Turner et al. 2003) cos.; also w to Montague Co. (BRIT) in Cross Timbers and Prairies and in Gulf Prairies and Marshes; e U.S. from NJ s to FL w to KS and NM. Late Aug–Nov.

Gymnopogon brevifolius Trin., (short-leaved), SHORT-LEAF SKELETON GRASS, SLIM SKELETON GRASS. Plant similar to *G. ambiguus*, distinguished as in the key; culms usually weak, decumbent; glumes (2–)3.5–6 mm long; lemma of fertile floret ca. 2–3.5 mm long, with an awn 1–3(–4.5) mm long; rudimentary floret usually reduced to a naked pedicel, without an awn. Sandy soils, typically in shade; Tyler (SBSC), Nacogdoches, Newton, and San Jacinto (Smith 2003) cos. in the Pineywoods; otherwise known from TX only from Galveston Co. (TAES) in the n Gulf Prairies and Marshes; se U.S. from NJ s to FL w to AR, OK, and TX. Aug–Nov. Gould (1975b) questioned the distinctiveness of this species from *G. ambiguus*, saying that the "characters by which the species are distinguished in Texas, however, do not appear sufficiently consistent to warrant the recognition of more than one species." However, two taxa seem recognizable, and we are following recent sources (e.g., Allen 1992b; Jones et al. 1997; Kartesz 1999; Smith 2003) in recognizing *G. brevifolius* at the specific level.

HETEROPOGON Pers. TANGLEHEAD

Annuals or perennials, freely branching; ligule a minute ciliate membrane; inflorescence a spike-like raceme, usually solitary and terminal, remaining intact in lower part, disarticulating in upper part below each fertile spikelet, leaving a sharp conspicuously hairy callus on dispersal units; spikelets paired, dissimilar or those at lower nodes of inflorescence similar; pedicelled spikelets larger, usually staminate or neuter, awnless, the glumes green, somewhat bract-like, the lemma fragile, the palea absent; sessile spikelets with glumes hard, dark-colored, short-hairy, tightly enclosing 2 florets and subsequently caryopsis; lower floret vestigial, obscure; upper floret fertile, the lemma membranous, with a long and extremely conspicuous, dark brown, geniculate and twisted awn, the palea lacking; stamens 3.

A genus of 8–10 species (Barkworth 2003l) nearly cosmopolitan in the tropics and subtropics; some authors, however, believe the genus is native to the Old World and naturalized in the Americas (Pohl 1994c; Powell 1994). Like all members of the Andropogoneae, *Heteropogon* is characterized by C_4 photosynthesis (Watson & Dallwitz 1999; Kellogg 2000a). While some species provide good grazing when young, the very sharp calluses (capable of penetrating flesh) and long hygroscopic awns can be painful to livestock and humans (Mabberley 1997); they are reported as particularly injurious to sheep (Hitchcock 1951). The dispersal unit of *Heteropogon* species (sharp callus derived in part from inflorescence axis, glumes, vestigial sterile floret, and fertile floret with obvious awn) and the dispersal unit of *Nassella leucotricha*, TEXAS WINTER GRASS (sharp callus derived in part from rachilla and a fertile floret with obvious awn), look and function remarkably alike, yet they are structurally quite different—a good example of convergent evolution. The common name, TANGLEHEAD, probably derives from the extremely long awns, which sometimes twist around each other and become tangled. (Greek: *heteros*, different, and *pogon*, beard, in reference to the difference between the awnless staminate and awned pistillate spikelets—Hitchcock 1951, or "to the difference between the calluses of the spikelets in the heterogamous pairs"—Barkworth 2003l) (subfamily Panicoideae, tribe Andropogoneae)

REFERENCES: Emery & Brown 1958; Tothill & Hacker 1976; Pohl 1994c; Barkworth 2003l.

1. Plant a cespitose perennial 0.2–1(–1.5) m tall; leaf sheaths without glands on the keel; pedicelled spikelets 6–10 mm long, the lower glume sparsely papillose-hispid or glabrous, without glands; ligule < 1 mm long ____ **H. contortus**
1. Plant an annual (0.5–)1–2 m tall; leaf sheaths (particularly the upper ones) with a row of concave glands on upper part of keel; pedicelled spikelets 15–25 mm long, the lower glume glabrous, with a row of depressed glands (glandular pits) along the midvein; ligule 2–4 mm long ____ **H. melanocarpus**

Heteropogon contortus (L.) Beauv. ex Roem. & Schult., (contorted), TANGLEHEAD, BUNCH SPEAR GRASS, BLACK SPEAR GRASS, RETORCIDO MORENO, BARBA NEGRA. Perennial 0.2–1(–1.5) m tall; leaf blades 3–7.5(–10) mm wide; inflorescence 3–7 cm long; sessile spikelets (5–)7–8(–10) mm long, with lemma awn of upper floret 5–10(–12) cm long. Sandy soils of grasslands; Bexar (Turner et al. 2003) and Harris (SBSC) cos.; L. Brown (pers. comm.) noted that the Harris Co. specimen is a student collection from an unlikely habitat (wooded area) and could be mislabeled; widespread in s 1/2 of TX; AL, AZ, CA, FL, NM, and TX. (Mar–)Jun–Nov(–Dec). [*Andropogon contortus* L.] This species is considered a significant weed by Watson and Dallwitz (1999) and is designated a noxious weed in CA (Kartesz 1999). While considered fair to good livestock forage before maturity, the awns and calluses are problematic when the plants mature (Powell 1994). The callus is needle-sharp and "readily penetrates clothing and is a ferociously efficient dispersal mechanism" (Clayton & Renvoize 1986); it can even penetrate the skin or the lining of the digestive tract of animals (Emery & Brown 1958). This species is reported to be apomictic (= reproducing by means other than sexual) and to exhibit great variation in ploidy level (Emery & Brown 1958; Tothill & Hacker 1976). Some authorities (e.g., Kartesz 1999; Barkworth 2003l) consider it native to the U.S., while others (e.g., Tothill & Hacker 1976; Pohl 1994c) indicate the species is probably an Old World native, possibly of the Asian tropics. ⊘ ?☜

Heteropogon melanocarpus (Elliott) Elliott ex Benth., (bearing black or dark fruit), SWEET TANGLEHEAD. Annual (0.5–)1–2 m tall, erect; leaf blades (3–)5–10(–12) mm wide, sometimes with glands on midvein of lower surface; inflorescence 3–6.5 cm long, at lower nodes both spikelets of each pair staminate or neuter and awnless, with bract-like glumes, the spikelet pairs at upper nodes with conspicuously different sessile and pedicelled spikelets: sessile spikelet perfect, (8–)9–10(–11.5) mm long, with lemma awn of upper floret 9–12(–15) cm long; pedicelled spikelet staminate or neuter, with awnless lemma. Sandy soils, roadsides, disturbed areas, open woods; Waller Co. (TAES—verified by A. Chase) on s margin of East TX, also listed by Correll and Johnston (1970) as "very rare and probably not persistent in s.e. Tex"; we know of no other TX collections; AL, AZ, FL, GA, MS, SC, and TX. Summer–fall. While some authorities (e.g., Kartesz 1999) consider this species native to the U.S., we are following Pohl (1994c) and Barkworth (2003l) who indicate that it is probably an Old World native. [*Andropogon melanocarpus* Elliott] The plants when fresh are reported to emit an odor resembling citronella oil (Hitchcock 1951; Correll & Johnston 1970; Barkworth 2003l). ☜

HILARIA Kunth CURLY-MESQUITE, GALLETA

A C_4 genus of 10 xerophytic species ranging from the sw U.S. to n Guatemala, primarily in dry grasslands and desert areas; a number of species are important as forage and as soil binders (Barkworth 2003g). *Hilaria* is sometimes viewed as consisting of two groups, the *Hilaria* group and the *Pleuraphis* group (Barkworth 2003g). However, while some authorities recognize these groups at the generic level (e.g., Turner et al. 2003), "their overall similarity is striking. ... and there seems little value in promoting each to generic rank" (Barkworth 2003g). Molecular evidence (Columbus et al. 1998) reinforces a close relationship between the two groups. ☠ *Hilaria* species can cause "staggers syndrome" in grazing livestock, due to ergot alkaloids from fungal infections (Burrows & Tyrl 2001); see discussion under *Paspalum* for further details. (Named for

Auguste François César Prouvençal de St.-Hilaire, 1779–1853, French botanist, explorer, and entomologist—Barkworth 2003g) (subfamily Chloridoideae, tribe Cynodonteae)
REFERENCES: Cory 1948; Brown & Coe 1951; Sohns 1956; Scholl & Kinucan 1996; Columbus et al. 1998; Barkworth 2003g.

Hilaria belangeri (Steud.) Nash, (named for Charles Paulus Bélanger, 1805–1881), COMMON CURLY-MESQUITE. Low tufted perennial 10–35 cm tall, with slender stolons that produce new tufts; nodes densely bearded with spreading hairs; ligule a membrane 0.5–3 mm long; leaf blades 1–2(–3) mm wide, short and often forming a curly tuft, but sometimes longer and erect; inflorescence a slender, bilateral, pedunculate spike 2–3.5(–4) cm long, with 4–8 clusters of 3 spikelets each, the clusters usually 4.5–6(–8) mm long, each deciduous as a unit; central spikelet fertile, 1-flowered; lateral spikelets staminate, 2(–3)-flowered; glumes united below, usually asymmetrical; glumes of central spikelet with awns usually 2.5–5 mm long; lemmas awnless. Open brushy and rocky areas, usually on calcareous soils; Bell, Bexar, Travis (BRIT), Comal, DeWitt, Hays, Williamson, and Wilson (Turner et al. 2003) cos.; w and sw boundaries of East TX w through w 2/3 of TX; AZ, NM, and TX. (Mar–)Aug–Oct(–Nov). This species was the dominant grass on the shortgrass prairies of TX (Barkworth 2003g). It is one of the few species which increases in dominance under heavy grazing, and it is considered a valuable forage grass in c and w TX (Brown & Coe 1951; Scholl & Kinucan 1996). It can be confused with *Buchloe dactyloides* (BUFFALO GRASS), but *H. belangeri* has consistently bearded culm nodes, while in *B. dactyloides* the nodes are mostly glabrous (Snow 2003c).

HOLCUS L. VELVET GRASS

A C_3 genus of 8 species native to Europe, North Africa, and the Middle East (Standley ined.); some are considered significant weed species (Watson & Dallwitz 1992). It is apparently related to *Deschampsia*, HAIR GRASS (Clayton & Renvoize 1986). (Latin: *holcus*, old name for a kind of grain—Hitchcock 1951) (subfamily Pooideae, tribe Poeae)
REFERENCES: Beddows 1971; Thompson & Turkington 1995; Tucker 1996; Standley ined.

Holcus lanatus L., (woolly), COMMON VELVET GRASS, YORKSHIRE-FOG, CREEPING SOFT GRASS. Tufted or clumped perennial; culms 35–100(–150) cm long, erect, sometimes spreading basally; culms (particularly adjacent to the lower nodes) and leaves densely soft-hairy, velvety to the touch; ligule a ciliate membrane 1.5–4.5 mm long; leaf blades flat, usually 4–10(–12) mm wide; inflorescence a dense panicle 4–15(–20) cm long; spikelets 3.5–5.5(–6) mm long, with 2 florets, disarticulating below the glumes; glumes subequal, 3–5.5(–6) mm long, exceeding rest of spikelet in length, ciliate on keel and veins, sometimes with short hairs between the veins; lower floret perfect, awnless, ca. 2 mm long, glabrous; upper floret staminate, with lemma awned from below apex, the awn 1–2 mm long, curled or hooked at maturity; paleas slightly shorter than lemmas. Disturbed areas, marshes; scattered in East TX in Harrison, Robertson (BRIT), and Rusk (Turner et al. 2003) cos.; also Pecos Co. (Turner et al. 2003) in the Trans-Pecos and reported for Gulf Prairies and Marshes (Gould 1975b; Hatch 2002) but vouchers not seen; e and sw Canada (B.C.) and throughout most of the U.S. May–Jun. Native of Europe widely naturalized in the U.S. and most other temperate areas. [*Nothoholcus lanatus* (L.) Nash] This species was "widely distributed in North America by 1800" (Standley ined.). It has been reported to be a potential cause of hydrocyanic acid poisoning (Fuller & McClintock 1986), but Tucker (1996) indicated that it is not cyanogenic. However, it is poor forage and ingestion has been reported to cause inflammation of mucous membranes of the mouth (Tsvelev in Tucker 1996). It can also cause hay fever where abundant (Yatskievych 1999). The foliage is distinctly velvety to the touch.

HORDEUM L. BARLEY

Mostly annuals (in East TX) or, in case of *H. jubatum*, perennial; leaves with or without auricles; ligule a membrane; inflorescence a dense, 2-sided spike or spike-like raceme, breaking apart in



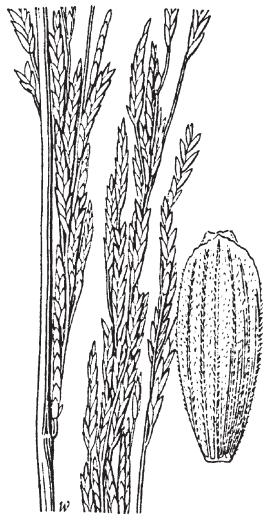
Festuca pratensis [YAT]



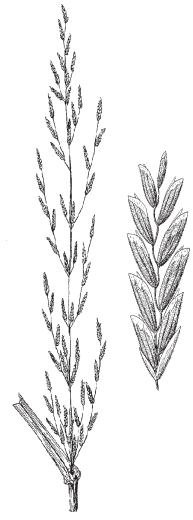
Festuca subverticillata [GO2]



Festuca versuta [HI1]



Glyceria arkansana [HI1]



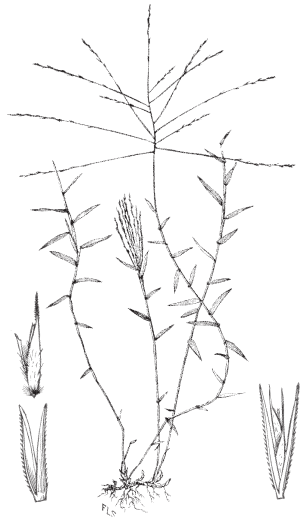
Glyceria septentrionalis [GLE]



Glyceria striata [HI1]



Gymnopogon ambiguus [USB]



Gymnopogon brevifolius [USB]



Heteropogon contortus [HI1]

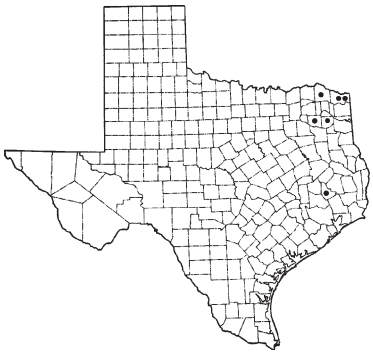
age except in *H. vulgare*; spikelets 3 per node, each 1-flowered (or lateral spikelets reduced to a group of awns), the central spikelet sessile, usually perfect, the 2 lateral spikelets usually short-pedicelled, staminate or sterile (perfect in *H. vulgare*); lemma usually awned apically.

A C_3 genus of ca. 32 species (Petersen & Seberg 1998a, 1998b; Bothmer et al. ined.) of temperate and adjacent subtropical areas; it includes *H. vulgare* (cultivated BARLEY) as well as several cosmopolitan weeds. BARLEY is a very old cereal crop originally grown by people of the ancient Near East, and it is considered along with WHEAT to be one of the oldest cultivated plants. The germinated (sprouted) fruits are known as malt; they are currently used primarily in beer- and whiskey-making and as animal feed (Heiser 1990; Yatskievych 1999). The awns of some species are minutely barbed and cause physical damage (especially to the eyes) and infection in livestock. Some species also cause problems with wool or are considered significant weeds (Stephens 1980; Watson & Dallwitz 1992). Hybridization and polyploidy have played major roles in the evolution of *Hordeum* species (Doebley et al. 1992). There is no general agreement about generic relationships within the Triticeae (Barkworth 2000), but hybridization between *Elymus* and *Hordeum* (Lu & Bothmer 1990) and between *Triticum* and *Hordeum* (Watson & Dallwitz 1992) clearly links *Hordeum* with other members of the tribe. (Ancient Latin name for BARLEY) (subfamily Pooideae, tribe Triticeae)

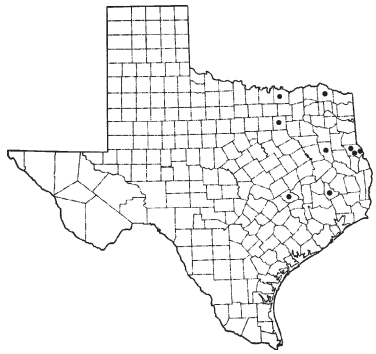
REFERENCES: Covas 1949; Bowden 1959; Best et al. 1978; Bothmer et al. 1981, 1991, ined.; Dewey 1982; Estes & Tyrl 1982; Löve 1984; Baum & Bailey 1986, 1989, 1990; Bothmer & Jacobsen 1985; Giles & Lefkovitch 1986; Asfaw & Bothmer 1990; Lu & Bothmer 1990; Doebley et al. 1992; Baden & Bothmer 1994; Zohary & Hopf 1994; Jacobsen & Bothmer 1995; Tucker 1996; Petersen & Seberg 1998a, 1998b; Barkworth 2000; Baum & Johnson 2000; Mason-Gamer & Kellogg 2000.

1. Lateral 2 spikelets of each 3-spikelet cluster conspicuously smaller than central spikelet or reduced to awn-like glumes; lemmas of lateral spikelets absent or much smaller (1/3–1/2 as long) than lemma of central spikelet; leaf sheaths without auricles at summit or auricles inconspicuous (< 0.5 mm long); broadest leaf blades 1.5–4(–5) mm wide.
   2. Lemma of central spikelet with spreading or curved awn 2–10(–18) mm long; glumes of central spikelet 8–17 mm long, flattened at base; inflorescence erect; plants annual, widespread in East TX _____ **H. pusillum**
   2. Lemma of central spikelet with ± straight awn (10–)30–80(–90) mm long; glumes of central spikelets 35–85 mm long, not flattened; inflorescence often curved or nodding; plants perennial in East TX, known in the area only from Nacogdoches Co. _____ **H. jubatum**
1. Lateral 2 spikelets of each 3-spikelet cluster ± as large as or larger than the central spikelet; lemmas of lateral spikelets as large as lemma of central spikelet; leaf sheaths with well-developed auricles at summit; broadest leaf blades 3–18 mm wide.
   3. Leaf blades (1–)3–6(–8) mm wide; lemmas 1.3–1.9 mm wide; lateral spikelets short-pedicelled; glumes of central spikelet with marginal cilia near base (the cilia often ca. 1 mm long); axis of inflorescence disarticulating at maturity, each node with only the central floret forming seed _____ **H. murinum**
   3. Leaf blades mostly 7–18 mm wide; lemmas 3 mm or more wide; lateral spikelets sessile; glumes of central spikelet glabrous or scabrous near base; axis of inflorescence not disarticulating at maturity, each node with 1, 2, or 3 florets forming seed _____ **H. vulgare**

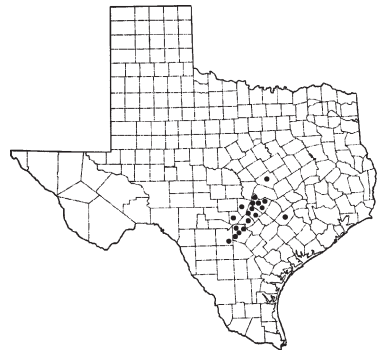
Hordeum jubatum L., (with awns, crested, maned), FOX-TAIL BARLEY, SQUIRREL-TAIL GRASS, SKUNK-TAIL GRASS. Short-lived perennial; culms 30–75 cm tall, erect or decumbent basally, with nodes dark; inflorescence usually 4–10 cm long (excluding awns); lemmas of lateral spikelets much reduced or often lacking, the lateral spikelets often greatly reduced to awn-like glumes. Moist disturbed areas; Nacogdoches Co. (Turner et al. 2003); the species is rare in East TX and sparsely scattered in the w 2/3 of the state; indigenous to w North America; throughout Canada and most of the U.S. except the extreme se. Mainly May–Jul. [*Critesion jubatum* (L.)



Festuca paradoxa



Festuca subverticillata



Festuca versuta



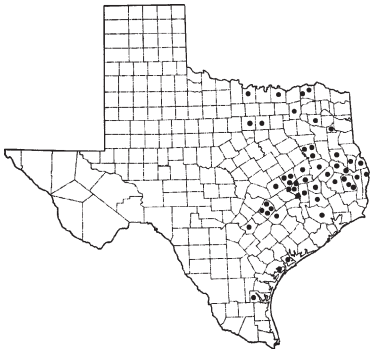
Glyceria arkansana



Glyceria septentrionalis



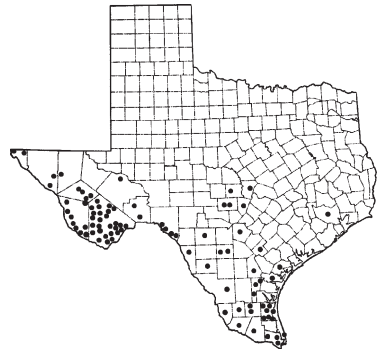
Glyceria striata



Gymnopogon ambiguus



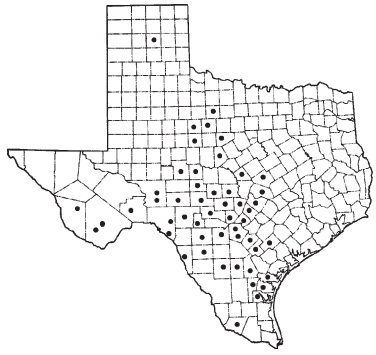
Gymnopogon brevifolius



Heteropogon contortus



Heteropogon melanocarpus



Hilaria belangeri



Holcus lanatus

Nevski] The awns can become embedded in and cause mechanical damage to the nose, eyes, mouth, nostrils, and intestines of grazing livestock; this species is thus not valuable as forage except when very young (Best et al. 1978; Yatskievych 1999). The long awns are part of a wind dispersal "syndrome"—"small, light seeds and long, setaceous glumes and awns which spread out in the fruiting stage and serve as a flying apparatus" (Bothmer et al. 1981). The rough awns also stick to animals, resulting in further seed dispersal (Best et al. 1978).

Hordeum murinum L. subsp. **leporinum** (Link) Arcang., (sp.: mouse-gray; subsp.: hare-like), HARE BARLEY. Annual 30–75(–110) cm tall; culms erect or decumbent basally; inflorescence 3–8 cm long (excluding awns), often enclosed in part by uppermost leaf sheath; lateral 2 spikelets of 3-spikelet clusters sterile (usually staminate); lemma awn 10–35 mm long. Disturbed sites; Dallas, Harris, Williamson (BRIT), Bexar, Collin, Madison and Travis (Turner et al. 2003) cos.; widely scattered in TX; e U.S. from ME s to GA, also sw Canada (B.C.) and w U.S. from WA s to CA e to MT and TX. Apr. Native of the Mediterranean region. [*Critesion murinum* subsp. *leporinum* (Link) Á. Löve, *H. leporinum* Link] The appropriate taxonomic level at which to recognize the variation seen in the *H. murinum* complex is not completely clear. Giles and Lefkovitch (1986) noted that morphology suggests recognizing separate species, while interfertility supports recognition of a number of subspecies, as suggested by Jacobsen and Bothmer (1995) and Bothmer et al. (ined.) and as followed here. This species exhibits adaptations for dispersal by animals—the margins of the awns, glumes, and rachis internodes have stiff scabrid hairs which cause attachment of the dispersal units to fur and clothing (Bothmer et al. 1981). The awns can cause mechanical injury to grazing livestock (Burlage 1968).

Hordeum pusillum Nutt., (very small), LITTLE BARLEY, MOUSE BARLEY. Annual 12–60 cm tall; culms erect or with bent or decumbent base, with nodes dark; inflorescence (2–)4–8 cm long (excluding awns), flattened; lateral 2 spikelets of 3-spikelet clusters sterile, with lemmas ca. 1/3 to 1/2 as long as lemma of central spikelet. Disturbed sites; throughout TX; scattered in s Canada and throughout most of the U.S. Apr–May. [*Critesion pusillum* (Nutt.) Á. Löve, *H. pusillum* var. *pubens* Hitchc.]

Hordeum vulgare L. subsp. **vulgare**, (common), BARLEY, COMMON BARLEY. Glabrous annual; vegetatively resembling WHEAT and RYE; culms 50–120 cm tall; axis of inflorescence (2–)6–10 cm long, remaining intact (vs. abscising at each node in other East TX species); spikelets all fertile; lemma awn long, to 18 cm. Cultivated throughout much of TX and occasionally occurring as a transitory waif along roadsides, railroads, and field margins; Brazos (BRIT), Nacogdoches, Travis, Washington, Williamson (Turner et al. 2003), and San Jacinto (E. Keith, pers. comm.) cos.; sparsely scattered in TX; throughout most of Canada and most of the U.S. Apr–May. Like its wild ancestor, *H. vulgare* subsp. *spontaneum* (C. Koch) Thell., BARLEY is native to Eurasia (Zohary & Hopf 1994). Subspecies *spontaneum* and subsp. *vulgare* are interfertile and very similar at the molecular level (Asfaw & Bothmer 1990; Doebley et al. 1992). BARLEY is considered one of the two oldest cultivated plants (WHEAT, *Triticum aestivum*, is the other), having been brought into cultivation prior to 7,000 BC. As such, it was probably important in the development of early civilization in the Near East (Clayton & Renvoize 1986; Heiser 1990; Hancock 2004). BARLEY is able to stand drier, less fertile, and more saline conditions than WHEAT; its short growing season "has enabled it to extend into the arid and high altitude fringes of temperate agriculture" (Clayton & Renvoize 1986). It is the main cereal used in Old World beer production (Zohary & Hopf 1994).

IMPERATA Cirillo SATIN-TAIL

A genus of 9 species of tropical to warm temperate areas of both hemispheres (Gabel 2003). It is considered by some authorities (e.g., Clayton & Renvoize 1986) to be allied to *Miscanthus*, and hybrids are known with *Saccharum* (Watson & Dallwitz 1992). Like all members of the

Andropogoneae, it is characterized by C_4 photosynthesis (Kellogg 2000a). Several species are considered significant weeds (Watson & Dallwitz 1992). (Named for Ferrante Imperato, 1550–1625, of Naples, Italian naturalist and apothecary) (subfamily Panicoideae, tribe Andropogoneae)
REFERENCES: Gabel 1982, 2003; Allen et al. 1991; Johnson & Shilling 1998; King & Grace 2000; Lippincott 2000; Matlack 2002; Van Loan et al. 2002.

Imperata cylindrica (L.) Raeusch., (cylindrical, in reference to the shape of the inflorescence), COGON GRASS, BLADY GRASS, COGON, LALANG, ALANG-ALANG, COTTON GRASS, KUNAI, SATIN-TAIL. Strongly rhizomatous, tufted perennial usually 1 m or less tall, rarely taller; culms erect; leaf blades (1–)3–11(–28) mm wide, with whitish midvein markedly off-center, scabrous marginally, the cauline blades reduced; ligule membranous, 3.5 mm or less long; inflorescence a terminal, narrowly cylindrical, silky, whitish panicle, usually 6–22 cm long, to 3.5 cm wide; inflorescence branches appressed, not disarticulating, the spikelets falling from pedicels at maturity; spikelets 2.6–5.5 mm long, unawned, in pairs of 1 short-pedicelled and 1 long-pedicelled, otherwise alike, with 2 florets (lower sterile, upper fertile); base of spikelet (callus) with a tuft of hairs (6–15 mm long) longer than spikelet; stamens 2; filaments not dilated basally. Disturbed areas (e.g., roadsides); Brazos (*Wolfe s.n.,* TAES, specimen collected on grounds of maintenance building at Texas A&M Univ.) and Tyler (Van Loan et al. 2002—reported by U.S. Geologic Survey, voucher not seen) cos.; no county distribution map is provided; se U.S. in SC and from FL w to e TX. Typically Mar–May or in fall, flowering often initiated by stressful conditions (e.g., burning, cutting, mowing, drought, soil disturbance). Native from the Old World tropics to the Mediterranean. [*Lagurus cylindricus* L.] This species has only recently been reported from TX, but given its reputation as a harmful invasive, it should be watched for and eliminated if found. COGON GRASS was introduced to the U.S. accidently (at Mobile, AL in 1911 in shipping crates where the grass was used as a packing material) and intentionally (by the USDA for use as forage and erosion control, and as an ornamental grass) (Johnson & Shilling 1998; King & Grace 2000; Kaczor 2003). However, this species is an aggressively rhizomatous invasive weed that displaces other vegetation, is low in nutritive value and palatable to few animals (the leaf margins are scabrous and have silica crystals), and can alter the natural fire regime (Mabberley 1997; Lippincott 2000; Van Loan et al. 2002). It is a noxious weed in FL, HI, and NC, and it is also a U.S. federal noxious weed (Kartesz 1999; USDA Natural Resources Conservation Service 2002). Some authorities (e.g., Gabel 2003) consider it "one of the world's 10 worst weeds," possibly even worse than KUDZU (Kaczor 2003). In the tropics, extensive areas become densely infested with COGON GRASS, resulting in fire-prone monocultures due to the extremely flammable foliage and the fire-resistant underground rhizomes; such areas are difficult to reclaim with other types of vegetation (Van Loan et al. 2002). The diminutive cultivar 'Red Baron,' which is available commercially, is non-weedy even though individual shoots may revert to the aggressive form (Gabel 2003). A related species, *Imperata brasiliensis* Trin., BRAZILIAN SATIN-TAIL, native to Central and South America, is also both a noxious weed in FL and a U.S. federal noxious weed (Kartesz 1999; USDA Natural Resources Conservation Service 2002). It can be distinguished by its flowers having a solitary stamen and the filament being dilated basally.

KOELERIA Pers. DOG-TAIL GRASS, KOELER'S GRASS

A cosmopolitan C_3 genus of about 35 species of awnless perennials which grow in dry grasslands and rocky soils (Standley ined.). Some authorities (e.g., Clayton & Renvoize 1986) suggest it is related to *Trisetum*, and hybrids with that genus are known (Watson & Dallwitz 1992). Annual species similar to *Koeleria* but with awned lemmas have sometimes been segregated into the genus *Lophochloa* (e.g., Jonsell 1980) or more recently into *Rostraria,* as done here following Clayton and Renvoize (1986), Mabberley (1997), Kartesz (1999), Hatch (2002), and Standley (ined.). Other authorities, however, do not consider the differences worthy of generic

recognition and maintain the annuals in *Koeleria* (e.g., Shinners 1956a; Allen 1992b; Watson & Dallwitz 1992; Wilken 1993a; Tucker 1996). Some species are considered significant weeds. (Named for Georg Ludwig Koeler, 1765–1807, German professor of natural history at Mainz and student of grasses) (subfamily Pooideae, tribe Poeae)
REFERENCES: Shinners 1956a; Arnow 1994; Tucker 1996; Dixon 2000; Standley ined.

Koeleria macrantha (Ledeb.) Schult., (large-flowered), JUNE GRASS, PRAIRIE JUNE GRASS. Erect perennial 20–75(–130) cm tall, forming small clumps; leaves mostly crowded toward base; ligule membranous, 0.5–1(–2) mm long; leaf blades usually 1–3(–4.5) mm wide; inflorescence a dense, terminal, spike-like panicle (2–)5–15(–27) cm long, usually interrupted at base, the main axis puberulent; spikelets shiny, sessile, mostly 2–3-flowered (usually 2 fertile), ca. 3–6 mm long, disarticulating above the glumes and between the florets; glumes subequal, the upper one widest near middle, gradually narrowing to an acute apex; lemmas usually acute or minutely apiculate. Grasslands, typically in calcareous soils; Delta, Grayson, Kaufman (BRIT), and Dallas (Mahler 1988) cos.; also Denton and Young (Turner et al. 2003) cos. to the w of East TX and in the Trans-Pecos; throughout most of Canada and most of the U.S. except the se. May–Jun. [*K. cristata* of authors in part, not Pers., *K. nitida* Nutt., *K. pyramidata* of authors in part, not (Lam.) P. Beauv.] There has been significant nomenclatural confusion regarding this species. While *K. pyramidata* (a European species) and *K. macrantha* (circumboreal in distribution) were previously sometimes combined and the name *K. pyramidata* applied to American material (e.g., Correll & Johnston 1970; Gould 1975b), Arnow (1994) demonstrated that the two are specifically distinct and that the correct name for American material is *K. macrantha*. Dixon (2000) gave a detailed discussion of various aspects of the biology of this species. Infection of the spikelets by the ascomycete fungus *Claviceps purpurea* (Fr.: Fr.) Tul. has been reported (Arnow 1994). For a discussion of this fungus, see the generic synopsis of *Secale*.

LEERSIA Sw. CUT GRASS, WHITE GRASS

Perennials (our taxa), rhizomatous (except *L. monandra*); ligule a membrane; spikelets 1-flowered, perfect, sessile or subsessile, secund along the distal portions of the branchlets of the panicle, compressed laterally, disarticulating from pedicel; glumes absent, each spikelet thus consisting solely of a floret; lemma oblong to elliptic, with veins and keel hispid-ciliate; stamens 2, 3, or 6.

A C_3 genus of ca. 17 aquatic to wet-mesic species native worldwide in tropical and warm temperate areas (Pyrah ined.), with the center of diversity (8 species) in tropical Africa (Tucker 1988). The species are typically marsh grasses and are sometimes used as fodder. Some are considered significant weeds (Watson & Dallwitz 1992). *Leersia* is closely related (Ge et al. 2002) to *Oryza sativa* L. (RICE), an annual with spikelets 7–10 mm long (vs. < 6 mm long in *Leersia*), and there has been some confusion regarding generic limits. However, *Leersia* lacks glumes, while they are consistently present in *Oryza*. The common name, CUT GRASS, is derived from the tendency of the leaf margins of some species to scratch or cut human skin because of the presence of minute sharp hairs which act like the teeth of a tiny saw. *Leersia* species are renowned for their phenotypic variability, probably resulting from variation in water level, length and depth of inundation, and available nutrient concentrations (Pyrah 1969; Tucker 1988; Yatskievych 1999). The genus is particularly unusual in having species with 1, 2, 3, or 6 stamens (Pyrah 1969; Tucker 1988). (Named for Johann Daniel Leers, 1727–1774, a German botanist and pharmacist—Pyrah ined.) (subfamily Ehrhartoideae, tribe Oryzeae)
REFERENCES: Pyrah 1969, ined.; Terrell 1983; Terrell et al. 1983; Tucker 1988; Duvall et al. 1993a.

1. Inflorescence branches with spikelets nearly to their bases; spikelets 3.2–4.7 mm long; stamens 6 per floret ____ **L. hexandra**
1. Inflorescence branches usually bare of spikelets on the lower 1.5–4 cm; spikelets 1.3–5.5 mm long; stamens 2 or 3 per floret.



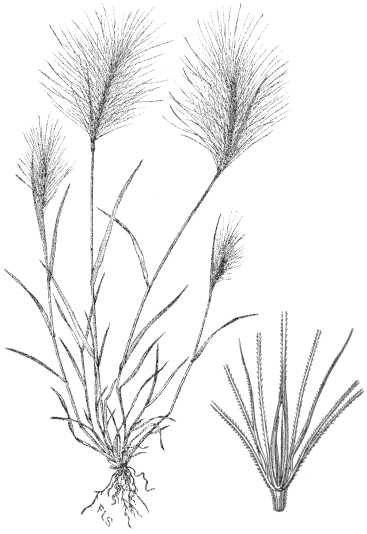
Heteropogon melanocarpus [HI1]



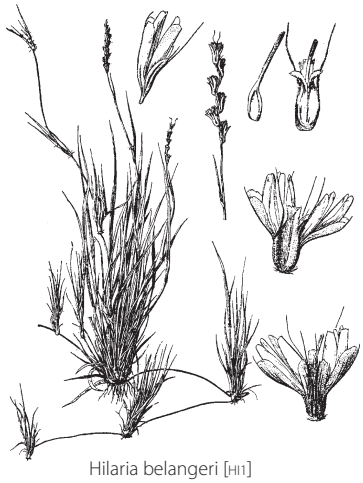
Hordeum murinum subsp. leporinum [MAR]



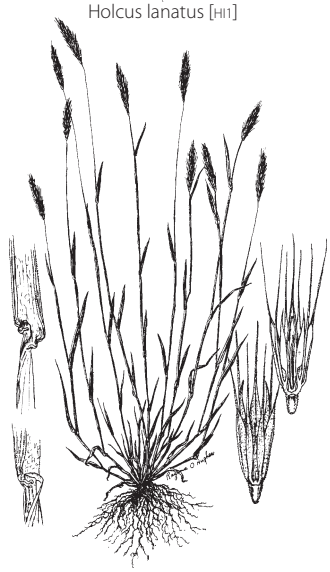
Holcus lanatus [HI1]



Hordeum jubatum [USB]



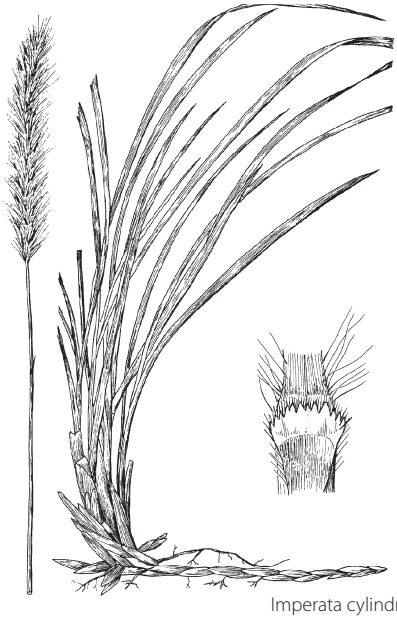
Hilaria belangeri [HI1]



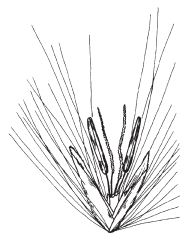
Hordeum pusillum [REE]



Hordeum vulgare subsp. vulgare [HI1]







Imperata cylindrica [FNA]

2. Spikelets 3–4(–4.5) mm wide, suborbicular in outline, less than twice as long as wide; leaf blades (5–)10–20(–22) mm wide ____ **L. lenticularis**
2. Spikelets 2 mm or less wide, elliptic to ovate in outline, 2–3 times longer than wide (except in *L. monandra* with very small spikelets); leaf blades usually 3–11 mm wide.
   3. Spikelets 4–5.5 mm long, (1.3–)1.5–2 mm wide; leaf sheaths and blades coarsely scabrous; lower inflorescence branches fascicled, 2 or more per node; stamens 3 per floret ____ **L. oryzoides**
   3. Spikelets 1.3–3(–3.6) mm long, 1.3 mm or less wide; leaf sheaths and blades smooth or slightly scabrous; lower inflorescence branches 1 per node; stamens 2 per floret.
      4. Spikelets 2.2–3(–3.6) mm long, 2–3 times longer than wide, with some hairs on the margins and scattered over the surface; culms decumbent basally; plants rhizomatous; species widespread in East TX ____ **L. virginica**
      4. Spikelets 1.3–2 mm long, only slightly longer than wide (to only 1 1/2 times longer than wide), completely glabrous; culms erect from base; plants not rhizomatous; species known in East TX only from w margin of area ____ **L. monandra**

Leersia hexandra Sw., (six-stamened), CLUB-HEAD CUT GRASS, SOUTHERN CUT GRASS. Rhizomatous perennial, the rhizomes not scaly; vegetative culms decumbent or creeping; flowering culms erect, 50–100(–150) cm tall; leaf blades and sheaths minutely scabrous to glabrous, the blades 2–7(–15) mm wide; inflorescence loosely contracted, the branches erect to ascending or rarely somewhat spreading; spikelets much longer than wide, ca. 0.5–1.5 mm wide; lemma and paleas with cilia on keel; stamens 6. Moist to wet areas, often aquatic in shallow water; Anderson (BRIT), Leon, Liberty (ASTC), Harris, Jefferson, Waller (TAES), Austin, Colorado, Orange, Robertson, and Wood (Turner et al. 2003) cos.; also Gulf Prairies and Marshes and South TX Plains; se U.S. from MD s to FL w to TX. Apr–Nov, but more in late summer and fall. Pyrah (1969) noted that infertility is common and the plants profusely propagate vegetatively. As a result, some large populations may represent clones. More recently, Pyrah (ined.) indicated that "no seed appears to be set." Some authorities consider this species an important pasture grass (e.g., Watson & Dallwitz 1992), but according to Weakley (2000), it is a serious weed in the tropics.

Leersia lenticularis Michx., (lens-shaped), CATCHFLY GRASS, OATMEAL GRASS. Rhizomatous perennial, the rhizomes scaly; culms 0.5–1.5 m long, erect or sprawling and ascending; leaf sheaths and blades glabrous to scabrous; inflorescence open, with spikelets clustered toward ends of flexuous, often drooping branches, the branches naked basally; spikelets suborbicular, slightly asymmetrical, 4–5.5 mm long; keel and veins of lemma and palea ciliate with conspicuous (under magnification), stiff hairs, giving the appearance of widely spaced comb-like teeth or eyelashes; stamens 2. Wet or moist areas along streams and lakes; widespread in e part of East TX w to Brazos, Henderson, Lamar (at edge of oxbow lake in Red River drainage) and Robertson (BRIT) cos.; also n Gulf Prairies and Marshes; e U.S. from MD s to FL w to MN and TX. Mostly Jul–Nov. This is the only species in *Leersia* endemic to the U.S. (Pyrah 1969). According to Pyrah (1969), "The common name of 'catchfly grass' apparently arose from a comment made by Pursh which was later written on an herbarium sheet. The notation reads: 'Pursh says he saw this plant catching flys (sic) like *Dionea muscipula*.'" There is no evidence that such an ability exists. This species has the largest, most conspicuous spikelets of any East TX *Leersia* species.

Leersia monandra Sw., (one-stamened), BUNCH CUT GRASS. Perennial without rhizomes (this is the only East TX *Leersia* lacking rhizomes); culms 30–100(–120) cm tall; leaf blades 3.5–6 mm wide; inflorescence branches naked in lower 1/2 to 2/3; spikelets 1.3–2 mm long, the smallest of any East TX *Leersia*, glabrous; stamens 2, despite the scientific name. Moist to wet areas, but also in drier well-drained sites, grasslands, shaded woods, bluffs, typically in limestone soils; Hays (BRIT) and Comal (Pyrah 1969; Turner et al. 2003) cos. on w margin of East TX; also Gulf Prairies and Marshes and South TX Plains; FL and TX. Mar–Nov. Pyrah (ined.) noted that there are few recent collections of this species; it could thus possibly be of conservation concern. Larry Brown (pers. comm.) noted that there are Brazoria Co. collections (SBSC) made in 2000 and 2002. ?⚠

Leersia oryzoides (L.) Sw., (like rice—*Oryza*), RICE CUT GRASS. Rhizomatous perennial, the rhizomes slender, scaly, the scales not imbricate; culms (0.5–)1–1.5 m tall, erect or sprawling and ascending; leaf blades usually 6–11 mm wide; inflorescence branches usually numerous, naked of spikelets for ca. 1/3 their length; spikelets (1.3–)1.5–2 mm wide; lemma and palea ciliate on keel and hispid over surface; stamens 3. Marshes, other wet places, sometimes in wet wooded areas; widespread in TX; s Canada and throughout the U.S. Usually Sep–Nov. Late-season inflorescences bearing cleistogamous spikelets are reported to remain completely or mostly enclosed by the upper leaf sheaths (Tucker 1988; Yatskievych 1999).

Leersia virginica Willd., (of Virginia), WHITE GRASS, VIRGINIA CUT GRASS. Rhizomatous perennial, the rhizomes stouter than culm base, with imbricate scales; culms 0.5–1.2 m tall; leaf blades usually 3–8 mm wide, rarely wider; inflorescence branches few, 1 per node, widely spaced, long and slender, to 8–12 cm long, naked for 1/3 to more than 1/2 their length; lemma and palea minutely ciliate on veins and sometimes minutely hispid over surface; stamens 2. Ditches, moist areas; widespread in East TX w to e Edwards Plateau; se Canada and throughout e U.S. w to ND and TX. May–Nov. [*Homalocenchrus virginicus* (Willd.) Britton] This species is superficially similar to *Microstegium vimineum* (Mehrhoff 2000)—see discussion under that species.

LEPTOCHLOA P. Beauv. SPRANGLETOP, FEATHER GRASS

Annuals or perennials; inflorescence a panicle or subdigitate cluster of spicate branches; spikelets usually with 3–12 bisexual florets, sessile or nearly so, overlapping in 2 rows on 1 side of a nearly terete branch, disarticulating above the glumes and between florets; lemmas in ours awnless or with a short awn to 1.5 mm long.

A C_4 genus of 32 species (including those sometimes segregated into *Diplachne*) (Snow 1997, 2003a) of warm temperate and tropical areas of the New World, Africa, Asia, and Australia; some are used as fodder while a number are considered significant weeds (Watson & Dallwitz 1992). Phillips (1982) discussed generic boundaries and concluded that *Diplachne* (which would include a number of East TX species) should be recognized at the generic level; more recently, research by Snow (e.g., 1998b) suggested that these species should be recognized in *Leptochloa*. Thorough revisionary work on the genus by Snow (1997, 1998a) has resulted in a substantial number of name changes in the genus; his classification is followed here. (Greek: *leptos*, slender, and *chloa*, grass, from the slender inflorescence branches) (subfamily Chloridoideae, tribe Cynodonteae)

REFERENCES: Valls 1978; McNeill 1979; Phillips 1982; Snow & Davidse 1993, 1998; Nicora 1995; Snow 1996, 1997, 1998a, 1998b, 2003a; Peterson et al. 1997; Yatskievych 1999.

1. Lemmas 1–1.6(–2) mm long; spikelets 1.5–3.5(–4) mm long, with 2–4 florets; leaf sheaths usually pilose with papilla-based hairs (*L. panicea*) OR not so (*L. nealleyi*).
   2. Leaf sheaths usually pilose with papilla-based hairs; inflorescence branches variable in length, (2–)4–15 cm long, but at least some usually > 4 cm long, spreading or spreading-ascending (even when < 4 cm long), the inflorescence thus not conspicuously narrow; species widespread and abundant in East TX _____ **L. panicea**
   2. Leaf sheaths glabrous or minutely scabrous, but without papilla-based hairs; inflorescence branches usually 1.5–4(–6) cm long, usually ± appressed to main axis, making the inflorescence conspicuously narrow; species known only from s boundary of East TX _____ **L. nealleyi**
1. Lemmas (1.5–)2.3–5 mm long; spikelets (2–)3–12 mm long, with 3–13 florets; leaf sheaths glabrous to pilose, any hairs present not papilla-based.
   3. Tip of lemmas appearing chopped off, usually notched, awnless; anthers 1–1.6 mm long; some inflorescences usually completely hidden in the lower leaf sheaths (in addition to the exserted inflorescences) _____ **L. dubia**
   3. Tip of lemmas not appearing chopped off, blunt to acute or acuminate (but may be slightly

notched), awnless or mucronate or with an awn 0.5–3.5(–11) mm long; anthers 0.2–1 mm long; inflorescences not hidden.

4. Axils of inflorescence branches pilose; spikelets (2–)3–4 mm long; plants perennial _____ **L. virgata**
4. Axils of inflorescence branches glabrous; spikelets (3.5–)4–10(–12) mm long (5 mm or more in most East TX specimens); plants annual.
   5. Spikelets 5–10(–12) mm long, with 6–12 florets; lemmas (at least some) with an awn 0.5–1.5(–3.5) mm long (in *L. fusca* subsp. *fascicularis*) OR awnless or mucronate (in *L. fusca* subsp. *uninervia*); inflorescences usually with ca. 8–35 branches; species widespread in East TX _____ **L. fusca**
   5. Spikelets (3.5–)4–5 mm long, with 4–7 florets; lemmas awnless or mucronate; inflorescences usually with (20–)40–90 branches; species rare, if present, in East TX _____ **L. panicoides**

Leptochloa dubia (Kunth) Nees, (doubtful), GREEN SPRANGLETOP, TEXAS CROWFOOT. Tufted perennial; culms 25–115 cm long, erect or ascending, unbranched above base; ligule a truncate membrane with dense row of cilia, 1–1.5(–2) mm long; apical inflorescence exserted but some inflorescences hidden in lower leaf sheaths (unique in the genus—Snow 1997); inflorescences with (2–)7–15 unbranched, flexuous, loosely erect or spreading main branches; spikelets (4–)5–12 mm long, usually with 3–8(–13) florets; lemmas usually 4–5 mm long; glumes and lemmas awnless. Rocky slopes, loams, most typically on well-drained sites; widespread in w 2/3 of TX, scattered further e; sc U.S. from MO s to TX w to CO and AZ, also CA and FL. Spring–fall. [*Diplachne dubia* (Kunth) Scribn.] While this plant is valuable as forage, because of hydrogen cyanide production in new growth after rains, caution is advised (Hilsenbeck in Powell 1994). According to Snow (1997), this species is most likely to be confused with *L. fusca* subsp. *uninervia*, which can have lemmas somewhat chopped off in appearance—however, that taxon has shorter lemmas (1.8–3(–3.6) mm long), lacks hidden inflorescences, is an annual, and usually grows in wet habitats. ☠

Leptochloa fusca (L.) Kunth, (brown, dusky), BEARDED SPRANGLETOP. Tufted annual; culms (15–)50–100(–130) cm tall, erect to spreading and ascending; ligule a membrane, 2–7 mm long, lacerate but not ciliate; inflorescences with ca. (3–)8–35 stiffly erect or erect-spreading branches; glumes and lemmas awned or awnless. There has been significant nomenclatural confusion and change regarding this taxon. Snow and Davidse (1998) proposed that the older (but obscure and of somewhat doubtful application) name *L. malabarica* (L.) Veldkamp [*Poa malabarica* L.] be rejected in favor of *L. fusca*. The Nomenclatural Committee for Spermatophyta (Brummitt 2000) recommended acceptance of the proposal. We are therefore following Snow and Davidse (1998) and Snow (1998a) in using the name *L. fusca* for this species. Further, we are following Snow (1998a) in treating the taxa formerly recognized (e.g., Gould 1975b; Diggs et al. 1999) as *L. fascicularis* and *L. uninervia* as subspecies of *L. fusca*.

1. Upper glume (2.5–)3–4.2(–5) mm long; inflorescence branches 4–12(–22) cm long; lemmas lance-elliptic, acute to acuminate, 2.5–4(–5) mm long, usually with awn 0.5–1.5(–3.5) mm long; inflorescence base often enclosed in the uppermost leaf sheath; uppermost leaf blade often surpassing panicle; mature lemmas often light with a dark spot below the middle _____ subsp. **fascicularis**
1. Upper glume < 3 mm long; inflorescence branches often only 3–6 cm long (sometimes longer); lemmas obovate, blunt, 1.8–3(–3.6) mm long, awnless or abruptly mucronate; inflorescence base usually not enclosed in the uppermost leaf sheath; uppermost leaf blade usually not surpassing panicle; mature lemmas without a dark spot _____ subsp. **uninervia**

subsp. **fascicularis** (Lam.) N. Snow, (fascicled, clustered), BEARDED SPRANGLETOP, SALT MEADOW GRASS, SALT SPRANGLETOP. Mud, sometimes alkaline or subsaline; Dallas, Grayson, (BRIT), Bastrop, Bexar, Guadalupe, Orange, Travis (Snow 1997), Brazos, Jefferson, and Washington (Turner et al. 2003) cos.; scattered throughout TX; scattered in s Canada and nearly throughout



Koeleria macrantha [HI1]



Leersia hexandra [USB]



Leersia lenticularis [USB]



Leersia monandra [USB]



Leersia oryzoides [MAS]



Leersia virginica [HI1]



Leptochloa dubia [USB]



Leptochloa fusca subsp. fascicularis [USB]



Leptochloa fusca subsp. uninervia [USB]

the U.S. May–Oct. [*Diplachne fascicularis* (Lam.) P. Beauv., *L. fascicularis* (Lam.) A. Gray] According to Snow (1997), this is the most common *Leptochloa* in North America.

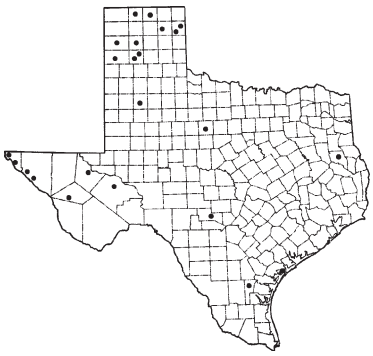
subsp. **uninervia** (J. Presl) N. Snow, (one-nerved), MEXICAN SPRANGLETOP. Similar to subsp. *fascicularis* and distinguished as in the key to subspecies. Mud, sometimes alkaline or subsaline; Brazos, Jefferson (TAES), Red River (Snow 1997), Bexar, Grayson, and Williamson (Turner et al. 2003) cos.; mainly s 1/2 of TX, scattered elsewhere; throughout s 1/2 of the U.S., also NJ, MA, ME, and OR. Spring–summer(–fall). [*Diplachne uninervia* (J. Presl) Parodi, *L. uninervia* (J. Presl) Hitchc. & Chase] While specimens intermediate with subsp. *fascicularis* are occasionally seen, the two "generally maintain their morphological distinctness when growing together" (Snow 1997).

Leptochloa nealleyi Vasey, (for Greenleaf Alley Nealley, 1846–1896, possibly the earliest botanist at Texas A&M), NEALLEY'S SPRANGLETOP. Tufted annual; culms 30–150(–250) cm tall, stiffly erect; ligule 1.5–3 mm long, lacerate; inflorescence branches 25–75 or more; spikelets 2.8–3.4 mm long; glumes and lemmas awnless, the lemmas sometimes apiculate. Usually in wet areas such as ditches, pond margins, or marshes; Gonzales, Jefferson, Wilson (Snow 1997), Bastrop, and Harris (Turner et al. 2003) cos. near s boundary of East TX; this primarily coastal species is otherwise known in TX only from the Gulf Prairies and Marshes and South TX Plains; AZ, LA, and TX. Apr–Nov. "The numerous, short, stiffly ascending or erect panicle branches make *Leptochloa nealleyi* easy to identify" (Snow 2003a).

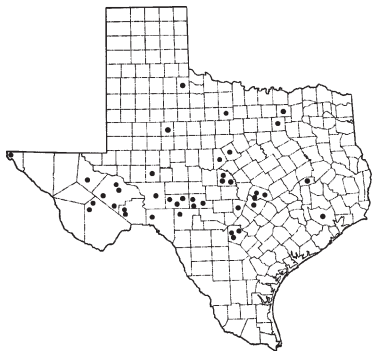
Leptochloa panicea (Retz.) Ohwi, (of *Panicum*—panic grass), RED SPRANGLETOP, SLENDER GRASS. Tufted annual; culms 10–80(–150) cm long, erect to spreading and ascending; ligule 0.5–2(–3.2) mm long, lacerate or ciliate; inflorescence branches 10–70(–100), scattered; spikelets 1.5–3.5(–4) mm long, widely spaced and only slightly overlapping; glumes and lemmas usually awnless or nearly so. Moist soils and mud; nearly throughout TX; widespread in the s 2/3 of the U.S. Late spring–fall. [*L. attenuata* (Nutt.) Steud., *L. filiformis* (Lam.) P. Beauv., *L. mucronata* (Michx.) Kunth] This species has recently undergone several nomenclatural changes. While long known as *L. filiformis*, Snow and Davidse (1993) indicated that the correct name was *L. mucronata*. More recently, Snow (1997, 1998a), based on detailed revisionary work, concluded that the correct name is *L. panicea* and that there are two subspecies in the U.S., subsp. *brachiata* (Steud.) N. Snow and subsp. *mucronata* (Michx.) Nowack. Yatskievych (1999) and Snow (2003a) recognized the two subspecies and differentiated them as shown in the following key (included for those wishing to identify subspecies). However, we have been unable to find consistent differences in TX material. Many East TX specimens appear somewhat intermediate, the spikelets are ± awnless, there is usually no pubescence on the lemmas, and the upper glume is either shorter or longer than the rest of the spikelet (this sometimes varying on the same plant). As a result, we are not formally recognizing subspecies. However, L. Brown (pers. comm.) noted that there are collections from Anderson and Fort Bend (SBSC) cos. that are discernable as subsp. *mucronata*.

1. Glumes lanceolate to narrowly elliptic, sharply pointed at the tip but awnless, the upper glume usually shorter than the rest of the spikelet; lemmas 1.3–1.7 mm long, distinctly hairy along the veins; caryopses usually with a narrow, shallow ventral groove, smooth, the apices broadly obtuse to acute _____ subsp. *brachiata*
1. Glumes linear to narrowly lanceolate, tapered to a minute awn at the tip, the upper glume usually longer that the rest of the spikelet; lemmas 0.9–1.2 mm long, nearly glabrous along the veins, except at the base; caryopses without a ventral groove, often somewhat coarsely rugose, the apices broadly obtuse _____ subsp. *mucronata*

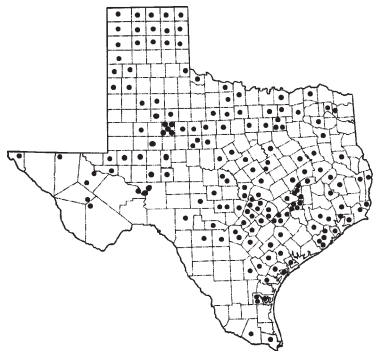
Leptochloa panicoides (J. Presl) Hitchc., (resembling *Panicum*—panic grass), AMAZON SPRANGLETOP. Tufted annual; culms 40–100(–110) cm tall, usually erect; ligule an erose membrane ca. 2–4 mm long; glumes and lemmas awnless, the lemmas usually mucronate. Wet areas such as



Hordeum jubatum



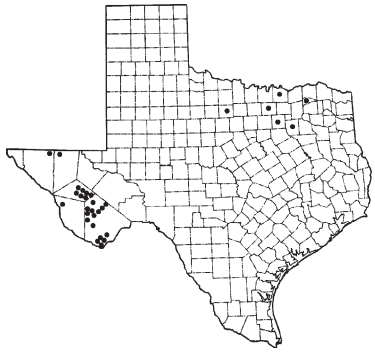
Hordeum murinum subsp. leporinum



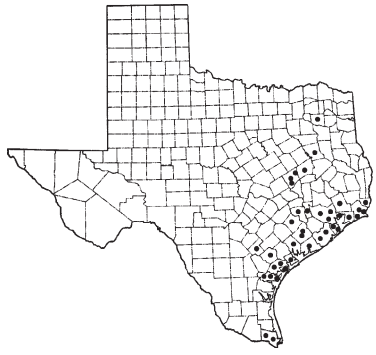
Hordeum pusillum



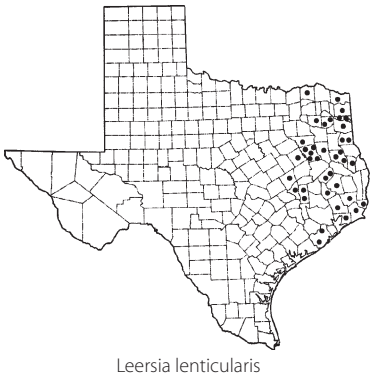
Hordeum vulgare



Koeleria macrantha



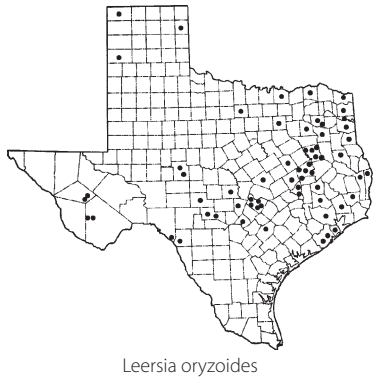
Leersia hexandra



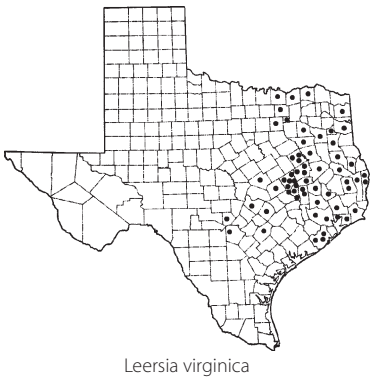
Leersia lenticularis



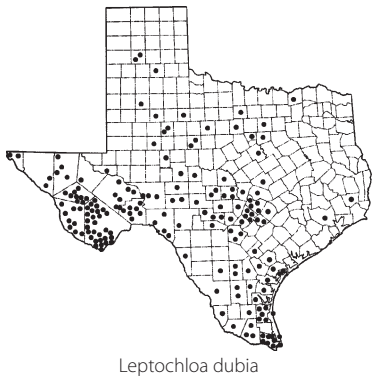
Leersia monandra



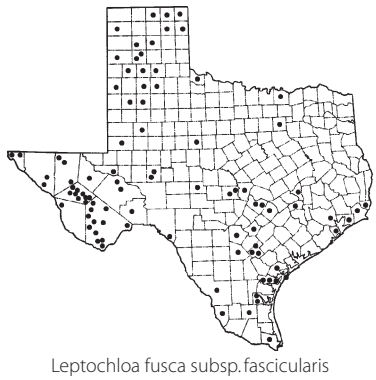
Leersia oryzoides



Leersia virginica



Leptochloa dubia



Leptochloa fusca subsp. fascicularis

swamps; Bowie, Harris, and Liberty (SBSC) cos.; also Johnson Co. (*Carr 17715*, BRIT) just to the w of East TX, and Fort Bend Co. (SBSC) in the n part of Gulf Prairies and Marshes; Snow (1997, 2003a) cited no TX specimens; e U.S. from IN s to FL w to MO and TX. Spring–fall. [*Diplachne panicoides* (J. Presl) McNeill] Considered by Gould (1975b) to be introduced from Brazil, but treated more recently as a U.S. native (e.g., Kartesz 1999; Snow 2003a).

Leptochloa virgata (L.) Beauv., (wand-like), TROPIC SPRANGLETOP. Tufted perennial; culms 30–200 cm tall, usually erect; ligule a membrane 0.2–1 mm long; axils of inflorescence branches pilose; lemmas awnless or with awns to 3(–11) mm long. Ditches or other moist sites; Bexar (Snow 1997) and Jefferson (Turner et al. 2003) cos. at extreme s margin of East TX; mainly Gulf Prairies and Marshes; FL, SC, and TX. May–Nov. [*Cynosurus virgatus* L., *L. domingensis* (Jacq.) Trin.] While Nicora (1995) divided this species into several taxa, Snow (1997) indicated that though it is highly polymorphic, separation into infraspecific taxa is not warranted. Snow (2003a) also noted that "Awn length and lemma pubescence vary continuously and independently, precluding their use in recognizing additional taxa."

LIMNODEA L.H. Dewey OZARK GRASS

☙A monotypic C_3 genus of the s United States (Snow ined.). It is related to the perennial genus *Cinna* and is sometimes treated in that genus (Tucker 1996; Yatskievych 1999). However, Brandenburg and Thieret (2000) enumerated numerous differences between these genera (e.g., *Limnodea* is an annual, is smaller, and has longer lemma awns) and concluded that they are not congeneric. (Name altered from *Limnas*, a related Old World genus) (subfamily Pooideae, tribe Poeae)

REFERENCES: Tucker 1996; Brandenburg & Thieret 2000; Snow ined.

Limnodea arkansana (Nutt.) L.H. Dewey, (of Arkansas), OZARK GRASS. Annual 15–60(–100) cm tall; ligule a lacerate-ciliate membrane 1–2 mm long; leaf blades 2–8 mm wide, glabrous or more often hispidulous or hispid on upper and lower surfaces; inflorescence a narrow but not cylindrical panicle, erect or nodding at tip; spikelets 1-flowered, 3–4 mm long excluding awn, disarticulating below the glumes; lemma usually slightly 2-toothed at apex, awned from back at or near the base of the 2 teeth, the awn (4–)8–12(–14.5) mm long, geniculate; anthers 3. Prairies and disturbed areas, calcareous soils, often in sand; throughout most of TX except extreme w and nw; se U.S. from SC s to FL w to OK and TX, except GA. Mar–Jun. [*Cinna arkansana* (Nutt.) G.C. Tucker]

LOLIUM L. RYE GRASS, DARNEL

Annuals or perennials; leaves auricled; ligule a membrane; inflorescence an unbranched spike (rarely branched) with sessile spikelets in 2 ranks on opposite sides of the axis, the axis remaining intact, disarticulation occurring above glume and between florets; spikelets 1 per node, placed with edge (keels of lemmas) against axis of inflorescence, sometimes partially in concavity in axis, without a glume on that side, (2–)5–15(–22)-flowered.

☙A temperate Eurasian C_3 genus of 5–8 diploid species (Bulinska-Radomska & Lester 1988; Loos 1993a; Terrell ined.), including valuable fodder and lawn grasses as well as significant weeds. *Lolium* is considered to be of recent origin, and the species are closely related (Charmet et al. 1997). While previously placed in the tribe Triticeae based on its spicate inflorescence, *Lolium* is now recognized as being in the Poeae. A number of workers (e.g., Bulinska-Radomska & Lester 1988) have noted similarities between the genera *Lolium*, *Festuca*, and *Vulpia*, and hybrids between *Lolium* and *Festuca* are known (Watson & Dallwitz 1992; Terrell ined.). Darbyshire (1993) suggested that *Festuca* subgenus *Schedonorus*, the broad-leaved fescues (including *F. arundinacea*) be shifted to *Lolium*. However, based on recent molecular studies (e.g.,

Charmet et al. 1997; Gaut et al. 2000; Torrecilla & Catalán 2000), it is not yet clear what is the best arrangement of these genera (i.e., one large genus, a number of smaller genera, etc.). We are therefore following recent authors (e.g., Yatskievych 1999; Terrell ined.) in continuing to recognize *Lolium* and retaining subgenus *Schedonorus* in *Festuca*, at least for the present. As more information becomes available, a reassessment of generic boundaries may be necessary. See generic synopsis of *Festuca* for more detail. *Lolium* is well known (e.g., Terrell 1966; Loos 1993a; Charmet et al. 1996) to contain both cross-pollinated (e.g., *L. perenne*) and self-pollinated species (e.g., *L. temulentum*). (Old Latin name for darnel, *Lolium temulentum*, apparently first mentioned in Virgil's *Georgics*—Terrell ined.) (subfamily Pooideae, tribe Poeae)
REFERENCES: Terrell 1966, 1968a, ined.; Bulinska-Radomska & Lester 1985a, 1988; Loos & Jarvis 1992; Darbyshire 1993; Loos 1993a, 1993b, 1994; Charmet et al. 1996, 1997; Tucker 1996; Zwierzykowski & Naganowska 1996; Aiken et al. 1998; Pasakinskiene et al. 1998; Gaut et al. 2000; Torrecilla & Catalán 2002.

1. Glume markedly shorter than rest of the spikelet, 1/3 to 2/3 as long, (4–)5–10(–12) mm long; lower lemmas firmly membranous basally; florets (2–)5–15(–22) per spikelet; plants annuals to short-lived perennials _____ **L. perenne**
1. Glume ca. 3/4 as long as to longer than the rest of the spikelet (excluding awns), 5–25 mm long; lower lemmas hard basally OR not so; florets (2–)4–10(–11) per spikelet; plants annuals.
   2. Spikelets ± sunken in thickened axis of inflorescence and partly concealed by glumes; lower lemmas firmly membranous basally, usually awnless or with an awn to 3(–10) mm long; caryopsis 3–5 times longer than wide; species rare, if present, in East TX _____ **L. rigidum**
   2. Spikelets not sunken in thickened axis of inflorescence, not partly concealed by glumes; lower lemmas hard basally, usually awned, but varying from awnless to with awn 5–18(–23) mm long; caryopsis 2–3 times longer than wide; species widely scattered in East TX _____ **L. temulentum**

Lolium perenne L., (perennial), PERENNIAL RYE GRASS, ENGLISH RYE GRASS. Annual or short-lived perennial forming tufts or clumps; culms 25–100(–120) cm tall; ligule 0.5–3 mm long; inflorescence 5–25(–30) cm long; spikelets usually 5–15 mm long excluding awns; glume (4–)5–10(–12) mm long, 1/3–2/3 as long as spikelet; lemmas awned or awnless. Cultivated for winter-green lawns, erosion control, and forage, escaped to roadsides, disturbed areas; throughout TX; throughout most of Canada and the U.S. Mar–Jun. Native of Eurasia. Humphries (1980), Wilken (1993b), and Terrell (ined.) treated the following two varieties as distinct species, while Kartesz (1994, 1999) and Diggs et al. (1999) recognized them as subspecies. Gould (1975b), however, did not recognize infraspecific taxa, and indicated that, "Texas plants exhibit much variation in plant and spikelet size and may have awnless or awned lemmas. The grouping of these plants into more than one species does not appear justifiable, and even recognition of two varieties is not satisfactory." Hatch (2002) also combined them into one species without recognizing infraspecific taxa. Recently, Turner and Nesom (2000) discussed the use of the categories variety and subspecies. After analyzing the morphological variation seen in East TX material, considering the fact that the two freely hybridize and intergrade (Humphries 1980; Terrell ined.), and contemplating the use of the categories variety and subspecies, recognition of the taxa as varieties seems most appropriate. We are thus following a number of recent authorities (e.g., Jones et al. 1997; Yatskievych 1999) in treating the variation within this species at the varietal level. However, considering that these two introduced entities are maintaining more or less distinct morphologies even when sympatric, a detailed study is needed to determine whether treatment as separate species might indeed be more appropriate. According to Hitchcock (1935, 1951), this species was the first pasture grass to be cultivated in Europe, and it is considered one of the best pasture species in temperate regions (Clayton & Renvoize 1986). While widely planted for forage or hay, there are potential problems in livestock (e.g., tremors, staggers, "ryegrass staggers") if plants are infected with an endophytic (= growing within the plant tissue)

fungus (*Neotyphodium lolii,* previously in genus *Acremonium*) that produces toxic alkaloids (Clay 1988; Yatskievych 1999; Burrows & Tyrl 2001); see detailed discussion of a similar problem under *Festuca arundinacea*. In addition, a different fungus can cause a type of photosensitization in livestock (Burrows & Tyrl 2001). This species is a major cause of hay fever in some individuals. It has also been pointed out (Myers 2003) that PERENNIAL RYE GRASS is an invasive exotic that takes over the habitat of native TX wildflowers and reduces their numbers. It is reported to be cross-pollinated, with only a low degree of self-fertility (Terrell 1966).

1. Leaf auricles long, slender, pointed; lemmas usually all with awns to 15 mm long, rarely all awnless or occasionally only a few in upper spikelets awned; spikelets usually with 10–15(–22) florets _____ var. **aristatum**
1. Leaf auricles mostly short, rounded; lemmas usually awnless, rarely with awns to 8 mm long; spikelets with (2–)5–10 florets _____ var. **perenne**

var. **aristatum** Willd., (with a stiff awn or bristle), ITALIAN RYE GRASS, ANNUAL RYE GRASS. Annual or biennial, not producing sterile shoots at base; leaf blades (2–)3-8(–13) mm wide, rolled in bud. Widespread in TX; throughout most of Canada and the U.S. Native of Europe. [*L. multiflorum* Lam., *L. perenne* var. *italicum* sensu D.R. Parn., *L. perenne* var. *multiflorum* (Lam.) Thuill. ex Bastard, *L. perenne* subsp. *multiflorum* (Lam.) Husn.] This variety is more common in cultivation than var. *perenne*.

var. **perenne**, PERENNIAL RYE GRASS, ENGLISH RYE GRASS. Perennial but grown as winter annual, producing sterile shoots at base; usually shorter than var. *aristatum* and with narrower leaf blades ((1–)2–4(–6) mm wide) that are folded in bud (Terrell ined.). Widespread in TX; throughout most of Canada and the U.S. Native of Eurasia. This taxon and var. *aristatum* are "interfertile and intergrade" (Terrell ined.).

Lolium rigidum Gaudin, (rigid, stiff), STIFF RYE GRASS, WIMMERA RYE GRASS. Annual; culms (45–)70 cm or less tall tall; inflorescence to 25(–30) cm long; spikelets 5–18 mm long excluding awns, with (2–)5–8(–11) florets; glume typically 3/4 as long as spikelet to slightly longer; lemmas usually awnless, or sometimes with an awn 3(–10) mm or less long. Roadsides and waste places; reported for Trinity and Walker (Barkworth et al. 2002) cos.; however, we have seen no TX material and only tentatively consider this species a member of the East TX flora; sc Canada and scattered locations mostly in the s U.S. (AZ, CA, LA, MO, MS, OR, TX). Spring–summer. [*L. perenne* L. var. *rigidum* (Gaudin) Coss. & Durieu, *L. perenne* subsp. *rigidum* (Gaudin) Á & D. Löve, *L. strictum* C. Presl, *L. subulatum* Vis.] Native of the Old World. This species is reported to intergrade with both *L. temulentum* and *L. perenne* and to hybridize with *L. perenne* var. *aristatum* (Terrell ined.). According to Terrell (ined.), "Cattle grazing on *L. rigidum* that has been infected by a nematode often develop staggers, but the species is so uncommon in North America that this is not a serious problem." The species was also reported as toxic by Kartesz (1999).

Lolium temulentum L., (drunken), DARNEL, DARNEL RYE GRASS, BEARDLESS DARNEL RYE GRASS, POISON DARNEL. Annual, forming tufts; culms 30–90(–120) cm tall; ligule 0.5–2.5 mm long; inflorescence 7–28(–40) cm long; spikelets (5–)10–28 mm long excluding awns, with 4–10 florets; glume (7–)10–25 mm long; lemmas awnless or with an awn usually 5–18(–23) mm long. Roadsides, sandy weedy areas; widely scattered in East TX; scattered elsewhere in the state; s Canada and throughout most of the U.S. May–Jun. Native of Eurasia. [*L. temulentum* var. *leptochaeton* A. Braun] This species is reported to be self-pollinating (Terrell 1966; Loos 1993a; Charmet et al. 1996). Gould (1975b) separated awned and awnless forms as varieties; this single character does not seem worthy of formal recognition, and we are thus here including var. *leptochaeton* (the awnless form). This species is poisonous due to alkaloids produced by an endophytic fungus (probably *Endoconidium temulentum* Prill. & Delacr.) living intercellularly in the plant tissues, including the grains. Livestock can be affected with various symptoms, including "rye-grass



Leptochloa nealleyi [USB]



Leptochloa panicea [HI1]



Leptochloa panicoides [YAT]



Leptochloa virgata [GO2, HI1]



Limnodea arkansana [USB]



Lolium perenne var. aristatum [USD]



Lolium rigidum [ABR]



Lolium perenne var. perenne [USB]

staggers" in sheep. Infected grains were formerly used to make an intoxicating beverage (Muenscher 1951; Mabberley 1987; Clay 1988; Hardin & Brownie 1993; Burrows & Tyrl 2001). Gould (1975b) commented that "Darnel has been known as a poisonous weed of cultivated fields since the earliest historical periods. ... Infected grains have been found in an Egyptian tomb believed to date from 2000 B.C." Also "Because primitive agricultural practices could not separate seeds of *L. temulentum* from those of wheat, infected seeds often resulted in poisonous flour" (Terrell ined.). According to Hitchcock (1951), "Darnel is supposed to be the plant referred to as the tares sown by the enemy in the parable of Scripture [Matthew 13:25–30]." It is considered to be a noxious weed in OK (Kartesz 1999).

LUZIOLA Juss. WATER GRASS

An American C_3 genus of ca. 12 species (Terrell ined.) of wet areas, ranging from the se U.S. to Argentina (the majority in South America); it includes the monotypic segregate *Hydrochloa*. Molecular evidence suggests that within the Oryzeae, *Luziola* and *Zizaniopsis* appear most closely allied, with *Zizania* relatively closely related. *Leersia* and *Oryza*, which appear to be each other's closest relatives, are in a second monophyletic lineage within the Oryzeae (Ge et al. 2002). (Name modified from *Luzula*, a genus of Juncaceae—Hitchcock 1951) (subfamily Ehrhartoideae, tribe Oryzeae)

REFERENCES: Swallen 1965; Terrell & Robinson 1974; Tucker 1988; Duvall et al. 1993a; Hatch et al. 1998; Judziewicz et al. 2000; Terrell ined.

Luziola fluitans (Michx.) Terrell & H. Rob., (floating), SOUTHERN WATER GRASS, SILVER-LEAF GRASS, WATER GRASS. Aquatic, monoecious, rhizomatous, bottom-rooted perennial; culms 30–100+ cm long, freely branched, floating or trailing, rooting at the nodes; upper branches often entwined and forming floating mats, the branch tips ascending above the water surface; leaves cauline, numerous; ligule membranous, ca. 0.5–1.5(–2) mm long, uneven; leaf blades 2–5(–8) cm long, 1–4(–5) mm wide; inflorescences terminal and axillary, infrequent, 1–few-flowered, inconspicuous; staminate spikelets in small terminal panicles or racemes; pistillate spikelets solitary or in small racemes in the leaf axils; spikelets 1-flowered, glabrous, awnless, the staminate ca. 2.5–4 mm long and with 6 stamens, the pistillate ca. (1.5–)2–3 mm long; disarticulating at base of lemma; glumes lacking. Ponds, slow streams, marshes; Smith, Upshur (BRIT), Nacogdoches, Trinity (ASTC), Harrison, and Tyler (Turner et al. 2003) cos.; se U.S. from SC s to FL w to AR and TX. Late summer–fall. [*Hydrochloa caroliniensis* P. Beauv., *H. fluitans* (Michx.) Torr., *Zizania fluitans* Michx.] Gould (1975b) and Godfrey and Wooten (1979) segregated this species into the monotypic genus *Hydrochloa*. However, most recent authorities (e.g., Tucker 1988; Kartesz 1999; Judziewicz et al. 2000; Terrell ined.) follow Terrell and Robinson (1974), who considered it to be an aquatic species of *Luziola* with reduced inflorescences. The seeds and leaves provide significant food for wildlife in some parts of the se U.S. (e.g., Florida). Unfortunately, large populations can become dense and mat-like and interfere with recreational fishing (Tucker 1988).

Luziola peruviana Juss. ex J.F. Gmel., (of Peru, but native from s U.S. s to Argentina—Hitchcock 1951), PERUVIAN WATER GRASS, was recently reported for coastal TX (Jefferson Co. sw of Port Arthur, *Hatch, Rosen, & Thomas 6746*, BRIT) just s of East TX by Hatch et al. (1998). This species can be distinguished by its much longer leaf blades ((6–)10–16.5 cm long, 0.5–4 mm wide), much longer lacerate ligules (5–12 mm long), and the diffuse paniculate pistillate inflorescences to 7 cm long.

MELICA L. MELIC, MELIC GRASS

Tall perennials; leaf sheaths closed; ligule a membrane; inflorescence a panicle; pedicels sharply bent just below spikelets (in our species); spikelets usually with (1–)2–3 perfect florets, also usually with 2–3 reduced, neuter florets ("rudiments") above; disarticulation below glumes (in our species); glumes broad, somewhat papery, at least marginally; lemmas (in our species) awnless.

A variable C_3 genus of 60–84 species (depending on inclusion of segregates) of temperate regions excluding Australia (Mejía-Saulés & Bisby 2000; Barkworth ined.). The genus is unusual in having some species (subgenus *Melica*) with disarticulation below the glumes and others (subgenus *Bromelica*) with disarticulation above the glumes (Clayton & Renvoize 1986; Yatskievych 1999). More specifically, "The North American species fall into two groups. In one, the pedicels are sharply bent and the spikelets disarticulate below the glumes; in the other, the pedicels are straight and disarticulation is above the glumes" (Barkworth ined.). (Greek: *meli*, honey, classical name for some plant, possibly a species of sorghum with sweet sap (Barkworth ined.), taken up by Linnaeus for this genus) (subfamily Pooideae, tribe Meliceae)
REFERENCES: Boyle 1945; Tucker 1996; Mejía-Saulés & Bisby 2000; Barkworth ined.

1. Panicles usually simple (rarely compound), the branches themselves not branched; glumes ca. equal in length or the upper slightly longer; spikelets ± flat-topped and triangular in shape; ligule 1.5 mm or less long; rudiments broadly obovate to obconic, truncate (appearing abruptly cut off), oriented at a sharp angle to the rachilla _____ **M. mutica**
1. Panicles usually compound, the branches themselves branched; upper glume notably longer than the lower; spikelets neither flat-topped nor triangular in shape; ligule (1–)3–6.5 mm long; rudiments narrowly obovate or oblong, not truncate, oriented in a ± straight line with the rachilla _____ **M. nitens**

Melica mutica Walter, (blunt, pointless), TWO-FLOWER MELIC, NARROW MELIC. Culms usually 40–80(–100) cm tall from creeping rhizomes; ligule 1.5 mm or less long; leaf blades ca. 2–6 mm wide; inflorescence 4–16(–25) cm long; spikelets 7–11 mm long; fertile florets usually 2, their tips about at the same level in the spikelet; rudiments broadly obovate to obconic, almost club-like. Forest openings on sandy soils; widespread in Pineywoods, less so in Post Oak Savannah; also n Gulf Marshes and Prairies and sparsely scattered to the w; e U.S. from NJ s to FL w to IA and TX. Apr–Jun.

Melica nitens (Scribn.) Nutt. ex Piper, (shining), THREE-FLOWER MELIC, TALL MELIC, LADD'S-FAVORITE. Plant rhizomatous; culms 50–120(–150) cm tall; ligule (1–)3–6.5 mm long; leaf blades 3–11 mm wide; inflorescence usually 10–26 cm long; spikelets 8–12(–15) mm long, much longer than broad; fertile florets usually 2–3, their tips at different levels in the spikelet. Woodlands, rocky grasslands; Bexar, Grayson, Limestone, Travis (BRIT), Austin, Burleson, Comal, and Williamson (Turner et al. 2003) cos. in w and s parts of East TX; mainly w 2/3 of TX; e U.S. from PA s to GA w to MN and TX, also AZ and NM. Apr–Jun.

MICROSTEGIUM Nees BROWNTOP, SASA GRASS, JAPANESE GRASS

A genus of ca. 15 species (Thieret 2003b) of tropical and warm areas of the Old World, particularly se Asia. Like all members of the Andropogoneae, *Microstegium* is characterized by C_4 photosynthesis (Kellogg 2000a). Preliminary molecular evidence suggests that *Microstegium* may be polyphyletic and that it is closely related to such genera as *Miscanthus* and *Saccharum* (Kellogg 2000a; Mathews et al. 2002). A relationship to *Eulalia* has also been suggested (Clayton & Renvoize 1986). (Greek: *mikros*, small, little, and *stego*, shelter, cover, possibly in reference to the small lemma or glumes) (subfamily Panicoideae, tribe Andropogoneae)
REFERENCES: Bor 1952a; Fairbrothers & Gray 1972; Winter et al. 1982; Barden 1987; Nixon et al. 1987; Hunt & Zaremba 1992; Horton & Neufeld 1998; Mehroff 2000; Thieret 2003b.

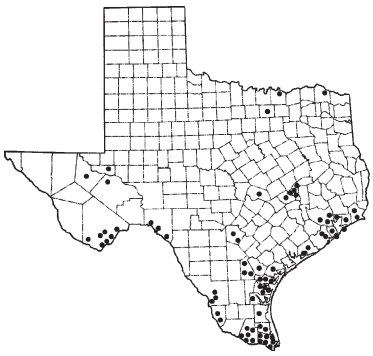
Microstegium vimineum (Trin.) A. Camus, (with long slender shoots, like *Salix*—willows or osiers), NEPALESE BROWNTOP, FLEXIBLE SASA GRASS, JAPANESE GRASS, EULALIA, JAPANESE STILT GRASS. Annual, mat-forming, sometimes in dense colonies; culms creeping at base and rooting at the lower nodes, to 100(–150) cm long, branched, ascending; ligule a very short membrane to ca. 0.8 mm long; leaf blades to 2–10(–12) cm long and 3–15 mm wide; inflorescences terminal and lateral (cleistogamous inflorescences can also be concealed in the upper sheaths), of (1–)2–5(–6)

usually subdigitately arranged, spike-like racemes 3–5(–7) cm long, disarticulating in the axes into joints bearing the spikelets; inflorescence joints and pedicels pubescent or glabrous; spikelets in pairs, the pedicelled and sessile of each pair ca. the same size, both 2-flowered, the upper floret perfect, the lower floret reduced to an empty scale; glumes equal, strongly keeled, 4.5–6.5 mm long, slightly longer than the florets, the lower glume conspicuously grooved on one side; upper glume awned or awnless; lemma of fertile floret awnless or sometimes with an awn 4–8 mm long, the awn spirally twisted; palea of fertile floret absent or small; anthers very small, ca. 0.5 mm long. Stream banks, bottomland forests; Bowie (ASTC, TAES; Nixon et al. 1987) and Red River (BAYLU) cos.; e U.S. from NY s to FL w to MO and TX. Sep–Nov. Native of Asia. [*Andropogon vimineum* Trin., *Eulalia viminea* (Trin.) Kuntze, *Eulalia viminea* var. *variabilis* Kuntze, *M. vimineum* var. *imberbe* (Nees) Honda] The first known U.S. collection was made in 1919 in TN (Fairbrothers & Gray 1972), and this shade-tolerant species (Winter et al. 1982) is now widespread in the e U.S. (Kartesz 1999; Thieret 2003b). The first TX report was by Nixon et al. (1987). While various authorities have recognized awned and awnless varieties, Fairbrothers and Gray (1972) concluded these were not taxonomically meaningful. The species rapidly fills disturbed, mesic, shaded areas, and it can invade disturbed understory habitats along stream banks and surrounding mesic forests (Barden 1987; Horton & Neufeld 1998). Weakley (2000), in referring to its spread in the Carolinas and Virginia, said that this "species has become a very serious pest, now ranking as one of the most destructive introduced plants in our area, forming extensive and dense patches, sprawling over and eliminating nearly all other herbaceous plants." Based on this information, we agree with Watson and Dallwitz (1992) in considering it a significant weed. This species is superficially similar vegetatively (but quite different in reproductive structures) to *Leersia virginica*, WHITE GRASS, but it can be distinguished vegetatively as follows: *M. vimineum* has nodes glabrous and summit of leaf sheath collars with cilia on one or both sides, while *L. virginica* has nodes with short divergent hairs ca. 1 mm long and summit of leaf sheath collars glabrous (Mehrhoff 2000). Clayton and Renvoize (1986) indicated that *Microstegium* is unusual in that the empty scale representing the lower floret is a palea rather than a lemma). ⊘ ☜

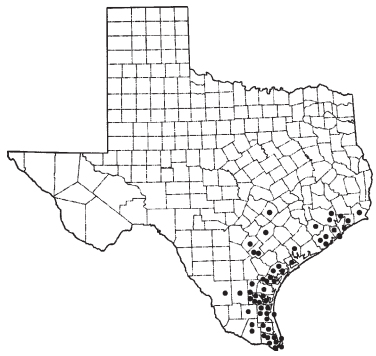
MISCANTHUS Andersson SILVER GRASS

☙ A genus of ca. 25 species (Barkworth 2003i) of the Old World tropics, e Asia, and s Africa; some are cultivated as ornamentals. Preliminary molecular evidence (Spangler et al. 1999) suggests that *Miscanthus,* and several other taxa now recognized as genera, belong in *Sorghum*, which is paraphyletic without them. However, until additional evidence is available, we are continuing to recognize *Miscanthus* at the generic level. *Miscanthus* is also related to *Saccharum*, SUGARCANE, and is known to hybridize with that genus (Clayton & Renvoize 1986; Daniels & Roach 1987). Like all members of the Andropogoneae, *Miscanthus* is characterized by C_4 photosynthesis (Kellogg 2000a). (Greek: *mischos*, pedicel, and *anthos*, flower, from the stalked spikelets) (subfamily Panicoideae, tribe Andropogoneae)
REFERENCES: Lee 1964; Daniels & Roach 1987; Barkworth 2003i.

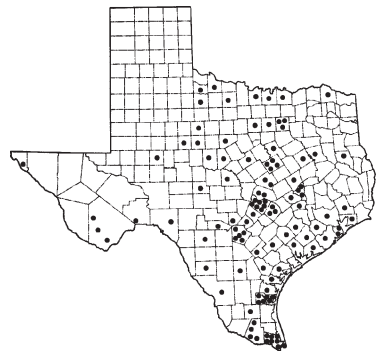
Miscanthus sinensis Andersson, (Chinese), SILVER GRASS, EULALIA, PLUME GRASS, CHINESE SILVER GRASS. Perennial ca. 1–3(–more) m tall, forming dense bushy clumps; leaves mostly basal, with some distributed up the culm, the blades to ca. 1 m long and 2 cm wide, green or variegated (with green and white or yellow bands or stripes) in some cultivated forms, the margins sharply scaberulous; ligule a ciliate membrane 1–3 mm long; inflorescence a dense panicle 10–35 cm long, 5–20(–28) cm wide, the branches 8–15(–30) cm long, ascending; inflorescence branches not disarticulating, the spikelets falling from pedicels at maturity; spikelets in pairs, of 1 short-pedicelled and 1 long-pedicelled (pedicels 1–6 mm long), otherwise alike, with 2 florets (lower sterile, upper fertile), 4–5.5(–7) mm long; base of spikelet (callus) with a tuft of long hairs often longer than spikelet; lemmas shorter than glumes; upper lemma with a twisted,



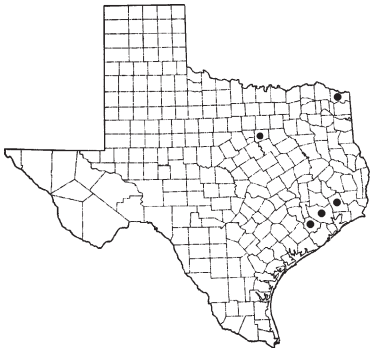
Leptochloa fusca subsp. uninervia



Leptochloa nealleyi



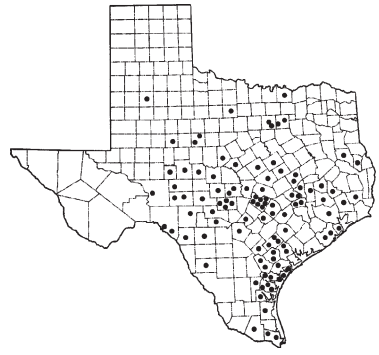
Leptochloa panicea



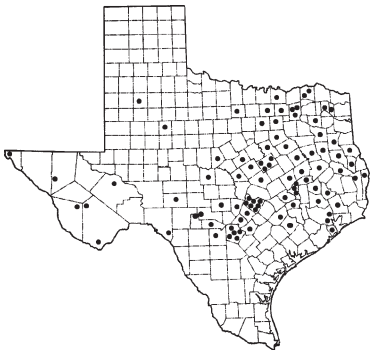
Leptochloa panicoides



Leptochloa virgata



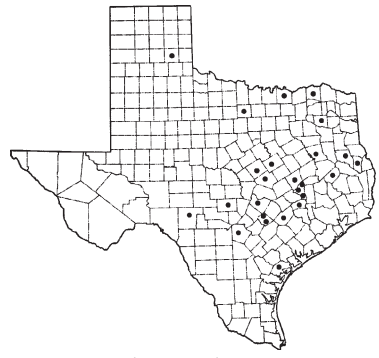
Limnodea arkansana



Lolium perenne
(both vars.)



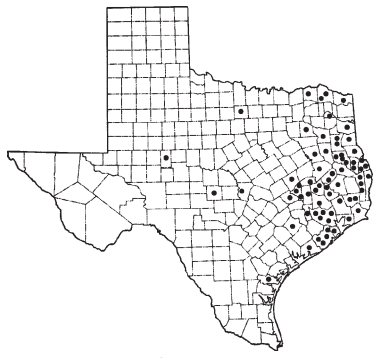
Lolium rigidum



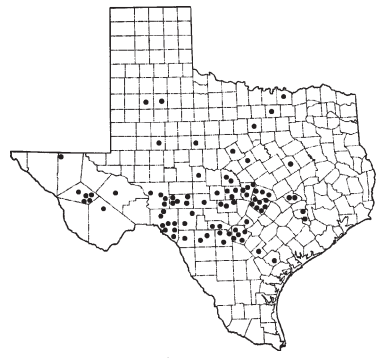
Lolium temulentum



Luziola fluitans



Melica mutica



Melica nitens

geniculate awn 5–12 mm long. No escaped East TX specimens have been seen, but this species is widely cultivated, persists, and possibly escapes; no county distribution map is provided; se Canada (Ont.) and much of the e 1/2 of the U.S., also CA, CO, and NM. Fall. Native of e Asia. Plants with white cross bands have been recognized as forma *zebrina* (G. Nicholson) Nakai (Yatskievych 1999). This species is "the subject of extensive field trials as fuel and raw material for making paper and chipboard." (Watson & Dallwitz 1999).

MONANTHOCHLOE Engelm. SHORE GRASS

A C_4 genus of 2 species (Thieret 2003a) ranging from s U.S. to Argentina, occurring along the coast in North America and in saltpans in South America. It is apparently related to *Distichlis* (Clayton & Renvoize 1986) but differs in its highly reduced inflorescences (Thieret 2003a). Hybrids between the two genera have been reported (Stephenson 1972). (Greek: *monos*, single, *anthos*, flower, and *chloe*, grass, in reference to the unisexual flowers or the usually solitary spikelets) (subfamily Chloridoideae, tribe Cynodonteae)
REFERENCES: Villamil 1969; Thieret 2003a.

Monanthochloe littoralis Engelm., (of the seashore), SHORE GRASS, DWARF-STAND SALT GRASS, KEY GRASS. Dioecious, creeping and mat-forming, rhizomatous and extensively stoloniferous, wiry perennial; flowering culms short (8–25 cm tall), stiff, erect to ascending, much-branched; leaves cauline, clustered, overlapping, conspicuously distichous; ligule minute, membranous, ciliate; leaf blades short (usually < 1(–1.5) cm long), 1–2(–3) mm wide, subulate, often obtuse or with a minute mucro, bluish green or grayish green; inflorescence typically reduced to a single(–few) spikelet, terminal(–subterminal), very inconspicuous, enclosed and obscured by the uppermost leaf sheaths; spikelet usually with 3–5 florets, the upper ones rudimentary; disarticulation of pistillate spikelet at lower rachilla nodes; glumes lacking. Mainly salt flats and coastal marshes, brackish or saline conditions; Fayette (Turner et al. 2003) and Gonzales (Gould 1975b) cos. in s part of East TX; L. Brown (pers. comm.) questions the identity of these two inland collections); primarily Gulf Prairies and Marshes and adjacent South TX Plains; CA, FL, LA, and TX. Mar–May.

