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Eleocharis angusticeps (Cyperaceae), a New Spikerush from the Highmarsh of Camden County, Georgia, U.S.A.

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ABSTRACT

A novel spikerush, *Eleocharis angusticeps*, from the highmarsh of Camden County, Georgia, is described, and the results of a morphometric analysis are presented in support of the recognition of this new species. A technical description, dichotomous key, comparative photographs of achenes, spikelets, and plant habit, distribution maps, habitat data, and specimen citations are included.
Key words: Cyperaceae, *Eleocharis*, high marsh, morphometric analysis, new species

INTRODUCTION

During a 1996 survey of Kings Bay Submarine Base in Camden County, Georgia, the second author discovered an unusual spikerush resembling *Eleocharis albida* (Carter 2015). The widely distributed *Eleocharis albida* grows in saline soils on the edges of brackish marshes, ponds, and ditches in outer coastal regions of the eastern United States (Figures 1 and 2), Mexico, Central America, and Bermuda (Smith et al. 2002). The novelty exhibits morphological divergence, with taller and slenderer reclining stems, unlike *E. albida* with its upright habit and erect stems. Other differences are narrower spikelets, achenes, and tubercles, and bristles longer than the achene. Although our new species is highly restricted in range, with only three known populations, the Coastal Plain of the southeastern United States is a known narrow endemic hot spot (Noss et al. 2015). Since this discovery, we have referred to these plants by the working name "angusticeps", because of their narrow spikelets and tubercles, and they are included in Weakley's treatment of the southeastern flora as "*Eleocharis species 1*" (Weakley 2022). Herein, we provide (1) evidence supporting the recognition of these populations as a new species, based upon multivariate and other numerical analyses of morphological characteristics, (2) a technical description to facilitate its identification, and (3) a dichotomous key to enable their separation from the similar species, *E. albida*. Much of this paper is extracted from the first author's Master's thesis (Lowe 2018).

MATERIALS AND METHODS

A preliminary review of the literature (Svenson 1937; Smith et al. 2002) and herbarium specimens revealed 16 possibly informative morphological variables selected for analysis (Table 1). All variables were continuous. We chose 94 specimens that were complete in exhibiting all characters selected as variables: 79 of *Eleocharis albida* and 15 of the putative new species. These specimens were from: GA, LSU, and VSC herbaria (Thiers 2021). Each variable was measured for each specimen. Fine details were measured to the nearest 0.1 mm using an Olympus SZ 51 stereo dissecting microscope and a Minitool Micro-Scale (Minitool Inc., Campbell, California). Measurements were recorded in an Excel spreadsheet with a unique identifier (combination of collector name, collection number or date, and herbarium abbreviation) linked to each source specimen; however, two variables, bristle length

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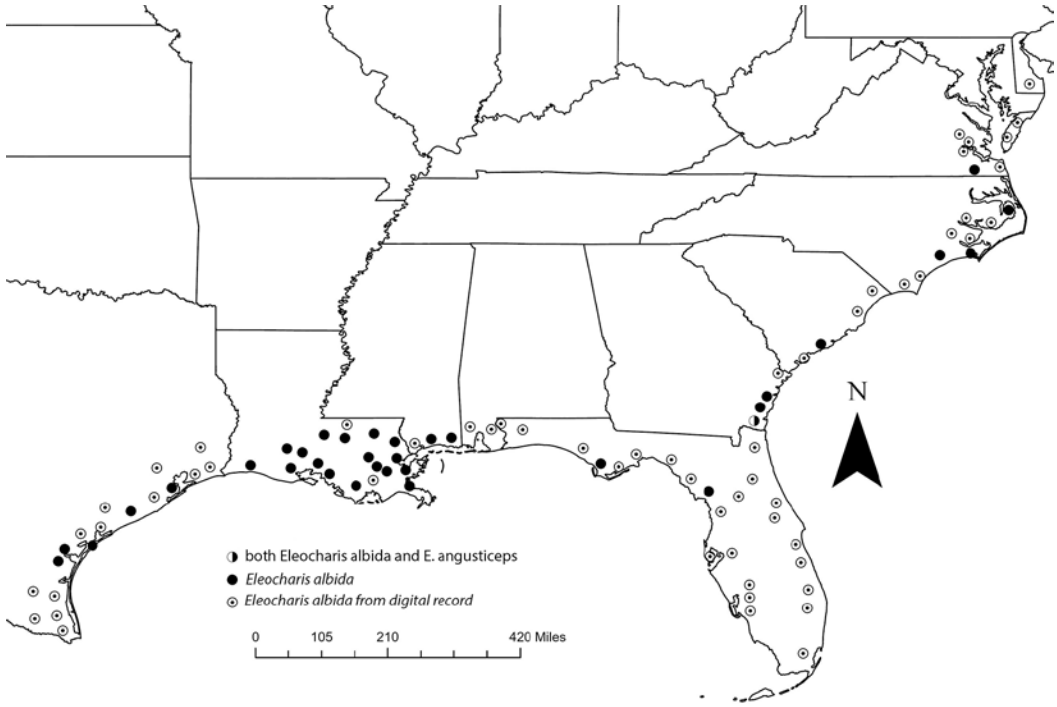

Figure 1. Distribution of *Eleocharis albida* and *E. angusticeps* in the southeastern United States.

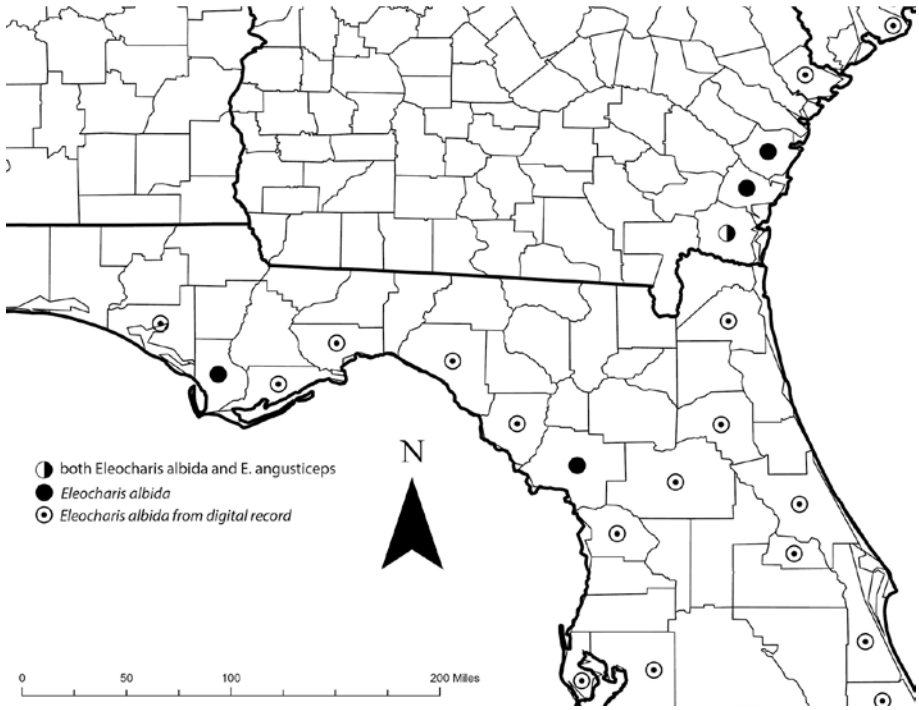

Figure 2. Distribution by county of *Eleocharis albida* and *E. angusticeps* in southern Georgia and northern Florida.

