

## New and Noteworthy Cyperaceae from the Hawaiian Islands<sup>1</sup>

MARK T. STRONG & WARREN L. WAGNER<sup>2</sup> (Department of Botany, MRC 166,  
National Museum of Natural History, Smithsonian Institution, Washington, DC 20560, USA)

Since the preparation of a treatment of the indigenous and naturalized Cyperaceae of the Hawaiian Islands by Koyama in 1987 for publication in the *Manual of the flowering plants of Hawai'i* (Koyama, 1990) a number of new distribution records as well as several additional naturalized species have been collected. Some of them were apparently inadvertently overlooked by Koyama, while others represent focused collecting efforts after publication of the *Manual* in 1990. In this paper we report on them, give descriptions, and provide couplets that can be integrated with the keys published in the *Manual*. The arrangement of the species is alphabetical within each genus. The descriptions are adapted from relevant literature cited under each species and examination of specimens.

This paper reports new archipelago and island records for the sedge family (Cyperaceae) and clarifies one taxonomic problem. We report 7 species never recorded before from the Hawaiian Islands, which were found in study of unidentified material in 2 major Hawaiian collections (BISH, US), and through field collections. They are: *Carex longii*, *Eleocharis olivacea*, *E. schaffneri*, *Fimbristylis ferruginea*, *F. miliacea*, *Rhynchospora radicans* subsp. *microcephala*, and *Schoenoplectus mucronatus*. We include descriptions and keys for 4 additional species. Three of these, *Cyperus confertus*, *C. cyperoides*, and *Schoenus apogon*, were previously incidentally reported as new naturalized species in the Hawaiian Islands (Herbarium Pacificum Staff, 1996). The fourth, *Cyperus prolifer*, previously known only from cultivation in the islands, is here reported as a new naturalized species on Kauai. Additional collecting since 1987 has resulted in a new island distribution record for *Cyperus rotundus*. We also report a taxonomic change in *Cyperus* and a verification of naturalized status for *Cyperus esculentus*.

All identifications are by M. Strong except as noted. Island abbreviations found in the keys follow Wagner *et al.* (1990).

### *Carex*

#### *Carex longii* Mackenzie

#### New state record

Originally reported as *Carex ovalis* Gooden by Fosberg & Sachet (1975) based on a collection from the island of Hawai'i [Kohala Mountains, Kahua Ranch, 1000 m, 2 August 1956, *Rubtzoff* 2720 (US)]. By the time the *Manual of flowering plants of Hawai'i* went to press in early 1988, this specimen could not be located to verify the identification, and no other collections from the Hawaiian Islands were then known. Thus it was included by Koyama (1990: 1387) as a short note. Since then, this collection was found in the unmounted Polynesian backlog at US, and several other specimens were found at BISH in the undetermined Cyperaceae folder which were inadvertently not examined by Koyama. A. Reznicek identified the plant as *Carex longii*, a widespread, New World

1. Contribution No. 1997-004 to the Hawaii Biological Survey.

2. Research Associate in Botany, Department of Natural Sciences, Bishop Museum, Honolulu, Hawaii.

species that is now becoming naturalized in the Pacific (Hawaiian Islands and New Zealand). *Carex longii*, now known from a number of localities in the Hawaiian Islands, has unquestionably become part of the naturalized flora. It occurs on Hawai'i from Waimea Reservoir, South Kohala District, south to Honoanau Forest Reserve, South Kona District, and was recently collected on East Maui.

The following couplets can be used in conjunction with the key in the *Manual* provided by Koyama (1990: 1387). Insert at couplet 4.

- 4(3). Perigynium (1.5–)2.5–3.5 mm long, base cordate, edges not winged; spikes spicately disposed, the lowermost remote; leaves filiform, 0.8–1(1–1.5) mm wide; K, M, H ..... **C. echinata**
4. Perigynium 3–4.5 mm long, base cuneate, wing-margined; spikes crowded at culm tips; leaves linear 1–4 mm wide (**4a**).
- 4a(4). Inflorescence capitate, 1–2 cm long; perigynia 1.5–1.7 mm wide, spreading; inner band of leaf sheath scarious, hyaline, obscurely veined; M, H ..... **C. macloviana**
- 4a. Inflorescence moniliform-spicate, 3–5 cm long; perigynia 1.7–2.5 mm wide, closely appressed; inner band of leaf sheath green, herbaceous, prominently veined; EM, H ..... **C. longii**

*Carex longii* can be distinguished from other species of *Carex* in the Hawaiian Islands by the terminal moniliform-spicate inflorescence with ascending, closely appressed perigynia and green, herbaceous, prominently veined inner bands of the leaf sheaths. It can be characterized as follows: Densely tufted perennial, forming small to medium sized clumps; culms sharply triangular, (15–) 30–80 (–120) cm tall, scabrous on angles just below the inflorescence. Leaves linear, flat, usually shorter than the culms, 1.5–4 mm wide; sheaths pale green, closely surrounding the culm, the inner band green, herbaceous, prominently veined. Inflorescence a narrowly ovoid to oblong-ovoid, head-like cluster of (2–) 3–10 (–11) spikes, the axis usually obscured, the spikes silvery green to silvery brown, ovoid, 7–11 cm long, 5–8 mm wide, gynecandrous, sessile; bracts short; pistillate glumes pale brown or reddish brown, membranaceous, ovate, shorter and narrower than their perigynia, the apex obtuse to subacute. Perigynium membranaceous, pale brown, ascending, the beaks appressed, elliptic to rhombic, widest near the middle, 3–4.5 mm long, 1.7–2.5 mm wide, prominently several nerved, margins narrowly winged, scabrous toward the apex, the apex gradually narrowed to a beak ca. 1 mm long, the beak deeply bifid on dorsal side, shallowly 2-toothed on ventral side; stigmas 2. Achenes ovoid, lenticular, substipitate. Literature used in preparing description was Correll & Johnston (1970), Standley & Steyermark (1958), and Fernald (1950).