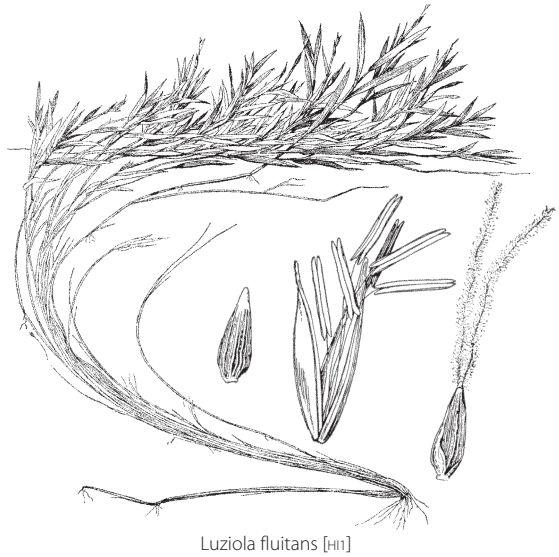
MUHLENBERGIA Schreb. MUHLY

Ours perennials, with or without rhizomes; ligule a membrane; inflorescence a panicle, open and widely spreading to contracted and spike-like; spikelets usually 1-flowered, disarticulating above the glumes; glumes 1-veined or veinless, rarely 3–5-veined; lemma 3(–5)-veined, awned or awnless; palea 2-veined; stamens 3.

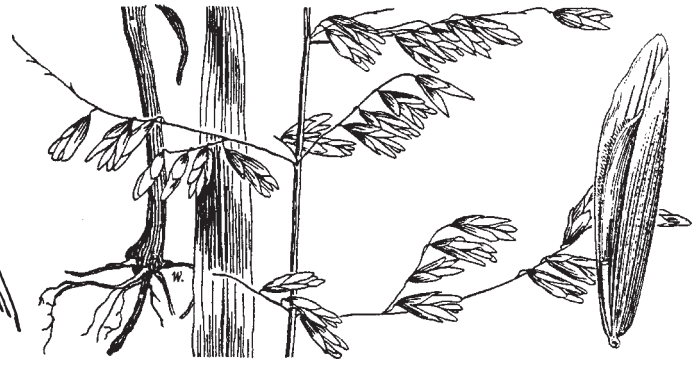
A genus of ca. 155 species primarily of tropical and warm areas of the Americas, with a few (6 species) in s Asia (Peterson 2000, 2003b). The genus is important in arid and semi-arid regions, and the species are characterized by C_4 photosynthesis (an advantage in arid environments) (Watson & Dallwitz 1992). Both morphological and some molecular data suggest that *Muhlenbergia* is related to *Sporobolus* (Clayton & Renvoize 1986; Hilu & Alice 2000). However, recent molecular data (Hilu & Alice 2001) link *Muhlenbergia* with genera such as *Aegopogon*, *Schedonnardus*, and *Bouteloua* and raise questions about the monophyly of *Muhlenbergia*. Yatskievych (1999) pointed out that in Missouri, the 3-veined lemmas of *Muhlenbergia* distinguish it from most members of the similar genus *Sporobolus*, which is usually characterized by 1-veined lemmas (except *S. ozarkanus* and *S. vaginiflorus* with faintly 3-veined lemmas). Those two *Sporobolus* species are clearly distinguished by being annuals and having all or most of their inflorescences enclosed within leaf sheaths, versus *Muhlenbergia* species being perennials with at least some inflorescences conspicuous and exserted. The same situation applies to East TX. (Named for Gotthilf Henry Ernest Muhlenberg, 1753–1815, distinguished American botanist and Lutheran minister of PA) (subfamily Chloridoideae, tribe Cynodonteae)
REFERENCES: Scribner 1907; Soderstrom 1967; Pohl 1969; Kurtz & Sutherland 1977; Morden &



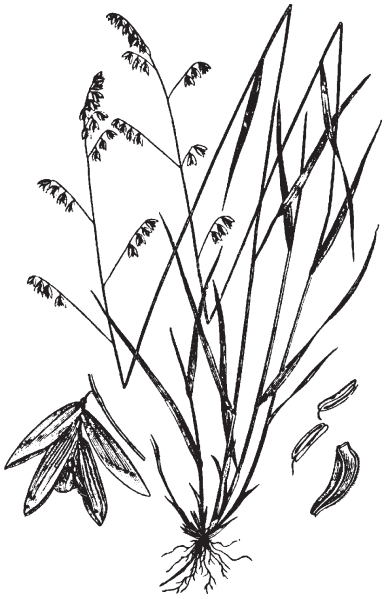
Lolium temulentum [USB]



Luziola fluitans [HI1]



Melica nitens [HI1]



Melica mutica [USB]



Microstegium vimineum [GLE, TOR]



Miscanthus sinensis [HI1]

Hatch 1987, 1989, 1996; Peterson & Annable 1991; Duvall et al. 1994; Crosswhite & Crosswhite 1997; Peterson et al. 1997; Peterson 2000, 2003b.

1. Panicles open, usually 2–17 cm or more wide; branches bare of spikelets for a distance from base; including species widespread in East TX.
   2. Leaf sheaths keeled; pedicels usually 2–5(–8) mm long; lemma awn 0.5–2(–4) mm long; panicles 2–5(–7) cm wide, with branches narrowly spreading _____ **M. ×involuta**
   2. Leaf sheaths rounded; pedicels 3–25 mm long, usually at least some 10 mm or more long; lemma awn 0.5–15(–18) mm long; panicles 4–17(–20) cm wide, with branches usually widely spreading.
      3. Lemma with awn usually 0.5–4 mm long (rarely to 7 mm); upper glume usually not awned, < 1/2 as long as lemma body; inflorescences often nearly as wide as long, loosely contracted to open but not diffuse; spikelets straw-colored, brownish, or slightly purplish; species known in East TX only from w margin of area _____ **M. reverchonii**
      3. Lemma awnless or with awn (0–)2–15(–18) mm long; upper glume (longer of the two) usually awned, 1/2 as long as lemma body or longer (including glume awn if present); inflorescences clearly longer than wide, diffuse; spikelets usually pink or purple; including species widespread in East TX.
         4. Glumes with bodies < 1/2 as long as lemma body; lemma usually with an awn (0–)2–15(–18) mm long; species widespread and common in East TX _____ **M. capillaris**
         4. Glumes with bodies 1/2–2/3 as long as lemma body; lemma usually awnless or with an awn 3 mm or less long; species rare in East TX _____ **M. expansa**
1. Panicles contracted, usually < 2(–3) cm wide; branches with spikelets nearly to base; species primarily of n and w portions of East TX (except the widespread *M. schreberi*).
   5. Plants usually decumbent, sometimes mat-like, small (culms 30(–40) cm or less long), of wet areas; leaf blades mostly 1–2(–3.5) cm long, 0.5–1(–2) mm wide; both glumes and lemma usually 1.4–2(–2.4) mm long _____ **M. utilis**
   5. Plants usually not decumbent except at base, not mat-like, typically larger (culms usually more than 40 cm long, often much more), of various habitats; leaf blades mostly 4 cm or more long, 1–3 (or more) mm wide; either glumes or lemma or both > 2 mm long.
      6. Glume(s) minute, 0.4 mm or less long, the first often absent; culms usually decumbent at base, often rooting at lower nodes; plants without rhizomes; ligule 0.5 mm or less long; species widespread in East TX _____ **M. schreberi**
      6. Glumes usually much longer; culms often (but not always) erect; plants with OR without rhizomes; ligule quite variable, 0.2–15(–35) mm long; species primarily of n and w portions of East TX.
         7. Plants without scaly creeping rhizomes; culms unbranched, erect, usually (50–)80–150 cm tall; leaf sheaths sharply keeled OR rounded; inflorescences (8–)15–54(–60) cm long, 4–15(–30) mm wide.
            8. Leaf sheaths sharply keeled; ligule (8–)10–15(–35) mm long _____ **M. lindheimeri**
            8. Leaf sheaths rounded, not sharply keeled; ligule 0.5–10 mm long.
               9. Spikelets 2.4–4 mm long; ligule 0.5–2(–3) mm long; leaf blades 1.5–6 mm wide; inflorescence 5–12 mm wide; lemmas unawned or merely mucronate; anthers yellow to purple _____ **M. rigens**
               9. Spikelets 3.8–5 mm long; ligule 4–10 mm long; leaf blades 1–2 mm wide; inflorescence 6–24 mm wide; lemmas unawned or with awns to 6 mm long; anthers greenish _____ **M. dubia**
         7. Plants with scaly creeping rhizomes; culms either much-branched above or not erect, to ca. 90 cm tall, usually much smaller; leaf sheaths sharply keeled; inflorescences variable in size, to 21 cm long and 10 mm wide, usually smaller.
            10. Lemma glabrous, including at base; culms puberulent and dull just below the nodes (use hand lens or dissecting scope) _____ **M. glabriflora**

10. Lemma with a tuft of hairs at base; culms glabrous and shining between the nodes and at the nodes OR puberulent and dull just below the nodes.
    11. Lemma with a conspicuous awn (3–)5–10(–18) mm long; culms puberulent and dull just below the nodes (use hand lens or dissecting scope); species rare, if present, in East TX _____ **M. sylvatica**
    11. Lemma awnless or with an awn to 3 mm long (rarely to 8 mm in *M. bushii*); culms puberulent and dull just below the nodes OR nodes and internodes glabrous and shiny; including species widely scattered in East TX.
        12. Glumes overlapping nearly to middle, ovate, abruptly tapering to an awn tip; plants with few axillary panicles, but those present usually long-exserted, the peduncles to 11 cm long _____ **M. sobolifera**
        12. Glumes not overlapping or overlapping only at base, lanceolate, gradually tapering to an awn tip; plants with numerous axillary panicles, these not long-exserted (often partially enclosed in leaf sheath), the peduncles usually only 1–2 cm long.
            13. Glumes 1/2–2/3 as long as lemma, 1.2–2(–2.5) mm long; ligule 0.7 mm or less long; terminal panicle often well-exserted; leaves of the lateral branches often shorter and narrower than those of the main culms _____ **M. bushii**
            13. Glumes 3/4 as long to slightly longer than lemma, usually ca. 2–4.1 mm long; ligule 0.7–1.4(–1.7) mm long; terminal panicle usually not well-exserted (at least base enclosed in subtending leaf sheath); leaves of the lateral branches about same length and width as those of the main culms _____ **M. frondosa**

Muhlenbergia bushii R.W. Pohl, (for Benjamin Franklin Bush, 1858–1937, amateur botanist of Missouri, and discoverer of this species), NODDING MUHLY. Rhizomatous perennial; culms 30–100 cm tall, erect, becoming much-branched above, nodes and internodes glabrous and shiny; leaf sheaths rounded or slightly angled; ligule 0.7 mm or less long; panicles numerous, slender; spikelets 2.5–3.6 mm long; lemma pilose basally, awnless or with awn rarely to 8 mm long. Rich or low woods, along streams, often calcareous conditions; Grayson, Hunt, McLennan, Van Zandt (BRIT), Dallas, Navarro (TAES), and Travis (Turner et al. 2003) cos.; also Cross Timbers and Prairies; much of the c U.S. from IN s to LA w to NE and TX, also GA and WV. Jul–Oct. [*M. brachyphylla* Bush]

Muhlenbergia capillaris (Lam.) Trin., (hair-like), HAIRY-AWN MUHLY, LONG-AWN HAIR GRASS, SLENDER MUHLY, HAIR GRASS. Densely tufted perennial without rhizomes; culms erect, 60–100(–150) cm tall; leaf sheaths rounded, the basal ones often fibrous but not extensively so; ligule 1.8–8 (–10) mm long; panicles open, diffuse, 15–40(–60) cm long, 5–30(–40) cm wide, the branches and pedicels capillary and widely spreading at maturity; spikelets usually (2.6–)3–4.5(–5) mm long; glume body < 1/2 as long as lemma body; upper glume usually with awn 0.5–5 mm long; lemma occasionally with setaceous teeth to ca. 2 mm long, with variable awn (0–)2–15(–18) mm long. Sandy or rocky forests, openings; widespread in East TX; also Gulf Prairies and Marshes, scattered in the Cross Timbers and Prairies, and w to Taylor Co. (Peterson 2003b; Turner et al. 2003); e U.S. from MA s to FL w to KS and TX. Aug–Nov. This species is grown as an ornamental (Peterson 2003b).

Muhlenbergia dubia E. Fourn., (doubtful), PINE MUHLY, PINELAND MUHLY. Densely tufted perennial without rhizomes; culms erect, 30–100 cm tall; leaf sheaths rounded; ligule 4–10 mm long; panicle 10–40 cm long, to 2.4 cm wide, contracted, densely-flowered, the branches with flowers to base; spikelets (3.8–)4–5 mm long; lemma glabrous proximally, scabrous distally, awnless or with awn to 6 mm long. Slopes, rock outcrops; Travis Co. (*M.C. Johnston 12442* (TAES, TEX); Denny 2003) near w margin of East TX; since this species was added after map pages for the flora were completed, no county distribution map is provided; mainly Trans-Pecos but also

Bandera, Edwards, and Kerr (Denny 2003) cos. on the Edwards Plateau; AZ, NM, and TX. Sep–Nov. According to Peterson (2003b), this species "resembles *M. rigens*, but differs in having looser, contracted (but not spikelike) panicles, longer ligules, olivaceous anthers, and generally longer lemmas."

Muhlenbergia expansa (Poir.) Trin., (expanded), SAVANNAH HAIR GRASS, CUTOVER MUHLY. Tufted perennial without rhizomes, similar to *M. capillaris*; culms erect, 60–100(–150) cm tall; leaf sheaths rounded, the basal ones often very fibrous or sometimes not so; ligule ca. 2–5(–10) mm long; panicles open, diffuse; spikelets 3–5 mm long; glume body 1/2–2/3 as long as lemma body; upper glume awnless or with minute awn; lemma without setaceous teeth, usually awnless or with an awn 3 mm or less long. Moist to wet pine forests, savannahs, bogs, sandy soils; Hardin (*MacRoberts & MacRoberts 3724*, SBSC), Jasper, Newton (Peterson 2003b), and Liberty (Gould 1975b) cos.; e U.S. from NC s to FL w to OK and TX. Aug–Oct. [*Agrostis trichopodes* Elliott, *M. capillaris* (Lam.) Trin. var. *trichopodes* (Elliott) Vasey] Gould (1975b) treated this taxon as *M. expansa* and commented that it has "characters sufficiently distinct to warrant specific recognition." Morden and Hatch (1989), however, concluded that there is overlap with *M. capillaris* in supposedly diagnostic characters and that "there is no clear separation of taxa"; they therefore treated the taxon as *M. capillaris* var. *trichopodes*. Jones et al. (1997), Peterson (2000), and Hatch (2002) recently recognized *M. expansa*, as did Peterson (2003b) in his *Flora of North America* treatment.

Muhlenbergia frondosa (Poir.) Fernald, (leafy), WIRE-STEM MUHLY, NIMBLE-WILL, SATIN GRASS. Rhizomatous perennial; culms often becoming decumbent or sprawling, to 100(–130) cm long; leaf sheaths rounded to slightly angled; ligule 0.7–1.4(–1.7) mm long; panicles numerous, slender; spikelets 2.3–4.1 mm long; lemma basally pubescent, awnless (in TX material—Correll & Johnston 1970; awned elsewhere in the species range—see e.g., Yatskievych 1999; Peterson 2003b). Woods, clay soils; in TX reported only from Dallas and Grayson (Correll & Johnston 1970) cos. at w margin of East TX; however, we have seen no TX material of this species and its status in TX is unclear; se Canada and e U.S. w to ND and TX, also OR. Oct. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

Muhlenbergia glabriflora Scribn., (smooth-flowered), INLAND MUHLY, SMOOTH MUHLY. Rhizomatous perennial similar to *M. frondosa*; leaf sheaths rounded to slightly angled; ligule 1.5 mm or less long; panicles numerous, slender; spikelets 2–3.5 mm long; lemma glabrous, including at base, usually awnless. Moist woods, clay soils, Dallas Co. (BRIT; Peterson 2003b), in TX known only from the Blackland Prairie, the type of this species was collected by Reverchon in Dallas (Mahler 1988); c U.S. from IN s to LA w to MO and TX. Sep. This species is similar to *M. frondosa* but can be distinguished by the glabrous lemmas, shorter fruits (1.2–1.4 mm long), and culms puberulent below the nodes (versus lemmas pubescent basally, fruits 1.6–1.9 mm long, and culms glabrous in *M. frondosa*). This is one of a group of somewhat similar species (others are *M. bushii*, *M. frondosa*, *M. sobolifera*, and *M. sylvatica*) that are rather rare in East TX, whose relationships are unclear, and that are in need of study. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

Muhlenbergia ×**involuta** Swallen [*M. lindheimeri* × *M. reverchonii*], (rolled inward), CANYON MUHLY. Densely tufted perennial without rhizomes; culms stiffly erect, 60–140 cm tall; leaf sheaths keeled; ligule 3–12 mm long; panicles ca. 18–40 cm long, open but branches only narrowly spreading; spikelets 3–4 mm long; lemma 3–4 mm long, minutely bifid apically, with awn 0.5–2(–4) mm long from between the minute apical teeth. Prairie draws and openings, calcareous slopes, and canyons; Hays, Travis (BRIT), Bexar (Turner et al. 2003), and Comal (Mahler 1988) cos. on sw margin of East TX; mainly Edwards Plateau, also s margin of Cross Timbers

and Prairies; endemic to TX (Carr 2002b, 2002c). Fall. The type was collected 20 mi ne of San Antonio (Gould 1975b). This taxon is sometimes cultivated as an ornamental. While *M.* ×*involuta* has usually been assumed to be a hybrid between *M. lindheimeri* and *M. reverchonii*, Peterson (2003b) suggested that "*M. rigida* seems to be another plausible possibility" as a parent.

Muhlenbergia lindheimeri Hitchc., (for Ferdinand Jakob Lindheimer, 1801–1879, German born TX botanist), LINDHEIMER'S MUHLY. Large tufted perennial without rhizomes; culms stiffly erect, usually 80–100(–150) cm tall; leaf sheaths sharply keeled; ligule 8–15(–35) mm long; panicles (10–)20–54 cm long, tightly or loosely contracted, densely-flowered, the branches with flowers nearly to base; spikelets ca. 2–4 mm long; lemma glabrous, scabrous, or puberulent, awnless or infrequently with awn to 3(–4) mm long. Mesic limestone areas and creek banks; Bell, Bexar, Travis (BRIT), Comal, Hays, and Williamson (Turner et al. 2003) cos. on sw margin of East TX; mainly Edwards Plateau, also s part of Cross Timbers and Prairies and n part of South TX Plains; this species is known only from TX and Mexico. Sep–Dec. It is sometimes cultivated as an ornamental.

Muhlenbergia reverchonii Vasey & Scribn., (for Julien Reverchon, 1837–1905, a French-American immigrant to Dallas and important botanical collector of early TX), SEEP MUHLY, REVERCHON'S MUHLY. Densely tufted perennial without rhizomes; culms stiffly erect, 40–80 cm tall; leaf sheaths rounded; ligule 2–7(–9) mm long; panicles open; spikelets 3.5–5 mm long; glumes to 3 mm long, these usually not awned (sometimes a minute awn to ca. 0.5 mm long present); lemma glabrous or scabrous at apex, with awn 0.5–4(–7) mm long. Calcareous soils, typically in moist or wet areas; Bell, Dallas, Hays, Travis, Williamson (BRIT), Bexar, Brazos [cultivated?], and Comal (Turner et al. 2003) cos., Blackland Prairie w to West Cross Timbers and s to n Edwards Plateau; endemic to OK and TX. Aug–Nov. This species resembles *M. capillaris* but according to Peterson (2003b), differs in having smooth and shiny lemmas (versus not shiny in *M. capillaris*).

Muhlenbergia rigens (Benth.) Hitchc., (rigid, stiff), DEER GRASS. Large tufted perennial without rhizomes; culms erect, (50–)100–150 cm tall; leaf sheaths rounded; ligule 2(–3) mm or less long; panicles spike-like, (8–)15–40(–60) cm long, tightly contracted, densely-flowered, the branches with flowers to base; spikelets 2.5–3.5(–4) mm long; lemma glabrous or scabrous, awnless or mucronate or with an awn to ca. 1 mm long. Flats along streams; Travis Co. (Turner et al. 2003) near w margin of East TX; also Kendall Co. in e Edwards Plateau and Lampasas Co. in the Lampasas Cut Plain (Turner et al. 2003), but primarily Trans-Pecos; sw U.S. from TX w to CA. Jul–Oct. [*Epicampes rigens* Benth., *M. marshii* I.M. Johnst., *M. mundula* I.M. Johnst.] Peterson (2003b) noted that this species is commercially available as an ornamental.

Muhlenbergia schreberi J.F. Gmel., (for Johann Daniel Christian von Schreber, 1739–1810, German botanist), NIMBLE-WILL, SATIN GRASS, SCHREBER'S MUHLY. Tufted perennial without rhizomes; culms decumbent below, rooting at lower nodes, usually 10–40(–80) cm tall, much-branched; leaf sheaths keeled; ligule 0.5 mm or less long; panicles contracted; spikelets 1.8–2.8 mm long; glumes 0.4 mm or less long, the first often absent; lemma basally pubescent, with awn 1.5–5 mm long. Woods, thickets, bottomland hardwood forests, disturbed areas; widespread in East TX w to East Cross Timbers and e Edwards Plateau; se Canada (Ont.) and throughout e U.S. w to NE and TX, also AZ, CO, NV, and UT. Jun–Oct. Though native in our area and not problematic, this species is sometimes considered a significant weed in other ecosystems (e.g., Watson & Dallwitz 1992); it is officially designated a noxious weed in CA (Kartesz 1999).

Muhlenbergia sobolifera (Muhl. ex Willd.) Trin., (bearing sprouts), ROCK MUHLY, ROCK-DROPSEED. Rhizomatous perennial; culms 40–85(–100) cm tall, much-branched above; ligule 1 mm or less long; panicles contracted; spikelets (1.7–)2–3 mm long; glumes about equal, overlapping basally; lemma basally pubescent, awnless or with awn to 1(–3) mm long. Rocky slopes, open woods,

usually in partial shade; Grayson (BRIT) and Dallas (TAES, Mahler 1988) cos. and reported for Pineywoods by Gould (1975b), Hatch et al. (1990), and Hatch (2002), also two East TX localities were mapped (without specific county) by Pohl (1969); also Brown and Hamilton (HPC) cos. in s Cross Timbers and Prairies, Hemphill Co. (Correll & Johnston 1970) in the Panhandle, and reported for Edwards Plateau (Hatch et al. 1990); se Canada (Ont.) and throughout most of e U.S. w to NE and TX. Sep–Oct. This species is treated as including [*M. sobolifera* var. *setigera* Scribn.], the type of which was collected by Reverchon (70) in Dallas (Mahler 1988). Pohl (1969) indicated that plants of *M. sobolifera* with awned lemmas often have misshapen and shrunken pollen grains. He suggested they might be sterile hybrids between this and some other species. Yatskievych (1999) noted that the "situation requires further study."

Muhlenbergia sylvatica Torr. ex A. Gray, (forest-loving), FOREST MUHLY, WOODLAND MUHLY. Rhizomatous perennial; culms decumbent or sprawling below, usually 40–100(–110) cm long, freely branching at middle nodes; internodes puberulent; leaf sheaths rounded to slightly angled; ligule 1.5(–2.5) mm or less long; panicles terminal and axillary, slender, contracted; spikelets 2.2–3.2(–3.7) mm long; lemma basally pubescent, with a conspicuous awn (3–)5–10(–18) mm long. Woods and shaded stream banks; included based on citations of vegetational area 4 by Gould (1975b), Hatch et al. (1990), and Hatch (2002), also a single locality was mapped (without specific county) by Pohl (1969) at the w margin of East TX; also reported (Hatch 2002) for Cross Timbers and Prairies and Edwards Plateau; however, Turner et al. (2003) map no East TX locations (they map only Burnet Co.) and we have seen no East TX specimens. This species is thus tentatively included; no county distribution map is provided; e Canada and throughout most of e U.S. w to ND and TX, also AZ. Aug–Sep. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

Muhlenbergia utilis (Torr.) Hitchc., (useful), APAREJO GRASS, APAREJO MUHLY. Low rhizomatous perennial; culms (7–)20–30(–40) cm long; ligule to 0.8 mm long; leaf blades very narrow, 0.5–1(–2) mm wide; panicles narrow, interrupted, loosely-flowered, 1–4(–5) cm long; spikelets usually 1.4–2(–2.4) mm long; glumes 0.6–1(–1.5) mm long; lemma usually 1.3–2(–2.4) mm long, scarcely mucronate. Along streams, marshy meadows, usually very wet areas of calcareous soils; Bexar (BRIT), Bell, Brazos [cultivated?], Comal, Hays, Travis and Williamson (Turner et al. 2003) cos. near w margin of East TX; mainly Edwards Plateau; AZ, CA, NV, and TX. Late summer–fall. According to Morden and Hatch (1996), this species "was used by people of Mexico for stuffing packsaddles, hence the common name 'aparejo grass'" [aparejo = gear].

NASSELLA (Trin.) E. Desv. TUSSOCK GRASS

A New World C_3 genus of 116 species, primarily of South and Central America, with the center of diversity in Argentina (72 species) (Barkworth & Torres 2001). *Nassella* is related to the genus *Stipa,* and many of its species were in the past treated therein (e.g., Gould 1975b). Barkworth (1990), however, treated *Stipa* in a narrower sense and argued convincingly that *Nassella*, previously interpreted as a South American genus of ca. 14 species, is a distinct lineage that should be expanded and recognized as distinct from *Stipa*—it can be unambiguously distinguished from all other members of the tribe by its strongly overlapping lemma margins (Barkworth 1990, ined.). Numerous recent authors (e.g., Pohl 1994a; Jones et al. 1997; Kartesz 1999) follow this circumscription. The genus name is sometimes incorrectly spelled "Nasella" (e.g., Clayton & Renvoize 1986). ⊘ The South American SERRATED TUSSOCK GRASS (*Nassella trichotoma* (Nees) Hack.) is an aggressive invader and has been officially designated a federal noxious weed in an attempt to prevent its introduction into the U.S. (USDA Natural Resources Conservation Service 2002). (Latin: *nassa*, a basket with a narrow neck for catching fish) (subfamily Pooideae, tribe Stipeae)



Monanthochloe littoralis [USB]



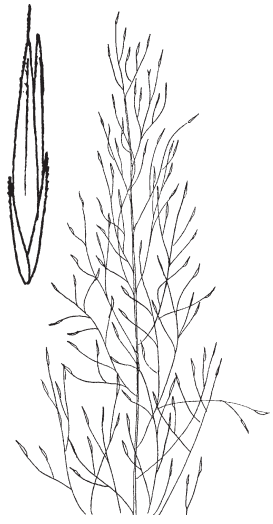
Muhlenbergia bushii [HI1]



Muhlenbergia capillaris [HI1]



Muhlenbergia dubia [HI1]



Muhlenbergia expansa [SIL]



Muhlenbergia frondosa [HI1]



Muhlenbergia glabriflora [SIL]



Muhlenbergia ×involuta [HI1]



Muhlenbergia lindheimeri [HI1]

REFERENCES: Hitchcock 1925; Parodi 1947; Brown 1952; Thomasson 1978; Barkworth 1990, 1993, ined.; Tucker 1990; Valdés-Reyna & Barkworth 1994; Jacobs et al. 2000; Barkworth & Torres 2001.

Nassella leucotricha (Trin. & Rupr.) Pohl, (white-haired), WINTER GRASS, TEXAS WINTER GRASS, SPEAR GRASS, TEXAS NEEDLE GRASS, TEXAS TUSSOCK GRASS. Perennial, tufted, 25–100(–120) cm tall, green from late fall to summer; ligule variable, absent or a membrane to 1 mm long; leaf blades 3.6 mm or less wide; panicles terminal, open; axillary cleistogamous florets produced in lower sheaths; spikelets 1-flowered, disarticulating above the glumes; glumes acuminate, (12–)14–18 (–21) mm long; lemma 9–13 mm long, indurate, light brown, with overlapping margins; lemma base and rachilla together forming a sharp-pointed bearded callus 1.5–4.5 mm long; lemma apex with smooth white neck (crown) ca. 0.6–1(–2) mm long, the crown often flaring from its base; lemma awn very long (4–10 cm), geniculate, twisted, with a ring of whitish hairs around base; caryopsis permanently enclosed within the lemma. Prairies, disturbed sites; throughout TX; AR, LA, OK, SC, and TX. Apr–May. This species was a minor component of the original prairie and increases under disturbance. [*Stipa leucotricha* Trin. & Rupr.] The callus is so sharp-pointed that it will easily stick into clothing or skin; Correll and Johnston (1970) indicated that when thrown they are "... therefore, of considerable recreational value to boys." Unfortunately, they can also cause wounds to the mouth or other body parts of animals (Lipscomb & Diggs 1998). The dispersal unit of this species (sharp callus derived in part from rachilla and a fertile floret with obvious awn) and the dispersal unit of *Heteropogon melanocarpus*, SWEET TANGLEHEAD (sharp callus derived in part from inflorescence axis, glumes, vestigial sterile floret, and fertile floret with obvious awn), look and function remarkably alike yet are structurally quite different. This is a good example of convergent evolution.

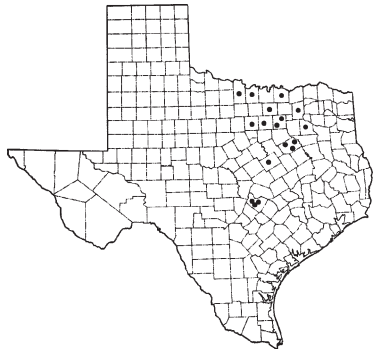
OPLISMENUS P. Beauv. BASKET GRASS, MOUNTAIN GRASS

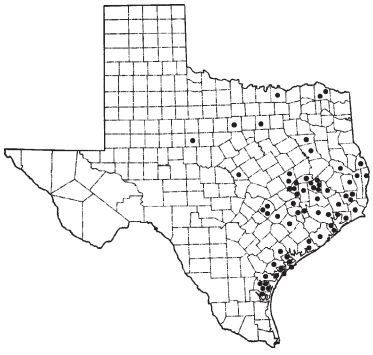
A small C_3 genus of about 5 variable and very closely related species of the tropics and warm areas. There is, however, considerable disagreement on the exact number of species, with some authorities recognizing 9 (Scholz 1981) or even more (10–15 species—Pohl & Davidse 1994a). *Oplismenus hirtellus* cultivar 'Variegatus' is a cultivated greenhouse hanging-basket plant sometimes sold under the misnomer *Panicum variegatum* (Wipff 2003h). Several are significant weeds (Watson & Dallwitz 1992). Davidse (1987a) indicated that most species have sticky secretions on the awns, which serve as a mechanism of animal dispersal. Clayton and Renvoize (1986) noted that this "is an unusual means of fruit dispersal in the grasses," and the spikelets, which adhere to clothing, have been referred to as "stick-tights" (Peterson et al. 1999). (Greek: *hoplismos*, a weapon, or *hoplismenos*, armed, referring to the awns) (subfamily Panicoideae, tribe Paniceae)
REFERENCES: Hitchcock 1920a; Kerguélen 1976; Smith 1976; Davey & Clayton 1978; Scholz 1981; Crins 1991; Peterson et al. 1999; Wipff 2003h.

Oplismenus hirtellus (L.) P. Beauv. subsp. **setarius** (Lam.) Mez ex Ekman, (sp.: rather hairy; subsp.: containing bristles), BASKET GRASS, LONG-LEAF BASKET GRASS. Perennial with culms creeping and rooting at the nodes; nodes usually pubescent; culm axis and leaf sheaths glabrous or with a few scattered hairs; ligule a ciliate membrane; leaf blades 1.5–7.3 cm long, (2–)5–15(–20) mm wide, widely spreading to reflexed; inflorescence with 3–5(–7) widely spaced, very short, spike-like branches ca. 1–6 mm long, with spikelets sessile or nearly so, in 2 rows on 1 side of each branch; spikelets 2.2–3(–3.3) mm long, 2-flowered, the lower floret sterile, the upper floret perfect; disarticulation usually below glumes (and occasionally below fertile floret); glumes subequal, awned; awn of lower glume 4–10 mm long, much longer than awn of upper glume (ca. 1–4 mm long); lemma of sterile floret with awn 1.2 mm or less long; lemma of fertile floret indurate, the margins virtually enclosing the palea. Shaded moist areas; widespread in e 1/3 of TX; most of se U.S. from MD s to FL w to OK, and TX. Summer–Oct. Native to New World tropics and subtropics. [*O. compositus* (L.) Beauv. var. *setarius* (Lam.) F.M. Bailey, *O. setarius* (Lam.)


Microstegium vimineum


Monanthochloe littoralis

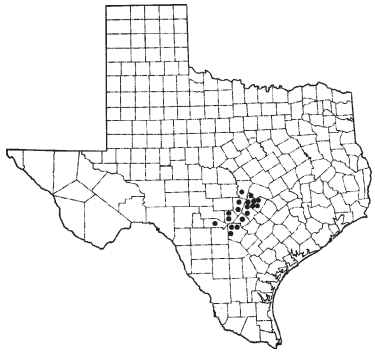

Muhlenbergia bushii


Muhlenbergia capillaris


Muhlenbergia expansa


Muhlenbergia frondosa


Muhlenbergia glabriflora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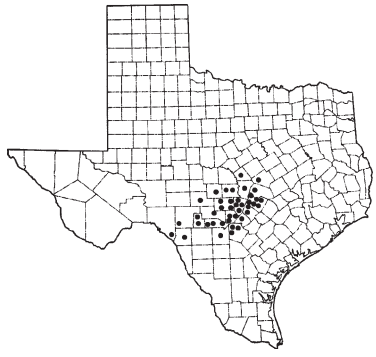
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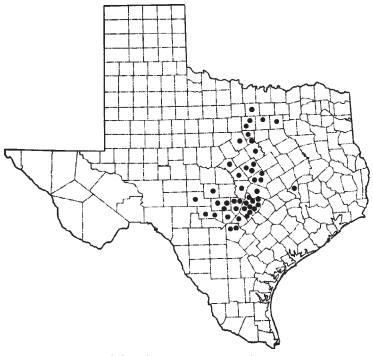
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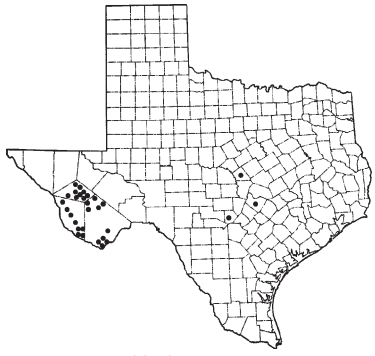
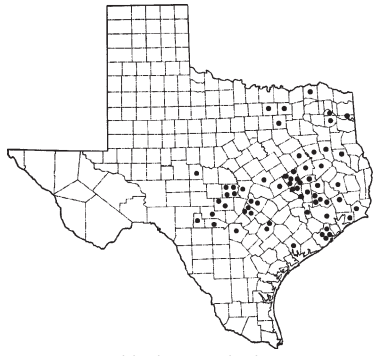

Muhlenbergia rigens


Muhlenbergia schreberi

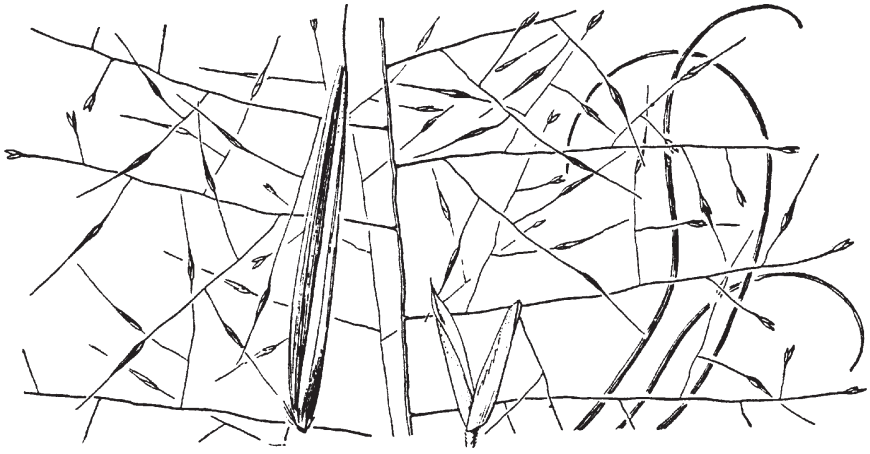
Roem. & Schult.] This taxon has been treated quite differently by various authorities. Hitchcock (1951) and Kartesz (1994) recognized it as a separate species (*O. setarius*). Davey and Clayton (1978), however, studied the group worldwide and concluded that *O. setarius* should be included in *O. hirtellus*. Subsequently, Scholz (1981) recognized 11 subspecies in *O. hirtellus*, including subsp. *setarius*. This subspecies was not recognized as a separate entity by either Crins (1991), Jones et al. (1997), or Diggs et al. (1999). Most recent authorities (e.g., Pohl & Davidse 1994a; Kartesz 1999; Peterson et al. 1999; Wipff 2003h), however, treat it at the subspecific level, and while there seems to be some geographical and morphological overlap between taxa (Wipff 2003h), in order to recognize the variation present, it seems most appropriate to follow these authorities. All TX material of this species falls within subsp. *setarius*. Other subspecies found in the U.S. have either longer inflorescence branches, pilose leaf sheaths, or longer spikelets (Peterson et al. 1999). This species has viscid (= adhesive, sticky) awns (Sorensen 1986) which "are undoubtedly very efficient agents in seed dispersal" (Chippindall 1946).

ORYZA L. RICE

A tropical and subtropical C_3 genus of ca. 20–22 wild species and 2 cultivated species, *O. sativa* (ASIAN RICE) and *O. glaberrima* Steud. (AFRICAN RICE) (Lu et al. 2000; Terrell & Barkworth ined.); the approximate number of species occurring in different parts of the world are: 12 species in se Asia and Australia, 6 in Africa, and 3 in the New World (Tucker 1988). *Oryza* is closely related to *Leersia*, CUT GRASS (Ge et al. 2002), and there has been some confusion concerning generic limits. However, *Leersia* lacks glumes, which are consistently present in *Oryza*. There is disagreement over spikelet structure in *Oryza*—e.g., the two bracts beneath the fertile floret are sometimes interpreted as glumes (e.g., Terrell & Barkworth ined., and as done here) or by other workers as sterile lemmas. *Oryza sativa*, ASIAN RICE or RICE, is arguably the world's most important food plant—it is the staple food for 1/2 or more of the world's population (Heiser 1990; Lu et al. 2000). ASIAN RICE is possibly derived from *O. rufipogon* Griff., a wild Asian grass, probably first through selection as a weed in flooded *Colocasia* (TARO—Araceae) fields (ca. 5,000 BC in the Lower Yangtze of China, in Thailand, and n India) and then through artificial selection (Mabberley 1997). Another wild Asian grass, *O. nivara* Sharma & Shastry, is closely related and may also be involved in the origin of ASIAN RICE (Lu et al. 2000). There is "some evidence that the two major Asian races, tropical Indica and cool-tolerant Japonica, were domesticated independently" (Clayton & Renvoize 1986). Several species are considered significant weeds (Watson & Dallwitz 1992), and *O. rufipogon*, BROWN-BEARD RICE, is considered a noxious weed in CA and FL and is listed as a U.S. federal noxious weed (Kartesz 1999; USDA Natural Resources Conservation Service 2002). (Greek: *oryza*, rice, derived from Arabic: *eruz*, rice—Tucker 1988) (subfamily Ehrhartoideae, tribe Oryzeae)

REFERENCES: Tateoka 1963; Adair et al. 1973; Chang 1976, 1988; Terrell 1983; Terrell et al. 1983; Duistermaat 1987; Tucker 1988; Duvall et al. 1993a; Chaturvedi et al. 1998; Whang et al. 1998; Lu et al. 2000; Terrell & Barkworth ined.

Oryza sativa L., (cultivated, sown, or planted), RICE, ASIAN RICE, CULTIVATED RICE, RED RICE. Tufted annual; culms erect, 50–160(–200) cm tall; leaf sheaths usually auriculate; ligule a 2-lobed membrane, ca. 4–16 mm long, rarely longer; leaf blades 20–50(–70) cm long, 5–20 mm wide, sometimes thickened and spongy basally near midrib; inflorescence a panicle, the branches often drooping; spikelets laterally flattened, 7–11 mm long (excluding awns), 2–4 mm wide, sometimes reddish, with 1 perfect flower subtended by 2 pointed, linear-lanceolate glumes usually 1.5–3 mm long; disarticulation below glumes; lemma oblong-ovate, keeled, varying from glabrous to hirsute, usually short-pointed and awnless or with an awn to 5(–70) mm long; palea similar to lemma, awnless; stamens 6. Moist areas; se part of East TX; also Gulf Prairies and Marshes and n South TX Plains; se Canada (Ont.) and se U.S. from VA s to GA w to MO, OK, and TX, also CA. Jul–Dec. Native of Asia. In the s part of East TX and in the Gulf Prairies and



Muhlenbergia reverchonii [HI1]



Muhlenbergia rigens [HI1]



Muhlenbergia schreberi [REE]



Muhlenbergia sobolifera [HI1]



Muhlenbergia sylvatica [USB]



Muhlenbergia utilis [HI1]



Nassella leucotricha [GO1]



Oplismenus hirtellus subsp. setarius [HI1]

Marshes and South TX Plains, RICE is cultivated (e.g., Adair et al. 1973) and is occasionally a waif or weed in moist soils. While less widely distributed than WHEAT, RICE feeds more people, being the basic food for 1/2 or more of the world's human population (Heiser 1990; Lu et al. 2000). Together, RICE, WHEAT, and CORN provide ca. 45–50% of total human caloric intake (Chrispeels & Sadava 1977; Mabberley 1997). Although RICE is usually cultivated in flooded fields (lowland forms), there are some upland forms that are grown on dry land (Clayton & Renvoize 1976; Mabberley 1997). RICE is used in a variety of ways: glutinous forms are used for puddings; non-glutinous forms are widely used in curries, paella, risotto, etc.; the flour is used in cooking, breakfast foods, and in commercial starch; some rice is fermented to produce beer or the wine sake (Mabberley 1997). There are thousands of named and unnamed forms and variations of this species (Tucker 1988). There can be great variability in awn length, from awnless to extremely long (70 mm—*Taylor & Taylor 17203*, BRIT). ☞

PANICUM L. PANIC GRASS

Annuals or perennials with or without rhizomes; basal rosette leaves not developed, the basal leaves few, usually withering by flowering time; ligule usually a membrane, often ciliate or with a fringe of hairs; panicles much-branched, normally produced in one continuous period of bloom, terminal or both terminal and lateral; spikelets awnless, with 2 florets; lower floret sterile or staminate, with lemma resembling upper glume; upper floret perfect, with lemma firm to hardened, glabrous, shiny, with margins inrolled; glumes usually both present, the first typically shorter.

☙ The generic delimitation of *Panicum* has been the focus of considerable and continuing controversy, and the number of taxa recognized has varied widely. As treated in the broadest sense by some authorities, it is a genus of > 600 species in 6 subgenera, making it the largest genus of grasses (Zuloaga 1987) and one of the largest genera of flowering plants (Crins 1991). The segregate genus *Dichanthelium* was recognized by Gould (1974), Gould and Clark (1978), Hatch (2002), and others on the basis of such characters as an overwintering rosette of short broad leaves, the C_3 photosynthetic pathway, and spring chasmogamous inflorescences and small, late-season, axillary, cleistogamous inflorescences. However, the overlap and blurring of these and other characters in Central and South American taxa caused Zuloaga (1987) to question the generic recognition of *Dichanthelium*. Nevertheless, it now seems clear that, based on cladistic analyses of molecular and morphological data (Gómez-Martínez & Culham 2000; Zuloaga et al. 2000; Giussani et al. 2001), *Panicum* in the broad sense is not a monophyletic group. Unfortunately, there is at present insufficient data to definitively determine the best way to divide the genus into segregates. Some authorities (e.g., Yatskievych 1999) are continuing to recognize *Panicum* in the broad sense until further information is available. Other authorities (e.g., Freckmann & Lelong 2003b) segregate *Dichanthelium* and *Steinchisma* but still retain a diverse assemblage of species in *Panicum*. According to Freckmann and Lelong (2003b), recent work "suggests that *Panicum* subg. *Panicum* is a monophyletic group that should have a rank equivalent to *Dichanthelium* and *Steinchisma*. The two other subgenera..., subg. *Agrostoidea* and subg. *Phanopyrum*, are not monophyletic, but the relationships of their species to other members of *Panicum sensu lato* are not well enough understood to suggest a better treatment, nor to justify the name changes a differing generic treatment would require." Thus, until better information is available, we are following Freckmann and Lelong (2003b) in recognizing a rather broadly conceived (and possibly polyphyletic) *Panicum* while treating *Dichanthelium* and *Steinchisma* at the generic level. As thus delimited, *Panicum* may have as many as 525 species; Freckmann and Lelong (2003b) indicated that 72 are native or naturalized in North America. It is a difficult group taxonomically because of complications ranging from apomixis and polyploidy to hybridization and introgression (Freckmann & Lelong 2003b). Some species here treated in *Urochloa* have previously been included in *Panicum*. This is illustrative of the

fact that generic limits among *Panicum* and a number of related genera (e.g., *Brachiaria*, *Dichanthelium*, *Digitaria*, *Eriochloa*, *Paspalidium*, *Sacciolepis*, *Setaria*, and *Urochloa*) need critical revision (Watson & Dallwitz 1992). In *Panicum* and many related Paniceae, the fertile floret is hardened and enclosed by the herbaceous glumes and the lemma of the lower floret—this has been suggested (Davidse 1987a) as a mechanism for internal dispersal by grazing animals—i.e., to protect the seeds on their journey through the gut of the grazer. *Panicum* species are characterized by either C_3 or C_4 photosynthesis (Watson & Dallwitz 1992). They are native from tropical to temperate areas throughout the world, and a number are used as fodders, pasture grasses, grains, or cultivated ornamentals, while others are considered significant weeds (Watson & Dallwitz 1992). The recent treatment by Freckmann and Lelong (2003b) was used extensively in preparing the following key and descriptions. (Latin: *panus*, an ear of millet, or *panis*, bread) (subfamily Panicoideae, tribe Paniceae)

REFERENCES: Hitchcock & Chase 1910; Silveus 1942; Lelong 1984, 1986; McGregor 1985; Zuloaga 1987; Webster 1988, 1992; Webster et al. 1989; Crins 1991; Darbyshire & Cayouette 1995; Zuloaga & Morrone 1996; Zuloaga et al. 2000; Giussani et al. 2001; Freckmann & Lelong 2002, 2003b.

1. Inflorescence branches with spikelets crowded, in general the spikelets borne along only one side of the branches (= secund); spikelets sessile or subsessile, the longest pedicels usually less than 2 mm long, rarely to 3 mm.
   2. Spikelets 5.5–7 mm long; leaf blades 7–30 mm wide; upper floret of each spikelet 1.9–2.2 mm long, less than 1/3 as long as the spikelet (plants sometimes recognized in the monotypic segregate genus *Phanopyrum*) _____ **P. gymnocarpon**
   2. Spikelets 1.6–4.4 mm long; leaf blades 1.5–15 mm wide; upper floret 2/5 as long as to almost equaling the spikelet.
      3. Spikelets swollen, ca. 2 mm wide, apically obtuse; lower glume 3/4 to as long as the spikelet, 5- or 7-veined; plants typically with elongate stolons from a knotty or rhizomatous base _____ **P. obtusum**
      3. Spikelets not swollen, 1 mm or less wide, apically acute to acuminate; lower glume 1/2–2/3 as long as the spikelet, 1- or 3-veined; plants lacking stolons, but often with rhizomes.
         4. Lemma of upper (fertile) floret thin, similar in texture to glumes and lemma of lower floret, clasping the palea only at the base; leaf blades 5–15 mm wide; lower floret staminate; lower palea nearly equal in length to the lower lemma; plants with scaly creeping rhizomes _____ **P. hemitomon**
         4. Lemma of upper floret thick, much different (more rigid) in texture than glumes and lemma of lower floret, clasping the palea its entire length; leaf blades 1.5–12 mm wide; lower floret sterile; lower palea 2/3 or less the length of the lower lemma; plants without OR with scaly creeping rhizomes.
            5. Spikelets 2.3–3.9 mm long, often curved, conspicuously spreading at ca. a 45˚ angle from the branch; plants with scaly creeping rhizomes _____ **P. anceps**
            5. Spikelets 1.6–2.8 mm long, not curved, not conspicuously spreading from the branch; plants without scaly creeping rhizomes.
               6. Leaf blades 2–12 mm wide; lower leaf sheaths strongly compressed, keeled; inflorescences with numerous branches and spikelets; tip of lemma of fertile floret with a few small hairs (use 20x magnification) _____ **P. rigidulum**
               6. Leaf blades 1.5–3(–4) mm wide; lower leaf sheaths rounded, not compressed; inflorescences with few branches and spikelets; tip of lemma of fertile floret glabrous _____ **P. tenerum**

1. Inflorescence branches with spikelets widely spaced OR crowded, the spikelets not borne on only one side of the branches; spikelets pedicellate, the longest pedicels 2–20 mm long.
   7. Spikelets conspicuously warty under a hand lens, the upper glume and lemma of lower floret verrucose or tuberculate.

8. Spikelets 1.7–2.2(–2.5) mm long, ca. 1 mm wide, glabrous; leaf blades 3–10 mm wide; plants of wet habitats _____ **P. verrucosum**
8. Spikelets 3–3.6(–4) mm long, ca. 1.5–2 mm wide, conspicuously hispid; leaf blades 1–3 mm wide; plants of relatively dry habitats _____ **P. brachyanthum**

7. Spikelets glabrous or with various pubescence, but not warty.
9. Culms usually swollen and corm-like at very base; leaf sheaths keeled; upper (fertile) floret finely transversely rugose; spikelets often purplish; species of extreme w margin of East TX _____ **P. bulbosum**
9. Culms neither swollen nor corm-like at base; leaf sheaths not keeled; upper floret usually smooth or striate; spikelets variously colored but usually not purplish; including species widespread in East TX.
10. Culms (at least the lower part) knotty, the conspicuously swollen nodes as much as twice as thick as the middle of the internodes, almost woody (bamboo-like) in texture, 0.5–3 m tall; rhizomes ca. 1 cm thick, bearing pubescent scale-like leaves _____ **P. antidotale**
10. Culms not as above; rhizomes absent or less than 0.5 cm thick, bearing glabrous scale-like leaves.
11. Plants perennial, with long-creeping or short knotty rhizomes; lower floret of each spikelet staminate.
12. Spikelets usually gaping open at apex; lower glume > 1/2 as long as spikelet; culms 3–5 mm thick; ligule (1.5–)2–6 mm long _____ **P. virgatum**
12. Spikelets not gaping open at apex or only slightly so (except often gaping open in *Steinchisma hians* which was previously included in *Panicum*); lower glume < 1/2 as long as spikelet; culms < 3 mm thick; ligule 0.5–2 mm long.
13. Lower glume truncate to rounded to broadly acute, 1 mm or less long; spikelets 2.2–2.8 mm long; plants with long scaly rhizomes; upper (fertile) floret widest at or above the middle, rounded apically _____ **P. repens**
13. Lower glume abruptly narrowed to an acute apex, 1 mm or more long; spikelets (2.5–)2.8–3.5 mm long; plants with only short knotty rhizomes; upper (fertile) floret widest below the middle, narrowed to a minute apical beak _____ **P. coloratum**
11. Plants annual or perennial, usually without rhizomes; lower floret of each spikelet sterile.
14. Lower (first) glume about 1/4–1/3 as long as spikelet, apically truncate to rounded or broadly acute; leaf sheaths ± compressed, usually glabrous or sparsely pubescent; culms slightly succulent _____ **P. dichotomiflorum**
14. Lower glume 1/3 or more as long as spikelet, apically acute or acuminate; leaf sheaths rounded, glabrous to with conspicuous pubescence; culms not succulent.
15. Spikelets 4–6.5 mm long; EITHER spikelets ca. 2–2.5 mm wide OR upper glume and lemma of lower floret exceeding the fertile floret by 3–4 mm.
16. Spikelets ca. 2–2.5 mm wide, ovoid; upper glume and lemma of lower floret exceeding the fertile floret by only ca. 1 mm; fertile floret 3–3.8 mm long _____ **P. miliaceum**
16. Spikelets < 1.5 mm wide, lanceolate; upper glume and lemma of lower floret exceeding the fertile floret by 3–4 mm; fertile floret 1.6–2 mm long _____ **P. capillarioides**
15. Spikelets 1–3.7(–4.2) mm long; spikelets much less than 2 mm wide AND glume and lemma of lower floret not exceeding the fertile floret by 3–4 mm.
17. Spikelets very small, 1–1.4 mm long; leaf blades 2–7 cm long; species reported in East TX only from Travis Co. _____ **P. trichoides**

17. Spikelets 2–3.7(–4.2) mm long; leaf blades 3–60 cm long; including species widespread in East TX.
    18. Plants perennial, usually somewhat thickened basally; leaf sheaths usually glabrous but varying to hispid or hirsute; inflorescences usually 1/2 or less the height of the entire plant.
        19. Lower inflorescence branches usually in whorls of 3–7, pilose in the axils; inflorescences detaching at base and acting as tumbleweeds _____ **P. bergii**
        19. Lower inflorescence branches solitary, glabrescent in the axils; inflorescences not detaching at base.
            20. Palea of sterile (lower) floret enlarged and indurate at maturity, giving the spikelets an expanded appearance (spikelets at maturity gaping open at apex), the sterile floret with palea much larger than lemma; spikelets 1.8–2.4 mm long (previously in *Panicum* subgenus *Steinchisma*) _____ see **Steinchisma hians**
            20. Palea of sterile (lower) floret neither enlarged nor indurate, the spikelets neither with an expanded appearance nor gaping open, the sterile floret with palea much smaller than lemma; spikelets 2.1–3.7(–4.2) mm long.
                21. Leaf sheath margins often ciliate with a line of ascending hairs; nodes spreading-pilose; leaf blades usually sparsely hirsute on lower (= abaxial) surface; plants green _____ **P. diffusum**
                21. Leaf sheath margins glabrous or with a tuft of hairs at the summit, not ciliate; nodes appressed-pubescent or glabrous; leaf blades glabrous or nearly so on lower surface; plants often glaucous _____ **P. hallii**
    18. Plants annual, not noticeably thickened basally; leaf sheaths conspicuously hispid or hirsute; inflorescences usually 1/2 or more the height of the entire plant (except in *P. capillare* var. *sylvaticum*).
        22. Inflorescences usually 6 cm or less wide, more than twice as long as wide, the main branches ascending; pulvini (= swellings) at base of lower inflorescence branches pubescent; leaf blades 1–7 mm wide _____ **P. flexile**
        22. Inflorescences 4–24 cm wide, often less than twice as long as wide but sometimes more, the main branches widely spreading to spreading-ascending; pulvini at base of lower inflorescence branches glabrous; leaf blades 2–18(–25) mm wide _____ **P. capillare**

Panicum anceps Michx., (two-edged), BEAKED PANICUM. Perennial 30–100(–130) cm tall with scaly, often stout rhizomes; ligule a minute membranous collar 0.4 mm or less long; inflorescence branches 1-sided; spikelets subsessile, 2.3–3.9 mm long, often curved, conspicuously spreading at ca. a 45° angle from the branch. Low moist areas, often in sandy soils; widespread in East TX; also Gulf Prairies and Marshes and e Cross Timbers and Prairies; e U.S. from NY s to FL w to KS and TX. Jul–Nov. [*P. anceps* var. *rhizomatum* (Hitchc. & Chase) Fernald, *P. anceps* subsp. *rhizomatum* (Hitchc. & Chase) Freckmann & Lelong, *P. rhizomatum* Hitchc. & Chase] Plants with short spikelets (2.3–2.8 mm long) and relatively long, slender rhizomes are recognized by Jones et al. (1997) as var. *rhizomatum* and by Freckmann and Lelong (2003b) as subsp. *rhizomatum*.

Panicum antidotale Retz., (acting as or of the nature of an antidote), BLUE PANIC, BLUE PANIC GRASS. Rhizomatous perennial 0.5–2(–3) m tall; ligule 1.5 mm or less long; rhizomes ca. 1 cm thick; culms becoming almost woody (bamboo-like), much-branched, knobby, the swollen nodes conspicuously thicker than the internodes; spikelets 2.4–3.4 mm long; lower glume 1/2 as long as spikelet or less, rounded to obtuse apically. Recommended by some for planting as a forage grass and used in range reseeding (Gould 1975b); Bexar, Brazos, McLennan, and Travis (Turner et al. 2003) cos.; widely scattered in TX, but primarily s 1/2; sporadically across the s 1/3 of the U.S. from NC s to FL w to CA. Spring–fall. Native of India. This species is considered a noxious weed in CA (Kartesz 1999). ⊘ ☜

Panicum bergii Arechav., (for F.G.C. Berg, former director of the Museo Nacional de Buenos Aires, Argentina), BERG'S WITCHGRASS. Tufted perennial 50–100(–140) cm tall; lower nodes with a collar of hairs; leaves with sheaths glabrous or often sparsely to densely pilose, the blades densely so at base; ligule a short membranous base ca. 0.5 mm long with fringe of hairs to 3 mm long; panicles ca. 1/3–1/2 the height of the entire plant, open, the whole inflorescence detaching as a tumbleweed at maturity, the lower panicle branches in verticils of 3–7, stiffly spreading, the secondary branches usually from distal 1/3 of primary branches; spikelets glabrous, 2–3 mm long. Low areas, ditches; Austin, Brazos, Navarro (BRIT), Colorado, Harris, and Waller (Turner et al. 2003) cos.; also Gulf Prairies and Marshes and McMullen Co. (Turner et al. 2003) in the South TX Plains; AL and TX. Late Apr–May. Native of e South America. [*P. pilcomayense* Hack.] While this species was long treated as *P. pilcomayense*, *P. bergii* is an older name and thus has nomenclatural priority. ☜

Panicum brachyanthum Steud., (short-flowered), PIMPLE PANICUM, PRAIRIE PANIC GRASS. Largely glabrous annual with erect to decumbent culms to ca. 100 cm long; ligule usually 0.3 mm or less long; leaf blades 1–3 mm wide; panicles few-flowered; spikelets 3–3.6(–4) mm long, conspicuously warty, covered with short stiff hairs. Open, often sandy woods, fencerows, along highways, relatively dry habitats; Pineywoods and Post Oak Savannah; also Gulf Prairies and Marshes; AR, GA, LA, MS, OK, and TX. Aug–Nov. This species resembles *P. verrucosum*, also with warty spikelets—however, that species has glabrous, much smaller spikelets only 1.7–2.5 mm long, broader leaf blades, and a preference for wetter habitats.

Panicum bulbosum Kunth, (bulbose), BULB PANIC GRASS. Rhizomatous perennial; culms 1.4(–2) m or less tall, usually with swollen, corm-like bases; spikelets usually 2.8–4.2(–5.4) mm long; fertile floret finely transversely rugose. Gravelly river banks; Bexar and Bell (Turner et al. 2003) cos.; mainly w 1/3 of TX; AZ, NM, NV, and TX. (Jul–)Aug–mid-Oct. This species is used in parts of its range as a forage grass and for hay (Freckmann & Lelong 2003b). The county distribution map includes plants sometimes treated as *P. plenum* Hitchc. & Chase. Freckmann and Lelong (2003b) recognized these plants as a distinct species, based on smaller spikelets (2.5–3.4 mm long), longer rhizomes, and culm bases not swollen. Hatch (2002) did not mention *P. plenum*, and Turner et al. (2003) included it in *P. bulbosum*. Additional work needs to be done to determine the appropriate disposition of these taxa.

Panicum capillare L., (hair-like), WITCH GRASS. Annual with erect to partly decumbent culms usually (8–)20–100 cm long; leaf blades usually hirsute or pilose on both surfaces or glabrous on the upper surface (occasionally merely ciliate marginally below); leaf sheaths with papilla-based hairs; ligule of hairs, 2 mm or less long; inflorescence very open (the branches widely spreading to spreading-ascending), large for size of plant (often > 1/2 height of plant), often with reddish or purplish coloration; peduncle often detaching at maturity and the inflorescence acting as a tumbleweed (Crins 1991; Freckmann & Lelong 2003b); spikelets 1.4–3.5(–4) mm long; palea of lower floret usually absent (do not be confused by lodicules); lemma of fertile floret without a crescent-shaped marking at base. Open areas, disturbed sites, and banks of ponds and streams; widespread in TX; s Canada and nearly throughout the U.S. May–Nov. This



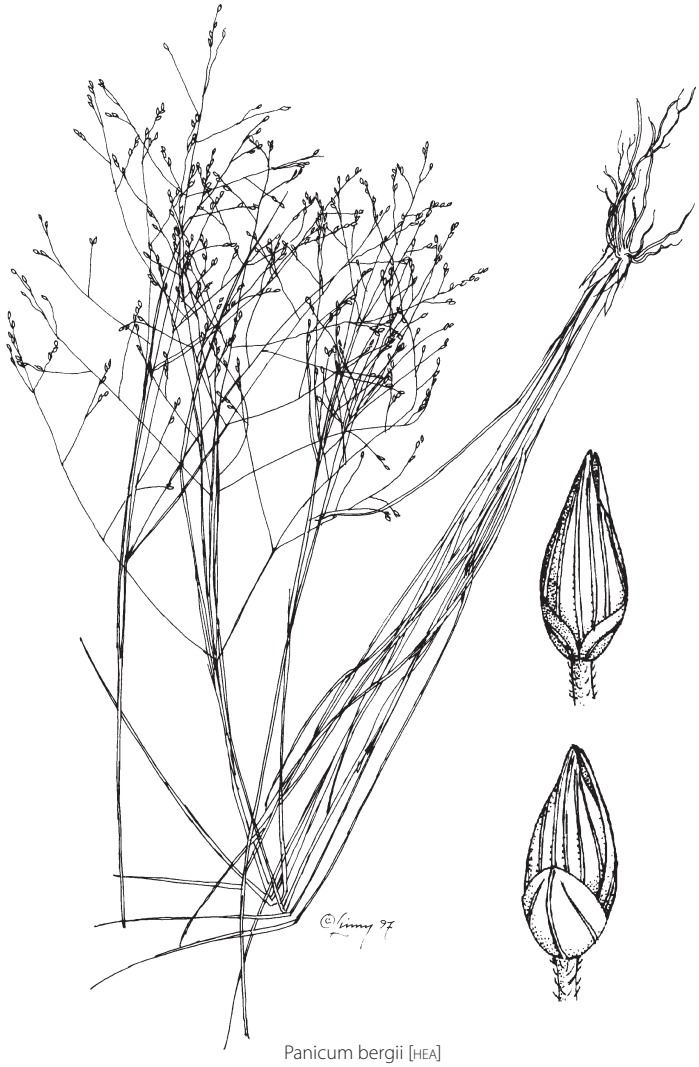
Oryza sativa [HI1]



Panicum anceps [USB]



Panicum antidotale [GO1]



Panicum bergii [HEA]



Panicum brachyanthum [GO1]



Panicum bulbosum [HI1, USB]

species is superficially quite similar to the unrelated *Digitaria cognata* which differs in having essentially glabrous leaves and usually spikelets which lack a lower glume (or have the lower glume vestigial). There is a lack of agreement on how to treat the variation seen in *P. capillare* and its relatives, with some authorities including all the taxa in an undivided *P. capillare* (e.g., Turner et al. 2003), while others variously recognize a number of separate species, subspecies, or varieties. For example, some authors (e.g., McGregor 1985; Zuloaga & Morrone 1996; Diggs et al. 1999; Hatch 2002) treat *P. hillmanii* Chase, which occurs to the w of East TX (e.g., Archer and Brown cos.—BRIT), as a distinct species—it has the lower floret with a palea, inflorescence usually without reddish or purplish coloration, and lemma of fertile floret with a crescent-shaped marking at base. Alternatively, Freckmann and Lelong (2003b) treated these plants as *P. capillare* subsp. *hillmanii* (Chase) Freckmann & Lelong, but recognized no other infraspecific taxa. The description of *P. capillare* given above does not apply to these plants. Hatch (2002) and Freckmann and Lelong (2003b) recognized the similar *P. philadelphicum* as a distinct species. However, Jones et al. (1997) treated it as a variety (var. *sylvaticum*) of *P. capillare*, while Turner et al. (2003) simply synonymized it with *P. capillare*. According to Freckmann and Lelong (2003b), *P. capillare* "appears to hybridize" with *P. philadelphicum*. Because of the morphological similarity and hybridization, until further research is done, we are recognizing the variation seen in this complex at the varietal level. The county distribution map includes all three varieties of *P. capillare* (including taxa previously treated as *P. hillmanii* and *P. philadelphicum*). Freckmann and Lelong (2003b) separated the two taxa occurring in East TX using the following characters:

1. Panicles usually more than 1/2 the total height of the plant, breaking at the base of the peduncle at maturity and becoming a tumbleweed; spikelets 1.9–4 mm long; mature upper florets stramineous or nigrescent _____ var. **capillare**
1. Panicles usually less than 1/2 the total height of the plant, the base of the peduncle usually not breaking at maturity; spikelets 1.4–2.4 mm long; mature upper florets often dark brown _____ var. **sylvaticum** [*P. philadelphicum*]

var. **capillare**, WITCH GRASS. Widespread in TX; s Canada and nearly throughout the U.S. May–Nov.

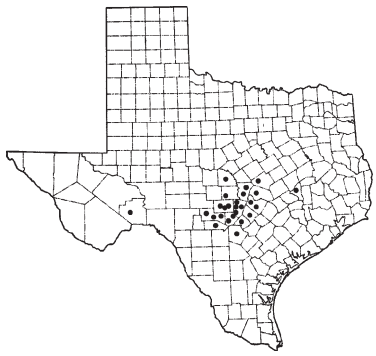
var. **sylvaticum** Torr., (forest-loving), PHILADELPHIA WITCH GRASS, PHILADELPHIA PANIC GRASS, WOOD WITCH GRASS. Similar to var. *capillare*, distinguished as in the key; inflorescence usually 1/3–1/2 as broad as long. Sandy or gravelly soils; e 1/3 of TX (e.g., Dallas Co.—*Reverchon 1842*, MO—Zuloaga & Morrone 1996); se Canada and widespread in e 1/2 of the U.S. Summer–early fall. [*P. philadelphicum* Benth. ex Trin.] This taxon intergrades with var. *capillare*, apparently as a result of hybridization (Freckmann & Lelong 2003b).

Panicum capillarioides Vasey, (presumably resembling *Panicum capillare*, witch grass), LONG-BEAK WITCH GRASS. Hirsute perennial from a knotty crown; culms 30–60(–75) cm tall; ligule ca. 0.5–1 mm long; spikelets 5–6.5 mm long, long-acuminate, glabrous; upper glume and lemma of lower floret exceeding the upper floret by 3–4 mm. Grasslands, savannahs, often in sandy soils; Bexar (BRIT), DeWitt, and Gonzales (Turner et al. 2003) cos. near s margin of East TX; mainly Gulf Prairies and Marshes and South TX Plains; in the U.S. known only from TX; also Mexico. Apr–Dec. Gould (1975b) noted that this species is "readily distinguished by the peculiarly elongated second glume and by the lemma of the lower floret, both of which are much prolonged beyond the fruit ..."

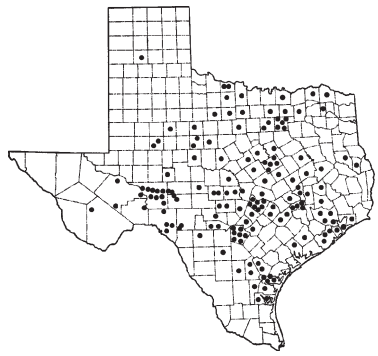
Panicum coloratum L., (colored), KLEIN GRASS, BUFFALO GRASS. Tufted perennial usually 60–135 cm tall from often short, knotty rhizomes; leaf sheaths glabrous or with papilla-based hairs; ligule a fringed membrane 0.5–2 mm long including hairs; leaf blades glabrous or sparsely hairy; spikelets (2.5–)2.8–3.5 mm long, glabrous; lower glume ca. 1/4 as long as spikelet, abruptly narrowed to an acute apex. Introduced as a forage grass, open usually wet areas; scattered in e



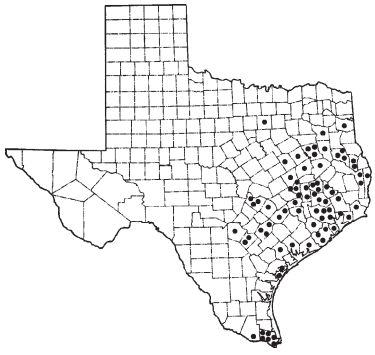
Muhlenbergia sobolifera



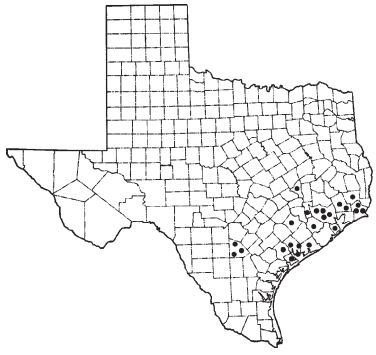
Muhlenbergia utilis



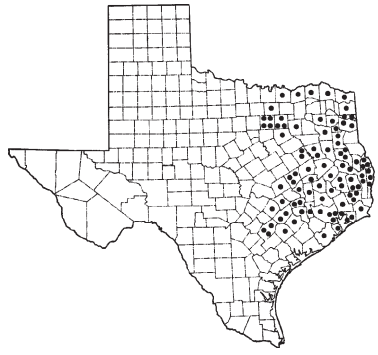
Nassella leucotricha



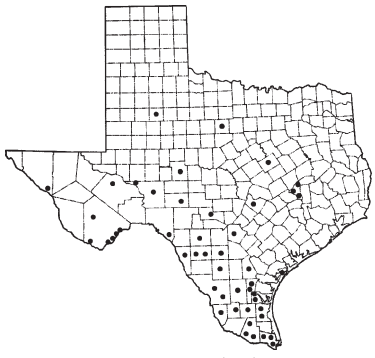
Oplismenus hirtellus subsp. setarius



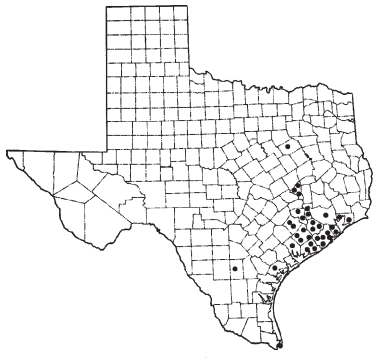
Oryza sativa



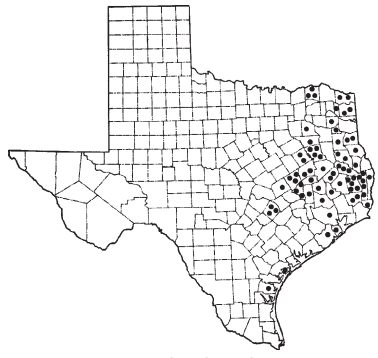
Panicum anceps



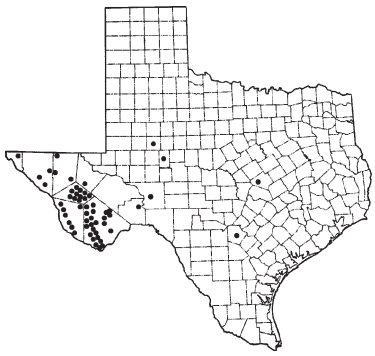
Panicum antidotale



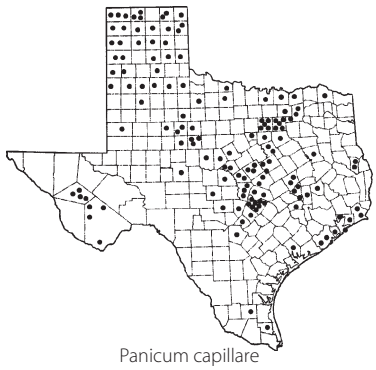
Panicum bergii



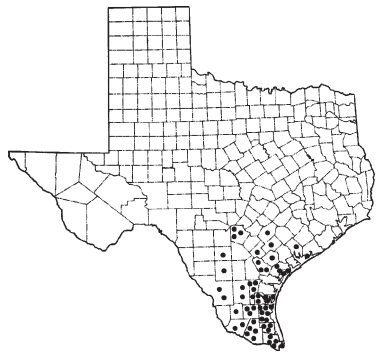
Panicum brachyanthum



Panicum bulbosum



Panicum capillare
(all three vars.)



Panicum capillarioides

2/3 of TX; NM and TX. May–Sep. Native to Africa. While widely grown for fodder and forage, under certain conditions, KLEIN GRASS is known to cause photosensitization (= increased sensitivity to light, thus easily sunburned) and liver damage in sheep, goats, and horses; the cause is possibly saponins (Burrows & Tyrl 2001; Hart et al. 2001). ☠ ☜

Panicum dichotomiflorum Michx., (with flowers in pairs on equal branches—even though this is often not the case—Zimdahl 1989), FALL PANICUM, SPREADING WITCH GRASS. Coarse annual with culms 1–2 m long, erect or trailing, slightly succulent; ligule a 0.5–1 mm long membrane with cilia ca. 2 mm long; leaf blades usually glabrous (rarely puberulent); spikelets 2.3–3(–3.8) mm long, glabrous; lower glumes 1/4–1/3 as long as spikelets. Moist, disturbed soils; widespread in TX, but primarily in the e 1/2 of the state; scattered in s Canada and nearly throughout the U.S. Aug–Nov. This species can cause photosensitization in livestock (Burrows & Tyrl 2001). ☠

Panicum diffusum Sw., (diffuse, spreading), SPREADING PANICUM, SPREADING WITCH GRASS. Perennial in small dense tufts, from short rhizomes; culms slender, spreading (rarely ascending), often branching, usually to ca. 30 cm long but occasionally much longer (to 100 cm); nodes spreading-pilose; leaf sheaths glabrous or with papilla-based hairs; ligule a membrane ca. 0.5–1 mm long, with cilia 1–2 mm long; spikelets 2.1–2.7(–2.9) mm long, glabrous. Disturbed wet areas, highway margins, loamy or clayey soils; Brazos, Grayson, Hopkins, McLennan, and Robertson (BRIT) cos.; scattered in TX; cited by Gould (1975b) and Hatch (2002) for vegetational areas 2, 3, 4, 5, 6, 7, 8, and 10; in the continental U.S. known only from TX; also Latin America. Apr–Nov. Zuloaga and Morrone (1996) considered this species to occur on the Caribbean Islands but not in the U.S. Jones et al. (1997) synonymized it with *P. hallii* var. *filipes*. Stephan Hatch (pers. comm. and 2002) considers it to occur in TX and to be distinct from *P. hallii*, as do Freckmann and Lelong (2003b). According to Gould (1975b), *P. diffusum* differs from *P. hallii* var. *filipes* "in usually having a prostrate growth habit, green, not glaucous leaves and the tetraploid ($2n = 36$) chromosome complement." We are tentatively following Hatch (2002) and Freckmann and Lelong (2003) in treating this taxon at the species level. However, based on its morphological similarity to *P. hallii* var. *filipes*, varietal recognition may be more appropriate. Further research needs to be done on this taxon to definitively determine its appropriate rank and to document its distribution in TX.

Panicum flexile (Gatt.) Scribn., (pliant, limber), WIRY WITCH GRASS. Delicate tufted annual; culms 10–75 cm long, only ca. 1 mm in diam., the nodes densely pilose; panicle 1/2 or more the height of the plant; spikelets (2.5–)3–3.4(–3.7) mm long. Moist to wet areas, pastures, open woods, Weches outcrops; San Augustine Co. (*George & Nixon 96*, 1986, ASTC; cited by Turner et al. 2003 as *P. flexicaule*), also Red River Co. (Correll & Johnston 1970); apparently known in TX from only these two counties; se Canada and widespread in the e U.S. w to ND and TX. Summer–early fall. [P. *capillare* var. *flexile* Gatt., *P. flexicaule* of Turner et al. 2003—apparently misspelled] While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

Panicum gymnocarpon Elliott, (bearing naked fruit), SAVANNAH PANICUM, SAVANNAH PANIC GRASS. Stout glabrous annual; culms to 100 cm tall from sprawling or creeping bases to 2 m long, these rooting at the nodes; ligule 0.5–1(–1.5) mm long; inflorescence branches with spikelets borne along one side; spikelets 5.5–7 mm long, only ca. 1 mm wide, glabrous; upper floret 1.9–2.2 mm long, ca. 1/3 or less as long as the spikelet. Wet forests; primarily s portions of Pineywoods and Post Oak Savannah; also n Gulf Prairies and Marshes; se U.S. from NC s to FL w to TX and OK. Jul–Oct. [*Phanopyrum gymnocarpon* (Elliott) Nash] This distinctive species is sometimes recognized in the monotypic segregate genus *Phanopyrum* (e.g., Small 1903). More recently, it has been treated as the only species in *Panicum* subgenus *Phanopyrum* section *Phanopyrum* (e.g., by Freckmann & Lelong 2003b). Freckmann and Lelong (2003b) noted that *P. gymnocarpon* often forms extensive colonies.

Panicum hallii Vasey, (for its discoverer, Elihu Hall, 1822–1882, American botanist and explorer of the Rocky Mts.), HALL'S WITCH GRASS. Tufted perennial 12–80(–100) cm tall; ligule to 2 mm long, a short, fibrous, readily splitting membrane with a fringe of hairs; panicle open, rather small. Prairies, disturbed sites, most commonly on limestone or calcareous clay but also on sand and gravel. Apr–Nov. The county distribution map does not distinguish varieties. Freckmann and Lelong (2003b) treated infraspecific variation in *P. hallii* at the subspecies level.

1. Panicle usually only slightly exceeding the leaf blades and usually with > 15 branches; spikelets 2–3 mm long, ± crowded on the branches; leaves neither clustered at plant base nor curled at maturity; leaf sheaths without papilla-based hairs _____ var. **filipes**
1. Panicle usually much exceeding the leaf blades and usually with < 15 branches; spikelets 3–3.7(–4.2) mm long, not crowded, the branches with relatively few spikelets; leaves clustered near plant base, curled at maturity; leaf sheaths mostly with papilla-based hairs _____ var. **hallii**

var. **filipes** (Scribn.) F.R. Waller, (slender), FILLY PANICUM. Often in moist soils; widely distributed in TX; AZ, LA, NM, and TX. [*P. filipes* Scribn., *P. hallii* subsp. *filipes* (Scribn.) Freckmann & Lelong] This variety is similar to *P. diffusum*; see discussion under that species.

var. **hallii**, HALL'S PANIC. Nearly throughout TX; AZ, CO, KS, NM, OK, and TX. [*P. lepidulum* Hitchc. & Chase] This taxon is reported to usually grow on drier sites than does var. *filipes* (Freckmann & Lelong 2003b).

Panicum hemitomon Schult., (half-cut or halved, apparently from the spikelets borne on 1 side of the branches), MAIDEN-CANE, SIMPSON'S GRASS. Robust perennial with scaly creeping rhizomes; culms to 1.5(–2) m tall; ligule < 1 mm long; inflorescence narrow, usually < 15 mm wide, the branches bearing spikelets to their bases, the spikelets on 1 side of the branches; spikelets 2–2.6(–2.8) mm long; lemma of fertile floret relatively thin, flexible, clasping the palea only basally. In water or wet areas of ditches, lake shores, ponds, riverbanks, marshes, and swamps; primarily s portions of Pineywoods and Post Oak Savannah; also n Gulf Prairies and Marshes; se U.S. from NJ s to FL w to TX. Apr–Sep. This aquatic or semi-aquatic species can form extensive colonies or nearly pure stands, often with sterile shoots far outnumbering the fertile shoots (Gould 1975b; Freckmann & Lelong 2003b).

Panicum miliaceum L., (like millet grass—*Milium*), PROSO MILLET, BROOMCORN MILLET, PROSO, HOG MILLET, RUSSIAN MILLET, COMMON MILLET. Coarse annual 20–100(–120) cm tall; leaf sheaths with long papilla-based hairs; ligule a fringed membrane ca. 1–3 mm long including the hairs; leaf blades variously pubescent to glabrous; inflorescence ± contracted, usually nodding; spikelets plump, 4–6 mm long, 2–2.5 mm wide; palea of lower floret truncate to bilobed; fertile floret not disarticulating at maturity. Persisting or escaping from cultivation in disturbed areas; Burleson, Robertson (TAES), Bexar, and Red River (Turner et al. 2003) cos; also Montague Co. (BRIT) in Cross Timbers and Prairies and Uvalde Co. (Turner et al. 2003) near n margin of South TX Plains; s Canada and throughout most of the U.S. Jul–Nov. Native to the Old World, probably c Asia (Zohary & Hopf 1994). This species is cultivated in Asia and Europe as a grain crop for humans and for fodder and has been grown since prehistoric times in China and India (Freckmann & Lelong 2003b). In the U.S. it is more commonly used as animal food and is widely used as a component of birdseed (Freckmann & Lelong 2003b). An advantage is that it has "one of the lowest water requirements of any cereal grain" (Freckmann & Lelong 2003b). In some areas it can become a problematic weed (Crins 1991); it is considered a noxious weed in CO and OR (Kartesz 1999). ⊘ ☜

Panicum obtusum Kunth, (blunt), VINE-MESQUITE. Perennial from knotty, rhizomatous base, producing long slender stolons to 2 m long; culms erect or partly decumbent, 12–60(–80) cm tall; nodes densely hairy (on stolons) or nearly glabrous (on erect culms); ligule a short membrane 0.2–2 mm long; leaf blades usually ± glabrous; inflorescence narrow, spike-like, the spikelets

borne on 1 side of the branches; spikelets swollen, glabrous, (2.8–)3.4–4(–4.4) mm long, ca. 2 mm wide; glumes slightly shorter than to as long as spikelet. Low prairies, roadsides, seasonally wet areas; nearly throughout TX except Pineywoods; c U.S. from MO s to TX w to UT and AZ. May–Oct. This native is sometimes planted as a pasture grass or for erosion control.

Panicum repens L., (creeping), TORPEDO GRASS. Perennial from long scaly rhizomes; culms 20–75(–90) cm tall; ligule 0.5–1 mm long; inflorescence narrow (usually < 5 cm wide); spikelets 2.2–2.8 mm long, glabrous; lower glume truncate to rounded or broadly acute, 1/5–1/3(–2/5) as long as spikelet. Moist beaches, lake shores, sandy soils, "occasionally extending out into or onto the water" (Freckmann & Lelong 2003b); Sabine Co. (E. Keith, pers. comm.) and Jefferson Co. (Turner et al. 2003) at extreme se margin of East TX; mainly n Gulf Prairies and Marshes; se U.S. from SC s to FL w to TX, also CA. Late Aug–Oct. Tropical and subtropical coasts worldwide; possibly not native to the U.S. (Gould 1975b; Freckmann & Lelong 2003b). [*P. gouinii* E. Fourn.] This species is considered a noxious weed in HI (Kartesz 1999) and is a prohibited plant in TX (Texas Parks & Wildlife 2003b). ⊘ ?☜

Panicum rigidulum Bosc ex Nees, (somewhat rigid), RED-TOP PANIC, RED-TOP PANICUM. Clump-forming perennial 30–125 cm tall, without conspicuous rhizomes; culms and leaf sheaths compressed, the sheaths sharply keeled, glabrous or sometimes hispid; ligule a ragged, ciliate, short membrane 0.3–3 mm long; leaf blades glabrous or sparsely hispid to pilose; spikelets rather crowded, borne along 1 side of the panicle branches, 1.6–2.7 mm long. Damp sandy woods and thickets, disturbed sites, wet areas, often in partial shade; widespread in e 1/3 of TX w to e Cross Timbers and Prairies and e Edwards Plateau; se Canada and widespread in the e U.S. w to WI and TX, also CA and OR. Jun–Oct. [*P. agrostoides* Spreng.] A number of infraspecific taxa are often recognized in this species (e.g., Lelong 1984; Kartesz 1994, 1999; Jones et al. 1997). Lelong (1986) gave a key separating four varieties, and Freckmann and Lelong (2003b) recognized five subspecies. Other authorities (e.g., Hatch 2002; Turner et al. 2003) do not recognize infraspecific taxa. All East TX material seems to belong to two taxa (here treated as varieties), var. *pubescens* and var. *rigidulum*; these are not distinguished on the county distribution map. They can be separated as follows based on Freckmann and Lelong (2003b):

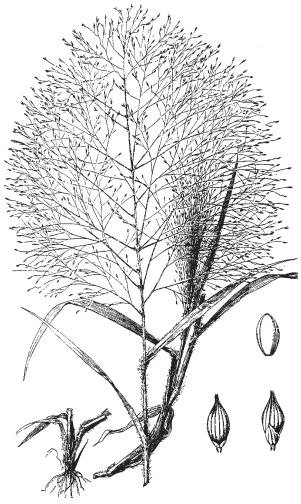
1. Leaf blades usually 5–12 mm wide, flat, mostly glabrous or scabridulous adaxially (= on upper surface); spikelets 1.6–2.5 mm long _____ var. **rigidulum**
1. Leaf blades usually 2–7 mm wide, often folded or involute, usually pilose adaxially, at least near the base; spikelets 2–2.7 mm long _____ var. **pubescens**

var. **pubescens** (Vasey) Lelong, (downy). [*P. anceps* Michx. var. *pubescens* (Vasey) Fernald, *P. longifolium* Torr., *P. rigidulum* subsp. *pubescens* (Vasey) Freckmann & Lelong]

var. **rigidulum**. [*P. agrostoides* Spreng., *P. condensum* Nash, *P. rigidulum* subsp. *rigidulum*] According to Freckmann and Lelong (2003b), this is "the most common, most variable, and widest ranging" of the infraspecific taxa.

Panicum tenerum Beyr. ex Trin., (tender, soft), BLUE-JOINT PANIC GRASS, SOUTHEASTERN PANIC GRASS. Tufted perennial with short knotted rhizomes; culms 40–100 cm tall; ligule 0.4 mm or less long; leaf blades 1.5–3(–4) mm wide; inflorescence of few spikelets, contracted, < 1 cm wide, the spikelets borne on 1 side of the branches; pedicels usually with a few apical hairs; spikelets (1.8–)2.2–2.8 mm long. Wet to moist, usually sandy soils of savannahs and other wetland habitats; Angelina, Hardin, Newton (BRIT), San Augustine, San Jacinto, and Tyler (Turner et al. 2003) cos.; se Pineywoods; se U.S. from NC s to FL w to TX. May–Jul. According to Freckmann and Lelong (2003b), "*Panicum tenerum* exhibits numerous features of the widespread and polymorphic *Panicum rigidulum*."

Panicum trichoides Sw., (resembling hair, fine as hair), TROPICAL PANIC GRASS, SMALL-FLOWER PANIC GRASS. Annual; culms with long-creeping bases rooting at the nodes, to 100 cm long; leaf



Panicum capillare var. capillare [HI1]



Panicum capillarioides [HI1, USB]



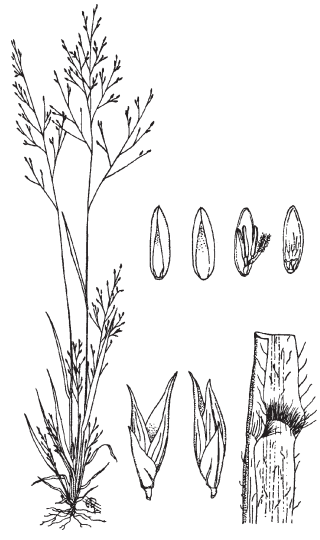
Panicum coloratum [HEA]



Panicum dichotomiflorum [REE]



Panicum diffusum [HEA, USH]



Panicum flexile [CRO]



Panicum gymnocarpon [USB]



Panicum hallii var. filipes [USB]



Panicum hallii var. hallii [HI1]

blades broad, 2–7 cm long, 5–22 mm wide, only 4–6 times as long as wide; inflorescence open; pedicels elongate, 9–20 mm long; spikelets 1–1.4 mm long, with sparse pubescence. Moist weedy areas; Travis Co. (Turner et al. 2003) near w margin of East TX; also Cameron Co. (Gould 1975b; Turner et al. 2003) at the s tip of TX; in the U.S. known only from TX. Aug–Oct. Native to Latin America. According to Gould (1975b), this species is "probably not established" in TX.

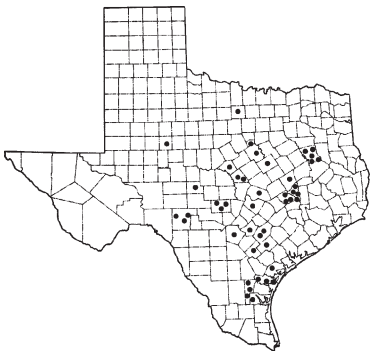
Panicum verrucosum Muhl., (warty), WARTY PANICUM, WARTY PANIC GRASS. Glabrous annual with erect to decumbent culms to 120(–150) cm long; ligule 0.5 mm or less long; leaf blades 3–10 mm wide; panicle few-flowered; spikelets 1.7–2.2(–2.5) mm long, conspicuously warty, glabrous. Moist to marshy areas and open woodlands, sandy soils; widespread in Pineywoods and Post Oak Savannah; e U.S. from MA s to FL w to MO and TX. Jul–Nov. See description of *P. brachyanthum* for comparison with that similar species.

Panicum virgatum L., (twiggy, wand-like), SWITCH GRASS. Large rhizomatous perennial 0.6–2(–3) m tall; nodes glabrous; leaf sheaths usually glabrous; ligule a fringed membrane (1.5–)2–6 mm long; leaf blades 3–15 mm wide, glabrous or often pilose at base; panicle large, usually 15–55 cm long, the branches spreading to ascending; spikelets acuminate-pointed, 2.8–5 mm long, usually gaping open at apex; lower glume > 1/2 as long as spikelet. Low moist areas and prairies; throughout TX; se Canada and throughout most of the U.S. Aug–Nov. SWITCH GRASS was one of the dominants in the original tall grass prairie; it is considered one of the "big four" tall grasses along with *Andropogon gerardii, Schizachyrium scoparium,* and *Sorghastrum nutans*. However, its abundance in native grasslands decreases with grazing (Freckmann & Lelong 2003b). This species is seen in East TX in two growth forms: 1) LOWLAND SWITCH GRASS—very large isolated clumps often nearly 2(–3) m tall, usually in low moist areas, and 2) UPLAND SWITCH GRASS—shorter plants not apparently clumped, with culms more scattered along the creeping rhizomes, found in drier sites. Davis et al. (1995) pointed out additional differences and suggested the variation is possibly worthy of taxonomic recognition. The morphological variation seen is not surprising since the species is quite variable in terms of chromosomal makeup—"plants in a small area can range from diploid through duodecaploid [12X], with dysploid derivatives" (Freckmann & Lelong 2003b). While native to North America, this species has been introduced as a forage species to other parts of the world (Freckmann & Lelong 2003b).

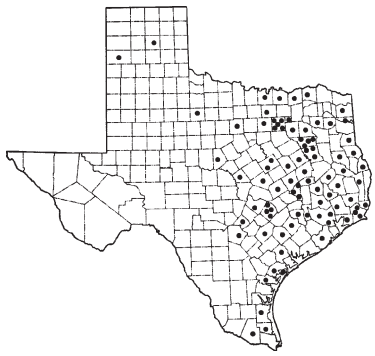
PAPPOPHORUM Schreb. PAPPUS GRASS

A New World C_4 genus of 8 species (Reeder & Toolin 1989; Reeder 2003) ranging from the s U.S. to Argentina. There has been taxonomic confusion in the past, with the number of species recognized ranging from 8–20 (Reeder & Toolin 1989). Preliminary molecular data (Hilu & Alice 2001) suggest an affinity with some species of *Eragrostis*. Salt glands, to dispose of excess salt, have been observed in two species (as in a number of other species of subfamily Chloridoideae) (Taleisnik & Anton 1988). (Greek: *pappos*, pappus, and *phoros*, bearing, in reference to the pappus-like crown of the lemma) (subfamily Chloridoideae, tribe Pappophoreae)
REFERENCES: Pensiero 1986; Taleisnik & Anton 1988; Reeder & Toolin 1989; Reeder 2003.

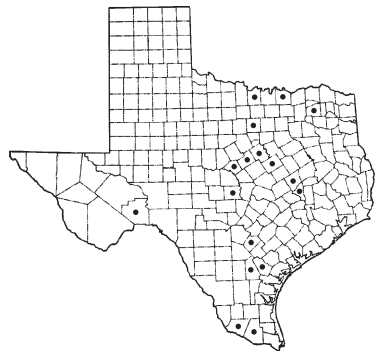
Pappophorum bicolor E. Fourn., (two-colored), PINK PAPPUS GRASS. Tufted perennial to 100 cm tall; ligule a ring of hairs ca. 1 mm long; leaf blades 5 mm or less wide; inflorescence a contracted spike-like panicle to ca. 20 cm long, often with some erect-spreading branches, pink or purplish at maturity; spikelets 6–8(–10) mm long (including numerous awns), composed of 2–3 perfect florets with 1–2 reduced florets above, disarticulating above the glumes, the florets falling as a unit; lemmas rounded on the back, indistinctly many-veined, with 11–15 awns; bodies of lower lemmas 2.5–4 mm long; awns variable in length, the longest 2.5–5(–6) mm long, to 1.5 times the length of the lemma body; reduced florets similar to fertile ones but smaller. Grassy or brushy areas, roadsides, and along streams; Bexar and DeWitt (TAES) cos. near sw margin of East TX; mainly s and w TX; in the U.S. known only from TX (Reeder 2003); also n Mexico. Apr–Nov.