Table 1. Principal component analysis matrix with eigenvalues and loadings for each variable.

		PC1	PC2	PC3	PC4	PC5	PC6
Eigenvalue		3.493055	2.121326	1.462343	1.163207	1.05968	0.956904
Proportion		0.249504	0.151523	0.104453	0.083086	0.075691	0.06835
Cumulative		0.249504	0.401027	0.50548	0.588566	0.664258	0.732608
Variable							
ACHL	Achene length (mm)	0.142244	–0.01432	–0.43071	0.464333	–0.37909	–0.14988
ACHW	Achene width (mm)	0.362822	0.081509	–0.3251	0.164202	0.257945	–0.04467
ACHMX/ACHL	Ratio of distance from achene base to point of its maximum width:achene length	–0.04977	–0.02289	0.505193	0.489778	–0.32314	–0.10748
ANTHL	Anther length (mm)	0.238517	–0.21867	0.206791	–0.45888	–0.06832	–0.00618
BRIL/(ACHL+TUBL)	Ratio of bristle length: achene–tubercle complex length	–0.3129	–0.21246	0.147658	0.172952	0.165287	0.357691
CULML	Length of longest culm (cm)	–0.36699	–0.34886	–0.26008	–0.10078	0.044723	–0.08848
CULMW	Width of widest culm at mid-culm (mm)	0.25709	–0.30658	–0.15984	0.243785	0.087768	0.560289
SCLL	Scale length (mm)	0.275398	–0.27168	0.069575	0.099064	–0.04188	–0.5584
SCLW	Scale width (mm)	0.310084	–0.21638	0.190721	–0.04537	0.152077	–0.1761
SHTHL	Sheath length (mm)	–0.16688	–0.47257	–0.38827	–0.0179	0.037429	–0.15563
SPKLTL	Length of longest spikelet (mm)	0.080284	–0.44473	0.091543	–0.26731	–0.37927	0.0791
SPKLTW	Width of longest spikelet (mm)	0.390181	–0.18751	0.123612	0.110394	–0.12832	0.334363
TUBL	Tubercle length (mm)	0.011303	0.249168	–0.24889	–0.26846	–0.65213	0.16706
TUBW	Tubercle width (mm)	0.362521	0.212123	–0.13508	–0.19893	0.178259	0.035231

[BRIL] and achene distance from base to point of maximum width [ACHMX], were only used in the calculations of (1) the ratio of distance from achene base to its point of maximum width:achene length [ACHMX/ACHL], a proxy for achene outline (Carter and Bryson 2000), and (2) the ratio of bristle length:achene-tubercle complex length [BRIL/(ACHL+TUBL)]. All physical specimens used in this study are cited either as type specimens or in the appendix. Source specimens for the morphometric analysis include type specimens and those specially designated in the appendix. To show more completely the distribution of *E. albida*, digital images and data from herbarium vouchers were used to supplement data derived from physical specimens (SERNEC Data Portal 2021). Data from these digitized specimens are available electronically upon request. Maps were generated in ESRI's ArcMap (ESRI 2021) using county level data from the herbarium records. All base maps were obtained from the United States Geological Survey (Georgia GIS Clearinghouse, USGS, Savannah, Georgia).

The resulting data set of 14 variables was subjected to principal component analysis (PCA), and PCA loadings were used to determine the most significant variables (i.e., diagnostic characteristics) for cluster analysis. A three-dimensional score plot incorporating the first three principal components (PC1, PC2, and PC3) was constructed, and a Euclidean distance dendrogram was produced through cluster analysis employing the most important diagnostic characteristics revealed through PCA: spikelet width [SPKLTW], culm length [CULML], achene width [ACHW], and ratio of bristle length to achene-tubercle complex length [BRIL/(ACHL+TUBL)]. A three-dimensional scatter plot of three of the more salient diagnostic characteristics culm length [CULML], spikelet width [SPKLTW], and ratio of bristle length to achene-tubercle complex length [BRIL/(ACHL+TUBL)] was also generated. Minitab 17 (2010) was used to run all statistical analyses, to produce graphical depictions of results of statistical and other numerical analyses, and to construct box plots and interval plots to analyze variation between the two taxa vis-á-vis the most important characteristics (i.e., variables) of the first two principal components (PC1 and PC2).

Scanning electron micrographs were prepared using a JEOL JSM-6480LV scanning electron microscope (SEM; JEOL, Tokyo, Japan). Representative achenes were harvested from specimens and mounted on aluminum stubs with carbon paint. The stubs were then imaged on low magnification (30–80X) using a secondary electron detector. The resulting images were edited to maximize contrast. Representative herbarium sheets were photographed as were higher resolution images of representative spikelets.

RESULTS

Results of the PCA are presented in Table 1 and Figures 3 and 4. The matrix loadings in Table 1 indicate that the most important character variables accounting for variance in PC1 are spikelet width [SPKLTW], culm length [CULML], achene width [ACHW], tubercle width [TUBW], ratio of bristle length to length of achene-tubercle complex [BRIL/(ACHL+TUBL)], which correlate well with our initial observations and general assessment of salient differences between *E. albida* and the putative new taxon. Both the two-dimensional score plot of PC1 and PC2 (Figure 3) and three-dimensional score plot of PC1, PC2, and PC3 (Figure 4) show two distinct clusters corresponding with our *a priori* determinations of the source specimens as two separate taxa. The groups shown in the Euclidean distance dendrogram (Figure 5) generated via cluster analysis also correspond with our *a priori* determinations, as do those in Figure 6, a simple three-dimensional scatter plot limited to only three of the more salient diagnostic characteristics: culm length [CULML], ratio of bristle length to achene-tubercle complex length [BRIL/(ACHL+TUBL)], and spikelet width [SPKLTW]. Box plots in Figure 7 and interval plots in Figure 8 compare the main character variables for *Eleocharis albida* and our putative new species, as defined by PC1 and PC2, indicating discontinuities in critical diagnostic characters and degrees of overlap in others. Figures 9 and 10 show SEM micrographs comparing achenes and a comparison of representative spikelets of the two taxa, respectively. Figures 11 and 12 are representative of plant habit.