*Carex longii* is native to North America, from Canada (Great Lakes Region and the Maritime Provinces) to New England, south to Florida and Texas. Sporadic throughout Mexico, Central America, the West Indies, and Andean South America, and naturalized in the Hawaiian Islands since at least 1956 and in New Zealand since 1949 (Healy & Edgar, 1980).

*Additional material examined.* MAUI: East Maui, West Wailuaiki along ditch rd., 1981, *Hobdy 1094* (BISH); East Maui, Lower Kipahulu Valley, below Puu Ahuula, 1 mi NW of Kipahulu Village, 19 July 1980, *Canfield & Stemmermann 791* (MICH). HAWAII: Kona, July 1964, *Carlson s.n.* (BISH); Honoaunau Forest Reserve, S. of jeep rd., 1400 m. July 1970, *Herbst 1705* (BISH); muddy pasture SW of Waimea Reservoir, 9 September 1986, *Stemmermann 7106* (BISH, US); South Kona District, Kealakekua Ranch, Kealakekua ahupua'a, road to Papaloa, 1030 m, 11 March 1988, *Wagner et al. 5955, 5958* (BISH, US).

### *Cyperus*

In the genus *Cyperus* we report 3 new state records, new island records for another 2 species, and discuss a taxonomic change for another species. We use a broad circumscription of the genus here including *Mariscus* following the recent trend among specialists in the family (e.g., Tucker, 1994). Two of the species included here, *C. confertus* and *C. cyperioides*, were mentioned as new records earlier by the Herbarium Pacificum Staff (1996), but they did not include keys or descriptions.

#### *Cyperus confertus* Swartz (syn.: *Mariscus confertus* (Swartz) C.B. Clarke)

The single collection of this species apparently was from a naturalized population, but the extent of its distribution in the Hawaiian Islands is not known. The following couplets can be used in conjunction with the key in Koyama's treatment (1990: 1415), and should be inserted in key to *Mariscus* at couplet 4:

- 4(2). Spikes globose-ovoid or broadly ovoid to hemispherical with an abbreviated rachis; spikelets appearing fascicled (**4a.**)
4. Spikes cylindrical to oblong-cylindrical with an elongated rachis; spikelets spicately disposed (**5.**)
- 4a(4). Glumes ovate, 2.2–2.5 mm long, stramineous or yellowish, apex cuspidate, awned; mature achenes obovate, 1–1.2 mm long, blackish, punctulate; H...  
 ..... **C. confertus (M. confertus)**
- 4a. Glumes oblong-lanceolate or oblong-elliptic, 2.7–3.5 mm long, reddish brown, apex acute; mature achenes oblong-obovoid, 1.2–1.5 mm long, brown, smooth;  
 O ..... **C. congestus (M. congestus)**

*Cyperus confertus* can be characterized as follows: Plants perennial, variable in size. Culms tufted or solitary, (2–)6–50(–65) cm tall, (0.5–)1–2(–2.5) mm wide, trigonous, smooth, forming small cornlike enlargements at base with age. Leaves 2–4, all basal or rarely 1/3 of the way up the culm; blades linear, 3–35 cm long, (0.5–)1–5(–7.5) mm wide, thinly herbaceous, soft, gradually acuminate at apex; sheaths tinged with brownish purple. Inflorescence umbelliform, simple, congested in a head in poorly developed individuals; involucre bracts 2–5, elongate, leaflike, 2–3 times as long as the inflorescence; rays 2–5, patent, 1–9(–13) cm long, slender; prophylls ca. 5 mm long, straw-colored, purplish tinged, the orifice shallowly 2-toothed. Spikes globose-ovoid, densely bearing (5–)8–20(–30) spikelets on an abbreviated axis, 10–15 mm long and 10–15 wide, straw-

colored or light stramineous-brown. Spikelets divergent, jointed at base, oblong-lanceolate, 6–10 mm long, 2.0–2.2 mm wide, compressed, straw-colored, 6- to 18-flowered; rachilla very narrowly winged; glumes ovate, 2.2–2.5 mm long, 1.8–2 mm wide, thickly membranaceous or thinly herbaceous, straw-colored or light yellowish brown, 3- or 4-nerved on both sides, gradually narrowed from above the base toward a 3-dentate apex, the costa wide, green, projected beyond the apex into a slightly excurved cusp 0.3 mm long. Stigmas 3. Achenes oblong-obovate, 3-angled, 1.0–1.2 mm long, 0.7–0.8 mm wide, blackish, punctulate, tapering at base, contracted above to mucronulate apex. Literature used in preparing description was Koyama (1979).

*Cyperus confertus* is indigenous to the West Indies, Venezuela, Colombia, and Galapagos Islands.

*Material examined.* HAWAII: South Kona, Lava field inland of Kapua Bay, 7 Oct 1986, Stemmermann 7125 (BISH).

*Cyperus cyperoides* (L.) O. Kuntze (syn.: *Mariscus sumatrensis* (Retz.) J. Raynal).