Panicum coloratum



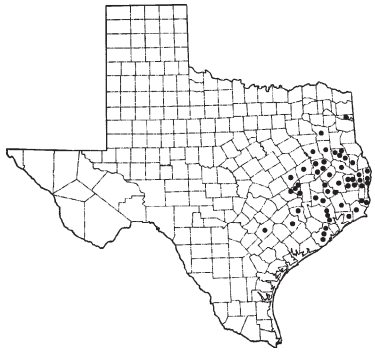
Panicum dichotomiflorum



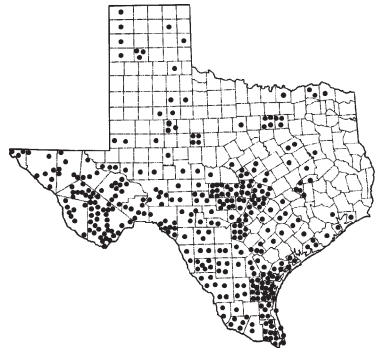
Panicum diffusum



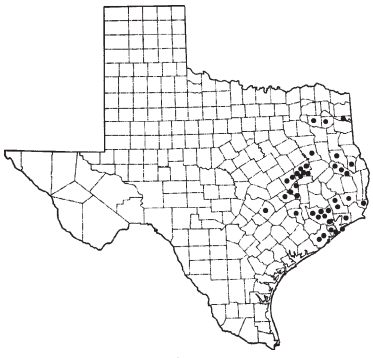
Panicum flexile



Panicum gymnocarpon



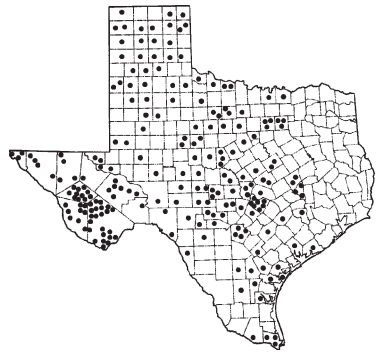
Panicum hallii
(both vars.)



Panicum hemitomon



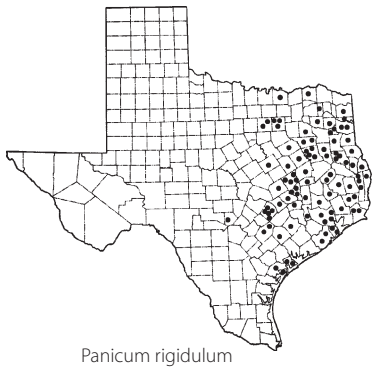
Panicum miliaceum



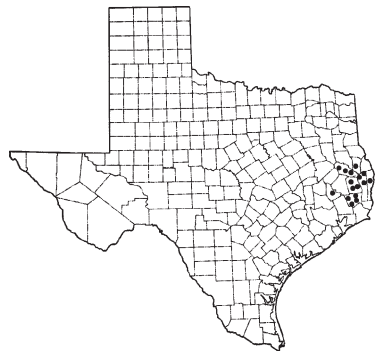
Panicum obtusum



Panicum repens



Panicum rigidulum
(both vars.)



Panicum tenerum

PARAPHOLIS C.E. Hubb. SICKLE GRASS

An Old World C_3 genus of 6 species ranging from w Europe to India. The plants typically grow in coastal habitats and salt marshes (Worley ined.). The genus has sometimes been put in tribe Hainardieae. (Greek: *para*, beside, and *pholis*, scale, in reference to the two side-by-side glumes—Worley ined.) (subfamily Pooideae, tribe Poeae)
REFERENCES: Runemark 1962; Worley ined.

Parapholis incurva (L.) C.E. Hubb., (bent inward), CURVED SICKLE GRASS, SICKLE GRASS. Tufted, branched annual; culms 2–25(–35) cm or less tall, curved-erect to decumbent; upper leaf sheaths inflated; ligule a membrane 1.5 mm or less long; leaf blades usually 2–30 mm long (rarely longer), 0.5–2(–3) mm wide; spike cylindrical, curved, 1–10(–15) cm long, usually 2.5 mm or less wide, rigid, disarticulating at nodes of axis; spikelets partially sunken into spike axis, with 1 floret, 4.5–7(–8) mm long, awnless; glumes subequal, somewhat asymmetric; lemma shorter than glumes; anthers 1.3 mm or less long; $2n$ = 32, 36, 38, 42 (Runemark 1962; Worley ined.). Disturbed areas, well-drained soils; included based on report for the Big Thicket National Preserve (Harcombe 2004); since this species was added after map pages for the flora were completed, no county distribution map is provided; mainly Gulf Prairies and Marshes; e and w coast of the U.S. Mar–Jun. Native to coastal areas of the Mediterranean. [*Aegilops incurva* L., *Aegilops incurvata* L., *Pholiurus incurvus* (L.) Schinz & Thell.]

PASPALIDIUM Stapf WATER-CROWN GRASS

A mainly tropical primarily Old World C_4 genus (Asia, Africa, Australia) of ca. 40 species, with a number of Australian endemics (Mabberley 1987; Crins 1991; Watson & Dallwitz 1992; Allen 2003a). Several are important pasture grasses while a number are significant weeds (Watson & Dallwitz 1992). The genus is related to *Setaria* (Webster 1995) and is sometimes treated in that genus (e.g., Veldkamp 1994; Webster 1995; Mabberley 1997). This relationship is reflected in the fact that some Australian species have spikelets subtended by bristles as in *Setaria* (Webster 1988). (Greek diminutive of *Paspalum*, in reference to a similarity to that genus) (subfamily Panicoideae, tribe Paniceae)
REFERENCES: Crins 1991; Webster 1988, 1995; Allen 2003a.

Paspalidium geminatum (Forssk.) Stapf, (twin), EGYPTIAN PASPALIDIUM, WATER PASPALIDIUM, EGYPTIAN WATER-CROWN GRASS, EGYPTIAN WATER GRASS. Erect glabrous perennial 35–80(–100) cm tall, rhizomatous or stoloniferous, superficially resembling members of the genus *Paspalum*; ligule a ciliate membrane 1.2 mm or less long; inflorescence a narrow panicle with a central axis and (5–)7–18 spike-like branches; branches floriferous to base, appressed, with spikelets in 2 rows on each, the branch axis extended slightly beyond the terminal spikelet into a short sterile bristle tip 2.5–4 mm long; spikelets 2.2–3(–3.2) mm long, 2-flowered, the lower floret sterile, with glume-like lemma, the upper floret fertile, with hardened grain-like lemma; disarticulation below the glumes; lower glume broad, rounded to truncate, 1/4–1/3 as long as spikelet; upper glume resembling lemma of sterile floret. Shallow water or wet ground; scattered in the e 1/2 of TX; AR, FL, LA, MO, OK, SC, and TX. May–Aug. [*Paspalidium geminatum* var. *paludivagum* (Hitchc. & Chase) Gould] Sometimes placed in the genus *Panicum* [as *P. geminatum* Forssk.] or in *Setaria* [as *S. geminata* (Forssk.) Veldkamp] (Webster 1995). Webster (1988) and Crins (1991) considered this species introduced and naturalized in the s U.S. However, Gould (1975b) and Godfrey and Wooten (1979) treated it as native, and recently Allen (2003a) considered it native from the southeastern U.S. to the West Indies and tropical America. While some authorities (e.g., Gould 1975b; Hatch 2002) distinguish varieties, we are following the recent treatment by Allen (2003) in not recognizing infraspecific taxa. For those wishing to recognize varieties, Hatch (2002) separated them using the following characters:

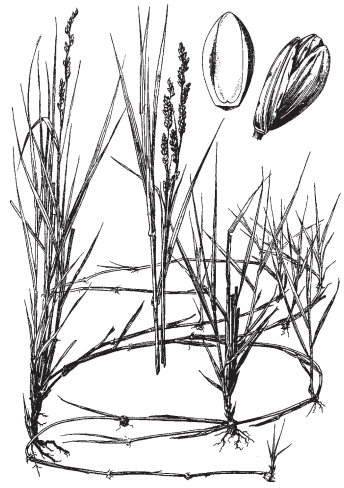
1. Lemma of lower floret with veins inconspicuous; spikelets less than 2.7 mm long _____ var. *geminatum*
1. Lemma of lower floret with veins conspicuous; spikelets 2.8 mm long or longer _____ var. *paludivagum*



Panicum hemitomon [GLE]



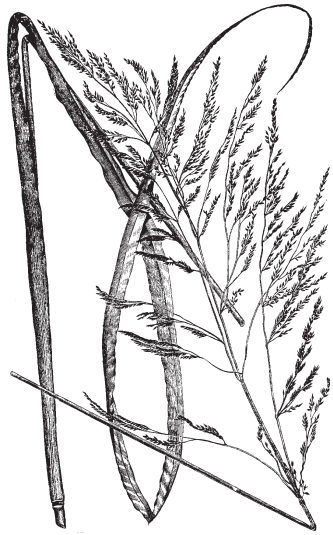
Panicum miliaceum [USB]



Panicum obtusum [HI1]



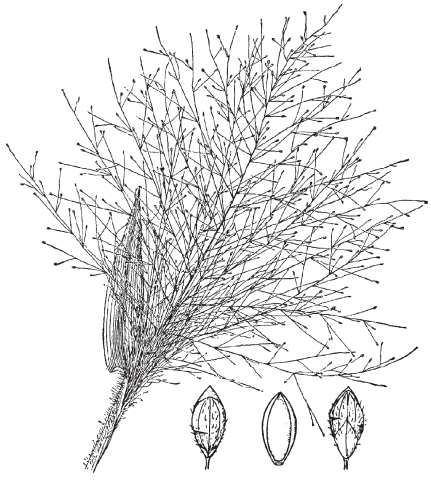
Panicum repens [USB]



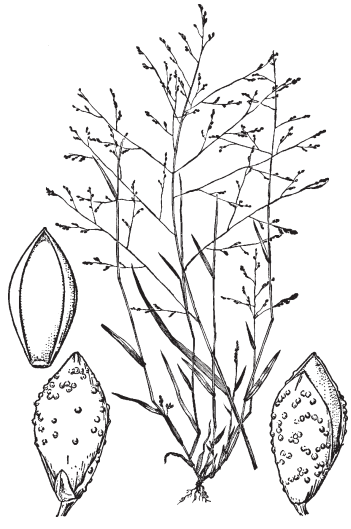
Panicum rigidulum var. rigidulum [RCA]



Panicum tenerum [GWO]



Panicum trichoides [HI2]



Panicum verrucosum [HI1, USB]

PASPALUM L. CROWN GRASS, BEAD GRASS

Primarily perennials (*P. boscianum, P. convexum, P. repens*, and *P. scorbiculatum* are annuals); ligule a membrane; inflorescence a panicle with a central axis and (1–)2–many spike-like branches; spikelets solitary or in pairs, subsessile or short-pedicelled, in 2–4 rows on one side (abaxial) of each flattened, sometimes winged branch, lanceolate to nearly circular in outline, flattened on one face, 2-flowered, the lower floret sterile or staminate, the upper floret perfect, the spikelets oriented so that the rounded back of the lemma of the fertile floret is facing the axis of the inflorescence branch; disarticulation below the glumes; lower glume usually absent or reduced; upper glume and lemma of sterile floret similar to each other; lemma of fertile floret usually firm or hardened, typically smooth and shiny, with firm inrolled margins.

A C_4 genus of 300–400 species (Allen & Hall 2003), principally of tropical and warm areas of the Americas, with a few species in the Old World (Morrone et al. 1996). Morrone et al. (1996) reported ca. 330 species. Some are characteristic of the pampas; *P. pyramidale* Nees grows to 15 m tall in the Amazon. A number of species are variously used for fodder, as pasture species, or as a grain crop (*P. scrobiculatum* L.—KODO-MILLET in India), while others are considered significant weeds (Watson & Dallwitz 1992). Ergot fungi, *Claviceps purpurea* (Fr.: Fr.) Tul., *C. paspali* F. Stevens & J.G. Hall and related species, are known to grow on a number of TX grasses including *P. dilatatum* and other *Paspalum* species. These fungi, whose overwintering structures (= sclerotia) replace some grains in the grass inflorescence, often produce toxic alkaloids (e.g., ergocryptine and ergotamine) chemically similar to LSD. Cattle who consume infected plants can become hyperexcitable, have convulsions or tremors, develop staggers syndrome ("paspalum staggers") or gangrene, or die; significant livestock losses have occurred. Humans can also be affected (see discussion under the genus *Secale*) (Sperry et al. 1955; Kingsbury 1964, 1965; Burrows & Tyrl 2001; Hart et al. 2001). (Probably from the Greek *paspalos*, millet or meal) (subfamily Panicoideae, tribe Paniceae)

REFERENCES: Chase 1929; Silveus 1942; Banks 1966; Allred 1982; Brummitt 1983; de Wet et al. 1983a; Crins 1991; Pohl & Davidse 1994b; Cialdella et al. 1995; Morrone et al. 1995, 1996, 2000; Rua 1996; Allen & Hall 2003; Zuloaga et al. 2004.

1. Inflorescence branches with axis broadly winged, sometimes almost leaf-like, nearly as wide or wider than the rows of spikelets, the wing margins sometimes even slightly wrapping around the spikelets.
   2. Axis of inflorescence branch extending beyond the most distal spikelet in form of a pointed tip; inflorescence branches usually numerous (8–65+), eventually falling from the main axis; spikelets 1.2–1.7(–2) mm long _____ **P. repens**
2. Axis of inflorescence branch not extending beyond the most distal spikelet; inflorescence branches usually 2–12(–15), not falling from the main axis; spikelets 1.7–4 mm long.
   3. Spikelets 3.2–4 mm long, not in pairs (with neither aborted spikelet nor pedicel present immediately beside or below fertile spikelet); species rare in East TX _____ **P. acuminatum**
   3. Spikelets 1.7–3.6 mm long, in pairs or with aborted remnant spikelet or pedicel beside or below fertile spikelet (except not in pairs in *P. dissectum* which has spikelets 2.3 mm or less long); including species widespread and common in East TX.
      4. Spikelets 1.7–2.1(–2.3) mm long, in 2 rows on the branch axis, not in pairs (with neither aborted spikelet nor pedicel present immediately beside or below fertile spikelet) _____ **P. dissectum**
      4. Spikelets 2–3.6 mm long, usually in 4 or less frequently 2 rows on the branch axis, in pairs or with aborted remnant spikelet or pedicel beside or below fertile spikelet.
         5. Spikelets pubescent.
            6. Leaf blades flat, (4–)6–18 mm wide, the margins often crisped; spikelets 1.5–2 mm wide _____ **P. pubiflorum**
            6. Leaf blades often folded or involute, usually 2–6 mm wide, the margins not crisped; spikelets ca. 1.5 mm or less wide _____ **P. hartwegianum**

5. Spikelets glabrous.
   7. Spikelets relatively rounded (broadly obovate to ovate or suborbicular); inflorescence usually with 4–12(–15) branches; lemma and palea of fertile florets dark brown at maturity; upper glume and lemma of lower (sterile) floret brownish ____ **P. boscianum**
   7. Spikelets rather narrow (elliptic to obovate); inflorescence usually with 3–7(–10) branches; lemma and palea of fertile florets straw-colored or light at maturity; upper glume and lemma of lower floret greenish to straw-colored or somewhat purplish.
      8. Leaf blades usually 3–6 mm wide; spikelets 2.2–2.6 mm long, 1.2–1.5 mm wide; inflorescence branches usually (1–)1.5–4(–5) cm long; edge of wing of inflorescence axis sometimes with a few long (3–8 mm) hairs _____ **P. lividum**
      8. Leaf blades (4–)6–18 mm wide; spikelets 2.6–3.6 mm long, 1.5–2 mm wide; inflorescence branches (2–)3–7(–10) cm long; edge of wing of inflorescence axis without long hairs _____ **P. pubiflorum**

1. Inflorescence branches with axis not broadly winged, if flattened or narrowly winged, then axis conspicuously narrower than the rows of spikelets.
   9. Spikelets with long hairs around the margin, glabrous or short-pubescent on the faces; upper glume and lemma of sterile floret abruptly pointed beyond the blunt fruit (except in *P. conjugatum*).
      10. Spikelets 1.3–1.7(–1.9) mm long. 0.8–1.1 mm wide, solitary; inflorescence branches 2 or sometimes 3; species known in East TX only from Liberty Co. on s margin of area _____ **P. conjugatum**
      10. Spikelets 1.8–4 mm long, 1.1–2.5 mm wide, mostly in pairs; inflorescence branches 2–36; species widespread in East TX.
         11. Spikelets 1.7–2.5 mm wide; inflorescence branches 2–8 _____ **P. dilatatum**
         11. Spikelets 1.1–1.5 mm wide; inflorescence branches 7–36 _____ **P. urvillei**
   9. Spikelets glabrous or uniformly short- or long-pubescent; upper glume and lemma of sterile floret not abruptly pointed beyond the fruit.
      12. Inflorescence branches usually only 2, these arising at the same point or less than 1 cm apart (1–2 additional branches occasionally present below the terminal pair).
         13. Plants usually of upland habitats; spikelets broadly ovate to broadly elliptic or obovate, obtuse or broadly acute at apex.
            14. Spikelets 2.6–3.6(–4) mm long; leaf sheaths and blades glabrous or nearly so; leaf blades flat or conduplicate _____ **P. notatum**
            14. Spikelets 1.9–2.5 mm long; leaf sheaths and blades (lower ones) often with pubescence; leaf blades flat _____ **P. minus**
         13. Plants typically of wet habitats (except the relatively rare *P. almum* often in upland habitats); spikelets narrowly ovate to elliptic, tapering to an acute apex.
            15. Plants densely tufted, not extensively spreading, without either creeping rhizomes, stolons, or culms rooting at the nodes; lower glume absent; upper glume glabrous; species apparently rare in East TX _____ **P. almum**
            15. Plants extensively spreading, with creeping rhizomes or stolons or culms rooting at the nodes; lower glume absent OR present; upper glume glabrous OR pubescent; including species widespread and common in East TX.
               16. Upper glume glabrous; lower glume usually absent; spikelets 3–4.5 mm long; species primarily of sub-brackish to saline coastal areas in Gulf Prairies and Marshes, known in East TX only from Jefferson Co. on extreme se margin of area _____ **P. vaginatum**
               16. Upper glume usually pubescent; lower glume usually present; spikelets 2.4–3(–3.2) mm long; species widespread in East TX _____ **P. distichum**
      12. Inflorescence branches (1–)2–numerous, IF only 2, then the branches 1 cm or more apart.
         17. Spikelets usually 3.6–4.8 mm long, overlapping; plants usually large, the culms usually 1–2.1 m tall _____ **P. floridanum**

17. Spikelets 1.6–4 mm long (IF > 3.6 then the spikelets widely spaced on the inflorescence branches, the pairs not overlapping or only slightly so); plant size various.
    18. Lower glume present on some or all spikelets (usually 1/4–1/3 as long as spikelet).
        19. Leaf blades typically involute, usually 2 mm or less wide (when inrolled); inflorescence branches (5.6–)8–25(–30) cm long _____ **P. monostachyum**
        19. Leaf blades flat, 2–18 mm wide; inflorescence branches 1–13 cm long.
            20. Spikelets widely spaced on the inflorescence branches, the pairs not overlapping or only slightly so; spikelets (3.1–)3.3–4 mm long; upper glume and lemma of lower floret glabrous; leaf blades and sheaths often with conspicuous long pubescence; plants with short rhizomes _____ **P. bifidum**
            20. Spikelets not widely spaced on the inflorescence branches, conspicuously overlapping; spikelets 2.2–3(–3.2) mm long; upper glume and sometimes lemma of lower floret pubescent; leaf blades and sheaths glabrous, with minute pubescence, OR with conspicuous long pubescence; plants rhizomatous or not so.
                21. Spikelets usually 2.2–2.7 mm long, paired; plants without stolons or rhizomes; leaf blades usually (4–)7–18 mm wide; leaf blades and sheaths glabrous or with minute pubescence; upper glume and lemma of lower floret usually with brownish glandular blotches _____ **P. langei**
                21. Spikelets 2.4–3(–3.2) mm long, usually solitary; plants with stolons or rhizomes, the stolons rooting at the nodes; leaf blades usually 3–6 (–8) mm wide; leaf blades and sheaths glabrous OR with conspicuous long pubescence; upper glume and lemma of lower floret without brownish glandular blotches _____ **P. distichum**
    18. Lower glume absent on all spikelets (lemma of sterile lower floret resembles upper glume).
        22. Upper glume (as well as lower glume) absent; spikelets 1.8–2.2 mm long; inflorescence usually with 10–45 branches _____ **P. malacophyllum**
        22. Upper glume present; spikelets of various lengths; inflorescence with various numbers of branches.
            23. Lemma and palea of fertile florets dark brown and shiny at maturity.
                24. Lemma of lower floret usually with transverse wrinkles along the margin; spikelets elliptic to elliptic-ovate to obovate; plants perennial, sometimes with short rhizomes _____ **P. plicatulum**
                24. Lemma of lower floret usually without wrinkles; spikelets usually ovate to suborbicular or broadly obovate; plants annual.
                    25. Spikelets glabrous, 2–2.2 mm long; inflorescence usually with 4–12 or more branches; branch axis narrowly winged _____ **P. boscianum**
                    25. Spikelets minutely appressed-pubescent, usually (2.1–)2.3–2.6 (–3) mm long; inflorescence with 1–4(–5) branches; branch axis flattened but unwinged or nearly so _____ **P. convexum**
            23. Lemma and palea of fertile florets green, light brown, or straw-colored at maturity.
                26. Spikelets widely spaced on the inflorescence branches, the pairs not overlapping or only slightly so; plants rhizomatous _____ **P. bifidum**
                26. Spikelets not widely spaced, conspicuously overlapping; plants rhizomatous or not so.
                    27. Axils of upper leaves commonly bearing inflorescences, these partially or completely enclosed by leaf sheathes (inflorescences also at tips of main culms) _____ **P. setaceum**

27. Axils of upper leaves not bearing inflorescences (inflorescences usually developed only at tips of main culms and thus one per culm).
    28. Spikelets relatively rounded (broadly ovate to suborbicular or broadly obovate), almost as wide as long.
        29. Spikelets solitary (not in pairs) on either side of branch axis _____ **P. laeve**
        29. Spikelets paired (the pair arising from a short, forked stalk) or both solitary and paired on either side of branch axis _____ **P. praecox**
    28. Spikelets rather narrow (elliptic to ovate or obovate), definitely longer than wide.
        30. Leaf blades (4–)6–18 mm wide, flat, the margins often crisped; species widespread in East TX _____ **P. pubiflorum**
        30. Leaf blades usually 0.2–6 mm wide, sometimes folded or involute, the margins not crisped; species of the s part of East TX.
            31. Inflorescence branches (5.6–)8–25(–30) cm long; leaf blades usually involute, usually 2 mm or less wide (when inrolled); plants with long scaly rhizomes _____ **P. monostachyum**
            31. Inflorescence branches 7.5 cm or less long; leaf blades usually flat, 2–6 mm wide; plants without long scaly rhizomes.
                32. Spikelets 2–2.6 mm long, glabrous _____ **P. lividum**
                32. Spikelets (2.2–)2.5–3.6 mm long, pubescent OR glabrous (if glabrous then 2.9 mm or more long).
                    33. Spikelets glabrous, 2.9–3.6 mm long, in 2 rows on the branch axis; branch axis ca. 1 mm wide _____ **P. almum**
                    33. Spikelets pubescent, (2.2–)2.5–2.9(–3.2) mm long, usually in 4 rows on the branch axis; branch axis 1.3–2 mm wide _____ **P. hartwegianum**

Paspalum acuminatum Raddi, (long-pointed, tapering to tip), BROOK CROWN GRASS, BROOK PASPALUM. Rhizomatous perennial; culms 30–100 cm tall; ligule 1–2.4 mm long; inflorescence with 2–5 branches 2–7 cm long, the branch axes broadly winged; spikelets solitary, in 2 rows, 3.2–4 mm long; lower glume absent; upper glume and lemma of sterile floret glabrous. Wet areas, ditches, also a weed in rice fields; Harris Co. (*Brown 22748*, nw of Houston, SBSC), R. Evans (pers. comm.) also indicates that the species occurs in the Pineywoods and S. Hatch (pers. comm.) notes that it is found in the Post Oak Savannah; no county distribution map is provided; Hatch (2002) cited vegetational areas 1, 2, 3, 5, and 6; however, Turner et al. (2003) mapped only the Gulf Prairies and Marshes; se U.S. from GA and FL w to TX. Aug–fall.

Paspalum almum Chase, (nourishing), COMB'S PASPALUM, COMB'S CROWN GRASS. Clump-forming perennial; culms 10–50 cm tall; ligule 0.5–2 mm long; inflorescence branches usually 2 (one 0.5–2 cm below the other) or sometimes 3–5, 3.5–7.5 cm long, the branch axes only slightly winged; spikelets usually solitary, in two rows, 2.9–3.6 mm long; lower glume absent; upper glume and lemma of sterile floret glabrous. Disturbed areas, roadside ditches, and pastures, probably introduced as a forage species (Allen & Hall 2003); Jefferson (BRIT), Anderson, Angelina, Brazos, Hardin, and Orange (Gould 1975b) cos. in s part of East TX; also Gulf Prairies and Marshes; LA and TX. Summer–early fall. Native to Argentina, Brazil, Paraguay, and Uruguay (Allen & Hall 2003).

Paspalum bifidum (Bertol.) Nash, (divided into two parts), PITCHFORK PASPALUM, PITCHFORK CROWN GRASS. Perennial with short rhizomes; rhizomes with ovate, overlapping, densely hairy scales; culms 60–140 cm tall; ligule ca. 2–4 mm long; leaf sheaths (at least lower ones) with dense long pubescence; inflorescence branches 2–5, 4–13 cm long, the branch axes ± unwinged; spikelets (3.1–)3.3–4 mm long, mostly paired, widely spaced on the inflorescence branches, the pairs not overlapping or only slightly so; lower glume often present, reduced; upper glume and lemma of sterile floret glabrous. Forest margins and openings, loamy sandy or sandy soils; scattered from Pineywoods and n Gulf Prairies and Marshes w to Dallas and Limestone (BRIT) cos.; se U.S. from VA s to FL w to MO, OK, and TX (Jun–)Aug–Nov. [*P. bifidum* var. *projectum* Fernald] Allen and Hall (2003) reported that this species grows vigorously following fire.

Paspalum boscianum Flüggé, (for its discoverer, Louis Augustin Guillaume Bosc, 1759–1828, French naturalist), BULL PASPALUM. Tufted annual; culms (15–)40–70(–100) cm tall; ligule 1–3.2 mm long; inflorescence branches typically 4–12(–15), usually 3–8 cm long, the branch axes winged; spikelets paired, typically in 4 rows, usually 2–2.2 mm long; lower glume absent; upper glume and lemma of sterile floret glabrous. Ditches, edges of fields, disturbed areas; Jefferson Co. (Gould 1975b) near the s margin of the Pineywoods; also reported from the Gulf Prairies and Marshes (Gould 1975b; Hatch 2002), but we have seen no confirming specimens; its status in TX is unclear; se U.S. from MD s to FL w to AR and TX, also PA. Late summer–fall. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

Paspalum conjugatum P.J. Bergius (jointed in pairs, wedded), SOUR PASPALUM, SOUR CROWN GRASS. Stoloniferous perennial; culms to ca. 80 cm tall; ligule 0.5–0.8 mm long; inflorescence branches usually 2, a third sometimes present, 2.5 to ca. 13 cm long, the branch axes ± unwinged; spikelets solitary, 1.3–1.7(–1.9) mm long; lower glume absent; upper glume and lemma of sterile floret marginally pilose. Disturbed areas, forest margins; Liberty Co. (*Brown 28310*, SBSC—identification confirmed L. Brown); a cultivated Hardin Co. collection—*McLeod*, TAES—was erroneously cited by Turner et al. 2003 and apparently by Allen and Hall (2003); the Digital Flora of Texas Herbarium Specimen Browser (2002) also cited Cameron Co. at the s tip of TX, and Hatch et al. (1990) cited the Gulf Prairies and Marshes; se U.S. from FL w to TX. Jul–Nov. Allen and Hall (2003) noted that the species is sometimes used as a lawn grass. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

Paspalum convexum Humb. & Bonpl. ex Flüggé, (domed, with rounded surface), MEXICAN PASPALUM, LATIN AMERICAN CROWN GRASS. Tufted annual; culms 10–53 cm tall; ligule 2–4.1 mm long; inflorescence branches 1–4(–5), (2–)3–4(–7) cm long, the branch axes flattened but unwinged or nearly so; spikelets paired, often appearing to be in 3 or 4 rows, usually (2.1–)2.3–2.6(–3) mm long; lower glume absent; upper glume and lemma of sterile floret minutely appressed-pubescent. Sandy roadsides, disturbed areas; Jasper Co. (*Silveus 7384*, TAES); Gould (1975b) indicated that the species was "known in Texas from a single collection made on a sandy roadside site 10 miles north of the city of Jasper in Jasper Co." We have seen no additional TX specimens; LA, MS, and TX. Late summer–fall. Native from Mexico and the Caribbean islands to Brazil (Hall & Allen 2003). ☜

Paspalum dilatatum Poir., (dilated, widened, expanded), DALLIS GRASS, PASPALUM GRASS, WATER PASPALUM, GOLDEN CROWN GRASS. Clump-forming perennial from hardened knotty base; culms low-spreading to erect, 25–120(–175) cm long; lower leaf sheaths pilose, the upper glabrous except at summit; ligule 1.5–3(–3.8) mm long; inflorescence branches 2–8, 3–12 cm long, the branch axes only slightly winged; spikelets mostly paired, appearing in 4 rows, (2.3–)2.9–4 mm long, with long hairs around the margin, usually with short pubescence on the faces; lower glume absent; upper glume and lemma of sterile floret abruptly pointed beyond the blunt fruit.



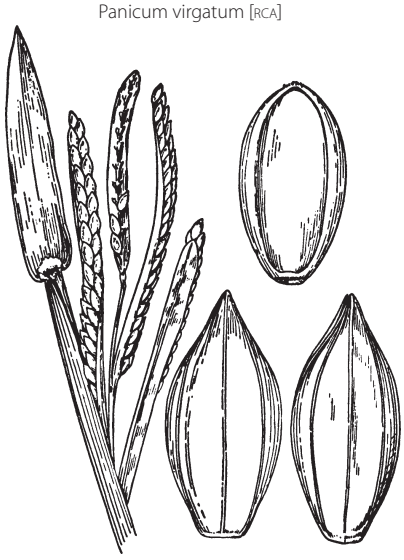
Panicum virgatum [RCA]



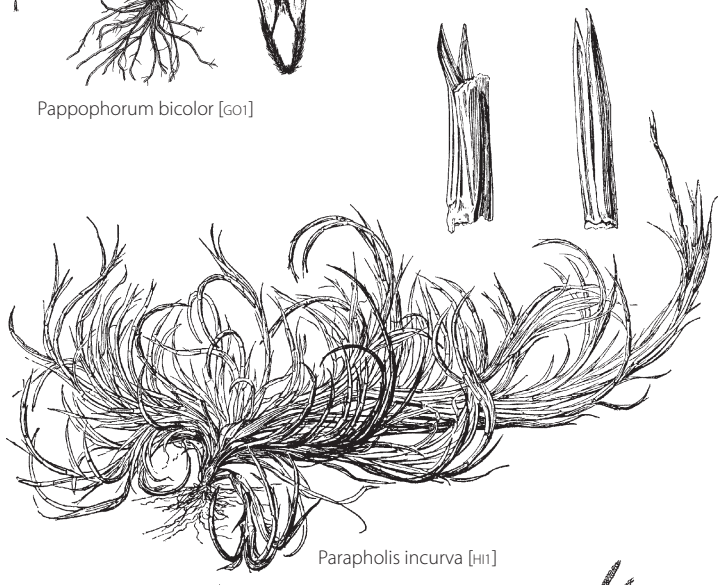
Pappophorum bicolor [GO1]



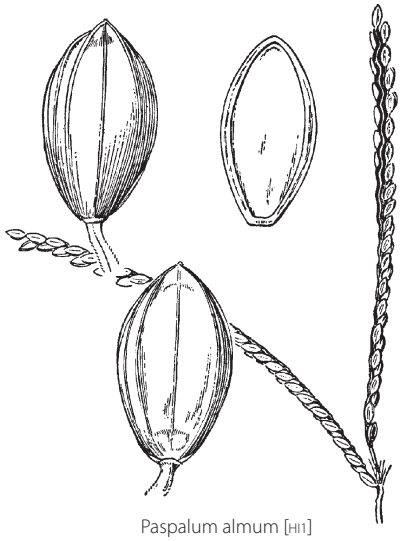
Paspalidium geminatum [HI1]



Paspalum acuminatum [HI1]



Parapholis incurva [HI1]



Paspalum almum [HI1]



Paspalum bifidum [USB]



Paspalum boscianum [USB]

Abundant weed in disturbed sites, lawns, and roadsides; throughout TX; widespread in s 1/2 of the U.S., also OR. May–Nov. Native of South America (Brazil and Argentina). This species is reported to be commercially important as a forage crop in the tropics (Yatskievych 1999), but it is sometimes a troublesome weed (Clayton & Renvoize 1986). Ergot alkaloids can be present—see generic synopsis. While almost all grasses are wind-pollinated, this grass is unusual in sometimes being pollinated at least partially by halictid bees (Adams et al. 1981).

Paspalum dissectum (L.) L., (dissected, deeply cut), MUDBANK PASPALUM, MUDBANK CROWN GRASS. Mat- or clump-forming perennial without conspicuous rhizomes; culms 15–60 cm long; leaf sheaths glabrous; ligule 1.5–2.5 mm long; inflorescence branches 2–6, 1–3(–5.3) cm long, the branch axes broadly winged, sometimes almost leaf-like, as wide or wider than the rows of spikelets, the wing margins sometimes even slightly wrapping around the spikelets; spikelets solitary (with neither aborted spikelet nor pedicel present immediately beside or below fertile spikelet), in 2 rows, 1.7–2.1(–2.3) mm long; lower glume absent; upper glume minutely pubescent; lemma of sterile floret glabrous. Lake shores, ditches, sandy soils; Leon (BRIT), Harris (SBSC), Guadalupe, Montgomery (Morrone et al. 1996), Angelina, Bastrop, Caldwell, Gonzales, and Nacogdoches (Turner et al. 2003) cos.; also Gulf Prairies and Marshes; e U.S. from NJ s to FL w to KS and TX. Jul–Nov. [*Panicum dissectum* L.] This species can have cleistogamous spikelets with very small anthers (ca. 0.3 mm long); such spikelets do not open to expose the anthers and stigmas and are thus self-pollinated (Morrone et al. 1996).

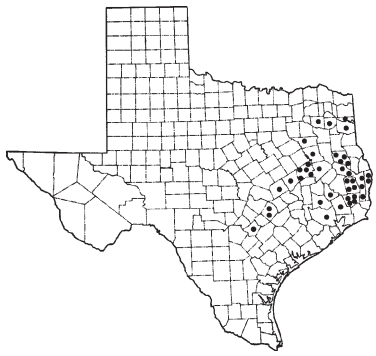
Paspalum distichum L., (two-spiked), KNOT GRASS, ETERNITY GRASS, JOINT GRASS, FORT THOMPSON GRASS, JOINTED CROWN GRASS, THOMPSON GRASS. Perennial 10–65 cm tall, with trailing and rooting culms (stolons) sometimes several meters long; leaf sheaths usually glabrous or pilose; ligule 0.6–2 mm long; inflorescence branches 2, occasionally 3–4, these usually paired or one slightly below other, 1–5(–7) cm long, the branch axes only slightly winged; spikelets 2.4–3(–3.2) mm long, mostly solitary, usually in 2 rows; lower glume often present, reduced; upper glume usually minutely pubescent; lemma of sterile floret glabrous. Moist or wet areas along ponds, lakes, streams, and ditches; throughout TX; s 1/2 of the U.S., also NJ, OR, and WA. Jun–Oct. [*Digitaria paspaloides* Michx., *P. distichum* var. *indutum* Shinners, *P. paspaloides* (Michx.) Scribn.] While some authorities (e.g., Jones et al. 1997) recognize var. *indutum* (known only from Dallas Co.—Gould 1975b) with leaf sheaths pubescent, we are following Allred (1982), Allen (1992b), Kartesz (1999), and Allen and Hall (2003) in not recognizing infraspecific taxa. Larry Brown (pers. comm.) notes that the upper glume can be pubescent on some spikelets but glabrous on others (on the same plant) and that likewise the first glume can be either present or absent—these conditions suggest that the species should perhaps be merged with *P. vaginatum*.

Paspalum floridanum Michx., (of Florida), FLORIDA PASPALUM, BIG FLORIDA PASPALUM, BIG PASPALUM, FLORIDA CROWN GRASS. Rhizomatous perennial; culms erect, usually 1–2.1 m tall; leaf sheaths and blades nearly or completely glabrous or ± densely hirsute; ligule 1–3.3 mm long; inflorescence branches usually 2–5(–8), 3–13(–17) cm long, the branch axes ± unwinged; spikelets usually 3.6–4.8 mm long, mostly paired, in 4 rows, glabrous; lower glume absent. Grasslands and open woodlands; widespread in e 1/3 of TX; e U.S. from NJ s to FL w to KS and TX. Aug–Nov. [*Paspalum floridanum* var. *glabratum* Engelm. ex Vasey] Some authorities (e.g., Jones et al. 1997; Yatskievych 1999; Hatch 2002) recognize var. *glabratum*, based on ± glabrous leaf sheaths and blades (versus with pubescence). However, we are following Allen and Hall (2003) in not recognizing infraspecific taxa.

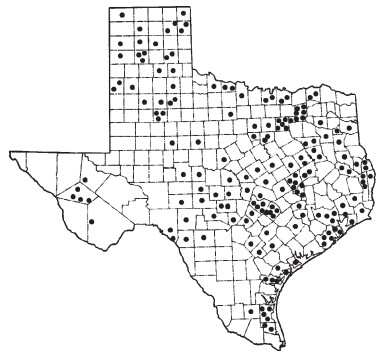
Paspalum hartwegianum E. Fourn., (for Theodore Hartweg, 1812–1871, Royal Horticultural Society collector in CA and Mexico), HARTWEG'S PASPALUM, HARTWEG'S CROWN GRASS. Tufted perennial similar to *P. pubiflorum*; inflorescence branches (3–)4–8, 3–7 cm long, the branch axes winged; spikelets (2.2–)2.5–2.9(–3.2) mm long, typically paired, usually in 4 rows on the branch axis; lower glume absent; upper glume and lemma of sterile floret pubescent. Ditches, low areas;



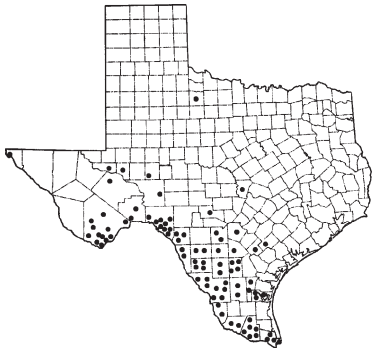
Panicum trichoides



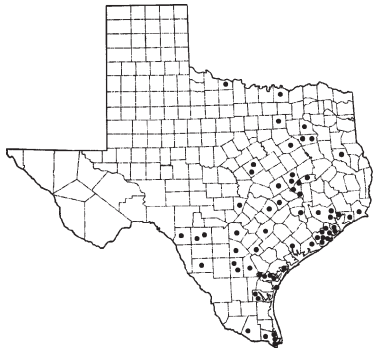
Panicum verrucosum



Panicum virgatum



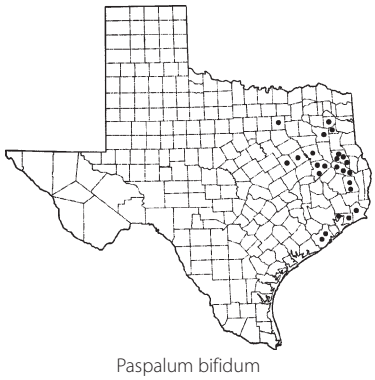
Pappophorum bicolor



Paspalidium geminatum



Paspalum almum



Paspalum bifidum



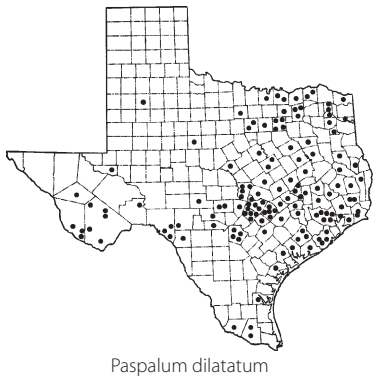
Paspalum boscianum



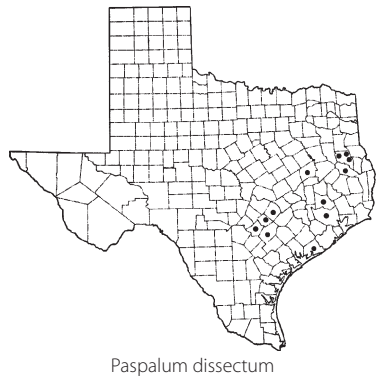
Paspalum conjugatum



Paspalum convexum



Paspalum dilatatum



Paspalum dissectum

Guadalupe Co. (Turner et al. 2003) near sw margin of East TX; mainly Gulf Prairies and Marshes and South TX Plains; in the U.S. known only from TX; also Latin America. Jun–Nov.

Paspalum laeve Michx., (smooth), FIELD PASPALUM, FIELD CROWN GRASS. Tufted perennial without rhizomes or only shortly rhizomatous; culms to ca. 100(–120) cm tall; leaf sheaths glabrous to pilose; leaf blades sometimes marginally crisped; inflorescence branches (2–)3–6(–8), (2–)4–10(–12) cm long, the branch axes ± unwinged; spikelets 2.4–3.4 mm long, solitary, in 2 rows; lower glume absent; upper glume and lemma of sterile floret glabrous. Prairies, open woods, disturbed or moist areas, often on sand; Pineywoods and Post Oak Savannah; also n Gulf Prairies and Marshes; e U.S. from MA s to FL w to KS and TX. Jul–Oct. While some authorities (e.g., Kartesz 1999; Turner et al. 2003; Allen & Hall 2003) do not recognize varieties in this species, until a detailed study of the group is carried out, we are following Gould (1975b), Jones et al. (1997), Yatskievych (1999), and Hatch (2002) in recognizing the 3 somewhat overlapping varieties—not all individuals can be assigned with certainty. The maps in Turner et al. (2003) and the one presented here do not distinguish varieties.

1. Spikelets 2.7–3.2 mm wide, ca. as wide as long and circular in outline or nearly so _____ var. **circulare**
1. Spikelets 2–2.5 mm wide, conspicuously longer than wide, broadly ovate to broadly obovate in outline.
   2. Lower leaf sheaths and lower leaf blades glabrous or with sparse hairs _____ var. **laeve**
   2. Lower leaf sheaths and often lower leaf blades moderately to densely hairy _____ var. **pilosum**

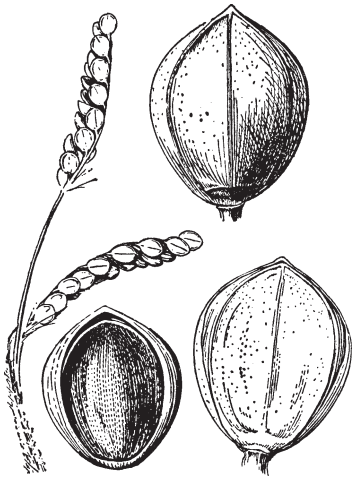
var. **circulare** (Nash) Fernald, (circular), ROUND-SEED PASPALUM. Lamar, Liberty, Marion, San Augustine, and Upshur (BRIT) cos. [*P. circulare* Nash]

var. **laeve**, FIELD PASPALUM, SMOOTH PASPALUM. Anderson, Freestone, Henderson, Houston, Jefferson, Morris, Panola, Rusk, Shelby, Titus, Upshur (BRIT), and Lamar (Carr 1994) cos. This is the most common variety in East TX.

var. **pilosum** Scribn., (with long soft hairs), HAIR-LEAF PASPALUM. Panola and Titus (BRIT) cos. [*P. longipilum* Nash]

Paspalum langei (E. Fourn.) Nash, (for Johann Martin Christian Lange, 1818–1898, Danish botanist), RUSTY-SEED PASPALUM, RUSTY-SEED CROWN GRASS, LANGE'S PASPALUM. Cespitose perennial without rhizomes; culms 30–125 cm tall; ligule ca. 0.6–2 mm long; leaf sheaths and blades glabrous or with minute pubescence; leaf blades (4–)7–18 mm broad, often conspicuously crisped marginally; inflorescence branches (1–)2–5, usually 4–10(–13) cm long, the branch axes ± unwinged; spikelets usually 2.2–2.7 mm long, usually paired, appearing in 2 or 4 rows; lower glume present on some or all spikelets, reduced; upper glume and lemma of sterile floret pubescent, usually with brownish glandular blotches. Shaded ditches, stream bottoms, moist woods; s part of East TX; also Gulf Prairies and Marshes, South TX Plains, e Edwards Plateau, and disjunct to Tarrant Co. (BRIT) in Cross Timbers and Prairies; FL, LA, OK, and TX. Apr–Nov. [*Dimorphostachys langei* E. Fourn.]

Paspalum lividum Trin., (lead-colored, bluish gray), LONG-TOM, PULL-AND-BE-DAMNED. Tufted perennial; culms decumbent to stoloniferous basally, to 70 cm tall but to over 1.5 m long; ligule (1–)2.2–4.7 mm long; inflorescence branches usually 3–7(–11), (1–)1.5–4(–5) cm long, the branch axes winged; spikelets 2.2–2.6 mm long, typically paired, usually in 4 rows; lower glume absent; upper glume and lemma of sterile floret glabrous. Ditches, wet places, muddy coastal areas, fresh or brackish water; Bexar, Colorado, Harris, Jasper, Jefferson, Orange, Waller, and Wilson (Turner et al. 2003) cos. on s margin of East TX; mainly Gulf Prairies and Marshes and South TX Plains, also Burnet and Brown (Turner et al. 2003) cos. near w margin of Cross Timbers and Prairies; FL, LA, and TX. May–Nov. This species is important for cattle grazing along the Gulf Coast (Hatch et al. 1999).



Paspalum conjugatum [HI1]



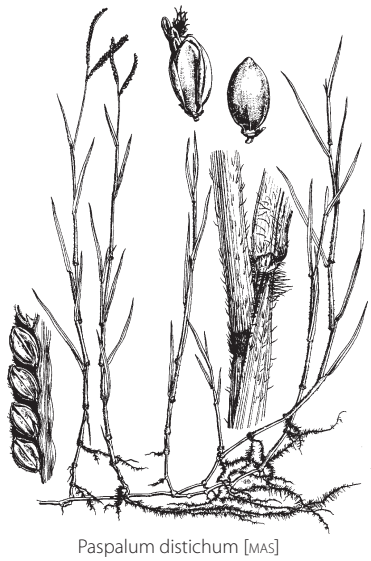
Paspalum convexum [HI2]



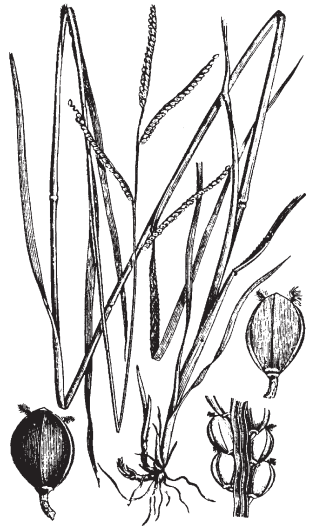
Paspalum dilatatum [HI1]



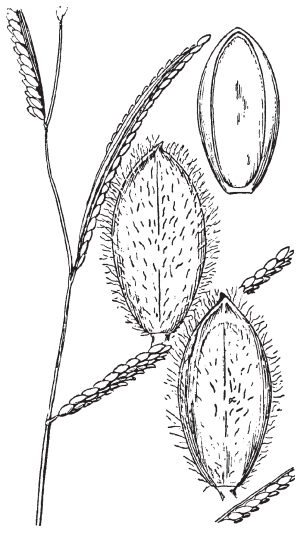
Paspalum dissectum [GWO, HI1]



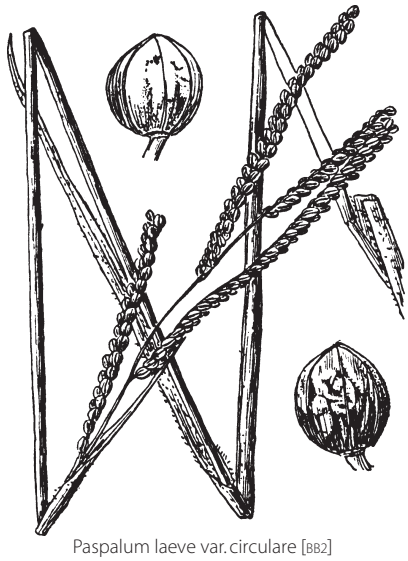
Paspalum distichum [MAS]



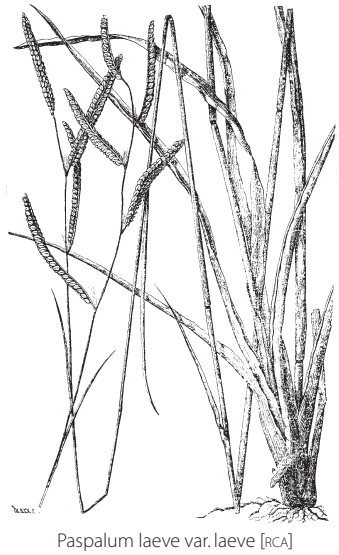
Paspalum floridanum [USB]



Paspalum hartwegianum [HI1]



Paspalum laeve var. circulare [BB2]



Paspalum laeve var. laeve [RCA]

Paspalum malacophyllum Trin., (soft-leaved), RIBBED CROWN GRASS. Large tufted perennial; short rhizomes sometimes present; culms to 2 m tall; ligule 4–6 mm long; inflorescence branches usually 10–45, 2–10 cm long, the branch axes only slightly winged; spikelets 1.8–2.2 mm long, ca. 1 mm wide, paired, in 4 rows, glabrous; both glumes absent, the spikelets consisting only of the lemma of the sterile floret and the complete fertile floret (palea of sterile floret usually absent or rudimentary). Partially shaded areas, introduced as a potential forage grass and for soil conservation (Gould 1975b; Allen & Hall 2003); in TX known only from Brazos (BRIT), Atascosa, Bexar, and Travis (Turner et al. 2003) cos.; in the U.S. known only from FL, GA, and TX. Late summer–fall. Native from Mexico to Bolivia and Argentina. ☞

Paspalum minus E. Fourn., (smaller), MAT PASPALUM, MATTED CROWN GRASS. Rhizomatous perennial similar to *P. notatum*; culms 60 cm or less tall; ligule 0.2–0.7 mm long; leaf sheaths and blades (lower ones) often with pubescence; inflorescence usually with 2(–3) branches, these usually paired or one slightly below other; branches 2–7 cm long, the branch axes ± unwinged; spikelets 1.9–2.5 mm long, solitary, in 2 rows; lower glume absent; upper glume and lemma of sterile floret glabrous. Disturbed areas, forest margins; Hardin, Jefferson, and Liberty (Turner et al. 2003) cos. near se margin of East TX and Bexar Co. (Turner et al. 2003) on sw margin of East TX; also n Gulf Prairies and Marshes and South TX Plains; se U.S. from FL w to TX. May–Nov.

Paspalum monostachyum Vasey, (one-spiked), GULF DUNE PASPALUM, GULF DUNE GRASS. Rhizomatous perennial; culms 50–120 cm tall; ligule 0.5–3 mm long; leaf blades involute, usually 2 mm or less wide (when inrolled); inflorescence branches 1–3, if more than 1 then 1 cm or more apart, (5.6–)8–25(–30) cm long, the branch axis ± unwinged; spikelets mostly paired, usually 2.5–3.1(–3.5) mm long; lower glume usually absent (irregularly developed on some spikelets); upper glume and lemma of sterile floret glabrous. Sandy or mucky soils, dunes, wet prairies, other wet areas; Austin (*Rosen 2167*, SBSC), Colorado (*Brown 2884*, TAES) and Harris (*B.C. Tharp, s.n.*, BRIT) cos.; mainly Gulf Prairies and Marshes; FL, LA, and TX. (May–)Jun–Nov.

Paspalum notatum Flüggé, (marked), BAHIA GRASS, COMMON BAHIA GRASS, PENSACOLA BAHIA GRASS. Rhizomatous perennial; culms erect, usually (20–)40–75(–110) cm tall; ligule 0.5 mm or less long; inflorescence branches usually 2(–5), these usually paired or one slightly below other, (3–)5–15(–18) cm long, the branch axes only slightly winged; spikelets ca. 2.6–3.6(–4) mm long, broadly ovate or broadly obovate (rarely elliptic), solitary, in 2 rows; lower glume absent; upper glume and lemma of sterile floret glabrous. Introduced as a pasture grass, for turf, and for erosion control; forest openings, disturbed areas, and roadsides; widespread primarily in e 1/2 of TX; se U.S. from NC s to FL w to OK and TX, also CA. Jun–Nov. Native to Latin America. [*P. notatum* var. *latiflorum* Döll, *P. notatum* var. *saurae* Parodi] The status of varieties in this species is controversial. Some authorities (e.g., Crins 1991; Allen 1992; Zuloaga et al. 2004) recognize 2 varieties (*notatum* and *saurae*) in the se U.S., while Kartesz (1999) recognized 3 for TX (the above 2 plus var. *latiflorum*). Jones et al. (1997) listed only var. *latiflorum* and var. *saurae* for TX. Other authorities (e.g., Pohl & Davidse 1994b; Hatch 2002; Turner et al. 2003; Allen & Hall 2003) do not recognize infraspecific taxa. We are following Allen and Hall (2003) who recently indicated that they were not recognizing varieties "because the variation among them is continuous." Allen and Hall (2003) noted that a number of turf grass cultivars exist, including 'Common Bahiagrass', 'Pensacola Bahiagrass,' and 'Argentine Bahiagrass.' ☞

Paspalum plicatulum Michx., (plicate, folded like a fan), BROWN-SEED PASPALUM, BROWN-SEED CROWN GRASS, PLAITED PASPALUM. Tufted or clumped perennial 50–110 cm tall, sometimes with short rhizomes; ligule 2–3 mm long; inflorescence branches usually (2–)3–7(–10), racemosely arranged, (1.6–)3–7(–10) cm long, the branch axes ± unwinged; spikelets 2.2–2.8(–3) mm long, paired, in 4 rows; lower glume absent; upper glume and lemma of sterile floret glabrous or minutely pubescent; lemma of sterile floret usually with transverse wrinkles along the margin. Roadsides, ditches, open woods, disturbed areas, sometimes in partial shade, sandy or sandy

loam soils; widespread in the s part of East TX and Cass Co. (Turner et al. 2003) to the n; also Gulf Prairies and Marshes, South TX Plains, and e Edwards Plateau; se U.S. from SC s to FL w to TX. Mar–Nov. [*P. texanum* Swallen]

Paspalum praecox Walter, (appearing or developing early), EARLY PASPALUM, EARLY CROWN GRASS. Perennial with short rhizomes; culms 50–100(–160) cm tall; ligule 1–2.5 mm long; inflorescence branches usually 3–6(–10), 2–7(–10) cm long, the branch axes only slightly winged; spikelets 2.2–3.3 mm long, paired or both solitary and paired on either side of branch axis; lower glume absent; upper glume and lemma of sterile floret glabrous. Bogs, wet savannahs, other wet habitats; Freestone, Hardin, Jasper, Tyler (BRIT), Liberty, Sabine (SBSC), Anderson, Angelina, Gonzales, Harris, and Jefferson (Turner et al. 2003) cos., mainly se part of East TX, disjunct sw to Gonzales Co. (Turner et al. 2003); also n Gulf Prairies and Marshes; se U.S. from VA s to FL w to AR and TX, also IL. May–Oct. [*P. lentiferum* Lam., *P. praecox* var. *curtissianum* (Steud.) Vasey]

Paspalum pubiflorum Rupr., (hairy-flowered), HAIRY-SEED CROWN GRASS, HAIRY-SEED PASPALUM. Tufted perennial without rhizomes; culms decumbent below, often rooting at the lower nodes, usually 40–80(–130) cm tall; leaf sheaths glabrous or the lower pilose; ligule 1–3.2 mm long; leaf blades with margins often crisped; inflorescence branches (2–)3–7(–10), usually 3–10 cm long, the branch axes winged, sometimes rather broadly; spikelets 2.6–3.6 mm long, mostly paired, in 4 rows, glabrous or pubescent; lower glume absent. Ditches and other moist areas; the map in Turner et al. (2003) and the one presented here do not distinguish varieties; e U.S. from PA s to FL w to CO and TX. Mainly May–Nov. While some authorities (e.g., Allen 1992; Kartesz 1999; Allen & Hall 2003) do not recognize infraspecific taxa, we are following Gould (1975b), Jones et al. (1997), and Hatch (2002) in recognizing 2 varieties in this species. However, if additional characters are not found, the usefulness of recognizing varieties solely on the basis of spikelet pubescence is questionable.

1. Spikelets glabrous _____ var. **glabrum**
1. Spikelets pubescent _____ var. **pubiflorum**

var. **glabrum** Vasey ex Scribn., (smooth, without hairs), SMOOTH-SEED PASPALUM. Dallas, Delta, Fannin, Grayson, Hunt (BRIT), Harris, and Rockwall (Gould 1975b) cos.; scattered in the e 1/2 of TX, but less frequent than var. *pubiflorum* (Gould 1975b).

var. **pubiflorum**, HAIRY-SEED PASPALUM, HAIRY-FLOWER PASPALUM. Widespread in TX except the nw part of the state.

Paspalum repens P.J. Bergius, (creeping), WATER PASPALUM, HORSE-TAIL CROWN GRASS, HORSE-TAIL PASPALUM. Mat- or tuft-forming creeping annual (perennial in tropical America) of wet habitats, the culms often floating; decumbent culms to 1(–2) m long, the flowering culms to ca. 60 cm tall; ligule 1–2(–4) mm long; inflorescence with branches usually numerous (8–65+), these eventually falling from the main axis, usually (2–)3–7(–9.5) cm long, the branch axes broadly winged, almost leaf-like, extending beyond the most distal spikelet as a pointed tip, as wide or wider than the rows of spikelets, the wing margins sometimes even slightly wrapping around the spikelets; spikelets 1.2–1.7(–2) mm long, solitary, in 2 rows; lower glume absent; upper glume and lemma of lower floret puberulent. Wet areas of ditches, marshes, edges of lakes and streams; s Pineywoods and adjacent Post Oak Savannah; also reported by Gould (1975b) and Hatch et al. (1990, 1999) for Gulf Prairies and Marshes; e U.S. from MD s to FL w to KS and TX. Mostly late summer–fall. [*P. fluitans* (Elliott) Kunth, *P. mucronatum* Muhl., *P. repens* var. *fluitans* (Elliott) Wipff & S.D. Jones] The TX members of this species have long gone under the name of *P. fluitans* (e.g., Correll & Johnston 1970; Gould 1975b; Hatch et al. 1990; Kartesz 1999). Jones and Wipff (1994 [1995]) treated the temperate members as *P. repens* var. *fluitans*. However, Morrone et al. (1996), in the most recent revision of the group, combined both the temperate (*P. fluitans*)

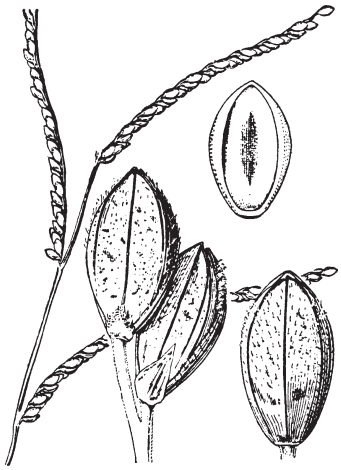
and tropical (*P. repens*) forms into *P. repens*. Yatskievych (1999) and Allen and Hall (2003) followed this treatment, with Yatskievych (1999) indicating that the minor differences in *P. fluitans* are "probably merely adaptations in the temperate portion of the distribution of the complex." We are therefore following Morrone et al. (1996) for nomenclature of this species.

Paspalum setaceum Michx., (bristle-like), THIN PASPALUM, SLENDER CROWN GRASS, FRINGE-LEAF PASPALUM, HURRAH GRASS, YELLOW SAND PASPALUM. Clump-forming perennial from a knotty base or very short rhizomes; culms 20–100 cm long; leaf sheaths and blades pilose to glabrous except on margins, often with fine pubescence in addition to or instead of long hairs; ligule 0.2–0.5(–1) mm long; inflorescence branches usually 1–2 or occasionally 3–4(–6), 2–12(–17) cm long, the branch axes ± unwinged; spikelets mostly in pairs, in 4 rows, 1.4–2.6 mm long, glabrous or pubescent; lower glume absent. Disturbed sites, roadsides; throughout TX; se Canada (Ont.) and widespread in e 2/3 of the U.S. w to MT and AZ. May–Oct. [*P. ciliatifolium* Michx., *P. separatum* Shinners, *P. setaceum* Michx. var. *ciliatifolium* (Michx.) Vasey, *P. setaceum* Michx. var. *muhlenbergii* (Nash) D.J. Banks, *P. setaceum* Michx. var. *stramineum* (Nash) D.J. Banks, *P. stramineum* Nash] Banks (1966) divided this species into a number of varieties, and Gould (1975b), Jones et al. (1997), Yatskievych (1999), and Hatch (2002) recognized 4 of the varieties. Gould (1975b), Jones et al. (1997), and Hatch (2002) also recognized *P. separatum*, known only from the type collection in Wood Co., as a separate species, though it was treated as part of var. *stramineum* by Allen and Hall (2003). Allen and Hall (2003) recognized nine varieties, four of which are said to occur in TX. Yatskievych (1999), however, noted that "Some specimens can be quite difficult to assign to variety." There is considerable intergradation within the variation seen in this species, and until the situation is clearer, we are following Kartesz (1999) and Turner et al. (2003) in not formally recognizing infraspecific taxa. For those wishing to separate varieties occurring in TX, the key by Gould (1975b) (modified using Allen & Hall 2003) is given below:

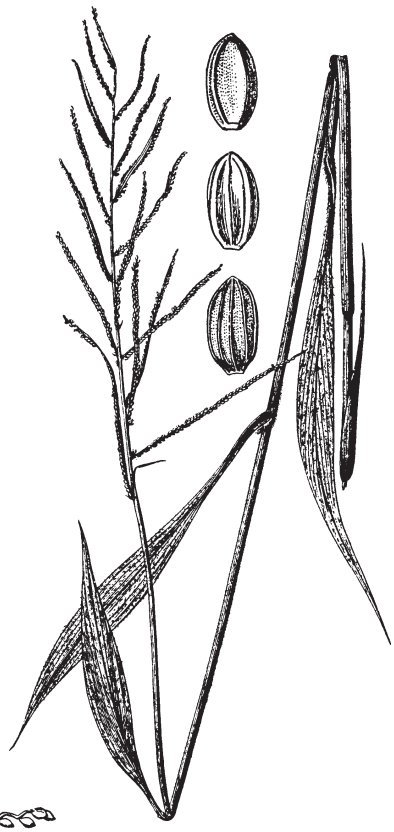
1. Leaf blades densely pubescent, 1.5–7 mm broad; spikelets 1.4–1.9 mm long _____ var. *setaceum*
1. Leaf blades glabrous or variously pubescent, 3–20 mm broad; spikelets 1.6–2.6 mm long.
   2. Leaf blades with conspicuous pubescence.
      3. Midvein of lemma of lower (sterile) floret usually not evident; spikelets usually pubescent, sometimes glabrous _____ var. *stramineum*
      3. Midvein of lemma of lower (sterile) floret usually present; spikelets usually glabrous _____ var. *muhlenbergii*
   2. Leaf blades glabrous or essentially so.
      4. Herbage yellowish green to dark green; leaf blades 3–15 mm wide; midvein of lemma of lower (sterile) floret usually not evident _____ var. *stramineum*
      4. Herbage dark green to purplish; leaf blades 3–20 mm wide; midvein of lemma of lower floret usually present _____ var. *ciliatifolium*

Paspalum urvillei Steud., (for its discoverer, Jules Sébastien César Dumont d'Urville, 1790–1842, French hydrographer and explorer), VASEY'S GRASS, URVILLE'S PASPALUM. Clump-forming perennial from hardened base, without rhizomes or essentially so; culms erect or bent at base, 50–200(–250) cm tall; lower leaf sheaths densely short-bristly with fine, stiff hairs that catch and stick to the skin when touched; upper leaf sheaths glabrous; inflorescence branches 7–36, erect, 4–11.5(–14) cm long, the branch axes only slightly winged; spikelets mostly in pairs, in four rows, each with long hairs around the margin, usually with short pubescence on the faces, 1.8–2.8 mm long; lower glume absent; upper glume and lemma of sterile floret abruptly pointed beyond the blunt fruit. Low disturbed areas; widespread in e 1/2 of TX; scattered further w; e U.S. from VA s to FL w to KS and TX, also CA. Mid-May–Oct. Native of South America. [*P. larranagai* Arechav.]

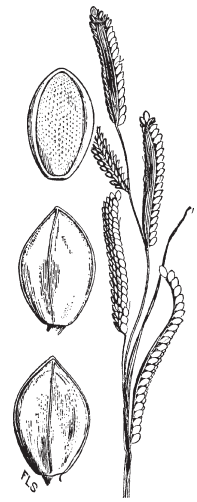
Paspalum vaginatum Sw., (sheathed, having a sheath), SEASHORE CROWN GRASS, SEASHORE PASPALUM. Rhizomatous and stoloniferous perennial; culms usually 60(–79) cm or less tall; inflorescence branches usually 2(–5), ± paired at culm apex, 2–8 cm long, the branch axes only



Paspalum langei [HI1]



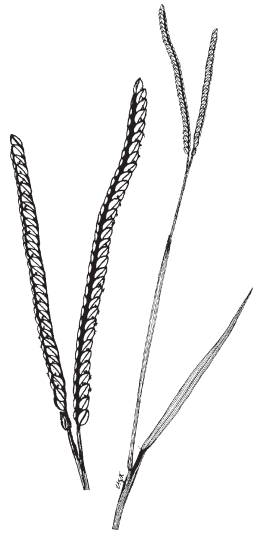
Paspalum malacophyllum [MAR, USH]



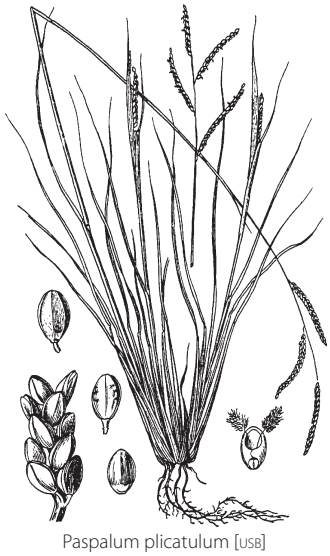
Paspalum lividum [HI1]



Paspalum minus [HI1]



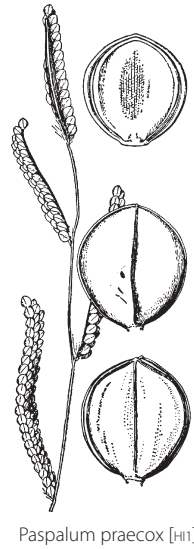
Paspalum notatum [GO1]



Paspalum plicatulum [USB]



Paspalum monostachyum [USB]



Paspalum praecox [HI1]

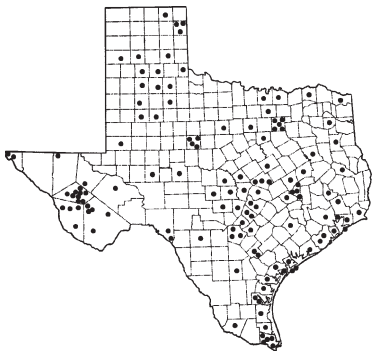
slightly winged; spikelets solitary, in 2 rows, 3–4.5 mm long; lower glume absent; upper glume and lemma of sterile floret glabrous. Sandy soils, usually in brackish areas or salt marshes near the coast; Jefferson Co. (Turner et al. 2003) near se margin of East TX; mainly Gulf Prairies and Marshes; se U.S. from NC s to FL w to TX. Flowering nearly throughout the year. This species, which is quite similar to *P. distichum*, was cited for Brazos Co. by Turner et al. (2003). However, the Brazos Co. collection (at TAES) is actually *P. distichum* and so is a TAES sheet from Lampasas Co. (mapped by Turner et al. 2003) in the Cross Timbers and Prairies. *Paspalum vaginatum* thus appears limited to coastal TX. Stephan Hatch (pers. comm.) suggests that *P. vaginatum* might better be combined with *P. distichum*. Larry Brown (pers. comm.) also notes that the two species appear to intergrade and perhaps should be merged.

Paspalum scrobiculatum L., (with trenched or pitted depressions), INDIAN CROWN GRASS, INDIAN PASPALUM, KODO-MILLET, DITCH-MILLET. Annual to 150 cm tall; ligule 0.3–1.2 mm long; inflorescence branches 5 or fewer, 3–10 cm long, the branch axes broadly winged; spikelets solitary, 1.8–3.2 mm long, glabrous; lower glumes absent; upper floret 1.4–1.8 mm wide, dark glossy brown; caryopses nearly orbicular (because of the lack of sufficient material, this description is entirely from Allen and Hall (2003)). Disturbed areas, possibly escaping cultivation; Hatch (2002) cited this species for the Post Oak Savannah; however, we have been unable to find any East TX specimens and at this point do not consider the species a member of the East TX flora; it is included here as a note to alert collectors; it would key out near *P. boscianum* in the key to species; also cited from the Edwards Plateau (Hatch et al. 1990) and the Gulf Prairies and Marshes (Barkworth et al. 2002); in the U.S. known only from AL, GA, and TX (Allen & Hall 2003). Native of India. [*P. orbiculare* G. Forst.] This species is grown as a cereal grain (KODO-MILLET) in India (Allen & Hall 2003) and has been cultivated for at least 3,000 years (de Wet et al. 1983a). However, under certain conditions KODO-MILLET is poisonous (producing unconsciousness or delirium with tremors)—either an alkaloid or a fungal infection is the suspected cause (de Wet et al 1983a). In the U.S. it is considered a federal noxious weed (Kartesz 1999; USDA Natural Resources Conservation Service 2002). ☠ ⊘ ☜

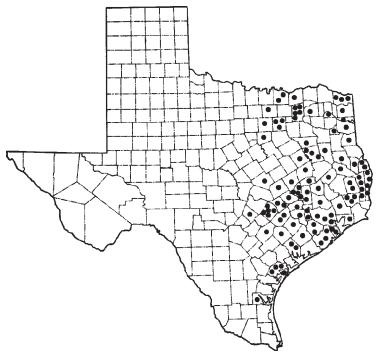
PENNISETUM Rich. FOUNTAIN GRASS, FEATHER-TOP

Ours perennials or 1 species an annual; ligule membranous, sometimes ciliate; inflorescence a spike-like panicle; spikelets in clusters (also called fascicles) of 1–12, each cluster subtended by an involucre of flexible bristles, the cluster and subtending involucre falling as a unit (disarticulation below the bristles); bristles free to base or nearly so, not spiny, of 3 kinds: outer, inner, and primary, the primary (or terminal) bristles located just below the spikelets, sometimes 1 or more kinds absent, at least some antrorsely scabrous, sometimes some long ciliate to plumose; callus below involucre neither flared nor swollen; spikelets with 2 florets, the lower floret sterile and with glume-like lemma, the upper floret fertile; glumes 1 or 2, the lower smaller than the upper or obsolete.

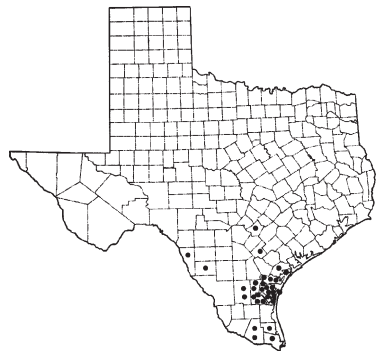
☁ A C_4 genus of 80–130 (Wipff 2003j) species of tropical and warm areas of the world. Some are used as fodder, pasture, or lawn grasses, in erosion control, or for their grains. In addition to those treated here, a number of *Pennisetum* species, including *P. alopecuroides* (L.) Spreng. (CHINESE FOUNTAIN GRASS), *P. macrostachyum* Trin., and *P. setaceum* (Forssk.) Chiov. (CRIMSON FOUNTAIN GRASS), are cultivated as ornamentals for their large and showy inflorescences. ⊘ Several introduced species are weedy and considered state and federal noxious weeds (Kartesz 1999; USDA Natural Resources Conservation Service 2002). The genus is closely related to *Cenchrus* (Crins 1991), and one species, *Pennisetum ciliare*, is sometimes included in *Cenchrus* as *C. ciliaris* (e.g., Watson & Dallwitz 1992) because its bristles are fused basally; see *Cenchrus* for further discussion. There has been extensive debate about the generic limits of *Pennisetum* and *Cenchrus* (Wipff 2001a; 2003j), and according to Wipff and Veldkamp (1999), *Pennisetum* "is morphologically and nomenclaturally complex and is in need of revision. In some cases the



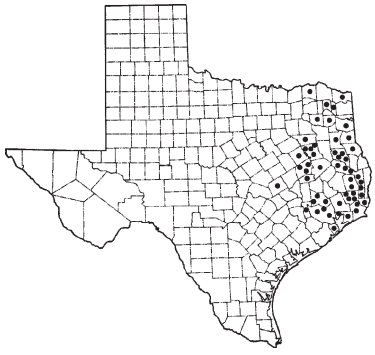
Paspalum distichum



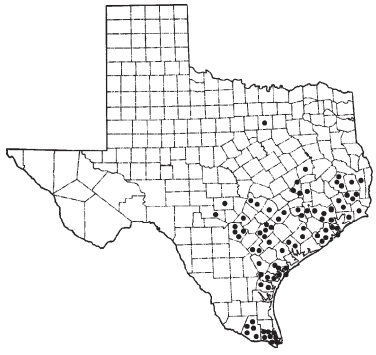
Paspalum floridanum



Paspalum hartwegianum



Paspalum laeve
(all three vars.)



Paspalum langei



Paspalum lividum



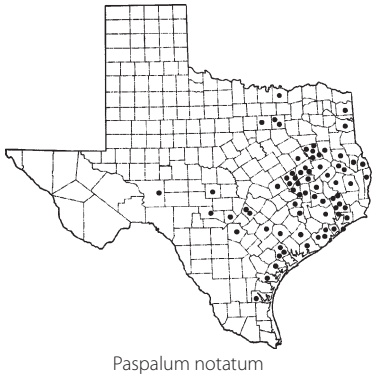
Paspalum malacophyllum



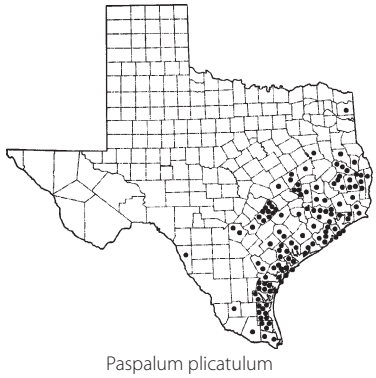
Paspalum minus



Paspalum monostachyum



Paspalum notatum



Paspalum plicatulum



Paspalum praecox

relationship of *Pennisetum* to allied genera (e.g. *Cenchrus* L.) is unresolved." Recent molecular studies suggest *Pennisetum* is "probably paraphyletic" without the inclusion of *Cenchrus* (Gómez-Martínez & Culham 2000). However, until more information is available, we are following most recent authorities (e.g., Wipff 2003j) in maintaining the traditional circumscription of *Pennisetum*. (Latin: *penna*, a feather, and *seta*, a bristle, referring to the feathery bristles around the spikelets) (subfamily Panicoideae, tribe Paniceae)
REFERENCES: Chase 1921; Brunken 1977; Türpe 1983; Webster 1988; Crins 1991; Ramu et al. 1996; Wipff & Veldkamp 1999; Wipff 2001a, 2003j.

1. Bristles of involucre united at base, forming a small shallow disk 0.5–1.5 mm in diam.; lower portion of inflorescence axis scabrous ____ **P. ciliare**
1. Bristles of involucre not united, free to base; lower portion of inflorescence axis pubescent.
   2. Inflorescence usually quite dense (so much so that they are not well-flattened on herbarium specimens), resembling that of a *Typha* (CAT-TAIL); peduncle stout, usually ca. 3–7 mm wide just below inflorescence; involucres and spikelets persistent on inflorescence axis even at maturity (= not disarticulating); bristles of involucre often (but not always) mostly about the length of the enclosed spikelets, sometimes longer; plants annuals ____ **P. glaucum**
   2. Inflorescence not so dense as to be difficult to flatten, usually much smaller than that of a *Typha*; peduncle more slender, < 2 mm wide just below inflorescence; involucres and spikelets readily deciduous from inflorescence axis; bristles longer than the enclosed spikelets, often much so; plants perennial.
      3. Spikelets (7–)9–12(–15) mm long; longest bristles of involucre usually 4–5(–7) cm long; lemma of lower floret with 7–11 veins; inflorescence 4–10(–12) cm long; leaf blades 2–5 mm wide ____ **P. villosum**
      3. Spikelets 4.4–7 mm long; longest bristles of involucre usually less than 3.5(–4) cm long; lemma of lower floret with 1–6 veins; inflorescence usually 8–37 cm long; leaf blades 2–40 mm wide.
         4. Plants usually (1–)2–4+ m tall; leaf blades (4–)12–40 mm wide; inflorescence golden yellow or dark purple; inflorescence axis straight, erect, with 30–40 spikelet clusters per cm; ligule 1.5–5 mm long ____ **P. purpureum**
         4. Plants 0.5–1.5+ m tall; leaf blades 2–11 mm wide; inflorescence white to greenish white or pink to dark burgundy; inflorescence axis often ± flexuous, erect or arching, with 5–12 spikelet clusters per cm; ligule 0.5–1.7 mm long.
            5. Longest bristles of involucre more than 2.5 cm long; leaf blades 2–3.5 mm wide, convolute or folded, green, the midvein noticeably thickened; nodes glabrous; inflorescence pink to dark burgundy; lower glume 0.3 mm or less long or absent ____ **P. setaceum**
            5. Longest bristles of involucre usually less than 2.5 cm long; leaf blades 3–11 mm wide, flat, green or burgundy, the midvein not noticeably thickened; nodes pubescent; inflorescence white or greenish white (sometimes purplish tinged); lower glume 1–2.2 mm long ____ **P. orientale**

Pennisetum ciliare (L.) Link, (ciliate, fringed with hairs), BUFFEL GRASS. Perennial, usually knotty at base; culms erect to geniculate-spreading, to 100(–150) cm long; inflorescence 3–10(–20) cm long, 1–2(–3.5) cm wide, erect, green to brown, brown-purple, or dark purple; spikelet clusters 11–37 per cm of inflorescence axis; bristles of involucre united at base, ca. 4–14(–23) mm long, purplish, often wavy; spikelets 1–12 per cluster, 2.2–5.6 mm long. Roadsides, disturbed sites; Brazos, Wilson (BRIT), Caldwell, and McLennan (TAES) cos. in s part of East TX; mainly Gulf Prairies and Marshes, South TX Plains, Edwards Plateau, and Trans-Pecos; sw U.S. from TX w to CA, also AL, FL, LA, MS, and MO. Spring–fall. Native of Africa, w Asia, and India. [*Cenchrus ciliaris* L.] This species has sometimes been treated as a *Cenchrus* (see *Cenchrus* for further discussion), based on its basally fused bristles. It also closely resembles *Setaria* in often having relatively short bristles and no spines, but the spikelet cluster (bristles and spikelet(s)) falls as a

unit as in other *Pennisetum* species, whereas in *Setaria* the spikelets disarticulate above the bristles. BUFFEL GRASS was introduced to the U.S. in the 1940s by the U.S. Soil Conservation Service and was formally released in San Antonio in 1946 as a forage crop for warm areas of the s U.S. and Mexico (Tellman 1997). It is resistant to drought and hard grazing (Clayton & Renvoize 1986) but is now a problematic invader of native habitats in some parts of sw North America, particularly in Sonora, Mexico where it has nearly eliminated cacti and other native plants in some areas (Tellman 1997). This species can dramatically change the fire ecology of an area—the large quantities of biomass produced by huge numbers of buffel grass plants contribute to devastating fires that can threaten whole ecosystems (Tellman 1997; Búuquez-Montijo et al. 2002; Enyedy 2002). Reproduction in this species is predominantly through apomixis (= type of reproduction in which an embryo is formed without fertilization) (Hignight et al. 1991).

Pennisetum glaucum (L.) R. Br., (whitened with a coating or bloom), PEARL-MILLET. Coarse annual; culms 40–100(–300) cm tall; ligule ciliate, 1–5 mm long; leaf blades 8–30(–70) mm wide; inflorescence 10–40(–200) cm long, quite dense, erect, superficially resembling those of *Typha* (CAT-TAIL); spikelet clusters 33–160 per cm of inflorescence axis; involucres and spikelets persistent on inflorescence axis (this is the only *Pennisetum* occurring in East TX that displays this character); bristles of involucres usually 3–6 mm long, sometimes with a single much longer bristle (rarely bristles all relatively long), the bristles scabrous, the inner ones plumose toward base; spikelets 1–9 per cluster, 3–7 mm long. A cultivated species probably occurring only as a transitory waif on roadsides or waste places; Sabine (*L. Brown*, ASTC) and Harris (Turner et al. 2003) cos.; Hatch (2002) cited vegetational areas 2, 3, and 4; however, we know of no other TX collections; scattered in the U.S., particularly in the se. Sep–Oct. There is disagreement on the area of nativity; according to Wipff (2003j), this species is native to Asia; however, Brunken (1977) indicated that it is native to both Asia and Africa and that the cultivated form is derived from wild African ancestors. Clayton and Renvoize (1986) also stated that it was probably domesticated in w Africa ca. 2,000–3,000 years BC. [*Chaetochloa glauca* (L.) Scribn., *Chaetochloa lutescens* (Weigel) Stuntz, *Panicum americanum* L., *Panicum glaucum* L., *Pennisetum americanum* (L.) Leeke, *Pennisetum typhoides* of authors, not (Burm.) Stapf & C.E. Hubbard, *Setaria glauca* (L.) Beauv.] Due to ambiguity and confusion over type material, there is controversy concerning the correct name for this species—some authorities (e.g., Yatskievych 1999) treat it as *P. americanum*; however, we are following Clayton and Renvoize (1986), Jones et al. (1999), Kartesz (1999), Wipff and Veldkamp (1999), Hatch (2002), and Wipff (2003j) in treating it as *P. glaucum*. Brunken (1977) concluded that the cultivated plant and its wild relatives were best treated as different subspecies of the same species; as a result, escaped cultivated plants are in subsp. *glaucum*. PEARL-MILLET is an important grain crop in dry areas of Africa; it is the most drought tolerant of the tropical cereal crops (Clayton & Renvoize 1986), with harvests obtained from as little as 250 mm of annual rainfall (Brunken 1977). In terms of annual production, Brunken et al. (1977) considered PEARL-MILLET the sixth most important cereal crop worldwide. This cultivated species has lost the ability to disperse its seeds effectively and thus does not persist for long without cultivation (Crins 1991). This is presumably the result of artificial selection for retention of the grains on the inflorescence and thus less loss of the grain crop; similar situations can be seen in corn, sunflower, and many other plants grown for their seeds. This species is considered a noxious weed in CO (Kartesz 1999). Under certain conditions, it is known to accumulate toxic levels of nitrates which can cause poisoning in grazing animals (Burrows & Tyrl 2001).

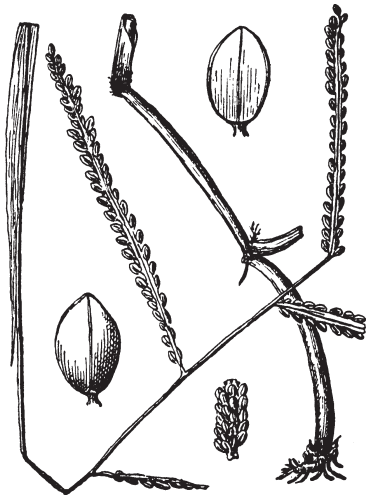
Pennisetum orientale Willd. ex Rich., (eastern, from the Orient), WHITE FOUNTAIN GRASS, LAURISA GRASS. Rhizomatous tufted perennial; culms ca. 40–150+ cm tall, much-branched basally, erect, the nodes pubescent; ligule membranous, 0.2–1.4(–1.7) mm long; leaf blades 3–11 mm wide; inflorescence ca. 10–25 cm long, rarely longer, often flexuous, white, greenish white, or sometimes purplish tinged; inner bristles of involucre 6.5–18.5 mm long, plumose; outer

bristles 2.2–10(–14) mm long, glabrous or scabrous; primary bristles to ca. 24 mm long; spikelets 1–6(–10) per cluster, 4.4–6.7 mm long; lower glume 1–2.2 mm long, the upper ca. 3–4.8(–5.5) mm long. Introduced as a cultivated grass (Hatch et al. 1999) and apparently escaping; included based on citation of Post Oak Savannah by Hatch (2002); Turner et al. (2003) also mapped Brazos Co., but all Brazos Co. specimens we have been able to find in TX herbaria were cultivated; also reported as escaped in the Gulf Prairies and Marshes (Hatch et al. 1999); no county distribution map is provided; in the U.S., records of escapes are known only from TX (Barkworth et al. 2002). May–Nov. Native to w Himalayas of India w through Asia Minor and n Africa to Morocco (Ramu et al. 1996). This species is known to hybridize with *P. ciliare* (Ramu et al. 1996). It reproduces at least partially through apomixis (= method of vegetative reproduction in which an embryo is formed without fertilization) (Ramu et al. 1996). It has been described as being potentially important as an ornamental grass and also as a possible source of germplasm for forage crop improvement programs (Ramu et al. 1996).

Pennisetum purpureum Schumach., (purple), ELEPHANT GRASS, NAPIER GRASS. Robust, stoloniferous, tufted perennial; culms (1–)2–4+ m tall, usually much-branched; nodes glabrous or pubescent; internodes glaucous; ligule membranous, ciliate, to 5 mm long; leaf blades (4–)12–40 mm wide; inflorescence 7–25(–30) cm long, 1–3 cm wide (excluding bristles), golden yellow or dark purple, the axis straight; peduncle (at point just below inflorescence) distinctly hairy; bristles of involucre usually less than 1.7(–4) cm long, scabrous, the inner ones plumose toward base; spikelets 4.4–7 mm long, 1–5 per cluster, 1 fertile and nearly sessile, the others, if present, staminate and pedicelled; lower glume minute or obsolete, 0.8 mm or less long, the upper glume usually 1/4–1/3 the length of the spikelet. Cultivated for pasture, also a weed along roadsides (planted for erosion control by highway dept.?); known in East TX only from Grayson (*J.A. Crosthwaite s.n.*, BRIT) and Bexar (Turner et al. 2003) cos.; Turner et al. (2003) also mapped Brazos Co., but all Brazos Co. material we have been able to find in TX herbaria was cultivated; also Gulf Prairies and Marshes; FL and TX. Oct–Nov. Native of tropical Africa. This species is reported to be highly productive for forage but becomes unpalatable at maturity (Hatch et al. 1999) because the mature leaves have razor-sharp margins (Bor 1960). When mature, the culms are "reed-like" and have been used in building fences, walls of huts, etc. (Bor 1960). After recognition for its value as a forage early in the 20th century, this species "... was introduced to most of the world's wet tropics where it has frequently escaped and has become naturalized" (Brunken 1977).

Pennisetum setaceum (Forssk.) Chiov., (bristle-like), TENDER FOUNTAIN GRASS, FOUNTAIN GRASS, CRIMSON FOUNTAIN GRASS. Perennial, tufted; culms to 100(–150) cm tall; leaf blades 3.5 mm or less wide, green, the midvein noticeably thickened; inflorescence usually 15–30 cm long, plumose, pink to dark burgundy; bristles of involucre plumose toward base, one bristle of each involucre longer than the others, the longest ca. 3 cm long; spikelets 1–4 per cluster, 4.5–6.5 mm long; lower glume usually absent (rarely to 0.3 mm long). Widely cultivated as an ornamental; included based on citation of Post Oak Savannah by Hatch (2002) and Brazos Co. by Barkworth et al. (2002); we have, however, seen no escaped specimens from East TX; no county distribution map is provided; AZ, CA, FL, KY, LA, NM, TN, and TX. Summer. Native of the e Mediterranean. This species can be invasive and is listed as a noxious weed in HI (Kartesz 1999).

Pennisetum villosum R. Br. ex Fresen., (softly hairy), FEATHER-TOP, FEATHER-TOP PENNISETUM. Perennial, tufted; culms 20–75 cm tall; ligule a ciliate membrane with hairs ca. 1–1.5 mm long; leaf blades 2–5 mm wide; inflorescence a relatively short, ± ovate, contracted panicle, whitish, tan, or yellowish, feathery, 4–10(–12) cm long; spikelet clusters 7–11 per cm of inflorescence axis; bristles of involucre usually 4–5(–7) cm long, the inner bristles plumose with silky hairs; spikelets 1(–4) per cluster, large, (7–)9–12(–15) mm long. Cultivated as an ornamental, tending to persist or become a transitory escape; Dallas, Travis (BRIT), Bexar (TEX), and Bell (Turner et al. 2003) cos.; Turner et al. (2003) also mapped Brazos Co., but all Brazos Co. material we have been



Paspalum pubiflorum var. glabrum [BB2]



Paspalum pubiflorum var. pubiflorum [GO1]



Paspalum setaceum [RCA]



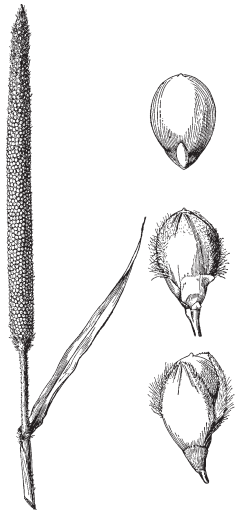
Paspalum urvillei [HI1]



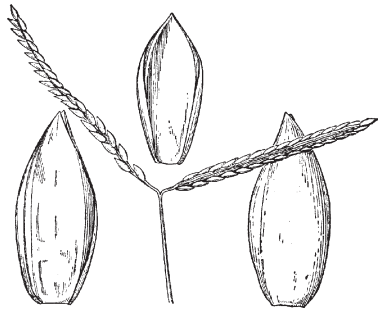
Paspalum repens [USB]



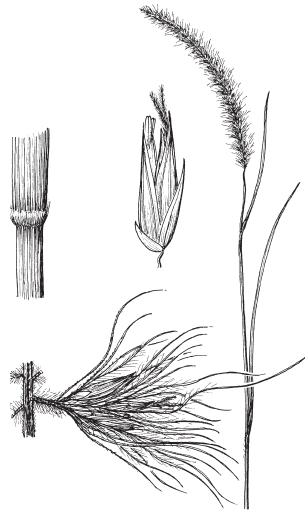
Pennisetum ciliare [GO1]



Pennisetum glaucum [HI1]



Paspalum vaginatum [HI1]



Pennisetum orientale [FNA]

able to find in TX herbaria was cultivated; scattered in TX; se Canada (Ont.), CA, CO, MI, and TX. Jun–Oct. Native of Africa (Ethiopia, n Somalia) and Arabian Peninsula. [*Cenchrus longisetus* M.C. Johnst.]

Pennisetum advena Wipff & Veldkamp, (visitor or stranger, in reference "to its mistaken identity and unknown origin"—Wipff & Veldkamp 1999), PURPLE FOUNTAIN GRASS. Beautifully pigmented perennial (but cultivated as an annual) without rhizomes, similar to *P. setaceum*; culms 100–150 cm tall, the nodes glabrous; ligule < 1 mm long; leaf blades to 11 mm wide; inflorescence 23–32 cm long, burgundy, flexuous and drooping; outer bristles of involucre antrorsely scaberulous, the inner bristles ciliate; spikelets ca. 5–6.5 mm long. Widely cultivated in East TX (and discussed here for that reason), but apparently not escaping (fruits rarely produced); cultivated throughout the U.S. May–frost. Presumed to have originated from the Old World but known only from cultivation (Wipff & Veldkamp 1999). [*P.* '*cupreum*'—a horticultural name that was never validly published (Wipff & Veldkamp 1999] This species, described in 1999 (Wipff & Veldkamp 1999) from cultivated material, has a confused and interesting history. While long a common ornamental in the s U.S., this strikingly colored species was widely known as *P. setaceum* 'Rubrum.' However, it differs from that species in numerous characters and can be distinguished as follows: leaf blades usually 3.5–11 mm wide, burgundy (rarely green), flat, with midvein not noticeably thickened; lower glume 0.5–1 mm long. Details about this important cultivated species (now extensively grown) can be found in Wipff and Veldkamp (1999). It is usually easily recognized by its strikingly colored leaves and inflorescences.

Pennisetum nervosum (Nees) Trin., (with evident nerves), BENT-SPIKE FOUNTAIN GRASS. Perennial 1.5–3+ m tall; leaf blades usually 8–12 mm wide; inflorescence 15–30 cm long, the axis flexible and drooping at maturity; peduncle apex hairy; bristles of involucre mostly only slightly longer than spikelets, < 12 mm long, often much less, all scabrous; spikelets 5–7 mm long. This species is cultivated in East TX and is discussed here for that reason; however, it is not known to have escaped or naturalized in the area; it was mapped for Brazos Co. by Turner et al. (2003), apparently based on a TAES collection (*Cecora*) from a refuse pile "near weed science greenhouses" at Texas A&M Univ.; Hatch (2002), Turner et al. (2003), and Wipff (2003j) noted its occurrence in the Gulf Prairies and Marshes and South TX Plains; CA and TX. Summer–fall. This species is somewhat similar to *P. orientale* and *P. purpureum* but can be distinguished by its bristles all being scabrous (versus at least some plumose basally in *P. orientale* and *P. purpureum*). Native of South America.

PHALARIS L. CANARY GRASS

Glabrous erect-tufted annuals; inflorescence a very dense, tightly contracted, spike-like panicle; spikelets sessile, strongly laterally compressed, with 1 terminal perfect floret and 2 sterile reduced or scale-like lemmas below; disarticulation above glumes, the sterile lemmas falling with the fertile one; glumes keeled and winged (along keel) in upper half, ± equal, awnless; lemma of fertile floret keeled, appressed-pubescent, awnless.

A primarily n temperate C_3 genus of 16–21 species native to Europe, the Mediterranean, Africa, n Asia, and the Americas, with centers of distribution in the Mediterranean and the sw U.S. (Baldini 1995; Barkworth ined.). Some are valuable as fodder, as pasture grasses, or as a grain crop (mainly for birdseed); others are considered significant weeds (Watson & Dallwitz 1992). Some species deposit silicon in the lemmas in the form of microfibers and friable sheets; the sharp, elongated fibers fall into a size range potentially important as carcinogens. The fruits of a number of species "are known contaminants of the cereal crops of the Middle East, and have been implicated as factors in the high incidence of oesophageal cancer in north-east Iran" (Sangster et al. 1983). The dense inflorescences are sometimes used in dried floral arrangements (Burrows & Tyrl 2001) and are sometimes dyed green and used to simulate shrubs in model

landscapes (Barkworth ined.). ⊘ *Phalaris arundinacea* L., REED CANARY GRASS, a circumpolar species native to the n U.S., is weedy and difficult to eradicate and is considered a noxious weed in WA and NC (Kartesz 1999). ☠ Some species of *Phalaris* are potentially toxic to grazing livestock, with toxins including alkaloids (Clay 1988; Burrows & Tyrl 2001). (Ancient Greek name for an undetermined grass) (subfamily Pooideae, tribe Poeae)

REFERENCES: Anderson 1961; Baldini 1995; Tucker 1996; Hatch et al. 2004; Barkworth ined.