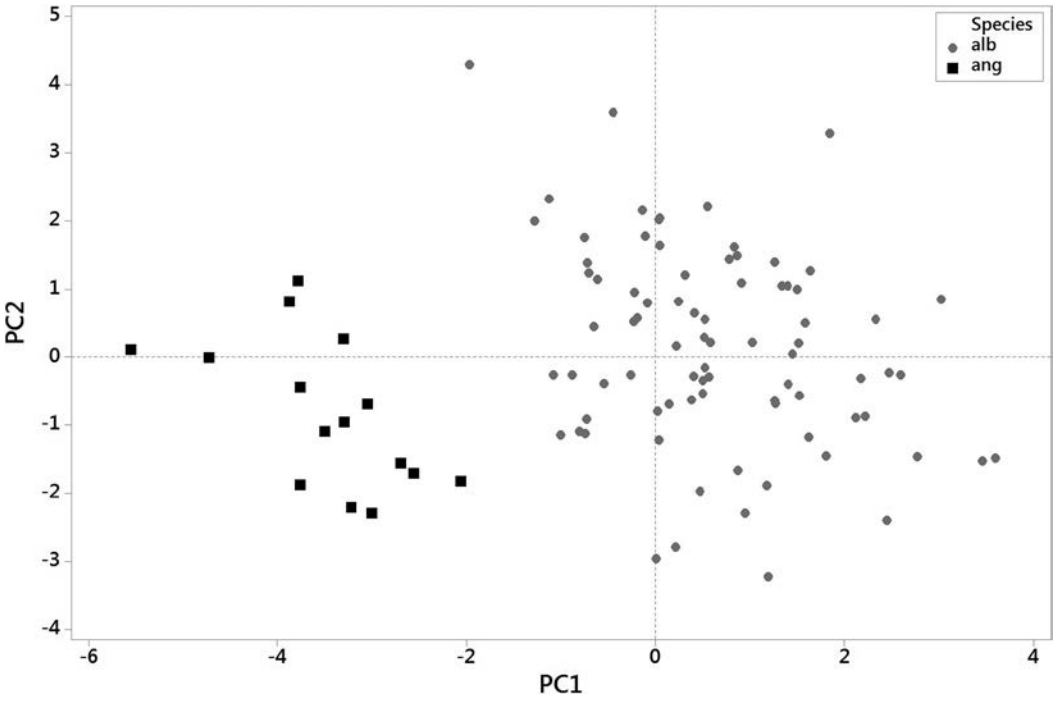

Figure 3. Two-dimensional score plot of first and second principal components (PC1, PC2) for *Eleocharis albida* (alb) and *E. angusticeps* (ang).

DISCUSSION

Results of our morphometric study involving PCA, cluster analysis, and a simple scatter diagram of selected characteristics confirm our initial observations that populations of this unusual spikerush are distinct from *Eleocharis albida* and worthy of formal recognition as a distinct species. Both two-dimensional and three-dimensional PCA score plots (Figures 3 and 4), Euclidean distance dendrogram (Figure 5), and scatter diagram restricted to salient diagnostic characteristics (Figure 6) reveal groups corresponding with our *a priori* determinations. Box plots and interval plots statistically support the utility of diagnostic characteristics highlighted by PCA. Spikelet width [SPKLTW] and culm length [CULML] were the most significant variables in PC1, supporting the initial field observations of conspicuously narrower spikelets (cf. Figure 10) in *E. angusticeps* and its longer, weaker, lax and leaning culms (Figures 11 and 12). These features, as well as narrower achenes and tubercles and longer bristles relative to achene-tubercle complex (Figure 9) mark this new species well.

Noss et al. (2015) discuss the significance of the Coastal Plain of the southeastern United States as a biodiversity hot spot, and in recent decades a number of narrow endemics from the outer coastal fringe have been formally named or mentioned as candidates for recognition, e.g., *Ptilimnium ahlesii* Weakley & G.L. Nesom (Weakley and Nesom 2004), *Trichostema nesophilum* K.S. McClell. & Weakley (Weakley et al. 2019), and "*Trichostema species 2*" (Weakley 2022). Given current trends and projections regarding climate and sea level change, it would seem prudent to document such narrow endemics along the coastal fringe, as their habitats will be among the first affected (Bellard et al. 2012; Arneth et al. 2020).

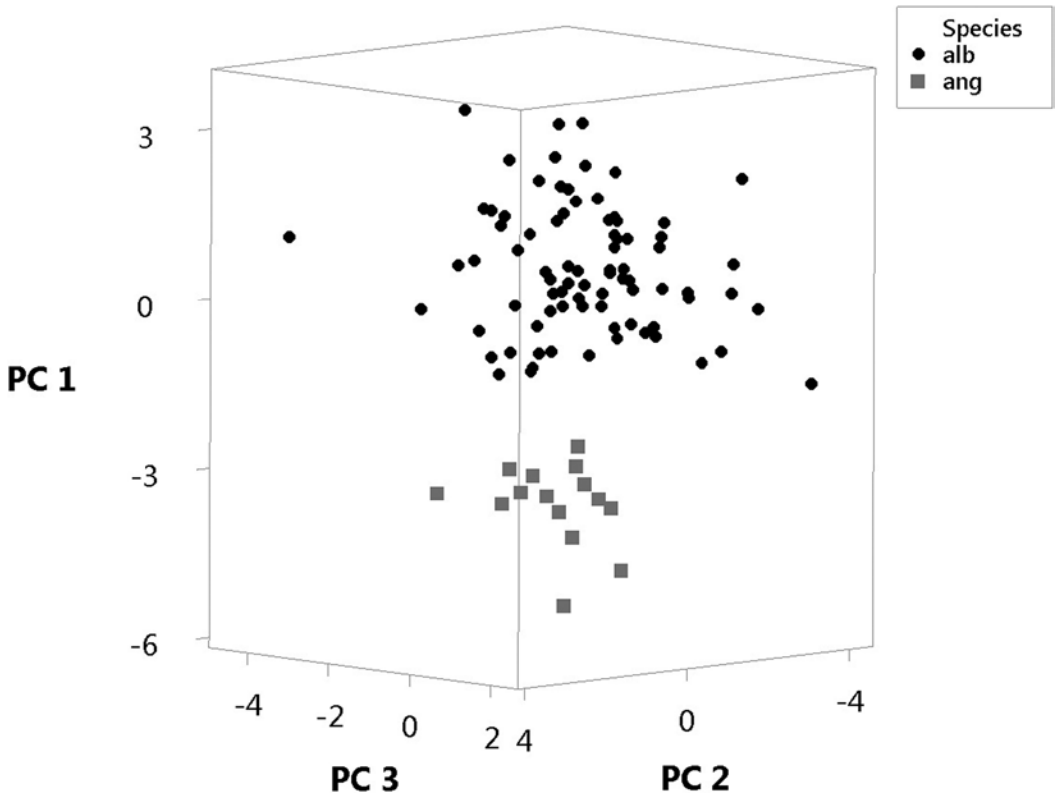

Figure 4. Three-dimensional score plot of first three principal components (PC1, PC2, PC3) for *Eleocharis albida* (alb) and *E. angusticeps* (ang).

TAXONOMIC TREATMENT

Eleocharis angusticeps J.R. Carter and P.D. Lowe, sp. nov.—TYPE: **U.S.A. Georgia. Camden County:** Kings Bay Submarine Base, upper reaches of North River estuary, 30.800680°N, 81.535600°W, 29 Aug 1996, *R. Carter 13617* (HOLOTYPE: GA; ISOTYPES: FLAS, LSU, NCU, NY, VSC).

PARATYPES: **U.S.A. GEORGIA. Camden County:** Kings Bay Submarine Base, fill site north of north end of dock and across Kings Bay from north end of Crab Island, USGS Harrietts Bluff Quad., 30.813118°N, 81.529421°W, 9 Jul 1996, *R. Carter 13182* (BRIT, CLEMS, FSU, MMNS, MO, US, USCH, VSC); Kings Bay Submarine Base, 0.75 mi W of jct. USS Henry L. Stimson Dr. and USS James Monroe Ave, along north side USS Henry L. Stimson Dr., 30.798398°N, 81.533657°W, 23 Aug 1996, *R. Carter 13589* (AUA, MO, NY, TROY, USMS, VSC).

