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## ELEOCHARIS YECORENSIS (CYPERACEAE), A NEW SPECIES OF SPIKE-SEDGE FROM MÉXICO

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### ABSTRACT

*Eleocharis* (Cyperaceae) includes approximately 200 species and is particularly diverse in the New World. A newly discovered species of subgenus *Limnochloa* is described from the states of Sonora and México, México. *Eleocharis yecorensis* is related to *E. acutangula*, *E. mutata*, and *E. quadrangulata* and can be distinguished from these species by its five-angled culms, obdeltoid achenes, and narrow neck between tubercle and achene body. In addition, *E. yecorensis* possesses root storage structures similar to those found in the Chinese water chestnut, *Eleocharis dulcis*.

Key words: Cyperaceae, *Eleocharis*, *Limnochloa*, México, new species.

*Eleocharis* R. Br. (Cyperaceae), the spike-sedges, includes about 200 species and has a world-wide distribution (González-Elizondo and Peterson 1997). New World diversity is impressive, and more than 45 taxa are recognized in México alone (Espejo-Serna and López-Ferrari 1997). While supraspecific taxonomy in this genus is problematic (Kukkonen 1990), one commonly recognized group is *Eleocharis* subgenus *Limnochloa*, to which the new species here described belongs.

*Eleocharis* subgenus *Limnochloa* (here forward referred to as *Limnochloa*) has been treated as a genus (*Limnochloa* P. Beauv. ex T. Lestib.), subgenus (*E.* subg. *Limnochloa* (P. Beauv. ex T. Lestib.) Torr.), section (*E.* sect. *Limnochloa* (P. Beauv. ex T. Lestib.) Benth. & Hook.f.), and series under the name *Mutatae* Svenson. *Limnochloa* is generally considered to include at least 23 species (González-Elizondo and Peterson 1997). *Limnochloa* has a world-wide distribution, and includes perhaps the most studied *Eleocharis* species, *E. dulcis* (Burm.f.) Hensch., the Chinese water chestnut (e.g., Osotsapar and Mercado 1976).

***Eleocharis yecorensis*** E. H. Roalson, sp. nov. TYPE: MÉXICO. Sonora: south/southwest side of Yécora, approx. 1500 m, 28°22'09"N, 108°56'04"W, 8 Sep. 1996, *E. H. Roalson 1385* (Holotype: RSA; Isotypes: MICH, UC, MO, MEXU). Fig. 1.

Species haec ab *E. acutangula* (Roxb.) Schult. differt culmis 5-angulus, setis acheniis suo 1/2–3/4 longioribus et radicibus praeditis fabricis tumidis.

*Duration*: perennial; *rhizomes*: 2.5–4.0 mm in diameter, up to 13 cm long between clumps of vertical shoots, unbranched, more or less horizontal; *roots*: swollen root structures present on short lateral roots off of primary roots or terminating primary roots;

*culms*: 6–10 dm tall, 3.5–5.0 mm in diameter (measured just above the uppermost sheath), green, sharply 5-angled, nearly vertical; *sheaths*: loose on culm, smooth, basal sheaths tan to reddish, apex hyaline-translucent, base opaque tan, longest up to about 2.5 dm, somewhat prolonged into a leaf-like blade up to ca. 1.5 cm long; *spikelets*: 1.2–3.0 cm long, 3–4 mm wide at widest point, cylindrical with acute apex, tan, ca. 30–50 flowered, lowest scale not fertile, sheathing spikelet base appearing to be a continuation of the culm in color and texture, 2–4 mm long, finely many-nerved with midvein keel an extension of one culm angle, margin and apex with brown to black band and hyaline fringe; *scales*: 4-ranked, 4–5 mm long, 3–3.5 mm wide, elliptic with broadly obtuse apex, midvein obscure to slightly raised at apex, tan to brown with hyaline margin and apex as lowest scale, finely many-nerved; *bristles*: 4, 1/2–3/4 achene length, obscurely to moderately retrorsely barbed; *anthers*: 3, filaments 2–3 mm long at fruiting; *style*: three-branched; *tubercle*: 0.5–1.0 mm long, triangular, brown; *achenes*: 2.5–3.0 mm long (including persistent style base, i.e., tubercle), 1.5–2.0 mm wide, broadly obovate in outline, shiny, with distinct longitudinal ridges (ca. 20 per face), yellow to brown, with about 40 rows of shallow, transversely linear cells with their margins slightly raised, narrowed at the summit to a neck 1/4 to 1/3 the width of the achene, broadening again to form the base of the elongated triangular style.

