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ELEOCHARIS FALLAX (CYPERACEAE): RECENT COLLECTIONS AND MORPHOLOGICAL COMPARISON WITH *E. AMBIGENS* AND *E. MONTEVIDENSIS*

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ABSTRACT

Recent collections of *Eleocharis fallax* Weatherby expand the species' range to North Carolina and significantly increase knowledge of its habitats. We provide a key, a table of morphological characters, and photos to distinguish it from other similar, outer Coastal Plain species, including *E. ambigens* Fernald and *E. montevidensis* Kunth. All known specimens of these three species from North Carolina are cited.

Since its description from a single site (Weatherby 1922), *Eleocharis fallax* Weatherby has been problematic due to a paucity of specimens for study and uncertainties regarding its specific status. Although his texts are brief, Svenson (1932, 1939), who monographed the genus worldwide, treated *E. fallax* as a distinct species. When Fernald described *E. ambigens* Fernald (1935) he was concerned mostly with distinguishing it from *E. uniglumis* and *E. halophila* and did not mention *E. fallax*. Despite many additional collections of *E. ambigens* since then, botanists have struggled to distinguish it from *E. fallax*, and even Svenson (1947) was led to conclude that *E. ambigens* was merely a form of *E. fallax*. He cited the presence of 3-parted styles and trigonous achenes in some spikes of *E. ambigens*, which normally has 2-parted styles and biconvex achenes. Subsequent authors tended to follow Svenson. For example, Ahles (1968) examined specimens of both entities, yet they treated *E. ambigens* as a synonym of *E. fallax*. Most recently, however, Smith (in Flora North America 2002) treated it as distinct from *E. ambigens* at the species level. Smith provided full descriptions and, along with his key, restored some measure of confidence among botanists that the two entities could be satisfactorily separated.

The scarcity of specimens of *Eleocharis fallax* remains an issue — Smith (2002) cited only Nova Scotia, Massachusetts, and New Jersey as its total range, possibly based on as few as three collections. That three areas with such a long history of botanical exploration should provide only a handful of specimens, representing an entire species, is enigmatic. In the past decade, however, annotation of specimens at NCU and collection of new specimens in North Carolina have expanded the known range of *E. fallax* sensu stricto southward and significantly increased the number of known collections.

Eleocharis montevidensis Kunth shares with these two species long horizontal rhizomes, reddish culm and leaf sheaths, and (on the Atlantic and Gulf Seaboard) maritime or near-maritime habitats. The shape and length of its spikes and the morphology of its scales are similar to those of *E. fallax* and have led to misidentifications. Therefore we have included this widespread species in this discussion.

Methods

Specimens were examined and measured at NCU. A minimum of ten measurements were made of each character, using a standard millimeter rule. Using the key and descriptions in Smith (2002) as a guide, we annotated all NCU specimens originally determined to be *E. ambigens, E.*

Table 1. Morphological and habitat characters of *Eleocharis ambigens, E. fallax,* and *E. montevidensis*.