1. Inflorescences usually 6–15(–20) cm long; glumes 3–5.5 mm long, with lateral veins scabrous with 9 or more stiff hairs; plants usually 60–170 cm tall; species known from the s part of East TX _____ **P. angusta**

1. Inflorescences usually 1.5–7 cm long; glumes 4–10 mm long, with lateral veins glabrous OR scabrous with 5 or fewer stiff hairs; plants usually 25–70(–100) cm tall; including species widespread in East TX.
   2. Glumes usually 6–10 mm long, the keel with a conspicuous wing to 1 mm wide near the tip; caryopsis (= fruit) 3.9–4.2 mm long; reduced lemmas 2.5–4.5 mm long, more than 1/2 as long as lemma of fertile floret; lemma of fertile floret 4.5–6.8 mm long; introduced species rare in East TX _____ **P. canariensis**
   2. Glumes 4.2–6 mm long, the keel with only a narrow wing to 0.5 mm wide near the tip; caryopsis 1.7–2.4 mm long; reduced lemmas 1.5–2.5 mm long, 1/3–1/2 as long as lemma of fertile floret; lemma of fertile floret 3–4.7 mm long; native species widespread and common in East TX _____ **P. caroliniana**

Phalaris angusta Nees ex Trin., (narrow), TIMOTHY CANARY GRASS. Culms usually 60–170 cm tall; ligule a membrane 3–7 mm long; leaf blades 3–18 cm long, 5–12 mm wide; inflorescences elongate, 6–15(–20) cm long, ca. 8–10 mm wide; glumes ca. 3–5.5 mm long; reduced lemmas 0.5–1.5 mm long; lemma of fertile floret (2–)2.3–3.2(–3.8) mm long; caryopsis less than 1.5 mm long. Ditches and other open moist areas; Hardin, Harris, Jefferson (BRIT), Brazos, Liberty, and Orange (Turner et al. 2003) cos. in se part of East TX; also Gulf Prairies and Marshes and Blanco Co. (Turner et al. 2003) in e Edwards Plateau; s 1/4 of the U.S. from SC s to FL w to CA, also OR. Apr–May. This species has an interesting distribution, occurring in both North and South America; there is some doubt about where it originated (Baldini 1995). The epithet *angustata* has sometimes been mistakenly used for this species (e.g., Gould 1975b).

Phalaris canariensis L., (of the Canary Islands), CANARY GRASS. Culms 25–70(–100) cm tall; ligule a membrane 2–6 mm long; leaf blades 5–15(–20+) cm long, 3–10 mm wide; inflorescences short, thick, 1.5–3(–4) cm long, 10–20 mm wide; glumes 6–10 mm long, glabrous or sparsely hispid, not scabrous, ± pale with dark green along the lateral veins. Waste areas, probably coming up from discarded birdseed and not long persisting; Brazos (BRIT), Bell (HPC), Bexar, Hill, Limestone, and Nacogdoches (Turner et al. 2003) cos.; widely scattered in TX; throughout most of Canada and the U.S. Mar–Jun. Native of s Europe and the Canary Islands. This species is important as a source of commercial bird feed; it is the canary seed of commerce (Gould 1975b; Mabberley 1987). ☜

Phalaris caroliniana Walter, (of Carolina), WILD CANARY GRASS, CAROLINA CANARY GRASS, SOUTHERN CANARY GRASS, MAY GRASS. Culms usually 25–70(–100) cm tall; ligule a membrane 1–5 mm long; leaf blades 6–15(–20) cm long, 3–10(–13) mm wide; inflorescences cylindrical to elliptic or nearly ovate in outline, usually 7 cm or less long (see note below), 8–13(–20) mm wide; glumes 4.2–6 mm long, the lateral veins glabrous or scabrous with 5 or less spicules. Moist areas, ravines, disturbed sites, often in sandy or gravelly soils; throughout TX; s 1/2 of the U.S. Apr–Jun. A few aberrant individuals of *P. caroliniana* with elongate inflorescences to 12 cm long (e.g., *Whitehouse 15711*, Dallas Co., BRIT) have been observed; they are reminiscent of *P. angusta*, but can be distinguished by the other characters in the key to species.

PHLEUM L. TIMOTHY, CAT-TAIL GRASS

A C_3 genus of ca. 15 species (Barkworth ined.) of temperate Eurasia, North America, and temperate South America, with a center of diversity in the e Mediterranean region (Tucker 1996). The genus is important agriculturally and some species are cultivated as forage grasses; nearly all are good fodder (Dogan 1991; Tucker 1996). The pencil-like inflorescence resembling that of a miniature member of the genus *Typha* (CAT-TAIL) is quite distinctive. (Greek: *phleos*, a kind of reed) (subfamily Pooideae, tribe Poeae)

REFERENCES: Piper & Bort 1915; Dogan 1991; Tucker 1996; Barkworth ined.

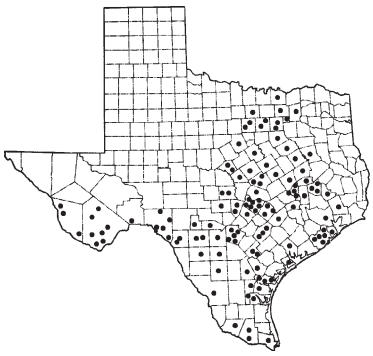
Phleum pratense L., (of meadows), TIMOTHY, CULTIVATED TIMOTHY, HERDS GRASS. Clump-forming perennial 30–100(–150) cm tall, glabrous except for scabrous leaf-blades; lower nodes sometimes swollen; ligule a membrane 2–4(–6) mm long; leaf blades 3–10 mm wide; inflorescence a pencil-like, slender, dense, cylindrical, spike-like panicle usually 4–9(–18) cm long and 5–9(–10) mm thick; spikelets strongly laterally compressed, 1-flowered, ca. 2–4 mm long excluding awns, disarticulating above the glumes; glumes essentially equal, as long as entire spikelet, with coarsely ciliate keel, abruptly short-awned, the awn 0.8–1.5(–2) mm long; lemma shorter than glumes, awnless, usually puberulent. Collected in Dallas in 1874 by Reverchon (whether wild or cultivated not known), found along railroad at Mineola, Wood Co. in East TX in June 1900 (Mahler 1988), and reported from Cass Co. (Turner et al. 2003); Correll and Johnston (1970) described it as an occasional waif in the e half of TX, not persisting, and brought in with hay; also Edwards Co. (Turner et al. 2003) on the Edwards Plateau; throughout most of Canada and the U.S. Mostly Apr–Jun. Native of Eurasia. This species is an important cool-climate pasture and hay grass, apparently not now cultivated in East TX. It is a common cause of hay fever (late spring and early summer) where cultivated (Steyermark 1963; Yatskievych 1999). According to Steyermark (1963), the common name TIMOTHY "... originated from Timothy Hanson of Maryland who introduced the grass from Europe about 1720."

PHRAGMITES Adans. REED

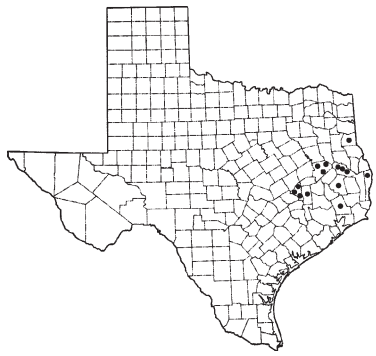
A cosmopolitan C_3 genus treated in the most recent works as monotypic (e.g., Allred 2003a); other authorities recognize 3–4 species (e.g., Mabberley 1997; Scholz & Böhling 2000). It is described by Clayton and Renvoize (1986) as a "uniform genus of barely separable species." The plants are often used for mats or thatching (Clayton & Renvoize 1986). The growth rate can be extremely rapid, and in some cases the plants can impede navigation along waterways. Plants in some areas (e.g., Europe) are harvested and the pulp used in paper, synthetic textiles, insulation, fertilizer, and other products (Mabberley 1997). Subfamily placement of *Phragmites* has been problematic—it was previously thought to be in the Panicoideae, but recent evidence suggests the Arundinoideae (Grass Phylogeny Working Group 2001). (Greek: *phragma*, fence or hedge, apparently from its fence-like or hedge-like growth, particularly along ditches) (subfamily Arundinoideae, tribe Arundineae)

REFERENCES: Clayton 1967b, 1968; Haslam 1972; Tucker 1990; Greuter & Scholz 1996; Chambers et al. 1999; Clevering & Lissner 1999; Koppitz 1999; Saltonstall 2002; Allred 2003a; Saltonstall et al. 2004.

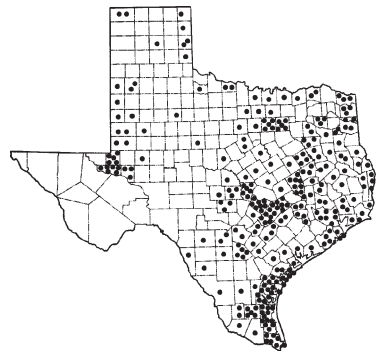
Phragmites australis (Cav.) Trin. ex Steud., (southern), COMMON REED, REED, NAL, DANUBE GRASS. Rhizomatous perennial often forming dense stands; culms (1–)2–4+ m tall, erect, usually unbranched; leaves cauline, the blades mostly 1.5–6 cm wide, flat, glabrous, marginally scabrous; ligule a ciliate membrane 1.5 mm or less long; inflorescences densely-flowered, plume-like panicles 15–35(–50) cm long; spikelets 10–15 mm long, usually with 3–10 mostly fertile florets, the lowermost sterile or staminate, the distal 1–2 reduced; rachilla joints densely long-hairy, the hairs to 10 mm or more long; disarticulation above glumes and between florets (individual florets thus shed with a section of the hairy rachilla—presumably for dispersal); glumes and lemmas



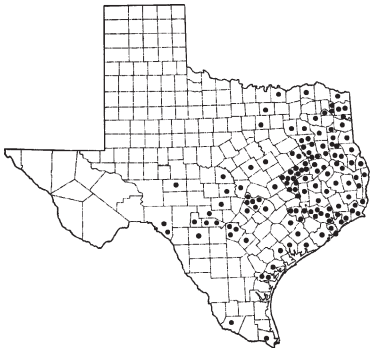
Paspalum pubiflorum
(both vars.)



Paspalum repens



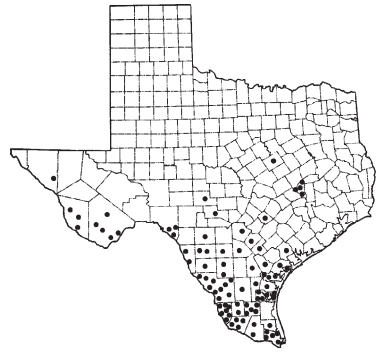
Paspalum setaceum



Paspalum urvillei



Paspalum vaginatum



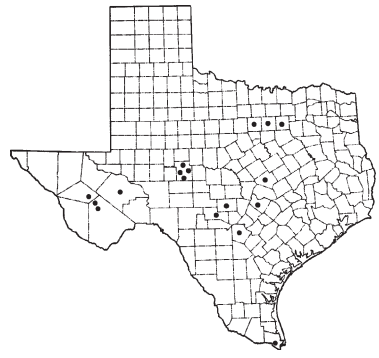
Pennisetum ciliare



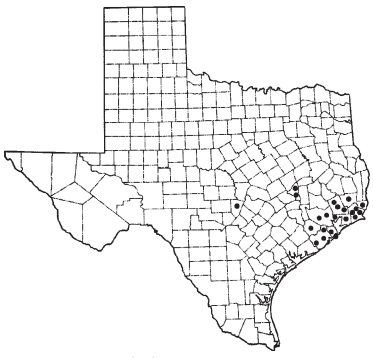
Pennisetum glaucum



Pennisetum purpureum



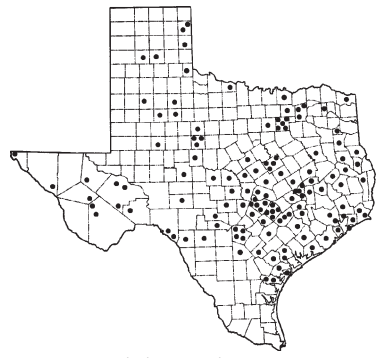
Pennisetum villosum



Phalaris angusta



Phalaris canariensis



Phalaris caroliniana

glabrous; glumes 3–8(–10) mm long, shorter than lowest lemma, the lower glume much shorter than upper; lowest lemma 7–12(–15) mm long, much longer than fertile upper lemmas. Wet areas of ponds, low areas, and roadsides, usually tight clay soils, also brackish conditions; sparsely scattered throughout TX; throughout most of Canada and the U.S. Native of North America, South America, Eurasia, Africa, and Australia. Mostly Jul–Nov. [*P. communis* Trin.] "Its uses include thatching, lattices, arrow shafts, construction boards, mats, and erosion control, and it was used in the past to make cigarettes and superior pen quills" (Allred 2003a). Also, the grains were eaten by Native Americans (Mabberley 1987). This species was long known as *P. communis*; however, Clayton (1968) concluded that *P. communis* and *P. australis* comprise a single species. *Phragmites australis* is the oldest name and thus has nomenclatural priority. This species appears to be native on every continent except Antarctica and has been described as having "... perhaps the broadest range of any flowering plant species. ..." (Yatskievych 1999) or of being perhaps the most widely distributed of all vascular plant species (Allred 1993b). It is thought to have been "a minor component of North American wetland plant communities for thousands of years, [but] has become a dominant species in the past century" (Chambers et al. 1999). Both genetic and environmental (e.g., habitat disturbance, change in salinity) factors have been proposed to explain its dramatic expansion (Chambers et al. 1999). However, recent evidence suggests that a non-native aggressive strain was introduced to North America within the past 150 years (Tucker 1990; Chambers et al. 1999; Natural Ohio 2000; Saltonstall 2002). In parts of the southern and midwestern U.S., this strain "... has spread along highways and sometimes becomes invasive in natural wetland communities" (Yatskievych 1999). The species is extremely variable phenotypically because of variation in chromosome number, clonal diversity, and plasticity of clones (Clevering & Lissner 1999; Koppitz 1999). Some studies have suggested that there are two genotypes in North America (Saltonstall 2002) that may be morphologically distinct (Blossey 2002). However, "How these genotypes relate to the various segregate species that have been recognized is not yet known" (Allred 2003a). Recently, Saltonstall et al. (2004) suggested that there are "three genetic lineages" in North America. The species is considered a noxious weed in South Carolina (Kartesz 1999), but since it is a native that is apparently not causing problems in Texas, we are not designating it as noxious. While *Phragmites* is somewhat similar to *Arundo*, the latter has subequal glumes, a glabrous rachilla, hairy lemmas, and a wedge-shaped, light to dark brown area at the base of the leaf blades (Allred 2003a).

PHYLLOSTACHYS Siebold & Zucc. BAMBOO

A C_3 genus of at least 50 species of hardy, temperate, Asian BAMBOOS (Barkworth & Clark ined.) native from the Himalayas to Japan, but especially China. They often form thickets by means of their spreading rhizomes. The genus includes the most frequently cultivated hardy BAMBOOS, and species are variously used for paper, timber, fishing rods, furniture, edible shoots, and cultivated ornamentals. (Greek: *phyllum*, a leaf, and *stachys*, a spike, referring to the leafy spikelets—Barkworth & Clark ined.) (subfamily Bambusoideae, tribe Bambuseae)
REFERENCES: Borowski et al. 1996; Hodkinson et al. 2000; Barkworth & Clark ined.

Phyllostachys aurea Carrière ex Rivière & C. Rivière, (golden), GOLDEN BAMBOO, FISH-POLE BAMBOO, YELLOW BAMBOO. Woody rhizomatous perennial vigorously forming extensive colonies (sometimes so thick as to be difficult to penetrate); culms 2–8 m tall, glabrous, green to yellowish, 1–4 cm in diam., flattened on 1 side above point on node where branches originate, the upper nodes glabrous; branches 2(–3) per node, 1 of these larger than the other; leaf sheath glabrous except for 2 tufts of bristles at apex; leaf blades narrowly lanceolate, 5–12(–15) cm long, 1–2.2 cm wide, basally cuneate to rounded, apically acuminate, glabrous on both surfaces except base of midvein on lower leaf surface often with short hairs along one side, marginally entire to scaberulous, petiole short but distinct, ca. 3–5 mm long; flowers or fruits usually not seen. Widely cultivated as an ornamental, persisting and spreading vegetatively, forming extensive,



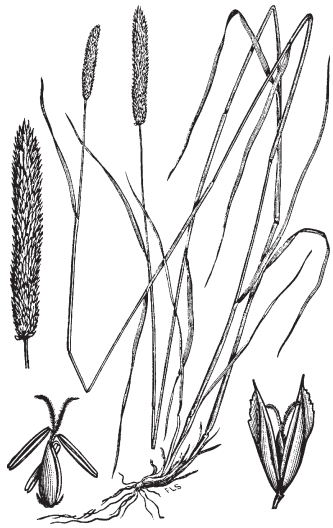
Pennisetum purpureum [HUT]



Pennisetum setaceum [BA1]



Pennisetum villosum [BA1]



Phalaris angusta [USB]



Phalaris canariensis [GO1, PBL]



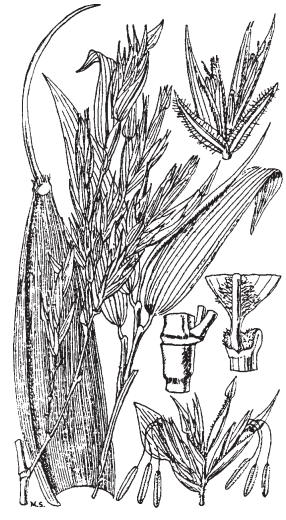
Phalaris caroliniana [USB]



Phleum pratense [HI1]



Phragmites australis [REE]



Phyllostachys aurea [KEW]

sometimes weedy colonies covering large areas (often excluding other vegetation); nearly throughout East TX w to Cross Timbers and Prairies (Borowski et al. 1996); se U.S. from MD s to FL w to AR and TX, also OR. We have seen only one flowering collection from East TX. Native of China. [*Bambusa aurea* Hort] Like many bamboos, *Phyllostachys* species generally flower synchronously only after intervals of many years. In some species, these flowering cycles are up to 120 years in length, apparently based on an internal physiological calendar (Janzen 1976; Judd et al. 1999). Janzen (1976) reported the intermast period (= time period between successive fruit/seed production events) in *P. aurea* to be "28–29 (2× 14–15)" years, based on specimens cultivated in Europe. However, he also indicated that cultivation and other factors can affect the flowering interval. Texas plants may thus have lost synchrony and not display such a flowering pattern. It has been hypothesized that such long intervals between flowering evolved as a mechanism to escape seed predation (Janzen 1976). Large amounts of seed produced at intervals would hinder the buildup of populations of seed predators and lead to satiation of any seed predators present—only so much can be eaten at one time and thus many seeds would escape predation. This species was introduced to the U.S. prior to 1870 (Rehder 1927) as an ornamental, for barrier planting, and for erosion control and soil stabilization (Borowski et al. 1996). The young shoots are reported to be "very palatable" (Barkworth & Clark ined.) and the mature culms are sometimes used as fishing poles. ☜

A variety of other exotic bamboos, including *Bambusa* species (e.g., *B. multiplex* (Lour.) Raeusch. ex Schult. & Schult. f., HEDGE BAMBOO) and additional species of *Phyllostachys* (e.g., *P. nigra* (Lodd.) Munro, BLACK BAMBOO, with black culms) are cultivated in East TX. Our only native bamboo, *Arundinaria gigantea* (GIANT CANE), occurs in moist woods and low areas from the Pineywoods and n Gulf Prairies and Marshes w to at least Lamar Co. (BRIT) in the Red River drainage.

PIPTOCHAETIUM J. Presl SPEAR GRASS

☙ A New World mainly temperate C_3 genus of 36 species (Cialdella & Giussani 2002), ranging from the U.S. to Argentina, with most in South America, and particularly abundant in Argentina (Barkworth ined.). Migration between North and South America is thought to have occurred during the late Tertiary Period, in association with the movement of herbivorous mammals (Williams 1975; Thomasson 1980). Recent studies (Cialdella & Giussani 2002) suggest the genus is monophyletic. *Piptochaetium* species have sometimes been put into *Stipa* (e.g., Gould 1975b) and also resemble species of *Nassella*. However, according to Clayton and Renvoize (1986), while the genus can imitate *Stipa* and *Nassella*, "but is readily distinguished by its grooved palea." Also, *Piptochaetium* can be distinguished unambiguously from *Nassella* (with strongly overlapping lemma margins) by its involute, non-overlapping lemma margins (Barkworth 1990, ined.) and palea protruding from the lemma (versus not protruding in *Nassella*) (Cialdella & Giussani 2002). (Greek: *pipto*, to fall, and *chaite*, long hair, mane, or bristle, in reference to the deciduous awns of the type species) (subfamily Pooideae, tribe Stipeae) REFERENCES: Hitchcock 1925; Parodi 1944; Thomasson 1978, 1980; Clayton 1983; Barkworth 1990, 1993, ined.; Tucker 1990; Cialdella & Arriaga 1998; Cialdella & Giussani 2002.

Piptochaetium avenaceum (L.) Parodi, (resembling *Avena*—OATS), BLACK-SEED SPEAR GRASS, BLACK-SEED NEEDLE GRASS, BLACK OAT GRASS, OATS NEEDLE GRASS, EASTERN NEEDLE GRASS. Perennial, tufted, (35–)50–80(–100) cm tall; ligule membranous, (0.4–)1.5–4.5 mm long; leaf blades ca. 0.8–1.5(–3) mm wide; panicles with few spikelets; spikelets 1-flowered, disarticulating above the glumes; glumes acuminate, (9–)10–12(–15) mm long, ± equal; lemma 8–12 mm long (including callus), indurate, dark (brown or purplish) at maturity, the margins involute, not overlapping (rounded portions abutting), with a very long (3.5–10 cm), geniculate, twisted awn; lemma apex without a white neck or crown (as in some *Nassella* species) but with a fringe of brown hairs

around awn base; lemma base and rachilla together forming a sharp-pointed bearded callus; palea slightly longer than the lemma, longitudinally grooved, the apex protruding between the lemma margins; caryopsis permanently enclosed within the lemma. Woodlands in shade, forest margins, sandy soils; widespread in Pineywoods and Post Oak Savannah w to Limestone, Robertson (BRIT), and Van Zandt (Turner et al. 2003) cos.; also n Gulf Prairies and Marshes and e Edwards Plateau; se Canada (Ont.) and e U.S. from MA s to FL w to MI and TX. Mar–Jun. [*Stipa avenacea* L.] This species can be confused with *Nassella leucotricha* (TEXAS WINTER GRASS), but can be distinguished by habitat (*Nassella* in open disturbed sites) by the lemmas (*Nassella* with lemmas light brown, with overlapping margins, and apically with a smooth white neck ca. 0.6–1 mm long), and by the ligules (*Nassella* with ligules 1 mm or less long).

POA L. BLUE GRASS

Annuals or perennials, sometimes with rhizomes; ligule a membrane; leaf blades sometimes with tips cupped; inflorescences open or contracted panicles; spikelets relatively small, usually with 2–6(–10) florets, awnless, disarticulating above glumes and between florets; glumes shorter than rest of spikelet; lemmas acute or obtuse, usually keeled on back, often with long, kinky hairs at base.

A C_3 genus of ca. 575 species, *Poa* is the largest genus of grasses (Gillespie & Soreng 2005). It is widespread but principally of temperate and cold areas of the world, including tropical mountains. Some are important as fodder grasses and for use in lawns and playing fields; many are important as pasture species, while a number are significant weeds (Watson & Dallwitz 1992). The genus approaches *Festuca* (lemmas rounded on back), but differs in its keeled lemma (Clayton & Renvoize 1986). *Poa* is morphologically rather uniform (Clayton & Renvoize 1986), and there is apparently little agreement on subdivisions within the genus (Tucker 1996). However, recent molecular research (e.g., Gillespie & Soreng 2005) has begun to clarify the broad phylogenetic structure within the genus. It is a taxonomically difficult group because of the widespread occurrence of polyploidy, apomixis, hybridization, and introgression (Clayton & Renvoize 1986; Soreng & Kellogg ined.). Some of the species have variable numbers of chromosomes, including aneuploid series (Tucker 1996). (Greek: *poa*, ancient name for grass or fodder)
(subfamily Pooideae, tribe Poeae)
REFERENCES: Marsh 1952; Hutchinson & Seymour 1982; Soreng 1990, 1998; Tucker 1996; Soreng & Barrie 1999; Soreng & Kellogg ined; Gillespie & Soreng 2005.

1. Florets developing into bulbils (often dark purple at base), the lemmas prolonged to 5–15 mm long as if sprouting; culms swollen at base; rare in TX, known only from Denton Co. near w margin of East TX ____ **P. bulbosa**
1. Florets not developing into bulbils; culms not swollen at base; including species widespread and abundant in East TX.
   2. Plants annual, 3–45 cm tall, without rhizomes; keel of glumes smooth (*P. annua*) or minutely scabrous-ciliate (*P. bigelovii* and *P. chapmaniana*).
      3. Branches of inflorescence appressed-erect, the inflorescence thus narrow and contracted, usually < 1 cm wide; species known in East TX only from Travis Co. on extreme w margin of area ____ **P. bigelovii**
      3. Branches of inflorescence spreading (at least the lower ones), the inflorescence thus not narrow, usually > 1 cm wide; including species widespread in East TX.
         4. Lemmas with long, kinky, cobwebby hairs at base, with 3 strong and 2 faint veins; anthers 0.1–0.3 mm long; species rare in East TX ____ **P. chapmaniana**
         4. Lemmas usually without long hairs at base (but long-pubescent on margins and keel), with 5 strong veins; anthers 0.5–1.3 mm long; species widespread and abundant in East TX ____ **P. annua**

2. Plants perennial, 15–100 cm tall, with OR without rhizomes; keel of glumes minutely to strongly scabrous-ciliate.
   5. Plants with slender creeping rhizomes; lemmas acute or with awn-like tip, pubescent only on keel or marginal veins; inflorescence branches tightly contracted to somewhat spreading, ± densely-flowered, often with flowers nearly to base but sometimes naked of spikelets in their lower half; plants of various habitats, including grasslands and other open areas.
      6. Culms and basal leaf sheaths strongly flattened, sharply keeled; species rare in East TX _____ **P. compressa**
      6. Culms and basal leaf sheaths terete or only slightly flattened, not sharply keeled; including species widespread in East TX.
         7. Lower lemmas of each spikelet 3.9–6.4 mm long; lowest node of inflorescence usually with (2–)3–4 branches, the branches often, but not always, bearing spikelets to the base or nearly so; plants with unisexual florets; species of undisturbed habitats, widespread in East TX _____ **P. arachnifera**
         7. Lower lemmas of each spikelet usually 2.5–3.2 mm long; lowest node of inflorescence usually with (4–)5 branches, the branches naked basally; plants with perfect florets; species of disturbed habitats, known primarily from n part of East TX (Brazos, Dallas, Fannin, Grayson, Lamar, Nacogdoches, and San Augustine cos.) _____ **P. pratensis**
   5. Plants without rhizomes; lemmas subacute or obtuse, pubescent at least on proximal surface (as well as on keel and marginal veins), sometimes over the entire surface; inflorescence branches widely spreading, loosely-flowered, naked of spikelets for half to four-fifths their length; plants of wooded habitats.
      8. Lowest node of inflorescence usually with 3–7 branches; spikelets 3–4.5 mm long; lemmas with long, kinky, cobwebby hairs at base _____ **P. sylvestris**
      8. Lowest node of inflorescence usually with 2 branches; spikelets usually 5–8 mm long; lemmas without long hairs at base but long-pubescent on margins and keel _____ **P. autumnalis**

Poa annua L., (annual, yearly), ANNUAL BLUEGRASS, LOW SPEAR GRASS, DWARF MEADOW GRASS. Glabrous tufted annual; culms usually geniculate, to ca. 30 cm long; inflorescences small, (1–)3–8(–10) cm long, erect, at least the lower branches spreading; spikelets 2.5–5.5 mm long; lemmas long-pubescent on margins and keel. Disturbed sites, lawns; widespread in e 1/2 of TX, scattered further w; throughout most of Canada and the U.S. Jan–May, occasionally as early as late fall. Native of Europe and Asia. [*P. annua* L. var. *reptans* Hausskn.] This weedy species is now distributed nearly worldwide, and Tucker (1996) indicated that it has "perhaps the widest distribution of any angiosperm." Clayton and Renvoize (1986) noted that it is "probably the most cosmopolitan of all grass species." The pollen is allergenic.

Poa arachnifera Torr., (spider-bearing, its long white hairs giving the appearance of a spider web), TEXAS BLUE GRASS. Sod-forming, glabrous perennial with long slender rhizomes; culms 20–60(–85) cm tall; inflorescences 3–15(–18) cm long, dense, rather narrow, erect; spikelets ca. (4–)6–8(–9) mm long; florets unisexual, the sexes on different plants (bisexual florets rarely found); lemmas of pistillate spikelets with long-ciliate keel and dense basal tuft of long, cobwebby hairs; lemmas of staminate spikelets with keel inconspicuously ciliate toward base and rather sparse basal tuft of cobwebby hairs. Calcareous or sandy clay prairies and oak openings, primarily undisturbed areas; widespread in TX but less common in far e, far s, and Trans-Pecos; native of KS, OK, and TX (Soreng & Kellogg ined.) but now found more widely—se U.S. from NC s to FL w to NM, also IL and KS. Late Mar–Apr. This species is frequent in original prairie, though not abundant; it increases under light disturbance and disappears early under heavy grazing.

Poa autumnalis Muhl. ex Elliott, (autumnal, of the fall), AUTUMN BLUE GRASS, FLEXUOUS SPEAR GRASS. Tufted perennial 30–75(–86) cm tall; inflorescences open, the branches usually spreading at maturity, the lower branches with spikelets only near the tips; spikelets usually 5–8 mm

long. Forests, floodplains, along streams; widespread in Pineywoods and scattered in Post Oak Savannah s to Burleson Co. (Turner et al. 2003); also n Gulf Prairies and Marshes; e U.S. from PA s to FL w to MI and TX. Mar–May (flowering in spring, despite the common name and specific epithet). [*P. flexuosa* Muhl., not Sm.]

Poa bigelovii Vasey & Scribn., (possibly for J. Bigelow, 1787–1879, professor of botany in Boston, MA and author of *American Medical Botany*—1817), BIGELOW'S BLUE GRASS. Glabrous annual; culms erect or with a geniculate base, to 15–35(–45) cm tall; inflorescences with branches appressed-erect; spikelets 4–6 mm long; lemma long-pubescent on margins and keel, with long, kinky, cobwebby hairs at base. Travis Co. (Turner et al. 2003) near w margin of East TX; mainly Edwards Plateau and Trans-Pecos; sw U.S. from OK and TX w to CA. Feb–Apr.

Poa bulbosa L., (bulbose), BULBOSE BLUE GRASS. Densely tufted, glabrous perennial 20–50 cm tall; culms swollen at base; florets usually developing into asexual bulbils instead of fruits, often dark purple at base; lemmas glabrous, strongly veined, the tips prolonged as if sprouting. Spreading from cultivation at Denton Agricultural Experiment Station (Shinners 1958) near w margin of East TX; otherwise unknown in TX; no county distribution map is provided; this species is widely scattered nearly throughout the U.S. (and in s Canada) and is included because of the likelihood of occurrence and to encourage collectors to look for it in East TX. Apr–May. Native of Europe. *Poa bulbosa* is spread by the vegetative bulbils, presumably "by a variety of means, including road graders, mud on shoes and car tires, water, animals, and wind" (Yatskievych 1999). Soreng and Kellogg (ined.) treated this species as having two subspecies, subsp. *vivipara* (Koeler) Arcang (florets bulbiferous) and subsp. *bulbosa* (florets producing caryopses).

Poa chapmaniana Scribn., (for Alvin Wentworth Chapman, 1809–1899, Florida botanist), CHAPMAN'S POA, CHAPMAN'S BLUE GRASS. Annual to ca. 30 cm tall; similar to *P. annua* and sometimes difficult to distinguish from it; spikelets with cleistogamous florets (anthers very small, 0.3 mm or less long). Lawns, fields, and roadsides, sometimes moist areas; Madison and Polk (Turner et al. 2003) cos.; cited for vegetational areas 1, 4 and 5 by Gould (1975b) and Hatch (2002); also Tarrant Co. (Turner et al. 2003) in Cross Timbers and Prairies; rare or poorly collected in TX; native from NE to IL, KS, and AR, but now extending to the eastern and southern coastal states (Soreng & Kellogg ined.); e U.S. from DE s to FL w to NE and TX, also MA and NY. Late fall–spring. This species is very closely related to *P. annua* and may represent a native North American phase of that Old World species (Yatskievych 1999). Gould (1975b) suggested that it is perhaps not specifically distinct from *P. annua*. According to Yatskievych (1999), the lemmas of *P. chapmaniana* remain appressed and the stamens and stigmas are usually not exserted during flowering. Hence the flowers are usually cleistogamous and self-pollinated.

Poa compressa L., (flattened), CANADA BLUE GRASS. Rhizomatous, mat-forming perennial 10–70(–80) cm tall; culms and basal leaf sheaths strongly flattened, sharply keeled; inflorescence branches appressed or only slightly spreading; spikelets 3–8 mm long; lemmas with or without long hairs at base. Cultivated as a forage and lawn grass, escaping?; Dallas Co. (Turner et al. 2003); also Donley and Lubbock cos. in nw TX and Starr Co. in the South TX Plains (Turner et al. 2003); otherwise reported in TX (Gould 1975b; Hatch et al. 1990; Hatch 2002) only from vegetational areas 5, 6, 9, and 10; throughout most of Canada and the U.S. Apr–Aug. Native of Eurasia (despite the common name). It is reported to cause hay fever (Steyermark 1963). This species is also planted to stabilize soil and for forage (Soreng & Kellogg ined.).

Poa pratensis L., (of meadows), KENTUCKY BLUE GRASS, JUNE BLUE GRASS, MEADOW GRASS. Sod-forming, glabrous, rhizomatous perennial 15–100 cm tall; inflorescences typically rather loose, with at least the lower branches spreading; spikelets 3–6 mm long; lemmas pubescent on keel and marginal veins, cobwebby at base. Disturbed areas, also appearing occasionally in lawns;

Lamar (BRIT), San Augustine (on Weches outcrop, SBSC), Brazos, Dallas, Grayson, Fannin, and Nacogdoches (Turner et al. 2003) cos., also scattered in n and w TX; throughout Canada and the U.S. Apr–Jun. This species consists of a number of subspecies, only one of which, subsp. *pratensis*, occurs in TX. This subspecies is native to Europe despite the common name. Other subspecies of *Poa pratensis* are native to the northern regions of North America, often in mountainous areas (Soreng & Kellogg ined.). While subsp. *pratensis* is introduced to TX (and considered a Eurasian native by Correll & Johnston 1970), we are following Tucker (1996), Kartesz (1999), and Soreng and Kellogg (ined.) in treating the species as native to the U.S. because of the other subspecies occurring natively farther north. According to Cory (1950b), it was first collected in n TX in 1949. It is one of the most popular lawn grasses in cooler parts of the country, is used on golf courses, and is a major forage species in cooler areas of North America. A number of lawn and pasture strains have been introduced into the U.S. (Gould 1975b; Sutherland 1986; Soreng & Kellogg ined.). Yatskievych (1999) considered it the most economically important member of the genus. It is reported to cause hay fever in spring (Steyermark 1963).

Poa sylvestris A. Gray, (of woodland), WOODLAND BLUE GRASS, SYLVAN BLUE GRASS. Tufted perennial 30–80(–100) cm tall; inflorescences erect, open, the branches naked of spikelets for 1/2–2/3 their length, the lower branches reflexed in age; spikelets 3–4.5 mm long. Woods in limestone ravines or low areas; scattered in East TX; not known elsewhere in the state; se Canada (Ont.) and e U.S. from NY s to FL w to SD and TX. Apr–May.

POLYPOGON Desf. RABBIT'S-FOOT GRASS, BEARD GRASS

Annuals or perennials without rhizomes; ligule a membrane; inflorescence a dense, contracted panicle; spikelets small, 1-flowered, disarticulating below glumes (sometimes near apex of pedicel, sometimes near base of pedicel); lemma 1/2–3/4 times as long as the glumes; anthers 3.

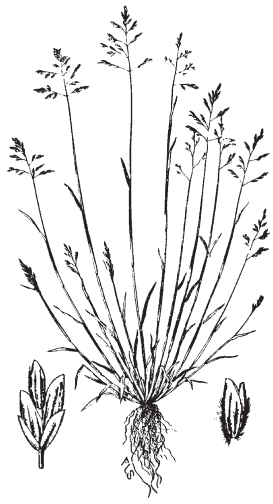
A C_3 genus of ca. 18 species (Tucker 1996; Barkworth ined.) of warm temperate areas and tropical mountains. It is similar to *Agrostis*, and hybridization is known between the two. However, in *Polypogon* disarticulation of the spikelets is below the glumes, while in *Agrostis* it is above (Tucker 1996). Both species occurring in East TX are considered significant weeds by some authorities (e.g., Watson & Dallwitz 1992). (Greek: *polys*, much, and *pogon*, beard, presumably because of the conspicuous awns of some species) (subfamily Pooideae, tribe Aveneae)
REFERENCES: Tucker 1996; Roalson & Allred 1997; Barkworth ined.

1. Glumes with awns 4–10 mm long; inflorescence so dense that its main axis is usually not visible; plants annual _____ **P. monspeliensis**
1. Glumes awnless; inflorescence often interrupted enough that its axis is visible in places; plants perennial _____ **P. viridis**

Polypogon monspeliensis (L.) Desf., (of Montpellier in s France), RABBIT'S-FOOT, ANNUAL BEARD GRASS, BEARD GRASS, RABBIT'S-FOOT GRASS, ANNUAL RABBIT'S-FOOT GRASS. Annual, tufted, largely glabrous; culms 15–75(–100) cm tall, sometimes geniculate at base; ligule (2.5–)4–10(–16) mm long; inflorescence ca. 2–15(–17) cm long, 1–3 cm broad, appearing bristly-woolly because of long yellowish awns; spikelets 1.5–2(–2.7) mm long (not including awns); glumes hispidulous, minutely notched apically, conspicuously awned; disarticulation near apex of pedicel; lemma 0.5–1.5 mm long, with a delicate awn usually 0.5–1 mm long. Low areas, sometimes in shallow water; throughout TX; s Canada and throughout most of the U.S. Mid-May–Jul. Native of s Europe and Turkey. A population with vegetatively proliferating spikelets producing plantlets was reported by Roalson and Allred (1997), who noted that the "lemma, palea, and flower are transformed into a plantlet arising from inside two normal glumes." According to Barkworth (ined.), "In Europe, *P. monspeliensis* hybridizes with *Agrostis stolonifera*, producing the sterile ×*Agropogon littoralis* (With.) C.E. Hubb. and with *P. viridis* [see below] ... but neither hybrid has



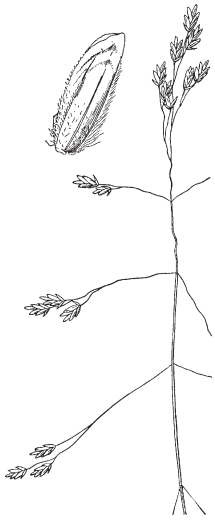
Piptochaetium avenaceum [GO2, USB]



Poa annua [USB]



Poa arachnifera [USB]



Poa autumnalis [HI1]



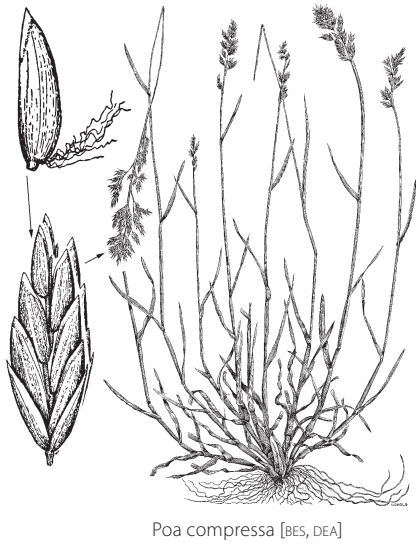
Poa bigelovii [HI1]



Poa bulbosa [HI1]



Poa chapmaniana [USB]



Poa compressa [BES, DEA]



Poa pratensis [USB]

been reported from North America." The common name RABBIT'S-FOOT GRASS "aptly describes the feel of the young panicles" (Barkworth ined.).

Polypogon viridis (Gouan) Breistr., (green), WATER BENT GRASS. Tufted, glabrous perennial; culms bent at base or trailing, 15–45(–90) cm long; ligule 2–5(–7) mm long; inflorescence usually 4–10(–12) cm long, 1–3 cm broad; spikelets 1.3–2(–2.5) mm long, awnless; disarticulation near base of pedicel, the spikelets falling with a significant piece of the pedicel; glumes scabrous; lemma ca. 1 mm long. Springs and in creek and river beds; Bell, Travis (BRIT), Bexar, and Limestone (Turner et al. 2003) cos. in w part of East TX; mainly w 2/3 of TX; w U.S. from WA s to CA e to WY, OK, and TX, also CT, NJ, SC, and VA. Apr–Jul. Native from s Europe to Pakistan. [*Agrostis semiverticillata* (Forssk.) C. Chr., *P. semiverticillatus* (Forssk.) Hyl.] This species has often been treated in the genus *Agrostis* (e.g., Gould 1975b; Powell 1994)—see discussion in generic synopsis above. Hybridization between this species and *P. monspeliensis* has been reported (Tucker 1996), with the hybrid known as *P.* ×*adscendens* Guss. ex Bertol.; however, the hybrid is not known from North America (Barkworth ined).

ROSTRARIA Trin. JUNE GRASS

An Old World genus of ca. 10 species of annuals native to the Mediterranean, se Europe, and w Asia, typically occurring in dry disturbed sites (Henderson & Schäfer 2003; Standley ined.). "The genus is sometimes included in *Koeleria*, but it differs in its annual growth habit and awned lemmas and paleas" (Standley ined.). However, some authorities do not consider the differences worthy of generic recognition and maintain the annuals in *Koeleria* (e.g., Shinners 1956a; Allen 1992b; Watson & Dallwitz 1992; Wilken 1993a; Tucker 1996). (Latin: *rostrum*, beak, and *ari*, much or very, in reference to the shape of the lemma apex in the type species—Standley ined.) (subfamily Pooideae, tribe Poeae)

REFERENCES: Shinners 1956a; Brummitt 1978; Jonsell 1980; Allen et al. 1990; Tucker 1996; Henderson & Schäfer 2003; Standley ined.

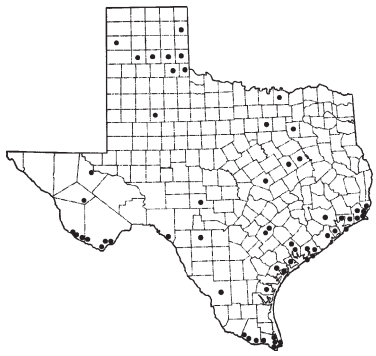
Rostraria cristata (L.) Tzvelev, (crested), ANNUAL KOELERIA, ANNUAL JUNE GRASS, CAT-TAIL GRASS. Annual (5–)10–30(–50) cm tall, tufted; ligule membranous, ca. 1–2 mm long; leaves basal and cauline; inflorescence a dense, uninterrupted, spike-like panicle usually 1.5–7(–12) cm long, glabrous or nearly so; spikelets usually 4–6-flowered, 3–5(–7) mm long, disarticulating above glumes; glumes unequal, the lower smaller; lemma with awn arising from between two minute apical teeth; awn usually 1–3 mm long; anthers 3. Open, disturbed areas; Brazos (*S. Hatch*, TAES, TAMU) and Washington (*S. Jones*, ASTC, TAMU) cos. in Post Oak Savannah, Walker Co. (Nesom & Brown 1998, SHST) and Harris Co. (SBSC) near s margin of East TX; also reported from Brazoria Co. in Gulf Prairies and Marshes (Turner et al. 2003), as a "rare waif in coastal areas near Galveston" by Correll and Johnston (1970), and for Cameron Co. by Hitchcock (1951); scattered in the U.S. in AL, AZ, CA, FL, LA, MD, NY, OR, PA, SC, and TX. May–Jun. Native of Europe. [*Festuca cristata* L., *Koeleria gerardii* (Vill.) Shinners, *Koeleria phleoides* (Vill.) Pers., *Lophochloa cristata* (L.) Hyl.] The nomenclatural problems surrounding this taxon were discussed by Shinners (1956a).

SACCHARUM L. PLUME GRASS, SUGARCANE

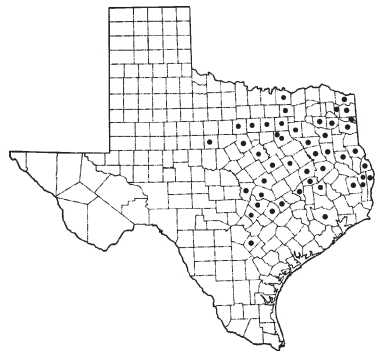
Large, stout, reed-like perennials to several meters tall; leaves cauline, the blades elongate, flat; ligule a ciliate membrane 0.5–6 mm long; inflorescence a large, dense, terminal panicle, often conspicuously hairy; spikelets all alike, perfect, in pairs of 1 sessile and one pedicellate, 2-flowered, the upper floret fertile, the lower floret sterile; disarticulation below the pedicellate spikelet and in the inflorescence branch so that the sessile spikelet falls with associated pedicel and section of the inflorescence branch; callus (= base of spikelet derived from rachilla) usually with a tuft of long hairs, the hairs shorter than to longer than the spikelet; lemma of fertile floret



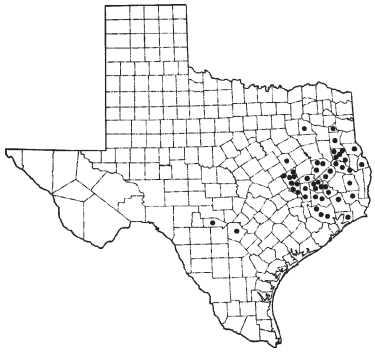
Phleum pratense



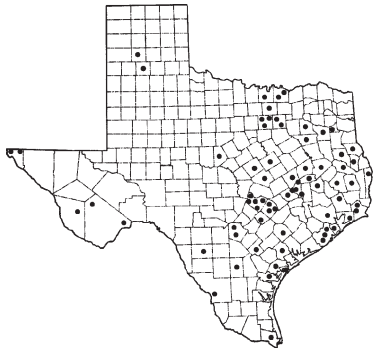
Phragmites australis



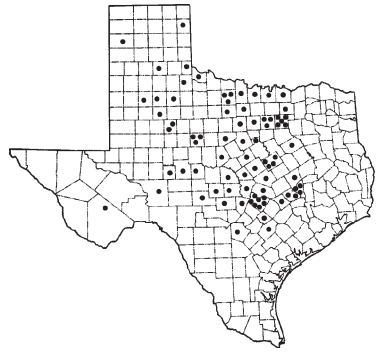
Phyllostachys aurea



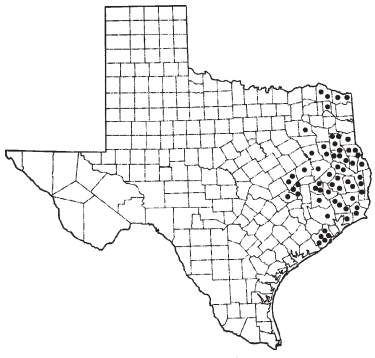
Piptochaetium avenaceum



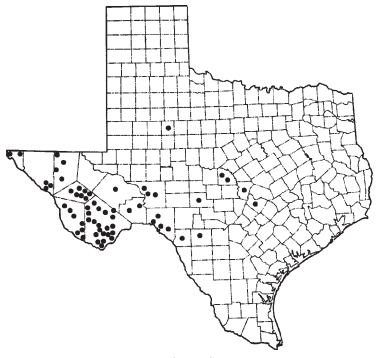
Poa annua



Poa arachnifera



Poa autumnalis



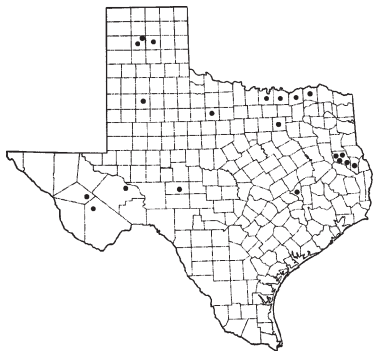
Poa bigelovii



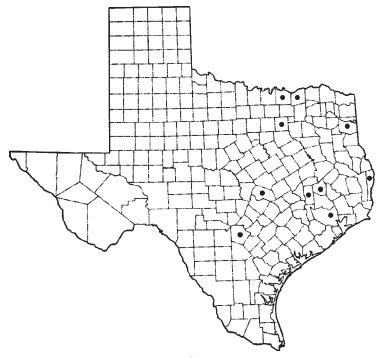
Poa chapmaniana



Poa compressa



Poa pratensis



Poa sylvestris

of each spikelet with a long awn (awn absent in *S. officinarum*); palea of fertile floret ca. 1/2 as long as lemma; palea of sterile floret absent; stamens usually 2 (3 in *S. officinarum*).

The genus, as treated here including *Erianthus*, comprises 35–40 species (Webster & Shaw 1995; Mabberley 1997; Webster 2003) of tropical and warm areas of the world. The center of diversity, with ca. 25 species, is tropical Asia (Webster & Shaw 1995). Like all members of the Andropogoneae, *Saccharum* is characterized by C_4 photosynthesis (Kellogg 2000a). The traditional segregation of awned species as *Erianthus* and awnless species as *Saccharum* has been described as "wholly artificial" (Clayton & Renvoize 1986). Some authorities (e.g., Daniels & Roach 1987; Whalen 1991) disagree, and they treat *Saccharum* more narrowly, including only SUGARCANE and its immediate relatives (only 5 species), with the rest of the species segregated into *Erianthus*. However, Burner and Webster (1994) successfully obtained hybrids between *Erianthus* species and SUGARCANE, and Burner et al. (1997) found North American *Erianthus* to be genetically similar to SUGARCANE cultivars. Nonetheless, recent molecular research (Dillon et al. 2001) raises the possibility that *Saccharum officinarum* (SUGARCANE) is derived from within *Sorghum*, while *Erianthus* appears more closely related to *Zea*; such results argue for the separate recognition of *Erianthus*. Likewise, Nair et al. (1999) found "considerable divergence" between *Erianthus* and *Saccharum*. Until such issues are resolved, we are following most recent authorities (e.g., Hatch 2002; Webster 2003) in treating *Saccharum* broadly, to include *Erianthus*. *Saccharum* is related to *Eulalia*, *Imperata*, and *Miscanthus*, and it also will hybridize with *Sorghum* (Gupta et al. 1978). Webster and Shaw (1995) indicated that the "single most reliable character for distinguishing among the [North American] taxa is the length of the callus hairs relative to spikelet length." The long callus hairs may aid in dispersal by wind (Webster & Shaw 1995). The economically most important member of the genus is *S. officinarum* L. (SUGARCANE), which is the source of ca. 1/2 of the world's sugar. ⊘ *Saccharum spontaneum* L., WILD SUGARCANE, known in the U.S. from HI and PR, is a federal noxious weed (Kartesz 1999; USDA Natural Resources Conservation Service 2002). The following treatment draws heavily on Webster and Shaw (1995). (Latin: *saccharum*, sugar, referring to the sweet sap) (subfamily Panicoideae, tribe Andropogoneae)

REFERENCES: Mukherjee 1958; Daniels & Roach 1987; Reveal et al. 1989; Whalen 1991; Gandhi & Dutton 1993; Burner & Webster 1994; Webster & Shaw 1995; Nair et al. 1999; Weakley 2000; Webster 2003.

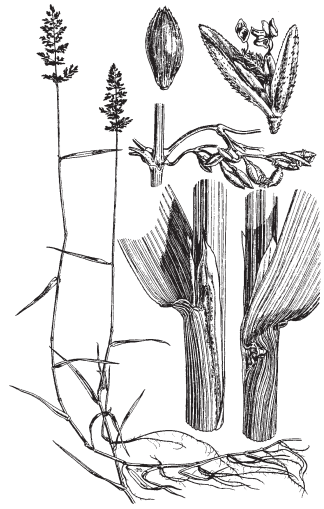
1. Lemma of fertile (= upper) floret without an awn; anthers 3 per floret; introduced cultivated species rarely if ever escaping in East TX _____ **S. officinarum**
1. Lemma of fertile floret with a conspicuous awn; anthers 2 per floret; native species widespread in East TX.
   2. Awn of lemma of fertile floret spiraled at base (the spiral is easily visible to the naked eye).
      3. Callus hairs (= conspicuous whorl of hairs attached directly below spikelet) equal to or shorter than spikelet, 3–6.5 mm long, white to straw-colored or brownish; peduncle (= stalk of inflorescence) glabrous or with sparse pubescence just below inflorescence _____ **S. brevibarbe**
      3. Callus hairs longer than spikelet, ca. 9–14 mm long, silvery or purplish tinged; peduncle with conspicuous, appressed, long pubescence just below inflorescence _____ **S. alopecuroides**
   2. Awn of lemma of fertile floret not spiraled at base.
      4. Callus hairs longer than spikelet, (7–)15–20(–25) mm long; lemma of fertile floret with a single vein; peduncle with conspicuous, appressed, long pubescence just below inflorescence; leaf blades with sparse long pubescence on upper surface _____ **S. giganteum**
      4. Callus hairs equal to or shorter than spikelet, 0–6.5 mm long or absent; lemma of fertile floret with 3 veins; peduncle glabrous or with sparse pubescence; leaf blades glabrous on upper surface.
         5. Callus glabrous or with hairs 2 mm long or less; main branches of inflorescence glabrous, appressed, the inflorescence thus only 1–3 cm wide _____ **S. baldwinii**



Poa sylvestris [USB]



Polypogon monspeliensis [HI1]



Polypogon viridis [MAS]



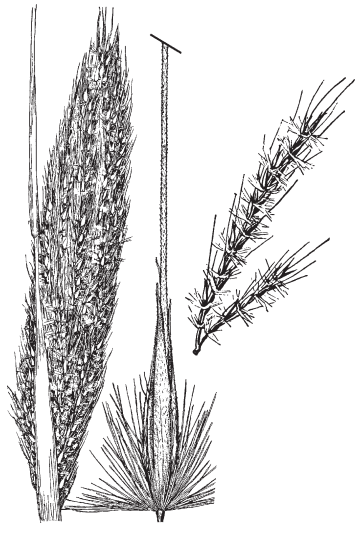
Rostraria cristata [BR2]



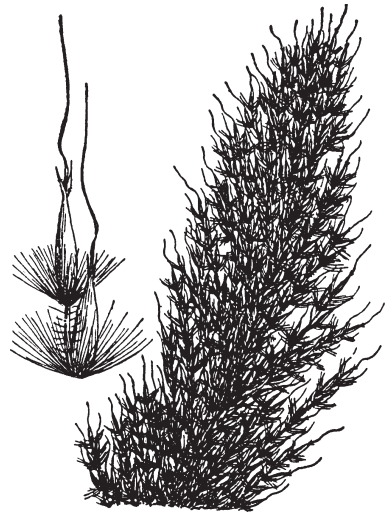
Saccharum alopecuroides [USB]



Saccharum baldwinii [GO2, USB]



Saccharum brevibarbe var. brevibarbe [GLE, HI1]



Saccharum brevibarbe var. contortum [BB2]

5. Callus hairs conspicuous, 3–6.5 mm long; main branches of inflorescence pubescent, ascending, the inflorescence usually 3–10 cm wide.
   6. Awn of lemma of fertile floret flattened at base; lemma of sterile (= lower) floret without distinct veins; both florets of a spikelet nearly equal in size, the lemma of fertile floret 0.9–1 times the length of the lemma of sterile floret; leaf sheaths without distinct auricles _____ **S. brevibarbe**
   6. Awn of lemma of fertile floret terete (= rounded) at base; lemma of sterile floret typically with 3 veins; florets of a spikelet unequal in size, the lemma of fertile floret only 0.7–0.8 times the length of the lemma of sterile floret; leaf sheaths with minute auricles 0.3–1 mm long _____ **S. coarctatum**

Saccharum alopecuroides (L.) Nutt., (resembling *Alopecurus*–foxtail grass), SILVER PLUME GRASS. Plant rhizomatous, culms 1–2.5 m tall, with white pilose hairs usually 7–12 mm long on the nodes (can be glabrous at maturity); leaf sheaths without auricles; ligule 1–3 mm long; leaf blades 14–28 mm wide, glabrous at maturity except for white pilose hairs at base; callus hairs longer than spikelet, ca. 9–14 mm long, silvery or with purplish tinge; spikelets 6–7 mm long; awn of lemma of fertile floret flattened and spiraled at base, geniculate, 14–20 mm long; $2n$ = 30 (Webster 1994). Dry clay slopes; widespread in the Pineywoods; e US from NJ s to FL w to IL, OK, and TX. Late summer–fall. [*Erianthus alopecuroides* (L.) Elliott, *Erianthus alopecuroides* var. *hirsutus* Nash, *Erianthus divaricatus* (L.) Hitchc., *Erianthus tracyi* Nash] This species is most similar morphologically to *S. giganteum* but is distinguished by the awn of the lemma of fertile floret being spiraled (Webster & Shaw 1995). While the specific epithet is sometimes spelled "alopecuroideum," the correct spelling is *alopecuroides* (Webster 2003).

Saccharum baldwinii Spreng., (probably for William Baldwin, 1779–1819, physician, botanist, and plant collector in the se U.S. and South America), NARROW PLUME GRASS. Plant from a knotty base; culms 0.9–1.8 m tall, the nodes glabrous or with minute hairs ca. 0.5 mm long; leaf sheaths with minute ovate auricles ca. 1 mm long; ligule 1–3 mm long; leaf blades 5–12 mm wide, the upper surface glabrous; callus glabrous or with straw-colored hairs much shorter than spikelets (2 mm or less long); spikelets 7–10 mm long; awn of lemma of fertile floret terete at base, not spiraled, straight or nearly so, 17–24 mm long; $2n$ = 30 (Webster 1994). Shaded river and stream bottoms; widespread in the Pineywoods; also n margin of Gulf Prairies and Marshes; se U.S. from MD s to FL w to MO, OK, and TX. Sep–Nov. [*Erianthus strictus* Elliott, *Saccharum strictum* (Elliott) Elliott ex Nutt.] This species is morphologically similar to *S. coarctatum* (Webster & Shaw 1995).

Saccharum brevibarbe (Michx.) Pers. (short-bearded), BENT-AWN PLUME GRASS, BEARD GRASS. Plant rhizomatous, culms 0.8–2.5 m tall, the nodes glabrous or with hairs; leaf sheaths without auricles; ligule 1–2 mm long; leaf blades 7–25 mm wide, glabrous; callus hairs shorter than the spikelet, 3–6.5 mm long, white to straw-colored; spikelets 6.5–10 mm long; awn of lemma of fertile floret flattened at base, either spiraled or not spiraled (depending on variety), 10–22 mm long; $2n$ = 60 (Webster 1994). Usually moist, sandy soils, but varying from well-drained to seasonally flooded sites; widespread in Pineywoods and n Post Oak Savannah; also n edge of Gulf Prairies and Marshes; the maps in Turner et al. (2003) and the one presented here do not separate varieties. Aug–Nov. This species is most similar to *S. coarctatum* (Webster & Shaw 1995). Webster and Shaw (1995) indicated that the 2 varieties of *S. brevibarbe* (previously often treated as separate species) are distinguished only by the lemma awn and associated characters. They further noted that intermediates between the varieties are not uncommon and that combining them into one species "was considered the most appropriate way to reflect the biological relationship."

1. Awn of lemma of fertile floret not spiraled at base, 10–18 mm long; lemma of fertile floret entire _____ var. **brevibarbe**

1. Awn of lemma of fertile floret spiraled at base with 2–4 spirals, 15–22 mm long; lemma of fertile floret bifid, with the 2 lateral lobes 2–2.5 mm long _____ var. **contortum**

var. **brevibarbe**. Bowie, Harrison (Webster & Shaw 1995), and Tyler (ASTC) cos.; also n margin of Gulf Prairies and Marshes; se U.S. from NC w to OK and TX, also MD. This variety is less common in East TX than var. *contortum*. [*Erianthus brevibarbis* Michx.]

var. **contortum** (Elliott) R.D. Webster, (contorted). Apex of lemma tearing as awn develops spirals during maturation of spikelet, resulting in the formation of two lateral lobes at apex of lemma. Widespread in Pineywoods and scattered in n Post Oak Savannah; also n margin of Gulf Prairies and Marshes; se U.S. from MD s to FL w to OK and TX. [*Erianthus contortus* Elliott, *Erianthus smallii* Nash, *S. contortum* (Elliott) Nutt.]

Saccharum coarctatum (Fernald) R.D. Webster, (bunched, pressed together), BUNCHED PLUME GRASS. Plant not or only shortly rhizomatous; culms 1–2.5 m tall, the nodes with hairs 1–3 mm long; leaf sheaths with auricles 0.3–1 mm long; ligule a fringed membrane 1–2 mm long; leaf blades 7–12 mm wide, glabrous; callus hairs ca. 1/2 as long as spikelet, 3–5 mm long, white to straw-colored; spikelets 6–8 mm long; awn of lemma of fertile floret terete at base, not spiraled, straight or nearly so, usually 16–26 mm long; $2n = 60$ (Webster 1994). Open, often seasonally flooded areas, usually moist sandy soils; Montgomery (TAES), Liberty, and Tyler (Brown & Marcus 1998) cos.; se U.S. from DE s to FL w to TX. Sep–Oct. [*Erianthus coarctatus* Fernald, *Erianthus coarctatus* var. *elliottianus* Fernald] This species is similar to *S. baldwinii* but can be distinguished by its pubescent nodes, though these sometimes become glabrous at maturity. The species is also distinguished by the straight, non-spiraled awn of the lemma of fertile floret and callus hairs ca. 1/2 the spikelet length (Webster & Shaw 1995). Given that it is known from only three counties in TX, this species is possibly of conservation concern in the state. ⚠

Saccharum giganteum (Walter) Pers., (gigantic), SUGARCANE PLUME GRASS, GIANT PLUME GRASS. Plant rhizomatous; culms 1–3 m tall, the nodes with a dense ring of hairs 1–6 mm long; leaf sheaths without auricles; ligule 1–6 mm long; leaf blades (4–)8–20(–30) mm wide, the upper surface often with hairs; callus hairs longer than spikelet, (7–)15–20(–25) mm long, straw-colored or brownish, sometimes with purplish tinge; spikelets 4.2–8 mm long; awn of lemma of fertile floret basally terete, not spiraled, straight or nearly so, 12–26 mm long; $2n = 30$, 60, and 90, and thus a polyploid series (Webster 1994). Usually moist sandy soils, but ranging from standing water to dry hillsides; widespread in East TX w to Henderson, Milam (BRIT), Guadalupe, and Travis (Turner et al. 2003) cos.; also n Gulf Prairies and Marshes; se U.S. from NJ s to FL w to MO, OK, and TX, also NY and PA. Sep–Nov. [*Erianthus giganteus* (Walter) P. Beauv., *Erianthus giganteus* var. *compactus* (Nash) Fernald, *Erianthus laxus* Nash, *Erianthus saccharoides* Michx.] This species is most similar to *S. alopecuroides*, and intermediates are occasionally found (Webster & Shaw 1995). *Saccharum giganteum* is distinguished by the straight awn of the lemma of fertile floret and callus hairs longer than the spikelet.

Saccharum officinarum L., (sold in shops, applies to medicinal, edible, and otherwise useful plants), SUGARCANE, NOBLE-CANE. Plant robust, bunch-forming, rhizomatous; culms to several m tall, 2–4.5 cm thick, often purplish, solid (the pith with abundant sugar); ligule a membrane ca. 2–3 mm long; leaf blades to 1+ m long and 4–6(–7) cm wide; inflorescence a plume-like panicle usually 30–60(–100) cm long; spikelets 3–4(–5) mm long; callus with white hairs longer than the spikelet; lemma without an awn; $2n = 80$ (Webster 2003). Plant cultivated for its high sugar content; included based on citation of Pineywoods by Hatch et al. (1990) and Hatch (2002); however, we are unaware of any East TX collections and question whether this species actually escapes and naturalizes in the area; also Gulf Prairies and Marshes and s South TX Plains; no county distribution map is provided; FL, LA, and TX. Oct., but rarely flowering (Allen 1992b). While there is not complete agreement on SUGARCANE'S place of origin, it is probably native either to

tropical se Asia (probably New Guinea—Clayton & Renvoize 1986) or the Polynesian Islands of the South Pacific (Daniels & Roach 1987). Clonally reproducing forms have been grown from Indochina through the East Indies to Polynesia "since prehistoric times as a garden plant for chewing" (Whalen 1991). Whalen (1991) noted that while numerous agronomic hybrids have been derived from some of these indigenous chewing or "noble" canes by crossing with other species, the name *S. officinarum* is appropriately applied only to the indigenous forms. According to Whalen (1991), "Virtually all commercial sugarcane clones in cultivation today are complex hybrids that have in their parentage not only *Saccharum officinarum* but also *S. spontaneum* or *S. sinense* or both." *Saccharum officinarum*, however, usually accounts for 75–88% of the genetic makeup of the commercial hybrids, and as a result they are usually classified as that species (Whalen 1991). We are following such standard usage (e.g., Allen 1992b) and using the name *S. officinarum* for cultivated hybrid SUGARCANE. Numerous products are made from this species, including sugar (ca. 1/2 the sugar produced worldwide—Mabberley 1997), molasses, syrup, rum, and ethanol (Whalen 1991). It is also cultivated for fodder (Watson & Dallwitz 1992).

SACCIOLEPIS Nash CUPSCALE, GLENWOOD GRASS

Annuals or perennials; leaves mostly cauline; ligule membranous, sometimes with a fringe of hairs; leaf blades flat; inflorescence a contracted, narrowly cylindric panicle; pedicels short, with discoid apices; spikelets glabrous, awnless, disarticulating below the glumes, 2-flowered, the lower floret staminate or neuter, the upper floret perfect; lower glume ca. 1/2–1/4 as long as upper glume or shorter; upper glume ca. as long as spikelet, with 7–13 raised veins, inflated and saccate (= sac-like) at base, the spikelet thus basally asymmetrical; lemma of lower floret about as long as upper glume; palea of lower floret present or much reduced; lemma and palea of upper floret hardened, smooth, shiny.

A C_3 genus of 30 species of tropical and warm areas, with the center of diversity (ca. 25 species) in Africa (Simon 1972; Wipff 2003i). The species are usually found in wet places, and typically have a spike-like inflorescence. Some species resemble *Panicum*, but the spikelets are asymmetric at base, the prominently multi-veined upper glume having a pouch- or sac-like swelling at base. (Greek: *saccion*, small bag, and *lepis*, scale, referring to the saccate upper glume) (subfamily Panicoideae, tribe Paniceae)

REFERENCES: Chase 1908; Simon 1972; Pohl & Lersten 1975; Judziewicz 1990a; Crins 1991; Allen 1992a; Bryson & Lockley 1993; Wipff 2003i.

1. Plants annual, tufted, 0.6(–1) m or less tall; leaf blades 3–6 mm wide; spikelets 2.5–3(–3.5) mm long; inflorescences 1.5–6(–10) cm long, usually 7 mm or less wide; lower inflorescence branches ca. 0.5 cm or less long; lower glume ca. 1/2 as long as upper; lower floret with palea 0.5–1 mm long, 1/2 as long as the lemma or shorter _____ **S. indica**

1. Plants perennial, stoloniferous, 0.8–1.5(–nearly 2) m tall; leaf blades (3–)6–15(–22) mm wide; spikelets (2.9–)3.5–5 mm long; inflorescences (6–)8–30 cm long, (7–)10–20(–31) mm wide; lower inflorescence branches (0.4–)2 cm or more long; lower glume < 1/3 as long as upper; lower floret with palea 2–4 mm long, 3/4 as long to nearly as long as the lemma _____ **S. striata**

Sacciolepis indica (L.) Chase, (of India), INDIA CUPSCALE, GLENWOOD GRASS, CHASE'S GLENWOOD GRASS. Tufted annual; culms 10–60(–100) cm tall; ligule 0.1–0.3(–0.7) mm long; lower glume ca. 1.3–1.9 mm long; lemma of fertile floret ca. 1.2–1.7 mm long. Moist to wet, disturbed habitats; Liberty (*Watson 23234-B*, Rice Univ.), Newton (Gould 1975b) and Tyler (Turner et al. 2003) cos. in the Pineywoods; se U.S. from NC s to FL w to TX. Aug–Oct. Native of Asia. [*Aira indica* L.] This introduced species was first reported for the U.S. in 1950 (Hitchcock 1951), for TX in 1975 (Gould 1975), for LA in 1992 (Allen 1992a), and for MS in 1993 (Bryson & Lockley 1993).

Sacciolepis striata (L.) Nash, (striated, striped), AMERICAN CUPSCALE. Perennial, sometimes rhizomatous; culms to ca. 2 m tall, rooting at creeping basal nodes; ligule 0.7 mm or less long;

lower glume ca. 1–1.7 mm long, < 1/3 as long as second, often 1/4 or less as long; lemma of fertile floret ca. 1.5–2 mm long. Moist sand, pond margins, along streams, and in ditches; widely scattered in East TX w to Lamar, Leon, Wood (BRIT), and Guadalupe (Turner et al. 2003) cos; also n Gulf Prairies and Marshes; se U.S. from NJ s to FL w to MO, OK, and TX, also MA and ME. Late Aug–Nov. [*Panicum aquaticum* Bosc ex Spreng.]

SCHEDONNARDUS Steud. TUMBLE GRASS, TEXAS CRAB GRASS

A monotypic C_4 genus of North America that has recently been introduced into Argentina (Snow 2003b). Some authorities consider it related to *Gymnopogon* (Clayton & Renvoize 1986), but recent molecular evidence (Hilu & Alice 2001) questions this conclusion. The inflorescence acts as a tumbleweed, and Mabberley (1997) noted that this species is a conspicuous feature of deserted towns in Western films. (Greek: *schedon*, near, and *Nardus*, from its resemblance to that grass genus) (subfamily Chloridoideae, tribe Cynodonteae)
REFERENCE: Snow 2003b.

Schedonnardus paniculatus (Nutt.) Trel., (with flowers in panicles), TUMBLE GRASS, TEXAS CRAB GRASS. Tufted perennial 8–50(–70) cm tall or long; leaves crowded toward base of plant; leaf sheaths compressed, keeled, glabrous; ligule a membrane 1–4 mm long; leaf blades 1–3 mm wide, spirally twisted on drying; inflorescence as long as or longer than the leafy portion of the culm, spreading to partly decumbent, finally breaking away in its entirety and acting as a tumbleweed, the main axis becoming loosely coiled, with a few widely spaced, spicate branches; spikelets appressed, in 2 rows along one side of each branch, not overlapping or only slightly so, with 1 floret, unawned, 3–5.5 mm long, disarticulating above the glumes; glumes unequal, the upper longer. Prairies, disturbed areas, various soils; throughout TX; sc Canada and c U.S. from MN s to LA w to MT and AZ, also CA. This was a minor member of original prairie which increases under disturbance; rather common on disturbed or overgrazed sites. Apr–Oct.

SCHIZACHYRIUM Nees BLUESTEM, FALSE BLUESTEM

Ours perennials; ligule membranous, 3 mm or less long, sometimes fringed; flowering culms much-branched, each leafy branch terminating in a spicate raceme (these sometimes crowded together and sometimes appearing axillary due to the shortness of the branches of the flowering stem); spikelets in pairs of one sessile and one pedicellate; sessile spikelets 2-flowered, the upper floret fertile, with toothed or cleft lemma, the lower floret neuter; pedicellate spikelets staminate or neuter; disarticulation at base of sessile spikelet so that associated pedicel and section of inflorescence axis fall with sessile spikelet.

A mainly tropical and subtropical genus of ca. 60 species (Wipff 2003k), particularly in savannahs. These plants were formerly treated along with *Bothriochloa* in a more inclusive *Andropogon* (e.g., Hitchcock 1951). However, most species of *Schizachyrium* differ from these other two genera in having only one raceme per peduncle (Wipff 2003k). In addition, *Schizachyrium* species have raceme internodes with cupulate tips and convex lower glumes veined between the keels—*Andropogon* species lack these features (Wipff 2003k). The common name, BLUESTEM, is derived from the bluish green color of the glaucous foliage of some plants. Like all members of the Andropogoneae, *Schizachyrium* is characterized by C_4 photosynthesis (Kellogg 2000a). Several species are important native pasture grasses while some are significant weeds (Watson & Dallwitz 1992). (Greek: *schizo*, to divide or split, and *achna*, chaff, referring to the toothed lemma) (subfamily Panicoideae, tribe Andropogoneae)
REFERENCES: Shinners 1954; Gould 1967; Grelen 1974; Türpe 1984; Carmen & Briske 1985; Butler & Briske 1988; Gandhi 1989; Briske & Anderson 1992; Gandhi & Smeins 1996; Wipff 1996a, 2003k.

1. Pedicels (of pedicellate spikelets) ciliate with long silvery hairs at least on the upper two-thirds; raceme internodes relatively thin and flexuous, ciliate with long silvery hairs the entire length or

nearly so; racemes > 2 mm wide at maturity (due to flexuous internodes and spreading pedicellate spikelets), often curved; sessile spikelets 5–8(–11) mm long; leaf blades (1.5–)3–7 mm wide, without a longitudinal stripe of white spongy tissue on their upper (= adaxial) surfaces _____ **S. scoparium**

1. Pedicels glabrous except for a few hairs near apex; raceme internodes relatively thick, not flexuous, glabrous or with limited pubescence only at base and apex; racemes very slender, usually only 1–2 mm wide, straight; sessile spikelets usually 3.5–5 mm long; leaf blades 0.5–1.5 mm wide, with a longitudinal stripe of white spongy tissue on their upper surfaces _____ **S. tenerum**

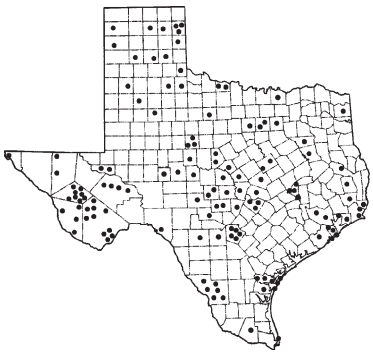
Schizachyrium scoparium (Michx.) Nash, (broom-like), LITTLE BLUESTEM, LITTLE FALSE BLUESTEM. Perennial 50–210 cm tall, tufted, non-rhizomatous, glaucous or less commonly green; racemes 2.5–6(–8) cm long; lemma of sessile spikelet with a geniculate awn (2.5–)7–15(–17) mm long; pedicelled spikelet shorter than to nearly as long as sessile spikelet, narrower, awnless or with a short straight awn. Nearly throughout TX; s Canada and throughout most of the U.S. There is wide variation in foliage color, with plants ranging from strongly glaucous with bluish gray or purplish foliage to green with little or no glaucousness (Yatskievych 1999). LITTLE BLUESTEM is one of our most important native grasses, often a vegetational dominant, and one of the "big four" tall grasses of the original native prairie, along with *Andropogon gerardii, Panicum virgatum,* and *Sorghastrum nutans.* It is valuable for forage and hay. The culms become a conspicuous tan to orangish brown after first frost (Yatskievych 1999), and the dried leaves curl. This is a variable species, with differing opinions on how the variation should be treated taxonomically (e.g., Shinners 1954; Gould 1975b; Gandhi & Smeins 1996; Wipff 1996a, 2003k). While some authorities (e.g., Gandhi & Smeins 1996) recognize variation within this species at the subspecific level, we are following Wipff (2003k) in treating it at the varietal level. According to Gould (1975b), the two varieties present in East TX sometimes grow intermingled. Varieties are not distinguished on the county distribution map provided.

1. Pedicelled spikelets (at least some) well-developed, as long as sessile spikelets or nearly so, 4–10 mm long (excluding awn), with 2 well-developed glumes; lower leaf sheaths and blades villous OR not so; species known in East TX from Pineywoods, Post Oak Savannah, and Blackland Prairie _____ var. **divergens**

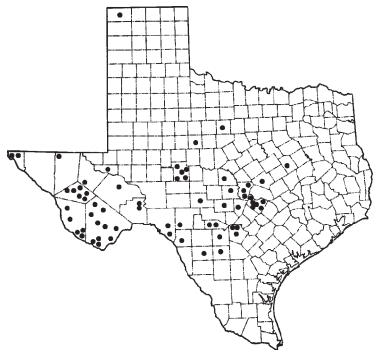
1. Pedicelled spikelets reduced, usually much shorter than sessile spikelets, 1.5–5 mm long, consisting of a single empty glume; lower leaf sheaths and blades glabrous or sparsely pubescent; species widespread in TX but more common from Blackland Prairie westward _____ var. **scoparium**

var. **divergens** (Hack.) Gould, (spreading in different directions), EASTERN LITTLE BLUESTEM, VIRILE LITTLE BLUESTEM. Open woods, along forest margins, apparently more shade tolerant than var. *scoparium*; Pineywoods and Post Oak Savannah w to Blackland Prairie; also Gulf Prairies and Marshes; se U.S. from KY s to FL w to AR and TX, also WI. Aug–Dec. [*Andropogon divergens* (Hack.) Andersson ex Hitchc., *Andropogon scoparius* Michx. var. *virilis* Shinners, *S. scoparium* subsp. *divergens* (Hack.) Gandhi & Smeins, *S. scoparium* var. *virile* (Shinners) Gould] According to Wipff (2003k), this variety and var. *scoparium* intergrade.

var. **scoparium**, LITTLE BLUESTEM, LITTLE FALSE BLUESTEM. Pedicelled spikelets reduced, narrow. Prairies, openings in woods; widespread in TX, but more common from Blackland Prairie westward; s Canada and throughout most of the U.S. Aug–Dec. [*Andropogon scoparius* Michx., *Andropogon scoparius* Michx. var. *frequens* F.T. Hubb., *S. scoparium* (Michx.) Nash var. *frequens* (F.T. Hubb.) Gould, *S. scoparium* subsp. *neomexicanum* (Nash) Gandhi & Smeins] This was the principal original climax dominant over much of the prairies of TX (Shinners 1954). Wipff (2003k) noted that this is a variable taxon "with morphological features that vary independently and continuously across its range, coming together in distinctive combinations in some regions. Some of these phases have been named as varieties, or even species, but they have proven to be untenable taxonomic entities when plants from throughout the range of the species are considered."



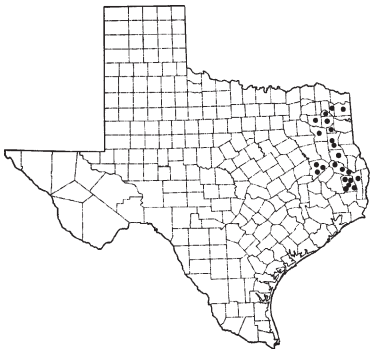
Polypogon monspeliensis



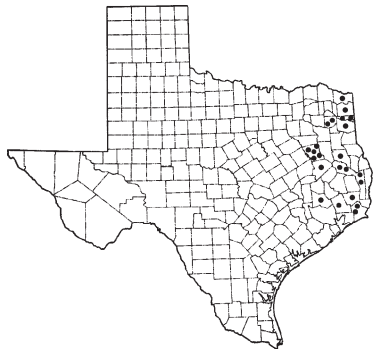
Polypogon viridis



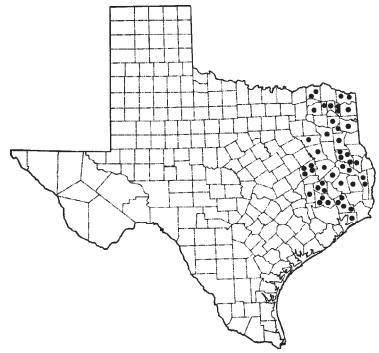
Rostraria cristata



Saccharum alopecuroides



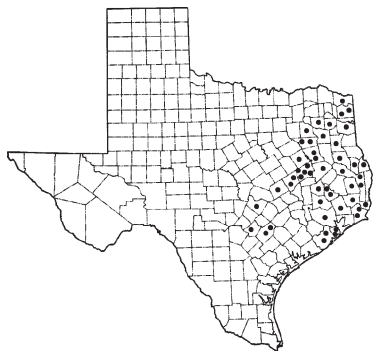
Saccharum baldwinii



Saccharum brevibarbe
(both vars.)



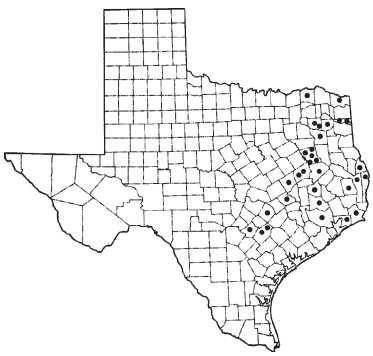
Saccharum coarctatum



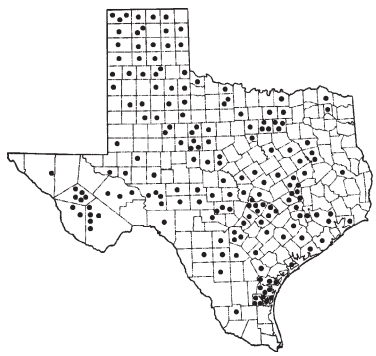
Saccharum giganteum



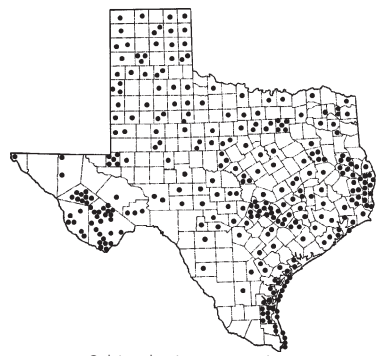
Sacciolepis indica



Sacciolepis striata



Schedonnardus paniculatus



Schizachyrium scoparium
(both vars.)

Schizachyrium tenerum Nees, (tender, soft), SLENDER BLUESTEM, SLENDER FALSE BLUESTEM. Tufted perennial; culms 40–100 cm tall, much-branched, often reclining; leaf blades flat or often involute; racemes usually 2–6 cm long, ± narrowly cylindrical, the raceme axis not flexuous and the pedicelled spikelets appressed; lemma of sessile spikelets with a geniculate awn ca. 6–11 mm long; pedicelled spikelets awnless, ca. as long as sessile spikelets but narrower. Open pine or pine hardwood forests or forest openings, usually in sandy soils; Angelina, Jasper, Newton (BRIT), Hardin, Harris, and Tyler (Turner et al. 2003) cos. in the s part of the Pineywoods and Lavaca Co. (Turner et al. 2003) in the s Post Oak Savannah; also n Gulf Prairies and Marshes; se U.S. from GA s to FL w to TX and OK. Aug–Nov. [*Andropogon tener* (Nees) Kunth]

SCLEROCHLOA P. Beauv. HARD GRASS

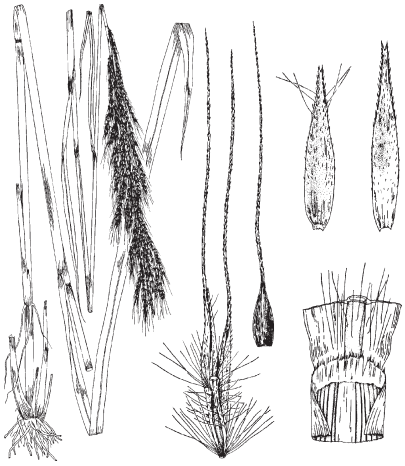
A C_3 genus of 2 species (Clayton & Renvoize 1986; Brandenburg et al. 1991b; Tucker 1996; Brandenburg ined.) of s Europe and w Asia or considered by some authorities as monotypic (e.g., Mabberley 1997). (Greek: *scleros*, hard, and *chloa*, grass, referring to thick leathery glumes and lemmas) (subfamily Pooideae, tribe Poeae)

REFERENCES: Brandenburg et al. 1991b; Tucker 1996; Angelov 2000; Saichuk et al. 2000; Brandenburg ined.

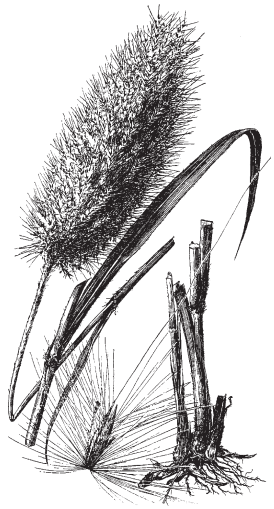
Sclerochloa dura (L.) P. Beauv., (durable, hard), HARD GRASS, COMMON HARD GRASS. Tufted, glabrous, prostrate to erect, often matted annual 3–15(–30) cm tall or long; leaf sheaths with margins free ca. 1/2 their length; ligule a membrane (0.3–)1–2(–3.3) mm long; leaf blades ca. 2–7 cm long, 1–4 mm wide, ± blunt apically; inflorescences spike-like, dense (the subsessile spikelets strongly overlapping), 1-sided, 1–3(–4.5) cm long; spikelets usually 5–12 mm long, with ca. 2–4 fertile florets and 1(–2) reduced sterile one above, awnless; disarticulation apparently somewhat irregular, between florets and below glumes or between portions of the inflorescence; glumes and lemmas blunt, distinctly veined (the lemmas with 5(–7) prominent, raised, almost parallel veins); glumes shorter than rest of spikelet, unequal, the upper longer; lemmas strongly keeled, the lowest ca. 4.5–6 mm long; stamens 3. Roadsides, waste places, or disturbed areas; Dallas, Collin, Ellis, Fannin, Grayson, Red River (BRIT), Bell, Bexar (Brandenburg et al. 1991b), and St. Augustine (Turner et al. 2003) cos., also e Cross Timbers and Prairies; se Canada (Ont.) and scattered through much the U.S. This species was first collected in the U.S. in 1895 and in TX in 1944 (Brandenburg et al. 1991b). It was only recently reported from LA (Saichuk et al. 2000). Feb–Apr (the short-lived plants turn yellowish brown and dry up by early summer—Yatskievych 1999). Native of Europe. This is a short, easily overlooked species whose spreading and often prostrate habit enables it to survive mowing, trampling, and other abuses of highly disturbed areas (e.g., roadsides, parking lots, sidewalk borders, athletic fields). It is sometimes mistaken for *Poa annua* but is only superficially similar. According to Brandenburg (ined.), the two species "occupy similar habitats and have a similar phenology," but *Sclerochloa dura* can be distinguished by its glabrous, blunt lemmas.

SECALE L. RYE

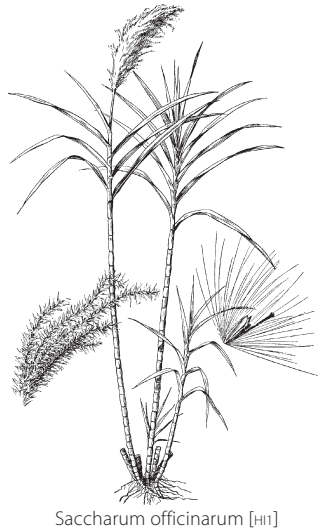
A Mediterranean and w Asian C_3 genus of 3 species (Sencer & Hawkes 1980; Frederiksen & Petersen 1997, 1998; Barkworth ined.), including cultivated RYE. It has previously been divided into as many as 15 species (Frederiksen & Petersen 1997). While clearly in the Triticeae, the precise generic relationships of *Secale* are unclear—different molecular studies have given conflicting results concerning its position within the tribe (Frederiksen & Petersen 1998). Intergeneric hybrids are known between *Secale* and *Aegilops*, *Agropyron*, *Elytrigia*, and *Triticum* (Watson & Dallwitz 1992). ×*Triticosecale*, an artificially derived hybrid between *Triticum* and *Secale*, is now widely cultivated (Barkworth ined.); this is sometimes referred to as TRITICALE. "Unlike other cereal grasses such as *Triticum*, *Hordeum*, and *Avena*, species of *Secale* are outcrossing ..."



Saccharum coarctatum [SID]



Saccharum giganteum [HI1]



Saccharum officinarum [HI1]



Sacciolepis indica [FNA]



Sacciolepis striata [HI1]



Schedonnardus paniculatus [USB]



Schizachyrium scoparium var. divergens [HI1]



Schizachyrium scoparium var. scoparium [USB]

(Barkworth ined.). Also unlike many other cultivated crops, all *Secale* species are diploids (Barkworth ined.). (Ancient Latin name for rye) (subfamily Pooideae, tribe Triticeae)
REFERENCES: Bowden 1959; Stutz 1972; Sencer & Hawkes 1980; Baum 1982, 1978, 1983; Vences et al. 1987; Petersen & Doebley 1993; Tucker 1996; Frederiksen & Petersen 1997, 1998; Barkworth 2000, ined.; Mason-Gamer & Kellogg 2000.

Secale cereale L., (pertaining to agriculture, from Ceres, goddess of farming), RYE. Erect annual usually 50–150 cm tall, vegetatively similar to WHEAT (*Triticum*); inflorescence a dense spike 5–19 cm long and ca. 1 cm wide (excluding awns), often distinctly nodding when dry, the sessile spikelets 1 per node, crowded along opposite sides of a persistent axis; disarticulation (tardy) in the inflorescence axis at the nodes; spikelets all similar, usually 2-flowered, both florets perfect; glumes narrowly lanceolate-subulate, 6–20 mm long, ca. 1–3.5 mm wide, acute or acuminate, apparently 1-veined, with an awn ca. 1–3 mm long; lemmas 10–16(–18) mm long, with stiff cilia on keel and margins; lemma awn 5–60(–70) mm long. Occasionally cultivated in much of TX, chiefly in sandy soils; found rarely as a transitory waif on roadsides or in disturbed areas; scattered in East TX; throughout most of Canada and the U.S. Apr–May. RYE is an important temperate area grain crop used for food, in producing alcohol (particularly in Canada for making whisky), and also as forage and in erosion control (Yatskievych 1999); it is tolerant of cold climates and poor soils (Clayton & Renvoize 1986). It is an Old World species brought into domestication later than WHEAT or BARLEY, but it is still quite old—remains of RYE, dating to 6,000 B.C. have been found in Turkey (Barkworth ined.). RYE is believed to have evolved from weeds (possibly *S. montanum* Guss. [= *S. strictum* (C. Presl) C. Presl]) invading the fields of early WHEAT and BARLEY farmers. Large fruited forms were brought into cultivation in e Turkey (Sencer & Hawkes 1980; Mabberley 1987; Heiser 1990).

RYE and a number of other grasses are susceptible to infection by ergot fungi, e.g., *Claviceps purpurea* (Fr.: Fr.) Tul., which through the production of LSD-like alkaloids can cause hallucinations, psychosis, gangrene of the extremities (due to vasoconstriction), convulsions, and death in humans and livestock. The condition was referred to in ages past as holy fire or Saint Anthony's fire. The reference to fire resulted from the assumption that the burning sensations and blackened (gangrenous) limbs were retribution for sins. Saint Anthony, supposedly with special powers to protect against fire, infection, and epilepsy, was often invoked by those with the condition. Large-scale epidemics of ergotism in Europe prior to 1800, caused by eating bread made with contaminated grain, resulted in thousands of deaths; isolated instances still occur where grain purity is not controlled. Ergotism is blamed by some for the hysteria that resulted in the Salem witch trials in 17th century Massachusetts (Kingsbury 1964; Caporael 1976; Mabberley 1987; Matossian 1989; Blackwell 1990; Mann 1992; Burrows & Tyrl 2001).

Steyermark (1963) noted that the pollen causes hay fever. This species is designated as a noxious weed in SC and WA (Kartesz 1999). ⊘ ☜

SETARIA P. Beauv. BRISTLE GRASS, FOXTAIL, FOXTAIL-MILLET

Annuals or perennials; ligule a ciliate membrane; inflorescence a usually dense, contracted, spike-like panicle, sometimes less dense and with lower branches somewhat spreading (*S. scheelei*); branches terminating in a bristle; all or at least some spikelets subtended by an involucre of 1–20 persistent bristles; spikelets awnless, 2-flowered, the lower floret sterile with glume-like lemma, the upper floret fertile with hardened grain-like lemma; disarticulation above the bristles (except above the glumes in *S. italica* and *S. magna*).

A C_4 genus of ca. 140 species of tropical and warm areas, particularly in Africa, Asia, and South America (Rominger 2003). Polyploidy is common in *Setaria* and asexual reproduction by agamospermy is known (Emery 1957a). *Setaria* is considered to be one of several genera closely related to *Panicum* but is easily distinguished "... by the presence of bristles subtending the spikelets, these representing modified inflorescence branches" (Fox & Hatch 1999). These reduced branches have lost their spikelets (Butzin 1977). *Setaria* is also closely related to

Paspalidium (Webster 1995), and that genus is sometimes included in *Setaria* (e.g., Webster 1995; Mabberley 1997). This relationship is reflected in the fact that some Australian species of *Paspalidium* have spikelets subtended by bristles as in *Setaria* (Webster 1988). According to some authorities, the genus *Pennisetum* (FOUNTAIN GRASS), which also has bristles below the spikelets, is considered only superficially similar to *Setaria*, the bristles being a parallelism developed in two separate lineages. This is reflected in the placement of *Pennisetum* in a different subtribe, the Cenchrinae versus the Setariinae (Crins 1991). However, recent molecular studies suggest a close relationship between members of a "setae-bearing" clade including *Cenchrus*, *Pennisetum*, and *Setaria* (Gómez-Martínez & Culham 2000). The ecological role of the bristles is unclear—while the retrorsely scabrous bristles of *S. verticillata* can cling to animal fur, this is not the case with most species, and further, the spikelets disarticulate above the bristles. It has been suggested (e.g., Davidse 1987a; Crins 1991) that "... they may serve as a shaking mechanism, whereby mature spikelets would be dislodged when the bristles came into contact with fur or some other adhesive surface" (Crins 1991). The barbed bristles can cause mechanical injury in animals when they penetrate the skin and migrate through tissues; serious infections can result (Burrows & Tyrl 2001). Some species are considered noxious weeds, others are used for hay, pasture, fodder, silage, birdseed, or cereal grain (e.g., *S. italica*—FOXTAIL-MILLET). (Latin: *seta*, a bristle, and *aria*, possessing, referring to the bristles subtending the spikelets) (subfamily Panicoideae, tribe Paniceae)
REFERENCES: Hubbard 1915; Pohl 1951, 1962; Emery 1957a, 1957b; Rominger 1962, 2003; Webster 1988, 1993a, 1995; Crins 1991; Wang et al. 1995; Fox 1999; Fox & Hatch 1999; Pensiero 1999; Northam & Stahlman 2000; Toolin & Reeder 2000.