This species was reported by Kükenthal (1935–1936) from the Hawaiian Islands based on a specimen collected by Hillebrand. However, efforts by Scanlan (1942) to locate this specimen were unsuccessful and thus this species was not included by Koyama (1990). We recently noted a single naturalized collection made in 1936. The current status of this species is not known. The following couplets can be used in conjunction with the key in Koyama's treatment (1990: 1416) to distinguish *Cyperus cyperoides* from other species in the Hawaiian Islands. Insert in key at couplet 11:

- 11(6). Glumes folded, the keel acute; spikelets flattened, brown; bearing 1–2 fertile glumes; HI exc. Ka ..... **C. pheloides (M. pheloides)**
- 11. Glumes involute, embracing upper glumes, the keel rounded; spikelets filiform, green, bearing 2–3 fertile glumes (**12**)
- 12(11). Spikes cylindrical, on peduncles up to 6 cm long; mature spikelets spreading, at right angles to the culm or reflexed; fertile glumes 1 or at most 2; achenes linear-oblong, 0.6 mm wide; H ..... **C. cyperoides (M. sumatrensis)**
- 12. Spikes obovate, sessile or on short peduncles up to 2 cm long; mature spikelets suberect, crowded; fertile glumes at least 2; achenes oblong-ellipsoid, 0.8–0.9 mm wide; K, O, Mo ..... **C. cyperinus (M. cyperinus)**

*Cyperus cyperoides* can be characterized as follows: Perennial with very short woody rhizome clothed with brown fibers. Culms solitary or few together, erect, triquetrous, 10–75 cm tall, 1–3 mm wide, smooth, the thickened base clothed with the remains of old leaf sheaths. Leaves shorter than to equaling the culm; blades linear, 3–6 mm wide, flattish plicate, herbaceous; sheaths pale, the lower eventually becoming brownish or reddish brown. Corymbs simple, rarely compound, open, 3–8 cm wide; rays 3–7, obliquely patent, the longer ones up to 6(–10) cm long, terminated by a spike; spikes cylindrical, 1.0–2.5 cm long, 6–10 mm wide, densely bearing many spikelets, greenish; involucre bracts 3–8, the lower ones surpassing the corymb. Spikelets spreading or the

lower ones usually reflexed, linear-lanceolate, 3–5 mm long, 0.5–1 mm wide, bearing 4 or 5 glumes, 1- or 2-fruited; rachilla straight, jointed above the base, with white-hyaline, lanceolate wings; glumes oblong-lanceolate, obtuse or mucronulate at apex, 3–3.5 mm long, ca. 1 mm wide, margin inrolled, herbaceous, pale green, faintly several nerved, the keel 3-nerved, forming an obtuse back. Stigmas 3. Stamens 3. Achenes 3-angled, linear-oblong, 1.7–2.3 mm long, 0.5–0.6 mm wide, rufous to castaneous, minutely punctulate. Literature used in preparing description was Koyama (1979) and Kern (1974).

*Cyperus cyperoides* is widespread from Africa to Asia, Malesia, and Australia, primarily in tropical and subtropical regions. In the New World, it has become naturalized in the West Indies.

*Material examined.* HAWAII: Kawaihae, Kohala, 1500 ft, 31 August 1936, *Hosaka 1558* (BISH).

### *Cyperus esculentus* L.

### Rediscovery

This species was previously known from only a single collection from Onomea, Hawaii in 1956 (Koyama, 1990: 1396), and was thought to perhaps no longer persist in the Hawaiian Islands. Based on one recent collection, it is now known to be at least sparingly naturalized in the Hilo area.

*Material examined.* HAWAII: Hilo, April 1984, *Stemmermann 6889* (BISH).

### *Cyperus involucratus* Rottb.

### Nomenclatural and taxonomic change

Bajjnath (1975) has shown that there is an earlier name, *C. involucratus*, for the widely naturalized plant known as *Cyperus alternifolius* L., *C. flabelliformis* Rottb., or *C. alternifolius* subsp. *flabelliformis* Kük. He showed that there are a number of characters that separate *C. alternifolius*, which is relatively rare in Madagascar and Reunion, from *C. involucratus* Rottb. (syn. *C. flabelliformis* Rottb., nom. superfl.), which is indigenous to Africa, and widely cultivated and naturalized around the world. Kükenthal (1935–1936) intended to make a new combination based on *C. flabelliformis* Rottb., but because it is an illegitimate name based on the same type as that of *C. involucratus* he actually proposed a new name (*C. alternifolius* subsp. *flabelliformis* Kük.) with the same type as that of *C. involucratus*, which is an acceptable and legitimate name for *C. involucratus* at the subspecies level. Bajjnath's study, however, suggests that because there are a number of non-overlapping morphological differences, and distinct geographical ranges for these two taxa, that they should be treated as separate species, *C. alternifolius* and *C. involucratus*.

### *Cyperus prolifer* Lam.

### New naturalized record

This species has been cultivated in the Hawaiian Islands, and is here reported as at least sparingly naturalized on Kaua'i. The synonyms *Cyperus aequalis* Vahl, *C. isocladus* Kunth, and *Cyperus prolifer* var. *isocladus* (Kunth) Kük. have often been used for this species in the literature. The following couplets will distinguish *Cyperus prolifer* from

other *Cyperus* species in the Hawaiian Islands. Insert in key to *Cyperus* at couplet 7 (Koyama, 1990: 1394):

- 7(6). Leaves at culm bases reduced to bladeless sheaths (7a).  
 7. Leaves at culm bases with blades (8).  
 7a.(7). Involucral bracts exceeding the length of the rays, 10–35 cm long, 3–20 mm wide; K, Mi ..... **C. involucratus**  
 7a. Involucral bracts shorter than the rays, 0.5–3 cm long, 1–3 mm wide; K ...  
 ..... **C. prolifer**