character	ambigens	fallax	montevidensis
horizontal rhizome	pale brown to red-purple, 1.3-2 mm thick, striate, +/- lustrous. [long, 1-2 mm thick]	red-brown to purple-black, 1-2 mm thick, striate, lustrous. [long, 1-2 mm thick]	dark brown to blackish, 1.0-1.5 mm thick, striate, +/- lustrous. [long, 0.7-2 mm thick]
culm height	35-80 cm. [25-80]	40-70 cm. [30-75 cm]	up to 37 cm (Florida), often <25 cm northward. [25-50 cm]
culm width at mid-culm	0.8-1.2 mm.	0.6-0.8 mm.	0.4-0.8 mm.
leaf sheath tooth	callose to short-toothed, up to 0.3 mm. [same]	callose to short-toothed, up to 0.3 mm. [rarely present, not callose]	callose to toothed, up to 0.9 mm. [same]
mature spike shape	elongate, acuminate. [ovoid to lanceoloid]	ovoid to ellipsoid, blunt to acute. [ovoid or subspheric]	short, acute to blunt. [ovoid to ellipsoid to subcyllindric]
mature spike length	8-19 mm. [5-23]	6-10 mm. [5-12]	5-9 mm. [4-12]
midspike scale apex (do not use lowermost scales)	acute. [acute, rarely obtuse]	broadly rounded, sometimes bluntly acute. [obtuse to acute]	as in fallax. [broadly rounded]
scale transversely wrinkled and/or apex recurved	no. [no]	yes—some to many. [no mention]	apparently all wrinkled; many recurved distally. [yes]
scale color	red-purple fresh, turning brown with age; central stripe and narrow margins hyaline. [medium brown]	reddish brown to brown; central stripe and broad margins hyaline. [red-brown to blackish brown]	quite orangey in living plants; central stripe and broad margins hyaline. [orange-brown]
style	2-fid. [2-fid, sometimes 3-fid]	3-fid. [3-fid or some 2-fid]	3-fid. [3-fid or some 2-fid]
achene color	golden yellow to golden brown. [dark yellow or stramineous]	ditto, varying to gray-brown. [dark yellow to medium brown]	gray-brown to blackish. [dark brown]
achene ornamentation	pits abundant and narrow. [finely rugulose]	pits far fewer than in ambigens, each pit larger. [finely rugulose]	pits abundant and narrow, but not well defined (ie, very shallow and sometimes obscure). [finely rugulose]
achene shape	unequally biconvex. [biconvex or some compressed-trigonous]	+/- trigonous. [compressed-trigonous or some thickly biconvex]	unequally biconvex to weakly trigonous. [compressed trigonous]
achene body length	1.6-1.8 mm. [not mentioned]	0.9-1.1 mm. [not mentioned]	0.9-1.1 mm. [not mentioned]
tubercle shape	depressed pyramidal, clearly wider than tall. [depressed pyramidal]	pyramidal, not depressed, as high as wide. [same]	+/- evenly triangular. [pyramidal, as high as wide or sometimes depressed]
tubercle height	0.15-0.3 mm. [not mentioned]	0.3-0.5 mm. [not mentioned]	0.25-0.3 mm. [not mentioned]
tubercle color and ornamentation	blackish, with whitish base or collar. [not mentioned]	blackish, with gray-brown base or collar. [not mentioned]	blackish but encrusted with whitish 'scales'. [not mentioned]
habitat	saltmarshes, brackish marshes, marshes close to tidal rivers and estuaries, interdune marshes. [coastal fresh to brackish pond shores and marshes]	maritime shrub swamps, maritime wet grasslands, tidal red cedar woodlands. [coastal fresh to brackish ponds, lakeshores, marshes]	dryish margins of maritime wet grasslands, sandy pondshores, dried flatwoods pond, tidal flats, roadside ditches. [fresh ponds, lakes, springs, seeps, marshes, ditches, grasslands]

fallax, and *E. montevidensis*. We created a table of characters through which we discovered additional means of discrimination. Habitats and ranges of the species are augmented with specimens seen at GA and GH.

Figure 1. Left, achene of *Eleocharis fallax*. Right, spike and 3 achenes. Scale bar is 1 mm for achene photos; 5 mm for spike photos.

Figure 2. Left, achene of *Eleocharis ambigens*. Right, spike and 3 achenes. Scale bar is 1 mm for achene photos; 5 mm for spike photos.

Figure 3. Left, achene of *Eleocharis montevidensis*. Right, spike and 3 achenes. Scale bar is 1 mm for achene photos; 5 mm for spike photos.

Figure 4. Left, achene of *Eleocharis halophila*. Right, spike and 3 achenes. Scale bar is 1 mm for achene photos; 5 mm for spike photos.