1. Plants very large, usually 1.5–4(–6) m tall; inflorescences very long and thick, 14–45(–50) cm long, 1.5–3(–5) cm in diam.; leaf blades 10–35 mm wide; lemma of fertile floret smooth and shiny; species rare, if present, in East TX _____ **S. magna**
1. Plants < 1.5(–2) m tall; inflorescences often much smaller in length, diam., or both (can be large in *S. italica*, but plant is much smaller and spikelets larger than in *S. magna*); leaf blades to 16(–21) mm wide, usually narrower; lemma of fertile floret finely or coarsely wrinkled and rugose (except smooth in *S. italica*); including species widespread and abundant in East TX.
   2. Bristles (short) usually present only at base of terminal spikelets (sometimes below a few other spikelets); plants resembling *Panicum* _____ **S. reverchonii**
   2. Bristles present below nearly all spikelets; plants not resembling *Panicum*.
      3. Bristles 4–20 below each spikelet; panicles cylindric, 2–20 cm long, so dense that axis is obscured.
         4. Inflorescences often nodding or drooping from near the base (particularly at maturity), (3–)6–20 cm long; bristles up to 6 (usually fewer) below each spikelet; upper surface of leaf blades with sparse to often dense, long, papilla-based hairs (can also be scabrous); species not currently known from East TX (included because of probability of occurrence) _____ **S. faberi**
         4. Inflorescences erect to curved or nodding toward the tip, but not from near the base, 2–10(–15) cm long; bristles 4–20 below each spikelet; upper surface of leaf blades glabrous or with sparse papilla-based hairs (may also be scabrous); including species widespread and abundant in East TX.
            5. Plants perennial, with hardened bases and knotty rhizomes; spikelets 1.9–2.8(–3) mm long _____ **S. parviflora**
            5. Plants annual, with soft bases and fibrous roots only; spikelets 2.7–3.5 mm long _____ **S. pumila**
      3. Bristles 1–3 below each spikelet; panicles variable in shape and length, the axis obscured or visible.
         6. Plants annual; bristles on average > 1 per spikelet (1–3 below each spikelet); inflorescences usually extremely dense in appearance, the axis not visible or visible in only a very few places.

7. Lemma of upper (fertile) floret coarsely transversely wrinkled and rugose (use hand lens or dissecting scope); species rare in East TX, known only from Harris, Jasper, Liberty, and Walker cos. _____ **S. corrugata**
7. Lemma of upper floret finely rugose or smooth; including species widespread in East TX.
   8. Bristles retrorsely scabrous (with down-pointing barbs visible with hand lens, the free end of the barbs below (= proximal to) the attached end); inflorescence branches in whorls; main inflorescence axis with short stiff hairs only _____ **S. verticillata**
   8. Bristles antrorsely scabrous (with up-pointing barbs visible with hand lens, the free end of the barbs above the attached end); inflorescence branches not in well-defined whorls; main inflorescence axis with long spreading hairs in addition to short stiff hairs.
      9. Inflorescences often nodding or drooping from near the base (particularly at maturity); upper surface of leaf blades with sparse to often dense, long, papilla-based hairs (can also be scabrous); species not currently known from East TX (included because of probability of occurrence) _____ **S. faberi**
      9. Inflorescences erect or nodding near the tip, but not from near the base; upper surface of leaf blades glabrous to scabrous, without long, papilla-based hairs (note: there may be long hairs along leaf margins); including species widespread in East TX.
         10. Panicles often lobed or interrupted, purple or yellow, often large and heavy, to 30 cm long; spikelets (2.5–)2.6–3.4 mm long, disarticulating between the lower and upper florets, the fertile floret deciduous from glumes and lemma of sterile floret; lemma of fertile floret smooth and shiny or nearly so _____ **S. italica**
         10. Panicles not lobed or interrupted, usually green, usually 10(–15) cm or less long; spikelets ca. 1.6–2.6 mm long, falling entire (disarticulation below the glumes); lemma of fertile floret finely rugose _____ **S. viridis**
6. Plants perennial; bristles mostly 1(–2) below each spikelet; inflorescences not extremely dense in appearance, much of the axis visible.
   11. Spikelets 2.8–3.4 mm long; leaf blades ± densely villous on both upper and lower surfaces; species mainly of w TX, disjunctly known in East TX only from Anderson Co. _____ **S. villosissima**
   11. Spikelets 1.8–2.8 mm long; leaf blades scabrous or variously pubescent but not villous; species widespread in East TX.
      12. Panicles very narrow, ca. 5 mm wide (excluding bristles), 2–8(–12) cm long; culms usually branching well above base (at some upper nodes); spikelets 1.8–2.1 mm long; herbage dark green; species known in East TX only from Bexar and Wilson cos. near extreme sw margin of area _____ **S. texana**
      12. Panicles usually 10–70 mm wide, 6–35 cm long; culms usually not branching above base; spikelets 1.9–2.7 mm long; herbage dark or light green; including species widespread in s and w parts of East TX.
         13. Mature spikelets 1.9–2.1(–2.3) mm long, strongly inflated and appearing nearly globose; palea of lower floret nearly as long as lemma, ovate; leaf blades, at least some, 7–15 mm wide; species known in East TX only from Bexar Co. on extreme sw margin of area _____ **S. macrostachya**
         13. Mature spikelets usually 2.1–2.8 mm long, neither strongly inflated nor globose; palea of lower floret usually one-half to three-fourths as long as lemma, lanceolate; leaf blades variable in width (see couplet 14 below); species widespread in s and w parts of East TX.
            14. Leaf blades narrow, usually 2–9 mm wide; panicles usually cylindric, not tapered, usually 6–15 cm long; bristles mostly 4–15 mm long, ascending _____ **S. leucopila**

14. Leaf blades broader, (5–)9–20 mm wide; panicles usually strongly tapered from a wide base to a narrow apex, (7–)11–35 cm long; bristles (10–)15–35 mm long, spreading ____ **S. scheelei**

Setaria corrugata (Elliott) Schult., (corrugated, wrinkled), COASTAL BRISTLE GRASS, COASTAL FOXTAIL. Coarse annual 30–100 cm tall; panicle 3–15 cm long; bristles highly variable in length and color, mostly (5–)7–15(–20) mm long, green, tawny, or purple; spikelets 1.6–2.5 mm long; lemma of fertile floret coarsely transversely ridged and rugose. Sandy disturbed areas, pinelands, waste places, along streams; Liberty (*Brown 28807*, SBSC), Jasper, Walker (Gould 1975b), and Harris (Turner et al. 2003) cos. in se part of East TX; se U.S. from NC s to FL w to TX. Summer. [*Chaetochloa corrugata* (Elliott) Scribn., *Panicum corrugatum* Elliott]

Setaria faberi R.A.W. Herrm., (for Ernst Faber, 1839–1899, who collected the type specimen in China), JAPANESE BRISTLE GRASS, NODDING FOXTAIL, GIANT FOXTAIL, CHINESE FOXTAIL Large annual 40–200 cm tall; panicle (3–)6–20 cm long; bristles usually 1–3 but sometimes to 6 per spikelet, 4–12 mm long; spikelets 2.4–3 mm long; lemma of fertile floret finely rugose. Disturbed areas; this species is not currently known from TX but is likely in the flora area; no county distribution map is provided; however, it is common in AR, MO, and LA, including immediately adjacent to the TX border (Rominger 2003); se Canada and widespread in the e U.S. w to SD and OK, also AZ, CA, CO, and WA. It is included here based on the likelihood of its occurrence in East TX and to encourage collectors to look for it. Jul–Oct. Native of Asia. Probably introduced into the U.S. from China in the 1920s (Rominger 1962). It is "a major nuisance in corn and bean fields of the midwestern United States" (Rominger 2003), is considered a serious weed (Rominger 1962), and has been designated noxious in CA and OK (Kartesz 1999). This species can resemble *S. viridis* var. *major* (in large size of plant and inflorescence) but can be distinguished by the pubescence on the upper surface of the leaf blades and by the panicles which at maturity droop from near the base (Rominger 1962). ⊘ ☜

Setaria italica (L.) P. Beauv., (of Italy), FOXTAIL-MILLET, ITALIAN-MILLET, GERMAN-MILLET, HUNGARIAN-MILLET. Annual similar to but larger and coarser than *S. viridis*; culms to 120 cm tall; leaf blades to 16(–30) mm wide; panicles to 30 cm long and to 3 cm thick; bristles to ca. 12 mm long; spikelets ca. (2.5–)2.6–3.4 mm long, disarticulating below the fertile floret (leaving behind glumes and sterile floret); lemma of fertile floret smooth and shiny or nearly so. Roadsides, apparently now being used to stabilize soil and prevent erosion following highway construction; Denton (damp limestone soil), Grayson (planted for erosion control along Hwy 82) (BRIT), Bexar, Brazos, Collin, Dallas, Harris, Hays, and Travis (Turner et al. 2003) cos.; scattered in TX; Gould (1975b) noted that *S. italica* does not persist in the state; se Canada and throughout most of the U.S. Jul–Aug. This species is related to and interfertile with its wild ancestor, *S. viridis*, native of Eurasia. *Setaria viridis* is sometimes treated as a subspecies of *S. italica* (e.g., by Prasada Rao et al. 1987). FOXTAIL-MILLET appears to be an old domesticate first brought into cultivation in e Asia, possibly 5,000–7,000 years ago. It is used as a cereal grain (particularly in China), as birdseed, and as animal fodder (Clayton & Renvoize 1986; Mabberley 1987; Prasada Rao et al. 1987; Zohary & Hopf 1994; Yatskievych 1999). When eaten in large amounts, *Setaria italica* inflorescences can cause joint and muscle pain and degenerative arthritis in livestock; a glycoside is a possible cause (Burrows & Tyrl 2001). ☠ ☜

Setaria leucopila (Scribn. & Merr.) K. Schum., (white-haired), PLAINS BRISTLE GRASS, STREAMBED BRISTLE GRASS. Tufted perennial 20–100 cm tall; bristles mostly 4–15 mm long; spikelets usually 2.2–2.8 mm long; lemma of fertile floret finely rugose and with transverse wrinkles. Well-drained soils, sometimes with abundant moisture; Bell, Travis (BRIT), Burleson, Grimes (TAMU), Anderson, Bexar, Brazos, Hays, and Nacogdoches (Turner et al. 2003) cos.; mainly w 2/3 of TX; AZ, CO, NM, OK, and TX. May–Nov. This species is quite variable (Emery 1957a). Rominger (1962) described it as the "most abundant and most widely dispersed of the perennial bristle

grasses of the plains. It, therefore, is of greater economic importance as forage and cover than any of the other perennial species of *Setaria* in the southwestern United States and northern Mexico."

Setaria macrostachya Kunth, (large-spiked), PLAINS BRISTLE GRASS. Tufted perennial 60–120 cm tall; panicles (6–)8–30 cm long; bristles mostly 10–20 mm long; spikelets 1.9–2.1(–2.3) mm long; lemma of fertile floret strongly inflated, coarsely rugose. Bexar Co. (Turner et al. 2003) near sw margin of East TX; mainly Gulf Prairies and Marshes and South TX Plains; also rare in Edwards Plateau and High Plains; AZ, NM, NV, and TX. May–Nov. A number of the *Setaria* species (*S. leucopila*, *S. macrostachya*, *S. scheelei*, *S. texana*, and *S. villosissima*) from the s and w parts of East TX appear to be related and have been referred to as the *S. macrostachya* complex (Emery 1957a). Some of these species are weakly delimited, and hybridization is suspected (Powell 1994). Kartesz (1999) included *S. macrostachya* in *S. vulpiseta* (Lam.) Roem. & Schult., a Latin American species, presumably following such authors as Renvoize (1984), Webster (1993a), and Powell (1994). However, Toolin and Reeder (2000), in a critical study of the type specimens, concluded that the two are separated by a number of characters and are distinct species. We are therefore following Toolin and Reeder (2000) and Rominger (2003) for nomenclature of this species.

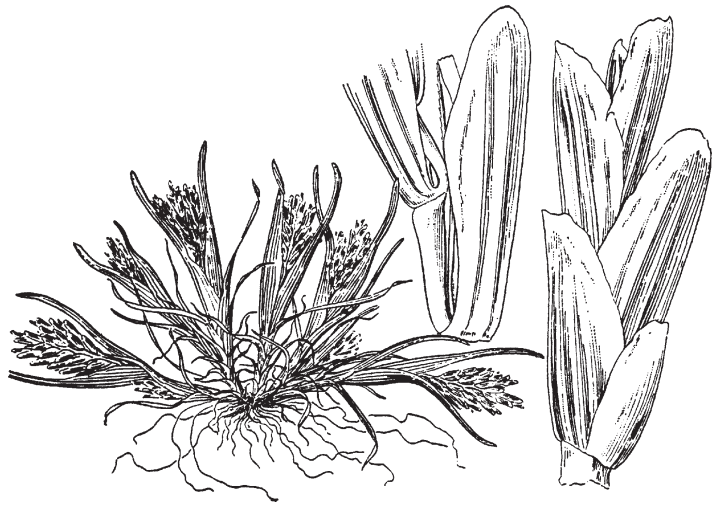
Setaria magna Griseb., (large), GIANT BRISTLE GRASS, GIANT FOXTAIL GRASS, SALT-MARSH FOXTAIL GRASS. Coarse annual; culms to 4(–6) m tall, to 1–2(–nearly 3) cm thick at base; panicle 14–45 (–50) cm long and 1.5–3(–5) cm in diam.; bristles 10–20 mm long; spikelets 2–2.5 mm long, disarticulating below the fertile floret (leaving behind glumes and sterile floret); lemma of fertile floret smooth and shiny, brown. Wet sand; this species has a special affinity for salt marshes (Rominger 1962); mainly Gulf Prairies and Marshes, disjunct w to Tarrant Co. (Trinity River bottom, Fort Worth Nature Center—BRIT) just w of East TX; included because of likelihood of occurrence in East TX; se U.S. from NJ s to FL w to AR and TX, also AZ. Oct. This is the largest *Setaria* species in North America.

Setaria parviflora (Poir.) Kerguélen, (small-flowered), KNOT-ROOT BRISTLE GRASS, KNOT-ROOT FOXTAIL. Perennial 15–150 cm tall, with hardened base and knotty rhizomes; leaf sheaths slightly compressed, keeled; leaf blades often pilose near base; panicle dense and stiff, 2–8(–10) cm long; bristles 4–12 below each spikelet, yellowish, tawny, greenish, or purplish, 5–12 mm long, antrorsely scabrous; spikelets 1.9–2.8(–3) mm long; lemma of fertile floret rugose. Stream banks, disturbed sites; widespread in TX; widespread in the U.S. except the nc part of the country. May–Nov. [*S. geniculata* (Lam.) P. Beauv.] This native species is extremely similar to the introduced *S. pumila* and difficult to distinguish, except that it is a perennial with knotty rhizomes and usually has smaller spikelets.

Setaria pumila (Poir.) Roem. & Schult., (dwarf), YELLOW BRISTLE GRASS. Annual with fibrous roots, similar to *S. parviflora*, differing in its annual habit, slightly larger spikelets, and panicle with relatively fewer spikelets per verticil; panicles 3–10(–15) cm long; bristles 5–20 below each spikelet, yellow at maturity, mostly 3–8 mm long, antrorsely scabrous; spikelets 2.7–3.5 mm long; lemma of fertile floret rugose. Disturbed soils; widespread in TX; s Canada and widespread in the U.S. Jun–Sep. Native to Europe and Africa. [*S. glauca* of authors, not (L.) P. Beauv., *S. lutescens* (Weigel) F.T. Hubbard] This species has long gone under the name *S. glauca*, but because of ambiguity and confusion over type material, *S. pumila* appears to be the most appropriate binomial (Clayton & Renvoize 1982). While the epithet *pumila* is accepted by most recent authors (e.g., Jones et al. 1997; Kartesz 1999; Rominger 2003), some (e.g., Yatskievych 1999) still utilize *glauca*. Subspecific taxa have been described. Kartesz (1999) recognized only subsp. *pallide-fusca* (Schumach.) B.K. Simon as occurring in the U.S., while Rominger (2003) indicated that subsp. *pumila* was the widespread subspecies, with subsp. *pallide-fusca* known in North America only from LA and OR. Jones et al. (1997) did not recognize infraspecific taxa. We are



Schizachyrium tenerum [HI1, USB]



Sclerochloa dura [HI1]



Secale cereale [HI1]



Setaria corrugata [USB]



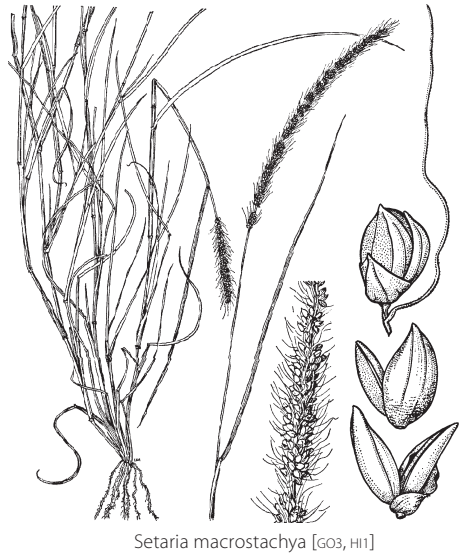
Setaria faberi [REE]



Setaria italica [USD]



Setaria leucopila [GO1]



Setaria macrostachya [GO3, HI1]

following the recent treatment by Rominger (2003) for nomenclature and circumscription of this species. Subspecies *pallide-fusca* can be distinguished by its smaller spikelets (2–2.5 mm long) and reddish bristles (Rominger 2003)—it is considered a federal noxious weed (Kartesz 1999; USDA Natural Resources Conservation Service 2002), and also is listed as noxious in FL. *Setaria pumila* is known to cause mechanical injury to the mouths of livestock; the bristles easily penetrate flesh and remain there because of their tiny barbs (Kingsbury 1964). ⊘ ☜

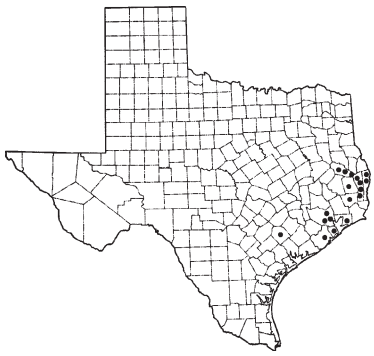
Setaria reverchonii (Vasey) Pilg. subsp. **reverchonii**, (for Julien Reverchon, 1837–1905, a French-American immigrant to Dallas and important botanical collector of early TX), REVERCHON'S BRISTLE GRASS. Tufted erect perennial 20–80 cm tall; culm bases hard, swollen; leaf sheaths pilose on margins and at summit; leaf blades scabrous; panicle (9.5–)25.3–32.6(–64.8) cm long; bristles (short) present only at base of terminal spikelets (sometimes below a few other spikelets)—plants thus resembling *Panicum*; lemma of fertile floret conspicuously rugose. Rock outcrops or gravelly soils on limestone; Bell, Bexar, DeWitt, Hill, McLennan (BRIT), Comal, Dallas, Hays, and Travis (Turner et al. 2003) cos. on w margin of East TX; mainly w 2/3 of TX; NM, OK, and TX. Apr–Jun, Sep. [*Panicum reverchonii* Vasey] Correll and Johnston (1970) treated this species in the genus *Panicum*. Fox and Hatch (1999) recently studied this and related species of *Setaria* and named a new subgenus, *Reverchoniae*. They also reduced *S. ramiseta* (Scribn.) Pilg., which occurs just to the s and w of East TX, to a subspecies of *S. reverchonii* (subsp. *ramiseta* (Scribn.) W.E. Fox). The two subspecies can be distinguished as follows:

1. Spikelets usually (2.9–)3–3.4(–4.5) mm long; penultimate leaf blades (3.6–)11.7–13.3(–28.6) cm long, usually tapering to an extremely narrow base, often involute; bristles shorter than to longer than spikelets (rarely > 6 mm long) _____ subsp. *reverchonii*
1. Spikelets (2.4–)2.7–2.8(–3.4) mm long; penultimate leaf blades (3–)6.8–7.6(–12.1) cm long, not or only slightly narrowing toward base, flat; bristles usually shorter than the spikelets _____ subsp. *ramiseta*

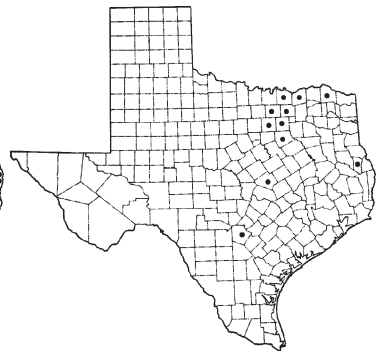
Setaria scheelei (Steud.) Hitchc., (for Adolf Scheele, 1808–1864, German botanist and clergyman), SOUTHWESTERN BRISTLE GRASS, SCHEELE'S BRISTLE GRASS. Coarse tufted perennial 70–130 cm tall; panicle usually strongly tapered from a narrow apex to a wider base; bristles (10–)15–35 mm long; spikelets 2.1–2.6 mm long; lemma of fertile floret rugose. Fencerows, ravines, open woods, often in shade; widespread in s 1/2 of TX except for the Pineywoods; in the U.S. known only from TX and NM; also Mexico. May–Nov.

Setaria texana Emery, (of Texas), TEXAS BRISTLE GRASS. Tufted perennial 15–70(–90) cm tall; panicle very narrow, ca. 5 mm wide (excluding bristles); bristles 3–10 mm long; spikelets 1.8–2.1 mm long; lemma of fertile floret finely rugose. In partial shade, beneath trees or brush, thickets, typically in sandy loam soils; Bexar and Wilson (Turner et al. 2003) cos. near extreme sw edge of East TX; also widespread in s and sw TX; endemic to TX and n Mexico (Gould 1975b). Flowering throughout the year under appropriate conditions.

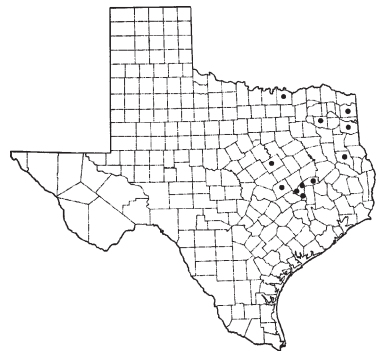
Setaria verticillata (L.) P. Beauv., (whorled), HOOKED BRISTLE GRASS, BUR BRISTLE GRASS, BUR FOXTAIL GRASS, ROUGH BRISTLE GRASS, BRISTLY FOXTAIL, FOXTAIL GRASS. Annual to 100 cm tall; leaf sheath margins glabrous to ciliate; panicle 5–15 cm long, the branches in whorls; bristles retrorsely scabrous, 4–7 mm long; spikelets 1.5–2.3 mm long; lemma of fertile floret finely rugulose. Disturbed places; Bexar, Brazos, Burleson, DeWitt (Turner et al. 2003), and Travis (Carr 2002a) cos.; scattered mainly in s 1/2 of TX; s Canada and widespread in much of the U.S. except the far se. Native to Europe and Africa. Spring–summer. [*S. adhaerans* (Forssk.) Chiov.] The retrorsely scabrous bristles can cling tenaciously to clothing (Clayton & Renvoize 1986). Some authorities (e.g., Gould 1975b; Kartesz 1999; Rominger 2003) recognize *S. adhaerans* as a separate species. However, based on morphological similarity, we are following Hatch (2002) in including it within *S. verticillata*. Clayton (1980) indicated that *S. adhaerens* is one of a number of variants of *S. verticillata* "which do not seem to merit specific rank." Rominger (2003) separated the 2 using the following characters. ☜



Schizachyrium tenerum



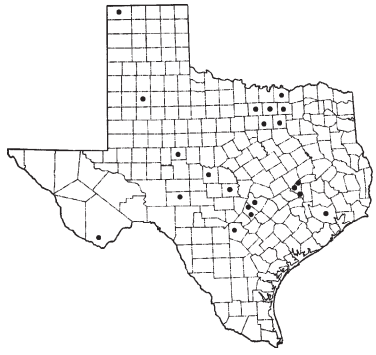
Sclerochloa dura



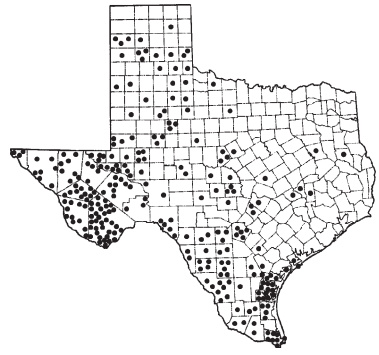
Secale cereale



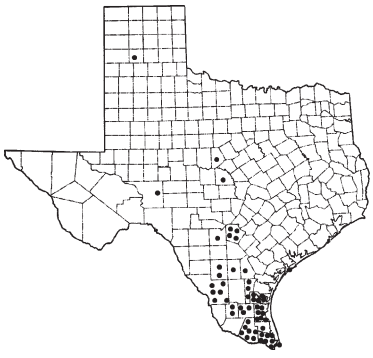
Setaria corrugata



Setaria italica



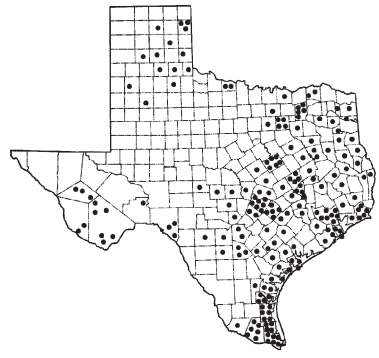
Setaria leucopila



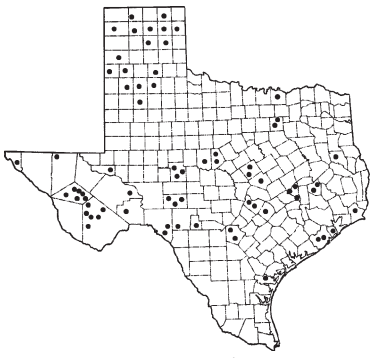
Setaria macrostachya



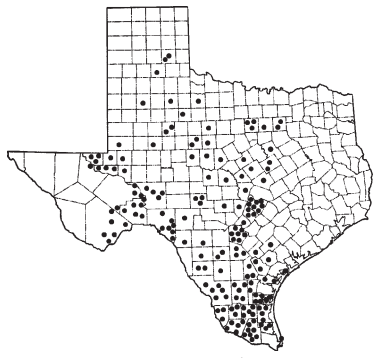
Setaria magna



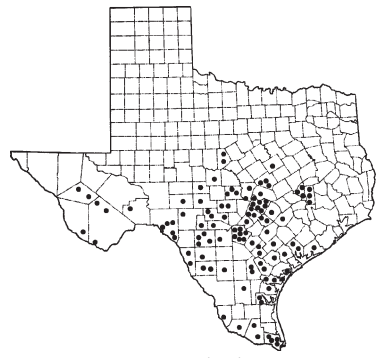
Setaria parviflora



Setaria pumila



Setaria reverchonii



Setaria scheelei

1. Margins of uppermost leaf sheaths glabrous; leaf blades strigose on the abaxial (lower) surfaces; distribution primarily subtropical _____ *S. adhaerans*
1. Margins of uppermost leaf sheaths ciliate; leaf blades scabrous on the abaxial surfaces; distribution primarily temperate _____ *S. verticillata*

Setaria villosissima (Scribn. & Merr.) K. Schum., (very villous, very soft hairy), HAIRY-LEAF BRISTLE GRASS. Tufted perennial 50–100 cm tall; leaf blades ± densely villous on both upper and lower surfaces; panicle usually 8–20 cm long; bristles mostly 12–25 mm long; spikelets 2.8–3.4 mm long; lemma of fertile floret finely but conspicuously rugose. Primarily on soils derived from granitic rocks; Anderson Co. (Turner et al. 2003)—if correctly identified, this is a surprising eastward disjunction since the species is primarily found in the Edwards Plateau and Trans-Pecos; Hatch (2002) cited only vegetational areas 6, 7, and 10; AZ and TX. Summer–fall. [*Chaetochloa villosissima* Scribn. & Merr.]

Setaria viridis (L.) P. Beauv., (green), GREEN BRISTLE GRASS, GREEN FOXTAIL GRASS. Annual to 100 cm tall; leaf sheaths slightly compressed; leaf blades mostly 3–10(–15) mm wide, glabrous or scabrous; panicle rather soft and flexible, erect or nodding from the tip but not from the base; bristles usually green; spikelets 1.6–2.6 mm long; lemma of fertile floret finely rugose. Disturbed sites; widely scattered in TX. May–Oct. Native of Eurasia. This species is sometimes treated as a subspecies of the cultivated *S. italica* as [*S. italica* (L.) P. Beauv. subsp. *viridis* (L.) Thell.] Some authorities (e.g., Rominger 1962; Jones et al. 1997; Kartesz 1999; Yatskievych 1999; Rominger 2003) recognize 2 varieties in *S. viridis*; all East TX material that we have seen falls into var. *viridis*. The following key to varieties is modified from Rominger (1962, 2003) and Yatskievych (1999). ⊘ ☜

1. Flowering culms (100–)150–250 cm long; leaf blades 15–40 cm long, 10–25 mm wide; inflorescences 8–20 cm long _____ var. *major*
1. Flowering culms to 100(–140) cm long; leaf blades 4–25 cm long, 3–10(–15) mm wide; inflorescences 3–10(–15) cm long _____ var. **viridis**

var. *major* (Gaudin) Peterm., (bigger, larger). Reported for TX (Kartesz 1999), but no definitive specimens seen; included here as note for clarification but not considered a member of the East TX flora; IL, MI, NJ, PA, TN, TX, and WI. Native of Europe. This is a robust form of the species. The longer inflorescences are reported to have a greater tendency to droop in their upper half (Yatskievych 1999). ☜

var. **viridis**. Widely scattered in TX; throughout most of Canada and the U.S. Native of Eurasia. A weed in crop fields; considered noxious in CO (Kartesz 1999). Rominger (1962) indicated that this is a cosmopolitan weed that is "undoubtedly an inhabitant of every province of Canada and state of the United States." ⊘ ☜

SORGHASTRUM Nash INDIAN GRASS

Coarse perennials; leaves mostly cauline; ligule a ciliate membrane; leaf blades flat, often conspicuously bluish green; inflorescence a long-exserted panicle, sometimes nodding; spikelets in pairs, one sessile and fertile, the other pedicelled and vestigial or absent (in ours reduced to only a hairy pedicel ca. as long as the fertile spikelet, the spikelet lacking); disarticulation so that associated pedicel and section of the inflorescence branch fall with sessile spikelet; terminal spikelet of a branch flanked by two pedicels; glumes subequal; fertile spikelet 2-flowered, the lower floret reduced or absent; lemma of the upper, fertile floret with a geniculate and twisted awn.

☙ A genus of 17 species (Dávila Aranda & Hatch 2003) of tropical and warm areas of the Americas and Africa, typically characterized by having the pedicellate spikelet reduced to a pedicel only. Like all members of the Andropogoneae, it is characterized by C_4 photosynthesis



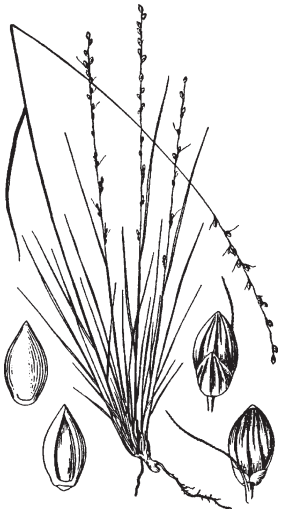
Setaria magna [USB]



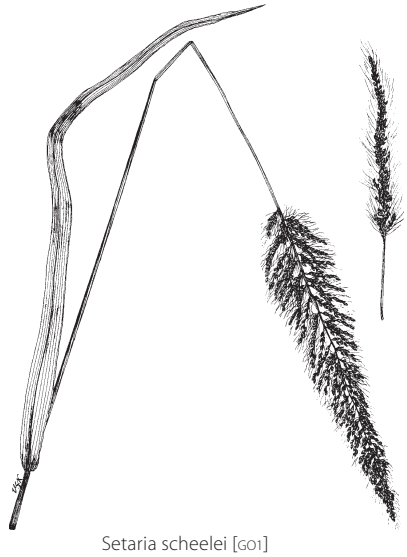
Setaria parviflora [HI1]



Setaria pumila [RCA]



Setaria reverchonii subsp. reverchonii [USB]



Setaria scheelei [GO1]



Setaria texana [GO1]



Setaria verticillata [MAS]



Setaria villosissima [HI1]



Setaria viridis var. viridis [RCA]

(Kellogg 2000a). It has sometimes been treated as a subgenus within *Sorghum* (e.g., Garber 1950). However, recent molecular evidence (Spangler et al. 1999) supports their separation. Some species are important pasture grasses. ☠ However, young plants represent a cyanide risk for grazing animals (the mechanism is similar to that seen in *Sorghum*), but "actual livestock losses are rare" (Burrows & Tyrl 2001). (Name from *Sorghum* and the Latin suffix *astrum*, 'a poor imitation of,' for its resemblance to the genus *Sorghum*—Dávila Aranda & Hatch 2003) (subfamily Panicoideae, tribe Andropogoneae)
REFERENCES: Garber 1950; Celarier 1958; Hall 1982; Dávila 1988, 1991; Spangler et al. 1999; Dávila Aranda & Hatch 2003.

1. Awns of lemmas mostly 23–40 mm long, usually twice-geniculate; spikelets at maturity usually dark brown; rhizomes not present ____ **S. elliottii**
1. Awns of lemmas usually 12–22 mm long, once-geniculate; spikelets at maturity light brown to straw-colored or yellowish; short scaly rhizomes present ____ **S. nutans**

Sorghastrum elliottii (C. Mohr) Nash, (for Stephen Elliott, 1771–1830, Carolinian botanist), SLENDER INDIAN GRASS, LONG-BRISTLE INDIAN GRASS. Plant not rhizomatous; culms usually 0.8–1.8 m tall; ligule 1–5 mm long; panicle narrow, looser than in *S. nutans*, sparsely-flowered, 15–30 cm long, dark colored; pedicels flexuous, often recurved; spikelets usually 5.5–7 mm long. Sandy wooded areas; widespread in East TX w to Dallas (*Reverchon*, 1876), Fannin (Talbot property) (BRIT), Bexar, and Hays (Turner et al. 2003) cos.; also n Gulf Prairies and Marshes; se U.S. from MD s to FL w to OK and TX. Sep–Nov.

Sorghastrum nutans (L.) Nash, (nodding), YELLOW INDIAN GRASS, INDIAN REED. **State grass of Oklahoma** (S. Barber, pers. comm.). Rhizomes short, scaly; culms erect, to 2.5 m tall; ligule 2–6 mm long; panicles loosely contracted, to 30 cm long, yellowish to yellowish-brown; spikelets usually 6–8 mm long. Prairies, savannahs, open woodlands; throughout TX; se Canada and throughout e 2/3 of the U.S. w to WY and AZ. Sep–Nov. [*S. avenaceum* (Michx.) Nash] This species was one of the dominants in the original tall grass prairie; it is considered one of the "big four" tall grasses along with *Andropogon gerardii, Panicum virgatum,* and *Schizachyrium scoparium*. It is an important forage grass and an indicator of good range conditions. INDIAN GRASS is recognizable in the field in vegetative condition by the bluish green foliage. The yellowish inflorescences can be quite showy in the fall, particularly in bright sunlight. The reproductive biology of this species was studied by McKone et al. (1998); it was found to be very unusual in allocating more resources to male reproduction (pollen production) than to female reproduction (seed production). ⚄/299

SORGHUM Moench SORGHUM

Robust annuals or perennials; culms erect; ligule a ciliate membrane; leaf blades flat; inflorescence an open or contracted panicle; spikelets in pairs, one sessile and fertile, the other pedicelled and staminate; disarticulation below sessile spikelets so that associated pedicel and section of inflorescence branch fall with spikelet, sometimes also disarticulating below pedicellate spikelets, or in cultivated taxa the spikelets not disarticulating or doing so tardily; sessile spikelet 2-flowered, the lower floret reduced to a lemma, the upper floret fertile, with lemma awned (awn twisted and geniculate) or awnless.

A mainly Old World genus of 25 species (Dillon et al. 2001; Barkworth 2003j) (Mexico, 1 species), including *S. bicolor*, SORGHUM, MILO, the world's fourth most important cereal after WHEAT, CORN, and RICE. This species, which is more tolerant of drought than most cereals, is of particular importance in Africa and Asia where it feeds millions of people (Heiser 1990). Some species (*S. ×almum, S. bicolor, S. halepense*) are considered significant weeds (Watson & Dallwitz 1992). Hybridization is common in the genus. Preliminary molecular evidence (Spangler et al. 1999,

2000) indicated that the genus *Sorghum*, as presently delimited, is paraphyletic, and that from the cladistic standpoint it should either be split into several separate genera or expanded to include the genera *Cleistachne*, *Miscanthus*, and a species of *Microstegium*. *Sorghum* is also related to *Saccharum* (PLUME GRASS, SUGARCANE), and hybrids between the two genera are known (Gupta et al. 1978; Clayton & Renvoize 1986). Other recent molecular research (Dillon et al. 2001) raises the possibility that *Saccharum officinarum* (SUGARCANE) is derived from within *Sorghum*. However, which circumscription approach is best is not yet clear, and until additional evidence is available, we are treating the genus in the traditional sense. Like all members of the Andropogoneae, *Sorghum* is characterized by C_4 photosynthesis (Kellogg 2000a). ☠ Some *Sorghum* species, under certain conditions, can be fatally poisonous to livestock due to the presence of a cyanogenic glycoside (dhurrin) which is broken down to form hydrogen cyanide (HCN); toxic levels of nitrates and tannins can also be present (Sperry et al. 1955; Weathers 1998; Burrows & Tyrl 2001). (Derivation unclear, possibly from *sorgho*, the Italian name of the plant, or perhaps from Latin *syricus*, Syria, and *granum*, grain, the presumed place of origin of *S. halepense*) (subfamily Panicoideae, tribe Andropogoneae)

REFERENCES: Snowden 1936; Snowden 1955; Celarier 1958; de Wet & Harlan 1971; de Wet 1978; Duvall & Doebley 1990; Spangler et al. 1999; Yatskievych 1999; Spangler 2000; Dillon et al. 2001; Barkworth 2003j.

1. Plants perennial, with rhizomes, often forming colonies; leaf blades usually 8–15(–40) mm wide; spikelets disarticulating at maturity; inflorescences open _____ **S. halepense**
1. Plants annual, without rhizomes, tufted or with a single culm; leaf blades 8–60(–100) mm wide; spikelets not disarticulating OR doing so tardily; inflorescences dense to open _____ **S. bicolor**

Sorghum bicolor (L.) Moench, (two-colored). Large succulent annual ca. 0.8–2.5+ m tall; leaf blades 8–60(–100) mm wide; inflorescences variable; sessile spikelets 3.5–5.5(–9) mm long. Turner et al. (2003) mapped this species (without distinguishing infraspecific taxa) as widely scattered in TX. Summer–fall. Native of Africa. This species has a confusing diversity of cultivars (Yatskievych 1999) which can be grouped into three subspecies (de Wet 1978), two of which are transitory escapes in TX. Hybridization is common between the different subspecies and cultivars of *S. bicolor* (de Wet 1978), and clear assignment of all individuals to a subspecies should not be expected; the county distribution map does not distinguish subspecies. The domesticated and hybrid forms (subsp. *bicolor* and subsp. ×*drummondii*) are thought to have originated directly or indirectly (via hybridization) from the wild African *S. bicolor* subsp. *arundinaceum* (Desv.) de Wet & J.R. Harlan. Plants can be poisonous in a manner similar to *S. halepense* (Hardin & Brownie 1993). The following key is modified from Yatskievych (1999). ☠ ⊘ ☜

1. Panicles usually compact and dense, not breaking into joints at maturity; spikelets usually open at maturity, exposing the fruit; lemma of fertile floret often awnless; leaf blades relatively broad, 20–60(–100) mm wide _____ subsp. **bicolor**
1. Panicles relatively more open, breaking tardily into joints at maturity; spikelets usually ± closed at maturity, the fruit thus not exposed; lemma of fertile floret usually with a geniculate twisted awn; leaf blades relatively narrow, 8–25 mm wide _____ subsp. ×**drummondii**

subsp. **bicolor**, SORGHUM, GRAIN SORGHUM, MILO, SORGO, KAFIR, HEGARI, BROOM-CORN, GUINEA-CORN, KAOLANG, KAFIR-CORN, DURRA, FETERITA, SORGHO. Lemma of fertile floret often awnless, but sometimes an awn can be present. Widely cultivated in TX; found as a transitory escape along roadsides, railroads, and field margins; Grayson, Titus, Travis, Van Zandt (BRIT), Brazos, and Harris (TAES) cos.; se Canada and nearly throughout the U.S. [*S. vulgare* Pers.] SORGHUM is thought to have been brought into cultivation in Africa in the region of Sudan and Nigeria, before 3,000 BC. It is cultivated for its grain and the sweet sap from the pith (sorghum syrup, sorgho, sorghum molasses). It is also used as a flavoring for beer, broom material (from the inflorescence branches), and silage, and as a forage and fodder plant. This species is a staple in

Africa, India, and China; it thrives under drier conditions than appropriate for corn. It was introduced into the New World in the early 16th century (Clark & Stemler 1975; de Wet 1978; Mabberley 1987; Yatskievych 1999; Barkworth 2003j). The common name KAFIR is derived from the Arabic word for unbeliever, in reference to the Bantu (of Africa) who grew the plant (de Wet 1978). The common name DURRA is derived from the Arabic name for SORGHUM (de Wet 1978). This taxon is considered a noxious weed in IA, IN, and OH (Kartesz 1999).

subsp. ×**drummondii** (Nees) de Wet, (for its discoverer, Thomas Drummond, 1780–1835, Scottish botanist and collector in North America). SUDAN GRASS, SHATTER CANE, CHICKEN CORN. Lemma of fertile floret usually awned, the awn ca. 10 mm long. A weed in SORGHUM fields, also cultivated for hay and forage and possibly escaping; included based on citation for the Post Oak Savannah and Blackland Prairie by Hatch (2002); also cited for Cross Timbers and Prairies by Hignight et al. (1988) and for Gulf Prairies and Marshes, South TX Plains, and Edwards Plateau by Hatch (2002); se Canada and widely scattered in the U.S. [*Andropogon drummondii* Nees, *S. bicolor* var. *drummondii* (Nees) Mohlenbr., *S. drummondii* (Nees) Millsp. & Chase, *S. sudanese* (Piper) Stapf, *S. vulgare* Pers. var. *drummondii* (Nees) Hack. ex Chiov.] We are following Barkworth (2003j) in treating this taxon as *S. bicolor* subsp. ×*drummondii* [*S. bicolor* subsp. *arundinaceum* × *S. bicolor* subsp. *bicolor*]. Treated as such, this subspecies represents all hybrids and backcrosses between the wild progenitor (*S. bicolor* subsp. *arundinaceum*) and the domesticated *S. bicolor* subsp. *bicolor* (Barkworth 2003j). While SUDAN GRASS is valuable as forage, because of cyanide production at certain stages, caution is advised. This subspecies is considered a noxious weed in IA, IN, and PA (Kartesz 1999).

Sorghum halepense (L.) Pers., (of Aleppo or Haleb, a city in n Syria), JOHNSON GRASS. Coarse perennial 25–200 cm tall with extensive rhizomes; leaf sheaths glabrous; leaf blades usually 8–15(–40) mm wide, mostly glabrous, often with discolored (purplish or brownish) areas, presumably due to a fungal infection by organisms such as the rust *Puccinia purpurea* Cooke (a number of different fungi are known to cause foliar diseases in *Sorghum*—J. Hennen, pers. comm.); ligule a membrane with fringe of hairs; panicles varying from narrow and dense to loose and open, yellow-brown or red-brown to purple-brown; sessile spikelets usually 4.5–5.5(–6.5) mm long, 1.5–2.3 mm wide; lemma of fertile floret awnless or with an often early deciduous awn ca. 10–15 mm long; pedicellate spikelets disarticulating cleanly at the nodes; caryopses 2–3 mm long. Fields, roadsides, disturbed areas; throughout TX; se Canada (Ont.) and nearly throughout the U.S. May–Nov. Native of s Eurasia e to India (de Wet 1978). It first appeared in southern U.S. states prior to 1840 (Tellman 1997) and was introduced into TX in the 1880s; it is now one of the most abundant grasses in East TX and a pernicious invader of native habitats, spreading by seeds or by pieces of the whitish rhizomes. *Sorghum halepense* is an important weed of a number of crops and is thought by some sources to be among the world's worst weeds (Holm et al. 1977); it is considered noxious in many states including OK (Kartesz 1999). While normally edible, this species can be poisonous to livestock, particularly after rains and in new growth (Hilsenbeck in Powell 1994). It was previously thought that stressful conditions such as dry weather, wilting, a frost, or period of high temperatures would stimulate production of the poison. However, Hilsenbeck's work (cited in Powell 1994) seems to dispute this. The poisonous principle is dhurrin, a cyanogenic glycoside which is enzymatically converted to hydrogen cyanide; grazing animals can be killed in as little as 15 minutes. JOHNSON GRASS is also known to cause "Sorghum cystitis" (incoordination, urinary incontinence, death—specific cause unknown) and nitrate intoxication (due to accumulation of nitrates in the plant; often fatal) (Pammel 1911; Burlage 1968; Hardin & Brownie 1993; Powell 1994; Burrows & Tyrl 2001; Hart et al. 2001). According to Burrows and Tyrl (2001), nitrate intoxication "is one of the most serious intoxication problems for the cattle industry in North America ..." Weedy individuals, known from nearly all warm temperate regions, are somewhat different from those found in native habitats of the Old World (de Wet 1978; Yatskievych 1999). De Wet (1978) suggested that in "the

Americas it [*S. halepense*] has introgressed with grain sorghum to produce the widely distributed Johnson grass." Thus, JOHNSON GRASS is "probably a stabilized hybrid resulting from past crosses between true *S. halepense* and cultivated *S. bicolor*" (Yatskievych 1999). Barkworth (2003j) noted that *S. halepense* readily hybridizes with *S. bicolor* and that derivatives of such hybrids are widespread. She considered *S.* ×*almum* Parodi (COLUMBUS GRASS, SORGHUM GRASS) to be one such derivative. It has wider (2–2.8 mm) sessile spikelets with more veins in the lower glumes (13–15 versus 10–13) than *S. halepense*; *S.* ×*almum* is not known from East TX. ☠ ⊘ ☜

SPARTINA Schreb. CORD GRASS, MARSH GRASS, SLOUGH GRASS

Coarse perennials, rhizomatous or non-rhizomatous; culms erect, unbranched; ligule a fringe of hairs; leaf blades often involute, particularly upon drying; inflorescence a panicle of spike-like, appressed or slightly spreading branches; spikelets 1-flowered, strongly laterally compressed, closely spaced, sessile; disarticulation below glumes; glumes unequal, keeled; palea as long as or longer than the lemma.

☁ A C_4 genus of 17–19 species of moist to wet, usually saline habitats (Barkworth 2003f), primarily of coastal America, Europe, and n Africa but sometimes in the interior; there is little morphological variation in the genus and the taxa are often difficult to distinguish (Clayton & Renvoize 1986). Preliminary molecular analyses (Hilu & Alice 2001) suggest a possible relationship between *Spartina*, *Zoysia*, and some species of both *Eragrostis* and *Sporobolus*. *Spartina* species are typically halophytic (= tolerant of salty or alkaline conditions), with one adaptation being the presence of salt-secreting hydathodes (salt glands) in the leaf epidermis (Levering & Thomson 1971; Oross & Thomson 1982; Clayton & Renvoize 1986). ⊘ Some species have the tendency to spread and are considered noxious weeds in NC and OR (Kartesz 1999). Two species, *S. alterniflora* Loisel. and *S. densiflora* Brongn. (the former native to the e U.S., the latter to South America), have become established on the n Pacific Coast of the U.S. and "now threaten the health of many coastal marshes and mud flats" (Barkworth 2003f). (Greek: *spartine*, a cord, made from *Spartium junceum*, probably applied to *Spartina* because of the tough leaves—Barkworth 2003f) (subfamily Chloridoideae, tribe Cynodonteae)
REFERENCES: Mobberley 1956; Barkworth 2003f.

1. Plants from widely spreading rhizomes 3–8 mm thick; inflorescence branches relatively long, 4–15 cm long; spikelets usually 10–25 mm long including conspicuous awns; upper (longest) glume with keel conspicuously (using hand lens) pectinate with erect, bristle-like hairs 0.2–0.4 mm long; lemma much shorter than upper glume; leaf blades 5–15 mm wide, flat when fresh _____ **S. pectinata**
1. Plants essentially without rhizomes; inflorescence branches relatively short, usually 1.5–4 cm long; spikelets 5–8(–10) mm long, awnless or with inconspicuous awns; upper glume with keel minutely scabrous or hispid, the hairs inconspicuous and < 0.2 mm long; lemma ca. as long as upper glume; leaf blades 1.5–4.5 mm wide, involute when fresh _____ **S. spartinae**

Spartina pectinata Link, (comb-like), PRAIRIE CORD GRASS, FRESHWATER CORD GRASS, TALL MARSH GRASS, SLOUGH GRASS. Rhizomatous perennial 1.5–2.5 m tall; ligule 1–3 mm long; inflorescence branches 5–50, appressed to slightly spreading; spikelets 10–25 mm long including scabrous awns of the glumes; anthers 4–6 mm long. Low moist areas, swales, fresh or brackish water; Grayson (Hagerman Natl. Wildlife Refuge), Fannin, Upshur, Van Zandt (Grand Saline) (BRIT), Harris (SBSC), Brazos, Gonzales, Gregg, Hopkins, Lamar (Turner et al. 2003), and Rockwall (Wallace Prairie, Mahler 1988) cos.; widely scattered in TX; s Canada and nearly throughout the U.S. except far se and far sw. Aug–Oct. Steyermark (1963) pointed out that the leaf margins of this species are razor-sharp and able to easily cut the skin. Other *Spartina* species are important salt marsh grasses; this is the only TX species that occurs widely inland.

Spartina spartinae (Trin.) Merr. ex Hitchc., (of or like *Spartina*, the species having been originally named in the genus *Vilfa*), GULF CORD GRASS, COASTAL SACAHUISTA, SACAHUISTA GRASS.

Non-rhizomatous perennial usually 0.6–1(–2) m tall; ligule 1–2 mm long; inflorescence branches usually 15–75, tightly appressed; spikelets 5–8(–10) mm long, awnless or with inconspicuous awns. Marshes, wet prairies, coastal flats; Harris, Jefferson (BRIT), Brazos, and Gonzales (Turner et al. 2003) cos.; mainly Gulf Prairies and Marshes, known from a few locations further w; AL, FL, LA, MS, and TX. Spring–summer. [*Vilfa spartinae* Trin.] Near the coast this species can be a vegetational dominant, sometimes excluding other species. Extensive meadows (thousands of hectares) of GULF CORD GRASS occur in coastal salt flats and inundated areas slightly inland (Gould 1975a; Hatch et al. 1999). According to Correll and Johnston (1970), "The young shoots emerging after fires are good forage but the older shoots are much too tough even for horses. Formerly vast acreages of sacahuista were therefore burned over purposely in the ranches of southern Texas; the practice is less common now."

SPHENOPHOLIS Scribn. WEDGE GRASS, WEDGESCALE

Annuals or short-lived perennials without rhizomes; ligule membranous, uneven apically; inflorescence a dense to open panicle; spikelets with (1–)2–3 florets, the third (uppermost) sometimes reduced and sterile; disarticulation below glumes (distal floret sometimes disarticulating beforehand); glumes conspicuously dimorphic, the upper (second) glume longer, wider, and obovate, broadly acute to rounded apically; lemmas obtuse to acute, usually awnless or with a minute awn (however, a species of the e U.S. has conspicuous awns); stamens 3.

A C_3 genus of 4–6 species (Tucker 1996; Daniel ined.) ranging from Canada to Mexico, with the greatest diversity in the se U.S. The genus is thought to be closely related to *Koeleria* and *Trisetum* (Tucker 1996). Jones et al. (1997) and Hatch (2002) treated *Trisetum interruptum* in the genus *Sphenopholis* as *S. interrupta* (Buckley) Scribn. (Greek: *sphen*, a wedge, and *pholis*, scale, referring to the shape of the broadly obovate or nearly cuneate upper glume) (subfamily Pooideae, tribe Poeae)

REFERENCES: Lamson-Scribner 1906; Erdman 1965; Tucker 1996; Yatskievych 1999; Daniel ined.

1. Lower (= first) glume conspicuously narrow, < 1/3 as wide as upper glume; lemma of second floret glabrous to scaberulous (primarily on keel, sometimes sparsely so on back); inflorescence dense to open, often ± spike-like.
   2. Lower leaf blades relatively short and broad, usually less than 15(–20) cm long (often much less), 2–8 mm wide, flat ____ **S. obtusata**
   2. Lower leaf blades very long and narrow, usually 15–45 cm long, filiform, 0.3–2 mm wide, the margins strongly involute ____ **S. filiformis**
1. Lower glume 1/3–2/3 as wide as upper glume; lemma of second floret strongly scabrous on keel and on back (use strong hand lens or dissecting scope); inflorescence open, loosely-flowered, not densely spike-like ____ **S. nitida**

Sphenopholis filiformis (Chapm.) Scribn., (thread-like), LONG-LEAF WEDGESCALE. Perennial (20–)35–75(–100) cm tall; culms tufted; ligule 0.5–1.2 mm long; lower leaf blades very long and narrow, to 45 cm long, 0.3–2 mm wide, strongly involute; inflorescence narrow, ca. 1.5 cm or less wide; spikelets 2.5–4 mm long, usually awnless; lemma of second floret glabrous or scaberulous. Roadsides, meadows, pine and pine-hardwood forests, forest margins, and openings, on sandy soils; Angelina, Jasper, Newton (BRIT), Shelby (TAES), Tyler (Erdman 1965), Hardin, Polk, and Sabine (Turner et al. 2003) cos. in the s part of the Pineywoods; also n Gulf Prairies and Marshes; se U.S. from VA s to FL w to OK and TX. Mar–May.

Sphenopholis nitida (Biehler) Scribn., (shining), SHINY WEDGESCALE, SHINING WEDGESCALE, SHINING WEDGE GRASS. Perennial (or apparently sometimes annual) 30–70(–80) cm tall; culms tufted; ligule 1–2 mm long; leaf blades 15 cm or less long, 2–6 mm wide; inflorescence open (ca. 1–8 cm wide), not spike-like; spikelets 2.5–4 mm long, usually awnless; lower glume 0.2–0.5



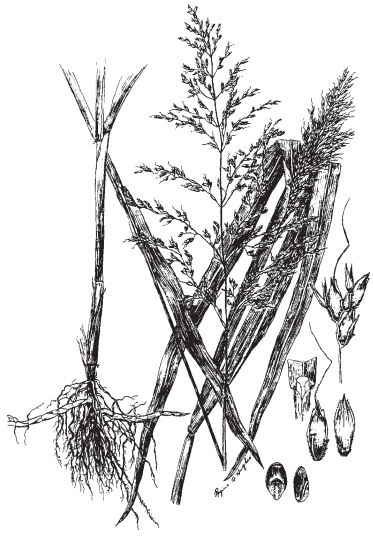
Sorghastrum elliottii [HI1]



Sorghastrum nutans [HI1, RCA]



Sorghum bicolor subsp. ×drummondii [USD]



Sorghum halepense [RCA]



Spartina pectinata [HI1]



Spartina spartinae [GO1]



Sphenopholis filiformis [HI1]



Sphenopholis nitida [HI1]

mm wide from keel to margin (as folded), wider than in other species; lemma of second floret strongly scabrous. Dense forests, forest openings; ne part of the Pineywoods; also reported from the Edwards Plateau (Erdman 1965); se Canada (Ont.) and e U.S. from VT s to FL w to MI, MO, and TX. Mar–May. This species is similar to *S. obtusata* but differs as in the key above and in having longer anthers (1.2–2 mm long versus 0.3–0.8 mm long in *S. obtusata*) (Yatskievych 1999).

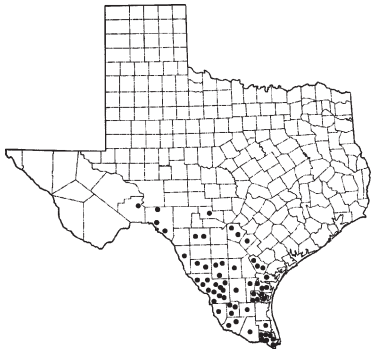
Sphenopholis obtusata (Michx.) Scribn., (obtuse, blunt), PRAIRIE WEDGESCALE, WEDGE GRASS. Annual (in TX) 15–100(–120) cm tall; culms single or tufted; ligule 1–3 mm long, glabrous or ciliate; leaf blades to 15(–20) cm long, 2–8 mm wide; inflorescence dense and spike-like or open, the axis glabrous or minutely scabrous; spikelets 1.5–5 mm long, awnless; apex of upper glume conspicuously obovate; lemmas glabrous to scaberulous. Widespread in TX; the map in Turner et al. (2003) and the one presented here do not separate the varieties found in TX.

1. Inflorescences open (relatively), at least the lowest branches loosely ascending to spreading; upper glume (larger of the 2 glumes) 3–6 times longer than wide (when viewed from the side—width from keel to margin—not unfolded), apically blunt to acute _____ var. **major**
1. Inflorescence dense, spike-like, almost all the branches appressed to ascending; upper glume 2–3 times longer than wide (when viewed from the side—from keel to margin—not unfolded), apically rounded _____ var. **obtusata**

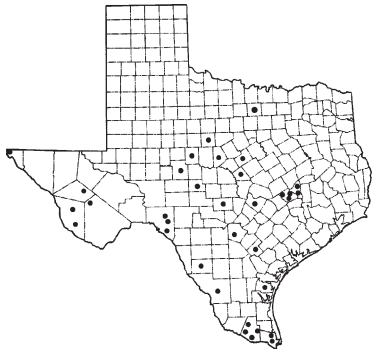
var. **major** (Torr.) Erdman, (greater, larger), SLENDER WEDGESCALE. Inflorescence relatively open. Prairies, woodlands, moist bottomland forests, typically in more shaded sites than var. *obtusata*; Angelina, Upshur (BRIT), Brazos, Grimes, Harris, Liberty, Polk, Smith (TAES), and Anderson (Erdman 1965) cos.; also Gulf Prairies and Marshes and Edwards Plateau (Gould 1975b; Hatch 2002); this variety is much less common in East TX than var. *obtusata*; AR, LA, and TX. Apr–May. [*S. intermedia* (Rydb.) Rydb., *S. intermedia* var. *pilosa* Dore, *S. longiflora* (Vasey) Hitchc.] This taxon has sometimes been treated as a distinct species, *S. intermedia* (SLENDER WEDGESCALE) (e.g., Hitchcock 1935, 1951; Allen 1992; Kartesz 1999). However, Erdman's (1965) detailed study documented numerous intermediates between this and *S. obtusata* var. *obtusata*. Such intermediates are "scattered throughout the United States but are most plentiful in the Southeast" (Tucker 1996). Some authors (e.g., Hitchcock 1935, 1951; Allen 1992; Kartesz 1999; Daniel ined.) have also recognized forms of var. *major* with large spikelets as *S. longiflora* (TEXAS WEDGESCALE), but according to Erdman (1965), "Although '*S. longiflora*' of Texas has the largest spikelets, there are numerous large-spikelet forms of *S. obtusata* var. *major* in all parts of its range which intergrade completely with '*S. longiflora*.' ... Obviously '*S. longiflora*' cannot be separated on the basis of size from *S. obtusata* var. *major* and I am considering it as an extreme form of that variety." We are therefore following Erdman (1965), Tucker (1996), Yatskievych (1999), and Hatch (2002) in treating these plants as *S. obtusata* var. *major*. According to Daniel (ined.), this taxon "is frequently confused with *Koeleria macrantha*, but *K. macrantha* has a dense, spike-like panicle, spikelets that disarticulate above the glumes, and glumes subequal but similar in shape, with the lower glumes not less than the width of the upper glumes."

var. **obtusata**, PRAIRIE WEDGESCALE, WEDGE GRASS. Inflorescence dense, spike-like; similar in aspect to *Koeleria macrantha* but with upper glume much more obovate and more blunt at apex. Prairies, low, open or partly shaded ground, clayey or sandy soils, typically in more open sites than var. *major*; throughout most of TX; s Canada and throughout the U.S. Apr–Jun. [*Aira obtusata* Michx.]

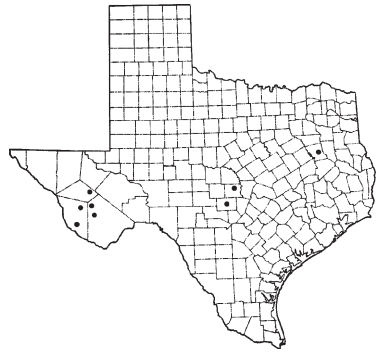
Sphenopholis pensylvanica (L.) Hitchc., (of Pennsylvania, but note different spelling), SWAMP WEDGESCALE, SWAMP-OATS, the only other species of this small genus, occurs in the e U.S. as far w as LA; it is not known from TX. This species can be distinguished by its large spikelets (ca. 5–9.5 mm long) and lemmas with geniculate awns nearly as long as the lemma bodies. It has been shown to hybridize with *S. obtusata* (Terrell 1963; Erdman 1965). [*Trisetum pensylvanicum* (L.) P. Beauv. ex Roem. & Schult.]



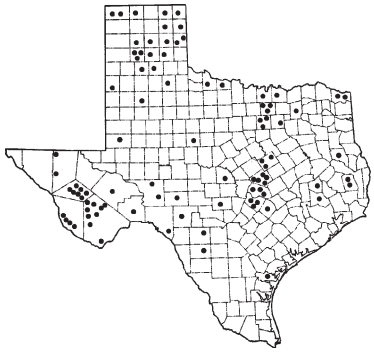
Setaria texana



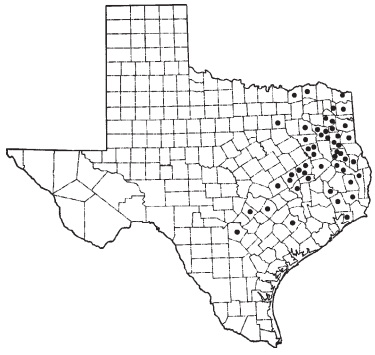
Setaria verticillata



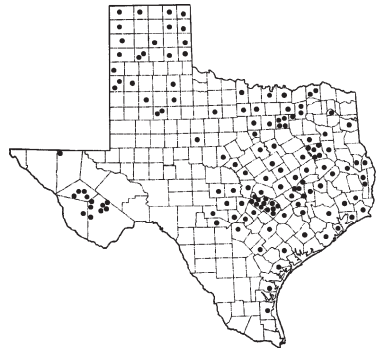
Setaria villosissima



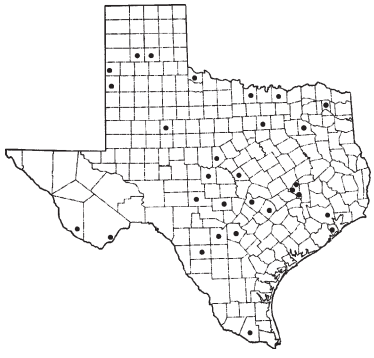
Setaria viridis



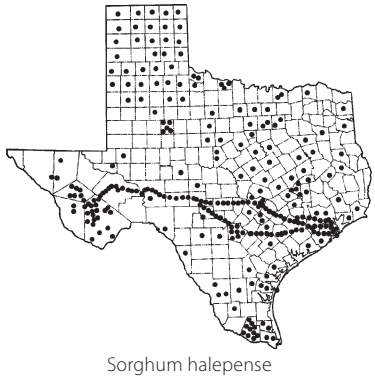
Sorghastrum elliottii



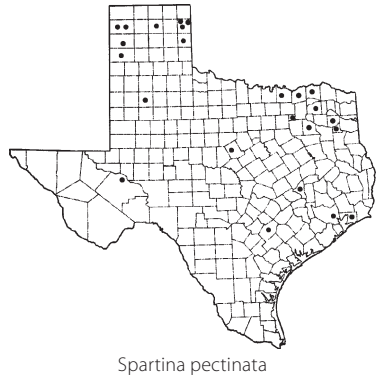
Sorghastrum nutans



Sorghum bicolor
(both subsp.)



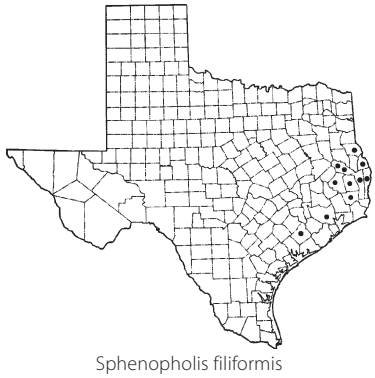
Sorghum halepense



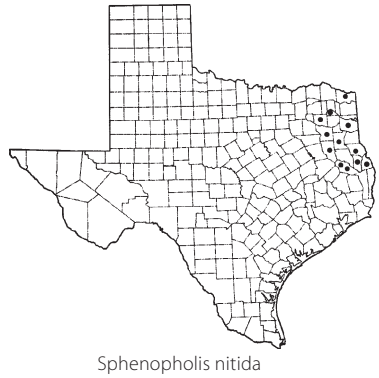
Spartina pectinata



Spartina spartinae



Sphenopholis filiformis



Sphenopholis nitida

SPOROBOLUS R. Br. DROPSEED

Annuals or perennials; ligule minute, largely a ciliate fringe on vestigial membranous base; inflorescence a contracted spike-like or open panicle, often partly included within a leaf sheath; spikelets 1-flowered, awnless; disarticulation above glumes; glumes usually unequal, shorter than or equaling the lemma, 1-veined; lemma usually 1-veined (faintly 3-veined in *S. ozarkanus* and *S. vaginiflorus*); fruit usually falling free from lemma and palea; seed coat not fused to the pericarp (therefore not a true caryopsis—Brandenburg (2003) refers to the fruit as a "modified caryopsis"); pericarp becoming mucilaginous when moist in most species (Peterson et al. 2003); stamens 3.

A taxonomically problematic C_4 genus of more than 160 species that grow in tropical, subtropical, and warm-temperate regions throughout the world (Peterson et al. 2003). The genus has been thought to be related to *Eragrostis* (Clayton & Renvoize 1986), but recent molecular data indicate a closer relationship to *Muhlenbergia* (Hilu & Alice 2000). However, molecular data (Ortiz-Diaz & Culham 2000) also indicate that the genus is monophyletic if circumscription is expanded to include four related species (including two previously placed in *Eragrostis*). The spikelets are similar to those of *Muhlenbergia* species, though *Muhlenbergia* spikelets have the lemma 3(–5)-veined and usually awned (Hatch et al. 1999). Some have edible grains, a number of species are important native pasture grasses, and some are considered significant weeds (Watson & Dallwitz 1992). Some species have part of their inflorescences permanently enclosed within leaf sheaths; these species "tend to reproduce cleistogamously, that is, pollen cannot be dispersed and obligately pollinates the same floret" (Yatskievych 1999). The common name DROPSEED refers to the grain usually falling free from the lemma and palea. Mucilage from the pericarps is thought to be transferred to the seeds, thus allowing them to stick to various animals and be dispersed (Davidse 1986; Brandenburg 2003). (Greek: *sporos*, seed, and *bolos*, a throw, referring to the free seeds, which are sometimes forcibly ejected when the mucilaginous pericarp dries—Peterson et al. 2003) (subfamily Chloridoideae, tribe Cynodonteae)
REFERENCES: Clayton 1965; Riggins 1977; Brown 1993; Wipff & Jones 1995; Peterson et al. 1997, 2003; Weakley & Peterson 1998; Hilu & Alice 2000; Ortiz-Diaz & Culham 2000; Brandenburg 2003.

1. Inflorescences contracted, very narrow, 2.2 cm or less wide (often much less), the branches appressed; plants annual or perennial.
   2. Plants annual; inflorescences usually 1–5 cm long.
      3. Glumes as long as or longer than floret; lemma 3-veined (midvein more conspicuous); lower leaf sheaths papillose-pilose _____ **S. ozarkanus**
      3. Glumes shorter than floret; lemma 1-veined, rarely 3-veined; lower leaf sheaths often glabrous, usually not papillose-pilose.
         4. Lemma and palea glabrous; spikelets (1.3–)1.6–2.8 mm long; species known in East TX only from w margin of area _____ **S. neglectus**
         4. Lemma and palea appressed-pubescent (use hand lens or dissecting scope); spikelets usually 3–5(–6) mm long; species widespread in East TX _____ **S. vaginiflorus**
   2. Plants perennial; inflorescences usually 5–40 cm long.
      5. Spikelets 1.4–2(–2.6) mm long; inflorescences mostly exserted from leaf sheaths; lower glume 1 mm or less long _____ **S. indicus**
      5. Spikelets 3–7.5 mm long; inflorescences at least partly included within leaf sheaths OR not so; lower glume 0.9–4 mm long.
         6. Panicle branches in distinct whorls (3 or 5 branches at lower nodes); lemma ± equal in length to upper glume; inflorescences mostly exserted from leaf sheaths; species known in East TX only from Bexar Co. at extreme sw corner of area _____ **S. purpurascens**
         6. Panicle branches not in distinct whorls (usually 1–2 branches per node); lemma usually longer than upper glume; inflorescences at least partly included within leaf sheaths; species widespread in East TX.

7. Lemma appressed-pubescent (use hand lens or dissecting scope); inflorescences 5–11(–15) cm long; pericarp not gelatinous when wet; fruits (1.5–)2.4–3.5 mm long ____ **S. clandestinus**
7. Lemma glabrous; inflorescences 5–30 cm long; pericarp gelatinous when wet; fruits 1–2 mm long ____ **S. compositus**

1. Inflorescences open, relatively much wider, usually 3–25 cm wide, the branches ascending OR widely spreading; plants usually perennial.
8. Pedicels 3–8(–14) mm long; spikelets (4–)4.5–7(–7.2) mm long; lemma 4.4 mm or more long; anthers 3–5 mm long ____ **S. silveanus**
8. Pedicels 0.2–2.5 mm long; spikelets 1.3–3.8 mm long; lemma 3.6 mm or less long; anthers 2 mm or less long.
9. Spikelets 3–3.8 mm long; inflorescence branches whorled ____ **S. junceus**
9. Spikelets 1.3–2.5(–2.8) mm long; inflorescence branches whorled (*S. pyramidatus*) OR not whorled (*S. cryptandrus* and *S. airoides*).
10. Inflorescences 3–15(–18) cm long, the lower branches visibly whorled (usually with 7–12+ branches per node), the inflorescences usually exserted beyond the uppermost leaf sheath; culms 10–35(–60) cm tall; anthers 0.2–0.4 mm long ____ **S. pyramidatus**
10. Inflorescences (12–)15–45 cm long, the lower branches not visibly whorled, the inflorescences partially included within and hidden by the uppermost leaf sheath OR exserted; culms 35–150 cm tall; anthers 0.5–1.8 mm long.
11. Inflorescences at maturity 2–8(–15) cm wide; summit of leaf sheath bearing tufts of long whitish hairs (ca. 2–4 mm long) and often ciliate on upper sheath margins; anthers 0.5–1 mm long; species widespread in East TX ____ **S. cryptandrus**
11. Inflorescences at maturity usually 15–25 cm wide; summit of leaf sheath lacking tufts of hairs or with a few hairs on the sides, otherwise glabrous; anthers 1.1–1.8 mm long; species rare in East TX, mainly in s part of the area ____ **S. airoides**

Sporobolus airoides (Torr.) Torr., (presumably for a resemblance to *Aira*—hair grass), ALKALI SACATON, FINE-TOP SALT GRASS. Perennial; culms (35–)50–150 cm tall; panicles open, diffuse, (12–)25–45 cm long, partially included within uppermost leaf sheath or exserted, variable, but the spikelets sometimes so widely spaced that they do not touch each other; spikelets 1.3–2.5(–2.8) mm long; glumes very unequal. Open sandy or gravelly areas, saline or alkaline flats; Harris (BRIT), Brazos, Montgomery, and Wood (Turner et al. 2003) cos.; widely scattered mainly in s and w TX; sw Canada (B.C.) and widespread in w 1/2 of the U.S. Jun–Nov. [*Agrostis airoides* Torr.] This species was described as often very abundant in the Trans-Pecos and Plains Country (Correll & Johnston 1970). It has sometimes been planted in areas where the soils are too salty for most other grasses (Yatskievych 1999).

Sporobolus clandestinus (Biehler) Hitchc., (concealed), HIDDEN DROPSEED, PURPLE-FLOWER DROPSEED, ROUGH DROPSEED. Perennial, usually without rhizomes; culms 40–100(–150) cm tall; leaf sheaths sparsely hairy apically, but without tufts of hairs; panicles 5–11(–15) cm long, at least partly included within leaf sheaths; spikelets (4–)5–7(–9) mm long; lemma longer than glumes. Grasslands, conifer-hardwood forests, oak woodlands, dry areas, fencerows, disturbed sites, often in sandy soils, but also in limestone derived soils; widespread in e 1/2 of TX; e U.S. from NH s to FL w to SD and TX. Aug–Oct. [*S. asper* (Michx.) Kunth var. *clandestinus* (Biehler) Shinners, *S. compositus* (Poir.) Merr. var. *clandestinus* (Biehler) Wipff & S.D. Jones] Wipff and Jones (1995) argued that this species differs morphologically from *S. compositus* var. *compositus* in only minor ways and thus should be recognized at the varietal level. However, there seems to be a number of characters (e.g., fruit length) differentiating it from *S. compositus*, and while the most appropriate taxonomic level at which to treat this taxon is not completely clear, we are following Peterson et al. (2003) in recognizing it as a distinct species. Further research is needed to definitively determine its status.

Sporobolus compositus (Poir.) Merr., (compound), HEAD-LIKE DROPSEED, ROUGH DROPSEED, FLAG GRASS. Perennial; culms (20–)60–120(–150) cm tall; panicle 5–30 cm long, at least partly included within leaf sheaths (cleistogamous spikelets often present in axillary panicles); spikelets 4–7.5(–10) mm long. [*S. asper* (Michx.) Kunth] This species long went under the name *S. asper*, but because of nomenclatural considerations, *S. compositus* is the appropriate binomial (Kartesz & Gandhi 1995). The map in Turner et al. (2003) and the one presented here do not separate varieties. According to Peterson et al. (2003), "The *Sporobolus compositus* complex is a difficult assemblage of forms, perhaps affected by their primarily autogamous breeding system." *Sporobolus clandestinus* is sometimes recognized as a variety of this species (e.g., Wipff & Jones 1995); see that species for discussion. However, we are following some recent authors (e.g., Peterson et al. 2003) in recognizing only three varieties in S. *compositus*.

1. Plants with evident short, creeping, scaly rhizomes _____ var. **macer**
1. Plants without creeping, scaly rhizomes.
   2. Terminal leaf sheaths 0.8–2(–2.5) mm wide when folded naturally (do not spread out to measure); culms slender, 1–2(–2.5) mm wide near base; primary inflorescence branches 8–18, not crowded _____ var. **drummondii**
   2. Terminal leaf sheaths (1.3–)1.5–6 mm wide when folded; culms stout, (1.4–)2–5 mm wide near base; primary inflorescence branches 12–35, crowded _____ var. **compositus**

var. **compositus**, TALL DROPSEED, LONG-LEAF RUSH GRASS, ROUGH RUSH GRASS. Cespitose, without rhizomes. Grasslands, disturbed sites; widespread in e 2/3 of TX; s Canada and widespread in the U.S., particularly the e 2/3. Sep–Nov.

var. **drummondii** (Trin.) Kartesz & Gandhi, (for its discoverer, Thomas Drummond, 1780–1835, Scottish botanist and collector in North America), MEADOW DROPSEED. Cespitose, without rhizomes. Grasslands, disturbed sites; widespread in e 1/2 of TX; sc U.S. from KY and GA w to IA and TX. Aug–Nov. [*S. asper* (Michx.) Kunth var. *drummondii* (Trin.) Vasey, *S. drummondii* (Trin.) Vasey] Jones et al. (1997) included this variety in var. *compositus*.

var. **macer** (Trin.) Kartesz & Gandhi, (thin, meager), MISSISSIPPI DROPSEED. Similar to var. *drummondii*, but rhizomatous; culms slender, 2(–2.5) mm or less wide; terminal leaf sheath 2.5 mm or less wide when folded. Open woods, margins of woods; Gregg, Titus (BRIT), Anderson, Bastrop, Brazos, Burleson, Camp, Jasper, and Robertson (TAES—annotated by S. Hatch) cos.; sc U.S. from MO and MS w to KS and TX. Aug–Nov. [*S. asper* (Michx.) Kunth var. *macer* (Trin.) Shinners, *S. macer* (Trin.) Hitchc.]

Sporobolus cryptandrus (Torr.) A. Gray, (with hidden flowers), SAND DROPSEED, COVERED-SPIKE DROPSEED. Perennial; culms 25–100(–120) cm tall; summit of sheaths with tufts of long white hairs 2–4 mm long; panicles 15–30(–40) cm long, 2–8(–15) cm wide, usually partially enclosed by the subtending sheaths; spikelets 1.5–2.3(–2.8) mm long; lemma ca. as long as or slightly longer than the upper glume. Grasslands, disturbed sites, sandy soils; throughout TX except Pineywoods; s Canada and throughout most of the U.S. May–Nov. The grains were consumed by Native Americans (Mabberley 1987); they were apparently ground into a flour and then baked (Yatskievych 1999).

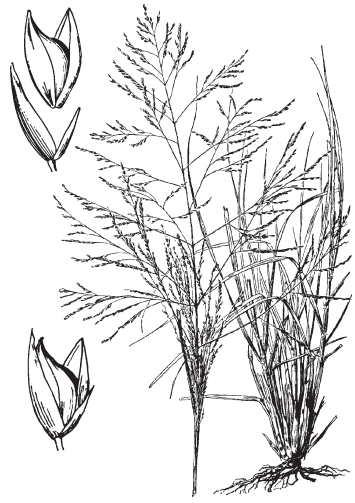
Sporobolus indicus (L.) R. Br., (of India), SMUT GRASS. Perennial; culms 30–100(–120) cm tall; panicles 10–30(–50) cm long; spikelets 1.4–2(–2.6) mm long; pericarp mucilaginous, the seed often sticking instead of falling readily. Moist soils, often in disturbed areas; widespread in e 1/3 of TX, sparsely scattered further w; e U.S. from NY s to FL w to MO, OK, and TX, also CA, MI, and OR. Mar–Dec. Native to Asia. The common name, SMUT GRASS, refers to the infection and blackening of the inflorescences and upper leaves by a fungus (*Bipolaris* spp.) (Peterson et al. 2003).



Sphenopholis obtusata var. major [CRO, HI1]



Sphenopholis obtusata var. obtusata [GO1]



Sporobolus airoides [LEI]



Sporobolus clandestinus [HI1]



Sporobolus compositus var. compositus [USB]



Sporobolus compositus var. drummondii [BB2]



Sporobolus compositus var. macer [HI1]



Sporobolus cryptandrus [USB]



Sporobolus indicus [REE]

Sporobolus junceus (P. Beauv.) Kunth, (rush-like, resembling *Juncus*—rush), PINEYWOODS DROPSEED, PURPLE DROPSEED, WIRE GRASS. Perennial; culms usually 50–100 cm tall; panicles usually 10–28 cm long; spikelets 3–3.8 mm long. Pine and hardwood forests, sandy prairies, usually sandy to loamy soils; Pineywoods and Post Oak Savannah, also Gulf Prairies and Marshes and n South TX Plains; se U.S. from VA s to FL w to AR and TX, also AZ. (Spring), mostly Sep–Nov. [*S. gracilis* (Trin.) Merr.]

Sporobolus neglectus Nash, (overlooked), PUFF-SHEATH DROPSEED, SMALL DROPSEED, POVERTY GRASS. Annual similar to *S. vaginiflorus*; culms 10–40 cm long, erect or decumbent; leaf sheaths mostly glabrous but with some hairs at apex, somewhat inflated; panicles contracted, 2–5 cm long, often only apical portion exserted from subtending sheaths, the axillary panicles shorter, almost entirely enclosed by sheaths; spikelets (1.3–)1.6–2.8 mm long; lemma white or purple-tinged, glabrous. Disturbed sites; Grayson Co. (BRIT) near nw margin of East TX; also Cross Timbers and Prairies (Bosque and Mills cos.—BRIT) and Edwards Plateau (Hatch et al. 1990; Hatch 2002); s Canada and widespread in much of the U.S. Aug–Nov. Jones et al. (1997) treated this species as *S. vaginiflorus* (Torr. ex A. Gray) A.W. Wood var. *neglectus* (Nash) Scribn. According to Yatskievych (1999), this species is sometimes difficult to separate from the closely related *S. ozarkanus* and *S. vaginiflorus*. Peterson et al. (2003) noted, "*Sporobolus vaginiflorus* is very similar to *S. neglectus*, but it differs in having strigose lemmas, sheaths that are sparsely hairy toward the base and, usually, longer spikelets." *Sporobolus neglectus* is unusual in that "when the fruits become wet, the outer coat [pericarp] swells slightly and becomes somewhat sticky or gelatinous, as opposed to merely becoming loosened from the seed (and often releasing it)" (Yatskievych 1999). While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

Sporobolus ozarkanus Fernald, (of the Ozarks), OZARK DROPSEED, OZARK POVERTY GRASS. Annual similar to *S. vaginiflorus* but differing as in the key and with all reproductive parts averaging smaller; culms 4–50(–60) cm tall; panicles 2–5 cm long; spikelets (1.9–)2.3–3.8(–4.2) mm long; lemma 2.1–3.5(–3.9). Limestone areas, roadsides; Grayson (BRIT), Grimes (TAMU) and San Jacinto (*E. Keith 20A*, BRIT) cos.; also cited for s part of Blackland Prairie (Gould 1975b) and Cross Timbers and Prairies and Edwards Plateau by Hatch et al. (1990); e U.S. from VA s to FL w to KS and TX. Aug–Oct. [*S. neglectus* Nash var. *ozarkanus* (Fernald) Steyerm. & C. Kucera, *S. vaginiflorus* (Torr. ex A. Gray) A.W. Wood var. *ozarkanus* (Fernald) Shinners] Jones et al. (1997) treated this taxon within *S. vaginiflorus* var. *neglectus*, while Kartesz (1999), Hatch (2002), and Peterson et al. (2003) recognized it as *S. vaginiflorus* var. *ozarkanus*. It differs from *S. vaginiflorus* in a number of characters, and until a detailed study is done of this and related taxa (e.g., *S. neglectus*), we are following Riggins (1969) and Yatskievych (1999) in recognizing it at the specific level. However, some individuals of *S. ozarkanus* and *S. vaginiflorus* are difficult to distinguish (Yatskievych 1999). While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

Sporobolus purpurascens (Sw.) Hamilton, (purplish or turning purple), PURPLE DROPSEED. Perennial; culms 25–95 cm tall; panicles (7–)10–25(–30) cm long, the branches short, in well-spaced and -defined whorls giving the inflorescence a distinctive interrupted appearance; spikelets 3–4.5 mm long. Prairies, brushy areas, sandy soils; Bexar Co. (Turner et al. 2003) near sw margin of East TX; otherwise s Gulf Prairies and Marshes and s South TX Plains; in the U.S. known only from TX; also Latin America. (Spring), but mostly Oct–Nov. [*Agrostis purpurascens* Sw.] According to Gould (1975b), this species is closely related to *S. junceus*. It can be distinguished by the narrower panicles 1.6 cm or less wide, with short branches 0.8–1.5(–2) cm long, these bearing flowers to the base or nearly so, versus *S. junceus* with the panicles 3–6 cm wide with branches 2–3.5 cm long, these naked on ca. the lower half.

Sporobolus pyramidatus (Lam.) Hitchc., (pyramidal), WHORLED DROPSEED, TARGET DROPSEED. Annual or short-lived perennial; culms 10–35(–60) cm tall; panicles 3–15(–18) cm long, becoming pyramidal and exserted at maturity, the lower branches in whorls of usually 7–12(–rarely more); spikelets 1.5–2 mm long. Open, disturbed sites; Navarro (BRIT), Anderson, Bastrop, Bexar, Brazos, Hunt, and Tyler (Turner et al. 2003) cos.; widely scattered in TX, but more common in the s part of the state; c U.S. from MO s to LA w to UT and AZ, also FL. Mar–Nov. [*Agrostis pyramidata* Lam., *S. patens* Swallen, *S. pulvinatus* Swallen] While this taxon is sometimes included in the Old World *S. coromandelianus* (Retz.) Kunth (e.g., Kartesz 1999; Hatch 2002), we are following Peterson et al. (2003) in treating *S. pyramidatus* as a separate species. They noted, however, that the two are morphologically "very similar ... suggesting that they are related."

Sporobolus silveanus Swallen, (for William Arents Silveus, 1875–1953, TX botanist, attorney, and author of *Texas Grasses*), SILVEUS' DROPSEED. Perennial; culms 0.7–1.2 m tall; panicles somewhat open, 20–50 cm long, (5–)10–12(–15) cm wide; spikelets purple, (4–)4.5–7(–7.2) mm long. Sandy soils, prairies, wet to mesic pine woodlands, forest openings; scattered in East TX in Hardin, Jasper, Rains (BRIT), Angelina, Brazos, Harris, Lamar (Tridens Prairie), Orange, Tyler, and Van Zandt (Weakley & Peterson 1998) cos.; also n Gulf Prairies and Marshes; w LA, se OK, and East TX (Weakley & Peterson 1998); Peterson et al. (2003) also mapped a single county in FL and a single county in GA. Jul–Nov. Brown (1993) concluded that all TX material previously identified as the related species *S. heterolepis* (A. Gray) A. Gray was actually *S. silveanus*. We are following Brown (1993) in not considering *S. heterolepis* to be a member of the TX flora.

Sporobolus vaginiflorus (Torr. ex A. Gray) A.W. Wood, (with flowers in the sheaths), POVERTY DROPSEED, SOUTHERN POVERTY GRASS, POVERTY GRASS. Annual; culms 15–50(–70) cm tall; panicles terminal and axillary, contracted, 1–5 cm long, 2–5 mm wide, usually partially enclosed within subtending sheaths; spikelets usually 3–5(–6) mm long; lemma often mottled with dark purple, with short appressed pubescence. Disturbed sites, roadsides, fields, sandy or clay soils, limestone outcrops; widespread in e 1/2 of TX, scattered further w; scattered in s Canada and throughout the e U.S. w to ND and TX, also AZ, ID, and NM. Aug–Nov. This species is similar to and apparently related to *S. ozarkanus*; see discussion under that species.

Sporobolus heterolepis (A. Gray) A. Gray, PRAIRIE DROPSEED, has often been reported for TX (e.g., Correll & Johnston 1970; Gould 1975; Hatch et al. 1990). Brown (1993), however, concluded that all TX material identified as this species was actually *S. silveanus*. We are following Brown (1993), Hatch (2002), and Turner et al. (2003) in considering *S. heterolepis* not to be a member of the TX flora. However, several old collections are still listed incorrectly as *S. heterolepis* on the Digital Flora of Texas Herbarium Specimen Browser (2002) and were apparently picked up in the recent Flora of North America treatment (Peterson et al. 2003).

STEINCHISMA Raf. GAPING PANIC GRASS

A New World genus of 5–6 species of tropical to warm-temperate regions, growing typically in moist or wet, usually open, sandy areas (Freckmann & Lelong 2003c). It has traditionally been included in *Panicum* (e.g., Correll & Johnston 1970; Hatch et al. 1990), sometimes in the subgenus *Steinchisma* (Zuloaga 1987). Recent studies (e.g., Zuloaga et al. 2000) support its recognition as a separate genus (Freckmann & Lelong 2003c). Photosynthesis is intermediate between that of C_3 and C_4 plants (Freckmann & Lelong 2003c). (Greek: *steinos*, narrow, and *chasma*, yawning, presumably in reference to the gaping glumes and somewhat narrow spikelets when compared to *Panicum*—Freckmann & Lelong 2003c) (subfamily Panicoideae, tribe Paniceae)
REFERENCES: Zuloaga et al. 1992, 1998. Freckmann & Lelong 2003c.

Steinchisma hians (Elliott) Nash, (gaping), GAPING PANICUM, GAPING GRASS, GAPING PANIC GRASS. Perennial with culms erect or decumbent at base, to 75 cm tall; nodes glabrous or scabrous; leaf sheaths glabrous or with hairs on upper margins; ligule a short membrane ca. 0.5 mm long; leaf

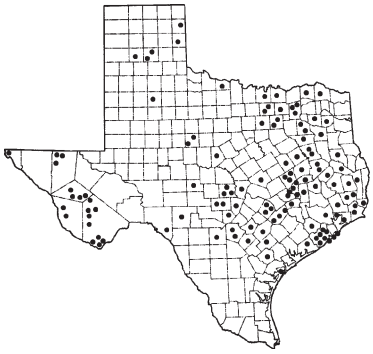
blades 2–5 mm wide; panicles usually 6–20 cm long, ca. 1/2 as wide as long, the lower 1–3 cm of each branch bare of spikelets; spikelets awnless, 2-flowered (the lower floret sterile, the upper floret perfect), glabrous, 1.8–2.4 mm long, sometimes purple-stained, at maturity gaping open at apex; glumes both present, the lower 1/3–1/2 as long as spikelet, acute; upper glume resembling lemma of lower floret; palea of the lower (neuter) floret inflated, obovate, indurate, often apiculate, distinctive, larger than the lemma and giving the spikelet an expanded, widely gaping appearance; upper (perfect) floret 1.6–1.9 mm long, the lemma and palea firm, but not tough and hard nor grain-like. Low areas, moist soils, often in shade; widespread in e 1/2 of TX; se U.S. from VA s to FL w to OK and TX, also MO and NM. Apr–Oct, typically early in growing season. [*Panicum hians* Elliott]

STENOTAPHRUM Trin. ST. AUGUSTINE GRASS

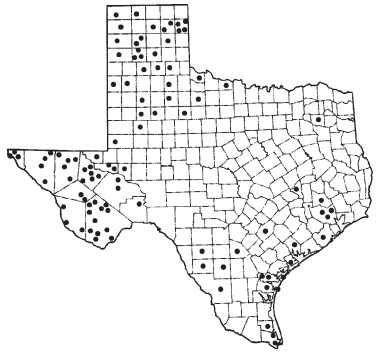
A C_4 genus of 7 species of tropical and warm areas of the world, primarily along the Indian Ocean rim, mainly along seashores or near the coast, rarely inland; three species are endemic to Madagascar and one is questionably native to North America (Clayton & Renvoize 1986; Allred 2003e). It has been suggested that the genus is derived from *Paspalidium* through a progressive reduction of the inflorescence branches and expansion of the central axis of the inflorescence (Sauer 1972; Clayton & Renvoize 1986). Other authorities (e.g., Webster 1988), however, disagree and suggest it is more closely related to two Old World genera, *Thuarea* Pers. and *Uranthoecium* Stapf. The swollen inflorescence axis has been postulated to be an adaptation to dispersal by sea; however, it remains buoyant for only ca. a week (Sauer 1972; Clayton & Renvoize 1986). Some species are used for pasture, for lawns, or playing fields, or are considered significant weeds (Watson & Dallwitz 1992). (Greek: *steno*, narrow and *taphros*, trench, from grooves in the inflorescence axis into which the reduced branches are sunken) (subfamily Panicoideae, tribe Paniceae)

REFERENCES: Sauer 1972; Crins 1991; Allred 2003e.

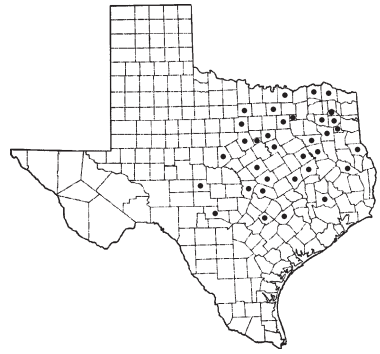
Stenotaphrum secundatum (Walter) Kuntze, (with parts arranged along one side), ST. AUGUSTINE GRASS, CARPET GRASS. Stoloniferous, sod-forming perennial; culms decumbent or ascending, rooting at the nodes, the flowering branches ascending to ca. 30 cm tall; leaf sheaths compressed, keeled, with a few hairs at summit; ligule a minute membrane with a very short ring of hairs; leaf blades 5–15(–18) cm long, 5–10 mm wide, ± obtuse apically; inflorescences spike-like, usually 5–10 cm long and 5–10 mm wide, the axis wide, flattened, and corky, appearing unbranched (cryptically a very reduced panicle with short appressed branches—each bearing 1–3(–5) spikelets—sunken into the axis); spikelets 4–5 mm long, awnless, 2-flowered, the lower floret staminate or neuter, the upper floret perfect, appressed and sunken into one side of the axis; lower glume 1–2 mm long, smaller than upper glume, the second ca. as long as spikelet; stamens 3. Commonly planted as a lawn grass, escaping locally to a limited extent; tending to freeze back in very severe winters, particularly in the n part of East TX; Bexar, Brazos, Dallas, Grayson, Harris (BRIT), Colorado, and Travis (Turner et al. 2003) cos.; scattered in TX w to e Cross Timbers and Prairies and Edwards Plateau; se U.S. from VA s to FL w to MO, OK, and TX, also CA. Jun–Aug. Native range uncertain; possibly native to the tropics (e.g., South America—Webster 1993b) though now widespread. Webster (1988) considered it probably introduced to the United States. However, it was known along the e coast of the U.S. before 1800 (Sauer 1972), and recently a number of authorities (e.g., Kartesz 1999; Allred 2003e) have considered it native to the U.S. This species is widely used as a lawn and turf grass in the tropics and subtropics (Sauer 1972; Crins 1991), and it is also used for soil stabilization (Webster 1988). It can be an aggressively weedy invader of flower beds where grown as a lawn; it can grow vigorously in some shade. A variegated form is known and is sometimes used as an ornamental in hanging baskets and greenhouses (Sauer 1972; Allred 2003e). Crins (1991) noted that diploid plants have yellow stigmas and are capable of normal sexual reproduction, while triploid (generally used for lawns) and tetraploid plants have purple stigmas and are sterile.