*Cyperus prolifer* can be distinguished from other species of *Cyperus* on the Hawaiian Islands by the spreading umbelliform inflorescence with approximate rays. *Cyperus prolifer* can be characterized as follows: Perennial with stout creeping rhizome, roots blackish brown or purplish. Culms crowded, erect, terete or triangular, glabrous, 25–110 cm long, 2–7 mm wide. Leaves reduced to bladeless sheaths; sheaths ferruginous to dark purple, glabrous, the apex mucronate. Inflorescence open, umbellate, 10–20 cm in diameter with elongate rays, often forming secondary culms 8–25 cm long topped by a new smaller inflorescence, the main rays 50–100 per culm, 4–10 cm long, all of subequal length, each bearing a 5–8 mm long reddish brown prophyll at the base, the spikelets borne in digitate, sessile clusters at ray tips or in clusters on slender raylets with 1 to several sessile spikelets at base. Spikelets linear, 3–12 mm long, 1–1.4 mm wide, 7–25 flowered, reddish brown; glumes oblong-ovate, 1.2–1.5 mm long, obtuse or mucronulate at apex. Stamens 3; anthers spinescent. Achenes obovate, trigonous, 0.4–0.5 mm long, 0.3–0.4 mm wide, maturing pale brown, smooth to minutely papillose. Literature used in preparing description was Haines & Lye (1983).

*Cyperus prolifer* is native to southeastern Africa, ranging north along the east coast to Kenya. It primarily occurs in coastal habitats on the mainland and on offshore islands. It has been reported to have escaped cultivation in central Florida where it is now apparently recently naturalized and invasive (Carter *et al.*, 1996).

*Material examined.* KAUA'I, Wahiawa Mountains, Wahiawa Bog (Kanaele Swamp), ca. 2100 ft, 7 September 1983, *Flynn 590* (BISH, US).

### *Cyperus rotundus* L.

### New island record

This species was reported by Koyama (1990: 1399) from Kure and Midway Atolls and all of the main Hawaiian Islands except Kaho'olawe and Moloka'i. Here we report a naturalized record from French Frigate Shoals.

*Material examined.* FRENCH FRIGATE SHOALS: Tern Island, June 1988, *Herbst & Takeuchi 9053* (BISH), *Herbst & Takeuchi 9076* (BISH).

### *Eleocharis*

Two species, *Eleocharis olivacea* and *E. schafferii* have not been previously reported from the Hawaiian islands. The following couplets can be used in conjunction with the key provided by Koyama (1990: 1402) to distinguish them from other Hawaiian species.

Insert in key to *Eleocharis* at couplet 3:

- 3(1). Apex of the sheath not hyaline, firm, with oblique orifice (4)
- 3. Apex of the sheath hyaline, membranaceous or scarious (6)
- 4(3). Stolons present; spikelets lanceoloid to narrowly ovoid, acute; style base spongy; Ni, O, Ka ..... **E. calva**
- 4. Stolons absent; spikelets ovoid to broadly ovoid-ellipsoid, obtuse; style base not or slightly spongy (5).
- 5(4). Achenes brown at maturity; style base deltoid, nearly as wide as the achene; K, O, Mo, M, H ..... **E. obtusa**
- 5. Achenes black at maturity; style base depressed-conical, up to 1/3 as wide as the achene or slightly wider; K, O, Mo ..... **E. geniculata**
- 6(3). Spikelets ovate, subacute, 2–3 mm long; scales broadly ovate, obtuse to acute; achene olive-green, 0.7 mm long, the surface with longitudinal black striations; style base small, depressed-conical; K ..... **E. schaffneri**
- 6. Spikelets ellipsoid to oblong-ovoid, acute, 3–7 mm long; scales ovate; achene olive to dark brown, 0.8–1 mm long, the surface punctulate; style base elongated, with conic-subulate center; H ..... **E. olivacea**

***Eleocharis olivacea* Torrey**

**New state record**

This species could have been introduced by migrating waterfowl, but the eastern North American indigenous distribution argues perhaps more for inadvertent introduction by humans on the muddy shores of the Wailuku River.

*Eleocharis olivacea* can be characterized as follows: Plants perennial. Culms tufted or scattered on filiform stolons, often decumbent, light green, compressed-filiform, soft, somewhat spongy, 0.5–4 dm long, 0.5–1 mm wide. Upper leaf sheaths hyaline, loose. Spikelets oblong-ovoid, 4–9 mm long, 1.5–2.2 mm wide, acute; glumes with brown to reddish sides and green midrib, ovate to ovate-oblong, 1.5–2.5 mm long, ca. 1 mm wide, the outer with rounded apex. Stigmas 2. Achenes olive to dark brown, lustrous, punctulate, obovoid, biconvex, 0.8–1 mm long, the style base conical, 1/4 as wide as the achene, sometimes prolonged into a subulate beak; bristles 6–8, green or whitish, opaque or semi-translucent, exceeding the achene, retrorsely spinulose. [2n = 20.] Literature used in preparing description was Svenson (1929).

*Eleocharis olivacea* is native in the United States along the Atlantic Coastal Plain from Nova Scotia south to Florida, locally inland from Maine to southern Ontario and Minnesota south to Pennsylvania, Ohio, and Michigan.

*Material examined.* HAWAII: Wailuku River, 12 mi W of Hilo, 1200 m, 8 September 1980, Fosberg 60578 (US).