Results and Discussion

Table 1 compares a number of characters useful to distinguish *Eleocharis ambigens*, *E. fallax*, and *E. montevidensis*. Data are from specimens at NCU; data from Smith (2002) are placed within brackets. Note that Smith based his concept of *E. fallax* from specimens collected from only three

localities; in our work we examined specimens from five North Carolina localities not available to Smith (Appendix 1). Discrepancies between Smith's data and ours may in part be due to the greater number of specimens available to us.

Table 1 provides a number of characters, or combinations of characters, which can be used to distinguish *Eleocharis ambigens*, *E. fallax*, and *E. montevidensis*. We have incorporated the most effective of these in the key below. In the field, two characters are highly useful in separating *E. ambigens* from *E. fallax* and *E. montevidensis*: spike length and culm width. Similarly, short culms and orangey scales indicate that one is viewing *E. montevidensis*. On herbarium sheets, scale color fades and is therefore not reliable on dried specimens, but spike length and culm width retain their utility.

In specimens we examined, achenes of *Eleocharis fallax* are trigonous or rounded-trigonous in cross-section; those of *E. ambigens* are biconvex with one face more tumid than the other. These data contradict statements of Svenson (1947) and of Smith (2002) that occasional achenes of *E. fallax* are biconvex and occasional achenes of *E. ambigens* are trigonous. While Svenson based his decision to synonymize *E. ambigens* within *E. fallax* primarily upon this one achene character, Table 1 suggests that there are other characters that amply separate these two taxa. They include culm width, spike shape and length, achene body and tubercle length, and tubercle shape. Smith (2002) concluded that occasional biconvex achenes and 2-fid styles found in *E. fallax* are insufficient to place *E. ambigens* in synonymy. In our own collections, we have not found biconvex achenes nor 2-fid styles in *E. fallax* sensu stricto. Figures 1-4 depict mature achenes and spikes of these three species plus *E. halophila* (Fernald & Brackett) Fernald, another maritime species that may co-occur with them south to North Carolina.

Key to *Eleocharis fallax* and similar species

This key is derived from Weakley (2012, keys D and E). NOTE: This key is primarily intended to aid those working in the outer Coastal Plain.

1. Achenes lenticular or biconvex, styles 2-branched; perennials or annuals.

2. Tufted or cespitose annuals, rhizomes short or absent ..... **Eleocharis atropurpurea, E. engelmannii, E. geniculata, E. obtusa**

2. Perennial, rhizomes horizontal and elongate.

3. Culms hollow and obviously transversely septate; mostly Coastal Plain Florida and Georgia to Texas and New Mexico; Mexico southward ..... **Eleocharis montana**

3. Culms spongy but not hollow, not septate or septa incomplete.

4. Proximal sterile scales 2–3, the lowest not encircling the base of the spike; northern; in southeastern USA occurs in mountains and piedmont (s to nw Arkansas, n Alabama, w North Carolina) ..... **Eleocharis palustris**

4. Proximal sterile scale 1, encircling the base of the spike; widespread geographically.

5. Achenes prominently pitted (like a honeycomb); tubercles wider than tall (depressed pyramidal), 0.15–0.3 mm tall;brackish and saline habitats of outer Coastal Plain ..... **Eleocharis ambigens**

5. Achenes faintly or obscurely pitted, or smoothish; tubercles taller than wide, 0.35–0.8 mm tall; mountains and piedmont or outer Coastal Plain.

6. Scales obtuse, 30–40 per spike; freshwater habitats mostly of mountains and piedmont, but also of Coastal Plain Delaware, Virginia ..... **Eleocharis erythropoda**
6. Scales acute, 5–30 per spike; brackish and saline habitats of outer Coastal Plain ..... **Eleocharis halophila**

1. Achenes trigonous or nearly so, styles 3-branched; perennial, rhizomes horizontal and elongate.

7. Plants cespitose, often mat-forming, horizontal rhizomes lacking; culm tips often arching and rooting; tubercles confluent with achene and with same texture and color; brackish and saline habitats of outer Coastal Plain, also inland saline microhabitats ..... **Eleocharis rostellata**
7. Perennial, rhizomes horizontal and elongate; culms erect, not rooting; tubercles distinct from achene in texture and color; fresh to brackish habitats of outer Coastal Plain.