*Phenology*.—Fruiting probably from September to November.

*Distribution and habitat*.—The states of Sonora and México in México. The type locality in a high elevation basin submerged in the wet season, with heavy silt-clay soil which dries completely during the dry

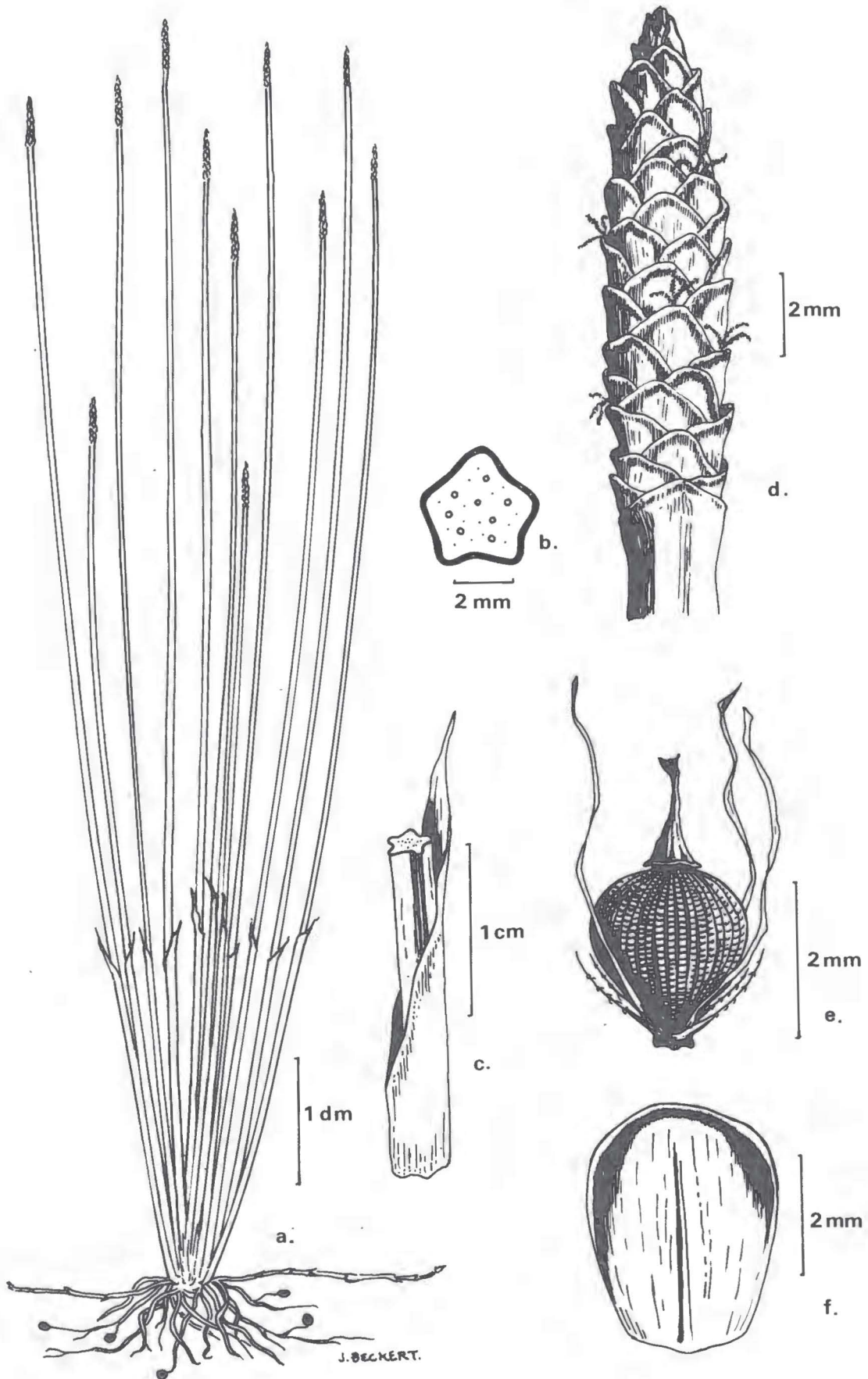


Fig. 1. *Eleocharis yecorensis*. a. habit; b. culm transverse section; c. sheath; d. spikelet; e. achene; f. scale.