***Eleocharis schaffneri* Boeck.**

**New state record**

This species can be characterized as follows: Plants annual. Culms tufted, light green, capillary, setaceous, spreading, sulcate, 3–5 cm long, 0.6–0.8 mm wide. Apex of upper leaf sheaths hyaline. Spikelets ovate, 3–4 mm long, 2 mm wide, subacute; glumes



green, frequently with light red or bronze sides, broadly ovate, obtuse or acute, 1.5–1.7 mm long, 0.7–0.8 mm wide. Stigmas 2. Achenes olive green with longitudinal black striations, obovoid, biconvex, 0.7 mm long, the style base very small, depressed-conical, 1/4 as wide as the achene; bristles 6 or 7, white, somewhat shorter than the achene, retrorsely spinulose. Literature used in preparing description was Svenson (1929).

*Eleocharis schaffneri* is native to southern Mexico, Honduras, Nicaragua, and Costa Rica. It was perhaps inadvertently introduced into the Hawaiian Islands by humans; however, habitat in wetland sites visited annually by a variety of migrating birds does not rule out natural introduction.

*Material examined.* KAUA'I: Hanalei Dist., National Wildlife Refuge, Hanalei Valley, in taro paddies, 9 May 1989, *Teixeira s.n.* (US); Hanalei National Wildlife Refuge, 10 m, growing in water of taro paddies, 11 June 1990, *Wagner & Flynn 6347* (US), 8 Oct. 1991, *Flynn et al. 4749* (US).

### *Fimbristylis*

#### *Fimbristylis ferruginea* (L.) Vahl

#### New state record

The following couplets can be used in conjunction with the key in the *Manual* provided by Koyama (1990: 1404). Insert at couplet 3:

- 3(1). Achenes coarsely to finely reticulate; lower bracts usually longer than the inflorescence; inflorescences simple, compound, or decomposed, bearing numerous spikelets (**3a**)
- 3. Achenes minutely reticulate-punctulate; lower bracts shorter to slightly longer than the inflorescence; inflorescence simple, bearing 1–5 spikelets (**4**)
- 3a. Scales glabrous; achenes coarsely reticulate with usually (5–)7–9(–12) rows of horizontally oriented, rectangular cells; K, O, Mo, M, H ..... **F. dichotoma**
- 3a. Scales with dense, silvery, short appressed hairs distally; achenes finely reticulate with usually 25–35 rows of isodiametric cells; O ..... **F. ferruginea**

*Fimbristylis ferruginea* can be characterized as follows: Perennial with short, stout rhizomes. Culms tufted, obscurely angled, subterete towards base, compressed near apex, to 1 m tall, 1.5–3 mm wide at base, many-ribbed, glabrous. Leaves 3–6; blades flat to involute, to 4 dm long, 1–2 mm wide, light green to brown, glabrous, scabrous on margins, abaxial side distinctly nerved, adaxial side smooth, spongy-thickened, the apex acute; sheaths prominently nerved on back, pale green, ligulate at adaxial base of blade, with a horizontal band of pale, appressed hairs, 0.3–0.4 mm wide, the wide, membranous inner band ferruginous to reddish brown, minutely red speckled, with a U-shaped orifice, sometimes convex to truncate on upper leaves, ciliate at apex. Inflorescence a simple or rarely compound, dense or sometimes subcapitate cyme, 2–4 (–7) cm in diameter; involucre bracts (2–) 3–6, flattened to subinvolute, to 7 cm long, 0.8–1.4 mm wide, scabrous on margins, shorter than to exceeding the inflorescence; rays compressed, short, 0.6–1 mm wide, finely ribbed. Spikelets (1–) 3–12, broadly to narrowly ovate, 0.6–1.2 cm long, 3–5 mm wide. Scales ovate to oblong-ovate, boat-shaped, 3.5–4 mm long, ca. 3 mm wide, 1-nerved medially, lateral nerves indistinct, pale reddish brown except for the green or grayish green median band, with dense, silvery, short appressed hairs distally, ciliate along



upper margin, the pale, narrow midrib ending in a short cusp at the obtuse to rounded apex. Stamens 3; anthers linear, ca. 1 mm long, bluntly apiculate at apex. Styles 2-branched, the branches 1/4 to 1/3 the length of the style, the unbranched portion flattened, 0.4–0.5 mm wide, fimbriate along the margins from base to apex. Achenes biconvex, obovoid, 1.5–1.7 mm long (including stipitate base), 1.1–1.2 mm wide, obtuse to truncate at apex, bluntly apiculate, stramineous to pale brown, finely reticulate with 25–35 rows of isodiametric cells. Literature used in preparing description was Strong (1996).

*Fimbristylis ferruginea* has a Pantropical distribution.

*Material examined.* O’AHU: Kahuku, near Kuilima, (Puna Ho’olopo Marsh), N edge of marsh, 1 October 1984, *Whistler s.n.* (BISH); James Campbell National Wildlife Refuge, Kahuku, in vicinity of bird-viewing gazebo, ca. 10 ft., 5 April 1992, *Imada et al.* 92–27 (BISH); Kahuku, Punahoolapa Marsh, growing in wetland, 11 June 1992, *Engilis & Reid* 92–24 (BISH, US).

***Fimbristylis miliacea* (L.) Vahl**

**New state record**

This species has not been reported previously in the Hawaiian Islands and was apparently overlooked by Koyama (1990) when he prepared his treatment of Hawaiian Cyperaceae. *Fimbristylis miliacea* was perhaps inadvertently introduced by humans; however, habitat in wetland sites visited annually by a variety of migrating birds does not rule out natural introduction. It appears to be well established on Kaua’i.