Plants perennial: Rhizomes soft, longest internodes 1–2 cm, cortex loose, scales membranous and translucent. Culms terete, 30–40 cm × (0.4) 0.5–0.6 (0.7) mm, often lax and reclining. Leaves 2, reduced to sheaths, proximally brown to red-brown, distally stramineous to green. Spikelets cylindric to lanceoloid, obtuse, at least proximal 2 or 3 (or 4) scales empty, (6.1) 6.7–8.1 (9.8) × (1.5) 1.9–2.4 mm; floral scales medially subcartilaginous, laterally chartaceous, appressed, broadly ovate, rounded, (1.7) 1.8–2 × (0.4) 0.5–0.6 (0.7) mm, tan. Perianth bristles 6, ±strap shaped, retrorsely spinulose, (1.1) 1.3–1.6 (2) mm, exceeding the achene, reddish brown. Stamens 3, anthers exserted at anthesis, oblong to narrowly elliptic, apiculate, (0.5) 0.6–0.8 mm long, tan to ochre. Style trifid, stigmas 3, exserted at anthesis, reddish brown. Achene trigonous, (0.7) 0.8–0.95 [excluding tubercle] × 0.5–0.7 (0.8) mm, elliptic to rarely narrowly obovate, base attenuate, apex acuminate, terminating in a short neck-like constriction, surface smooth to sparsely punctate, ochre to black;

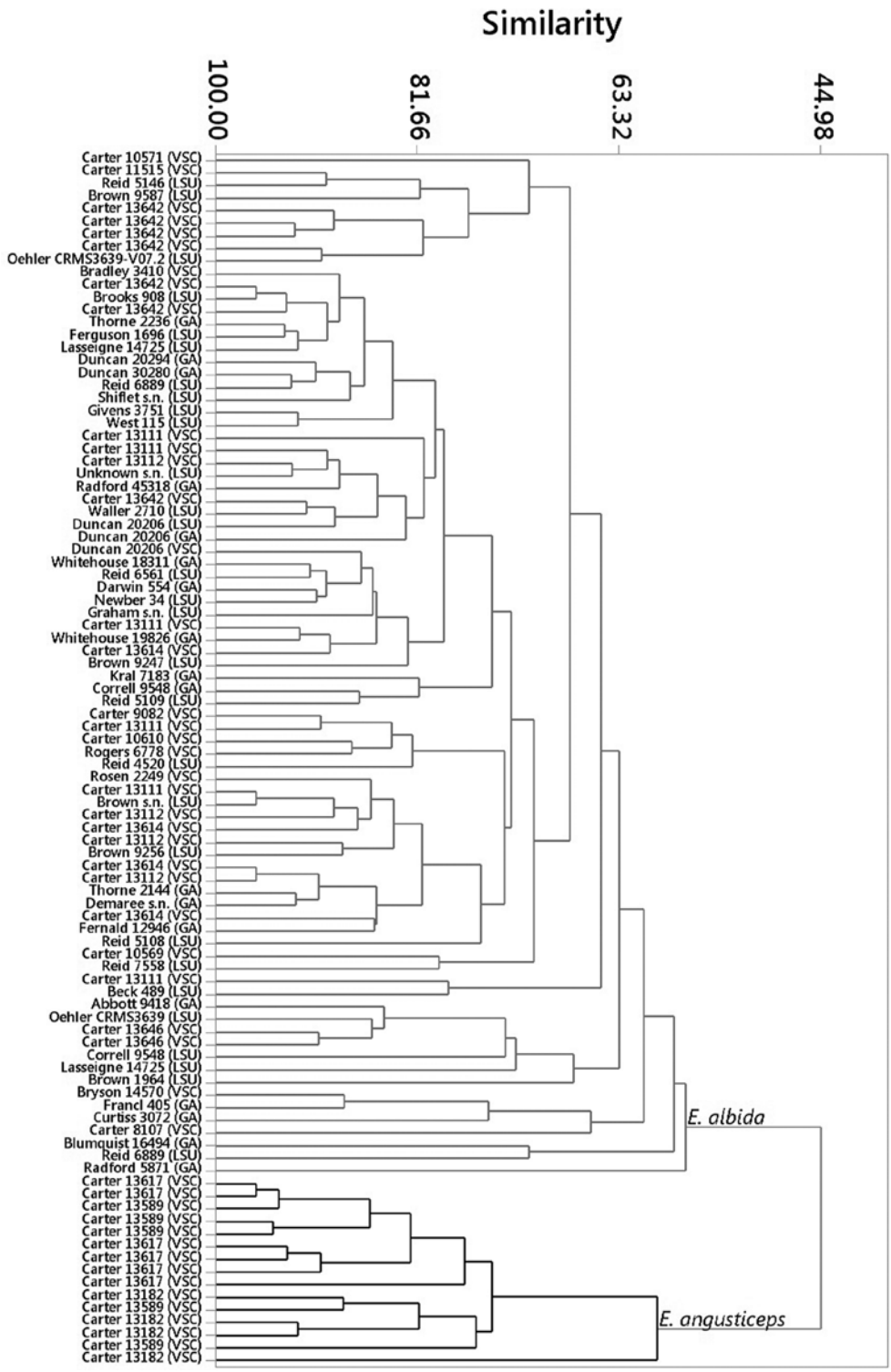

Figure 5. Euclidean distance dendrogram based on diagnostic characteristics separating *Eleocharis albida* and *E. angusticeps.*

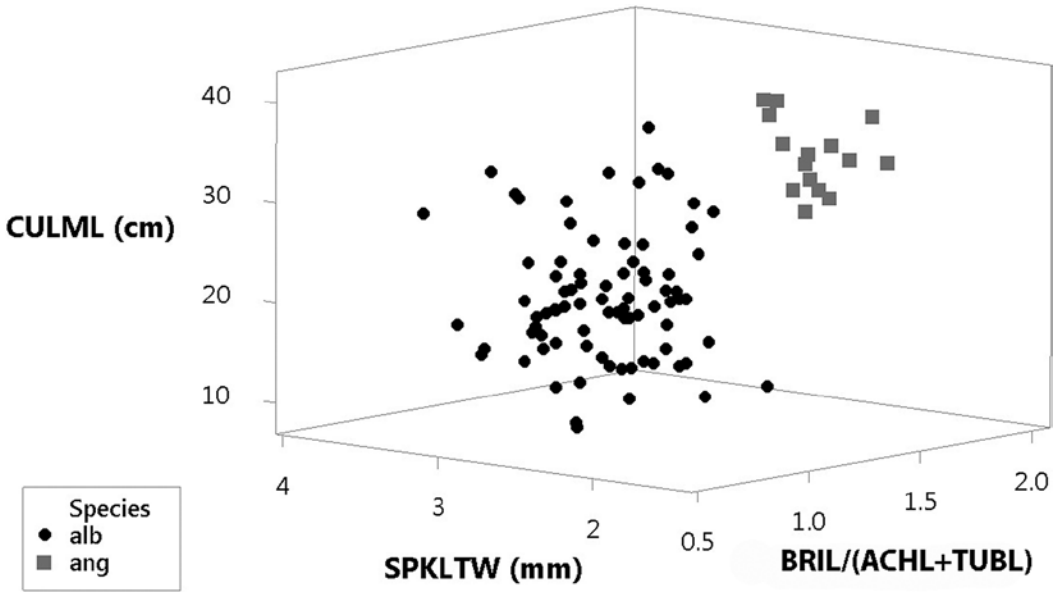

Figure 6. Three-dimensional scatter plot of the salient diagnostic characteristics culm length [CULML], spikelet width [SPKLTW], and ratio of bristle length to achene-tubercle complex length [BRIL/(ACHL+TUBL)] for *Eleocharis albida* (alb) and *E. angusticeps* (ang).

tubercle, pyramidal to oblong, triangular when viewed distally, withered, (0.15) 0.2–0.25 (0.35) × 0.15–0.21 (0.3) mm, brown. Figures 9b, 10b, and 12.