season (note: the Hinton collection from the state of México is from a lake). Associated species at type locale include *Ornithocarpa torulosa* Rollins (Brassicaceae), *Cyperus virens* Michx. (Cyperaceae), *Eleocharis montevidensis* Kunth (Cyperaceae), *Eleocharis macrostachya* Britton (Cyperaceae), *Echinochloa crus-gallii* (L.) P. Beauv. (Poaceae), *Luziola gracillima* Prodoehl (Poaceae), *Nothoscordum bivalve* (L.) Britton (Alliaceae), *Ranunculus fasciculatus* Sessé & Moç. (Ranunculaceae), and *Ranunculus hydrocharoides* A. Gray (Ranunculaceae). *Eleocharis yecorensis* may be palatable as a forage for horses during the dry season.

*Paratypes*.—MÉXICO. México: District of Temascaltepec, Volcán, in lake in crater, 1460 m, 6 Aug 1932, G. B. Hinton 1276 (RSA) (determined as *E. mutata*); Sonora: Yécora, freshwater marsh, 1505 m, 16 Jul 1997, T. R. Van Devender 97-810 (ARIZ, RSA); Yécora, freshwater marsh in grassland, 1540 m, 7 Sep 1996, A. L. Reina G. 96-486 (ARIZ, RSA).

COMPARISON TO OTHER SPECIES IN *ELEOCHARIS*  
SUBG. *LIMNOCHLOA*

Based on culm characteristics, *Limnochloa* can be divided, in very general terms, into the groups: the septate members with nonangled culms; the nonseptate members with angled, coarse culms [(1) 2–8 mm diam]; and the nonseptate members with angled, slender culms (0.7–2 (3.4) mm diam]. The only member of *Limnochloa* that does not fit well into one of these groups is *E. cellulosa* Torr. This species is nonseptate, but is also not angled, and while there is little question that it is part of *Limnochloa*, how it is related to the other members is unknown.

*Eleocharis yecorensis* belongs to the nonseptate, angled coarse-culmed species group which includes *E. quadrangulata* (Michx.) Roem. & Schult., *E. mutata* (L.) Roem. & Schult., *E. spiralis* (Rottb.) Roem. & Schult., and *E. acutangula* (Roxb.) Schult. Fernald (1925) provided characters for distinguishing New World *E. mutata*, *E. quadrangulata*, and *E. acutangula* (as *E. fistulosa* (Poir.) Link). These included achene size, achene shape, tubercle shape, and the width of the neck connecting the tubercle and achene apex. Ranges in achene size for each of these species are as follows: *E. quadrangulata*, 2.7–4.2 mm; *E. mutata*, 1.7–2.3 mm; and *E. acutangula*, 2.0–2.8 mm. While the ranges in achene size of all of these species overlap, when used in combination with other characters, the species are relatively easy to differentiate. There are distinct, though subtle, differences in achene shape and size of the neck between tubercle and achene body among these species. The overall shape of *E. yecorensis* achenes seems most similar to *E. acutangula* in having achenes broadly obovate in outline. Both *E. quadrangulata* and *E. mutata* have obovate achenes tending towards a more elliptical shape. The neck between tubercle and achene body is narrow in *E. ye-*

*corensis*, usually  $\frac{1}{4}$  to  $\frac{1}{3}$  the width of the achene, which is similar to *E. quadrangulata*, while in *E. acutangula* the neck is usually about  $\frac{1}{2}$  the width of the achene body and in *E. mutata* it is lacking. The most obvious character for distinguishing most of these species is culm angulation. Both *E. mutata* and *E. acutangula* are three-angled, *E. quadrangulata* is four-angled, and *E. yecorensis* is five-angled. This character appears to be consistent both within and among populations of each species.