The following couplets can be used in conjunction with the key in the *Manual* provided by Koyama (1990: 1404). Insert at couplet 1:

- 1. Styles not or scarcely flattened, the margins glabrous or ciliolate, not fimbriate; spikelets 2–6 mm long (**1a**)
- 1. Styles strongly flattened, the margins conspicuously fimbriate; spikelets 4–14 mm long (**3**)
- 1a(1). Upper leaves at base of culm reduced to bladeless sheaths; leaves laterally compressed; spikelets subglobose; K ..... **F. miliacea**
- 1a. Upper leaves at base of culm with blades; leaves not laterally compressed; spikelets ovoid, oblong-ovoid, ovoid-ellipsoid or cylindrical (**2**)

*Fimbristylis miliacea* can be characterized as follows: Plants annual. Culms densely tufted, 10–60 (–80) cm tall, 1–3 mm wide below, slender, rigid, flattened, or somewhat 4-angled toward base, often with a double margin along each edge, light green, glabrous, clothed at base with 2 or 3 bladeless sheaths. Leaves of sterile leaf shoots equitant, distichous; blades laterally compressed in transverse section, linear, rigid, glabrous, smooth except on spinulose scabrous upper margins, tapering evenly from wide, clasping sheaths to subacute apex; basal sheaths laterally flattened with a sharp dorsal edge. Inflorescence compound or decompound, composed of dense to loose system of cymes bearing many spikelets; involucre bracts 2 to 4, setaceous, 1/2 to 1/3 the length of the rays; rays 3 to 7, unequal, patent, 1–5 cm long, scabrous; spikelets solitary, ovoid-globular to globular, 1.5–3(–5) mm long, 1.5–3 mm wide, both ends rounded; glumes pale to reddish brown, membranaceous, ovate, broadly white hyaline on the margins, the midrib green or yellowish, rarely excurrent. Style slender, not fimbriate, 0.5–0.7 mm long, pyramidal at base;

stigmas 3. Achenes pale brown or cream-yellow, obovoid, trigonous, rounded to an apiculate apex, 0.6–0.8 mm long, 0.35–0.5 mm wide, conspicuously cancellate with 5–7 rows of fine, transversely linear-oblong cells, the longitudinal ribs frequently prominent and sparsely verruculose, the base cuneate. Literature used in preparing description was Kral (1971).

*Fimbristylis miliacea* occurs in both the New and Old World. In the New World, it occurs from the eastern and southern United States west along the Gulf into Texas, south throughout the West Indies, Central America, and South America. In the Old World it occurs from Asia eastwards through Malesia and many Pacific Islands.

*Material examined.* KAUA'I: Hanalei District, U.S. Fish and Wildlife Reservation, Hanalei Valley, in and around taro patches, 3 m, 18 July 1977, *Herbst 5952* (BISH, US); Mauka Reservoir, W of tree tunnel on Maluhia Rd., in mud flats at NE end of reservoir, 26 September 1985, *Flynn 1237* (BISH, PTBG, US); Waimea District, Hanapepe Valley, Hanapepe River at cement crossing between Ko and Awawa Roads, 5 May 1987, *Flynn & Lorence 2183* (BISH, PTBG, US); Hanalei Bridge, taro field along rd., near sea level, 31 March 1988, *Wagner & Lorence 5998* (BISH, US); National Wildlife Refuge, Hanalei Valley, in taro paddies, 9 May 1989, *Teixeira s.n.* (US).

**Rhynchospora**

*Rhynchospora radicans* (S. & C.) Pfeiff. subsp.

**New state record**

*microcephala* (Bertero ex Spreng.) W. Thomas

This taxon has not been reported previously from the Hawaiian Islands. It appears to be at least sparingly naturalized in cultivated lands in Puna District, Hawai'i. It was initially described as a species of *Dichromena* (*D. microcephala* Bertero ex Spreng.). Citing close similarities to *Rhynchospora* in characters of the stigma and style, Thomas (1984) showed that *Dichromena* Michx. is better placed under *Rhynchospora* as a section. In his monograph of *Rhynchospora* sect. *Dichromena*, he treated *Dichromena microcephala* as a subspecies of *Rhynchospora radicans* (S. & C.) Pfeiff., arguing that "both geographically and morphologically, these two taxa seem to form two ends of one cline." Not only is this record a new one for the Hawaiian Islands, it also represents the first record of this species occurring outside its indigenous range. Because of its occurrence in agricultural land rather than near areas visited by migrating waterfowl this species was probably introduced to the Hawaiian Islands inadvertently by humans. The following couplet can be used in conjunction with the key provided by Koyama (1990: 1428). Insert at couplet 1:

- 1. Inflorescence a single head of 3–6 spikelets at apex of the culm; H  
 ..... **R. radicans** subsp. **microcephala**
- 1. Inflorescence bearing 1–9 simple, compound, or decompound partial panicles (**1a**).
- 1a.(1). Inflorescence bearing 5–9 large, decompound partial panicles; leaves (5–) 7–18 mm wide; HI exc. Ni & Ka ..... **R. scleroides**
- 1a. Inflorescence bearing 1–5 small, simple to compound or decompound, corymbiform partial panicles; leaves 1.5–6 mm wide (**2**).