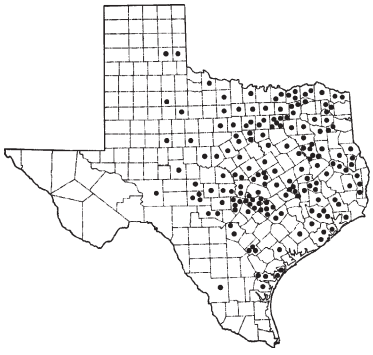
Sphenopholis obtusata
(both vars.)



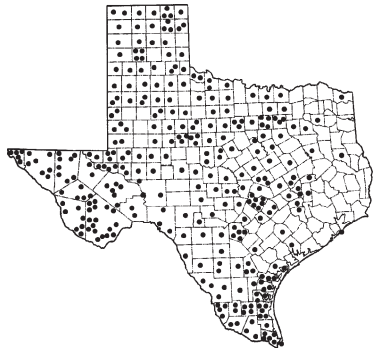
Sporobolus airoides



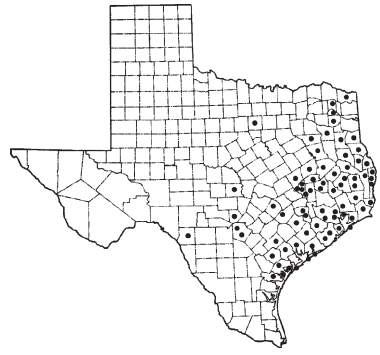
Sporobolus clandestinus



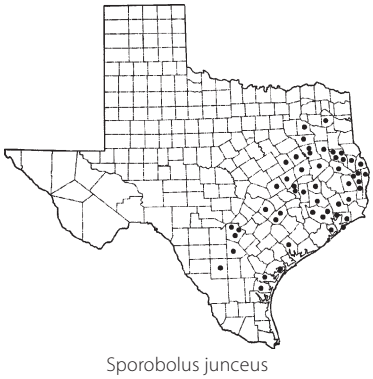
Sporobolus compositus
(all three vars.)



Sporobolus cryptandrus



Sporobolus indicus



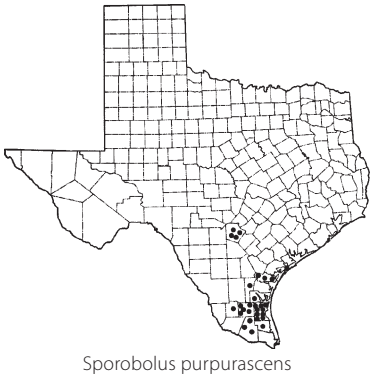
Sporobolus junceus



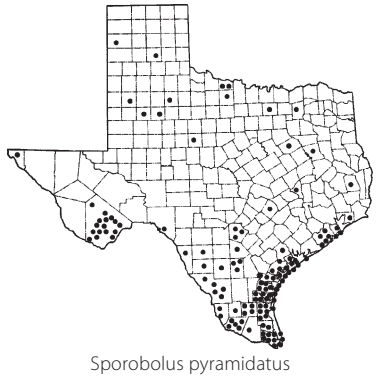
Sporobolus neglectus



Sporobolus ozarkanus



Sporobolus purpurascens



Sporobolus pyramidatus



Sporobolus silveanus

THEMEDA Forssk. KANGAROO GRASS, CHRISTMAS GRASS

An Old World tropical and subtropical genus of ca. 18 species (Barkworth 2003m), including some of the principal cover grasses in tropical fire-maintained grasslands. Some are used as ornamentals and others as forage; several are significant weed species (Watson & Dallwitz 1999). Like all members of the Andropogoneae, *Themeda* is characterized by C_4 photosynthesis (Watson & Dallwitz 1999; Kellogg 2000a). (Arabic: *thaemed*, a depression where water collects after rain and later evaporates, in reference to the habitat of some species—Barkworth 2003m) (subfamily Panicoideae, tribe Andropogoneae)

REFERENCES: Chippindall 1955; Gibbs Russell et al. 1991; Towne & Barnard 2000; Barkworth 2003m.

Themeda triandra Forssk., (with three stamens), KANGAROO GRASS, ROOIGRAS. Tufted rhizomatous perennial to 90(–150+) cm tall; leaf sheaths compressed, often with reddish coloration; ligule a notched membrane, sometimes ciliate; leaf blades abruptly or gradually pointed; inflorescences ± triangular clusters (of 1–several short, almost spikelet-like racemes) from the upper nodes (many clusters per culm), often drooping, typically (1–)1.5–2 cm long (not counting awns), each cluster subtended by a reddish spathe-like sheath 1.5–7 cm long; each cluster subunit (raceme) with 2 pairs of sterile or staminate sessile spikelets at base, forming what appears to be a loose involucre below the rest of the raceme, these involucral spikelets 6–15 mm long, awnless; rest of the raceme consisting of 1–4 smaller pairs of one sessile and one pedicellate spikelet, or sometimes only 3 spikelets with 1 sessile and fertile and 2 pedicellate and sterile or staminate; sessile, fertile spikelets 5–14 mm long, with a sharply pointed callus with brown hairs, composed of 2 florets, the lower reduced and sterile, the upper floret fertile, with lemma bearing a stout, bent, and twisted awn 3–7+ cm long, the palea absent; stamens 3; pedicellate spikelets similar to involucral spikelets, unawned. "Grass near house, recent invader" (from collector's label); Travis Co. (*Wendt 6988*, Nov 1997—TEX, previously Blackland Prairie site near Pflugerville); in the U.S. apparently known only from TX. Fall. [*T. australis* (R. Br.) Stapf] Native of the Old World. *Themeda triandra* is an exceedingly variable, taxonomically complex species divided by some authorities into numerous infraspecific taxa (e.g., Chippindall 1955). Because of the lack of comparative material or detailed treatments of the entire group, we are tentatively treating the species broadly without varieties or subspecies, to include *T. australis* (which is recognized by some authorities as a separate species). *Themeda triandra* is currently known from only a single collection in East TX, and thus appears to be a relatively recent arrival. As with many introduced species, its eventual abundance or impact is difficult to predict (i.e., will it become invasive?). The species is, however, widely dominant in parts of its native range and in some areas is considered an important native pasture grass (Watson & Dallwitz 1999). It can vegetatively resemble *Heteropogon contortus*, but that species has an undivided ligule and blunt leaf blades (Gibbs Russell et al. 1991).

TRACHYPOGON Nees CRINKLE-AWN GRASS

A genus of ca. 6 species of tropical and subtropical America and Africa (Dávila 1994; Wipff & Jones 1998). According to Allred (2003f), "Estimates of the number of species included range from 1 to 10. One species, *Trachypogon secundus*, grows in and is native to the [North American] *Flora* region, but some taxonomists (e.g., Dávila 1994) include it in *T. plumosus* (Humb. & Bonpl. ex Willd.) Nees and others (e.g., Judziewicz 1990b) include it, *T. plumosus*, and various other taxa in *T. spicatus* (L.f.) Kuntze." We are following Allred (2003f) in using the traditional treatment and nomenclature for North American plants because of the lack of evidence supporting the various other treatments. Like all members of the Andropogoneae, *Trachypogon* is characterized by C_4 photosynthesis (Watson & Dallwitz 1999; Kellogg 2000a). (Greek: *trachus*, rough, and *pogon*, beard, in reference to the plumose awn of the lemma of fertile floret) (subfamily Panicoideae, tribe Andropogoneae)

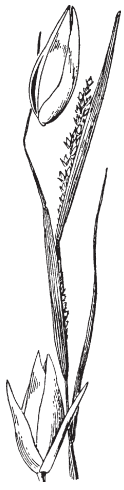
REFERENCES: Judziewicz 1990b; Dávila 1994; Wipff & Jones 1998; Allred 2003f.



Sporobolus junceus [LEI]



Sporobolus ozarkanus [ROE]



Sporobolus neglectus [HI1]



Sporobolus purpurascens [HI1]



Sporobolus pyramidatus [GO1]



Sporobolus silveanus [HI2]



Sporobolus vaginiflorus [USB]



Steinchisma hians [GO1]

Trachypogon secundus (J. Presl) Scribn., (one-sided, on one side), CRINKLE-AWN, CRINKLE-AWN GRASS. Tufted perennial 60–120 cm tall; culm nodes with discrete beard of up-pointing whitish hairs ca. 2–3 mm long, glabrate with age; ligule a membrane 1–5 mm long, sometimes fringed; leaf blades (1–)3–6(–8) mm wide; inflorescence a solitary, terminal, spike-like raceme 10–18(–28) cm long, the inflorescence axis remaining intact; spikelets in pairs, one subsessile, staminate, and awnless, the other short-pedicelled, perfect, and with a long awn; disarticulation near base of perfect spikelet, forming a sharp-barbed callus with a tuft of whitish hairs; staminate and perfect spikelets ca. 6–8 mm long, with spreading pubescence, similar in size and appearance except for awn; lemma awn of perfect spikelet very conspicuous, 40–60 mm long, twisted, contorted to ± geniculate, light colored at maturity, nearly glabrous apically but plumose in lower portion with hairs ca. 2–4(–5) mm long; palea obsolete. Prairies, pastures, woodlands, rocky areas, sandy soils; Colorado, DeWitt, Fayette, Goliad, Lavaca (TAES), Austin (SBSC), and Bexar (Turner et al. 2003) cos. in s part of East TX; also Gulf Prairies and Marshes and South TX Plains; AZ, NM, and TX. Sep–Nov. [*Heteropogon secundus* J. Presl, *T. montufari* of authors, not (Kunth) Nees] As noted above, some authors treat this species as *T. plumosus* or *T. spicatus*. Allred (2003f) noted that it, "resembles *Heteropogon*, but differs in the longer, non-disarticulating inflorescence and shorter, pale awns."

TRAGUS Haller BUR GRASS

An Old World tropical C_4 genus of 7 species, with the center of diversity in Africa (Watson & Dallwitz 1999; Wipff 2003e). They frequently occur as weeds in tropical and subtropical regions (Anton 1981), and several are considered significant weeds (Watson & Dallwitz 1999). Wipff (2003e) noted that the spine-like projections on the upper glumes make the genus easily recognizable. (Greek: *tragos*, he-goat, possibly in reference to the rigid hairs on the leaves and the bristles on the spikelets which may be reminiscent of a goat's beard—Watson & Dallwitz 1999) (subfamily Chloridoideae, tribe Cynodonteae)
REFERENCES: Anton 1981; Wipff 1992, 2003e; Sulekic & Zapater 2001.

Tragus berteronianus Schultes, (for Carol Giuseppe Bertero, 1789–1831), SPUR BUR GRASS, SPIKE BUR GRASS, PRICKLE GRASS, GOAT GRASS. Low annual; culms spreading, to only 30(–45) cm long; ligule a fringed membrane; leaf blades to 5(–8.5) cm long, 1.5–5 mm wide, typically with margins thickened, whitish, and fringed with stiff whitish hairs; inflorescences spike-like racemes, (2–)4–9(–13) cm long, (4–)5–8 mm wide, with spikelets in groups of 2(–3) in conspicuously prickly, nearly sessile burs, the bur pedicels only 0.2–0.4 mm long; disarticulation at base of each bur, the bur falling as a unit; spikelets awnless, with a single floret; lower glume rudimentary or absent; upper glume with 3–5 rows of stout hooked prickles; basal spikelet of bur (1.8–)2–3(–4.3) mm long, fertile, the lemma and palea membranous; upper spikelet (1–)1.2–2(–3.9) mm long, generally reduced and sterile. Waste places and along railroad tracks; Travis Co. (TEX; Correll & Johnston 1970; Carr 2002a); according to Carr (2002a), the Travis Co. specimens were found by Young (1920); the species is also reported from Colorado Co. (Wipff 2003e); however, a sheet at TAES (*Tracy s.n.* collected in 1902) is labeled as coming from Colorado, TX rather than Colorado Co.; we are not aware of any other recent collections or reports from East TX; scattered in the s and w parts of TX; AZ, NM, and TX, also scattered in far e U.S. Apr–Nov. Native of Africa and Asia. [*Nazia aliena* of authors, not (Spreng.) Scribn.] This species is considered a significant weed by some authorities (e.g., Watson & Dallwitz 1999).

TRICHLORIS E. Fourn. ex Benth. FALSE RHODES GRASS

A genus of 2 species native to North and South America (Barkworth 2003d). It has sometimes been treated in *Chloris* (e.g., Gould 1975b). However, preliminary molecular evidence does not support that position (Hilu & Alice 2001). Morphologically, the 3-awned lemmas distin-

guish it from *Chloris*. According to Barkworth (2003d), both species "have a disjunct distribution, populations in North America being widely separated from those in South America." (Latin: *tri*, three, and the genus *Chloris*, windmill grass, in reference to the 3-awned lemmas and the resemblance to *Chloris*) (subfamily Chloridoideae, tribe Cynodonteae)
REFERENCES: Hilu & Alice 2001; Barkworth 2003d.

Trichloris pluriflora E. Fourn., (many-flowered), MULTI-FLOWERED FALSE RHODES GRASS. Perennial, often stoloniferous; culms to 1.5 m tall; ligule to 3 mm long; leaf blades 10 mm or less wide; inflorescence a panicle with 7–20 branches in whorls, the branches to 20 cm long; spikelets with 2–6 florets, the lowest 1–2 florets bisexual, the distal ones reduced and sterile, disarticulating above the glumes, all florets falling as a unit; glumes 2–5 mm long, the upper one longer; lemmas of lower florets 3–5 mm long, apically 3-awned, the lateral awns 1.5 mm or less long, the middle awn much longer, 8–12 mm long. Low brushy areas; Bexar and Fannin (TAES) cos. (the Fannin County collection is well out of normal range and is likely the result of mistaken label data—it is not mapped on the county distribution map); mainly Gulf Prairies and Marshes and South TX Plains. Summer. [*Chloris pluriflora* (E. Fourn.) Clayton] According to Barkworth (2003d), this species is "native from southern Texas to Guatemala and, as a disjunct, from Ecuador to Argentina."

TRICHONEURA Andersson SILVEUS' GRASS

A C_4 genus of 7 species (Wipff 2003b), typically of dry, sandy or rocky soils of tropical Africa, the Middle East, Texas, n Mexico, Peru, and the Galapagos Islands; only two are native to the New World. (Greek, *thrix*, hair, and *neuron*, nerve, in reference to the ciliate veins of the lemma) (subfamily Chloridoideae, tribe Cynodonteae)
REFERENCE: Wipff 2003b.

Trichoneura elegans Swallen, (elegant), SILVEUS' GRASS, HAIRY-NERVE GRASS. Annual 30–115 cm tall, branching at base, rooting at lower nodes; ligule membranous, 1.5–3 mm long; leaf blades ca. 2–9 mm wide; inflorescence a panicle usually (5–)7–12(–20) cm long, the numerous unbranched primary branches erect to ascending-spreading; spikelets on pedicels ca. 1 mm long, with 5–10 florets, the terminal 1–4 reduced and staminate or sterile, ca. 7–11.5 mm long; disarticulation above the glumes and between the florets; glumes subequal, acuminate or with a short awn, the second longer and slightly shorter than to ca. as long as spikelet; lemmas apically notched, sometimes minutely apiculate, conspicuously ciliate (hairs to 1.6 mm long) on and adjacent to midsections of lateral veins, the hairs stiff. Fields, prairies, and roadsides, sandy soils; Bastrop (TAES), Bexar, and Wilson (TEX) cos. in s part of East TX; a Brazos Co. location mapped by Turner et al. (2003) is based on a cultivated "nursery" specimen (*Malone*, TAES); mainly Gulf Prairies and Marshes and South TX Plains; mainly TX, also mapped for AZ by Wipff (2003h), also n Mexico. (Spring–)late summer–fall.

TRIDENS Roem. & Schult. TRIDENS, FLUFF GRASS

Tufted perennials with erect culms, not rhizomatous or with short rhizomes; ligule a ciliate membrane; inflorescence a contracted or open panicle; spikelets 3–12-flowered, disarticulating above glumes and between florets; lower glume 1-veined; lemmas 3-veined, usually with pubescence on the veins below the middle, rounded on the back, obtuse or acute, usually ± 2-toothed or rounded-truncate at apex, the veins often slightly mucronate; stamens 3.

A C_4 genus of 14 species of warm areas of the Americas (e. U.S. to Argentina) (Valdés-Reyna 2003a), excluding *Erioneuron* and *Dasyochloa* which have sometimes been included (e.g., Hitchcock 1951). It was recognized as the genus *Triodia* by Hitchcock (1935). (Latin: *tri*, three, and *dens*, tooth, from the 2-toothed lemma tip often with a mucro from between the teeth) (subfamily Chloridoideae, tribe Cynodonteae)

REFERENCES: Tateoka 1961; McKenzie et al. 1987b; Peterson et al. 1997; Valdés-Reyna 2003a.

1. Panicle contracted, densely-flowered or elongate and spike-like, the panicle branches usually with spikelets nearly to base or apparently so (branches usually tightly appressed at base).
   2. Glumes much longer than the lower lemmas, usually extending to tip of distal florets or beyond (i.e., glumes usually as long as or longer than rest of spikelet); plants 50–170 cm tall _____ **T. strictus**
   2. Glumes slightly longer than to shorter than lower lemmas, not extending to tip of distal florets (i.e., much shorter than rest of spikelet); plants 20–80(–100) cm tall.
      3. Lemmas glabrous or hairy only at extreme base, awnless _____ **T. albescens**
      3. Lemma veins ciliate or puberulent to well above the base (at least lower third of lemma with hairs), awnless or awned.
         4. Lemmas awnless, the veins usually with pubescence to well beyond middle; panicle 6–20(–25) cm long, 10 mm or less wide _____ **T. muticus**
         4. Lemmas short-awned, the midvein excurrent (= extending slightly beyond margin), the veins with pubescence only on lower 1/3–1/2; panicle 5–8(–10) cm long, 12–25 mm wide _____ **T. congestus**
1. Panicle open, ± loosely-flowered, neither densely-flowered nor spike-like, the panicle branches conspicuously bare of spikelets at base.
   5. Lateral spikelets (= those not terminating an inflorescence branch) with pedicels ca. 1 mm or less long; inflorescence branches stiffly ascending; species of Pineywoods and Gulf Prairies and Marshes _____ **T. ambiguus**
   5. Lateral spikelets (at least some) with pedicels > 1 mm long; inflorescence branches (at least some) spreading and/or flexuous; including species widespread in East TX.
      6. Lemmas 2–3.2 mm long; species known in East TX only from Bexar and Hays cos. near extreme sw margin of area _____ **T. eragrostoides**
      6. Lemmas 4–6 mm long; including species widespread in East TX.
         7. Lemmas with lateral veins usually not reaching the lemma margin (use hand lens or dissecting scope); spikelets with 3–5 florets; species known in East TX only from Bexar, Comal, Hays, and Travis cos. on extreme sw margin of area _____ **T. buckleyanus**
         7. Lemmas with lateral veins reaching the lemma margin and often extending slightly beyond it (= excurrent) as short points (= mucros); spikelets with 4–12 florets; including species widespread in East TX.
            8. Leaf blades (3–)5–10(–13) mm wide; panicle mostly 15–35(–40) cm long; plants 60–180 cm tall; spikelets 5–9(–10) mm long, with 4–8 florets; species widespread in East TX _____ **T. flavus**
            8. Leaf blades mostly 1–3(–5) mm wide; panicle mostly 5–16 cm long; plants 20–75 cm tall; spikelets usually 6–13 mm long, with 6–12 florets; species known in East TX mainly from sw margin of area _____ **T. texanus**

Tridens albescens (Vasey) Wooton & Standl., (whitish), WHITE TRIDENS, WHITETOP, WHITE FLUFF GRASS. Plant 30–60(–100) cm tall, glabrous; leaf blades 1–4 mm wide; panicle 6–30 cm long; spikelets 4–10 mm long; lemmas white, often purplish distally, the spikelets thus often appearing banded. Low prairies, ditches, swales, and other periodically wet areas, often in clay soils; nearly throughout TX except the Pineywoods; sc U.S. from KS s to TX w to AZ. Mar–Nov. [*Rhombolytrum albescens* (Vasey) Nash, *Triodia albescens* Vasey]

Tridens ambiguus (Elliott) Schult., (uncertain, doubtful), PINE-BARREN TRIDENS, PINE-BARREN FLUFF GRASS. Plant 60–125 cm tall, nearly glabrous; leaf blades usually 2–5 mm wide; panicle 8–20 cm long; spikelets 4–6 mm long. Wet pinelands and adjacent areas; Hardin, Red River, Tyler (BRIT), Liberty (SBSC), Angelina, Jasper, and Newton (Turner et al. 2003) cos. in the Pineywoods; se U.S. from NC s to FL w to TX. Sep–Nov. [*Poa ambigua* Elliott, *Triodia ambigua* (Elliott) Benth. ex Vasey, *Triodia elliottii* Bush]



Stenotaphrum secundatum [USB]



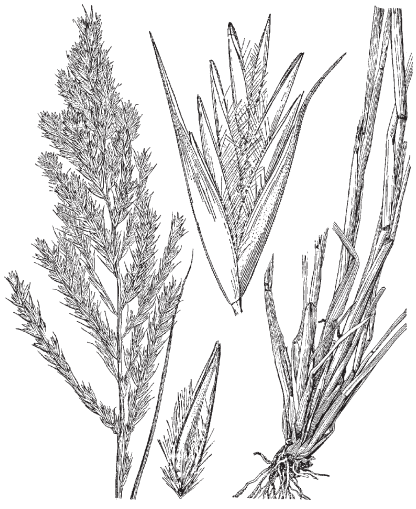
Themeda triandra [GSA]



Tragus berteronianus [HI1]



Trichloris pluriflora [USB]



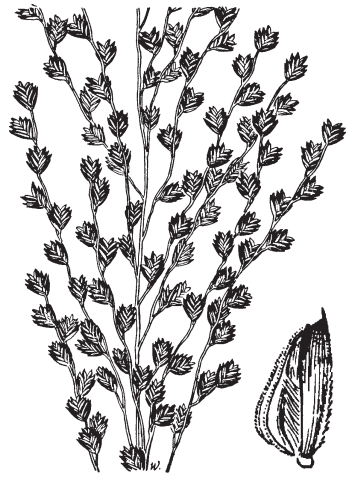
Trichoneura elegans [HI1]



Tridens albescens [USB]



Trachypogon secundus [HI1]



Tridens ambiguus [HI2]

Tridens buckleyanus (L.H. Dewey) Nash, (for Samuel Botsford Buckley, 1809–1884, state geologist of TX and plant collector), BUCKLEY'S TRIDENS, BUCKLEY'S FLUFF GRASS. Plant 40–80 cm tall, nearly glabrous; leaf blades 1–4 mm wide; panicle 10–28 cm long; spikelets 7–10 mm long. Shaded banks, forest margins, juniper-oak woodlands, rocky limestone soils; Bexar, Comal, Hays, and Travis (BRIT) cos. on sw edge of East TX; also s and e Edwards Plateau and s Lampasas Cut Plain (Mills Co.—Turner et al. 2003); endemic to TX (Kartesz 1999; Carr 2002b, 2002c). Late summer–fall. [*Sieglingia buckleyana* L.H. Dewey, *Triodia buckleyana* (L.H. Dewey) Vasey ex Hitchc.] (RARE 2001, 2002b: G3G4S3S4) ⚠

Tridens congestus (L.H. Dewey) Nash, (congested, crowded together), PINK TRIDENS, PINK FLUFF GRASS. Plant 30–75 cm tall, glabrous; leaf blades 1–5 mm wide; panicle 5–8(–10) cm long; spikelets usually 5–10 mm long; glumes and lemmas thin, papery, usually pink-tinged; lemma apex deeply cleft. Clay, disturbed sites, low moist areas; scattered in e 1/2 of TX; endemic to TX (Kartesz 1999; Carr 2002b, 2002c). Apr–Nov. [*Sieglingia congesta* L.H. Dewey, *Triodia congesta* (L.H. Dewey) Bush] This species resembles *T. albescens* but "usually has shorter panicles, spikelets that are more or less evenly pink rather than purple-tipped, and more deeply cleft lemma apices" (Valdés-Reyna 2003a).

Tridens eragrostoides (Vasey & Scribn.) Nash, (resembling *Eragrostis*, love grass), LOVE GRASS TRIDENS, LOVE FLUFF GRASS. Plant (10–)50–100 cm tall, glabrous or pilose; leaf blades 1–5 mm wide; panicle 8–25(–30) cm long; spikelets 3–7 mm long. Brushy grasslands, typically in partial shade; Bexar and Hays (Turner et al. 2003) cos. near extreme sw margin of East TX; widespread in s 1/2 of TX; AL, AZ, FL, NM, and TX. (May–Jun)Sep–Nov. [*Triodia eragrostoides* Vasey & Scribn.]

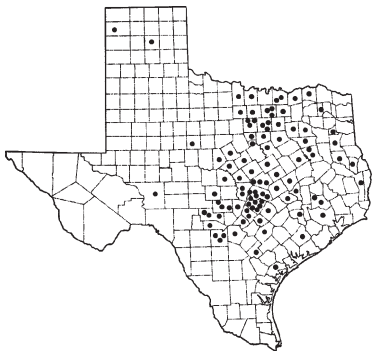
Tridens flavus (L.) Hitchc., (pale yellow), TALL REDTOP. Plant 60–180 cm tall, glabrous; lower leaf sheaths laterally compressed and keeled, often giving base of plant a flattish aspect; leaf blades (3–)5–10(–13) mm wide; panicle 15–35(–40) cm long; spikelets 5–9(–10) mm long, green or usually purplish. Widespread in e 1/2 of TX, scattered further w; the county distribution map does not distinguish the 2 varieties. Aug–Nov.

1. Inflorescence erect, not drooping, the branches stiffly spreading, with basal swollen area (= pulvinus) extending completely around branch, conspicuously pubescent, not greasy _____ var. **chapmanii**
1. Inflorescence drooping, the main axis and branches bending or curving, the branches with basal swollen area on upper side of branch only, glabrous or with inconspicuous pubescence, greasy _____ var. **flavus**

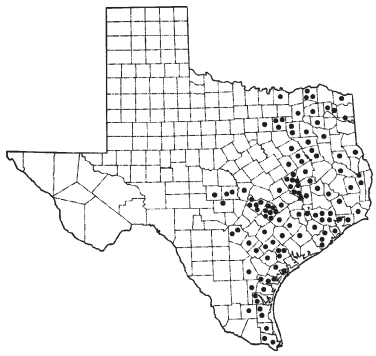
var. **chapmanii** (Small) Shinners, (for A.W. Chapman, 1809–1899, American botanist and author of *Flora of the Southern United States*), CHAPMAN'S TRIDENS. Spikelets on pedicels 3–20 mm long. Pinelands, forest openings; mainly Pineywoods, also Brazos and Van Zandt (BRIT) cos. in Post Oak Savannah; se U.S. from VA s to FL w to MO, OK, and TX. [*Sieglingia chapmanii* Small, *Tridens chapmanii* (Small) Chase, *Triodia chapmanii* (Small) Bush]

var. **flavus**, PURPLETOP, REDTOP, GREASE GRASS. Spikelets with pedicels 1–5 mm long; inflorescence branches greasy. Prairies, old fields, open woods, roadsides, disturbed areas; Pineywoods and Gulf Prairies and Marshes w to e Edwards Plateau and plains country; se Canada (Ont.) and widespread in e U.S. w to MN and NM. [*Poa flava* L., *Triodia flava* (L.) Smyth] The common name GREASE GRASS is the result of the greasy feel on the fingers after running them over the inflorescence. Small globules of a greasy substance are secreted where the inflorescence branches arise and at the nodes of the upper stem (Yatskievych 1999).

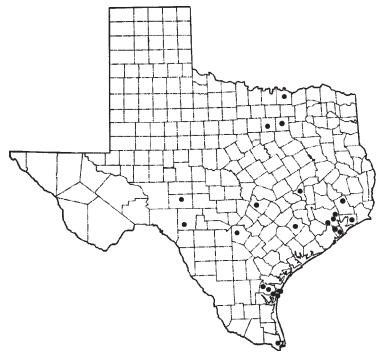
Tridens muticus (Torr.) Nash, (blunt, pointless), AWNLESS FLUFF GRASS. Plant 20–80 cm tall; culm nodes often bearded; panicle narrow, elongate, 6–20(–25) cm long; spikelets 7–13 mm long, short-pedicelled, appearing sessile, not densely crowded, purplish. Dry disturbed sites; widespread in TX; the county distribution map does not distinguish the 2 varieties. Apr–Nov.



Sporobolus vaginiflorus



Steinchisma hians



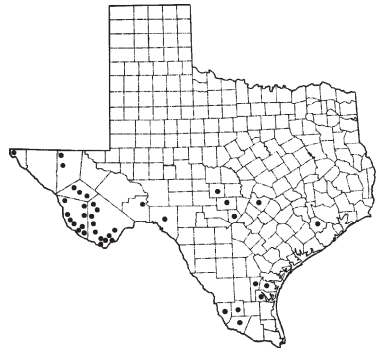
Stenotaphrum secundatum



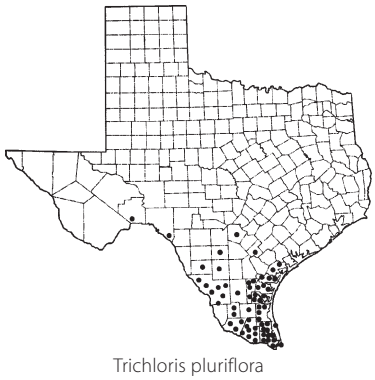
Themeda triandra



Trachypogon secundus



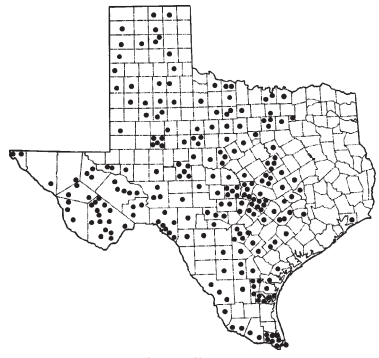
Tragus berteronianus



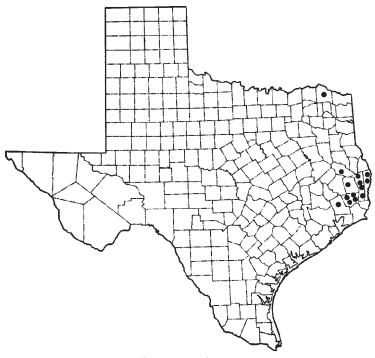
Trichloris pluriflora



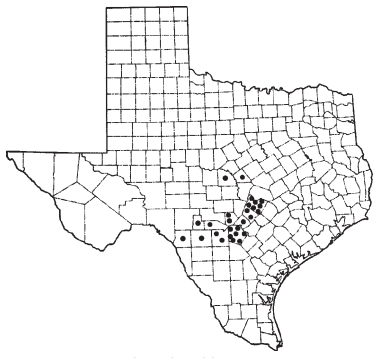
Trichoneura elegans



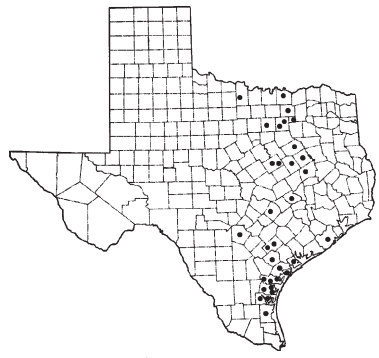
Tridens albescens



Tridens ambiguus



Tridens buckleyanus



Tridens congestus

1. Upper glume 3–7-veined, 5.5–8(–10) mm long; leaf blades usually 3–4 mm wide; culms usually 40–80 cm tall _____ var. **elongatus**
1. Upper glume 1-veined, 4–5(–6) mm long; leaf blades usually 1–2 mm wide; culms usually 50 cm or less tall _____ var. **muticus**

var. **elongatus** (Buckley) Shinners, (elongated), ROUGH TRIDENS. Dry disturbed sites; Bell, Bexar, Collin, Dallas, Travis, and Williamson (BRIT) cos.; in much of c and n TX from the Post Oak Savannah w; sc U.S. from MO s to LA w to CO and AZ. [*T. elongatus* (Buckley) Nash, *Triodia elongata* (Buckley) Scribn., *Uralepis elongata* Buckley]

var. **muticus**, SLIM TRIDENS. Dry disturbed sites; Bell and Travis (BRIT) cos.; widespread in TX, but more common in the w 2/3 of the state; sw U.S. from AR and TX w to CA. [*Tricuspis mutica* Torr., *Triodia mutica* (Torr.) Scribn.]

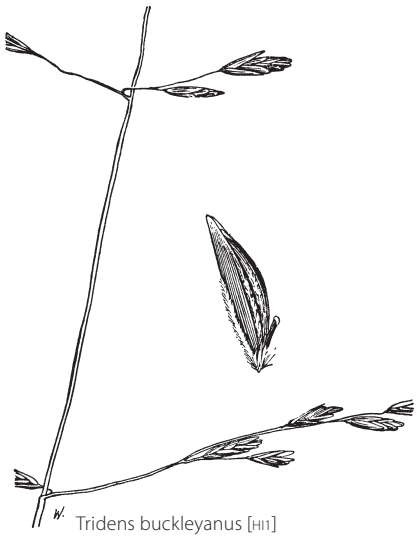
Tridens strictus (Nutt.) Nash, (erect), LONG-SPIKE TRIDENS. Plant 50–170 cm tall, glabrous; ligule ca. 0.5 mm long; leaf blades 2–8 mm wide; panicle 10–36 cm long, the branches erect-appressed; spikelets 4–7 mm long; glumes conspicuously longer than rest of spikelet (often twice as long as the adjacent lemmas). Prairies, open woods, disturbed sites, sandy or clayey soils; widespread in e 1/3 of TX, with several locations further w; e U.S. from PA s to FL w to KS and TX. Jul–Nov. [*Triodia stricta* (Nutt.) Benth. ex Vasey, *Windsoria stricta* Nutt.] A sterile hybrid (*T.* ×*oklahomensis* (Feath.) Feath. ex Chase) between this species and *T. flavus* is known from LA, MO, and OK (Crooks & Kucera 1973; McKenzie et al. 1987b; Yatskievych 1999).

Tridens texanus (Wats.) Nash, (of Texas), TEXAS TRIDENS, LONG-SPIKE FLUFF GRASS. Plant 20–75 cm tall; panicle usually 5–16 cm long, the branches flexuous, bare of spikelets basally; spikelets usually 6–13 mm long, usually purple or rose-purple at maturity, conspicuous (superficially similar to *Eragrostis secundiflora* subsp. *oxylepis*); glumes usually > 1/2 as long as lemmas; lemma veins pubescent below middle. Plains and dry slopes, often in protection of shrubs; Williamson (TAES), Bexar, Brazos, Caldwell, Hays, and Travis (Turner et al. 2003) cos.; mainly s 1/2 of TX; in the U.S. known only from TX, also n Mexico. May–early Jun, late Aug–Nov. [*Triodia texana* Wats.]

TRIPLASIS P. Beauv. SAND GRASS

A C_4 genus of 2 species (Hatch 2003a) occurring from the se United States to Costa Rica, typically in sandy soils. It is "probably related to *Tridens*" (Hatch 2003a). (Greek: *triplasios*, trifarious, threefold, or triple, from the tip of the lemma of the type species, *T. americana*, which has an awn and two long lobes) (subfamily Chloridoideae, tribe Cynodonteae)
REFERENCES: Cheplick 1996; Peterson et al. 1997; Cheplick & Wickstrom 1999; Hatch 2003a.

Triplasis purpurea (Walter) Chapm., (purple), PURPLE SAND GRASS, SAND GRASS. Tufted annual; culms 15–80(–100) cm long, spreading-erect or decumbent at base, with reduced, 1-flowered, cleistogamous spikelets in the axils of enlarged upper sheaths; ligule a short, dense ring of hairs 1.5 mm or less long; chasmogamous inflorescence an open panicle usually 3–11 cm long, basally often partly enclosed in subtending leaf sheath, with a few sparingly rebranched primary branches, the lower branches bare of spikelets on basal 1/3–1/2; spikelets usually with (2–)3–4 florets, 6–10 mm long, usually purple, disarticulating above glumes and between florets; sterile florets, if present, above the fertile florets; rachilla internodes elongated; glumes subequal, shorter than spikelet; lemmas 3–4 mm long, notched and with rounded lobes to ca. 1 mm long, mucronate or with midvein forming a short (< 2 mm long) awn from between the two lobes, silky pubescent on the 3 veins; stamens 3. Sandy soils, forest margins, stream banks, and open areas; widespread in TX; se Canada (Ont.) and nearly throughout the e U.S. w to ND and NM. (Jul–)Sep–Oct(–Nov). Steyermark (1963) indicated that, "Among grasses this species is unusual in having an acid taste." It is salt tolerant and in some areas is referred to as a coastal "dunegrass" (Cheplick & Demetri 1999).



Tridens buckleyanus [HI1]



Tridens congestus [HI1]



Tridens eragrostoides [USB]



Tridens flavus var. chapmanii [HI2]



Tridens flavus var. flavus [HI1]



Tridens muticus var. muticus [USB]



Tridens strictus [USB]



Tridens muticus var. elongatus [USB]

TRIPOGON Roem. & Schult. FIVE-MINUTE GRASS

A mainly tropical Old World C_4 genus of ca. 30 species with 1 in the New World (Clayton & Renvoize 1986; Watson & Dallwitz 1992; Wipff 2003a); it is apparently related to *Leptochloa*. Most species are associated with rock outcrops, growing when there are flushes of water (Clayton & Renvoize 1986). (Greek, *treis*, three, and *pogon*, beard, in reference to the hairs at the base of the three veins of the lemma—Hitchcock 1951) (subfamily Chloridoideae, tribe Cynodonteae)

REFERENCES: Phillips & Launert 1971; Wipff 2003a.

Tripogon spicatus (Nees) Ekman, (with spikes), AMERICAN FIVE-MINUTE GRASS, AMERICAN TRIPOGON. Small tufted perennial 10–30(–34) cm tall; leaves slender, usually involute, almost thread-like, 0.2–1.1 mm wide, mostly at base of plant; ligule a minute ciliate membrane 0.3 mm or less long; inflorescence a solitary, very narrow spike or spike-like raceme 2–10 cm long, 1.5–2.5(–3.5) mm wide, with the appressed spikelets in 2 ± alternating rows on one side of the inflorescence, the narrow edge of the spikelets toward the axis, the spikelets overlapping or, particularly at base of inflorescence, more widely spaced and not overlapping or only slightly so; spikelets with 6–12(–14) florets (most fertile, upper 1–3 sterile or staminate), 5–10(–12) mm long, sessile or on pedicels < 0.5 mm long; disarticulation above glumes and between florets; glumes unequal, the second longer, much shorter than spikelet; lemmas 3-veined, ca. 2–3 mm long, essentially glabrous except for an inconspicuous basal tuft of hairs, apically notched, with short awn/mucro 0.9 mm or less long. Usually in shallow soil on granitic or other igneous outcrops, occasionally on limestone; Travis Co. (Turner et al. 2003) at extreme w edge of East TX; also e Edwards Plateau; this mainly tropical American species reaches its n limit in TX and is found nowhere else in the U.S. Apr–Jul(–late summer), following rains. [*Bromus spicatus* Nees]

TRIPSACUM L. GAMA GRASS, MOCK GRAMA

A New World genus of 12 species (Barkworth 2003n) of monoecious perennials ranging from the e U.S. (MA) to Paraguay; the center of diversity is in Mexico, and the majority of species are found there (de Wet et al. 1981, 1982, 1983c; Li et al. 1999). *Tripsacum* is related to the genus *Zea*, and artificial hybrids can be made between *Zea mays* (CORN) and *Tripsacum* species (Harlan & de Wet 1971; Li et al. 1999); *Tripsacum* is thus of interest to plant breeders. Eubanks (2001) has suggested that *Tripsacum* may be involved in the origin of cultivated MAIZE—see further discussion under *Zea mays*. Like all members of the Andropogoneae, *Tripsacum* is characterized by C_4 photosynthesis (Kellogg 2000a). Some species are important as fodder or pasture grasses (Watson & Dallwitz 1992). (Origin unknown, but possibly from Greek: *tribein*, to rub, perhaps in allusion to the polished spike-like inflorescence) (subfamily Panicoideae, tribe Andropogoneae)

REFERENCES: Cutler & Anderson 1941; de Wet et al. 1976, 1981, 1982, 1983c; Larson & Doebley 1994; Li et al. 1999; Barkworth 2003n.

Tripsacum dactyloides (L.) L., (finger-like), EASTERN GAMA GRASS, EASTERN MOCK GRAMA. Large, clump-forming, hard-based, rhizomatous, monoecious perennial 0.5–2(–3+) m tall; leaf sheaths glabrous; ligule a short, membranous-based ring of hairs; leaf blades typically 10–25 mm wide, pilose above; inflorescence a terminal, ± subdigitate cluster of (1–)2–3(–4) spike-like racemes 10–30 cm long; lower pistillate portion of each raceme (or sometimes lower portion of whole inflorescence if branching occurs above pistillate portion) hard, rounded, cylindrical, 5–8 mm thick, breaking up at the nodes into bead-like units, the spikelets not paired, 2-flowered, 6–8 mm long, appressed to and appearing sunken into the axis, awnless, the upper floret perfect, the lower sterile, the glumes hardened and fused with axis and other spikelet parts; terminal portion of each raceme staminate, unbranched or with 2–3 branches, falling in age, the spikelets crowded, paired, unawned, 2-flowered, (5–)6–10(–12) mm long, the glumes papery. Prairies, depressions, or

low areas; nearly throughout TX but more common in the e part; e U.S. from MA s to FL w to NE and TX. Late Apr–Jul, less commonly to Nov. This is a variable species sometimes divided into varieties (de Wet et al. 1982) that are not clearly defined (Yatskievych 1999); if varieties are recognized, all East TX material would fall into var. *dactyloides*. EASTERN GAMA GRASS is a valuable native prairie grass, prized for both hay and grazing. It is sometimes referred to as an "ice cream plant" because it is quickly targeted by grazing animals (H. McCarley, pers. comm.). ⚅/306

TRISETUM Pers. FALSE OAT

A C_3 genus of ca. 75 species of temperate, subarctic, and alpine areas (Rumley ined.) worldwide except Africa; it is apparently closely related to *Koeleria* (Tucker 1996) and is similar to *Sphenopholis*. According to Rumley (ined.), "*Trisetum* differs from *Sphenopholis*, with which it occasionally hybridizes, in having spikelets that disarticulate above the glumes (also below in a few species), and awns that are inserted lower on the lemmas and are usually longer." Some species are cultivated as pasture grasses or for fodder (Watson & Dallwitz 1992). (Latin: *tres*, three, and *seta*, a bristle, from the awned and 2-toothed lemma—i.e. three-awned appearance in the type species, *Trisetum flavescens* (L.) P. Beauv.—Rumley ined.) (subfamily Pooideae, tribe Poeae) REFERENCES: Louis-Marie 1928; Tucker 1996; Rumley ined.

Trisetum interruptum Buckley, (interrupted, not continuous), PRAIRIE TRISETUM, PRAIRIE FALSE OAT, PRAIRIE WEDGESCALE. Annual 7–50(–60) cm tall; leaf sheaths short scabrous to hispid or pilose; ligule an asymmetrical, ragged-margined membrane (1–)1.5–2(–2.5) mm long; leaf blades ca. 1–4 mm wide, flat; panicle (2–)5–10(–15) cm long, narrow, ± spike-like, the branches short; spikelets 2–3-flowered (upper floret often reduced and sterile), 3–6 mm long (excluding awns); disarticulation below glumes and between florets; glumes subequal, ca. as long as the lemmas; lemmas with 2 slender acuminate to usually bristle-like apical teeth ca. 1–1.5 mm long, also awned from back at or just below base of the teeth, the awn 4–8 mm long, twisted and geniculate. Disturbed sites; throughout much of TX; AZ, CO, LA, NM, OK, and TX. (Late Mar–)Apr–May. Jones et al. (1997) and Hatch (2002) treated this taxon in the genus *Sphenopholis* as [*S. interrupta* (Buckley) Scribn.]; however, we are following Rumley (ined., forthcoming *Flora of North America* treatment) in recognizing it in *Trisetum*.

TRITICUM L. WHEAT

A C_3 genus of 4 (Mabberley 1997) to 10–20 (Tucker 1996) species, depending on the authority. Many cultivated genera have such variation in the number of species due to differing taxonomic interpretations (e.g., depending on whether the variation is recognized at the level of species, subspecies, or variety). *Triticum* species range from the Mediterranean to Iran. The genus is related to *Aegilops*, which may have contributed one or more genomes to polyploid WHEAT (e.g., An et al. 1985). Worldwide, WHEAT (all species together) ranks first in grain production and accounts for more than 20% of total food calories consumed by humans. WHEAT is also the most widely cultivated plant in the world and is thought to have been one of the first two cultivated plants (BARLEY—*Hordeum vulgare*, is the other); as such it was probably important in the development of early civilization in the Near East (Heiser 1990). It is thought to have been domesticated prior to 7,000 BC (Clayton & Renvoize 1986). WHEAT is superior to many other grain crops because of its high (8–14%) protein content (Zohary & Hopf 1994); it is particularly important for bread-making because gluten, the characteristic protein, makes bread dough stick together and gives it the ability to retain gas, thereby making it ideal for making leavened (or raised) bread (Heiser 1990). *Triticum aestivum* (BREAD WHEAT) is the most important temperate cereal and represents ca. 90% of the total world WHEAT crop. Intergeneric hybrids with many other members of the Triticeae are known including *Aegilops*, *Agropyron*, *Elymus*, *Elytrigia*, and *Secale* (Watson & Dallwitz 1992; Saufferer ined.). For example, various

×*Triticosecale* hybrids, the result of hybridization between *Triticum* and *Secale*, "are becoming increasingly important as cereal crops" (Barkworth ined.). While sometimes treated within *Triticum* (e.g., Gould 1975b; Hatch 2002), *Aegilops* appears to be morphologically, ecologically, and phylogenetically distinct (van Slageren 1994; Morrison ined.; Saufferer ined.) and is widely recognized as a separate genus (e.g., Yatskievych 1999; Morrison ined.; Saufferer ined.). The Triticeae has a complex evolutionary history and there is still no general agreement on generic concepts in the tribe (Barkworth 2000). (The classical name for wheat, possibly from Latin: *tritus*, rubbed, in reference to the rubbing or threshing needed to separate the grain from the chaff—Zimdahl 1989) (subfamily Pooideae, tribe Triticeae)

REFERENCES: Bowden 1959; Helbaek 1966; Baum 1982, 1978, 1983; Waines et al. 1982; Löve 1984, An et al. 1985; Gupta & Baum 1986, 1989; Waines & Barnhart 1992; Zohary & Hopf 1994; Tucker 1996; Barkworth 2000; Mason-Gamer & Kellogg 2000; Campbell ined.

Triticum aestivum L., (summer), BREAD WHEAT, WHEAT, COMMON WHEAT. Glabrous annual 40–120 cm tall; culm with internodes usually hollow; ligule a membrane 2–3 mm long; leaf blades prolonged at base into 2 narrow, thin, early-withering, pointed auricles on summit of leaf sheath; spike terminal, unbranched, rather stiff, bilateral, dense, usually 5–12 cm long (excluding awns if present) and ca. 1 cm thick, the spikelets sessile, solitary at each node, borne on opposite sides of the zigzag persistent spike axis (the axis not disarticulating, even under pressure); spikelets ca. 8–15 mm long, 2–5(–9)-flowered, only the lower 2 or 3(–5) florets perfect; glumes ± equal, broadly ovate, (3–)3.6–6.5 mm wide, asymmetrical, 3(–more)-veined, loosely enclosing the florets, awnless or with awn to 60 mm or more long; lemmas broad, slightly keeled, awnless or with awn to 150 mm or more long. Commonly cultivated, sometimes planted for erosion control near construction sites, frequently seen as a transitory escape along highways, railroads, and waste places; scattered throughout TX; throughout most of Canada and the U.S. Apr–May. Along with RICE and CORN, WHEAT is one of the three most important food plants for humans worldwide. It is used to make bread flour, pastry-grade flour, Oriental-style soft noodles, and cereals (Campbell ined.). It is a hexaploid (= 6 sets of chromosomes) species believed to have originated in sw Asia through hybridization between the wild diploid *Aegilops squarrosa* L. and a tetraploid cultivated species, *Triticum turgidum* L. (RIVET WHEAT) (Zohary & Hopf 1994). Like many other cultivated species (e.g., CORN, SUNFLOWER), WHEAT has been artificially selected for retention of the fruits on the inflorescence and thus less loss of the grain crop—therefore disarticulation of the inflorescence does not occur as in non-domesticated members of the genus. WHEAT is sometimes infected by the rust fungus *Puccinia graminis* Pers. (black stem rust of wheat) which can cause significant economic losses; this heterecious (= using more than 1 host to complete its life cycle) rust also infects some species in the genus *Berberis* (e.g., the introduced *B. vulgaris* L.—EUROPEAN BARBERRY). Because of this, the sale or transport of certain BARBERRY species is illegal in the U.S. and Canada. WHEAT pollen is reported to cause hay fever (Steyermark 1963).

UROCHLOA P. Beauv. SIGNAL GRASS, LIVER-SEED GRASS, PARA GRASS

Annuals or perennials, often rooting at lower nodes; ligule a ciliate membrane 2 mm or less long; leaf blades flat, rounded or abruptly narrowed basally; inflorescence a panicle, the primary spike-like branches rebranched or unbranched (inflorescence sometimes resembling that of *Panicum* or *Paspalum*), terminating in a spikelet (unlike those of *Paspalidium* or *Setaria* which terminate in a bristle), the spikelets conspicuously arranged on one side of the branches or not so; inflorescence branches and pedicels often with some long whitish hairs; spikelets usually awnless or with only minute awns, 2-flowered, the lower floret sterile or staminate, the upper perfect; disarticulation below the glumes; glumes usually both present, the first shorter (ca. 1/5–3/4 as long as the second); lower lemma resembling upper glume; lemma of perfect floret hardened, glabrous, usually roughened-rugose, with inrolled margins; stamens 3.

A C_4 genus of ca. 100 species (including most species previously treated in *Brachiaria*) of tropical, subtropical, and warm areas of the world, with greatest diversity in the Old World Tropics (Crins 1991; Wipff & Thompson 2003). Some *Urochloa* species resemble either *Panicum* or *Paspalum* and at times have been placed in those genera. East TX species have in the past been treated in *Panicum* or more commonly in *Brachiaria* (e.g., Correll & Johnston 1970; Gould 1975b; Hatch et al. 1990; Kartesz 1994). However, characters previously used to separate *Brachiaria* and *Urochloa* are unreliable (Webster 1988), and we are following most recent authors (e.g., Webster 1988; Morrone & Zuloaga 1992; Jones et al. 1997; Kartesz 1999; Wipff & Thompson 2003) in treating the species in *Urochloa*. *Brachiaria*, as presently considered in the narrow sense (only ca. 1–3 species), is a small, originally Old World genus now more widely introduced (Morrone & Zuloaga 1992); it is not known from East TX (Fox et al. 1996). The two genera can be distinguished by the fertile (upper) florets (roughened-rugose in *Urochloa*, smooth and shiny in *Brachiaria*). *Urochloa maxima* (Jacq.) R.D. Webster (GUINEA GRASS), native to Africa, is "of immense economic importance in the tropics as a forage crop" (Crins 1991). Other species are used for fodder or as pasture grasses (Watson & Dallwitz 1992). (Presumably from Greek: *ouros*, tail, and *chloa*, grass, in reference to the abruptly awned lemmas of some species—Wipff & Thompson 2003) (subfamily Panicoideae, tribe Paniceae)

REFERENCES: Chase 1920a; Webster 1988; Webster et al. 1989; Crins 1991; Morrone & Zuloaga 1992, 1993; Wipff et al. 1993; Fox et al. 1996; Wipff & Thompson 2003.

1. Spikelets conspicuously (at a quick glance) arranged on one side of each flattened main inflorescence branch, the main branches not rebranched; plants sometimes superficially resembling *Paspalum*.
   2. Plants perennial, large, 90–200(–300) cm tall; nodes villous; inflorescences 5–10 cm wide; species known in East TX only from Jefferson Co. in se corner of the area ____ **U. mutica**
   2. Plants annual, smaller, to 60(–100) cm tall; nodes glabrous or with sparse pubescence; inflorescences 2–5 cm wide; species widespread in East TX.
      3. Spikelets small, 1.8–2.2 mm long, mostly in unequally pedicelled pairs except near branch tips; lower glume clearly much less than 1 mm long (0.2–0.5 mm); inflorescence branches 3(–4) cm or less long; culms ca. 35 cm or less tall ____ **U. reptans**
      3. Spikelets relatively larger, 3.5–4.5(–5) mm long, solitary at mid-branch; lower glume 1.2–1.8 mm long; inflorescence branches 3–8 cm long; culms 30–60(–100) cm tall ____ **U. platyphylla**

1. Spikelets not conspicuously arranged on one side of each flattened inflorescence branch, the main inflorescence branches sometimes rebranched; plants sometimes superficially resembling *Panicum*.
   4. Branches at lowest node of inflorescence in whorls; inflorescence an open panicle, the primary branches with secondary and tertiary branches; plants perennial ____ **U. maxima**
   4. Branches at lowest node of inflorescence not in whorls; inflorescence usually with spikelike branches, these unbranched or sometimes with secondary branches; plants annual or perennial.
      5. Spikelets 1.8–2.2 mm long; lower glume 0.5 mm or less long ____ **U. reptans**
      5. Spikelets usually 2.4–6 mm long; lower glume (0.6–)1–ca. 4 mm long.
         6. Lower glume ca. 2/3–3/4 as long as spikelet, ca. (2.3–)3–4 mm long; spikelets (3–)3.5–6 mm long; upper glume densely long-hairy OR not so.
            7. Spikelets (3–)3.5–4.5 mm long; upper glume densely long-hairy; inflorescences 2–7 cm long ____ **U. ciliatissima**
            7. Spikelets 5–6 mm long; upper glume glabrous or with scattered hairs, not densely long-hairy; inflorescences usually 7–25 cm long ____ **U. texana**
         6. Lower glume 1/4–1/2 as long as spikelet, 1.5 mm or less long; spikelets 2.4–3.5 mm long; upper glume glabrous.
            8. Upper glume with distinct cross veins; upper glume and lemma of lower floret glabrous; lemma of lower floret with 7 veins ____ **U. fusca**

8. Upper glume without distinct cross veins; upper glume and lemma of lower floret usually puberulent; lemma of lower floret with 5 veins _____ **U. ramosa**

Urochloa ciliatissima (Buckley) R.D. Webster, (very fringed with hairs), FRINGED SIGNAL GRASS, FRINGED LIVER-SEED GRASS, SANDHILL GRASS. Perennial 10–50 cm tall; culms erect or usually decumbent below; inflorescence with few, short, spreading or ascending branches and relatively few spikelets; spikelets (3–)3.5–4.5 mm long; lower glume glabrous, ca. 3/4 as long as spikelet; upper glume densely long-hairy; lemma of sterile floret glabrous except for pilose margins. Rocky or sandy open sites; widespread in TX but more commonly in the s and w parts of the state; AR, NM, OK, and TX. May–Sep. [*Brachiaria ciliatissima* (Buckley) Chase]

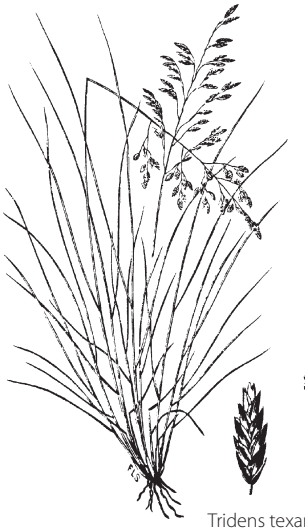
Urochloa fusca (Sw.) B.F. Hansen & Wunderlin, (brown, dusky), HURRAH GRASS, BROWNTOP, BROWN-TOP SIGNAL GRASS, FIELD GRASS, BROWN-TOP LIVER-SEED GRASS. Annual with spreading to erect, branching culms 10–85 cm long; inflorescence with primary branches appressed or erect-spreading, unbranched or sometimes rebranched, the branches and pedicels often with some long whitish hairs; spikelets 2.4–3.5 mm long; lower glume 1/4–1/3 as long as spikelet; glumes and lemma of lower floret glabrous, often brownish. Dried-up pond or stream margins, roadsides, disturbed sites; throughout much of TX but less common in the Pineywoods and Panhandle; s U.S. from FL w to AZ. May–Oct. [*Brachiaria fasciculata* (Sw.) Parodi, *Brachiaria fasciculata* var. *reticulata* (Torr.) Vickery, *Panicum fasciculatum* Sw. var. *reticulatum* (Torr.) Beal, *Panicum reticulatum* Torr., *U. fasciculata* var. *reticulata* (Torr.) R.D. Webster—invalid] The complicated nomenclatural history of this species was discussed by Wunderlin and Hansen (2001).

Urochloa maxima (Jacq.) R.D. Webster, (largest), GUINEA GRASS, GUINEA LIVER-SEED GRASS. Rhizomatous perennial; culms (0.6–)1–2.5 m tall; inflorescence an open panicle 20–50(–65) cm long, the branches at lowest node in whorls, the primary branches with secondary and tertiary branches (the plant thus superficially very much resembling *Panicum*); spikelets 2.7–3.6 mm long, glabrous; lower glume ca. 1/3 as long as spikelet. Weedy areas, presumably escaping from cultivation; Harris (*Brown 24214*, SBSC), Bell, Dallas, Travis, and Williamson (Barkworth et al. 2002) cos.; also Galveston Co. (SBSC, TAES); scattered in the s U.S. in CA, FL, GA, LA, OK, and TX. Sep–Nov. Native of Africa. [*Panicum maximum* Jacq.] This species is an important forage grass, particularly in tropical-subtropical pastures (Gould 1975b). ☜

Urochloa mutica (Forssk.) T.Q. Nguyen, (blunt, pointless), PARA LIVER-SEED GRASS, PARA GRASS. Perennial with culms long, decumbent and rooting at lower nodes, the upright portion usually 90–200(–300) cm tall; inflorescence with 10–30 unbranched, spike-like branches, the branches 2.5–8 cm long; spikelets 2.5–3.5 mm long; lower glume 1/5 –1/3 as long as spikelet. Moist disturbed areas; Jefferson Co. (BRIT, TAES) at se corner of East TX; a Brazos Co. record (Turner et al. 2003) was collected at the Agricultural Experiment Station and is therefore presumably cultivated; mainly s tip of TX; AL, FL, SC, and TX. Sep–Dec. Native of Africa. [*Brachiaria mutica* (Forssk.) Stapf, *Panicum muticum* Forssk., *Panicum purpurascens* Raddi] This species is grown as a forage crop in the tropics (Wipff & Thompson 2003). ☜

Urochloa platyphylla (Munro ex C. Wright) R.D. Webster, (broad-leaved), BROAD-LEAF SIGNAL GRASS, BROAD-LEAF LIVER-SEED GRASS. Coarse annual with decumbent and spreading culm bases, ca. 30–60(–100) cm tall; inflorescence with primary branches unbranched, the branches 3–8 cm long, widely spaced, winged (the plant thus superficially very much resembling *Paspalum*); spikelets 3.5–4.5(–5) mm long, without a distinct tuft of hairs at base; lower glume 1/4–1/3 as long as spikelet; glumes and lemma of lower floret glabrous. Disturbed areas, roadsides, ditches; in much of the e 1/2 of TX; se U.S. from VA s to FL w to MO, OK, and TX. Apr–Nov. [*Brachiaria platyphylla* (Munro ex C. Wright) Nash, *Paspalum platyphyllum* Griseb. not Schult.] See note at *U. mosambicensis* (following *U. texana*).

Urochloa ramosa (L.) R.D. Webster, (branched), BROWNTOP-MILLET, DIXIE LIVER-SEED GRASS. Annual; culms 25–100 cm tall; inflorescence branches ascending, often rebranched; spikelets (2.4–)

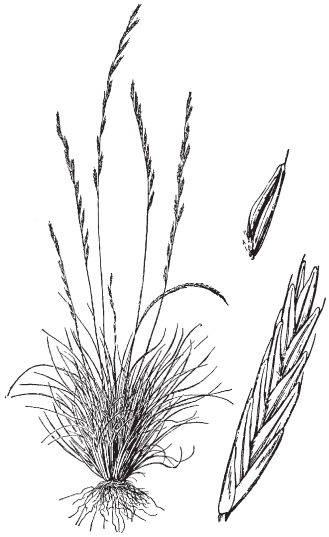


Tridens texanus [HI2, USB]





Triplasis purpurea [BB2]



Tripogon spicatus [HI1]



Tripsacum dactyloides [HI1]



Trisetum interruptum [USB]



Triticum aestivum [HI1]



Urochloa ciliatissima [GO4]



Urochloa fusca [GO1]

3–3.5 mm long; lower glume ca. 1/3–1/2 as long as spikelet, glabrous; upper glume and lemma of lower floret usually puberulent. Planted for erosion control and wildlife food (Brown & Marcus 1998) and escaping on roadsides; Brazos, Liberty, and Montgomery (TAES) cos.; also Chambers Co. in n Gulf Prairies and Marshes (SBSC, TAES, Brown & Marcus 1998); se U.S. from VA s to FL w to AR and TX. Jul–Oct. Native of Africa and Asia (Crins 1991). [*Brachiaria ramosa* (L.) Stapf, *Panicum ramosum* L.] This species was first reported for TX by Brown and Marcus (1998).

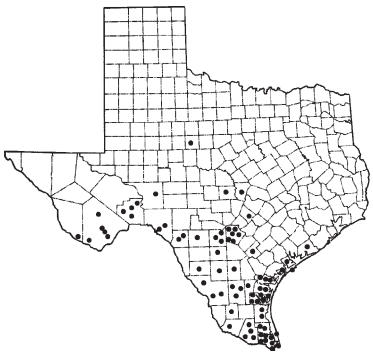
Urochloa reptans (L.) Stapf, (creeping), SPRAWLING LIVER-SEED GRASS, SPRAWLING SIGNAL GRASS. Mat-forming annual to ca. 35 cm tall; inflorescence branches ascending, sometimes rebranched basally; spikelets 1.8–2.2 mm long (smallest of East TX species); lower glume ca. 1/5–1/4 length of spikelet; glumes and lemma of lower floret glabrous. Planted for erosion control and wildlife food (Brown & Marcus 1998), adventive on roadsides, disturbed sites; widespread in s part of East TX; also Gulf Prairies and Marshes and South TX Plains; AL, GA, LA, and TX. Aug–Oct. Native of tropical Asia. [*Brachiaria reptans* (L.) C.A. Gardener & C.E. Hubb., *Panicum prostratum* Lam., *Panicum reptans* L.]

Urochloa texana (Buckley) R.D. Webster, (of Texas), TEXAS SIGNAL GRASS, TEXAS PANICUM, TEXAS-MILLET, COLORADO GRASS, TEXAS LIVER-SEED GRASS, CONCHO GRASS. Coarse annual, erect or decumbent at base, 40–120 cm tall; inflorescence compact with erect-appressed branches, the branches usually unbranched; spikelets 5–6 mm long; lower glume ca. 2/3 as long as spikelet, strongly 5–7 veined; upper glume and lemma of lower floret with scattered hairs. Moist, disturbed soils; nearly throughout TX except Trans-Pecos and Panhandle; s 1/3 of the U.S. from SC s to FL w to CA, also MA. May–Nov. [*Brachiaria texana* (Buckley) S.T. Blake, *Panicum texanum* Buckley]

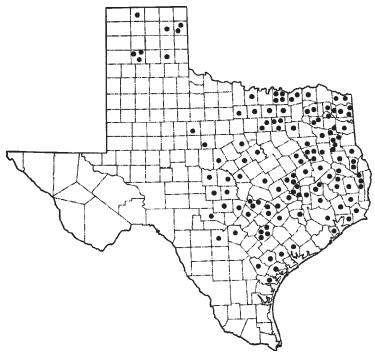
Urochloa mosambicensis (Hack.) Dandy, (for Mozambique, a country of se Africa between Tanzania and South Africa), MOZAMBIQUE LIVER-SEED GRASS, SABI GRASS. This weedy African perennial is present in s TX, and was mistakenly reported by Turner et al. (2003) for Bexar and Travis counties, based on cultivated material inadvertently entered into the Digital Flora of Texas Herbarium Specimen Browser (2002). We do not consider it to be a member of the East TX flora. The species was first reported for TX by Wipff et al. (1993). It may be recognized by the following characters: inflorescence with (2–)3–6(–15) primary branches, these unbranched, very dense with spikelets (thus superficially resembling *Paspalum*); pedicels with 1–3 conspicuous hairs nearly as long as spikelets; and spikelets (3–)4–4.7(–5) mm long, often with a tuft of whitish hairs at base. This species resembles *U. platyphylla* in spikelet size and arrangement (conspicuously arranged on one side of each flattened main inflorescence branch). The two can be distinguished as follows:

1. Pedicels sparsely pilose with hairs ca. 1 mm long or less; lower glume ca. 1/4–1/3 as long as spikelet, 1.2–1.8 mm long, glabrous; spikelets uncrowded enough so as to appear as if in one row (with spikelets slightly overlapping) along the inflorescence branches _____ *U. platyphylla*
1. Pedicels with 1–3 conspicuous hairs nearly as long as spikelets (to ca. 5 mm long); lower glume (1/2–)2/3–3/4 as long as spikelet, (2–)2.8–3.5 mm long, usually with 1–3 long hairs from the surface; spikelets so crowded as to appear in ca. 3–4 rows _____ *U. mosambicensis*

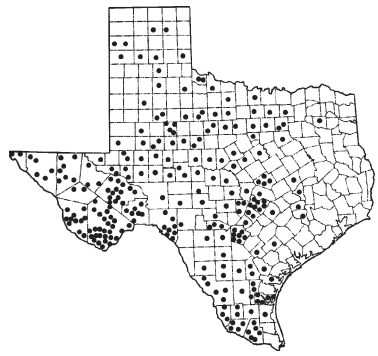
Urochloa panicoides P. Beauv., (resembling *Panicum*, panic grass), PANIC LIVER-SEED GRASS, LIVERSEED GRASS. [*Panicum panicoides* (P. Beauv.) Hitchc.] This weedy African native is found naturalized to the s of East TX in the Gulf Prairies and Marshes and South TX Plains (Wipff et al. 1993); it is also reported from AZ (Wipff & Thompson 2003), MD, and NM (Kartesz 1999). It resembles *U. mosambicensis* and *U. platyphylla* in spikelet size and arrangement (conspicuously arranged on one side of the flattened main inflorescence branches). It can be distinguished by the following combination of characters: lower glume 1/2 or less as long as the spikelet, 1.3–1.6 mm long, glabrous (similar to *U. platyphylla*); pedicels with 1–3 conspicuous hairs to 5 mm long (similar to *U. mosambicensis*). This species is designated a U.S. federal noxious weed (Kartesz 1999; USDA Natural Resources Conservation Service 2002).



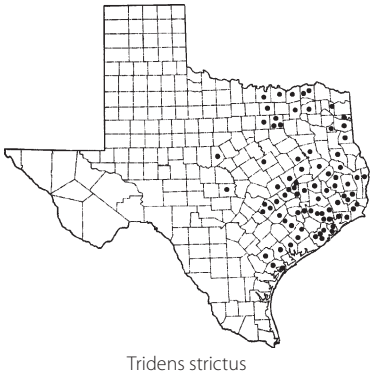
Tridens eragrostoides



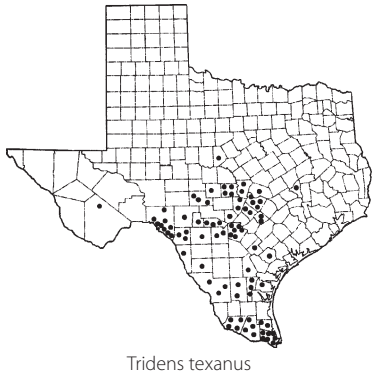
Tridens flavus
(both vars.)



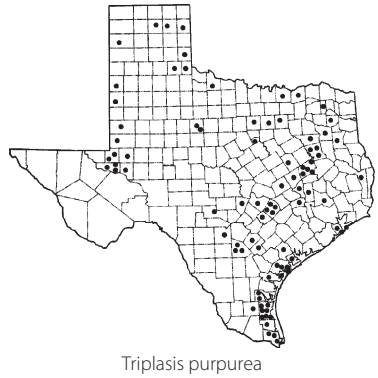
Tridens muticus
(both vars.)



Tridens strictus



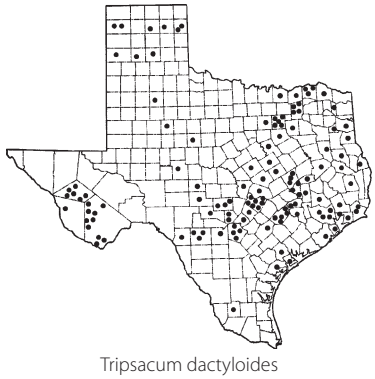
Tridens texanus



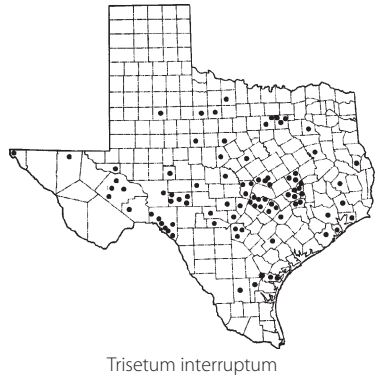
Triplasis purpurea



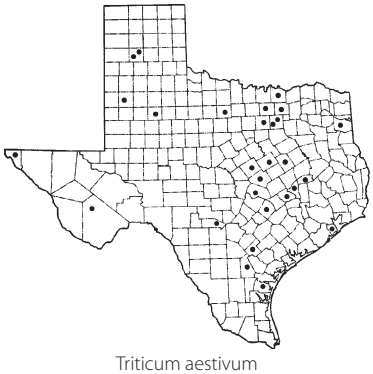
Tripogon spicatus



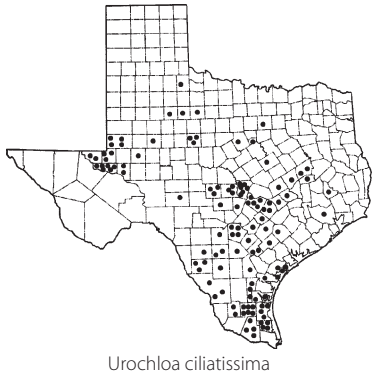
Tripsacum dactyloides



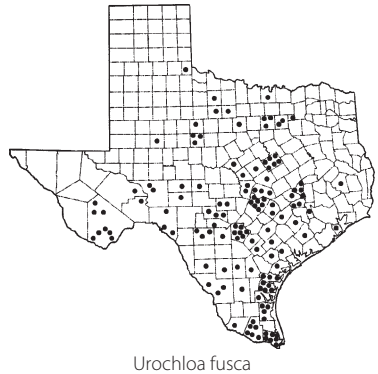
Trisetum interruptum



Triticum aestivum



Urochloa ciliatissima



Urochloa fusca

Urochloa plantaginea (Link) R.D. Webster, (resembling *Plantago*—plantain), PLANTAIN SIGNAL GRASS, CREEPING SIGNAL GRASS, PLANTAIN LIVER-SEED GRASS. [*Brachiaria plantaginea* (Link) Hitchc., *Panicum plantagineum* Link] Gould (1975b) noted that the species had been reported by "Gould (1969) for region 1, presumably based on *Shinners 15714*, but the Tracy Herbarium specimen annotated by Shinners in 1953 as *B. plantaginea* appears referable to *B. platyphylla*." Hatch et al. (1990) reported it for vegetational area 1. However, we have seen no East TX specimens and neither Hatch (2002) nor Wipff and Thompson (2003) list it for TX—we therefore do not consider *U. plantaginea* to be a member of the East TX flora. It is found in much of se U.S. from GA and FL w to TX[?], also MD, NJ, and PA. Native to western and central Africa (Wipff & Thompson 2003). This species resembles *B. mosambicensis* and *B. platyphylla* in spikelet arrangement (conspicuously arranged on one side of the flattened main inflorescence branches), but it can be recognized by the following combination of characters: spikelets ca. 4.5–6 mm long; lower glume 1.9–2.2 mm long, ca. 1/3 as long as spikelet or less, glabrous.

VULPIA C.C. Gmel.

SIXWEEKS GRASS, SIXWEEKS FESCUE GRASS, ANNUAL FESCUE

Annuals, tufted, usually small (75 cm or less tall); leaf blades 0.1–2.5(–3) mm wide; leaf sheaths open, glabrous; ligule a short membrane; inflorescence a usually contracted, ± 1-sided panicle or spicate raceme; spikelets with 3–17 florets, the upper 1–3 usually sterile; disarticulation above glumes and between florets; glumes unequal, much shorter than spikelet; lemmas not toothed at apex, awned or awnless, the backs rounded, not plainly veined except at apex; stamen usually 1 per floret (infrequently 3); flowering in spring.

A C_3 genus of 30 species (Lonard ined.) of annuals found in the n temperate zone (especially Europe and the Mediterranean) and temperate South America (Cotton & Stace 1977; Tucker 1996). It is distinguished by its annual habit and usually 1 stamen per floret. A number of workers (e.g., Bulinska-Radomska & Lester 1988) have noted similarities between the genera *Festuca, Lolium*, and *Vulpia,* and *Vulpia* has been treated as part of the genus *Festuca* by some authorities. Hybrids have also been found between *Vulpia* and both *Festuca* and *Lolium* (Ainscough et al. 1986; Lonard ined.). It is possible that *Vulpia* may be more closely related to *Lolium* (Tucker 1996). Some molecular studies (e.g., Charmet et al. 1997) indicate that *Lolium*, *Vulpia*, and possibly *Dactylis* are derived from within *Festuca* and raise the possibility that *Festuca* might even be polyphyletic. A more recent study (Torrecilla & Catalán 2002) suggests that *Festuca* in the broad sense (including *Lolium* and *Vulpia*) is monophyletic and that *Vulpia* is most closely related to the group known as the "fine-leaved fescues." It is thus not yet clear what is the best arrangement of these genera (e.g., one large genus, a number of smaller genera, etc.). We are therefore following such recent authors as Yatskievych (1999) in recognizing *Vulpia* and in retaining subgenus *Schedonorus* (e.g., *F. arundinacea*) in *Festuca*, rather than transferring it to *Lolium*, at least for the present. (Named for J.S. Vulpius, 1760–1846, pharmacist-botanist of Baden, Germany) (subfamily Pooideae, tribe Poeae)

REFERENCES: Lonard & Gould 1974; Cotton & Stace 1977; Stace & Jarvis 1985; Bulinska-Radomska & Lester 1988; Darbyshire & Warwick 1992; Tucker 1996; Torrecilla & Catalán 2002; Lonard ined.

1. Lower glume often very small, inconspicuous, 0.5–1.5(–2.5) mm long, less than half as long as upper (usually one-third or less); inflorescence often not completely exserted from sheath; lemma awn 7.5–22 mm long ____ **V. myuros**
1. Lower glume (1.3–)1.6–5 mm long, half as long as the upper or more; inflorescence usually well-exserted from sheath; lemma awn 0–12(–15) mm long.
   2. Lemmas nearly awnless or with awn usually shorter than lemma body, the lemma awn 0.3–7(–9) mm long; spikelets with 5–17 florets ____ **V. octoflora**

2. Lemmas (except lowest) usually with awn longer than lemma body, the lemma awn 3–12 (–14) mm long; spikelets with 3–6(–7) florets.
   3. Lemma of lowermost floret 2.5–3.5 mm long; spikelets 3.5–5 mm long (excluding awns); lower glume 1.3–2.7 mm long; lemmas pubescent; caryopsis (= fruit) 1.5–2 mm long _____ **V. sciurea**
   3. Lemma of lowermost floret 3.5–7.5 mm long; spikelets 5–12 mm long (excluding awns); lower glume (2.5–)3.5–5 mm long; lemmas glabrous, scabrous, or puberulent; caryopsis 3–5.5 mm long _____ **V. bromoides**

Vulpia bromoides (L.) Gray, (like *Bromus*), BROME SIXWEEKS GRASS, BROME FESCUE. Plant 5–50 cm tall; panicle 5–15 cm long, well-exserted; upper glume 4.5–7(–9.5) mm long; lemmas glabrous, scabrous, or puberulent, with awn 3–12(–15) mm long. Prairies, disturbed habitats; Hunt (Clymer Meadow—BRIT), Brazos, Jasper, Robertson, and Washington (Turner et al. 2003) cos.; also Hamilton Co. (Stanford 1971) in Cross Timbers and Prairies; while reported from vegetational areas 1, 3, 4, and 7 by Gould (1975b), and vegetational areas 1 and 3 by Hatch (2002), we have not seen other specimens; w Canada and scattered in the U.S., particularly in the se and w. Spring. Native of Europe. [*Festuca bromoides* L., *V. dertonensis* (All.) Gola] This species is considered a significant weed by some authorities (e.g., Watson & Dallwitz 1992).

Vulpia myuros (L.) C.C. Gmel., (mouse-tail), RAT-TAIL SIXWEEKS GRASS, RAT-TAIL FESCUE, FOXTAIL FESCUE. Plant 15–75 cm tall; panicle narrow, 3–25 cm long, usually only partially exserted from the sheath; spikelets 5–12 mm long, with 3–7 florets; lemmas scabrous or ciliate, with awn 7.5–22 mm long. Disturbed areas, roadsides; widespread in East TX; also Tarrant Co. (Turner et al. 2003) in the Cross Timbers and Prairies and Sutton Co. (Turner et al. 2003) on the Edwards Plateau; se and w Canada and most of the U.S. except the nc part of the country. Apr–May. Native of Europe and n Africa. [*Festuca myuros* L., *V. myuros* var. *hirsuta* Hack.] Individuals with lemmas marginally ciliate near their apex have sometimes been separated as var. *hirsuta* (e.g., Hatch 2002). However, we are following Kartesz (1999), Yatskievych (1999), and Lonard (ined.) in not recognizing this variety. Lonard (ined.) treats such individuals as forma *megalura* (Nutt.) Stace & R. Cotton. This species is considered a significant weed by some authorities (e.g., Watson & Dallwitz 1992).

Vulpia octoflora (Walter) Rydb., (eight-flowered), COMMON SIXWEEKS GRASS, EIGHT-FLOWER SIXWEEKS GRASS, SIXWEEKS FESCUE. Plant 10–60 cm tall; panicle usually 1–7(–20) cm long, rather dense, usually narrow, erect or with slightly drooping tip; lemmas glabrous, scabrous, or pubescent, with awn 0.3–7(–9) mm or less long. Disturbed sandy or sandy clay soils, limestone gravel, eroding clay, open areas; throughout TX; the county distribution map provided does not distinguish varieties. Apr–May. This species is frequently seen growing on seed harvester ant mounds. Three varieties, separated by Gould (1975b) as follows (with slight modifications), occur in East TX; however, they intergrade and are separated with extreme difficulty. Lonard (ined.), while recognizing the three varieties, notes that "their characterization is not completely satisfactory."

1. Spikelets, excluding awns, usually 4–5(–6) mm long; awn of lowermost floret 0.3–3 mm long _____ var. **glauca**
1. Spikelets, excluding awns, 5.5–10 mm long; awn of lowermost floret 2.5–7(–9) mm long.
   2. Lemmas sparsely to densely pubescent or long scabrous _____ var. **hirtella**
   2. Lemmas glabrous or slightly scabrous _____ var. **octoflora**

var. **glauca** (Nutt.) Fernald, (whitened with a coating or bloom). Lemma bodies 2.5–4.5 mm long. Pineywoods w to Rolling Plains and s to Edwards Plateau; se and sw Canada and throughout most of the U.S. [*Vulpia octoflora* var. *tenella* (Willd.) Fernald]

var. **hirtella** (Piper) Henrard, (somewhat hairy), HAIRY SIXWEEKS GRASS. Lemma bodies ca. 3–6 mm long. Bexar, Colorado, Guadalupe, Leon, McLennan, Sabine, Wilson (BRIT), and Lamar (Carr 1994) cos.; nearly throughout TX; sw Canada (B.C.), most of the w 1/2 of the U.S. and FL.

var. **octoflora**, COMMON SIXWEEKS GRASS. Lemma bodies 3.5–6.5 mm long. Pineywoods and Gulf Prairies and Marshes w to West Cross Timbers and Edwards Plateau; sw Canada and throughout most of U.S. [*Festuca octoflora* Walter] This is apparently the most common variety in East TX.

Vulpia sciurea (Nutt.) Henrard, (squirrel), SQUIRREL SIXWEEKS GRASS, SIXWEEKS FESCUE, SQUIRREL-TAIL FESCUE. Plant 15–60 cm tall; panicles narrow, elongate, 5–20 cm long, drooping toward tip; upper glume 2.3–4 mm long; lemmas pubescent, particularly near apex, with awn 4.5–10 mm long. Loose sandy soils; scattered in e 1/2 of TX; e U.S. from NJ s to FL w to IA and TX. Apr–early May. [*Festuca sciurea* Nutt., *Vulpia elliotea* (Raf.) Fernald] There has been disagreement over the correct nomenclature for this species. While it has often been known as *V. elliotea* (e.g., Gleason & Cronquist 1991; Fernald 1950a; Kartesz 1999; Yatskievych 1999), we are following a number of recent authorities (e.g., Tucker 1996; Hatch 2002; Lonard ined.) in considering *sciurea* the correct epithet if the taxon is treated in *Vulpia* (rather than in *Festuca*). Lonard (ined.) considers this to be the most distinct *Vulpia* species native to North America—it has a "narrow panicle, small spikelets, and apically pubescent lemmas."

WILLKOMMIA Hack. WILLKOMMIA

A C_4 genus of 3 species with an unusual disjunct distribution—3 species in s tropical Africa and one in the New World, including TX (Clayton & Renvoize 1986; Wipff 2003c). (Named for Heinrich Moritz Willkomm, 1821–1895, student of Spanish flora and successively professor of botany at Tharandt, Dorpat, and Prague) (subfamily Chloridoideae, tribe Cynodonteae)
REFERENCES: Hitchcock 1903; Wipff 2003c.

Willkommia texana Hitchc. var. **texana**, (of Texas), TEXAS WILLKOMMIA. Tufted perennial, not stoloniferous; culms 20–40 cm tall; leaves mostly basal, the blades 1–3 mm wide; ligule a minute fringe of cilia, 0.6 mm or less long or obsolete; inflorescence a very narrow spike-like panicle 7–18 cm long, 3–10 mm wide, with spikelets in 2 rows along the short (ca. 2–4 cm long) appressed branches; spikelets 1-flowered, sessile, awnless, 3.5–5 mm long, disarticulating above the glumes; glumes glabrous, unequal, the lower glume ca. 1/2–2/3 as long as the upper, rounded and membranous apically, the upper glume slightly longer than lemma, 1-veined, acute; lemma with appressed hairs on back and densely appressed ciliate marginally. Bare clay or sandy soils, sometimes in saline or alkaline conditions; Harris Co. (BRIT) at s margin of East TX, Ellis Co. (Hitchcock 1903) in the n Blackland Prairie, and a recent Anderson Co. collection (*Keith 601*, Sep 2003, open saline prairie, SBSC) in between; listed variously as restricted to the Pineywoods and Gulf Prairies and Marshes (Gould 1975b), the Gulf Prairies and Marshes and Post Oak Savannah (Hatch et al. 1990; Hatch 2002), or primarily Gulf Prairies and Marshes (Carr 2001; Turner et al. 2003); endemic to TX (Kartesz 1999; Carr 2002b, 2002c), though apparently recently introduced to OK (Wipff 2003c). The type specimen is from Ennis (Ellis Co.) (Hitchcock 1903). Variety *stolonifera* Parodi, (stolon-bearing), is disjunct to Argentina. The two varieties are similar, with var. *stolonifera* being stoloniferous versus tufted. Mainly Apr–Jun. (RARE 2001, 2002b: G3G4T3S3) ⚠

ZEA L. MAIZE, CORN

The genus consists of 5 species (Iltis 2003). Four are native to Mexico and Central America, and the fifth, MAIZE, is one of the most important New World cultivated crops. *Zea* is related to *Tripsacum* (Clayton & Renvoize 1986). Like all members of the Andropogoneae, it is characterized by C_4 photosynthesis (Kellogg 2000a). According to Iltis (2003), "The often weedy, wild taxa, known as 'teosinte' ... " have been used in plant breeding as well as in developmental, evolutionary, physiological, and genetic research. The genus has been the subject of other important research such as the Nobel prize-winning discovery by Barbara McClintock of "jumping genes," which can move from one chromosome to another. The common name is from "Spanish *maiz*,



Urochloa maxima [HI1]



Urochloa mutica [HI1]



Urochloa platyphylla [USB]



Urochloa ramosa [FNA]



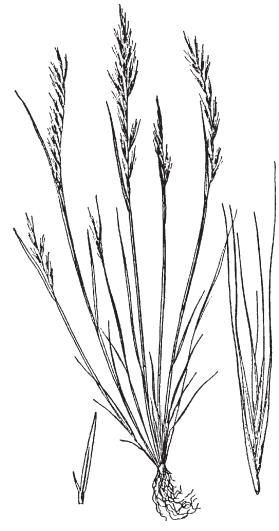
Urochloa reptans [USB]



Vulpia bromoides [USH]



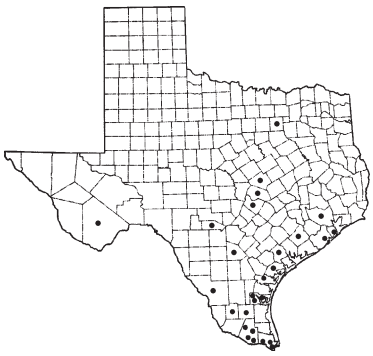
Urochloa texana [GO1, USB]



Vulpia myuros [USB]

which in turn is derived from *mahiz*, a Haitian word which Columbus adopted for this grain" (Shosteck 1974). The widely used English common name, CORN, is related to the German *Korn*, which may be a corruption of the Latin *granum*, seed or small kernel (Shosteck 1974). (Greek: *zea* or *zeia*, a kind of grain—Iltis 2003) (subfamily Panicoideae, tribe Andropogoneae)
REFERENCES: Finan 1948; Iltis 1972, 1983, 1987, 2000, 2003; Doebley & Iltis 1980; Iltis & Doebley 1980; Crosswhite 1982; Doebley et al. 1987, 1995; Doebley 1989, 1990, 1996; Gaut & Doebley 1997; Provan et al. 1999; Benz 2001; Eubanks 2001; Piperno & Flannery 2001; Smith 2001; Matsuoka et al. 2002; Westerbergh & Doebley 2002; Hancock 2004.

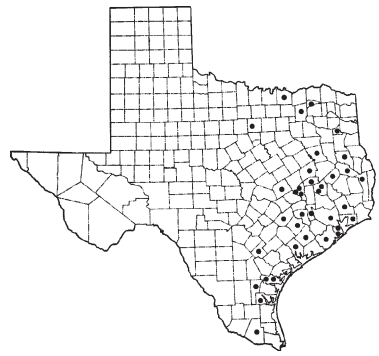
Zea mays L. subsp. **mays**, (from an aboriginal name), MAIZE, CORN, INDIAN CORN. Large, coarse, monoecious annual to ca. 4+ meters tall; culms succulent, to 5 cm in diam.; leaves mostly cauline, 2-ranked; ligule a short membrane; leaf blades very broad (to 10–80 mm wide), flat, with auricled base; pistillate spikelets sessile, numerous, paired in several rows on a much thickened, woody-corky axis (= cob), the whole cylindrical inflorescence (= ear) not disarticulating, covered by modified leaves or bracts (= shucks or husks), each pistillate spikelet with 2 florets, the upper perfect, the lower usually sterile and reduced; styles (= silk) elongated, unbranched, dangling from the inflorescence; staminate spikelets resembling those of *Tripsacum*, in pairs on a terminal panicle (= tassle) with spike-like branches, 1 spikelet of each pair with pedicels 3–6 mm long, the other nearly sessile; pedicelled and sessile spikelets similar, each with 2 staminate florets. Widely cultivated and occasional as a transitory escape along roads, disturbed sites, or waste areas; McLennan (BRIT) and Grayson (G. Diggs, pers. obs.) cos., though not often collected, probably on roadsides in numerous counties where cultivated; throughout TX; se Canada and throughout most of the U.S. May–Jul, sporadically to Oct. Because artificial selection by humans has resulted in MAIZE being quite different from any other grass (particularly in terms of its pistillate inflorescence), there has long been disagreement over its origin. Based on numerous molecular and morphological studies (see Doebley and/or Iltis references above), MAIZE is now generally accepted to be derived from a wild Mexican grass, TEOSINTE—*Z. mays* L. subsp. *parviglumis* H.H. Iltis & Doebley (Iltis 2000). Further, MAIZE is fully interfertile with TEOSINTE, a fact of importance to corn geneticists, and introgression between MAIZE and TEOSINTE can occur. However, Eubanks (2001) has suggested that *Tripsacum* may also be involved in the origin of cultivated MAIZE—successful crosses have been made between *Zea diploperennis* H.H. Iltis, Doebley & Guzmán (a diploid, perennial TEOSINTE) and *Tripsacum dactyloides*, with some of the resulting progeny having features resembling ancient MAIZE (Eubanks 2001). Nonetheless, genetic research over the past three decades has "overwhelmingly established ... teosinte as the solitary wild ancestor of maize" (Smith 2001). MAIZE has long been cultivated (first domesticated about 6,000–9,000 years ago) by Native Americans and was soon widely planted from North to South America, but it is thought to have originated in Mexico (Mabberley 1987; Doebley 1990; Heiser 1990; Benz 2001; Piperno & Flannery 2001; Matsuoka et al. 2002; Iltis 2003). Recent molecular evidence (Matsuoka et al. 2002) suggests that all modern MAIZE strains can trace their origins to a single domestication in southern Mexico. This species was very important in pre-Columbian Mesoamerica as part of the maize/beans/squash agricultural system. Along with WHEAT and RICE, MAIZE is one of the three most important food plants for humans worldwide; while world MAIZE production is nearly as great as that for either WHEAT or RICE, a much higher percentage of MAIZE is used for animal food (Chrispeels & Sadava 1977). Overall, MAIZE is considered the "world's third most important crop plant," and "No other American grass has such agricultural importance" (Iltis 2003). MAIZE can also be converted to alcohol, some of which is used as a substitute for gasoline in motor vehicle fuel (however, such a use is questionable due to the high energy costs of producing MAIZE). There are various other uses—e.g., the shucks as a covering for the cooking of tamales. Hundreds of indigenous races exist (particularly in Mexico), and numerous cultivars have been developed. According to Iltis (2003), "Supersweet cultivars have a double recessive gene that delays the conversion of sugar to starch; flint corns have unusually hard endosperm; and waxy cultivars have endosperm with an unusually high level of proteins and oils.



Urochloa maxima



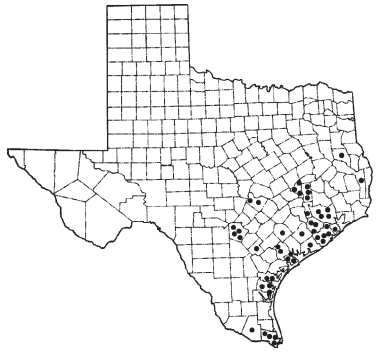
Urochloa mutica



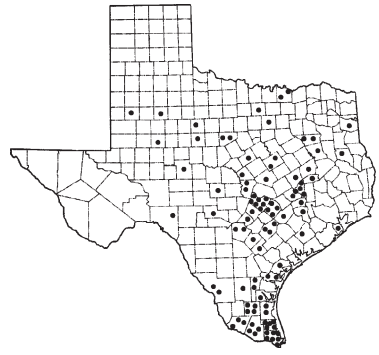
Urochloa platyphylla



Urochloa ramosa



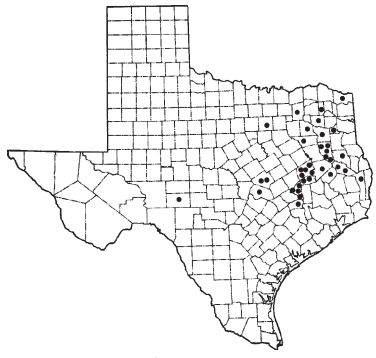
Urochloa reptans



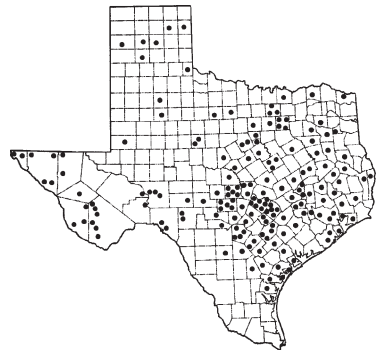
Urochloa texana



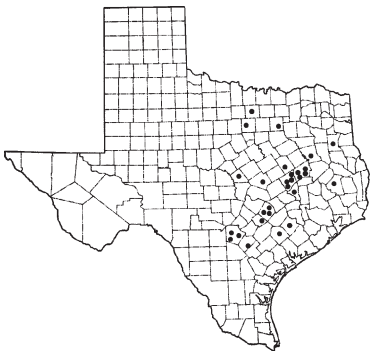
Vulpia bromoides



Vulpia myuros



Vulpia octoflora
(all three vars.)



Vulpia sciurea



Willkommia texana



Zea mays

Popcorns have a core of soft, relatively moist endosperm surrounded by hard endosperm. The grains 'pop' when heat causes the moisture of the inner endosperm to vaporize." Cultivars with colored grains (e.g., blue corn) were used ritually by Native Americans. The leaves of CORN sometimes have lesions caused by the rust fungus *Puccinia sorghi* Schwein. (J. Hennen, pers. comm.). Animals turned into cornfields after harvest sometimes develop "cornstalk disease," possibly as a result of cyanide or (more likely) nitrate toxicity (Burrows & Tyrl 2001).

ZIZANIA L. WILD RICE

Aquatic, monoecious, nearly glabrous annuals or perennials; culms erect or long-streaming in flowing water, unbranched; leaves basal and cauline; ligule a membrane, ca. as long as width of leaf blade; leaf blades flat; inflorescence a panicle, with staminate spikelets on lower branches and pistillate on upper; spikelets with a single floret, disarticulating below the lemma; glumes absent; staminate and pistillate spikelets very different in appearance; staminate spikelets pendulous, with lemma awnless or nearly so; stamens 6; pistillate spikelets appressed, with lemma long-awned.