8. Culms 40–70 cm tall; scales hyaline with red-brown to blackish brown central stripes; achenes prominently pitted (like a honeycomb); tubercle 0.3–0.5 mm tall ..... **Eleocharis fallax**
8. Culms up to 37 cm tall (reportedly taller, but not verified; in North Carolina-South Carolina, culms mostly are less than 25 cm); scales hyaline with orange-brown to dull orange central stripes (notably orangey in life); achenes faintly or obscurely pitted; tubercle 0.25–0.3 mm tall ..... **Eleocharis montevidensis**

Habitat notes

Eleocharis ambigens inhabits brackish or fresh tidal marshes and ponds. Specifically, these are marshes bordering fresh tidal rivers, marshes within stable interdune swales, and shores of permanent ponds which lie adjacent to ocean beaches or to estuaries. In all cases, salt spray input is frequent and direct intrusion of storm-driven saltwater is occasional. In the case of the specimen from far inland Ouachita Parish, Louisiana, the site may possibly be in saline soils. One current North Carolina population occurs at the edge of a marsh within old forested dunes, along with the halophile/calciphile *Potamogeton illinoensis*.

The type locality for *Eleocharis fallax* is the margin of a fresh tidal inlet on Cape Cod, Massachusetts. Despite numerous attempts, including by the authors, no one has rediscovered this population. We have not examined specimens from Nova Scotia or New Jersey, the only other locations cited by Smith (2002). However, in North Carolina at least five current populations are known. One is in a fresh tidal red cedar forest dominated by *Juniperus virginiana* var. *silicicola*. The others occur in sedge-grass depressional marshes within forested dunes, where they form dense swaths or patches under a broken canopy of *Cornus stricta* and *Salix caroliniana*. Plants are abundant at each locality.

Eleocharis montevidensis is widespread in the New World, extending from the USA to Argentina. In North Carolina it inhabits seasonally wet maritime grasslands and open interdune swales. Within these habitats it occupies drier sandy margins with *Hydrocotyle bonariensis*. Elsewhere on the Atlantic and Gulf Coastal Plain it inhabits roadside ditches, pond and creek margins, and dry tidal flats, all within the range of salt spray.

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Appendix 1. Selected specimens.

ELEOCHARIS AMBIGENS Fernald. **Louisiana**. Orleans Par.: New Orleans, no date, *Cocks s.n.* (GH). Ouachita Par.: 7 mi SSW of West Monroe, frequent in wet clay soil of oak-pine flats, *Kral 8724* (NCU). **Massachusetts**. Dukes Co.: peaty margin of Sheep Pond, Cuttyhunk, 11 Aug 1927, *Fogg 2526* (GH). **Mississippi**. Hancock Co.: Bay St. Louis, salt marsh, 9 May 1970, *Rogers 3240* (NCU). **North Carolina**. Beaufort Co.: freshwater marsh 1 mi SW of Washington, 6 Jul 1958, *Radford 36120* (NCU). Currituck Co.: marsh near causeway to Knott's Island, 27 Aug 1952, *Radford 6560* (NCU). Dare Co.: fresh marsh in Jennette Sedge SE of Doctor's Hill, Buxton, 27 Jun 2013, *Sorrie 13216* (NCU, NCSC). New Hanover Co.: brackish marsh at W end of bridge over Northeast Cape Fear River, Wilmington, 12 Jun 1958, *Bell 13025* (NCU). Pamlico Co.: brackish marsh by Trent Creek, 5 Jul 1958, *Radford 36040* (NCU). Pasquotank Co.: swamp border, branch of Big Flatty Creek, 31 Jul 1958, *Ahles 48134* (NCU). **Rhode Island**. Washington Co.: Block Island, dry sandy shore of Wash Pond, 22 Aug 1913, *Fernald, Hunnewell, & Long 8887* (GH). **Virginia**. James City Co.: James City, small marsh near James River, 8 Aug 1974, *Ware 5711* (NCU). New Kent Co.: shallow water of marsh near York River, 25 Jun 1974, *Soltis 226* (NCU). Princess Anne Co.: marshes bordering ponds, Dam Neck, 30 Jul 1934, *Fernald & Long 3765* (type, GH); swampy border of Rainey Pond outlet, Sand Bridge, 19 Jun 1936, *Smith & Hodgdon* Pl. Exs. Gr. 621 (NCU). Surry Co.: small marsh-bordered pond, Hog Island Waterfowl Refuge, 15 Jun 1974, *Ware 5468* (NCU).