Diagnosis: *Eleocharis angusticeps* has longer and narrower, weaker, and often more lax and reclining culms, unlike those of *E. albida* (shorter, wider, ±erect). The spikelets of *E. angusticeps* are narrower and cylindrical to lanceoloid, in contrast with the broader, ovoid spikelets of *E. albida*. *Eleocharis angusticeps* achenes are narrower, ranging from elliptic (to rarely narrowly obovate), in contrast with the broader, ovate to obovate achenes of *E. albida*, and have a narrower withered tubercle, in contrast with the well-developed pyramidal tubercle of *E. albida*. In *E. angusticeps* the bristles exceed (often nearly twice as long as) the achene-tubercle complex, while in *E. albida* they rarely exceed (and then only barely so) the achene-tubercle complex. The Mexican species *Eleocharis rzedowskii* S. González, like *E. albida* and *E. angusticeps*, has subcartilaginous floral scales. However, it differs from *E. angusticeps* in its narrower culms, paler, finer and shorter (sometimes rudimentary) perianth bristles, longer anthers, and montane distribution (González-Elizondo 1985).

Habitat: *Eleocharis angusticeps* occurs on sandy banks at the upper reaches of tidal creeks in brackish areas generally influenced only by the most extreme high tides. This species is a narrow endemic known from only three populations in Camden County, Georgia (Figures 1 and 2). Associated species at the holotype locality were *Quercus virginiana* Mill., *Juniperus silicicola* (Small) L.H. Bailey, *Sabal palmetto* (Walter) Lodd. ex Schult. & Schult.f., *Liquidambar styraciflua* L., *Pinus taeda* L., *Ilex vomitoria* Aiton, *Morella cerifera* (L.) Small, *Sabal minor* (Jacq.) Pers., *Nekemias arborea* (L.) J. Wen & Boggan, *Juncus roemerianus* Scheele, *Panicum virgatum* L., *Echinochloa walteri* (Pursh) A. Heller, *Fimbristylis castanea* Vahl, *Pluchea odorata* (L.) Cass., *Bacopa monnieri* (L.) Wettst., *Canna flaccida* Salisb., *Saururus cernuus* L., *Triglochin striata* Ruiz & Pav., and *Hydrocotyle umbellata* L.

Etymology: The specific epithet *angusticeps* refers to the narrow spikelets and tubercles.

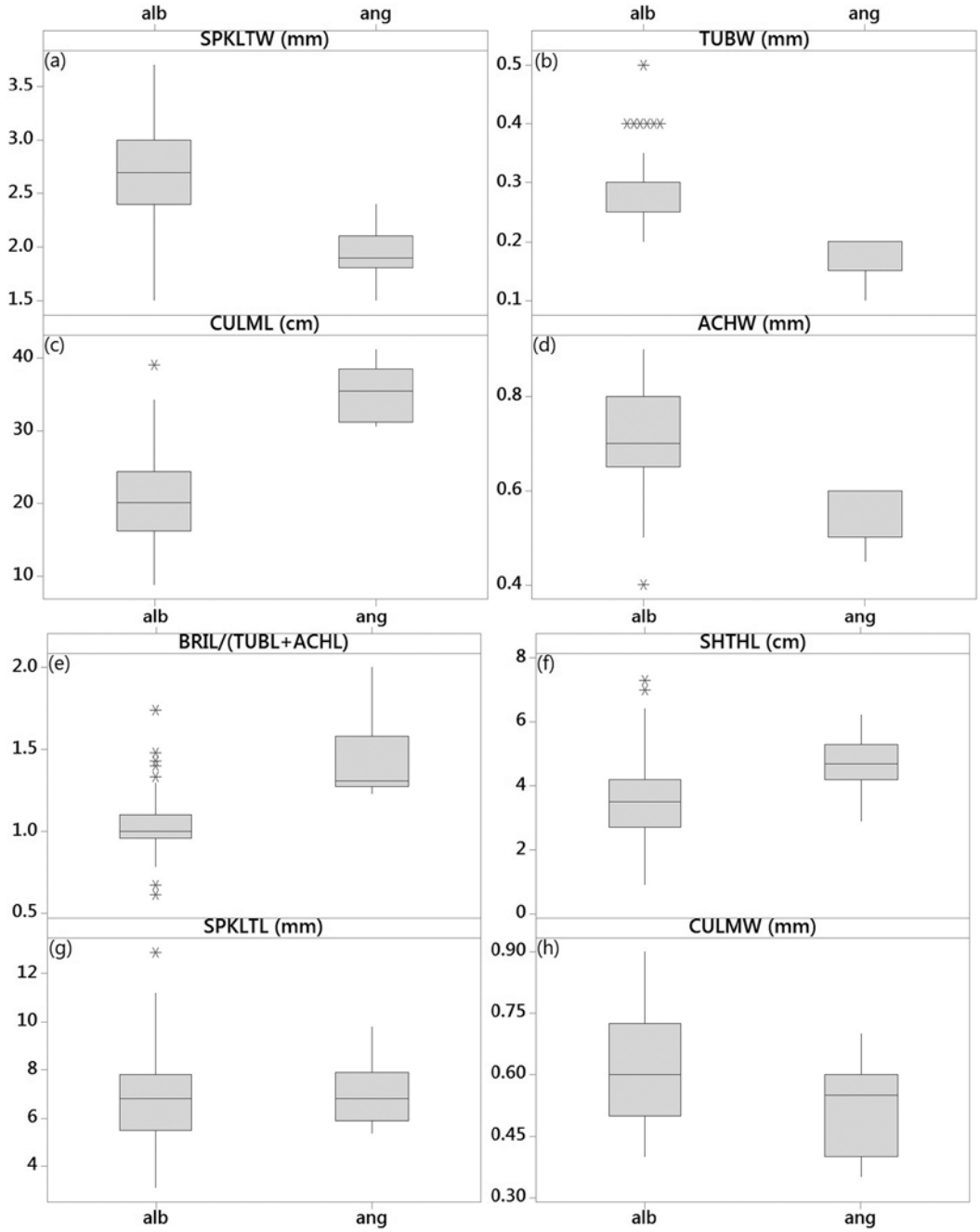

Figure 7. Box plots of variables accounting for most variance in principal component one (a–e), spikelet width [SPKLTW], tubercle width [TUBW], culm length [CULML], achene width [ACHW], and ratio of bristle length to achene-tubercle complex length [BRIL/(ACHL+TUBL)], and principal component two (f–h), sheath length [SHTHL], spikelet length [SPKLTL], and culm width [CULMW], for *Eleocharis albida* (alb) and *E. angusticeps* (ang).