Recently, species status of *E. mutata* has been called into question in a report by Browning et al. (1997) that *E. mutata* is a hybrid between *E. dulcis* and *E. acutangula*. This is questionable for several reasons. First, *E. mutata* was originally described from the New World (Linnaeus 1759), only more recently being reported as occurring in Africa (Hooper 1972; Haines and Lye 1983; Browning et al. 1995). *Eleocharis dulcis*, on the other hand, is not native to the Americas. It has been cultivated in the U.S., but there are no reports of its escape, and *E. mutata* has been known from the Americas far longer than *E. dulcis* has been cultivated here. This brings into question what is being called *E. mutata* in Africa. It may be that a hybrid in Africa looks superficially like *E. mutata*. Detailed population studies of these species across their ranges are necessary to explain this confusion. Also, the culm transverse anatomy of *E. mutata* and *E. acutangula* is distinctly different from *E. dulcis*, and hybrids (at least  $F_1$ s) would be expected to be variable for culm anatomy. That is not what is seen, at least for *E. mutata* in the New World. The primary rationale that Browning et al. (1997) give for the hybrid status of *E. mutata* is its "approximate intermediacy" between *E. acutangula* and *E. dulcis* and they provide a table of morphological characters and the states for each taxon (Browning et al. 1997, p. 178). When this table is examined critically, few if any of the characters are truly intermediate. Also, *E. dulcis* is a member of the septate *Limnochloa* species with nonangled culms. For these reasons, *E. mutata* is being treated here as a distinct species based on culm transverse anatomy, achene shape, scale shape and texture, culm angulation, septae presence, spikelet morphology, and geographic distribution. *Eleocharis spiralis*, on the other hand, which may be confused with *E. mutata*, is historically known from Madagascar (Svenson 1939), and shares most of its geographic range with *E. dulcis* and *E. acutangula* (Svenson 1939). The relationship among these species needs to be pursued.

In addition to the characters of angulation, culm coarseness, and the lack of culm septae, there are several culm anatomical characters which distinguish these four species from the rest of *Limnochloa* and all other species of *Eleocharis*, at least those whose culm transverse anatomy has been studied (Metcalf 1971;

Govindarajalu 1975; Ueno et al. 1989). The most obvious characters separating these species from the rest is the presence of the net system of parenchyma cells through the air-cavities and the distribution of vascular bundles throughout the culm, not just along the periphery. Although several species of *Eleocharis* are known to have a net system through the central cavity (Govindarajalu 1975; Ueno et al. 1989), no species outside of the four species discussed here has been shown to have vascular bundles along this net. Also, the shear number of vascular bundles (50–120) within the culm far exceeds that found elsewhere in the genus (Metcalfe 1971; Govindarajalu 1975; Ueno et al. 1989).

*Eleocharis yecorensis* is the first New World member of *Limnochloa* observed to have root storage structures. These swollen structures have an expanded cortex region which turns deep black when stained with iodine/potassium iodine indicating starch storage. *Eleocharis dulcis*, also of *Limnochloa*, is well known for its root storage structures.

*Eleocharis yecorensis*, *E. quadrangulata*, *E. mutata*, and *E. acutangula* occur in similar habitats. These can vary from freshwater ponds and lakes to brackish coastal waters (Svenson 1957). *Eleocharis quadrangulata*, *E. mutata*, and *E. acutangula* seem to only inhabit those wetland areas that have consistent water levels and are submerged year-round. *Eleocharis yecorensis*, at least at the type locality, dominates a wetland of deep standing water, but this basin completely dries up during the dry season and has been used for horse grazing (T. Van Devender pers. comm.).

KEY TO THE NONSEPTATE, ANGLED-, COARSE-CULMED SPECIES OF SUBGENUS *LIMNOCHLOA*

1. Culms four- or five-angled.
  2. Culms four-angled; achene 2.7–4.2 mm long (including the tubercle), narrowly obovate in outline; root storage structures absent . . . . . *E. quadrangulata*
  - 2.' Culms five-angled; achene 2.5–3.0 mm long (including the tubercle), broadly ovate in outline; root storage structures present . . . . . *E. yecorensis* sp. nov.
- 1.' Culms three-angled.
  3. Achene constricted below the summit into a neck about ½ the width of the achene . . . . . *E. acutangula*
  - 3.' Achene not constricted, but gradually prolonged into a cellular beak.
    4. Achene dark brown, with obscure narrowly linear cells . . . . . *E. spiralis*
    - 4.' Achene yellowish, with conspicuous quadrangular cells . . . . . *E. mutata*

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