ELEOCHARIS FALLAX Weatherby. **Massachusetts**. Barnstable Co.: fresh to springy border of Dinah's Pond, Yarmouth, 16 Aug 1919, *Fernald & Long 18025* (type NEBC, isotype GH). **North Carolina**. Carteret Co.: marsh in Bogue Barrier woods, 4 mi W of Atlantic City, 24 Jun 1959, *Burk b17-3* (NCU). Dare Co.: Cape Hatteras National Seashore, Mountains-to-Sea Trail, shallow wet swale in *Pinus taeda-Ilex vomitoria* woodland, 11 Jun 2012, *Sorrie 12995* (NCU); Cape Hatteras National Seashore, E of Cape Point Campground, maritime wet grassland, 12 Jun 2012, *Sorrie 13002* (CAHA, NCU); Cape Hatteras National Seashore, marsh near junction of Lighthouse Road and NC 12, 31 May 2013, Sorrie *13187* (GH, NCU). Onslow Co.: New River Marine Corps Air Station, tidal red cedar forest, 29 May 1996, *Leblond & Schafale 4548* (NCU).

ELEOCHARIS MONTEVIDENSIS Kunth. **Alabama**. Mobile Co.: Dauphin Island, moist ditch near water tank, 1 May 1965, *Deramus D452* (NCU). **Florida**. Collier Co.: margin of Palm Creek, W of Everglades, Jul (no year), *Curtiss 3073* (NCU). Franklin Co.: tidal flats along bay at Apalachicola, 9 Jun 1955, *Godfrey 53444* (NCU). St. Johns Co.: moist roadside ditch along Fla. 210, 22 May 1965, *Hodgson s.n.* (NCU). **Georgia**. Chatham Co.: Tybee Island, 1958, *Duncan 20822* (GA). Louisiana. Tangipahoa Par.: wet ditch along route 122, *Allen 8208* (NCU). **Mississippi**. Harrison Co.: vicinity of Biloxi, along beach, 17 Jun 1970, *Rogers 3440* (NCU). Jackson Co.: Moss Point, wet sand, edge of saltmarsh, 3 Jun 1972, *Rogers 8276* (NCU). **North Carolina**. Carteret Co.: near Shackleford Point, 11 Apr 1898, *Ashe s.n.* (NCU). Dare Co.: in wet meadows, Cape Hatteras, 16 Jun 1898, *Ashe s.n.* (NCU), Cape Hatteras National Seashore, maritime wet grassland by Billy Mitchell Airfield, 15 May 2012, *Sorrie 12948* (CAHA, NCU). Hyde Co.: Ocracoke Island, maritime wet grassland, 20 May 2006, *LeBlond 6202* (NCU). Onslow Co.: Camp Lejeune Marine Corps Base, seepage area by Mile Hammock Bay, 30 Aug 1991, *LeBlond 2480* (NCU).