A C_3 genus of 4 species, 3 in North America (primarily eastern) and 1 in e Asia (Terrell et al. 1997; Terrell ined.); this classic disjunct distribution pattern is discussed under the genus *Brachyelytrum* (Poaceae). Molecular evidence suggests that within the Oryzeae, *Luziola* and *Zizaniopsis* appear most closely allied, with *Zizania* relatively closely related. *Leersia* and *Oryza*, which appear to be each other's closest relatives, are in a second monophyletic lineage within the Oryzeae (Ge et al. 2002). WILD RICE has long been used by Native Americans for food (Johnson 1969), and *Z. palustris* L., NORTHERN WILD RICE, is still an important food, harvested in the wild and cultivated in MN, CA, Ontario, and Saskatchewan (Terrell et al. 1997). Both *Z. palustris* and *Z. aquatica* "are important constituents of aquatic plant communities in North America, providing food and shelter for numerous animal species" (Terrell ined.). The Asian *Z. latifolia* (Briseb.) Stapf is cultivated for its edible young shoots, especially those forms with culms swollen from infection by a smut fungus, *Ustilago esculenta* Henn. (Terrell & Batra 1982; Watson & Dallwitz 1992; Mabberley 1997; Terrell ined.). The following treatment draws heavily on Terrell et al. (1997) and Terrell (ined.). (Greek: *zizanion*, old name for a weed growing in grain—Terrell et al. 1997) (subfamily Ehrhartoideae, tribe Oryzeae)

REFERENCES: Fassett 1924; Emery 1967, 1977; Johnson 1969; Terrell et al. 1978, 1997; Emery & Guy 1979; Warwick & Aiken 1986; Duvall & Biesboer 1988a, 1988b, 1989; Tucker 1988; Duvall et al. 1993a; Horne & Kahn 1997; Power 2002; Power & Doyle 2004; Terrell ined.

1. Leaves usually emergent from water; culms usually erect, emergent from water (only rarely completely submersed); ligules of upper leaves often truncate or erose OR occasionally acuminate; plants annual, not stoloniferous; lemma of pistillate florets with awn 25–65(–100) mm long; grain ca. as long as palea; species a questionable member of the East TX flora, possibly in extreme e part of East TX _____ **Z. aquatica**

1. Leaves usually submersed; culms geniculate, long-streaming in flowing water or the upper parts emergent; ligules of upper leaves acuminate or caudate; plants perennial, stoloniferous; lemma of pistillate florets with awn 9–35 mm long; grain from ca. 1/2–nearly 3/4 as long as palea; species known in TX only from Hays Co. near extreme w margin of East TX _____ **Z. texana**

Zizania aquatica L., (growing in or near water), INDIAN WILD RICE, SOUTHERN WILD RICE, WILD RICE. Coarse annual; culms to ca. 3–4(–5) m tall; ligule 5–30 mm long; leaf blades to 1(–1.5) m long, to 50(–72) mm wide; inflorescence 40–60(–120) cm long, to 34(–50) cm wide, with staminate spikelets on the lower, spreading or drooping branches and pistillate spikelets on the upper ascending branches; pedicels to ca. 6 mm long; staminate spikelets 5–12.5 mm long (excluding awns), quickly deciduous, the lemma unawned or with awn 3 mm or less long; pistillate spikelets 7–25 mm long (excluding awns), the lemma long-awned. Marshes, lake shores, streams; included based on citation for TX by Godfrey and Wooten (1979), Tucker (1988), and Kartesz

(1999) (possibly as a result of misidentification of *Z. texana,* as in the erroneous on-line listing of a *Healley* collection from Hays Co. at TAES—Digital Flora of Texas Herbarium Specimen Browser 2002); however, we have seen no TX material and recent taxonomic treatments of North American *Zizania* (Terrell et al. 1997; Terrell ined.) give the distribution of this species as extending from s Canada and the e U.S. w only to sw LA. We are including the species because of the possibility of its occurrence and to encourage field botanists to look for it in TX; no county distribution map is provided. Jun–Nov. Breeding of this species (long gathered from wild stands) is "yielding non-shattering forms of potential economic importance" (Watson & Dallwitz 1992). Such forms exhibit retention of the seeds on the inflorescence and thus less loss of the grain crop; similar situations (presumably the result of artificial selection) can be seen in corn, sunflower, and many other plants grown for their seeds.

Zizania texana Hitchc., (of Texas), TEXAS WILD RICE. Perennial completely immersed and long-streaming in flowing water or the upper parts emergent; culms usually 1–2(–5) m long; ligules 4–12(–15) mm long, those of the upper leaves acuminate or caudate; leaf blades to ca. 1 m long and to 13(–25) mm wide; inflorescence 16–31 cm long, to 10 cm wide, with staminate spikelets on the spreading or ascending lower branches and pistillate spikelets on the appressed or ascending upper branches; staminate spikelets 6.5–11 mm long, the lemma awnless; pistillate spikelets when mature 9–12.5 mm long (excluding awns), the lemma awned. Clear flowing water from springs of constant cool temperature (TOES 1993); Hays Co. (BRIT, TAES), upper 4 km of the San Marcos River, within the city of San Marcos (Horne & Kahn 1997; Terrell et al. 1997) near w margin of East TX; endemic to Hays Co., TX. Fall–spring, usually early spring. While geographically much closer to *Z. aquatica* (SOUTHERN WILD RICE), which occurs as far sw as LA (and potentially in e part of East TX), a phylogenetic analysis of molecular data (Horne & Kahn 1997) indicated that *Z. texana* is more closely related to *Z. palustris,* (NORTHERN WILD RICE). Horne and Kahn (1997) concluded that *Z. texana* is a relict of the last glacial period. They suggested that as the post-glacial climate of TX became warmer and more arid, the increasingly isolated populations of drought-sensitive WILD RICE were gradually eliminated as spring systems dried up. The result is that at present *Z. texana* survives in only a single refugium of cool spring water along the Balcones fault zone. This species exhibits low levels of genetic diversity (Horne & Kahn 1997). The seeds are edible. This rare species has long been endangered due to human modification of its habitat (Emery 1967, 1977), and it is officially listed as a federally endangered species (Terrell et al. 1997; Terrell ined.). The most serious threat to its survival is cessation of spring flow from the San Marcos Springs, which are fed by the Edwards aquifer, the primary source of water for San Antonio and numerous other cities, ranches, etc. (Poole 2002). (TOES 1993: I; RARE 2002a: G1S1LEE) ⚠

ZIZANIOPSIS Döll & Asch. CUT GRASS, MARSH-MILLET

A wet area C_3 genus of 5 species of tropical and warm areas of the Americas; 1 species occurs in the se U.S. and Mexico and the other 4 in South America (Tucker 1988; Terrell ined.). Molecular evidence suggests that within the Oryzeae, *Luziola* and *Zizaniopsis* appear most closely allied, with *Zizania* relatively closely related. *Leersia* and *Oryza*, which appear to be each other's closest relatives, are in a second monophyletic lineage within the Oryzeae (Ge et al. 2002). The common name CUT GRASS comes from the scabrous leaf margins, which can easily cut human skin; they are sometimes described as "razor-sharp" (Steyermark 1963). (Named from *Zizania*, and Greek: *opsis*, sight or appearance, from resemblance to the genus *Zizania)* (subfamily Ehrhartoideae, tribe Oryzeae)

REFERENCES: Terrell & Robinson 1974; Tucker 1988; Holmes & Stalling 1990; Duvall et al. 1993a; Brandenburg 2003; Terrell ined.

Zizaniopsis miliacea (Michx.) Döll & Asch., (pertaining to millet, *Milum*), GIANT CUT GRASS, WATER-MILLET, SOUTHERN WILD RICE, MARSH-MILLET. Coarse, largely glabrous, rhizomatous,

monoecious perennial 1.5–3(–4) m tall, forming beds in wet ground or shallow water; ligule a prominent membrane 6–20 mm long; leaf blades to 1.2 m long, 10–35 mm wide, flat, with coarsely scabrous, cutting margins; panicle 30–60(–80) cm long, loose, the branches ascending-spreading, with staminate spikelets toward base of branches and pistillate spikelets toward tips of same branches; pedicels 1–7(–12) mm long; spikelets 1-flowered, 4–10 mm long, without glumes, disarticulating at base of lemma; lemma and palea similar to each other (resembling 2 glumes), strongly ribbed; lemma of staminate floret acuminate or with awn 2 mm or less long; stamens 6; lemma of pistillate floret short-awned (awn 2–4(–9) mm long); caryopsis modified (pericarp mostly free from seed coat—Brandenburg 2003). Marshes, creek bottoms, and lakeshores; widespread in e 1/2 of TX with a few locations further w; se U.S. from MD s to FL w to MO, OK, and TX. May–Sep. [*Zizania miliacea* Michx.] This species is unusual in that after shedding its seeds, the fertile culm elongates and axillary buds grow and produce leaves and adventitious roots. If the now modified fertile culm topples over, the "buds" can contact the substrate and take root, thus allowing more rapid exploitation of the habitat via asexual reproduction (Holmes & Stalling 1990). Brandenburg (2003) suggested that the "air space between the free pericarp and the seed" allows for bouyancy (i.e., the modified caryopsis floats) and thus dispersal in this aquatic species.

ZOYSIA Willd. ZOYSIA, TEMPLE GRASS

Rhizomatous, mat-forming perennials to only 40 cm tall; ligule of hairs, 0.3 mm or less long, leaf sheaths and blades ± glabrous; inflorescence a terminal, solitary, spike-like raceme; spikelets solitary, on short pedicels, with 1 floret, unawned or with awn to only 1.1 mm long; disarticulation below the glume(s) or not occurring; lower glume usually absent; upper glume enclosing spikelet; lemma thin; palea usually not present.

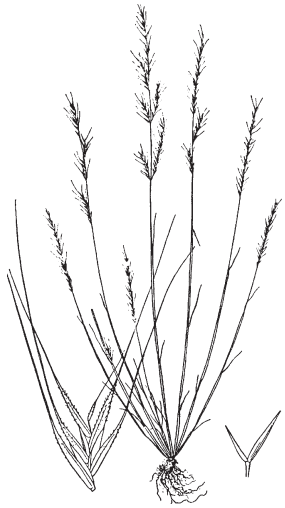
A C_4 genus of 11 species (Anderson 2003) ranging from se Asia to New Zealand, typically in sandy coastal areas; a number are used as lawn grasses or for playing fields, particularly in open xeric sites (Anderson 2002, 2003). The species occurring in East TX are generally salt tolerant (Anderson 2002). Preliminary molecular analyses (Hilu & Alice 2001) suggest a possible relationship between *Zoysia*, *Spartina*, and some species of both *Eragrostis* and *Sporobolus*. According to Anderson (2003), a number of cultivars have been derived from *Zoysia* species, sometimes involving hybridization. Further, "cultivars often exceed the normal range of variation for a species in one or more respects," and "hybridization has resulted in cultivars with vegetative characteristics more like those of one species and reproductive characteristics more like those of another species." This treatment is derived primarily from Anderson (2003). (Named for Karl von Zois, 1756–1800, plant collector of Carniola, Austria) (subfamily Chloridoideae, tribe Cynodonteae)
REFERENCES: Goudswaard 1980; Anderson 2002, 2003.

1. Leaf blades involute to convolute, to only 0.5 mm in diam.; raceme with 3–12 spikelets; peduncle included or extending to 1 cm beyond the sheath of the subtending leaf _____ **Z. pacifica**
1. Leaf blades flat to involute, 0.5–5 mm wide; raceme with 10–50 spikelets; peduncle extending (0.3–)1–6.5 cm beyond the sheath of the subtending leaf.
   2. Pedicels 1.6–3.5 mm long; spikelets ovate, 1–1.4 mm wide; culm internodes 2–10 mm long; leaf blades ascending _____ **Z. japonica**
   2. Pedicels 0.6–1.6 mm long; spikelets lanceolate, 0.6–1 mm wide; culm internodes 5–40 mm long, all plants with at least some internodes more than 14 mm long; leaf blades spreading _____ **Z. matrella**

Zoysia japonica Steud., (of Japan), JAPANESE LAWN GRASS, KOREA TEMPLE GRASS. Leaf blades to 6.5 cm long, flat to involute; inflorescence 2.5–4.5 cm long; spikelets 2.5–3.4 mm long, awned, the awn to 1.1 mm long. Persisting or possibly escaping from lawns; Harris Co. (Anderson 2003) near s margin of East TX; we, however, have seen no TX specimens of this species; Anderson



Vulpia octoflora var. glauca [USB]



Vulpia sciurea [USB]



Willkommia texana [HI1]







Zea mays subsp. mays [FUC, HI1, USB]



Zizania aquatica [HI1]



Zizania texana [HI1]



Zizaniopsis miliacea [USB]

(2003) also mapped several counties in the Gulf Prairies and Marshes; no county distribution map is provided; se Canada (Ont.) and widely scattered in the U.S. Native of Japan. [*Z. matrella* var. *japonica* (Steud.) Sasaki] This species is used for lawns and playing fields (Watson & Dallwitz 1992). According to Anderson (2003), this was "the first species of *Zoysia* introduced into cultivation in the United States, with the introduction of the cultivar 'Meyer' in the 1950s. It is the most cold-tolerant and coarsely textured of the three species ... and is the only species that is currently available as seed in the United States. The other two species treated here can be established from seed, but there are currently no commercial sources of either one in the United States."

Zoysia matrella (L.) Merr., (Derivation unknown, but possibly from an Urdu word *mehtar,* headman, because the original author gives the location of the type as from Malabar, India), MANILA TEMPLE GRASS, MANILA GRASS. Leaf blades to 7 cm long, weakly to strongly involute; inflorescence 1–4 cm long; spikelets 2.1–3.2 mm long, unawned or with awn to 1 mm long. Persisting or possibly escaping from lawns; included based on indication by S. Anderson (pers. comm.) that it possibly occurs in the area; no specimens have been seen and we are not aware of a county record; no county distribution map is provided; FL, NM, and possibly TX. Native of the coasts of the Indian Ocean. [*Agrostis matrella* L., *Z. pungens* Willd.] This species is considered by some authorities to be a significant weed species (Watson & Dallwitz 1992). According to Anderson (2003), "Many of the *Zoysia* lawn grasses grown in the southern and eastern United States are derived from hybrids between *Z. matrella* and *Z. pacifica* or *Z. japonica*, and have retained many of the characteristics of *Z. matrella*."

Zoysia pacifica (Goudswaard) M. Hotta & Kuroki, (of the Pacific), MASCARENE GRASS, MASCARENE TEMPLE GRASS, KOREAN VELVET GRASS. Leaf blades 3 cm or less long, involute to strongly convolute (the margins overlapping); inflorescence 0.4–2 cm long; spikelets 2.2–2.9 mm long, 0.5–0.8 mm wide, lanceolate to linear, unawned or with awn to 0.5 mm. Persisting or possibly escaping from lawns; included for East TX based on indication by S. Anderson (pers. comm.) that it possibly occurs in the area; no specimens have been seen and we are not aware of a county record; no county distribution map is provided; CA, FL, and possibly TX. Native of coasts of the w Pacific Ocean. [*Z. matrella* var. *pacifica* Goudswaard, *Z. tenuifolia* of authors not Willd. ex Thiele] This is the least cold-tolerant of the three species included here and is not a common lawn grass in the U.S. (Anderson 2003). "The cultivar 'Cashmere' has many of the characteristics of *Z. pacifica*; it is probably derived from a hybrid between *Z. matrella* and *Z. pacifica* (Anderson 2003)."

PONTEDERIACEAE Kunth
WATER-HYACINTH OR PICKEREL-WEED FAMILY

Glabrous perennial or annual herbs; leaves basal or alternate, simple, entire, both sessile and petiolate leaves often present; flowers solitary or in spikes, the inflorescence subtended by a spathe-like bract; perianth parts united proximally to form a very slender basal tube; perianth lobes 6, one differing slightly or greatly in size, shape, or coloration; stamens 3 or 6; pistil 1; ovary superior; fruit a many-seeded capsule or a 1-seeded utricle.

A small (ca. 30 species in 6 genera—Horn 2002) family of freshwater aquatic herbs of tropical and warm areas nearly worldwide, but especially in the Americas, with a few in the n temperate zone. Some are problematic weeds; a number are cultivated as ornamentals. The family appears related to such familes as the Hamemodoraceae and Commelinaceae (Chase et al. 2000; Reveal & Pires 2002). (subclass Liliidae—Cronquist; order Commelinales—APG II)
FAMILY RECOGNITION IN THE FIELD: rooted or free-floating, wet area or aquatic herbs; flowers often conspicuous, the perianth petaloid; inflorescence a solitary flower or a spike, subtended by a spathe-like bract.

REFERENCES: Dahlgren et al. 1985; Eckenwalder & Barrett 1986; Rosatti 1987; Graham & Barrett 1995; Kohn et al. 1996; Cook 1998b; Graham et al. 1998; Horn 2002.

1. Flowers solitary; perianth salverform; stamens 3 _____ **Heteranthera**
1. Flowers 4–numerous, in spikes; perianth funnelform; stamens 6.
   2. Perianth 4–6 cm long; petioles inflated; fruit a many-seeded capsule; plants typically free floating _____ **Eichhornia**
   2. Perianth 1–2 cm long; petioles not inflated; fruit a 1-seeded urticle; plants typically rooted in mud _____ **Pontederia**

EICHHORNIA Kunth WATER-HYACINTH

A genus of 7 species of rhizomatous or floating aquatics, all native to the New World tropics except for 1 African species (Barrett 1988; Kohn et al. 1996; Cook 1998b; Horn 2002). Molecular and morphological evidence suggests *Eichhornia* is not monophyletic and "raises the issue of whether the genus should be maintained as currently circumscribed" (Graham & Barrett 1995). (Named for Johann Albrecht Friedrich Eichhorn, 1779–1856, of Berlin, statesman and patron of horticulture)

REFERENCES: Penfound & Earle 1948; Mulcahy 1975; Horn 1987; Barrett 1988; Haynes 1988.

Eichhornia crassipes (Mart.) Solms, (with a thick stalk or stem), COMMON WATER-HYACINTH. Perennial normally floating on surface of water, with abundant fibrous roots; leaves shorter than the petioles, both sessile and petiolate, the sessile ones forming a basal rosette; petioles spongy-inflated; blades of petiolate leaves shorter than the petioles, flat, ovate to rhombic or reniform, the base broadly cuneate; inflorescence spicate or branched-spicate, well-exserted on a peduncle from a spathe, with 4–15 flowers; perianth slightly 2-lipped, with basal tube, the 6 segments free above, showy, bluish lavender, the upper segment with yellow spot surrounded by blue; fruit a many-seeded dehiscent capsule. Naturalized in lakes, ponds, and slow streams, sometimes cultivated; widespread in East TX; also Gulf Prairies and Marshes; large populations can be seen in some East TX lakes (e.g., Caddo Lake); se U.S. from VA s to FL w to MO and TX, also AZ and CA. Late Jun–Sep. Native of Brazil. This species was apparently introduced into the U.S. at the 1884 Cotton Centennial Exposition in New Orleans (Penfound & Earle 1948; Tveten & Tveten 1993) and since then has spread widely. It is an aggressive and problematic weed in some areas, such as FL, where it can choke waterways. It has an extremely rapid growth rate and is considered by some to be "probably the most aggressive aquatic weed ever known in the tropics" (Horn 2002). It is generally considered to be among the world's worst weeds (Holm et al. 1977). This species is considered a "harmful or potentially harmful exotic plant" and it is illegal to release, import, sell, purchase, propagate, or possess it in TX (Harvey 1998). It is also considered a noxious weed in AZ and SC (Kartesz 1999). However, the species has the ability to remove large amounts of inorganic pollutants dissolved in water (Woodland 1997) and in some places is thus useful in wastewater cleanup efforts (e.g., Beaumont, TX, B. Lipscomb, pers. obs.). Typically all flowers on an inflorescence open the same day, opening shortly after dawn and wilting by nightfall (Penfound & Earle 1948; Horn 2002). Tristyly (= pollination system involving styles of three lengths) is known in this species (Kohn et al. 1996). However, Penfound and Earle (1948) noted that the species appears largely self-pollinated. A related species from Brazil, *Eichhornia azurea* (Sw.) Kunth, PEACOCK-HYACINTH, previously known from FL (now eradicated—Horn 2002), is considered a U.S. federal noxious weed (Kartesz 1999; USDA Natural Resources Conservation Service 2002). A Tyler Co. sheet (*Nixon 13016*, ASTC) previously identified as this species was recently annotated (by L. Brown) as *E. crassipes*; likewise, an earlier report of this species for TX (Shinners 1962b) was based on a misidentified specimen (Horn 2002). *Eichhornia azurea* can be distinguished by its habit (typically rooting in mud), the absence of inflated petioles, sessile leaves alternate on an elongate stem, and erose perianth lobe margins (the latter character is unique within the genus) (Horn 1987, 2002). /285

HETERANTHERA Ruíz & Pav. MUD-PLANTAIN

Annual or perennial herbs submersed or rooted in mud; leaves linear, ribbon- or grass-like, without a distinct blade, or with ovate to elliptic or elliptic-lanceolate blade; flowers solitary (in East TX species), from a spathe; perianth ± radially symmetrical, salverform; fruit a many-seeded capsule.

A genus of 12 species (Horn 2002) of tropical and warm areas of Africa and the Americas n to North America. (Greek: *hetera*, different, and *anthera*, anther, from the dissimilar anthers of the first described species)
REFERENCES: Horn 1985, 1988.

1. Leaves all sessile, linear, grass-like, pellucid (= ± clear, almost transparent); flowers pale yellow; plants usually completely submersed except for flowers (can become emersed if water levels drop); spathes sessile in axils of leaves _____ **H. dubia**
1. Leaves (at least some) petiolate, with an expanded, oblong to ovate, thickish blade; flowers light blue to purplish blue to white; plants rooted in mud, the leaves forming emersed rosettes or the leaves floating at the water surface; spathes peduncled _____ **H. limosa**

Heteranthera dubia (Jacq.) MacMill., (dubious), GRASS-LEAF MUD-PLANTAIN, WATER STAR-GRASS. Perennial; petiolate leaves absent; flowers usually exposed at or above the water surface; stamens all alike; anthers coiled with age. Small streams, quiet waters, and ditches, growing most extensively in alkaline waters (Moyle 1945; Horn 2002); Comal, Travis (BRIT), Brazos (TAMU), Bastrop (TEX), Dallas, and Liberty (Turner et al. 2003) cos.; scattered in TX, but mainly c and s parts of the state; nearly throughout the U.S. and se Canada. Apr–Jun. Flowers are reported to open within 2 hours after dawn and to wilt by dusk (Horn 2002). [*H. liebmannii* (Buchneau) Shinners]

Heteranthera limosa (Sw.) Willd., (of muddy places), BLUE MUD-PLANTAIN. Annual 6–25 cm tall, tufted, becoming rhizomatous; both sessile and petiolate leaves present; sessile leaves forming a basal rosette; petiolate leaves with petioles 2–12 cm long; flowering stem with a terminal sheathing spathe; perianth light blue to purplish blue to white, with 3 of the lobes yellow at base; stamens dimorphic, 2 with short yellow anthers, the third with an elongate, light blue or yellow anther; anthers not coiled. Shallow water or wet places, including pond margins and ditches; scattered throughout much of TX but often inconspicuous and rarely collected; widespread in the c U.S. from KY and TN w to SD and AZ, also CA and FL. Jun–Oct. Flowers are reported to open within 1 hour after dawn and to wilt by midday (Horn 2002).

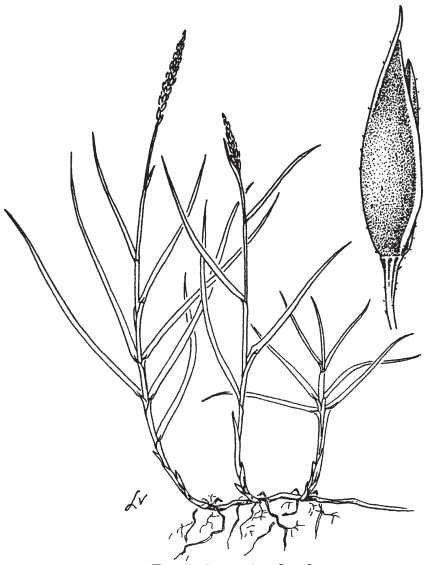
Heteranthera rotundifolia (Kunth) Griseb., (round-leaved), ROUND-LEAF MUD-PLANTAIN, is known from w TX and, according to C. Horn (pers. comm.), could possibly be found in the very w part of East TX. Horn (2002) distinguished this species from the similar *H. limosa* as follows:

1. Vegetative stems commonly elongating unless plant emersed from early age; petiolate leaf blade round to oblong, base cordate to truncate; distal central perianth limb lobe with lateral flanges _____ *H. rotundifolia*
1. Vegetative stems elongating only on plants in over 5 cm of water; petiolate leaf blade oblong to ovate, base truncate to cuneate; distal central perianth limb lobe without lateral flanges _____ *H. limosa*

PONTEDERIA L. PICKEREL-WEED

A New World genus of 6 species (Cook 1998b; Horn 2002) occurring from Canada to Argentina. (Named for Guilio Pontedera, 1688–1757, Italian botanist and professor at Padua)
REFERENCES: Fernald 1925; Ornduff 1966; Lowden 1973; Price & Barrett 1982; Horn 1987; Horn & Haynes 1987.

Pontederia cordata L., (cordate, heart-shaped), PICKEREL-WEED, WAMPEE. Emergent perennial rooted in mud, 40–80(–120) cm tall, from thick, short-rhizomatous base; leaves both sessile and



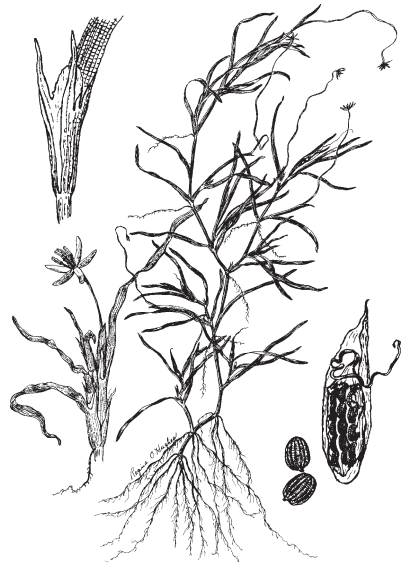
Zoysia japonica [HOL]



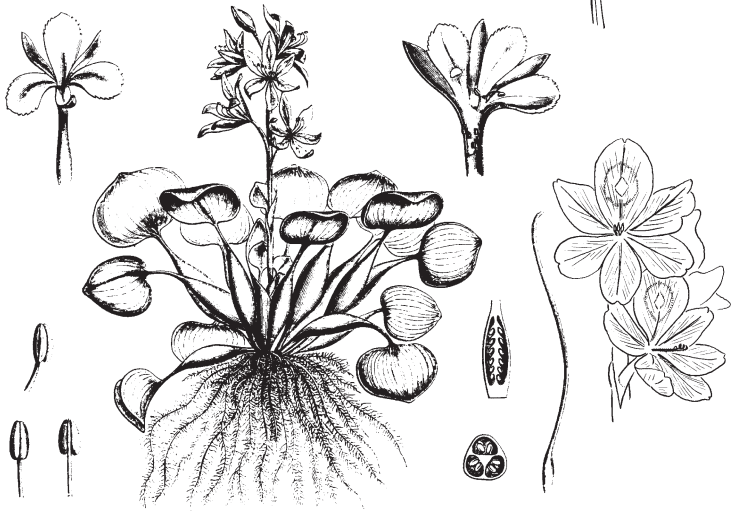
Zoysia matrella [HI1]



Zoysia pacifica [HEB]



Heteranthera dubia [REE]



Eichhornia crassipes [BT3, EN2]



Heteranthera limosa [CO1]

petiolate, mostly basal; petiolate leaves with petioles with long-clasping basal portion; leaf blades shorter than the petioles, 6–22 cm long, narrowly ovate to triangular-lanceolate, the base rounded-truncate to deeply cordate; inflorescence a slender terminal spike from a spathe; perianth violet-blue, the upper lobe with a central 2-lobed yellow-green or yellow spot; fruit a 1-seeded utricle. Margins of lakes, ponds, and streams; widespread in East TX; also Comanche Co. (Turner et al. 2003) in the Cross Timbers and Prairies and n Gulf Prairies and Marshes; throughout the e U.S. w to MI, KS, OK, and TX, also se Canada. Jun–Oct. [*P. cordata* var. *lanceolata* (Nutt.) Griseb., *P. cordata* var. *lancifolia* (Muhl. ex Elliott) Torr.] This species is sometimes cultivated as an ornamental; the fruit is said to be edible (Mabberley 1997). Tristyly (= pollination system involving styles of three lengths) is known in this species (Ornduff 1966; Price & Barrett 1982, 1984), and bumble bees are the most abundant pollinators (Wolfe & Barrett 1989). 🏵/296

POTAMOGETONACEAE Dumort.
PONDWEED FAMILY

Aquatic rhizomatous herbs; leaves in ours alternate or closely crowded, all submersed or with both submersed and floating blades, sessile or petiolate; flowers perfect, in 2–5 whorls on pedunculate axillary spikes; perianth 4-merous, inconspicuous; stamens 4; carpels 4, free, sessile; ovaries superior; fruits drupe-like, 1-seeded.

A small (ca. 90–100 species in 3 genera—Haynes & Hellquist 2000b; Haynes & Holm-Nielsen 2003) cosmopolitan family of perennial, rooted aquatics. While pollination in most members of the family is thought to be by anemophily (= wind-pollination) (Haynes et al. 1998c; Haynes & Holm-Nielsen 2003), hypohydrophily (= pollination under water) is known for *Potamogeton pusillus* var. *tenuissimus* (Philbrick 1983[1984]; Haynes et al. 1998c), and hydroautogamy (= self-pollination underwater) is thought to occur in a number of species (Philbrick & Anderson 1987). Haynes (1974) and Haynes and Hellquist (2000b) indicated that, like other aquatic vascular plants, members of the Potamogetonaceae are known for their phenotypic plasticity. However, individuals in fruit "have relatively consistent morphology within a species" (Haynes & Hellquist 2000b). Thus, for positive identification, it is essential to have specimens in reproductive condition. Vegetative reproduction by stem fragmentation or by turions (= swollen structure or offshoot, often serving to overwinter) is well known in the family. The third genus in the family (not found in East TX) is the monotypic Old World *Groenlandia* (with opposite leaves). Earlier molecular analyses (Duvall et al. 1993b; Les et al. 1993) indicated a relationship between Potamogetonaceae and Alismataceae or Zosteraceae (EEL-GRASS FAMILY), while more recent molecular results (Les & Haynes 1995) suggest a closer link to Zannichelliaceae and then Zosteraceae. In fact, Potamogetonaceae and Zannichelliaceae appear to be closely related sister groups (Haynes et al. 1998d), and some authorities (e.g., APG 1998; APG II 2003) now submerge the Zannichelliaceae into the Potamogetonaceae. (subclass Alismatidae—Cronquist; order Alismatales—APG II)

FAMILY RECOGNITION IN THE FIELD: aquatics with leaves all submersed or often with both submersed and floating leaves—the floating ones ± elliptic and rather leathery with a waxy, water-repellent upper surface; flowers small, inconspicuous, 4-merous, in dense, pedunculate, axillary spikes, the spikes not subtended by bracts.

REFERENCES: Morong 1893; Taylor 1909a; Haynes 1978; Dahlgren et al. 1985; Larsen & Barker 1986; Haynes et al. 1998c; Haynes & Hellquist 2000b; Haynes & Holm-Nielsen 2003.

1. Floating leaves present or absent; stipules free of the leaf base or adnate for < 4(–10) mm, often early deteriorating; submersed leaves translucent, flat, without grooves or channels, of variable width, sometimes less but often much wider than 1 mm (to 45 mm wide); peduncle stiff, if long enough the inflorescence thus held above the water surface; including species widespread and common in East TX ____ **Potamogeton**

1. Floating leaves absent (all leaves submersed); stipules adnate (= fused) to the leaf base for a distance of 10–30 mm, the free portion projecting as a ligule < half as long as the adnate portion; submersed leaves opaque, turgid, channeled, 0.2–1 mm wide; peduncle flexible, not holding the inflorescence above the water surface; species rare in East TX _____ **Stuckenia**

POTAMOGETON L. PONDWEED

Plants glabrous perennials; nodes sometimes with oil glands; plants with both submersed (usually filiform to ± lanceolate, thin and flexuous) and floating (usually ± elliptic and rather leathery, with a waxy upper surface) leaf blades or all leaves submersed; leaves sessile or petiolate; flowers in pedunculate axillary spikes, these usually held above the water.

A cosmopolitan genus of ca. 95 species (Haynes & Holm-Nielsen 2003), with the highest density of species in e North America (Wiegleb 1988). Wiegleb and Kaplan (1998), however, considered the genus to have ca. 69 species. It is renowned for its extensive morphological diversity, including species which can be characterized as heterophyllous (with both floating and submersed leaves) or homophyllous (with only submersed leaves) (Wiegleb 1988; Les & Sheridan 1990a, 1990b). PONDWEEDS are very important as a source of food for waterfowl (e.g., ducks) and as food and habitat for aquatic animals (Haynes 1974). In fact, in terms of its effect on animal life, it is "one of the most important genera in the aquatic environment" (Haynes & Hellquist 2000b). Because *Potamogeton* species are aquatic and difficult to collect, and because identification can be problematic, the group is neither well-collected nor well known. They are found in lakes, ponds, streams, or other aquatic habitats. Some species of *Potamogeton* exhibit hydrophily or water-mediated pollination (Cox 1988; Philbrick 1988). The underwater leaves of heterophyllous species and leaves (all underwater) of homophyllous species have reduced levels of flavonoids, while floating leaves of heterophyllous species have glycoflavones (Les & Sheridan 1990b); according to Les and Sheridan (1990b) the glycoflavones "are probably maintained in floating leaves because of their UV [radiation] filtering ability. ... The lack of glycoflavones in submersed leaves ... is attributable to the ability of naturally colored water to significantly absorb harmful UV radiation." *Potamogeton* species with submersed linear leaves are sometimes confused with two other linear-leaved aquatic genera, *Najas* (Hydrocharitaceae) and *Zannichellia* (Zannichelliaceae); however, both of these other genera have mostly opposite or whorled leaves, versus leaves alternate in *Potamogeton* (Yatskievych 1999). (Ancient name from Greek: *potamos*, river, and *geiton*, a neighbor, from the aquatic habitat)

REFERENCES: St. John 1916; Fernald 1932; Ogden 1943, 1966; Klekowski & Beal 1965; Haynes 1968, 1974, 1986; Reznicek & Bobbette 1976; Stuckey 1979; Les 1983; Philbrick 1983[1984]; Catling & Dobson 1985; Philbrick & Anderson 1987; Wiegleb 1988; Les & Sheridan 1990a, 1990b; Haynes & Hellquist 1996; Hollingsworth et al. 1998; Wiegleb & Kaplan 1998.

1. Submersed leaves 2.5 mm or less wide, mostly 20 times or more longer than wide, linear; floating leaves, if present, with blades ≤ 40 mm long (usually much less).
   2. Floating petiolate leaves with blades 5–40 mm long usually present; stipules usually adnate to the base of the submersed sessile leaf blades for ca. 1–4 mm, forming a sheath partially clasping the stem—leaf blades therefore apparently arising ± from the top of the sheath (however, note that stipule tips are free); fruit wall papery thin, the embryo coil plainly visible within _____ **P. diversifolius**
   2. Floating petiolate leaves absent, the leaves all alike, sessile, submersed; stipules free of the submersed sessile leaf blades; fruit wall firm, obscuring the embryo coil.
      3. Fruits dorsally smooth and rounded; stipules with veins usually not very evident; nodes of the stem usually with a pair of minute oil glands; species widespread in East TX _____ **P. pusillus**
      3. Fruits with an undulate to dentate, dorsal ridge or keel; stipules with evident veins appearing as ridges extending the length of the stipules; nodes of the stem usually without a pair of minute glands; species of questionable occurrence in East TX _____ **P. foliosus**

1. Submersed leaves either > 2.5 mm wide OR < 20 times longer than wide, linear-lanceolate to lanceolate, oblanceolate, oblong, or elliptic; floating leaves, if present, with blades usually > 40 mm long.
   4. Leaves all submersed, sessile, weakly to strongly clasping at base; leaf margins finely toothed (visible to the naked eye), often undulate-crisped (= ± ruffled) _____ **P. crispus**
   4. Leaves usually not all submersed, floating leaves commonly present by flowering time, occasionally absent; submersed leaves sessile or petiolate, not clasping the stem, with leaf margins entire or nearly so, not undulate-crisped or sometimes somewhat undulate-crisped.
      5. Petioles of floating leaves 2–9 cm long, usually shorter than the blades; submersed leaves acute to abruptly acuminate or mucronate, usually persistent, sessile or tapering to petioles to 4 cm long; species known in East TX mainly from w margin of area (but widely scattered in TX, particularly the Edwards Plateau) _____ **P. illinoensis**
      5. Petioles of floating leaves 4–20 cm long, usually longer than the blades; submersed leaves acute to blunt-tipped, sometimes disintegrating by fruiting time (*P. nodosus*), sessile or tapering to petioles to 3.5(–4.5) cm long (*P. pulcher*) OR petioles often much longer, (2–)3–13 cm long (*P. nodosus*); including species widespread in East TX.
         6. Floating leaf blades cuneate or rounded at base; submersed leaf blades not arcuate, flat marginally, tapering gradually to a petiole (2–)3–13 cm long; stems not spotted; mature fruits usually reddish, 4.3 mm or less long; species widespread and common in East TX _____ **P. nodosus**
         6. Floating leaf blades usually cordate, rarely rounded at base; submersed leaf blades often arcuate (= curved), crispate marginally; tapering rather abruptly to a sessile base or short petiole to 3.5(–4.5) cm long; stems usually conspicuously black-spotted; mature fruits light-brown to olive-green, 5–6.5 mm long; species less common in East TX _____ **P. pulcher**

Potamogeton crispus L., (crimped), CURLY MUCKWEED, CURLY PONDWEED, CURLED PONDWEED. Leaves all submersed, sessile, with finely toothed and often undulate-crisped (= ± ruffled) margins, linear-oblong to linear-oblanceolate, oblong, or oblanceolate, 3–10 cm long, 3–10(–15) mm wide; turions common. Widely scattered localities in TX including Burnet, Dallas, Hays, Travis, Wichita (BRIT), Grayson, Randall (Ogden 1966), and Hemphill (Turner et al. 2003) cos.; s Canada and throughout most of the U.S. Spring–Jun. Native of Eurasia (Wehrmeister & Stuckey 1992). This species, which was apparently introduced into North America about 1840, has subsequently spread throughout much of the continent (Stuckey 1979; Haynes & Hellquist 2000b). It is the only species of PONDWEED in North America with toothed leaves (Haynes & Hellquist 2000b). *Potamogeton crispus* is unusual in completing its fruiting in early summer, with the plants then decaying. Only fruits and turions survive the summer; the turions germinate in late summer or fall and the resulting small plants overwinter—even under the ice in northern states such as Ohio (Stuckey et al. 1978; Wehrmeister & Stuckey 1992; Haynes & Hellquist 2000b). This species is typically found in highly alkaline waters (Hellquist 1980), possibly explaining its distribution only on the w margin of East TX where soils are alkaline. It is considered to be the "most distinctive species within the genus" (Wiegleb & Kaplan 1998).

Potamogeton diversifolius Raf., (diverse-leaved), WATER-THREAD PONDWEED, WATER-THREAD. Submersed leaves sessile, linear, 1–8 cm long, 0.3–1.5 mm wide; floating leaves sometimes absent, if present, the blades 5–40 mm long, 3–20 mm wide, the petioles mostly 5–40 mm long; turions absent. Widespread in e 1/2 of TX, scattered further w; throughout much of the e U.S., scattered further w. May–Sep. [*P. capillaceus* Poir., in part; *P. diversifolius* var. *trichophyllus* in sense of Correll and Johnston 1970—this is actually a synonym of *P. bicupulatus* Fernald, a species of the ne U.S.] While Correll and Johnston (1970) recognized two varieties of this species, we are following the recent treatment in *Flora of North America* (Haynes & Hellquist 2000b) in treating this species as a variable entity without subdivisions. According to Haynes and Hellquist (2000b), this is likely the most common *Potamogeton* in the se U.S.

Potamogeton foliosus Raf., (leafy), LEAFY PONDWEED. Nodal glands usually absent, only rarely present; leaves all submersed, sessile, linear, 1.3–8.2 cm long, 0.3–2.3 mm wide; turions uncommon. Walker and Williamson (Ogden 1966) cos. in the Post Oak Savannah and s Blackland Prairie (no recent records for East TX); the range map in Haynes and Hellquist (2000b) indicated that *P. foliosus* is of questionable occurrence for East TX, and we have seen no confirming specimens; sparsely scattered in TX, mainly in the w part of the state; widespread in s Canada and throughout most of the U.S. May–Oct. [*P. foliosus* var. *macellus* Fernald] Among the linear-leaved *Potamogeton* species, *P. foliosus* is distinctive in having fruits with an undulating wing-like dorsal (abaxial) keel (Haynes & Hellquist 2000b). This species is considered to be related to *P. pusillus* (Wiegleb & Kaplan 1998).

Potamogeton illinoensis Morong, (of Illinois), SHINING PONDWEED, CORNSTALK PONDWEED, ILLINOIS PONDWEED. Submersed leaves sessile or tapering to a petiole to 4 cm long, with blades 5–20 cm long, 10–45 mm wide, elliptic to oblong-elliptic, linear-lanceolate, or lanceolate; floating leaves sometimes absent, if present, the blades 4–8(–19) cm long, 1–4(–7) cm wide; turions absent. Hays, Travis (BRIT), Austin, Bell, Bexar, Williamson (Ogden 1966), Comal, and Grayson (Turner et al. 2003) cos.; widely scattered in TX, but mainly Edwards Plateau; s Canada and throughout much of the U.S. Apr–Jun.

Potamogeton nodosus Poir., (knotty), LONG-LEAF PONDWEED. Submersed leaves often disintegrated by flowering time or sometimes persistent, tapering to a petiole, the blades 10–20(–30) cm long, 10–20(–35) mm wide, linear-lanceolate to lanceolate-elliptic; floating leaves with blades 4–10(–13) cm long, (1.5–)2–3(–4.5) cm wide; turions absent. Nearly throughout TX; s Canada and throughout most of the U.S. Apr–Jun. This is the most common PONDWEED in much of East TX. It is widespread geographically (both New and Old worlds) and is reported to be "one of the most polymorphic *Potamogeton* species" (Wiegleb & Kaplan 1998).

Potamogeton pulcher Tuck., (handsome), HEART-LEAF PONDWEED, SPOTTED PONDWEED. Stems usually conspicuously black-spotted; submersed leaves sessile or tapering to a short petiole, the blades oblong to lanceolate or linear-lanceolate, to 18 cm long and 35 mm wide (usually smaller), usually persistent, only rarely disintegrating by flowering time; floating leaves with blades 4.5–9(–11) cm long, 2–5.5(–8.5) cm wide; turions absent. Pineywoods and n Post Oak Savannah; se Canada (N.S.) and nearly throughout the e U.S. w to MN and TX. Apr–May. A similar species, *P. amplifolius*, that is expected for East TX, is discussed in a note below.

Potamogeton pusillus L., (very small). Nodal oil glands present on at least some nodes; leaves all submersed, sessile, linear, 0.9–6.5 cm long, 0.2–2.5 mm wide; turions common. Late May–Jun. Some authorities (e.g., Godfrey & Wooten 1979) do not recognize infraspecific taxa; Haynes (1974) indicated that while recognition at the varietal level is most appropriate, there is considerable intergradation and many individuals cannot be identified to variety with certainty. More recently, Haynes and Hellquist (1996) have recognized the variation at the subspecies level. The following key to subspecies is modified from Haynes (1974) and Haynes and Hellquist (2000b):

1. Mature fruits widest above the middle, the sides concave; beak of fruit toward adaxial edge, rarely median; peduncles filiform to cylindric, 1–3 per plant; inflorescences interrupted, usually of 2–4 distinct verticils (= whorls); leaf blades with 0–2 rows of lacunae along midrib, apically acute, rarely apiculate, rarely with a bristle; stipules connate; subspecies widespread in East TX _____ subsp. **pusillus**

1. Mature fruits mostly widest at or below the middle, the sides rounded; beak of fruit median, not toward adaxial edge; peduncles cylindric, more than 3 per plant; inflorescences continuous, mostly of 1–2(–3) adjacent verticils; leaf blades with 1–5 rows of lacunae along midrib, apically acute to obtuse; stipules convolute, mostly not connate; subspecies known in East TX only from extreme ne part of area _____ subsp. **tenuissimus**

subsp. **pusillus**, BABY PONDWEED, SMALL PONDWEED. Widespread in TX; this is the common subspecies in East TX; nearly throughout s Canada and the U.S.

subsp. **tenuissimus** (Mert. & W.D.J. Koch) R.R. Haynes & Hellq., (extremely fine, thin). Bowie Co. (Ogden 1966; Turner et al. 2003 as *P. berchtoldii*) in the extreme ne part of East TX; widespread in s Canada and much of the U.S. [*P. berchtoldii* Fieber, *P. berchtoldii* var. *tenuissimus* (Mert. & W.D.J. Koch) Fernald, *P. pusillus* var. *tenuissimus* Mert. & W.D.J. Koch] While known from only one collection in TX, according to Haynes and Hellquist (2000b), this "is the most common linear-leaved taxon of the family in temperate North America." No county distribution map is provided for the single locality of this variety. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this subspecies to be of conservation concern in TX. ⚠

Potamogeton amplifolius Tuck., (large-leaved), BROAD-LEAF PONDWEED, LARGE-LEAF PONDWEED, occurs just north of the Red River in OK and, according to Haynes and Hellquist (2000b), is expected in TX; it is widespread in s Canada and much of the U.S., particularly the e part. The submersed leaves of this species are "larger than those of most other species of *Potamogeton*, are arcuate, and have more veins than do any other species." It would key to *P. pulcher* in the key above, but can be distinguished as follows (from Haynes & Hellquist 2000b):

1. Submersed leaf blades ovate, with 19–49 veins; floating leaf blades with 27–49 veins _____ *P. amplifolius*
1. Submersed leaf blades linear-lanceolate to lanceolate, with 7–19 veins; floating leaf blades with 15–21(–29) veins _____ *P. pulcher*

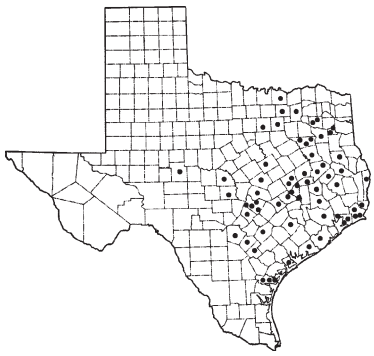
STUCKENIA Börner FALSE PONDWEED

A ± cosmopolitan genus of ca. 6 species previously treated as *Potamogeton* subgenus *Coleogeton* (Haynes & Hellquist 2000b). While the taxa now treated in *Stuckenia* have long been included in *Potamogeton*, according to Haynes and Hellquist (2000b), "Recent molecular evidence (D.H. Les, unpublished), combined with existing morphologic evidence, indicates that *Potamogeton* in the broad sense actually represents two separate lineages. We recognize those lineages at the generic level, *Potamogeton* in the strict sense and *Stuckenia*." While we are recognizing the genus *Stuckenia* for East TX, it should be noted that Wiegleb and Kaplan (1998) disagree, indicating that "the reasons for separating this group from the genus *Potamogeton* are not regarded as convincing." (Derivation unknown, not given by original author)
REFERENCES: Börner 1912; St. John 1916; Ogden 1966; Haynes 1968, 1986; Larson & Barker 1986; Les & Haynes 1996; Holub 1997; Haynes et al. 1998e.

Stuckenia pectinata (L.) Börner, (comb-like), FENNEL-LEAF PONDWEED, SAGO PONDWEED, SAGO, SAGO FALSE PONDWEED. Rhizomatous, aquatic, perennial herb, often growing in large masses; rhizomes sometimes with tubers; stems ca. 1 mm in diam., much-branched above, 0.3–0.75 m long; leaves all submersed, alternate, sessile, filiform to narrowly linear, 3–9.2 cm long, 0.2–1 mm wide, marginally entire; stipules fused with the leaf base for 10–30 mm and forming a sheath enfolding the stem (leaf thus seemingly arising from apex of sheath), the free portion of the stipules less than half as long as fused portion (i.e., stipules adnate for 2/3 or more of their length); turions absent; peduncles axillary, 3–25 cm long, flexuous, the inflorescences thus submersed; inflorescence a capitate or cylindrical, often interrupted spike with 2–5(–7) whorls of flowers, in fruit to 5 cm long; fruits 2.5–4 mm long, apiculate. Travis Co. (Ogden 1966; Turner et al. 2003) on w margin of East TX; widely scattered in TX; widespread in s Canada and throughout the U.S., except parts of the se. May–Oct. [*Coleogeton pectinatus* (L.) Les & R.R. Haynes, *Potamogeton pectinatus* L.] The fruits and vegetative parts (e.g., tubers) are very important foods for wildlife such as ducks (Moore 1913; Correll & Correll 1972). This species is known to reproduce vegetatively by its tubers (Haynes & Hellquist 2000b). It is typically found in highly alkaline



Zizania texana



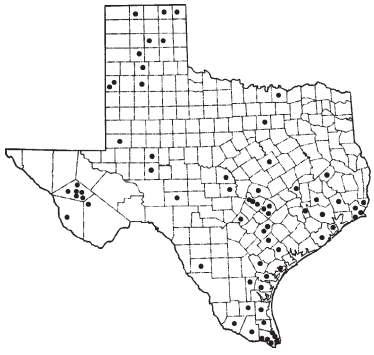
Zizaniopsis miliacea



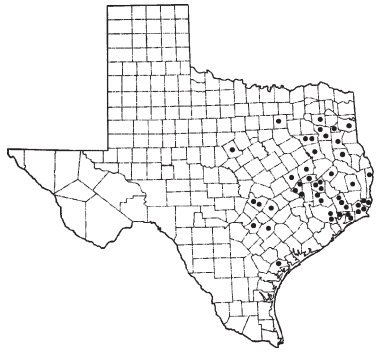
Eichhornia crassipes



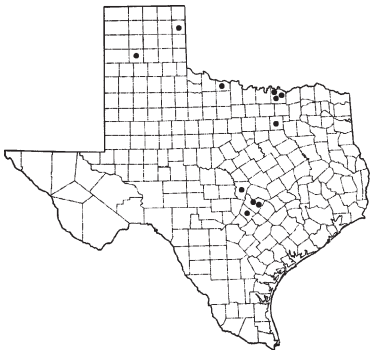
Heteranthera dubia



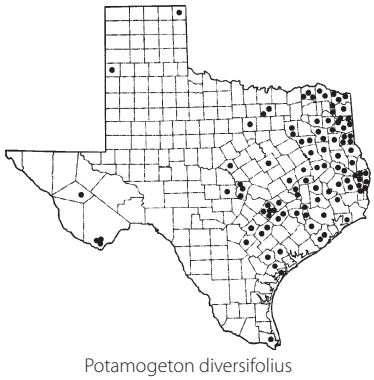
Heteranthera limosa



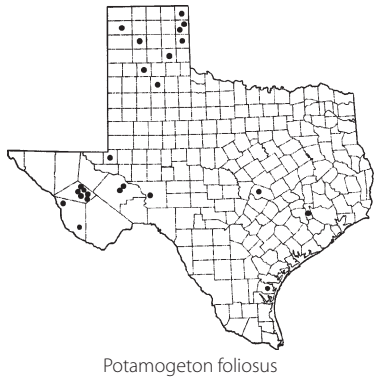
Pontederia cordata



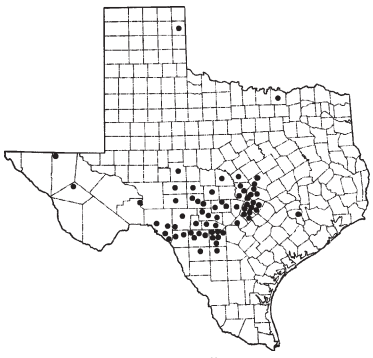
Potamogeton crispus



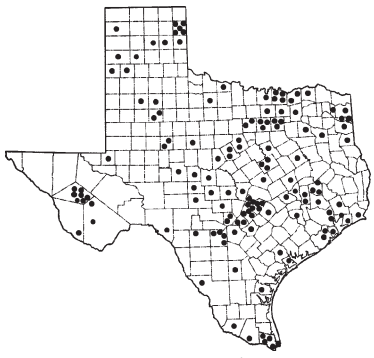
Potamogeton diversifolius



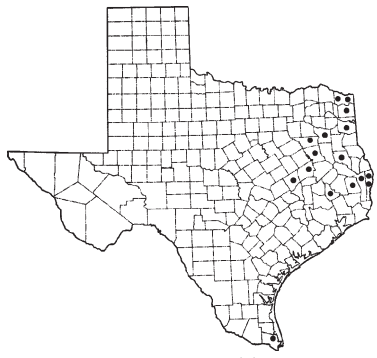
Potamogeton foliosus



Potamogeton illinoensis



Potamogeton nodosus



Potamogeton pulcher

waters (Hellquist 1980), possibly explaining its distribution only on the extreme w margin of East TX where soils are alkaline. Guo and Cook (1989) found that at least some pollination can occur underwater in this species.

RUPPIACEAE Horan. ex Hutch.
DITCH-GRASS FAMILY

A very small (ca. 10 species in a single genus—Haynes 2000c), nearly cosmopolitan family of submersed, glabrous, aquatic herbs of brackish or saline conditions or of fresh waters with high calcium or sulfur ion concentrations. The reduced flowers (perianth absent) and morphological variation have made it difficult to delimit species within the group (e.g., some workers have recognized only a single variable species). Ruppiaceae are unusual in lacking vessel elements (Mabberley 1997). The family is similar to and has sometimes been included in the Potamogetonaceae (e.g., Haynes 1978; Jacobs & Brock 1982; Dahlgren et al. 1985; Thorne 1993b), and it has been suggested that the Ruppiaceae evolved from the Potamogetonaceae by reduction (Heywood 1993). Molecular studies have suggested a closer relationship to the marine families Cymodoceaceae and Posidoniaceae (Les et al. 1993; Les & Haynes 1995; Haynes et al. 1998b), and we are following the recent treatment by Haynes (2000c) in segregating *Ruppia* into its own family. (subclass Alismatidae—Cronquist; order Alismatales—APG II)

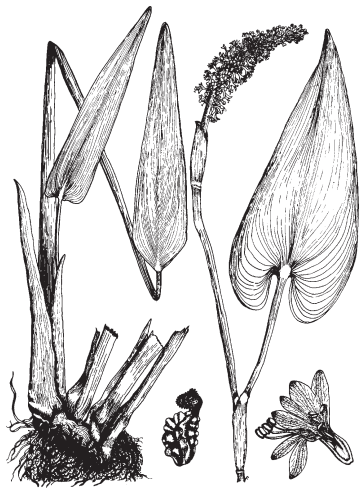
FAMILY RECOGNITION IN THE FIELD: submersed aquatic herbs of brackish, saline, or mineral waters, with thread-like leaves 0.5 mm or less wide, flowers without perianth, and a terminal spike that in fruit has an elongate, usually coiled peduncle.

REFERENCES: Haynes 1978; 2000c; Rico-Gray 1991; Haynes et al. 1998b.

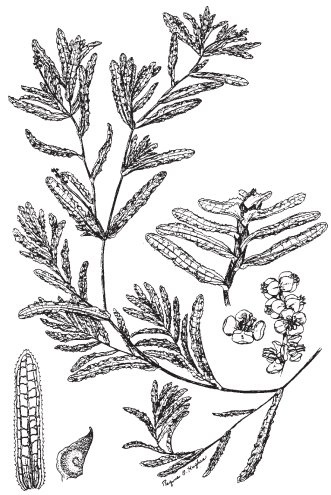
RUPPIA L. DITCH-GRASS, WIDGEON-GRASS, RUPPIA

Only two species occur in North America, with both known from TX (one known only to the s of East TX). The two are very similar and have been treated as variants of a single species by some authorities (e.g., Fernald & Wiegand 1914). However, we are following Thorne (1993b) and Haynes (2000c) in recognizing them at the specific level. Pollination takes place on the surface of the water. After release, the boomerang-shaped pollen grains aggregate by adhering end to end in chains or in snowflake-like groups and are rafted to the stigma, which is held at the water surface due to the elongated peduncle and buoyancy provided by stomata and intercellular spaces in the spongy tissue of the inflorescence (Haynes 1978; Dahlgren et al. 1985; Cox & Knox 1989; Lacroix & Kemp 1997). This type of hydrophily (= water-mediated pollination) occurring at the water surface is known as epihydrophily (in contrast to hypohydrophily or underwater pollination as seen in *Najas*—Hydrocharitaceae) (Philbrick 1993). Some workers (e.g., Cox 1988) further divide epihydrophily into a category in which pollen is transported just above the surface of the water (e.g., *Hydrilla*, *Vallisneria*) and a category in which pollen is transported directly on the surface of the water (e.g., *Elodea, Ruppia*). Cox and Knox (1989) have indicated that a variety of plants with pollen transported directly on the water surface (a two dimensional system) show striking convergent evolution that can be defined as a "surface-pollination syndrome"—floating pollen grains that join together in long floating rafts or "search vehicles" whose large size greatly increases the probability of encountering a stigma, as well as surface borne stigmas that are either elongate or that create a slight depression in the water surface (thus maximizing the probability of being encountered). *Ruppia* species are considered to be among the most valuable submersed aquatics as sources of food for waterfowl and other wildlife. They provide food and cover for fish, all parts of the plants are eaten by many species of waterfowl, and marsh and shorebirds eat the fruits and foliage (Correll & Correll 1972; Haynes 1978; Godfrey & Wooten 1979). (Named for Heinrich Bernhard Ruppius, 1688–1719, German botanist)

REFERENCES: Fernald & Wiegand 1914; Gamerro 1968; Richardson 1980; Jacobs & Brock 1982; Lacroix & Kemp 1997; Morgan & Holmes 2004.



Pontederia cordata [CO1]



Potamogeton crispus [REE]



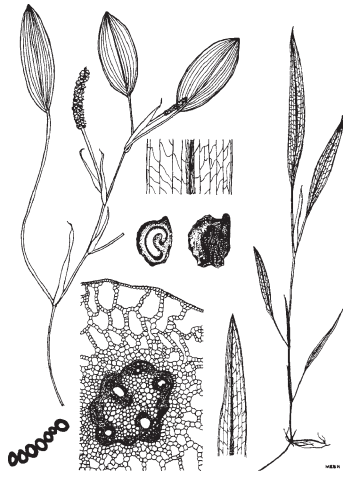
Potamogeton diversifolius [MAS]



Potamogeton foliosus [FAS, MAS]



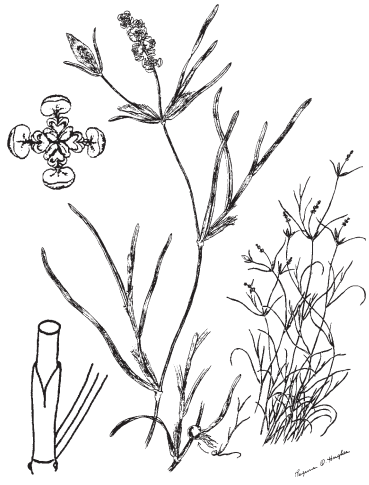
Potamogeton illinoensis [MAS]



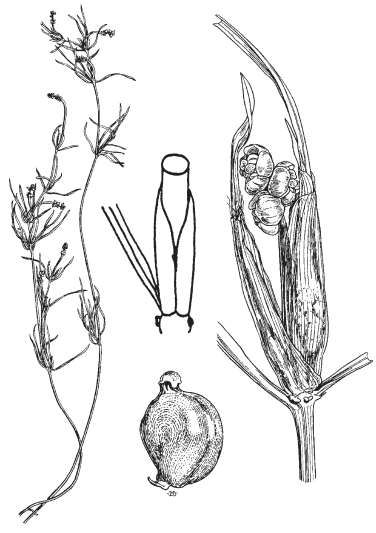
Potamogeton nodosus [LUN]



Potamogeton pulcher [GWO]



Potamogeton pusillus subsp. pusillus [LUN, REE]



Potamogeton pusillus subsp. tenuissimus [LUN, MAS]

Ruppia cirrhosa (Petagna) Grande, (with tendrils, presumably in reference to the thread-like leaves), SPIRAL DITCH-GRASS. Submersed, aquatic, non-rhizomatous herb; stems rooting at lower nodes, to 55 cm long; leaves alternate to subopposite, sessile, thread-like, ca. 3–45 cm long, 0.2–0.5 mm wide, apically acute, with widened basal portion ± sheathing the stem; inflorescences pedunculate 2-flowered spikes each subtended by a spathe; peduncles elongating and coiling so that at maturity 3–30 cm long, with 5 to 30 coils; flowers bisexual, minute; perianth absent; stamens 2, sessile; anther sacs 2 per stamen, these separated by a broad connective, the flower thus appearing to have 4 stamens; pistils 4–6, separate; ovaries superior, sessile at anthesis, but by maturity developing 20–35 mm long stalks so that the several fruits developing from a single flower appear to be in an umbel-like arrangement; fruits drupe-like, 1.5–2 mm long, each with an erect lateral beak to 1 mm long; 2*n*=40 (Thorne 1993b). Lakes, typically those with high mineral concentrations; Van Zandt Co. (Turner et al. 2003; R. Haynes, pers. comm.); this location is presumably in the area of Grand Saline, where there is an extensive salt marsh complex due to the presence of a salt dome; known from a few widely scattered localities in TX; widespread in w Canada and the w U.S., scattered further e (IL, OH, MI, MO, MN). Summer–fall. [*Buccaferrea cirrhosa* Petagna, *R. cirrhosa* subsp. *occidentalis* (S. Watson) Á. Löve, *R. occidentalis* S. Watson]

Ruppia maritima L., (growing on the seacoast), WIDGEON-GRASS, BEAKED DITCH-GRASS, DUCK-GRASS, found in TX only in the Gulf Prairies and Marshes and South TX Plains (Hatch et al. 1990), is known from shallow saline waters near the coast just to the s of East TX; it is primarily a coastal species occurring widely along the coasts of Canada and the U.S. Similar to *R. cirrhosa*; leaves 6–10.5 cm long, apically ± obtuse; fruit with beak terminal, slightly recurved, on stalks 12–19 mm long; 2*n*=20 (Thorne 1993b). Spring–fall. We are following Haynes (2000c) in not recognizing varieties in this species. The two TX species can be separated as follows:

1. Leaf apices acute; peduncles with 5–30 coils, 3 cm or more long; plants mostly from inland localities _____ *R. cirrhosa*
1. Leaf apices ± obtuse; peduncles with 0–3(–4) coils, less than 2.5 cm long; plants mostly from coastal localities _____ *R. maritima*

SMILACACEAE Vent.
GREENBRIER OR CATBRIER FAMILY

A small (375 species in 4 genera—rarely as many as 12 genera are recognized) family nearly worldwide in distribution but particularly in the tropics and subtropics, with a few in temperate areas (Holmes 2002c). Molecular evidence (e.g., Chase et al. 1995a) supports the monophyly of the family. The Smilacaceae has often been submerged into the Liliaceae or even combined with the Dioscoreaceae (Tyrl et al. 1994). Based on molecular evidence (Chase et al. 1993, 1995a; Rudall et al. 2000b; Vinnersten & Bremer 2001), the family falls "clearly within the Liliales" (Judd 1998). It is apparently most closely related to Liliaceae (Vinnersten & Bremer 2001), differing "mainly in leaf characteristics and in being dioecious" (Holmes 2002c). According to Holmes (2002c), the leaf venation is "atypical of monocotyledons in being reticulate [= net-like] between major veins." (subclass Liliidae—Cronquist; order Liliales—APG II)

FAMILY RECOGNITION IN THE FIELD: woody (except 1 species), usually prickly (painfully so) vines with tendrils and alternate, often ± leathery leaves, with the main veins longitudinal and the secondary veins in a net-like arrangement; flowers (small, inconspicuous) and fruits (small berries) in axillary umbels.

REFERENCES: Dahlgren et al. 1985; Judd 1998; Holmes 2002c.

SMILAX L. GREENBRIER, CATBRIER

Dioecious woody (herbaceous in 1 species) trailers or usually climbers from slender non-tuberous rhizomes or from starch-rich tuberous rhizomes, these sometimes quite large in size and some-

times woody; stems usually ± prickly, sometimes strikingly so; leaves alternate, short-petioled, bearing paired tendrils from the petioles; leaf blades usually glabrous or nearly so (hairy in 2 species), quite variable in shape, making identification of single leaves extremely difficult, with the several main veins longitudinal and the secondary veins in a net-like arrangement; flowers in peduncled axillary umbels; perianth green or yellow-green to bronze, small; tepals 6; stamens 6; pistil 1, usually of 3 carpels; pistillodes and staminodes often present in flowers of opposite sex; ovary superior; fruit in East TX species a 1–3(–6)-seeded blackish or bluish black or red to orange berry ca. 4–10 mm long, in some species ripening during the year following flowering.

A genus of ca. 350 species nearly worldwide in tropical and subtropical areas, with a few in temperate regions (Holmes 2002c). Most *Smilax* species are easily recognized in the field as woody vines armed with prickles; they frequently make moving through East TX forests difficult or painful—hence common names such as BULLBRIER, HELLFETTER, BLASPHEMEVINE, and DEVIL GREENBRIER. The sarsaparilla of commerce is obtained from a South American species and was used medicinally as a tonic, for digestive disturbances, or in treating rheumatism; the active substances are steroidal saponins (Dahlgren et al. 1985). The young shoots of many species grow quite rapidly, are soft and succulent, and can be eaten as a vegetable like asparagus (Coker 1944; Judd 1998; Yatskievych 1999). The tuberous rhizomes of some species (e.g., *S. smallii*) were valued as food by Native Americans, as they could be beaten and used for bread or mush after the fibrous material was removed (Coker 1944). *Smilax* species are also an important food for wildlife (Holmes 2002c); deer, for example, eat the foliage. The following treatment is modified in part from those by Coker (1944), Duncan (1967), and Holmes (2002c). (A classical name from Greek, *smile*, rough, a grater, or rasping, in reference to the sharp prickles, used variously by Theophrastus, Dioscorides, and Pliny for *Smilax aspera* L., *Taxus baccata* L., or *Quercus ilex* L.—Judd 1998)
REFERENCES: Morong 1874; Pennell 1916b; Coker 1944; Mangaly 1968; Vines 1960; Duncan 1967, 1975; Godfrey & Wooten 1979.

1. Stems herbaceous, annual, without prickles, to 3 m or less long; ovules (= immature seeds) usually 2 in each carpel; species rare in East TX in the Pineywoods _____ **S. lasioneura**
1. Stems woody, perennial, usually but not always prickly (usually prickly at least near base), varying in length but often much more than 3 m long; ovules solitary in each carpel; including species widespread and common in East TX.
   2. Stems hairy, not prickly; lower (= abaxial) surface of leaf blades densely hairy; plants trailing, suberect, or low climbing (< 1 m tall); fruits red, apically pointed; in East TX known only from the Pineywoods _____ **S. pumila**
   2. Stems glabrous (*S. bona-nox* can rarely have dark stellate hairs), usually but not always prickly (usually prickly at least near base); lower surface of leaf blades glabrous or rarely minutely hairy; plants sometimes erect but usually high climbing; fruits red, orange, black, to bluish (due to a waxy bloom), not apically pointed; including species widespread in East TX.
      3. Leaves evergreen, the blades conspicuously thick-coriaceous, oblong to oblong-linear or oblong-lanceolate to rarely broadly linear; leaf blades with only 3 main veins, the midvein on proximal third of lower leaf surface more prominent than lateral veins, the veins indistinct on the upper surface; fruits black, 1-seeded, ripening late in the next year following flowering _____ **S. laurifolia**
      3. Leaves deciduous or evergreen, the blades leathery to firm-coriaceous but not thick and usually without oblong blades; leaf blades usually with more than 3 main veins (sometimes 3 in *S. glauca*), with midvein scarcely or no more prominent than the lateral veins on lower leaf surface, the veins sometimes distinct on the upper surface; fruits red to orange, black, or bluish (due to a waxy bloom), 1–3-seeded, ripening the same year as flowering (or in the summer of the next year in *S. smallii*).
         4. Leaf blades glaucous (= whitened, silvery, or bluish gray) below when fresh (and usually also when dry); peduncles (= stalks of inflorescence) longer (usually much longer) than petioles of subtending leaves _____ **S. glauca**

4. Leaf blades ± the same green color above and below; peduncles longer or shorter than petioles of subtending leaves.
   5. EITHER stems with numerous, weak, bristle-like, dark prickles OR leaf blades with a thickened, cartilaginous, marginal band (as if with a rib (= vein) forming the edge—use magnification) and usually with indented sides; peduncles 1.5 or more times as long as petioles of the subtending leaves, to ca. 65 mm long; leaf bases cordate to truncate or rounded; fruits usually 1-seeded, black.
      6. Stems with relatively weak, somewhat bristle-like, usually dark prickles; leaf margins thin, without a cartilaginous band, obscurely minutely serrulate in basal half; leaves drying and fading to an ashy-green color; leaf blades of flowering branches ovate or rounded in outline, the sides ± curved outward, almost never indented, the base rounded to cordate _____ **S. tamnoides**
      6. Stems with rigid, broad-based, pale or only dark-tipped prickles; leaf margins often with a thickened cartilaginous band or rib (use magnification), entire or often with widely spaced, ± delicate prickles on the margins; leaves drying and fading to a tan color; leaf blades of flowering branches triangular to reniform (= kidney-shaped), the sides often indented to nearly straight or curved outward, the base nearly truncate to widely cordate _____ **S. bona-nox**
   5. Stems without numerous, weak, bristle-like, dark prickles AND leaf blades marginally thin, without a thickened cartilaginous band, and without indented sides; peduncles usually less than 1.5 times as long as petioles of the subtending leaves, usually to only 15 mm long (but sometimes longer); leaf bases cuneate (= wedge-shaped-triangular) or cordate to truncate or rounded; fruits 1–3-seeded, black to bluish black to various shades of red or orange.
      7. Leaves evergreen, the mature leaf blades thin-coriaceous, lanceolate to elliptic-lanceolate, usually 2 times longer than wide or longer, basally cuneate; stems terete; fruits dull red to reddish brown _____ **S. smallii**
      7. Leaves ± deciduous, the mature leaf blades firm-membranous, ovate-lanceolate to ovate or nearly rounded, sometimes < 1.5 times longer than wide, basally rounded to cordate; stems terete to 4-angled; fruits bright red to orange or bluish black to black.
         8. Fruits black or bluish black (when glaucous); principal stems and main branches with stout flattened prickles; leaf blades usually ovate to nearly rounded; plants of moist to dry habitats _____ **S. rotundifolia**
         8. Fruits bright red to orange; stems prickly mostly at base, the prickles mostly ± awl-shaped; leaf blades usually ovate-lanceolate to ovate-oblong; plants of wet habitats _____ **S. walteri**

Smilax bona-nox L., (good night, from the Spanish: *buenas noches*, for the West Indian species recorded by Clusius), SAW GREENBRIER, FIDDLE-LEAF GREENBRIER, STRETCHBERRY, GUMBERRY, CHINABRIER, BULLBRIER, CATBRIER, ZARZAPARRILLA, TRAMP'S-TROUBLE, FRINGED GREENBRIER. Plant forming low tangles or climbing on shrubs or trees; ± prickly, long, slender rhizomes and prickly tuberous rhizomes present, the prickles with dark resinous tips (this is the only East TX species with prickly tuberous rhizomes); stems with rigid, broad-based, pale or only dark-tipped prickles 4–9 mm long on both the internodes and the nodes, also often with patches of whitish, granular-warty or scruffy material (under magnification appearing as masses of short, ± branched hairs); leaves tardily deciduous, some often surviving the winter; leaf blades to ca. 10 cm long, varying greatly in size and shape, those of flowering branches triangular to reniform (= kidney-shaped), with the sides often indented to nearly straight or curved outward, often blotched or mottled with some areas paler or whitish, the base nearly truncate to widely cordate, often with ± delicate prickles on the margins, main veins, and petioles, the margins with a thickened cartilaginous band (as if with a rib (= vein) forming the edge); peduncles to

30(–60) mm long, 1.5 or more times as long as subtending petioles; fruits black, sometimes with a bloom, ellipsoid to subglobose, to 6 mm long and 3.5–5 mm wide. Woods, old fields, pastures, sandy or rocky soils, wet to well-drained situations; widespread in the e 2/3 of TX; e U.S. from VA s to FL w to IL, KS, OK, and TX. Apr–May. [*S. renifolia* Small] This is the most widespread of the East TX GREENBRIERS; it is also one of the most abundant. Leaf morphology is extremely variable in this species, even within individual plants (Holmes 2002c); it has been suggested that there may be a correlation between the variation and the degree of plant maturity (Steyermark 1963). This species is sometimes confused with *S. rotundifolia*, which differs in having proportionately shorter peduncles, lacking thickened leaf margins, having prickles only on the internodes, and not having the sides of leaves indented. A collection from Dallas Co. (*Milam 509*, BRIT) has unusually abundant masses of hairs on the stem, as well as consistently malformed leaves. The common name, STRETCHBERRY, derives from the elastic-like tissue surrounding the seed—this was sometimes used like chewing gum by pioneers. ⚄/299

Smilax glauca Walter, (whitened with a coating or bloom), SAWBRIER, CATBRIER, CAT GREENBRIER, WILD SARSAPARILLA, GLAUCOUS-LEAF GREENBRIER, SOWBRIER, SARSAPARILLA-VINE. Plant freely climbing; ± prickly, long, slender rhizomes and non-prickly, knotty, tuberous rhizomes present; stems terete, often glaucous, with scattered stiff slender prickles 1–5 mm long; leaves semi-evergreen; leaf blades elliptic to ovate or reniform, to 13 cm long and 10 cm wide, sometimes mottled, the lower surfaces strikingly glaucous (this, however, can be modified upon heating/drying), the bases rounded to subcordate, the margins thin (without a rib-like structure) though sometimes rolled when dry, without any prickles or cusps; peduncles to 30(–50) mm long, usually 1.5–3 times as long as the subtending petioles; fruits black to bluish, with a conspicuous bloom (= coating of white wax or powder), subglobose, 8–10 mm in diam. Sandy thickets, woods, fields, and along streams; Pineywoods and Post Oak Savannah w to e margin of Blackland Prairie; also n Gulf Prairies and Marshes and South TX Plains and Tarrant Co. (Turner et al. 2003) in Cross Timbers and Prairies; e U.S. from NY s to FL w to IL and TX. May–Jun. If the leaf glaucousness is lost, the terete (rather than 4-angled) stems and the peduncles that are often much longer than the subtending petioles can help distinguish this species from *S. rotundifolia*, while the rounded to subcordate leaf bases can separate it from *S. smallii* (with cuneate leaf bases).

Smilax lasioneura Hook., (woolly-veined), BLUE RIDGE CARRION-FLOWER. Stems herbaceous, annual, climbing, erect to ascending, to only 2.5 m long, without prickles; tendrils numerous; leaf blades ovate to nearly round, pubescent on lower surface, with convex lateral margins, to ca. 8 cm long, the bases cordate; peduncles to ca. 12 cm long; fruits bluish black to black, subglobose, ca. 8–10 mm in diam. Woods, moist soils; Marion, Nacogdoches, Sabine (BAYLU) and San Augustine (Correll & Johnston 1970, xerox of US sheet at BAYLU) cos. in the Pineywoods; se Canada and e U.S. from OH s to FL w to MT and TX. May–Jun. [*Nemexia lasioneura* (Hook.) Rydb., *S. herbacea* L. var. *lasioneura* (Hook.) A. DC., *S. herbacea* L. subsp. *lasioneura* (Hook.) Á. Löve & D. Löve]. This is the only herbaceous species of *Smilax* in the East TX flora. Pollination in a closely related species (*S. herbacea* L.) is reported to be by small bees, flies, and beetles that are attracted by the carrion-like odor of the flowers (Sawyer & Anderson 1998).

Smilax laurifolia L., (laurel-leaved), LAUREL GREENBRIER, BAMBOOVINE, BLASPHEMEVINE, CHINABRIER, LAURELBRIER, BAY-LEAF SMILAX, LAUREL-LEAF GREENBRIER. High-climbing, often extremely vigorous evergreen with dead as well as living stems often forming impenetrable entanglements; large, thick, semi-woody, tuberous, pinkish red rhizomes present, but long slender rhizomes absent; stems thick (to 15 mm), well-armed, especially on lower parts, with stout, rigid, flattened prickles to 12 mm long; tendrils intermittent, few or lacking on flowering stems; leaf blades heavily coriaceous, oblong to oblong-linear or oblong-lanceolate to rarely broadly linear, 6–20 cm long, 1–7.5 cm wide, with only 3 main veins (there are also often 2 additional

obscure marginal veins immediately adjacent to and almost indistinguishable from the ± cartilaginous leaf margin), the bases rounded to cuneate, green or somewhat glaucous on the lower surface, without any prickles or roughening; peduncles 5–15 mm long, shorter than to a little longer than the petioles; fruits black when ripe (green to rose-purple when immature—see photo on page 299), sometimes glaucous, ovoid to subglobose, 5–8 mm long. Usually swamp or bog margins, stream banks, and seeps; Pineywoods and n Post Oak Savannah; also n margin of Gulf Prairies and Marshes; se U.S. from DE s to FL w to OK and TX. Flowering late summer and autumn, fruits ripening the next season. The leaves are sometimes confused with those of *S. smallii* (also evergreen); however, in *S. laurifolia* the heavily coriaceous leaf blades with 3 main veins are usually mucronate at the apex, and there also is often an evenly submarginal vein ± at each edge of the leaf (more conspicuous upon drying), while in *S. smallii* the thinly coriaceous leaf blades with usually 5 main veins have an apex that is acute to shortly acuminate and there are no evenly submarginal veins (Duncan 1967). (Note: upon drying, the relatively thin leaf margins of *S. smallii* can be rolled marginally and have the appearance of thickened marginal veins or ribs). The large, semi-woody, tuberous rhizomes were reported to be used as food by Native Americans and early settlers (Vines 1960). ⚄/299

Smilax pumila Walter, (dwarf, very small), DWARF GREENBRIER, SARSAPARILLA-VINE, HAIRY GREENBRIER, PROSTRATE GREENBRIER, BRIERVINE, GROUNDBRIER, WILD SARSAPARILLA, Trailing, suberect, or low climbing (< 1 m tall), the plant dwarf compared to other perennial *Smilax* species; small, knotty, woody rhizome and one–several slender rhizomes present; stems hairy, without prickles; leaves ± evergreen; leaf blades ovate to ovate-lanceolate, 5–10 cm long, to 8 cm wide, the bases cordate, the lower (= abaxial) surface densely hairy (hairs curled, ca. 0.5–0.9 mm long); peduncles varying from shorter than to 1(–1.5) times as long as petiole of subtending leaf; fruits red, ovoid, 5–8(–10) mm long, apically pointed. Sandy soils, along streams, wooded areas; s part of the Pineywoods; also n Gulf Prairies and Marshes; se U.S. from SC s to FL w to AR and TX. Late summer and fall, fruits ripening the next season and often persisting. According to Holmes (2002c), *S. humilis* Mill. is an older name for this species. It has been proposed for rejection (Reveal 2000). However, if that proposal is not accepted, the name for this species will have to be changed to be *S. humilis*. The dried leaves are reportedly used in LA in making a tea for upset stomach (Holmes 2002c).

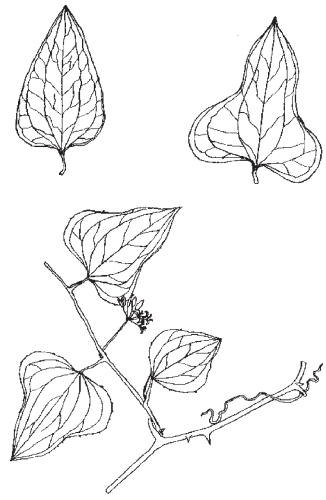
Smilax rotundifolia L., (round-leaved), COMMON GREENBRIER, BULLBRIER, HORSEBRIER, BISCUIT-LEAVES, WAIT-A-BIT, BAMBOOBRIER, DEVIL'S-HOPVINE, BREAD-AND-BUTTER, HUNGRYVINE, CATBRIER, HORSEBRIER, SOWBRIER. Plant high-climbing and forming thickets; long, slender, usually nonprickly rhizomes present but tuberous rhizomes absent; stems terete or 4-angled, with straight flat prickles to 12 mm long (lacking bristle-like prickles); leaves ± deciduous; tendrils numerous; leaf blades to 17 cm long, firm-membranous, ovate to nearly rounded, rounded to cordate at base, the margins not thickened (however, the thin margin can sometimes be rolled) but usually roughened with minute cusps; peduncles usually to ca. 15 mm long, usually slightly shorter than to slightly longer than the petiole of the subtending leaf (rarely longer); fruits bluish black to black, globose, 5–8 mm in diam. Thickets and woods, moist to dry areas; mainly Pineywoods and Post Oak Savannah, with one locality from Dallas Co. (Turner et al. 2003) further w; also Cross Timbers and Prairies (Bosque Co.—Carr 1989 and Fort Hood—Bell or Coryell cos.—Sanchez 1997); se Canada and throughout e U.S. w to KS and TX. Mar–Jun. The leaves of this species are similar to those of *S. bona-nox*, but the two can be distinguished by the thickened leaf margins (with a thickened cartilaginous band, as if with a raised vein forming the edge—use magnification) of *S. bona-nox* (Duncan 1967). It can also be confused with *S. tamnoides* but lacks the bristle-like, usually dark prickles of that species. The small green flowers produce minute amounts of nectar, and the male flowers have pollen grains linked to each other by viscin threads—preventing wind pollination; insect pollination is therefore expected (Kevan et al. 1991).



Stuckenia pectinata [MAS]



Ruppia cirrhosa [JEP]



Smilax bona-nox [BT3]



Smilax glauca [G&F]



Smilax lasioneura [YAT]



Smilax laurifolia [GLE]

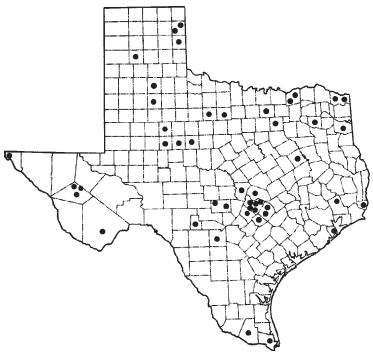


Smilax pumila [JEM]

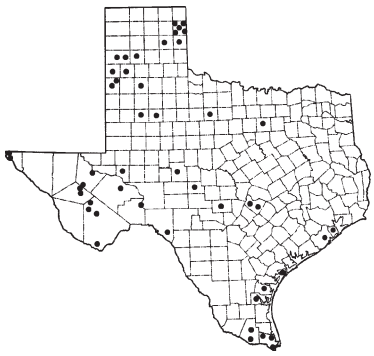
Smilax smallii Morong, (for its discoverer, John Kunkel Small, 1869–1938, botanist at New York Botanical Garden and author of numerous works, including *Manual of the Southeastern Flora*), SMALL'S GREENBRIER, CORAL GREENBRIER, JACKSONBRIER, BAMBOOVINE, JACKSONVINE, THORNLESS SMILAX, LANCE-LEAF GREENBRIER, SOUTHERN SMILAX. Often very high climbing, very robust plant; large, thick, tuberous rhizomes present (to 30 kg in weight and 1.8 m in length) (White 1998; W. Holmes, pers. comm.), with the texture of a very hard apple (Coker 1944), but long slender rhizomes absent; stems thick, to 20(–27) mm in diam., armed with scattered prickles below but mostly without prickles above, the prickles flattened, recurved, 3–4 mm long; leaves evergreen, the blades thin-coriaceous, to 6.6 cm long, lanceolate to elliptic-lanceolate, usually 2 times as long as wide or longer, with 5(–7) main veins, cuneate basally, bright green on upper surface, often glaucous below on younger branches, sometimes mottled, the margins smooth, not thickened; peduncles ca. 4–10(–23) mm long, usually ca. as long as petiole of the subtending leaf; fruits dull red to reddish brown, globose to subglobose, ca. 6 mm in diam. Along creeks, woodlands; Pineywoods and Post Oak Savannah w to Milam (BRIT), Falls, Kaufman (BAYLU), and Bastrop (Turner et al. 2003) cos., also a Reverchon collection from Dallas (BRIT); also n Gulf Prairies and Marshes; se U.S. from DE s to FL w to OK and TX. May–Jun. [*S. lanceolata* L.] This species can be confused with another very robust, very high climbing species, *S. laurifolia*, but can be distinguished by its less coriaceous leaves with 5–7 main veins and the ± reddish fruits. Material of this evergreen is sometimes used for winter decoration, and the species is also used as an ornamental vine (Coker 1944). Vines (1960) reported that "The large tubers were ground into a flour and made into bread or a cooling drink by the Indians and early settlers." This species is also apparently the source of "red coontie," a jelly prepared by Native Americans of the southeastern United States (Coker 1944). In addition, the "succulent, immature stems were used for food by Native Americans and early settlers" (Holmes 2002c). Holmes (2002c) noted that this is the highest-climbing species of *Smilax* in North America, reaching 10+ m in height. Initially, the tuberous rhizomes are ± linear, but when the above ground stem reaches a diam. of ca. 0.7 cm, the plant becomes sexual and the rhizomes branch. Further, there is a correlation between above ground stem diam. and the mass of the rhizome (White 1998; W. Holmes, pers. comm.).

Smilax tamnoides L., (resembling *Tamnus*, a genus in the Dioscoreaceae), CHINAROOT, HELLFETTER, BRISTLE GREENBRIER, DEVIL GREENBRIER, HAGBRIER, WILD SARSAPARILLA. Plant usually high-climbing; short, knotty, non-prickly rhizomes present but without either long slender rhizomes or tuberous rhizomes; lower stems with relatively weak, somewhat bristle-like, usually dark, ± blackish prickles ca. 3–10 mm long (this character is unique among the East TX species); leaves semi-deciduous to ± persistent; leaf blades of flowering branches to 13 cm long, ovate or rounded in outline, the sides ± curved outward, almost never indented, green on both sides, the base rounded to cordate, the margins not thickened but obscurely minutely serrulate in basal half; peduncles 15–65 mm long, much longer than subtending petioles; fruits black, globose to ovoid, 6–10 mm long. Stream bottom woods, sandy or less often silty clay soils; widespread in e 1/2 of TX; se Canada (Ont.) and e U.S. from NY s to FL w to SD and TX. Apr–May. [*S. hispida* Muhl. ex Torr.] This is one of the most abundant GREENBRIERS in much of East TX.

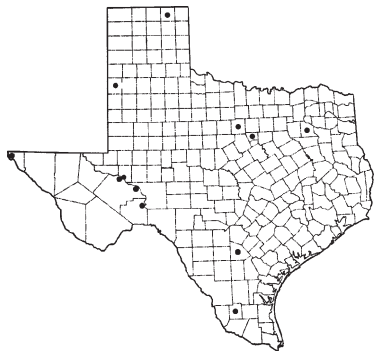
Smilax walteri Pursh, ("for Thomas Walter (?)1740–1789" [who first found the species]—Fernald 1950), RED-BEAD GREENBRIER, WALTER'S GREENBRIER, CORAL GREENBRIER, RED-BERRIED BAMBOO, SARSAPARILLA. Plant climbing and clambering; long, slender, non-prickly, rhizomes present but tuberous rhizomes absent; stems slender, with prickles on lower half, the prickles mostly ± awl-shaped; leaves ± deciduous; tendrils numerous; leaf blades firm-membranous, ovate-lanceolate to ovate-oblong, rather uniform in shape, usually 6–12 cm long, 3–7 cm wide, the base rounded, drying a distinctive light orange tinged with brown; petioles often reddish; peduncles 5–20 mm long, usually shorter than the subtending petioles; fruits bright red to orange, globose or ovoid, 7–9 mm long. Wet habitats such as sandy stream, pond, or swamp margins, sometimes actually in water; Hardin, Nacogdoches (BRIT), Newton (BAYLU), Angelina, Jasper, and Orange



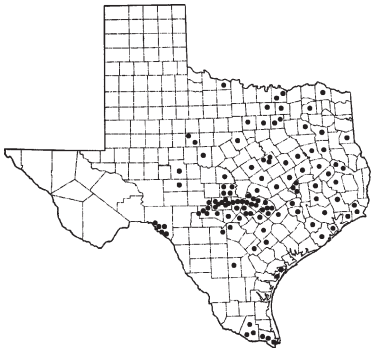
Potamogeton pusillus subsp. pusillus



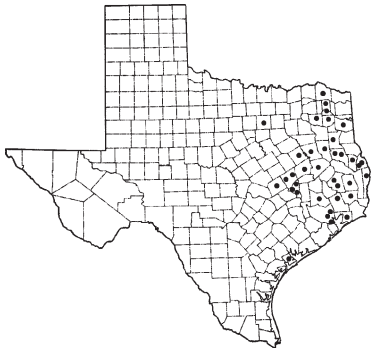
Stuckenia pectinata



Ruppia cirrhosa



Smilax bona-nox



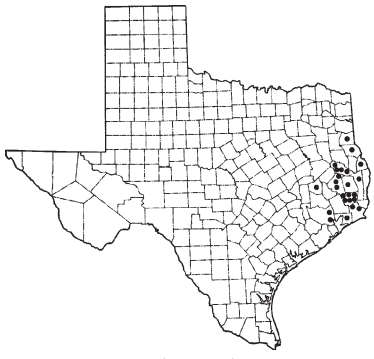
Smilax glauca



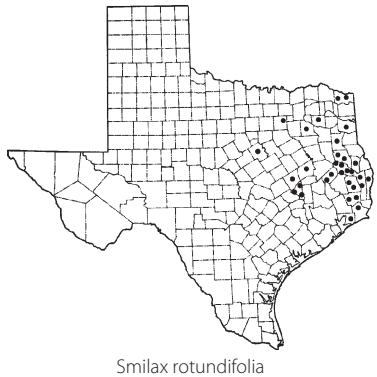
Smilax lasioneura



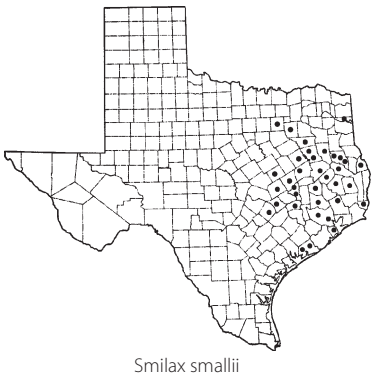
Smilax laurifolia



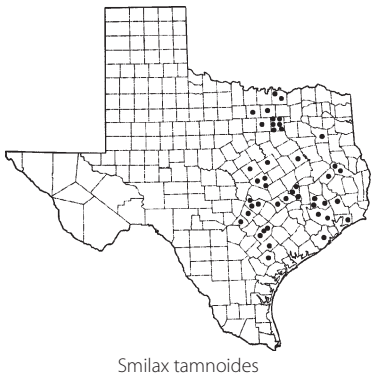
Smilax pumila



Smilax rotundifolia



Smilax smallii



Smilax tamnoides



Smilax walteri

(Turner et al. 2003) cos. in the se Pineywoods and Marion Co. (J. Singhurst, pers. comm.) in the n Pineywoods; also Gulf Prairies and Marshes; se U.S. from VA s to FL w to AR and TX. Apr–May, the fruit ripening in October of the first season, but sometimes long-persisting. Fruiting individuals of this species, which is similar to *S. rotundifolia* (fruits bluish black to black), can easily be distinguished by the fruit color (bright red to orange).

Smilax renifolia Small, (kidney-leaved), endemic to the Edwards Plateau, was reported from the Blackland Prairie by Hatch et al. (1990). However, no definitive specimens have been seen from East TX. Field observations on the Edwards Plateau (R. O'Kennon) raise doubts about the distinctiveness of *S. renifolia* from *S. bona-nox*. Also, Coker (1944), in a treatment of the woody species of *Smilax* in the U.S., indicated that the type of *S. renifolia* is actually *S. bona-nox*. While Correll and Johnston (1970) distinguished *S. renifolia* by its reniform or deltoid-reniform, mostly broader than long leaf blades (vs. blades typically panduriform to broadly ovate, usually longer than broad in *S. bona-nox*), they (1970) likewise indicated that *S. renifolia* "... should probably be treated as a geographic variant of *S. bona-nox*, its closest ally." Agreeing that this species does not warrant recognition, we are following Holmes (2002c) in synonymizing it with *S. bona-nox*.

SPARGANIACEAE Hanin
BUR-REED FAMILY

A very small family (1 genus, 14 species) of wind-pollinated species occurring primarily in the n temperate zone and arctic but extending in a few areas into the tropics and s temperate regions (Kaul 2000). The family has often been treated in the Typhales (e.g., Cronquist 1988; Takhtajan 1997), and it has been suggested that the Sparganiaceae is possibly best united with the very similar Typhaceae (Thorne 1993c; Mabberley 1997; Kubitzki 1998b; Judd et al. 1999). However, the most recent monographers of the group (Cook & Nicholls 1986, 1987) noted that the two groups are clearly distinct morphologically and have been so since at least the Oligocene (ca. 38 to 23 million years ago). They concluded that there is no purpose in uniting the two families (and significant disadvantages—e.g., nomenclatural instability). (subclass Commelinidae—Cronquist; order Poales—APG II)

FAMILY RECOGNITION IN THE FIELD: perennial emergents of wet areas with sheathing, parallel-veined, 2-ranked, linear leaves and flowers in several dense, globose, unisexual heads.

REFERENCES: Thieret 1982; Dahlgren et al. 1985; Kubitzki 1998b; Kaul 2000.

SPARGANIUM L. BUR-REED

Perennial, monoecious, rhizomatous (but not conspicuously so) herbs; leaves alternate, 2-ranked, sessile, sheathing, linear, apically rounded, parallel-veined, usually ascending to erect (in TX species), dying down in winter; inflorescences usually branched or sometimes simple, the flowers grouped into dense, ± globose, usually sessile (in East TX species), ± separated, unisexual heads; heads (at least lower ones) subtended by leaf-like bracts; staminate heads above and separated from the pistillate heads; perianth segments of both male and female flowers with dark tips; staminate flowers with 1–6 scale-like tepals and 1–8 stamens; pistillate flowers sessile or short pedicelled, with 3–8 scale-like tepals and a superior ovary; stigma 1 (in East TX species); fruits achene- or drupe-like, with spongy layers around the seed; style persistent as a beak, the pistillate heads thus bur-like, but at maturity the fruits falling away separately.