*Rhynchospora radicans* subsp. *microcephala* can be characterized as follows: Annual or short lived perennial, primarily glabrous; culms caespitose, arching to erect, 10–60 cm tall, 1–2 mm in diameter, triquetrous to obtusely so. Leaves (2–) 3–4 (–5), primarily cauline or from sterile shoots, a few basal; blades herbaceous, linear, 1.4–5 mm wide, to 30 cm long, flat to slightly involute, nerved, especially abaxially, often ciliate marginally at base, the basal leaves when present usually with reduced blades or bladeless sheaths, occasionally with blades to 10 cm long and 3 mm wide; inner band of leaf sheath herbaceous with concave orifice, hyaline only at apex. Inflorescence a conical to hemispherical head of 3–6 spikelets, 1–1.5 cm in diameter, the central spikelet largest; involucre bracts (3–) 4–5, leaflike, spreading to reflexed, exceeding the inflorescence, ciliate basally along margins, the basal bract longest, 4–15 cm long, 1.5–4.5 mm wide; spikelets 7–12 mm long, 2–4.3 mm wide; scales ca. 20–30, ferruginous, ovate, 4.2–5.2 mm long, 1.8–3.6 mm wide, boat-shaped, weakly carinate distally; stamens 3; perianth bristles absent; style 2-cleft to about the middle, the base very shallowly triangular to shallowly lunate, 0.1–0.4 mm high, 0.6–1.2 mm wide, brownish to stramineous or greenish. Achene stramineous to brownish orange or bony white, very widely obovate, 0.9–1.2 mm long, 0.8–1.4 mm wide, biconvex, bilaterally symmetrical, transversely rugulose on both sides. Literature used in preparing description was Thomas (1984).

*Rhynchospora radicans* subsp. *microcephala* is indigenous to the West Indies, Central America, western South America, and sporadically to the Guianas and Amapá, Brazil.

*Material examined.* HAWAII: Puna Dist., 0.4 mi. NW of Lava Tree State Monument, edge of abandoned cane field, ca. 180 m, 19 August 1992, *Wagner 6761* (US), *Kiehn & Luegmayer 920819-2/1* (BISH, PTBG, WU).

***Schoenoplectus***

***Schoenoplectus mucronatus* (L.) Pallas**

**New state record**

This species has not been reported previously from the Hawaiian Islands. Based on its occurrence in old agricultural land this species is presumably a recent inadvertent introduction by humans. The following couplets can be used in conjunction with the key provided by Koyama (1990: 1431) to distinguish this species from other Hawaiian species of the genus.

- 1. Inflorescence a head without elongate rays; culms 15–100 cm tall (3)
- 1. Inflorescence with elongate rays; culms usually 70–380 cm tall (2)
- 3(1). Culms 3-angled with plane or concave sides, stout, (2–)3–10 mm wide; H ...  
..... **S. mucronatus**
- 3. Culms subterete or rarely obtusely angled, slender, 1–4 mm wide; K, H .....  
..... **S. juncoides**

*Schoenoplectus mucronatus* can be characterized as follows: Plants perennial with short rhizomes. Culms tufted, rather stout, stiff, erect, sharply 3-angled, the sides usually concave, smooth, 0.5–1.0 m tall, (2–)3–8 mm wide. Leaves reduced to 1–2 bladeless sheaths, membranaceous, pale green to brownish, up to 7–20 cm long, often septate-nodu-

lose, the lowest somewhat scalelike. Inflorescence pseudolateral, consisting of a single capitate cluster of (2–)4–25 spikelets, up to 4 cm across; involucre bracts 3-angled, erect in anthesis, becoming divergent to reflexed with age, 1–10 cm long. Spikelets stramineous to brownish, sessile, 10–20 mm long, 4–6 mm wide, densely many flowered, base rounded, apex acute; glumes yellowish brown, ovate to ovate-orbicular, membranaceous, tightly appressed, 2.8–4 mm long, 2–3 mm wide, minutely ciliolate along the upper margin, midrib prominent, sides many-nerved, apex acute, short-mucronulate. Stigmas 3, but often 2 in some flowers. Stamens 3; anthers linear, cuspidate, 1–1.8 mm long. Achenes at maturity blackish brown to black, glossy, broadly obovate, plano-convex or subtrigonal, dorsoventrally compressed, 2–2.2 mm long, 1.8–2 mm wide, appearing smooth, but obscurely transversely wrinkled, apex mucronate; bristles 5–6, stout, unequal, slightly surpassing to distinctly longer than the achene, retrorsely scabrous. Literature used in preparing description was Kern (1974).

*Schoenoplectus mucronatus* is indigenous to tropical Africa, southern Europe to southern Asia, Japan, Malesia, Philippine Islands, and Australia; and naturalized in the United States.

*Material examined.* HAWAII: muddy area just SW of Waimea Reservoir, September 1986, *Stemmermann & Jacobsen 7105* (BISH, US).

### *Schoenus*

#### *Schoenus apogon* Roem. & Schult.

We have seen a single Hawaiian collection representing the first record of this genus from the Hawaiian Islands, and almost certainly an inadvertent introduction by humans, judging from the habitat of the single locality. The following couplet can be used in conjunction with the generic key provided by Koyama (1990: 1383) to distinguish it from other genera occurring in the Hawaiian Islands. This species was mentioned as a new record previously by the Herbarium Pacificum Staff (1996), but they did not include keys or descriptions.

- 12(11). Styles distinctly jointed at base, the style base conical or subulate, persistent on achene; stigmas 2 or almost undivided ..... **Rhynchospora**
12. Styles continuous with achene, not forming a distinctive style base; stigmas 2–3 or more (**12a**).
- 12a(12). Length of the lower internodes of the rachilla very short between the empty glumes, the upper ones elongated and zigzag between the flower-bearing glumes ..... **Schoenus**
- 12a. Length of the lower internodes of the rachilla not conspicuously different than those of the upper ones (**13**).