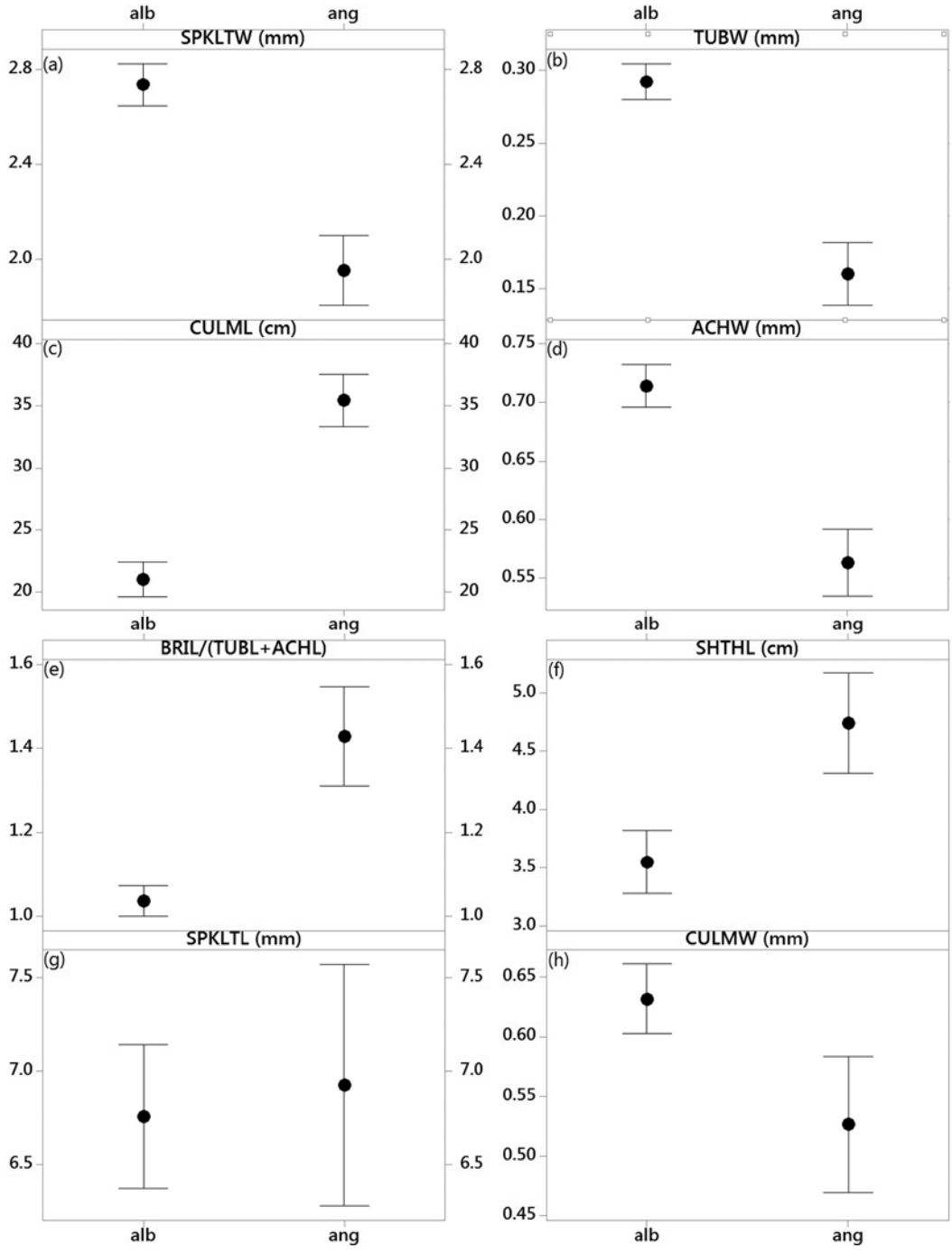

Figure 8. Interval plots of variables accounting for most variance in principal component one (a–e), spikelet width [SPKLTW], tubercle width [TUBW], culm length [CULML], achene width [ACHW], and ratio of bristle length to achene-tubercle complex length [BRIL/(ACHL+TUBL)], and principal component two (f–h), sheath length [SHTHL], spikelet length [SPKLTL], and culm width [CULMW], for *Eleocharis albida* (alb) and *E. angusticeps* (ang).

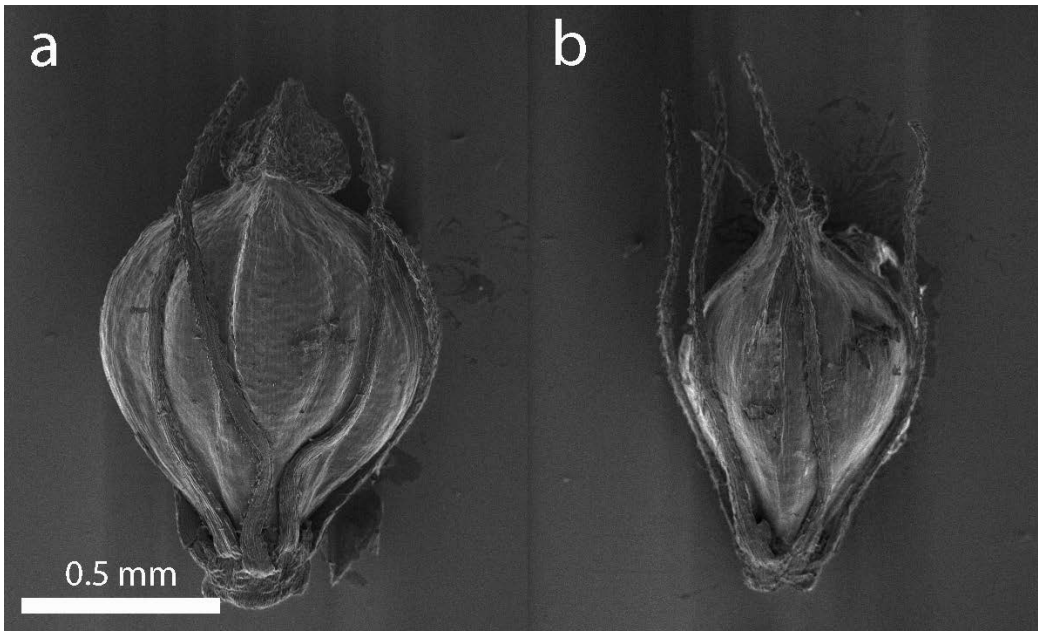

Figure 9. SEM micrographs of the achene-tubercle complex with attached bristles of (a) *Eleocharis albida* [*Reid 5216*, VSC] and (b) *E. angusticeps* [*Carter 13182*, VSC]

Figure 10. Comparison of spikelets of (a) *Eleocharis albida* [*Carter 8107*, VSC] and (b) *E. angusticeps* [*Carter 13617*, holotype].

Figure 11. Representative specimen of *Eleocharis albida* [*Carter 8107*, VSC].

Figure 12. Representative specimen of *Eleocharis angusticeps* [*Carter 13617*, holotype, GA].