BUR-REEDS are aquatic or wet area species, found throughout the temperate and arctic regions of the n hemisphere. The genus is also known in isolated tropical areas (central Sumatra, New Guinea, Mexico) and in s temperate areas (se Australia and New Zealand). The regions of greatest species diversity are North America and e Asia (Cook & Nicholls 1986). The plants provide

cover for various aquatic organisms, including waterfowl, and the fruits can be an important wildlife food. The seeds are apparently dispersed in part by floating on water (Yatskievych 1999), and seedlings develop only when submersed in water (Cook & Nicholls 1986). The common name is derived from the bur-like female heads with their persistent, beak-like styles. (Probably Greek: *sparganion,* a name used by Dioscorides for some plant, perhaps *Butomus umbellatus* L.; derived from *sparganon*, swathed or swaddling band, in reference to the long, narrow, strap-shaped leaves—Kaul 2000).

REFERENCES: Fernald 1922; Beal 1960b; Cook & Nicholls 1986, 1987.

1. Lateral inflorescence branches (if present) usually with 1–3 female heads; leaves erect but not stiff, flat to slightly keeled at base; fruiting heads 15–25 mm in diam.; fruit bodies (3.5–)4–5(–7) mm long, ca. 2 mm in diam., dull and brown to dark brown above; fruit beaks (1.5–)3–4.5(–5) mm long; stigmas 1–2 mm long; pedicels of female flowers and fruits 1–2(–3) mm long _____ **S. americanum**
1. Lateral inflorescence branches usually with only male heads (female heads only on main inflorescence axis); leaves erect and at least the middle ones stiff and usually strongly keeled to at least the middle; fruiting heads 25–35 mm in diam.; fruit bodies 5–7 mm long, 2.5–3 mm in diam., shiny and light brown above; fruit beaks (4–)4.5–7 mm long; stigmas 2–4 mm long; pedicels of female flowers and fruits 2.4–4 mm long _____ **S. androcladum**

Sparganium americanum Nutt., (of America), AMERICAN BUR-REED. Plant emergent and erect or sometimes submersed; flowering stems 30–ca. 100 cm long; basal leaves rarely exceeding the inflorescence, 30–100 cm long, (5–)6–12 mm wide, flat to slightly keeled at base; inflorescence 10–25(–30) cm long, with up to 3 branches or sometimes simple; lowermost bract of inflorescence 1–2 times as long as the inflorescence; female heads axillary, usually sessile, in fruit ca. 15–25 mm in diam.; male heads 10–15(–18) mm in diam.; pedicels of female flowers or fruits 1–2(–3) mm long; fruits dull and brown to dark brown above, sometimes pitted, with a straight or curved (but not hooked) beak. Shallow, still or flowing water; Pineywoods and n Post Oak Savannah; e Canada and throughout e U.S. w to MN and TX. Apr–Jun. This species is quite variable morphologically (Beal 1960b). ⚄/299

Sparganium androcladum (Engelm.) Morong, (with staminate branches), BRANCHED BUR-REED, STAMINATE BUR-REED. Plant usually emergent; flowering stems 40–100(–120) cm tall; basal leaves exceeding the inflorescence, to 100 cm or more long, 5–12(–15) mm wide, distinctly keeled from base to at least the middle (often to near apex); lowermost bract of inflorescence exceeding the inflorescence; female heads axillary, sessile, in fruit 25–35 mm in diam.; male heads ca. 10–15 mm in diam.; pedicels of female flowers or fruits 2.4–4 mm long; fruits shiny and light brown above, pitted and glandular below, with a usually curved, often hooked beak. Shallow water, swamps, marshes, along shores; reported for "e. Tex." by Correll and Johnston (1970) and for the Pineywoods, Post Oak Savannah, and Gulf Prairies and Marshes by Hatch et al. (1990); however, according to Cook and Nicholls (1987) and the range map in Kaul (2000), *S. androcladum* is a species primarily of the ne U.S. that extends s only to OK; se Canada and e U.S. from ME s to TN w to MN, OK, and ?TX. While no East TX specimens have been seen, it is included here based on the possibility of its occurrence; no county distribution map is provided. Apr–Jun. [*S. lucidum* Fernald & Eames]

THEMIDACEAE Salisb.
CLUSTER-LILY FAMILY

A small family (12 genera and ca. 60 species) of w North America, from sw Canada through the w U.S. and Mexico, with 1 species reaching Guatemala (Rahn 1998b). The family includes *Brodiaea* (CLUSTER-LILY) and its relatives. A few (e.g., species of *Androstephium* and *Brodiaea*) are grown as ornamentals. The genera have been variously treated in terms of family affiliation.

Many authorities have put them in a broadly defined and clearly polyphyletic (but practical) Liliaceae (e.g., Correll & Johnston 1970; Cronquist 1988; Diggs et al. 1999) based on superficial similarities in flower structure to the genus *Lilium*. Others have put them in the Amaryllidaceae (based on the umbellate inflorescence—e.g., Hutchinson 1934) or the Alliaceae (e.g., Dahlgren et al. 1985; Mabberley 1997), which they resemble morphologically (but onion odor is lacking). However, based on phylogenetic analyses (Fay & Chase 1996; Pires et al. 2001), we are following Rahn (1998b) and Pires et al. (2001) in recognizing the Themidaceae as a distinct family. It is apparently a monophyletic group in the order Asparagales, more closely related to the Hyacinthaceae than to the Amaryllidaceae-Alliaceae complex (Fay & Chase 1996). As such, it is more closely related to other Asparagales families such as the Iridaceae and Orchidaceae than it is to other taxa often put in a broadly defined Liliaceae (Chase et al. 1995a, 1995b, 1996, 2000; Fay et al. 2000; Pires et al. 2001). For a detailed discussion of the groups formerly treated as Liliaceae in the broad sense, see the family synopsis of the Liliaceae (here treated in a restricted sense) on page 726. Recently, the Angiosperm Phylogeny Group (APG II 2003) proposed optionally including Themidaceae in a very broadly defined Asparagaceae (including such families as Agavaceae and Hyacinthaceae). Family name from *Themis*, now considered to be included in *Triteleia* (TRIPLET-LILY), a genus of 15 species of w North America and n Mexico (Pires 2002). (Name a "nomen poeticum" according to Salisbury (1866), the original author) (subclass Liliidae—Cronquist; order Asparagales—APG II)

FAMILY RECOGNITION IN THE FIELD: the only East Texas species is a scapose perennial herb from a corm, with 1–6(–9) lavender-blue flowers in an umbel-like cluster subtended by membranous bracts; filaments ± united to form a tube, with appendages forming a crown between the anthers.

REFERENCES: Dahlgren et al. 1985; Fay & Chase 1996; Rahn 1998b; Pires et al. 2001; Pires & Sytsma 2002.

ANDROSTEPHIUM Torr. FUNNEL-LILY

A genus of 3 species of the sw U.S. and n Mexico (Pires & Reveal 2002); some are cultivated as ornamentals. (Greek: *andros*, male, and *stephanos*, a crown, in reference to the apical appendages of the fused filaments—Pires & Reveal 2002)

REFERENCES: Uphof 1944; Pires & Reveal 2002.

Androstephium coeruleum (Scheele) Greene, (dark blue), BLUE FUNNEL-LILY. Glabrous scapose perennial from a fibrous-coated corm; leaves gray-green, basal, linear, 2.5(–3) mm or less wide, longer than the scape (= flowering stem), exserted from a broad, loose, thinly papery, sheathing bract; scape to 25(–35) cm tall but usually < 15 cm; flowers 1–6(–9) in an umbel-like cluster subtended by membranous bracts, strongly spicy-sweet scented; perianth lavender-blue, 16–24(–30) mm long, of 6 segments fused basally to form a ± narrow tube, the free lobes slightly shorter to slightly longer than the tube; stamens inserted on perianth; filaments ± united to form a tube, with bifid apical appendages forming a crown between the anthers; ovary superior; style 1; capsule 10–16 mm long. Prairies; Blackland Prairie (on the Austin Chalk) w to e Edwards Plateau and Rolling Plains; KS, OK, and TX. Late Mar–mid-Apr.

TOFIELDIACEAE Takht.
FALSE ASPHODEL FAMILY

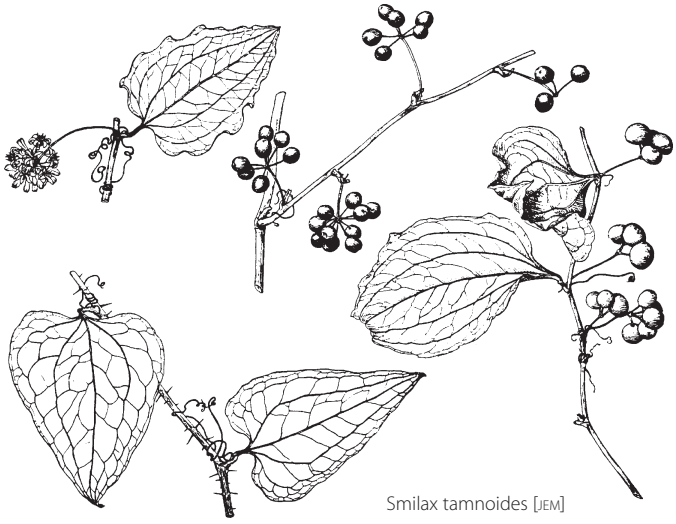
A very small family of 3 genera and ca. 18 species of rhizomatous herbs found in both the Old and New worlds, generally in temperate to circumboreal regions (Zomlefer 1997b). The genera have been variously treated in terms of family affiliation. Many authorities have put them in a very broad and clearly polyphyletic (but practical) Liliaceae (e.g., Correll & Johnston 1970; Cronquist 1988), while others have treated them in a polyphyletic Melanthiaceae (e.g., Dahlgren et al. 1985; Mabberley 1997) or Nartheciaceae (e.g., Tamura 1998c). The Tofieldiaceae,



Smilax rotundifolia [JEM]



Smilax smallii [JEM]



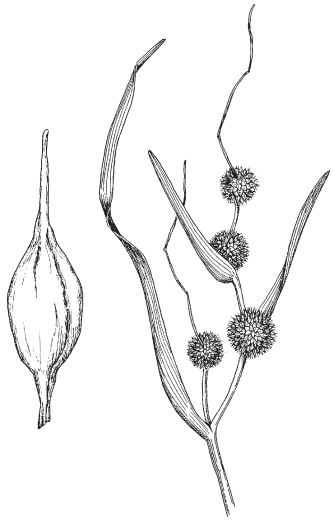
Smilax tamnoides [JEM]



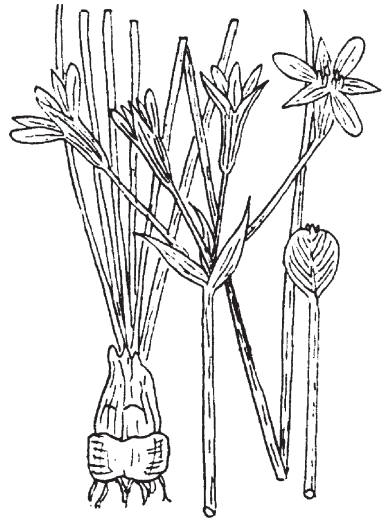
Smilax walteri [GLE]



Sparganium americanum [GLE]



Sparganium androcladum [GLE]



Androstephium coeruleum [RYD]

as treated here following Zomlefer (1997b), is a monophyletic group, only "distantly related" to other groups with which it has been affiliated in the past (Zomlefer 1997b). The Tofieldiaceae has sometimes been put in its own order, the Tofieldiales (Reveal & Zomlefer 1998; Zomlefer 1999), but recent molecular analyses (e.g., Chase et al. 2000) and the Angiosperm Phylogeny Group (APG II 2003) place the family in the Alismatales. It is thus in a clade near the base of the monocots, most closely related to a group of families including the Alismataceae and Araceae (Fuse & Tamura 2000). For a detailed discussion of the groups formerly treated as Liliaceae in the broad sense, see the family synopsis of the Liliaceae (here treated in a restricted sense) on page 726. Family name from *Tofieldia*, a North American and Eurasian genus of 7 or 8 (Packer 2002a) species, often interpreted to include species now segregated as *Triantha* (see e.g., Tamura 1998c). (Named for Thomas Tofield, 1730–1779, British botanist) (subclass Liliidae—Cronquist; order Alismatales—APG II)

FAMILY RECOGNITION IN THE FIELD: the only East Texas species is a subscapose perennial herb from rhizomes, with small, creamy white to white flowers in a racemose inflorescence, the scape minutely glandular pubescent below the inflorescence, and 3 basally fused styles.

REFERENCES: Zomlefer 1997a, 1997b, 1999; Reveal & Zomlefer 1998; Tamura 1998c; Fuse & Tamura 2000.

TRIANTHA (Nutt.) Baker FALSE ASPHODEL

A genus of 4 species of North America and Japan (Packer 2002b). It was previously placed in a heterogeneous *Tofieldia* (e.g., Correll & Johnston 1970; Hatch et al. 1990), but recent studies (Cruden 1991; Packer 1993, 2002b) support its recognition as a separate genus. (Greek: *tri-*, three-, and *anthos*, flower, in reference to the flowers aggregated in threes)

REFERENCES: Cruden 1991; Packer 1993, 2002b.

Triantha racemosa (Walter) Small, (with a raceme type inflorescence), STICKY TOFIELDIA, COASTAL FALSE ASPHODEL. Perennial subscapose herb from rhizomes; stem 30–70 cm tall, minutely glandular pubescent below inflorescence; leaves mostly at base of plant but one usually below middle of stem; basal leaves 2-ranked, linear, grass-like, erect, 30–40(–50) cm long, 3–6 mm wide; leaf of stem small, bract-like; inflorescence racemose, 5–15(–22) cm long, the flowers clusered 2–3(–7) together at the nodes in lower part of inflorescence, sometimes single above, with terminal flowers opening first; pedicels pubescent, each bearing 3 minute connate bracts just below the flower; flowers perfect; perianth segments separate, spreading, oblanceolate to oblong, creamy white or white, drying orangish, 3-nerved, obtuse, (2.5–)3–5 mm long, persistent in fruit; stamens 6; ovary superior, 3-locular; styles 3, connate basally into column 1/4–2/3 their length; capsule equal to or slightly shorter than and ± enclosed by the perianth, ca. 3–5 mm long, tipped by the divergent, enlarged, persistent styles; seeds numerous, ca. 2 mm long (body ca. 1 mm), usually appendaged at both ends with membranous white tails each ca. 1/2 as long as the body or shorter (one sometimes much shorter or absent) (these appendages are presumably for wind dispersal—Rendle 1930). Wet sandy soils of pine savannahs, bogs, seepage slopes; Tyler (BRIT, ASTC) and Jefferson (Turner et al. 2003) cos. in the Pineywoods; se U.S. from DE s to FL w to TX. Jun–Sep. [*Melanthium racemosum* Walt., *Tofieldia racemosa* (Walt.) Britton, Sterns, & Poggenb.] While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠ ▣/305

TRILLIACEAE Lindl.
WAKE-ROBIN FAMILY

A small n hemisphere family of probably 4–6 genera and ca. 50–71 species of woodland herbs, occurring in subarctic to subtropical areas (Zomlefer 1996; Tamura 1998d; Farmer &

Schilling 2002; Judd et al. 2002). Species of all the genera are cultivated (Zomlefer 1996). While the traditional view was that there were 2 genera (*Paris*, *Trillium*) in the family, more recently, different authors have recognized either 4 genera (e.g., Tamura 1998d) or only a single genus (Judd. et al. 2002). However, the most recent study, based on both molecular and morphological data, suggests that 6 genera may be warranted (Farmer & Schilling 2002). The genera have been variously treated in terms of family affiliation—since 1846 members of the family have been placed in five different families (Farmer & Schilling 2002). Some authorities have put them in a very broad and clearly polyphyletic (but practical) Liliaceae (e.g., Correll & Johnston 1970; Cronquist 1988). However, based on phylogenetic analyses, we are following Dahlgren et al. (1985), Zomlefer (1996), Tamura (1998d), Judd et al. (1999, 2002), and Farmer and Schilling (2002) in recognizing a narrowly defined Trilliaceae; as such, the family is monophyletic (Kato et al. 1995b). The family is related to the Melanthiaceae (in the narrow sense as treated here), and additional research is needed to clarify that relationship (Zomlefer 1997a). Indeed, some recent molecular and morphological analyses (e.g., Chase et al. 2000; Fuse & Tamura 2000; Rudall et al. 2000b; Zomlefer et al. 2001) have suggested that *Trillium* and related genera be included in Melanthiaceae, a course followed by the Angiosperm Phylogeny Group (APG II 2003). While clearly related to that family, such a treatment of *Trillium* and allies is, however, problematic in that it groups together plants of radically different morphologies (1 showy versus many small flowers, 3 bracts in a whorl versus basal leaves, berry fruit versus capsules, etc.). In fact, "there are no morphological synapomorphies that unite these two groups as separate from other Liliaceous plants" (Farmer & Schilling 2002). As a result, we are taking what we consider to be an intermediate, practical approach in recognizing the Trilliaceae as a separate family. For a detailed discussion of the groups formerly treated as Liliaceae in the broad sense, see the family synopsis of the Liliaceae (here treated in a restricted sense) on page 726. Some members of the Trilliaceae have been used medicinally (e.g., species of *Paris*, *Trillium*), and *Paris quadrifolia* L., HERBA PARIS, native to Europe and n Asia, is a well known medicinal and poisonous plant still used in homeopathy "for neurological disorders, gout, rheumatism, and other inflammatory maladies" (Zomlefer 1996); ☠ its fruits are considered very poisonous (Zomlefer 1996). (subclass Liliidae—Cronquist; order Liliales—APG II)

FAMILY RECOGNITION IN THE FIELD: plants with leaves (actually leaf-like bracts) in a single whorl of 3 at summit of the stem, flower 1 per plant, 3 showy petals, and fruit fleshy and berry-like.

REFERENCES: Dahlgren et al. 1985; Kato et al. 1995b; Zomlefer 1996; Tamura 1998d; Fuse & Tamura 2000; Rudall et al. 2000b; Farmer & Schilling 2002.

TRILLIUM L. WAKE-ROBIN, BIRTHROOT, TRILLIUM, TOAD-SHADE, SQUAW-ROOT, CARRION-FLOWER

Perennial rhizomatous herbs, lacking the odor of onion or garlic; stems unbranched, erect or nearly so, glabrous or slightly scabrous; leaf-like bracts (often referred to as leaves since they are the primary photosynthetic structures of the plant) usually 3, in a distinctive whorl at summit of stem, glabrous, with net venation; flowers perfect, solitary, sessile or pedicelled, at summit of stem with leaf-like bracts; perianth parts 6, in two series, free, the outer series (sepals) green or with some purplish pigmentation, persistent; inner perianth segments (petals) white to pink, purple, greenish, or yellow, not persistent; stamens 6; anthers linear, ca. as long as or longer than filaments; ovary superior; fruits fleshy, berry-like.

A genus of 43 species (Case 2002) with some authorities recognizing up to ca.48–50 species (Zomlefer 1996; Tamura 1998d; Kazempour Osaloo et al. 1999). They are rhizomatous herbs with an apical whorl of three leaf-like bracts and a single flower and are disjunctly distributed in w North America, e North America, and the Himalayas to e Asia, with the center of diversity in the Appalachian mountain region (Zomlefer 1996; Tamura 1998d). The genus is often considered an Arcto-Tertiary element (Tamura 1998d), and according to Kazempour Osaloo et al.

(1999), the majority of species "are associated with remnants of the ancient Arcto-Tertiary forests, which have persisted with dramatic changes in geographical ranges since the early Tertiary period in the northern hemisphere ..." Three other small genera (including *Paris*) are closely related (see e.g., Kato et al. 1995b), and Zomlefer (1996) speculated that phylogenetic analyses may result in the species in these three genera being put into a more broadly delimited genus *Trillium*. The genus has often been treated in the Liliaceae (e.g., Correll & Johnston 1970) or more recently in the Trilliaceae (e.g., Zomlefer 1996; Tamura 1998d; Judd et al. 1999) or a broadly defined Melanthiaceae (e.g., APG II 2003). *Trillium* has been divided into two groups (those with pedicellate flowers versus those with sessile flowers—e.g., Freeman 1975). However, different varieties of *T. pusillum* Michx. have both flower types, and pollen morphology does not support such a division (Takahashi 1982). Recent molecular evidence indicates that the sessile-flowered species of *Trillium* form a monophyletic group, while the pedicellate-flowered species do not (Kazempour Osaloo et al. 1999).

Morphologically, *Trillium* plants "produce no true leaves or stems above ground. The horizontal rhizome produces dry, scalelike leaves (cataphylls). The above-ground plant is a flowering scape, and technically the leaflike structures are bracts subtending the flower" (Case 2002). Although the plants are small, some individuals can live for at least 30 years (Hanzawa & Kalisz 1993). Pollination by dipterans (red-flowered species) and hymenopterans (white-flowered species) has been reported (e.g., Irwin 2000), but self-pollination is probably prevalent (Zomlefer 1996). Some species have seeds with arils or elaiosomes (= external food bodies) and are ant-dispersed (Handel et al. 1981; Mesler & Lu 1983; Kalisz et al. 1999); such a dispersal system is common among temperate forest herbs (Beattie & Culver 1981; Handel et al. 1981). Elaiosomes on some *Trillium* species have also been found to attract yellow jackets, which apparently also serve as dispersal agents (Zettler et al. 2001). Flower color polymorphisms (= multiple flower color forms) occur widely in *Trillium*, and in *T. sessile* L. (of e North America) the polymorphism is thought to have a relatively simple genetic basis, possibly based on a single gene mutation with incomplete dominance (Les et al. 1989). Several East TX species (e.g., *T. gracile*) show similar patterns of variation in flower color. Some species have been used medicinally (based on the presence of sapogenins) as astringents, coagulants, expectorants, and uterine stimulants; common names such as BIRTHROOT and INDIAN-BALM reflect these uses (Zomlefer 1996; Case 2002). ☠ According to Case (2002), "Fruits, seeds, and rhizomes of trilliums are generally considered to be poisonous." Trilliums are widely cultivated (Zomlefer 1996), but according to Yatskievych (1999), they are "relatively difficult to grow from seed; plants must be several years old before they will flower. Consequently, many of the plants sold at nurseries have been excavated from natural populations by unscrupulous collectors. This has adversely affected several of the species and the habitats in which they grow. Because of this and because many such plants were excavated without proper care and will not survive transplantation, gardeners are urged to become aware of the sources for their plants and to insist on nursery-propagated plants grown from seeds or rhizome divisions of cultivated stocks."

As with other native plants, many of which are becoming increasingly rare, collection of wild material to transplant should only be done when the natural population will not be adversely affected or will be imminently destroyed (e.g., when a natural area is to be destroyed for development, etc.). Recent studies (Jules 1998; Jules & Rathcke 1999) of the effects of habitat fragmentation on *Trillium ovatum* Pursh in the Pacific Northwest raise concerns about trilliums in East TX. Jules (1998) found that "the process of clearcutting and subsequent conifer planting results in the mortality of almost all trillium." While such studies have not been done for East TX, clearcutting, soil-shredding, and "coniferization" are widespread in East TX, and populations of trilliums and other native species are certainly being reduced at a rapid rate. In addition, research suggests that high deer populations "can lead to local extirpation of selected forbs such as *Trillium* in forest fragments and can inhibit efforts to restore populations" (Augustine & Frelich 1998). *Trillium* species exhibit considerable variation (e.g., flower color), resulting in

taxonomic confusion (Cabe 1995; Zomlefer 1996). Freeman (1975), for example, indicated that petal color "... should be considered one of the least reliable criteria (except in certain cases) by which to distinguish species within the sessile-flowered group [of *Trillium*]." Likewise, absolute size of structures does not appear reliable in distinguishing taxa (Freeman 1975). All species of *Trillium* occurring in TX are found in or near the Pineywoods. The common name WAKE-ROBIN is possibly in reference to the often early spring flowering period. (Latin: *tri*, three, in reference to the number of bracts or the flower parts in threes)

REFERENCES: Gates 1917; Peattie 1927; Barksdale 1938; Freeman 1969, 1970, 1975; Nixon et al. 1970; Takahashi 1982; Samejima & Samejima 1987; Les et al. 1989; Mitchell 1989, 1990; Cabe 1995, Cabe & Werth 1995; Kato et al. 1995a, 1995b; Kawano & Kato 1995; Zomlefer 1996; Case & Case 1997; Tamura 1998d; Kazempour Osaloo & Kawano 1999; Kazempour Osaloo et al. 1999; Irwin 2000; Case 2002; Singhurst et al. 2002b; Timmerman-Erskine et al. 2002.

1. Flowers on pedicels 2–4 cm long; petals white or pink (reddish with age), spreading-ascending, exposing the stamens and ovary; stigmas on a distinct style; leaf-like bracts not mottled _____ **T. pusillum**
1. Flowers sessile or essentially so; petals purple, greenish, or yellow, erect or erect-spreading, ± concealing the stamens and ovary; stigmas sessile; leaf-like bracts mottled or not mottled.
   2. Leaf-like bracts petiolate; filaments usually ca. as long as anthers; sepals (at flowering time) reflexed at base; rhizomes slender, the length of the internodes ca. equal to the rhizome diam., whitish; anther connectives strongly incurved _____ **T. recurvatum**
   2. Leaf-like bracts sessile; filaments usually much shorter than anthers; sepals various but not reflexed at base; rhizomes stout, the length of the internodes 1/5 or less the rhizome diam., brownish; anther connectives erect or slightly incurved.
      3. Petals purple, rarely yellow, 2–4 cm long; ovary 3-angled; anther dehiscence introrse (= facing inward) _____ **T. gracile**
      3. Petals greenish purple or greenish, with a purple claw, sometimes purple or yellowish green throughout, 3.5–8.5 cm long; ovary 6-angled; anther dehiscence lateral.
         4. Leaf-like bracts usually distinctly mottled, lacking stomata on upper leaf epidermis; scapes glabrous; stamens ca. 1/4 taller than height of gynoecium; stigmas divergent-erect, the tips rarely, if ever, extending between the stamens; plants usually < 31 cm tall _____ **T. ludovicianum**
         4. Leaf-like bracts not mottled or only obscurely mottled, sometimes (not usually) with stomata on upper leaf epidermis at the apex (visible as tiny white speckles under magnification); scapes usually scabrous near leaf-like bracts; stamens ca. 2–2.5+ times the height of gynoecium; stigmas widely spreading, often with the tips extending between the stamens; plants usually > 30 cm tall _____ **T. viridescens**

Trillium gracile J.D. Freeman, (slender, gracefully slight in form), SLENDER TRILLIUM, SLENDER WAKE-ROBIN, GRACEFUL TRILLIUM. Plant to 32.5(–36) cm tall, usually not in dense clumps; leaf-like bracts elliptic to elliptic-ovate or obovate, 6–10 cm long, rounded to acute, sessile, usually distinctly mottled; flowers sessile, with odor musty or like that of a morel fungus; sepals widely spreading and reflexed at tips, usually dark purple on adaxial surface, 15–26 mm long; petals erect, usually dark purple or rarely yellow, linear-elliptic or linear-oblanceolate; 21–40 mm long; stamens usually slightly less than 2 times the height of the gynoecium; anthers 10–15 mm long; ovary 3-angled; fruit not obviously angled. Sandy loam of rich hardwood-pine and pine forests on slopes and stream banks; Jasper, Newton, Sabine, San Augustine, Shelby, Tyler (BAYLU), Hardin, Jasper, Nacogdoches, Newton, Sabine, and San Augustine (BRIT), Angelina, San Jacinto, Shelby (TOES 1993), Jefferson and Nacogdoches (Singhurst et al. 2002b) cos. in the Pineywoods; endemic to se TX and sw LA (Mitchell 1989; Singhurst et al. 2002b). Late Mar–May. [*T. ludovicianum* of authors in part, not Harb.] This species was described by Freeman in 1969 based on specimens from East TX and adjacent LA; the holotype is from Sabine Co. Individuals with petals yellow or greenish yellow (lacking purple pigmentation) occur with more typical

purple-flowered plants; they have been segregated as forma *luteum* J.D. Freeman but are not formally recognized here. *Trillium gracile* is very similar to *T. ludovicianum* and is probably the "western expression" of that species (Mitchell 1989). However, Mitchell (1989) considered that there is "sufficient evidence taxonomically to split off *T. gracile* ..." This species differs morphologically (e.g., plant height, leaf shape, shorter sepals, 3-angled ovary) and flowers 2–3 weeks later (Mitchell 1989). *Trillium gracile* is also "closely related" to *T. viridescens* (scapes scabrous) but can be distinguished by its glabrous scapes (Mitchell 1989). (TOES 1993: V) ⚠ /305

Trillium ludovicianum Harb., (of Louisiana), LOUISIANA TRILLIUM. Plant to 28(–31) cm tall, usually in very dense clumps; leaf-like bracts lanceolate to broadly ovate, 5–9.5(–10) cm long, rounded to rarely acute, sessile, usually distinctly mottled, with a metallic sheen; flowers sessile, with light sweet fragrance (Singhurst et al. 2002b) or odor of carrion (Case 2002); sepals widely spreading, sometimes with tips reflexed, green, 19–40 mm long; petals divergent-erect, greenish with purple claw-like bases or purple striations (thus somewhat bicolored) or sometimes purple throughout, linear-oblanceolate, 35–55 mm long; anthers 7–20 mm long; ovary 6-angled; fruit ± 6-angled. Mixed hardwood-pine forests, slopes, typically on rather elevated ground; Newton, Jasper (BAYLU), and Tyler (Singhurst et al. 2002b) cos. LA, MS, and TX. Collections of this species from TX have often been misidentified as *T. gracile* (Singhurst et al. 2002). Feb–early Apr. While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this species to be of conservation concern in TX. ⚠

Trillium pusillum Michx. var. **texanum** (Buckley) Reveal & C.R. Broome, (sp.: very small; var.: of Texas), TEXAS TRILLIUM. Plant to 30 cm tall; leaf-like bracts narrowly lanceolate to elliptic-lanceolate or oblong, (3–)4–6(–8) cm long, obtuse to rounded, not mottled, sessile or abruptly narrowed to short petioles, farinose on adaxial surface due to numerous stomata; flowers on conspicuous erect pedicels, an odor, if present, not known; pedicels 2–4 cm long; sepals spreading, green, 1.7–3 cm long; petals spreading, white, becoming pink and eventually reddish with age, narrowly lanceolate to lanceolate, (1.5–)2–2.5(–3) cm long; gynoecium ca. as long as the stamens; fruit triangular-ovoid, sharply 6-ridged at base of style. Creek bottom bogs (baygalls) at the head of springs and seeps (Singhurst et al. 2002), acid hardwood bottoms and lower slopes; Cass, Harrison, Nacogdoches, Wood (BRIT), Cherokee, Rusk, Smith (BAYLU), Houston, Panola (Freeman 1970), Tyler, (TOES 1993), Jasper (MacRoberts & MacRoberts 1998a), Angelina (Singhurst et al. 2002b), and Marion (J. Singhurst, pers. comm.) cos. in the Pineywoods; endemic to nw LA and ne TX (Carr 2001). Mar–May. [*T. pusillum* Michx. var. *texanum* (Buckley) C.F. Reed—a later homonym, *T. texanum* Buckley] The TEXAS TRILLIUM has been variously treated as a distinct species (e.g., Correll & Johnston 1970; Hatch et al. 1990; Timmerman-Erskine et al. 2002), a variety of *T. pusillum* (e.g., Cabe & Werth 1995; Singhurst et al. 2002b), or part of *T. pusillum* var. *pusillum* (Case 2002). Recently, Timmerman-Erskine et al. (2002) argued that since var. *texanum* is unique in having both adaxial and abaxial leaf stomata, it should be treated as a separate species. However, until further work is done on *T. pusillum* throughout its entire range, we are following Singhurst et al. (2002b) in recognizing the TEXAS TRILLIUM at the varietal level. This approach formalizes the relationship with *T. pusillum* but also recognizes the morphological distinctiveness of the populations at the extreme sw edge of that species' range. According to Case (2002), *T. pusillum* "comprises widely disjunct, regional populations, each varying somewhat from the others and variable within itself as well." This is the only *Trillium* taxon in TX with pedicellate flowers (pedicellate species are segregated into subgenus *Phyllantherum*). (TOES 1993: V; RARE 2002a: G3T2T3S2S3SOC) ⚠/305

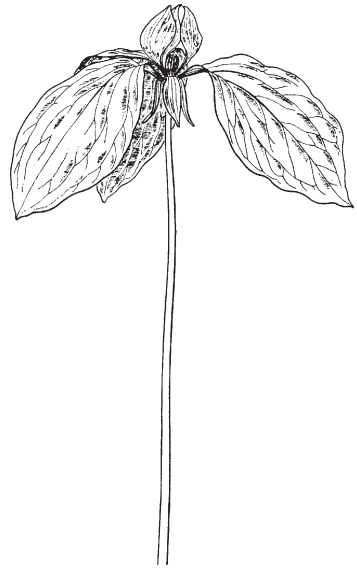
Trillium recurvatum L.C. Beck, (curved backwards), PRAIRIE TRILLIUM, PRAIRIE WAKE-ROBIN. Plant to 40(–50) cm tall; leaf-like bracts narrowly lanceolate to ovate, 5–11(–18) cm long, acute to slightly acuminate, usually obscurely mottled, petiolate (the petioles (0.05–)0.1–0.2(–0.3) the total



Triantha racemosa [GLE]



Trillium viridescens [HEB]



Trillium recurvatum [YAT]



Trillium ludovicianum [HEB]



Trillium pusillum var. texanum [HEB]



Trillium gracile [HEB]

bract length); flowers sessile or subsessile (pedicel 3 mm or less long), with a faint fetid aroma; sepals abruptly recurved basally and ± held against scape, green or streaked with purple, (15–) 20–30(–35) mm long; petals erect, dark purple to yellowish green or yellow, lanceolate to oblanceolate or ovate, distinctly clawed, 18–40(–50) mm long; anthers 5–16 mm long; gynoecium ca. reaching bases of anthers; ovary 6-angled or -winged; fruit 6-angled to nearly winged. Alluvial banks in rich mesic hardwood forests, typically neutral soils that are moist due to seepage; Rusk (BRIT), Nacogdoches (Freeman 1970; Nixon et al. 1970; TOES 1993), and Shelby (Singhurst et al. 2002b) cos. in the Pineywoods; ec U.S. from OH and AL w to WI and TX. Mar–May. First reported for TX by Nixon et al. (1970). (TOES 1993: IV) ⚠/305

Trillium viridescens Nutt., (greenish), LONG-PETALED TRILLIUM, OZARK GREEN TRILLIUM, OZARK TRILLIUM. Plant 20–50(–59) cm tall; leaf-like bracts ovate-elliptic to broadly ovate or elliptic, 9–14(–15) cm long, rounded to acute (acuminate to the n of TX), sessile, not mottled or only obscurely so, sometimes (not usually) with stomata on upper (= adaxial) leaf epidermis at the apex; flowers sessile, with musty-spicy odor similar (according to some) to rotting apples or spoiled fruit; sepals spreading, green or with purple tinge, 3.5–5.4(–6.5) cm long; petals erect or nearly so, variable in color, greenish purple or greenish, with a purple claw, sometimes purple or yellowish green throughout, linear-spatulate to narrowly spatulate, 4.3–8(–8.5) cm long; anthers 13–20 mm long; ovary 6-angled; fruit 6-ridged, rarely winged. Rich woods, wooded slopes, sandy or clay soils; Nacogdoches (BAYLU), Harrison, Marion, Red River (Freeman 1970), Bowie, and Sabine (Singhurst et al. 2002b) cos. in the n Pineywoods and Red River drainage; AR, KS, MO, OK, and TX. Apr–early May. These TX populations are the s extreme of the range of the species (Freeman 1970). While treating it as a separate species, Churchill (1986b) suggested that *T. viridescens* might be better treated as a subspecies of *T. viride* L.C. Beck. Yatskievych (1999) also discussed the similarities between *T. viridescens* and *T. viride*; he indicated the most reliable morphological character distinguishing them is the distribution of stomata on the bracts—evenly distributed over the abaxial leaf surface in *T. viride* and lacking or only at the leaf tip in *T. viridescens*; he suggested that ambiguities in other characters lend weight to the opinions of those botanists who would prefer to treat the two taxa as varieties or subspecies of *T. viride* or simply not recognize *T. viridescens* as distinct. Freeman (1975) raised the possibility of introgression between *T. viridescens* and *T. gracile*. This species is cited by Case (2002) as being of conservation concern. ⚠/305

TYPHACEAE Juss.
CAT-TAIL FAMILY

A very small (8–13 species—Smith 2000), cosmopolitan family of wind-pollinated and wind-dispersed plants represented by a single genus. *Typha* and *Sparganium* (Sparganiaceae) are quite similar, and it has been suggested that the two are best united into a single family (Thorne 1993c; Mabberley 1997; Kubitzki 1998b; Judd et al. 1999). Thieret and Luken (1996) quoted Müller-Doblies (1970) as saying that the "... obvious differences may be explained to a large extend [sic] by an adaptation of *Typha* to anemochory [wind dispersal]." However, the most recent monographers of *Sparganium* (Cook & Nicholls 1986, 1987) noted that the two groups are clearly distinct morphologically and have been so since at least the Oligocene (ca. 38 to 23 million years ago). They concluded that there is no purpose in uniting the two families, and significant disadvantages—e.g., nomenclatural instability. (subclass Commelinidae–Cronquist; order Poales—APG II)

FAMILY RECOGNITION IN THE FIELD: large perennial herbs with elongate, sublinear, spongy, 2-ranked leaves and dense, felty, brown, cylindrical inflorescences divided into a male portion above and a female portion below; typically found in wet places.

REFERENCES: Wilson 1909; Müller-Doblies 1970; Dahlgren et al. 1985; Thieret & Luken 1996; Kubitzki 1998b; Smith 2000.

TYPHA L. CAT-TAIL

Coarse perennial herbs of wet areas, typically emergent, to ca. 3+ m tall, forming clumps or mats from rhizomes; aerial shoots erect, simple, ± elliptic in cross section; leaves alternate, the sheath tubular, with overlapping margins and continuous with the grass-like blade which is internally spongy with prominent transverse partitions; inflorescence dense, terminal, spike-like (subsequently referred to as spikes), each inflorescence potentially producing hundreds of thousands of seeds (Smith 2000), the many crowded flowers making a felty, brown, cylindrical mass; flowers without perianth, imperfect; staminate flowers toward summit of spike, each consisting of one–several stamens (falling early); pistillate flowers on lower portion of spike, each consisting of one pistil on a pedicel bearing long hairs; ovary superior; fruit a minute, wind-dispersed follicle that splits in water to release the single seed.

CAT-TAILS provide food and habitat for many animals but are often considered pests because they spread rapidly and displace other species. According to Smith (2000), "Some species produce large amounts of biomass, comparable to the most productive agricultural crops." It has been shown (e.g., Prindle & Martin 1996; Gallardo et al. 1998, 2000) that CAT-TAILS release allelopathic chemicals (= those causing harmful effects on other plants) and that these compounds may play a role in CAT-TAILS displacing other species. *Typha* has numerous human uses, and CAT-TAILS have been called the "supermarket of the swamps" (Gibbons 1962). Some parts are eaten (e.g., young shoot bases, rhizomes, young spikes, pollen); leaves are used in dwellings, for mats, baskets, or other articles; and the "fluff" from the fruiting spikes has been used for stuffing various objects (e.g., mattresses, life preservers), for tinder, soundproofing, and for insulation (Steyermark 1963; Morton 1975; Thieret & Luken 1996; Smith 2000). CAT-TAILS are able to grow in some areas contaminated by pollutants and have been used in bioremediation (Keane et al. 1999). Hybrids are well known in the genus (e.g., Smith 1967, 1987, 2000; Gertz et al. 1994), including *T.* ×*provincialis* A. Camus, a hybrid between the two species found in East TX. This hybrid is known from very few collections and until recently was unknown from TX (Smith 2000). A collection made in Dallas Co. in 2003 (*R. Milam s.n.*, BRIT) appears to be *T.* ×*provincialis*. The incredibly numerous fruits of *Typha* are minute and very effectively wind-dispersed—thus CAT-TAILS are found in most potential habitats in East TX. (Perhaps from Greek, *typhein*, to smoke or to emit smoke, in reference either to the use of the spikes for maintaining smoky fires or to the smoky brown color of the fruiting spikes—Smith 2000)

REFERENCES: Hotchkiss & Dozier 1949; Fassett & Calhoun 1952; Smith 1967, 1987; Lee & Fairbrothers 1969; Lee 1975; Morton 1975; Sharitz et al. 1980; Gertz et al. 1994; Gallardo et al. 1998; Marcinko Kuehn & White 1999.

1. Staminate and pistillate portions of spike with a gap of 1–4 cm between them; base of leaf blades with orange-brown punctate mucilage glands on inner (= adaxial) side; pistillate spikes in fruit ca. 15–25 mm in diam.; pistillate flowers with bracteoles (these minute—the broadened tips among the stigmas, ca. 0.8 mm long, mostly wider than stigmas); stigmas thread-like, linear to narrowly lanceolate, often quickly deciduous _____ **T. domingensis**

1. Staminate and pistillate portions of spike usually touching (if staminate flowers have abscised, look for attachment scars of staminate flowers on the inflorescence axis just beyond the pistillate portion); base of leaf blades lacking mucilage glands; pistillate spikes in fruit ca. 24–36 mm in diam.; pistillate flowers lacking bracteoles; stigmas ovate to lanceolate, persistent _____ **T. latifolia**

Typha domingensis Pers., (of Santo Domingo), NARROW-LEAF CAT-TAIL, SOUTHERN CAT-TAIL, TULE. Plant 2–3+ m tall; leaf blades 0.6–1.8 cm wide (fresh), 0.5–1.5 cm wide (dry); inflorescence as tall

as or slightly overtopped by the leaves. Often very abundant in nutrient-rich ditches, marshes, stock tanks, and lake margins, in shallow water or wet ground; nearly throughout TX; s U.S. n to VA, NE, WY, and OR. Apr–Jul. During pioneer days, the creeping rhizomes "... were eaten, the abundant pollen was mixed with flour for the making of pancakes, and the young female inflorescences were boiled and eaten like miniature roasting ears" (Crosswhite 1980).

Typha latifolia L., (broad-leaved), COMMON CAT-TAIL, BROAD-LEAF CAT-TAIL, TULE ESPADILLA. Plant to ca. 3 m tall; leaf blades 1–2.3(–2.9) cm wide (fresh), 0.5–1.6(–2) cm wide (dry). Ditches, marshes, stock tanks, and lake margins, in shallow water or wet ground; throughout much of TX; throughout most of Canada and the U.S. Apr–Jun. These rhizomatous plants often spread to form large stands. /306

Typha angustifolia L., (narrow-leaved), NARROW-LEAF CAT-TAIL, is similar to *T. domingensis* but can be distinguished by the inflorescences much overtopped by the leaves and by the characters in the following key. This apparently introduced species (from Europe—Stuckey & Salamon 1987) was cited for s TX by Correll and Johnston (1970) and for the Pineywoods by Hatch et al. (1990). Jones et al. (1997) synonymized *T. angustifolia* with *T. domingensis,* while Kartesz (1999) indicated that *T. angustifolia* does not occur in TX. The recent treatment of *Typha* for *Flora of North America* (Smith 2000) indicated that *T. angustifolia* is a distinct species, but it is mainly northern, does not occur in TX, and only reaches OK sporadically. Smith (2000) separated *T. angustifolia* and *T. domingensis* as follows:

1. Mucilage glands present on adaxial surface of all of sheath and usually about 1–10 cm of adjacent blade; pistillate bracteole tips much paler than to about same color as stigmas, straw-colored to light brown, mostly acute to acuminate, in mature spikes exceeding pistil hairs; pistil hair tips colorless to usually orangish (or slightly brownish in hybrids), not evidently enlarged, or often with 1 subapical, orange, swollen cell evident at 20–30 ×; pistillate spikes bright cinnamon- to orange-brown; leaf sheath summits tapered to blade or sometimes with membranous auricles ——— *T. domingensis*

1. Mucilage glands absent from adaxial surface of blade and generally from central part of sheath near sheath summit; pistillate bracteole tips darker than (or as dark as) stigmas, very dark to medium brown, rounded (to acute), in mature spikes about equaling pistil hairs; pistil hair tips medium brown, distinctly enlarged at 10–20 × magnification; pistillate spikes medium to dark brown; leaf sheath summits with membranous auricles (these often disintegrating late in season) ——— *T. angustifolia*

XYRIDACEAE C. Agardh
YELLOW-EYED-GRASS FAMILY

A small (over 300 species in 5 genera—Kral 2000a; Kral, pers. comm.) family of mainly tropical and warm area herbs with a few in temperate regions; they usually occur in wet acidic habitats. The family seems to have a close relationship with Eriocaulaceae (Linder & Kellogg 1995; Stützel 1998; Givnish et al. 1999; Reveal & Pires 2002) or possibly Mayacaceae (Davis et al. 2004). (subclass Commelinidae—Cronquist; order Poales—APG II)

FAMILY RECOGNITION IN THE FIELD: grass-like or rush-like, moist or wet area herbs with basal leaves and long naked flowering stalks terminated by small, head-like or cone-like spikes with conspicuous brownish bracts subtending the usually yellow flowers.

REFERENCES: Kral 1979a, 1983, 1992, 2000a; Dahlgren et al. 1985; Rudall & Sajo 1999.

XYRIS L. YELLOW-EYED-GRASS

Perennial (except *X. jupicai*), tufted or solitary, grass- or rush-like scapose herbs; leaves basal, linear to filiform, 2-ranked, equitant; flowering stalks (= scapes) terminated by a head-like or

cone-like spike of spirally imbricated, brownish, almost woody-appearing bracts; lower bracts usually sterile; flowers 1 per fertile bract, perfect; sepals 3, dimorphic, the 2 lateral ones keeled and persistent, the outer one covering the flower in bud and deciduous; petals 3, subequal, yellow (whitish forms are rarely found in *X. caroliniana* and *X. platylepis*), composed of a broad blade and a long, narrow claw hidden by the subtending bract; stamens 3; staminodia 3; stigmas 3; ovary superior; fruit a dehiscent capsule.

A genus of more than 250 species (Kral 2000a) of tropical and warm areas of the world. According to Kral (2000a), "Most species of *Xyris* occur in the Guiana Highlands, Amazonia, and Brazilia in South America, with other smaller centers of endemism in Africa and Australasia." "The showy flowers of *Xyris* are ephemeral, and the corollas usually are expanded for no more than a few hours. Usually only one or two flowers per head are open at once. Flowers of sympatric species often open at different times of day" (Judd et al. 1999 from Kral 1966). The following treatment is adapted primarily from works by Kral (1966a, 1979a, 1999, 2000a), with some material from Bridges and Orzell (1987). Fertile material is virtually essential in identifying plants to species. (Greek: *xyris*, name of some plant with 2-edged leaves, from *xyron*, a razor)
REFERENCES: Blomquist 1955; Kral 1960, 1966a, 1998, 1999; Bridges & Orzell 1987, 2003.

1. Keel of lateral sepals firm, ciliate or fimbriate (look above bracts for lateral sepals).
   2. Tips of lateral sepals exserted beyond the subtending bract (even on closed spikes), fimbriate (usually crisped); seeds seldom shorter than 0.8 mm long, fusiform, with broad, flat, longitudinal ridges; sheaths of the scape exceeded by the leaves.
      3. Scape ridges conspicuous, harsh to the touch; spikes ovoid to broadly ellipsoid, blunt; leaf bases straw-colored to pale green or pinkish, shallowly set in substrate; leaves in fan-like arrangement, broadly linear; flowers opening in the morning; plants of very wet substrates, the bases often submersed _____ **X. fimbriata**
      3. Scape ridges lower, less conspicuous, smooth (minutely tuberculate or papillose under magnification); spikes narrowly ellipsoid or lance-ovoid, acute; leaf bases a lustrous chestnut brown, deeply sunken in the substrate; leaves not in fans, narrowly linear; flowers usually opening in the afternoon; plants of moist, but not wet, substrates _____ **X. caroliniana**
   2. Tips of lateral sepals not exserted beyond the subtending bract and not fimbriate (in old or dried spikes the lateral sepals may separate from the bracts and appear to be exserted, but exsertion here means that bracts are shorter than sepals); seed lengths and shapes various, but the seeds without broad, flat, longitudinal ridges; sheath lengths various.
      4. Plants small, 4–28 cm tall; sheaths of the scapes about as long as most of the foliage leaves; leaves, at or near their base, with a dark lustrous patch; spikes 3–8 mm long _____ **X. drummondii**
      4. Plants variable in size, often much more than 28 cm tall; sheaths of the scape definitely exceeded by the main foliage leaves; leaves without a dark lustrous patch; spikes 8–30 mm long.
         5. Leaves ascending, with blades twisted; bracts and lateral sepals with a small apical tuft of short, reddish-brown hairs; bases of leaves abruptly expanded, the bases of the plants therefore abruptly bulbose and the outermost leaves often scale-like (the scale-like leaves can be short but broad) _____ **X. torta**
         5. Leaves spreading, in fan-like arrangement (base of plant appearing laterally compressed), with blades scarcely twisted; bracts and sepals without a small apical tuft of short, reddish-brown hairs; bases of leaves not abruptly expanded, the bases of the plants therefore not abruptly bulbose, often invested by a stubble or ramentum of fibrous dead leaf bases.
            6. Leaf blades deep green with red or maroon coloration; plant bases maroon to maroon-brown; seeds farinose (= covered with a whitish mealy powder or mealiness); petal blades obtriangular, 3–5 mm long _____ **X. stricta**
            6. Leaf blades usually pale or olive green; plant bases pinkish, purplish, or straw-colored,

with dark longitudinal striations on inner leaf bases; seeds lustrous, translucent; petal blades obovate, 6–10 mm long _____ **X. ambigua**

1. Keel of lateral sepals usually quite thin, scarious, lacerate or rarely entire.
   7. Leaves linear-filiform or filiform (the blades usually < 1 mm wide), the blades gradually expanding below into lustrous, rich brown or tan, hard bases; plants densely cespitose; spikes ovoid, 4–7 mm long; staminodia lacking a beard _____ **X. baldwiniana**
   7. Leaves broader or not as above, the leaf bases softer or of a different color; plants or spikes not as above; staminodia with a beard.
      8. Lateral sepals exserted (slightly to conspicuously) beyond the tips of subtending bracts _____ **X. smalliana**
      8. Lateral sepals included, hidden by the subtending bracts.
         9. Bases of leaves rather abruptly expanded into thickened, flaring, equitant zones, thus the plants bulbose-based (the outer leaves are often shorter, darker, scale-like); scapes often flexuous, usually quite twisted; green upper portion of leaf blades often conspicuously twisted; flowers opening in the afternoon.
            10. Leaf and scape surfaces smooth OR scabrous only along the margins and ridges; seeds 0.5–0.6 mm long; petal blades obovate _____ **X. platylepis**
            10. Leaf and scape surfaces prominently papillose or tuberculate-scabrid, thus the foliage having a "glazed" look; seeds (0.6–)0.7–1 mm long; petal blades obovate to suborbicular _____ **X. scabrifolia**
         9. Bases of leaves and the plant bases not as above; scapes usually not flexuous, usually not conspicuously twisted; leaf blades not conspicuously twisted; flowers opening in the early or late morning.
            11. Plant bases pinkish, reddish, or purplish.
               12. Plants relatively large (scapes 17–90 cm tall); fertile bracts 5–7 mm long; spikes 10–35 mm long; summit of scape quite evidently flattened and broad relative to the spike (at least on living specimens), the scape ridges few, usually 2 or 3, the 2 most prominent ones along the scape edges (therefore the upper scape narrowly elliptic or fusiform in cross section); plants commonly of wet situations, sunny or shaded, in creek or river bottoms, titi swamps, cypress swamps, or rooted in muck of flowing water ditches, in fact almost always on fine-textured wet substrates; foliage smooth.
                  13. Spikes usually 10–15(–20) mm long, ovoid, acute; leaves 2–15 mm wide; two principal scape ridges noticeably and abruptly flattened and wing-like below the spike and in the plane of the flattened scape, their combined width (on live specimens) broader than the scape, thus the outline of the cross section of the scape bi-caudate; seeds translucent, ovoid or ellipsoidal, seldom longer than 0.6 mm _____ **X. difformis** var. **difformis**
                  13. Spikes usually (15–)20–35 mm long, broadly ellipsoidal or oblong, blunt; leaves 10–25 mm wide (when this species is mixed with the above, as it often is, it is a noticeably larger, broader-leaved and broader-scaped plant); two principal scape ridges not abruptly flattened, the scape itself flattened and 2-edged and in cross section narrowly elliptic; seeds farinose, dark when ripe, fusiform or narrowly oblong and never as short as 0.6 mm _____ **X. laxifolia** var. **iridifolia**
               12. Plants relatively small (scapes rarely as tall as 20 cm); fertile bracts ca. 3–4 mm long; spikes usually 5 mm or less long; summit of scape neither flattened nor broad relative to the spike, the scape ridges usually more than 3 and therefore the upper scape broadly oval or almost round in cross section (save for projecting ridges); plants of sandy peats of ditches and bogs, flatwoods, or acidic seepage areas; foliage, particularly the outermost leaves, papillose or tuberculate _____ **X. difformis** var. **curtissii**

11. Plant bases greenish, pale to dark brown, or straw-colored.
    14. The two primary scape ridges (1 spike length below a spike) commonly flattened, in combination nearly as broad as or broader than the body of the scape (on living plants), often scabrous; leaves commonly spreading, the upper, nonclasping portion elliptic-linear; mature spikes ovoid to subglobose, blunt or acute, the bracts usually tightly imbricated; plants perennial (except in drought), often in shaded situations _____ **X. difformis** var. **difformis**
    14. The two primary scape ridges not as above, hardly distinguishable from the somewhat flattened scape and certainly not, in combination, as broad as the body of the upper scape, not scabrous; leaves commonly ascending-linear; mature spikes narrowly ovoid to oblong, blunt, the bracts rather loosely imbricated; plants often annual (except in moistest, warmest situations), primarily of sunny disturbed situations or of sandy open swamps (this is the most abundant *Xyris* of roadside ditches and it frequently invades disturbed or fallow, open wetlands) _____ **X. jupicai**

Xyris ambigua Beyr. ex Kunth, (ambiguous), YELLOW-EYED-GRASS, COASTAL-PLAIN YELLOW-EYED-GRASS. Perennial, solitary or in small tufts; leaves 10–40 cm long, 3–20 mm wide, in broad fans; base of inner leaves with very prominent dark longitudinal veins in sharp contrast to the white or pale intervening tissue (older leaves need to be removed to observe this); scapes (15–)70–100 cm long; spikes 10–30 mm long. Moist sandy areas, sandy peats, bog margins, ditches, lake shores, savannahs, and pine flatwoods, not found where its base would be submersed for any length of time; s parts of the Pineywoods and Post Oak Savannah w to near e margin of the Blackland Prairie; also n part of the Gulf Prairies and Marshes; se U.S. from VA s to FL w to AR and TX. Flowers opening in the early morning, usually closed by midday; May–Jul. Kral (2000a) noted that this species "is one of the more widespread and weedy of xyrids, frequently invading disturbed moist, sandy areas. It is also one of the most variable in habit and apparently forms intermediates with *X. stricta* ..." See further discussion under *X. stricta*. ⊞/306

Xyris baldwiniana Schult., (for its discoverer, William Baldwin, 1779–1819, botanist and physician of PA), BALDWIN'S YELLOW-EYED-GRASS. Perennial growing in large tufts; leaves 10–30 cm long, usually 0.5–1 mm wide; scapes 20–40(–50) cm long; spikes 4–7 mm long. Moist sandy areas, sandy peats, hillside bogs, ditches, and savannahs; Pineywoods and Post Oak Savannah w to near e margin of the Blackland Prairie; se U.S. from NC s to FL w to AR and TX. Flowers opening in the morning; flowering early in the season–Jul. This is the only U.S. *Xyris* species with beardless staminodia (Kral 1966a).

Xyris caroliniana Walter, (of Carolina), CAROLINA YELLOW-EYED-GRASS. Perennial, solitary or in small tufts; leaves 20–50 cm long, 2–5 mm wide; scapes 50–110 cm long; spikes (13–)15–30 mm long; sepal keels fimbriate. Moist to well-drained sands of pine or oak-pine areas, never in permanently wet soils; Angelina, Jasper (VDB), Hardin, Newton, and Tyler (Turner et al. 2003) cos. in the se portion of the Pineywoods; e U.S. from NJ s to FL w to TX. Flowers usually opening in the afternoon; Jun–Aug. [*X. arenicola* Small, *X. flexuosa* Muhl. ex Elliott] *Xyris caroliniana* has been confused with *X. torta* but can be distinguished as follows (Kral 1966a): *Xyris caroliniana*—deepset, very broad and chestnut brown leaf bases; narrower usually longer spikes; exserted, almost linear lateral sepals; bracts lacking an apical tuft of hairs; seeds narrow, 0.8–1 mm long; flowers usually opening in the afternoon; *Xyris torta*—smaller, more shallowly set, reddish or pink leaf bases; shorter broader spikes; included curvate lateral sepals; bracts with an apical tuft of short hairs; seeds plump, ca. 0.5 mm long; flowers opening in the morning.

Xyris difformis Chapm., (of two forms), BOG YELLOW-EYED-GRASS. The following two varieties (not distinguished on the county distribution map) occur in East TX:

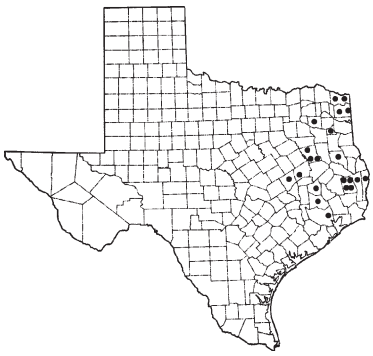
1. Plants relatively small (scapes usually < 20 cm tall; leaves mostly < 10 cm long); scapes not much widened distally, with all of the ribs ± equal; leaf sheaths papillose; fertile bracts ca. 3–4 mm long; spikes usually 5 mm or less long _____ var. **curtissii**
1. Plants relatively large (scapes 15–70 cm long; leaves 10–30(–50) cm long); scapes widened distally, with 2 of the ribs wider than the others; leaf sheaths smooth; fertile bracts 5–7 mm long; spikes ca. 10–15(–20) mm long _____ var. **difformis**

var. **curtissii** (Malme) Kral, (for its discoverer, Allen Hiram Curtiss, 1845–1907). Similar to var. *difformis* but smaller; leaves 1–4 mm wide; scape sheaths pinkish at base. Sandy peats of ditches, bogs, flatwoods, or acid seeps; Hardin Co. (Kral 1966a) in the s part of the Pineywoods and Robertson Co. (TAMU) in the Post Oak Savannah; se U.S. from VA s to FL w to AR and TX. Flowers opening in the early morning; spring–summer. [*X. curtissii* Malme] This small plant can be recognized by its pinkish papillate plant bases, round or scabrous-angled upper scapes, and small translucent seeds (Kral 1966a). While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state, we consider this variety to be of conservation concern in TX. ⚠

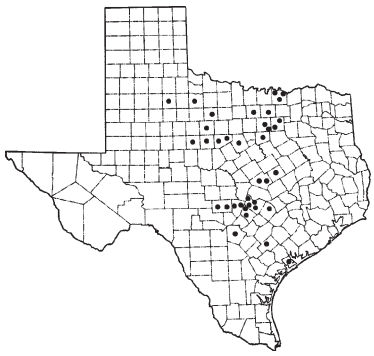
var. **difformis**, SOUTHERN YELLOW-EYED-GRASS. Perennial, solitary or in small tufts; leaves (2–)5–15 mm wide, spreading in fans; scape sheaths deep red-brown at base. Wet sands, sandy peats, pond and lake margins, ditches, alluvial situations, often in fairly heavy shade; widespread in Pineywoods and Post Oak Savannah; also Gulf Prairies and Marshes; se Canada and e U.S. from ME s to FL w to WI and TX. Flowers opening in the morning; spring–summer. Kral (1966a) emphasized that the broad scapes, reddish pigmentation, and spreading-leaved habit together easily distinguish *X. difformis* var. *difformis* from the somewhat similar *X. jupicai* in the field; unfortunately these characters are much less obvious after pressing. Kral (1966a) considered var. *difformis* to be native and *X. jupicai* to be introduced and rapidly spreading.

Xyris drummondii Malme, (for Thomas Drummond, 1780–1835, Scottish botanist and collector in North America, who collected the type), DRUMMOND'S YELLOW-EYED-GRASS. Perennial, usually in large tufts; leaves 3–8(–10) cm long, 1.5–5 mm wide; scapes 4–28 cm long; spikes 3–8 mm long. Low moist acid sands, sandy peats, sphagnous peats, hillside seepage bogs, roadside ditches, pine flatwoods, and disturbed lowlands, typically on the Catahoula geologic formation (Bridges & Orzell 1989a); Angelina, Jasper (BRIT, VDB), and Newton (Bridges & Orzell 1989a; TOES 1993) cos. in the se part of the Pineywoods; se U.S. from FL w to TX. Flowers opening in the morning; mid-summer. The species is distinctive in having the scape sheaths and leaves ca. equal in length and in having at or near the base of each leaf a dark lustrous patch; also the fresh spikes are somewhat flattened (Kral 1966a). It was first reported for TX in 1989 (Bridges & Orzell 1989a). This species is cited by Kral (2000a) as being of conservation concern. (TOES 1993: V; RARE 2002a: G3S2SOC) ⚠

Xyris fimbriata Elliott, (fringed), FIMBRIATE YELLOW-EYED-GRASS, FRINGED YELLOW-EYED-GRASS. Perennial, solitary or in small tufts; leaves 4–70 cm long, 5–25 mm wide; scapes 80–150 cm long; spikes 12–25 mm long. Very wet habitats such as with bald cypress, gum swamps, ditches, or flatwood ponds, the plants often submersed for nearly half their length; often on the Beaumont or Lissie geologic formations (Bridges & Orzell 1989a); Hardin, Jasper, Newton, and Tyler (BRIT, VDB) cos. in the se part of the Pineywoods; se U.S. from Delaware s to FL w to TX (but disjunct across most of LA—Kral 2000a). Flowers opening in the late morning; summer–fall. According to Kral (1966a), this is the last of the *Xyris* species to come into flower during the growing season. It is recognizable by the scape ridges that are harsh to the touch, the dull and fuzzy appearing spikes (due to the exserted lateral sepals), and the tall willowy appearance. It was first reported for TX in 1989 (Bridges & Orzell 1989a). While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), because this species is known in TX from only four counties and because the TX populations are isolated disjuncts (the nearest propulations are in e LA), we consider it to be of conservation concern in TX. ⚠



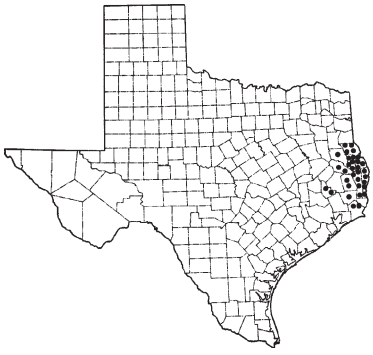
Sparganium americanum



Androstephium coeruleum



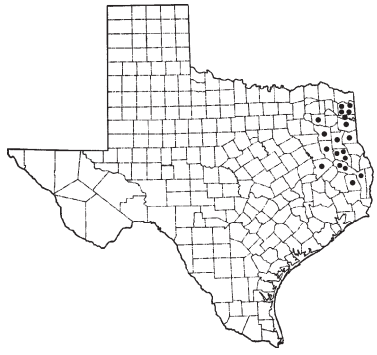
Triantha racemosa



Trillium gracile



Trillium ludovicianum



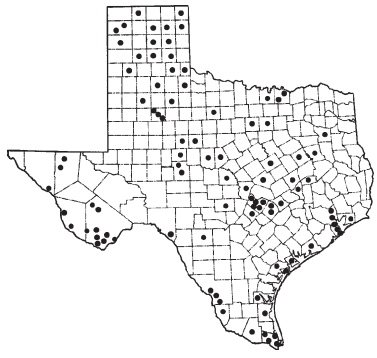
Trillium pusillum var. texanum



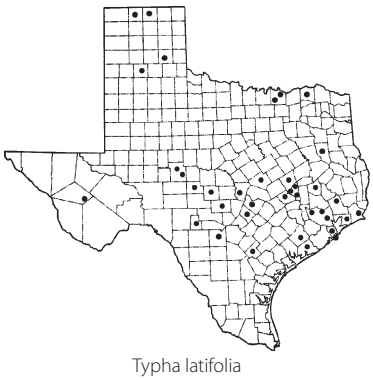
Trillium recurvatum



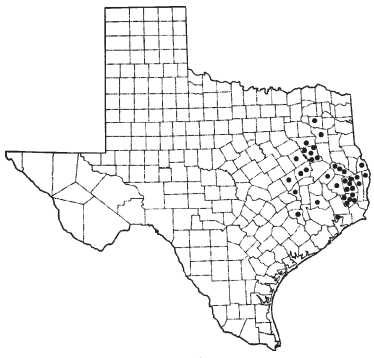
Trillium viridescens



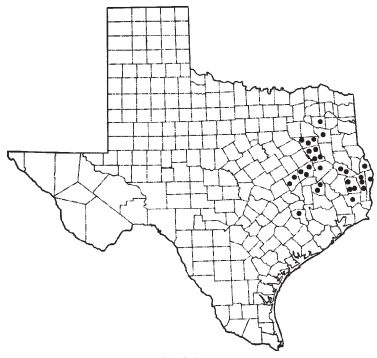
Typha domingensis



Typha latifolia



Xyris ambigua



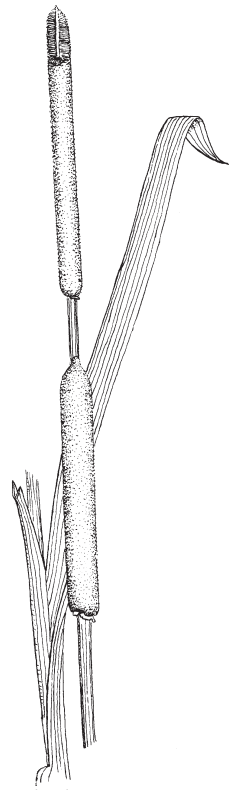
Xyris baldwiniana

Xyris jupicai Rich., (derivation unknown), RICHARD'S YELLOW-EYED-GRASS, YELLOW-EYED-GRASS. Plants solitary or in small tufts, annual or rarely biennial, lacking in red pigmentation; leaves 10–60 cm long, 3–10 mm wide, erect or ascending in narrow fans; scapes 20–70(–90) cm long; spikes 5–15(–25) mm long; seeds 0.4–0.5 mm long, faintly ribbed. Wet sands, sandy peat, alluvium of roadside ditches, flatwood pond margins, cypress swamps, lakeshores, and particularly in mechanically disturbed wetlands; widespread in Pineywoods and Post Oak Savannah; also Gulf Prairies and Marshes; se U.S. from NJ s to FL w to OK and TX. Flowers opening in the morning; Jun–Aug. Kral (1966a; 1979a; pers. comm.) considers this species to probably be adventive from Latin America (Mexico, West Indies, Central and South America). Kral (2000a) noted that it frequently shares habitat with two related species, *X. difformis* var. *difformis* and *X. laxifolia*. He commented, "It differs from both in its lack of red pigmentation, from *X. difformis* by its more erect leaves and narrower, less prominently ribbed scapes, and from *X. laxifolia* by its narrower leaves and scapes, shorter, narrower, paler spikes, and translucent (rather than mealy), shorter seeds." See further discussion under *X. difformis* var. *difformis* and *X. laxifolia*.

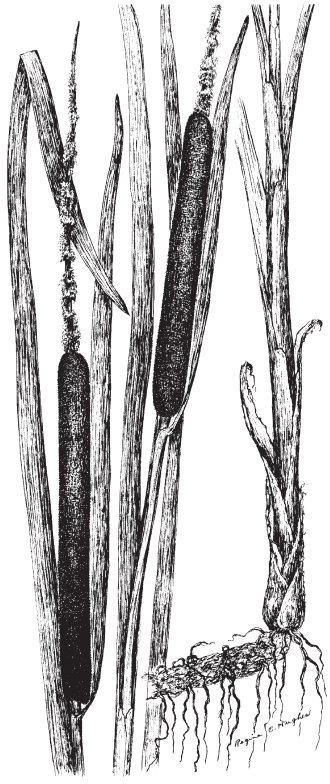
Xyris laxifolia Mart. var. **iridifolia** (Chapm.) Kral, (sp.: loose-leaved; var.: iris-leaved), IRIS-LEAF YELLOW-EYED-GRASS. Perennial, solitary or in small tufts, not bulbose at base; leaves 40–70 cm long, 10–25 mm wide; scapes 60–90 cm long, to 3–4 mm wide; spikes (15–)20–35 mm long; seeds farinose (= mealy), 0.7–0.9(–1) mm long. Wet sands, wet sandy clay, sandy peat, peat muck, alluvium of stream banks, cypress swamps, marshes, and pineland pond margins, the base of the plant commonly submersed; widespread in Pineywoods and Post Oak Savannah; also n margin of Gulf Prairies and Marshes; se U.S. from VA s to FL w to OK and TX. Flowers opening in the morning; Jul–Sep. [*X. iridifolia* Chapm.] This and *X. stricta* are the only East TX *Xyris* species with farinose seeds. According to Kral (2000a), "It differs [from the similar *X. jupicai*] in having taller, wider foliage and scapes, in the leaf sheaths being reddened (rather than greenish or straw-colored), in the larger, longer, thicker, darker spikes, and in the longer, mealy (rather than translucent) seeds. Scape ribs in X. *jupicai* are papillate distally; those of X. [*laxifolia* var.] *iridifolia* are smooth." The type variety, *Xyris laxifolia* var. *laxifolia*, is a common wetland plant in Central and South America (Kral 2000a).

Xyris platylepis Chapm., (broad-scaled), TALL YELLOW-EYED-GRASS, YELLOW-EYED-GRASS. Perennial, solitary or in small tufts, bulbose-based; leaves (15–)20–40(–50) cm long, (3–)5–10 mm wide; scapes 50–110 cm long; spikes 15–30(–40) mm long. Sands or sandy peats, pineland pond margins, savannahs, bogs, ditches, stream banks, and other moist sites, but seldom if ever on inundated areas, rather weedy; Jasper (BRIT), Newton (BRIT, VDB), Sabine (BRIT, MacRoberts & MacRoberts 1998a), Tyler (Bridges & Orzell 1989a), and Angelina (Turner et al. 2003) cos. in the se part of the Pineywoods, typically on the Catahoula geologic formation; se U.S. from VA s to FL w to TX. Flowers opening in the afternoon; summer. According to Kral (1966a), "This species, because of its coloured [sic], fleshy and scale-like leaf bases, could be confused with *X. torta* or *X. scabrifolia*. From the former it is distinguished by its lacerate sepal keels; from the latter it is distinguished by its smaller seed and its smooth leaf and scape surfaces." Kral (2000a) also noted, "*Xyris platylepis*, which may be associated with other bulbose-based species such as *X. torta* and *X. caroliniana*, appears very similar to larger extremes of the former but differs in its plane (rather than prominently ribbed) leaf surfaces and its lacerate (rather than ciliate) sepal keels, and from the latter in its more shallowly set and pinkish or red (rather than chestnut brown) bases, as well as in its sepal keels that are lacerate rather than fimbriate."

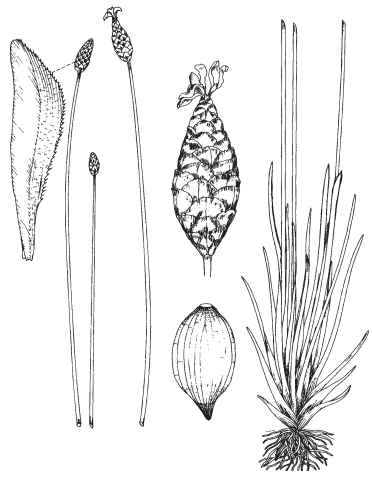
Xyris scabrifolia R.M. Harper, (rough-leaved), ROUGH YELLOW-EYED-GRASS, HARPER'S YELLOW-EYED-GRASS, ROUGH-LEAF YELLOW-EYED-GRASS. Perennial, solitary or in small tufts, bulbose-based or nearly so; leaves 10–40(–50) cm long, 2.5–10 mm wide; scapes 30–60 cm long; spikes 10–20 mm long. Moist to wet sandy peats of hillside acid sphagnous bogs or sandy seepage areas in pinelands; Angelina, Jasper, Newton, and Sabine (BRIT, VDB) cos. in the se part of the Pineywoods, and reported from Henderson Co. (Poole et al. 2002) and Wood Co. (Bridges &



Typha domingensis[BT3]



Typha latifolia [REE]



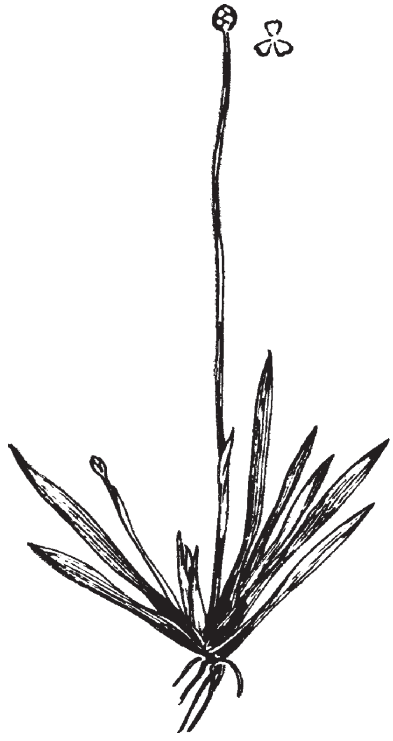
Xyris ambigua [FNA, SID]



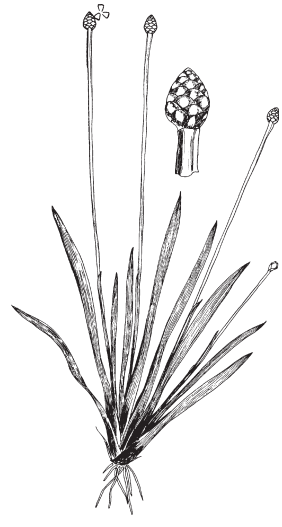
Xyris baldwiniana [SID]



Xyris caroliniana [FNA, SID]



Xyris difformis var. curtissii [SID]



Xyris difformis var. difformis [SID]

Orzell 1990, as *X. chapmanii*) further n; scattered in the se U.S. from NC s to FL w to TX (but disjunct across most of LA—Kral 2000a). Flowers opening in the afternoon; summer. Kral (1966a) considered this the rarest *Xyris* of the se U.S., and it is known from only six TX counties. However, if looked for in the appropriate habitat (hillside bogs on the Catahoula geologic formation), it can often be found—Bridges and Orzell (1989a) indicated that they had found 34 separate localities in four counties. It is most similar to *X. platylepis* but can be distinguished by its scabrous leaves and scapes. [*X. chapmanii* E.L. Bridges & Orzell] It was first reported for TX in 1989 (Bridges & Orzell 1989a). Kral (2000a) noted that regarding the morph recognized as *X. chapmanii*, that there is "such intergradation that it is impossible to break the two out even as varieties." (TOES 1993: V; RARE 2002a: G3S2SOC) ⚠

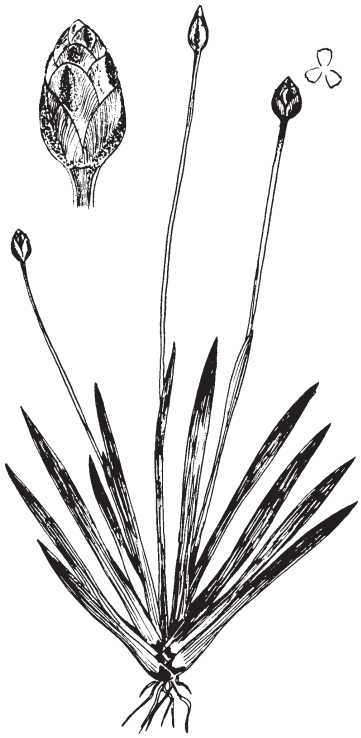
Xyris smalliana Nash, (for its discoverer, John Kunkel Small, 1869–1938, botanist at NY Bot. Garden and author of numerous works including *Manual of the Southeastern Flora*), SMALL'S YELLOW-EYED-GRASS. Perennial, solitary or in small tufts; leaves (19–)30–50(–60) cm long, 5–15 mm wide; scapes 50–150 cm tall; spikes 10–20(–30) mm long; seeds (0.6–)0.7(–0.8) mm long. Sands, sandy peats, peat-mucks of pineland pools/flatwood ponds, typically on the Lissie geologic formation (previously called the Bently and Montgomery) (Bridges & Orzell 1989a); Hardin, Jasper, Tyler (BRIT, VDB), and Newton (E. Keith, pers. comm.) cos. in the se part of the Pineywoods; e U.S. from ME s to FL w to TX (but disjunct across most of LA—Kral 2002a). Flowers opening in the afternoon; summer. This species is often associated with *X. fimbriata* or *X. jupicai*; however, it is distinguishable from *X. fimbriata* by its smooth scape edges (versus scabrous ones of *X. fimbriata*) and from *X. jupicai* by its exserted sepals and larger seeds (Kral 1966a). It was first reported for TX in 1989 (Bridges & Orzell 1989a). While not officially designated as such (e.g., TOES 1993; Carr 2002d; Poole et al. 2002), given its limited distribution in the state and its disjunct distribution, we consider this species to be of conservation concern in TX. ⚠

Xyris stricta Chapm., (erect, upright), PINELAND YELLOW-EYED-GRASS. Perennial, in small tufts; leaves in narrow fans; leaf sheaths purplish to reddish (versus straw-colored to pale brown in the somewhat similar *X. ambigua*); petal blades 3–5 mm long, obtriangular (versus 8–10 mm long, obovate in *X. ambigua*); seeds farinose (vs. translucent in *X. ambigua*). The two East TX varieties are not distinguished on the county distribution map. Summer–fall. Kral (2000a) separated the two varieties using the following characters:

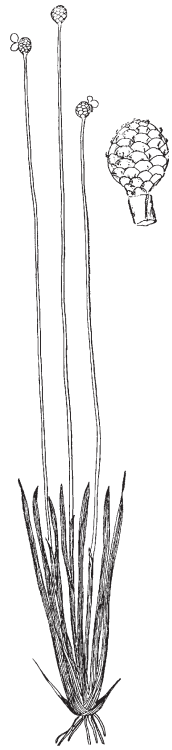
1. Plants 50–90(–104) cm tall; leaves 20–60 cm long, the blades 3–8 mm wide, with edges smooth to ciliolate or papillate; scapes distally sharply 2-ribbed, these making edges, but with no or few additional low ribs; ribs smooth, scabrous, or ciliolate; spikes lance-cylindric, or cylindric, 2–3 cm long; fertile bracts 6–7 mm long _____ var. **stricta**

1. Plants mostly 40–80 cm tall; leaves 20–40 cm long, the blades (2–)2.5–3(–4) mm wide, with edges scabrous or scabro-ciliolate; scapes distally strongly 2-ribbed, these making edges, but with several additional ribs between; all ribs minutely scabrous or papillate; spikes narrowly ovoid, lanceoloid, or ellipsoid, less than 2 cm long; fertile bracts 5–6.5 mm long _____ var. **obscura**

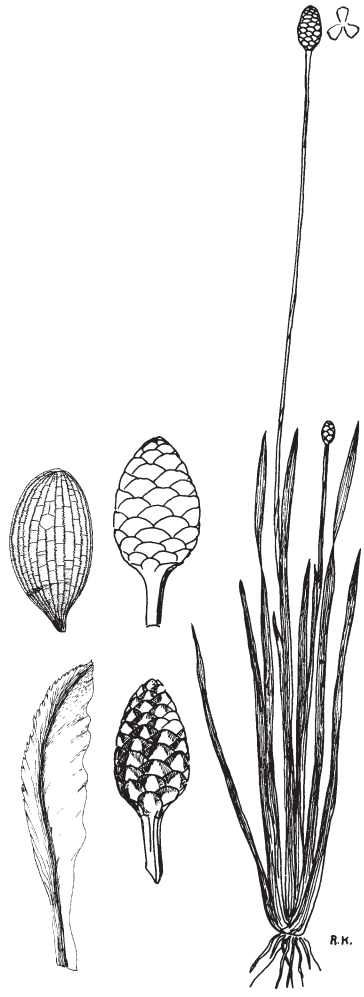
var. **obscura** Kral, (hidden), LOUISIANA YELLOW-EYED-GRASS, YELLOW-EYED-GRASS. Moist sands, moist fine sandy peats, or organic sandy clay, upslope or in drier habitats than var. *stricta* (but in the same habitat as *X. ambigua*); Hardin, Liberty (BRIT), Newton (VDB), Tyler (TAMU), and Jasper (Bridges & Orzell 1987) cos.; Turner et al. (2003) also mapped Orange Co. without specifying variety; se U.S. from FL w to TX. Flowers opening later in morning, closing in afternoon or evening (Bridges & Orzell 1987); summer–fall. [*X. louisianica* E.L. Bridges & Orzell] We are following Kral (1999, 2000a) in treating this taxon, which has also gone under the name *X. louisianica* (Bridges & Orzell 1987), as a variety of *X. stricta*. Kral originally believed this taxon was an extreme form of *X. ambigua*; subsequent work revealed "the plant overlaps most strongly with *X. stricta*" (Kral 2000a). Kral (2000a) further noted that these plants may have "evolved in the Gulf Coastal Plain from *X. stricta* and are backcrossing with it." See comparison of *X. stricta* and *X. ambigua* under the species description of *X. stricta*.



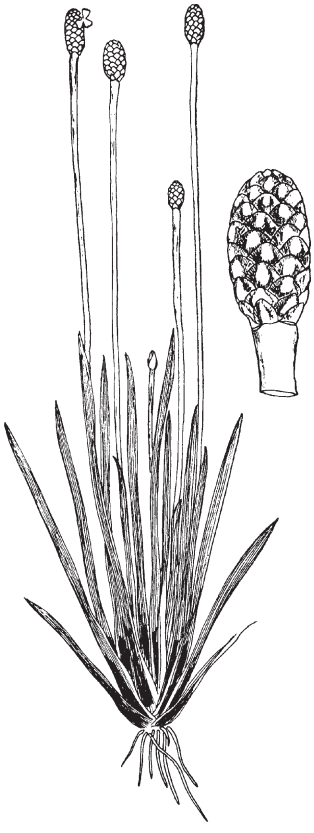
Xyris drummondii [SID]



Xyris fimbriata [SID]



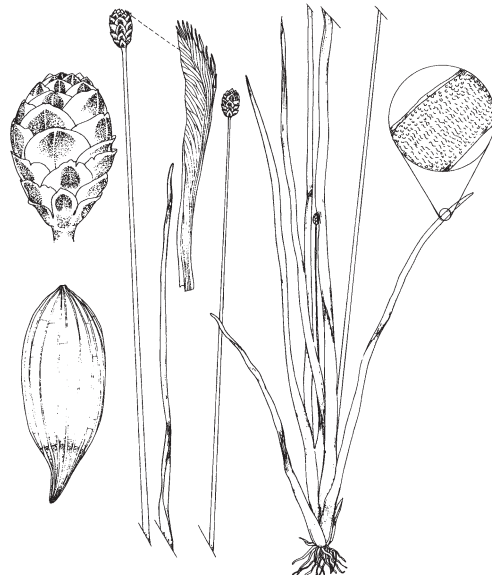
Xyris jupicai [SID]



Xyris laxifolia var. iridifolia [SID]



Xyris platylepis [SID]



Xyris scabrifolia [FNA]

var. **stricta**. Plants "taller, wider leaved, smoother, broader scaped, larger bracted" (Kral 2000a) than var. *obscura*. Acid swamps, deep wet bogs, wet savannahs, and wet sands, but mostly on peat-muck substrates, in wetter habitats than var. *obscura*; included based on mapped location (county unspecified) in extreme se part of the Pineywoods in Kral (2000a); se U.S. from SC s to FL w to TX. Flowers opening later in morning, closing early afternoon; summer–fall.

Xyris torta Sm., (twisted), TWISTED YELLOW-EYED-GRASS, SLENDER YELLOW-EYED-GRASS. Perennial, solitary or in tufts of a few individuals, bulbose-based; leaves 20–50 cm long, 2–5 mm wide, twisted; scapes 15–80(–100) cm long; spikes 8–25 mm long; sepal keels ciliate. Wet soils, bogs, stream banks and lake shores, wet sandy swales, and acid sandy swamps; widespread in Pineywoods and Post Oak Savannah; widespread in the e U.S. from NH s to GA w to MN, OK, and TX. Flowers opening in the morning; Jun–Jul. According to Kral (2000a), "*Xyris torta* is the widest-ranging of all North American xyrids and the most expressive ecologically; thus it is not surprising that it varies so much morphologically. It is often confused in the older literature with *X. caroliniana*. *Xyris torta* is the type species for the genus." See further discussion under *X. caroliniana*.

ZANNICHELLIACEAE Dumort
HORNED-PONDWEED FAMILY

A very small (10–12 species in 4 genera—Haynes & Hellquist 2000c) but nearly cosmopolitan family of submersed aquatic herbs. It is one of relatively few families that exhibit hydrophily—water-mediated pollination; in *Zannichellia* pollination actually occurs underwater (hypohydrophily) in contrast to some cases of hydrophily in which pollination occurs at the water surface (epihydrophily; e.g., *Vallisneria* in the Hydrocharitaceae or *Ruppia* in the Ruppiaceae) (Guo et al. 1990; Philbrick 1991, 1993). The family has been treated by some authorities in the Zosteraceae (EEL-GRASS family) (Tyrl et al. 1994) or as part of the Potamogetonaceae (APG 1998; APG II 2003). According to some research, it appears to occupy an isolated position at the base of a clade leading to these two families (Les et al. 1993). However, based on molecular studies, the Zannichelliaceae is apparently most closely related to Potamogetonaceae (Les & Haynes 1995), with the two being closely related sister groups (Haynes et al. 1998d). While recognizing the close relationship of the two families, we are following most recent treatments (e.g., Haynes et al. 1998d; Haynes & Hellquist 2000c; Reveal & Pires 2002) in maintaining Zannichelliaceae as a distinct family; whether to lump or split in this case seems arbitrary—therefore, not changing traditional circumscription seems the most prudent approach. (subclass Alismatidae—Cronquist; order Alismatales—APG II)

FAMILY RECOGNITION IN THE FIELD: the single East TX species is a submersed aquatic herb with opposite or apparently whorled, entire, almost thread-like leaves and small, curved, stalked fruits.

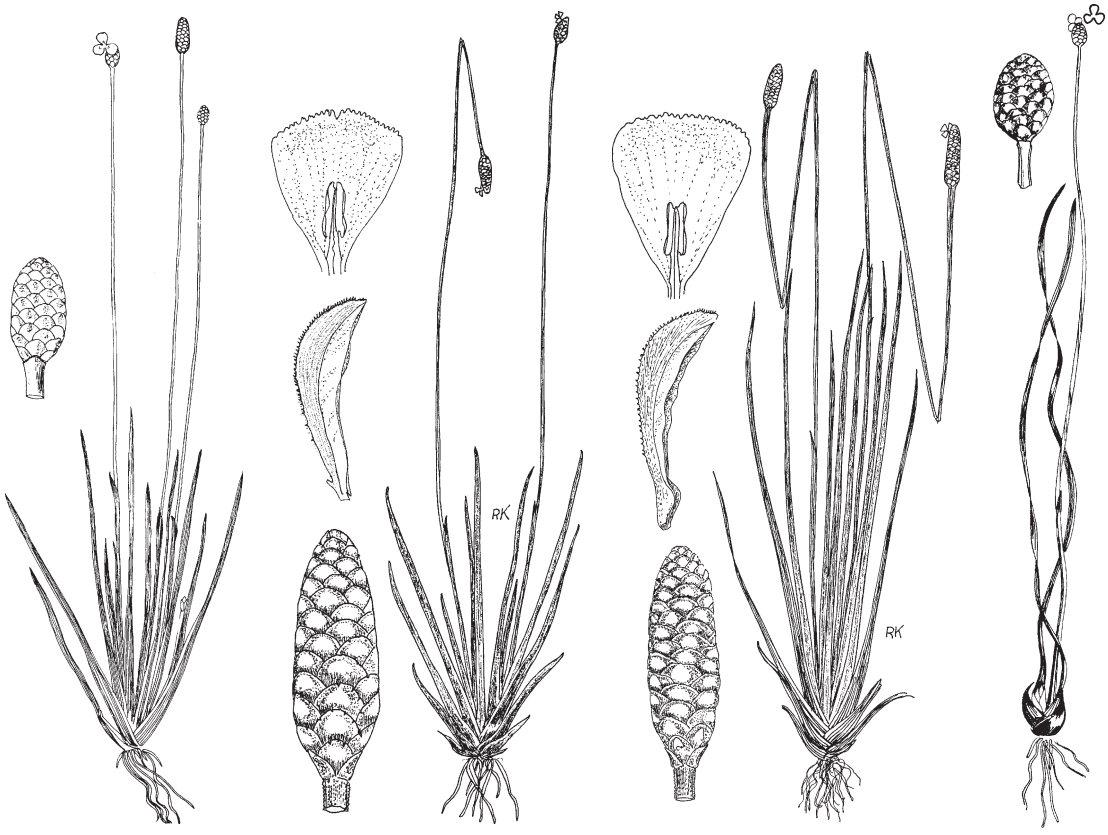
REFERENCES: Morong 1893; Campbell 1897; Taylor 1909a; Tomlinson & Posluszny 1976; Dahlgren et al. 1985; Haynes & Holm-Nielsen 1987; Haynes et al. 1998d; Haynes & Hellquist 2000c.

ZANNICHELLIA L. HORNED-PONDWEED

A nearly cosmopolitan genus of 1–ca. 5 species (Mabberley 1997; Haynes & Hellquist 2000c); pollination occurs underwater. (Named for Gian Girolamo Zannichelli, 1662–1729, a Venetian botanist and apothecary—Haynes & Hellquist 2000c)

REFERENCES: Reese 1967; Van Vierssen 1982a, 1982b, 1982c; Guo et al. 1990.

Zannichellia palustris L., (marsh-loving), COMMON POOLMAT, HORNED-PONDWEED. Monoecious, submersed, aquatic herb; stems much-branched; leaves opposite but sometimes appearing



Xyris smalliana [SID] Xyris stricta var. obscura [NOV] Xyris stricta var. stricta [NOV] Xyris torta [SID]

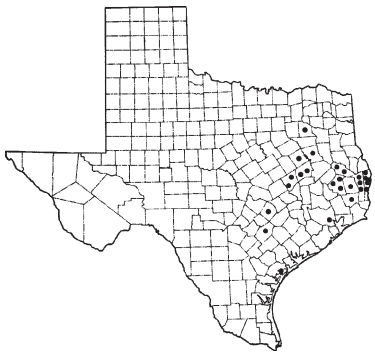


Zannichellia palustris [MAS]

whorled, very narrow, ca. 0.5 mm wide, to 10 cm long, entire, not sheathing basally (versus sheathing basally in the superficially similar *Najas*); stipules sheathing, membranous, to 4 mm long; inflorescences axillary, usually 2-flowered (1 flower staminate and 1 pistillate, the 2 together appearing as a single flower); perianth absent or nearly so (female flowers have a very reduced spathe or perianth—Guo et al. 1990); staminate flower of only a single stamen; pistillate flower of (2–)4(–8) free carpels; ovaries superior; fruits pedicellate nutlets 2–4 mm long including the beak (= persistent style), oblong, curved, ridged or dentate on back. Fresh or brackish waters of lakes or streams; McLennan, Travis (BRIT), Bastrop, Bell, Fannin, Gonzales, Hays, and Williamson (Turner et al. 2003) cos. mainly near w margin of East TX; widely scattered in TX, except the far e part; s Canada and widespread throughout most of the U.S. but less common in the se. Apr–Jul. The foliage and fruits are important foods for waterfowl (Kaul 1986).



Xyris caroliniana



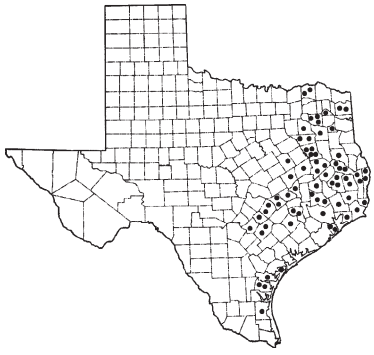
Xyris difformis
(both vars.)



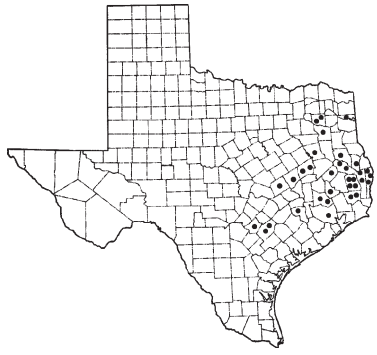
Xyris drummondii



Xyris fimbriata



Xyris jupicai



Xyris laxifolia var. iridifolia



Xyris platylepis



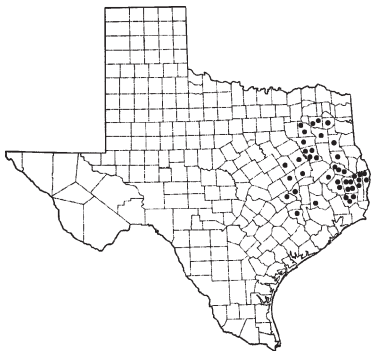
Xyris scabrifolia



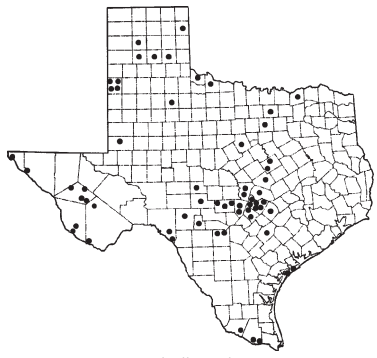
Xyris smalliana



Xyris stricta
(both vars.)



Xyris torta



Zannichellia palustris