*Schoenus apogon* can be characterized as follows: Tufted perennial, slender. Culms filiform, 5–25 cm long, ribbed, 1–3 nodose below the inflorescence. Leaves primarily basal, few cauline, linear-setaceous, canaliculate, shorter than the culms, 2–10(–15) cm long, 0.5–0.8 mm wide; sheaths of the cauline leaves narrowly tubular, unbearded at apex,

entirely purplish or purplish at base only, 1–2 cm long. Inflorescence dense, subcapitate, consisting of 2–5 loose or dense sessile or pedunculate fascicles of spikelets, both terminal and lateral from the upper leaf sheaths, aggregated or distant; involucre bracts similar to the leaves, the lowest one longer than the inflorescence, sheathing at the base; spikelets brown to purplish black, weakly compressed, lanceolate to oblong-lanceolate, acute, 4–7 mm long, 1–1.2 mm wide, subsessile to short-pedicellate, 2–3-flowered, the internodes at base of spikelet shorter in length than the zigzagging upper ones; glumes 6–8, the middle 2 or 3 flower-bearing, the lower 3 empty, oblong-lanceolate, distichous, glabrous, 3–4.5 mm long, somewhat spinulose-scabrous on the keel near tip, purplish black except for the narrow whitish hyaline margin and brownish keel. Stigmas 3. Stamens 3. Achenes white, subglobose, obtusely trigonous, 1 mm long, 0.8 mm wide, reticulate, with three longitudinal ribs ending in the apiculate tip; bristles 6, antrorsely scabrous, ferruginous, from a little shorter than to slightly overtopping the achene, not falling with the achene. Literature used in preparing description was Kern (1974), Jessop & Weber (1986), and Moore & Edgar (1970).

*Schoenus apogon* is indigenous to Australia, New Zealand, and Japan, including the Ryukyu Islands.

*Material examined.* HAWAII: “near 3500 ft” road sign, Volcano, among moss on roadside, 4 August 1976, *Degener 35812* (BISH, US).

### Acknowledgments

We thank A. Reznicek for determinations of *Carex* specimens, and Robynn K. Shannon for many helpful comments on an earlier draft of the manuscript.

### Literature Cited

- Bajjnath, H.** 1975. A study of *Cyperus alternifolius* L., sens. lat. (Cyperaceae). *Kew Bull.* **30**: 521–26, pl. 47.
- Carter, R., R.L. Mears, K.C. Burks, & C.T. Bryson.** 1996. A report of four exotic *Cyperus* (Cyperaceae) species new to Florida, U.S.A. *Sida* **17**: 275–81.
- Correll, D.S. & M.C. Johnston.** 1970. *Manual of the vascular plants of Texas*. Texas Research Foundation, Renner, Texas.
- Fernald, M.L.** 1950. *Gray's manual of botany*. 8th edition. American Book Co., New York. 1632 p.
- Fosberg, F.R. & M.-H. Sachet.** 1975. Polynesian plant studies 1–5. *Smithson. Contrib. Bot.* **21**: 1–25.
- Haines, R.W. & K.A. Lye.** 1983. *The sedges and rushes of East Africa*. East African Natural History Society, Nairobi.
- Healy, A.J. & E. Edgar.** 1980. *Flora of New Zealand*. Vol. 3. P.D. Hasselberg, Government Printer, Wellington.
- Herbarium Pacificum Staff.** 1996. New plant records for 1995. *Bishop Mus. Occas. Pap.* **46**: 3–8.
- Jessop, J.P. & J.Z. Weber.** 1986. Cyperaceae, p. 2001–2053. In: Jessop, J.P. & H.R.

- Toelken, eds., *Flora of South Australia, part 4. Alismataceae--Orchidaceae*. South Australian Government Printing Division, Adelaide.
- Kern, J.H.** 1974. Cyperaceae. *Flora Malesiana* (1) **7**: 435–753.
- Koyama, T.** 1979. Cyperaceae, p. 220–320. *In*: Howard, R.A., *Flora of the Lesser Antilles—Monocotyledons*, vol 3. Arnold Arboretum, Jamaica Plain, MA.
- . 1990. Cyperaceae, pp. 1381–1436. *In*: Wagner, W.L., D.R. Herbst & S.H. Sohmer, *Manual of the flowering plants of Hawai'i*. University of Hawaii Press & Bishop Museum Press, Honolulu.
- Kral, R.** 1971. A treatment of *Abildgaardia*, *Bulbostylis*, and *Fimbristylis* (Cyperaceae) for North America. *Sida* **4**: 57–227.
- Kükenthal, G.** 1935–1936. Cyperaceae—Scirpoideae—Cypereae. *Pflanzenr.* IV. **20** (Heft 101): 1–671.
- Moore, L.B. & E. Edgar.** 1970. *Flora of New Zealand*. Vol. 2. A.R. Shearer, Government Printer, Wellington.
- Scanlan, G.M.** 1942. A study of the genus *Cyperus* in the Hawaiian Islands. *Catholic Univ. Am. Bio. Ser.* **41**: 1–62.
- Standley, P.C. & J.A. Steyermark.** 1958. *Flora of Guatamala*. Vol. 24, part 1. Chicago Natural History Museum, Chicago.
- Strong, M.T.** 1996. Cyperaceae. *In*: Acevedo-Rodríguez, P. & collaborators, *Flora of St. John, U.S. Virgin Islands*. *Mem. N.Y. Bot. Gard.* **78**: 478–92.
- Svenson, H.K.** 1929. Monographic studies in the genus *Eleocharis*. *Rhodora* **31**: 224–42.
- Thomas, W.W.** 1984. The systematics of *Rhynchospora* section *Dichromena*. *Mem. N.Y. Bot. Gard.* **37**: 1–116.
- Tucker, G.C.** 1994. Revision of the Mexican species of *Cyperus*. *Syst. Bot. Monogr.* **43**: 1–213.
- Wagner, W.L., D.R. Herbst & S.H. Sohmer.** 1990. *Manual of the flowering plants of Hawai'i*. 2 vols. University of Hawaii Press & Bishop Museum Press, Honolulu.