Dichotomous Key to *Eleocharis albida* and *E. angusticeps*

1a. Spikelets (2.3) 2.4–3.2 (3.7) mm wide; plants 15–24 (28) cm tall, culm ±erect; achenes 0.65–0.8 mm wide; tubercles 0.25–0.3 (0.35) mm wide; bristles (0.8) 1–1.1 (1.2) times as long as achene-tubercle complex . . . . . *E. albida*

1b. Spikelets 1.5–2.3 (2.4) mm wide; plants 30–40 cm tall, culm lax and often reclining; achenes 0.5–0.7 (0.8) mm wide; tubercles 0.15–0.21 (0.3) mm wide; bristles 1.2–1.7 (2) times as long as achene-tubercle complex . . . . . *E. angusticeps*

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APPENDIX

Additional Specimens Examined

Table of specimen images from the SERNEC Data Portal (2021) used for distribution maps is available as Supplementary Information: **https://castaneajournal.com/supplemental_data/09CAST87(2)_Carter_Supplement_2022.csv**.

Bold = Source vouchers used in statistical analysis.

Eleocharis albida Torrey, Ann. Lyceum Nat. Hist. New York 3: 304. 1836.–TYPE: [Florida] Talbot Island, *Baldwin s.n.* (LECTOTYPE: NY 00051002, photograph seen).

Florida. Gulf County: 3 mi W Port St. Joe, 6 Jul 1958, *R. Kral 7183* (**GA**). **Levy County:** Waccasassa Bay State Preserve, T 15S R 15E S14, off end of Fiber Factory Rd, N of Cow Creek, W of Tenmile Creek, 7 Sep 1996, *J. R. Abbott 9418* (**GA**). **County Unspecified:** near Jacksonville, 30 May 1896, *A.H. Curtiss 5675* (GA); shore of St. Johns River, near Jacksonville, *A.H. Curtiss 3072* (**GA**). **Georgia. Camden County:** Kings Bay Submarine Base, 0.84 (air) mi ENE St. Marys Gate, inlet of North River marsh, ca 100 m E of dirt causeway through marsh, 30 Aug 1996, *R. Carter 13642* (**VSC**-7); Kings Bay Submarine Base, 1.09 mi S jct USS Kamehameha Ave and USS Henry L. Stimson Dr, W side of USS Kamehameha Ave, 8 Jul 1996, *R. Carter 13111* (**VSC**-6); *R. Carter 13112* (**VSC**-4); Kings Bay Submarine Base, ca 1.0 (air) mi WSW of Warrior Wharf along perimeter road, 29 Aug 1996, *R. Carter 13614* (**VSC**-4); S of Dungeness Ruins, 25 Aug 1990, *Gregory A. Krakow 952* (GA). **Glynn County:** 1 mi SE of Brunswick, 28 Nov 1935, *R. McVaugh 239* (GA); ditch cut from US Hwy 17 to salt-marshes, 5 mi SW of Brunswick, 7 Sep 1946, *R.F. Thorne 2236* (**GA**); Jekyll Island: Along S Beachview Dr, N of Summer Waves Water Park, aprox. 1.5 km S of intersection of GA Hwy 520 & S Riverview Dr., 20 Oct 2001, *K. Francl 405* (**GA**); salt flat 2 mi N of Brunswick, 4 Sep 1946, *R.R. Thorne 2144* (**GA**). **McIntosh County:** 2 mi from S end of beach on Sapelo Island, 26 Jun 1956, *W. Duncan 20206* (**GA**, **VSC**); around artesian well on Sapelo Island, 16 Jul 1956, *W.H. Duncan 20294* (**GA**); forming loose colony about 3 feet wide and 10 feet long at upper edge of salt marsh (covered by spring tides only) and under overhanging live oak trees back of beach dunes 2 miles from S end of beach on Sapelo Island, Sapelo Island, 26 Jun 1956, *W.H. Duncan 20206* (**LSU**). **Louisiana. Acadia Par.:** Crowley, Rice Experimental Station, rice field, Louisiana State University Agricultural Center, Rice Research Station, 20 Jun 1941, *C.A. Brown 9023* (**LSU**). **Cameron Par.:** beside Rutherford Beach Road near its terminus at the Gulf of Mexico, Rutherford Beach (29.7597222, –93.1241667), 21 May 2008, *C. Reid 6561* (**LSU**); collected 1.5 mi S of Cameron along the coast, Cameron, 24 Jun 1971, *J. Brooks 908* (**LSU**); found 5 mi S from Hwy 14 into Laccasine NW Refuge at Laccasine Rice and Cattle Corp. Illinois Plt. Exit, Lacassine Wildlife Refuge, Lacassine National Wildlife Refuge, 16 Oct 1976, *R. Aycock 245* (**LSU**); found at Little Chenier E of Creole, Little Chenier, 28 May 1942, *C.A. Brown 9247* (**LSU**); *C.A. Brown 9256* (**LSU**); found at Rockefeller Refuge, along boundary canal N of impd. #1, Rockefeller State Wildlife Refuge and Game Preserve, Rockefeller Wildlife Refuge, 21 Feb 1956, *J.L. Chamberlain s.n.* (**LSU**); found at Rockefeller Refuge, Rockefeller State Wildlife Refuge and Game Preserve, Rockefeller Wildlife Refuge, 16 Aug 1955, *J.L. Chamberlain* (**LSU**). **East Baton Rouge Par.:** on LSU campus near hospital, Louisiana State University campus (30.4146247, –91.1762223), 5 Jun 1934, *Chilton 28* (**LSU**); Steele Place, Baton Rouge, Baton Rouge, *Chilton 55* (**LSU**). **Iberia Par.:** found on Avery Island, Avery Island, 11 Jul 1938, *D.S. Correll 9548* (**GA**, **LSU**); Marsh Island, Marsh Island Refuge, shoreline just E of Mound Point and mouth of Oyster Bayou, Marsh Island (29.478, –91.818), 12 Jul 2004, *C. Reid 5108* (**LSU**); Marsh Island, Marsh Island Refuge, shoreline just E of Mound Point and mouth of Oyster Bayou, Marsh Island (29.4783333, –91.8188889), *C. Reid 5109* (**LSU**); near the corner of Marsh Island, Marsh Island Refuge, along Vermilion Bay, Marsh Island (29.604, –92.002), 13 Jul 2004, *C. Reid 5146* (**LSU**). **Jefferson Par.:** Barataria Basin, just west of Round Lake, Barataria Bay (29.56803, –90.01226), 11 Jul 2007, *S. Graham s.n.* (LSU); found on Grand Isle, Grand Isle, 28 Apr 1928, *C.A. Brown 1964* (**LSU**); Grand Terre Island, east of Fort Livingston and west of the headquarter's storage shed, Grand Terre Island (29.32257, –89.95115), 4 Jun 2009, *D.M. Ferguson 1696* (**LSU**); Grand Terre Island, on levee behind beach near center of island on Gulf side, Grand Terre Island, 11 Jun 2003, *C. Reid 4520* (**LSU**); Grand Terre Island, W end of island just E of Ft. Livingston, W of LDWF Marine Lab, Grand Terre Island (29.272, –89.945), 16 Jun 2004, *C. Reid 5020* (**LSU**). **Lafayette Par.:** outskirts of Rayne, on US 90, Rayne, 25 Jul 1968, *C.A. Brown 20202* (**LSU**). **Orleans Par.:** S side of Lake Pontchartrain, jct of Hwys I-10 & US 11, 17 Oct 1994, *C. Bryson 14570* (**VSC**). **Plaquemines Par.:** Delta National Wildlife Refuge, N of Pass a Loutre ca 2.5 mi E of Head of Passes, ca 3.5 air mi SE of Pilottown, Delta National Wildlife Refuge, Delta National Wildlife Refuge (29.1527778, –89.2108333), 30 Jul 2010, *C. Reid 7555* (**LSU**); Delta National Wildlife Refuge, N of Pass a Loutre ca 2.5 mi E of Head of Passes, ca 3.5 air mi SE of Pilottown, Pilottown, Delta National Wildlife Refuge (29.1527778, –89.2108333), *C. Reid 7558* (**LSU**); edge of bayou, 23 Jun 1978, *S. Darwin 554* (**GA**); marshes at N end of Barataria Bay W of Wilkerson Canal, spoil bank at Bay Lorio and Round Lake, Bay Lorio, 26 Oct 1975, *L.T. Beck 489* (**LSU**). **Pointe Coupee Par.:** found in False River, False River, 4 Mar 1973, *M. Newber 34* (**LSU**). **St. Bernard Par.:** 2.7 mi N of Chalmette jct Hwys LA 46 and LA 47, 15 Oct 1993, *R. Carter 11515* (**VSC**);

E of Mississippi river, ca 4 km E of LA 39, 4.4 km N of Saint Bernard, 4.5 km E-NE of Violet, and 4.7 km NNW of Toca, Department of Natural Resources monitoring station (Coastwide Reference Monitoring System) CRMS3639, Saint Bernard (29.905802, –89.85303), 8/2008, *D. Oehler CRMS3639* (**LSU**); S of Lake Borgne, 1.7 km SE of Shell Beach, 1.9 km E of Yscloskey, Department of Natural Resources monitoring station (Coastwide Reference Monitoring System) CRMS3800, plot V66, Shell Beach (29.841174, –89.668687), 27 Jul 2009, *D. Oehler CRMS3800-V66* (**LSU**); W of Biloxi State Wildlife Management Area, SE of Lake Borgne, 11.0 km ENE of Shell Beach. Department of Natural Resources monitoring station (Coastwide Reference Monitoring System) CRMS3639, plot V07, unknown #2, Shell Beach (29.905804, –89.853092), 17 Jul 2009, *D. Oehler CRMS3639-V07.2* (**LSU**). **St. Charles Par.:** found across bayou at end of LA Rt. 306, along Bayou Gouche, Bayou Gauche, 24 Apr 1985, *F.M. Givens 4212* (**LSU**); Salvador WMA, northwest part of Couba Island between Lakes Cataouatche and Salvador, about 7.5 air miles northwest of Jean Lafitte, Salvador State Wildlife Management Area (29.81436, –90.21965), 18 Jun 2014, *C. Reid 8896* (**LSU**). **St. John the Baptist Par.:** found S Bank of Pass Manchac, Pass Manchac, 12 Jul 1975, *B.L. Shiflet s.n.* (**LSU**). **St. Mary Par.:** edge spoil island in Atchafalaya River, ca 11 mi downstream from junction w/Intracoastal Canal (as it heads west), ca 12 air mi SSW of Berwick, Atchafalaya River Delta (29.5313889, –91.2744444), 5 Nov 2008, *C. Reid 6889* (**LSU**-2); Locality not specified beyond parish, *Unknown s.n.* (LSU). **St. Tammany Par.:** St. Tammany Wildlife Refuge, northshore of Lake Pontchartrain between terminus of LA 434 and Goose Point, W of mouth of Bayou Lacombe, ca 4 air mi SSW of Lacombe, St. Tammany Wildlife Refuge, 24 Aug 2004, *C. Reid 5216* (**LSU**). **Tangipahoa Par.:** 4 miles W of Hammond, Hammond, 30 Jun 1934, *Chilton & Trotter 142* (**LSU**). **Terrebonne Par.:** found on beach of Timbalier Island, Timbalier Island, 10 May 1984, *F.M. Givens 3751* (**LSU**); found on Timbalier Island about 1/4 mi NW Grand Isle, Timbalier Island, 30 Jun 1937, *E.M. West 115* (**LSU**); Pointe-aux-Chenes Wildlife Management Area, about 7 miles SE of jct of hwy 55 and hwy 65, Pointe-aux-Chenes Wildlife Management Area, Pointe Aux Chenes Wildlife Management Area, 19 May 2005, *A. Lasseigne 14725* (**LSU**). **Vermilion Par.:** coastal marsh. 0.51km E of Freshwater City Rd (3147), 26.5 km SE of White Lake, 29.2 km S-SW of Intracoastal City. Department of Natural Resources monitoring station (Coastwide Reference Monitoring System) CRMS063, plot V37, unknown #1, White Lake (29.5622485, –92.322203), 6 Aug 2007, *L. Babin CRMS0633-V37.1* (**LSU**). **Winn Par.:** found 3 mi SE of Winnfield, Winnfield, 16 Jul 1943, *C.A. Brown 9587* (LSU). **Mississippi. Harrison County:** Biloxi, 24 Jul 1971, *K. Rogers 6778* (**VSC**). **Jackson County:** Ocean Springs, 3 Jul 1951, *D. Demaree 31024A* (**GA**); Ocean Springs, edge of salt marsh at entrance to Gulf Coast Research Laboratory, S end of Halstead Rd, 27 Aug 1991, *R. Carter 9082* (**VSC**); Pascagoula, vicinity of Westbank shipyard, just W of bay and 1/2 mi S of hwy US 90, 8 Aug 1989, *R. Carter 8107* (**VSC**). **North Carolina. Carteret County:** 1 m W of Sea Level, Rte. 70, 22 Aug 1954, *H.L. Blomquist 16494* (**GA**); on South River near enterance, 27 Jun 1951, *A.E. Radford 5871* (**GA**). **Dare County:** near western end of Hatteras Island, Hatteras, N.C, Hatteras, 1 Aug 1955, *C.A. Brown s.n.* (LSU); salt flat, Pea Island, 1 Oct 1966, *A.E. Radford 45318* (**GA**); South lake, Pea Island, 11 Oct 1953, *A.E. Radford 7787* (GA). **Onslow County:** about 3 mi from E end of Topsail Island, 7 Oct 1976, *W.H. Duncan 30280* (**GA**). **South Carolina. Charleston County:** low areas near dock in Charleston, 21 Aug 1966, *T. Bradley 3410* (**VSC**). **Texas. Aransas County:** 1 mi NW of Rockport, 29 Apr 1948, *E. Whitehouse 19826* (**GA**); rear of Rockport Tourist Cottages, 25 Apr 1947, *Eula Whitehouse 18311* (**GA**). **Galveston County:** on private property 2 mi N of Greens Lake and 4 mi SE of the town of Hitchcock, 3 Aug 2002, *D.J. Rosen 2249* (**VSC**); roadside ditch, S. H. 146, 2 miles S. of Kemah, Kemah, 22 May 1974, *F.R. Waller 2710* (LSU). **Matagorda County:** behind dunes at Sargent Beach, 20 Mar 1975, *W. H. Duncan 29257* (GA). **Nueces County:** Mustang Island, 13.3 mi S of Port Aransas ferry landing, brackish marsh along N side of inlet and W of Hwy TX 361, 12 Sep 1992, *R. Carter 10610* (**VSC**). **San Patricio County:** Naval Station Ingleside, 11 Sep 1992, *R. Carter 10569* (**VSC**); *R. Carter 10571* (**VSC**). **Virginia. Nansemond County:** border of salt marsh by James River, Eclipse, 20 Jun 1940, *M. L. Fernald 12946* (**GA**).