

## *Uncinia* Pers. (Cyperaceae) in the Hawaiian Islands<sup>1</sup>

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**ABSTRACT:** The Hawaiian Islands contain two species of *Uncinia* (Cyperaceae): *Uncinia uncinata*, with glabrous utricles, occurs at high elevations in Hawai'i, Maui, Moloka'i, and Kaua'i, and is the most common species in New Zealand; *U. brevicaulis*, with hirsute-strigose utricles, is rare and previously unreported from Hawai'i. It otherwise occurs in the Juan Fernandez, Falkland, and Tristan da Cunha islands, western Chile, and Argentina. *Uncinia uncinata* var. *uliginosa* is not recognized as significantly distinct. The Hawaiian species are not considered taxonomically distinct from plants in their respective home areas. The occurrence of both species in the Hawaiian Islands is considered the product of separate long-distance dispersal events involving birds.

THE GENUS *Uncinia* (Cyperaceae) contains 40–50 species and occurs primarily in the southern hemisphere (except Africa) from New Guinea to New Zealand (32 species), and in South America from Argentina and Ecuador north into Mexico. The genus is similar to *Carex*, differing in its prolonged rachilla, which terminates in a distinct uncinata hook. The rachilla, representing the central axis of the lateral, one-fruited spikelet, aids in dispersal of the fruit (a nutlet) contained within a saclike utricle, and this is subtended by a bractlike, deciduous or persistent glume (Figure 1).

As in *Carex*, the flowers are monoecious, borne in slender spikes with pistillate flowers below staminate flowers. The genus was last monographed by Kükenthal (1909); New Zealand species have been treated by Hamlin (1959) and Edgar (1970).

### RESULTS AND DISCUSSION

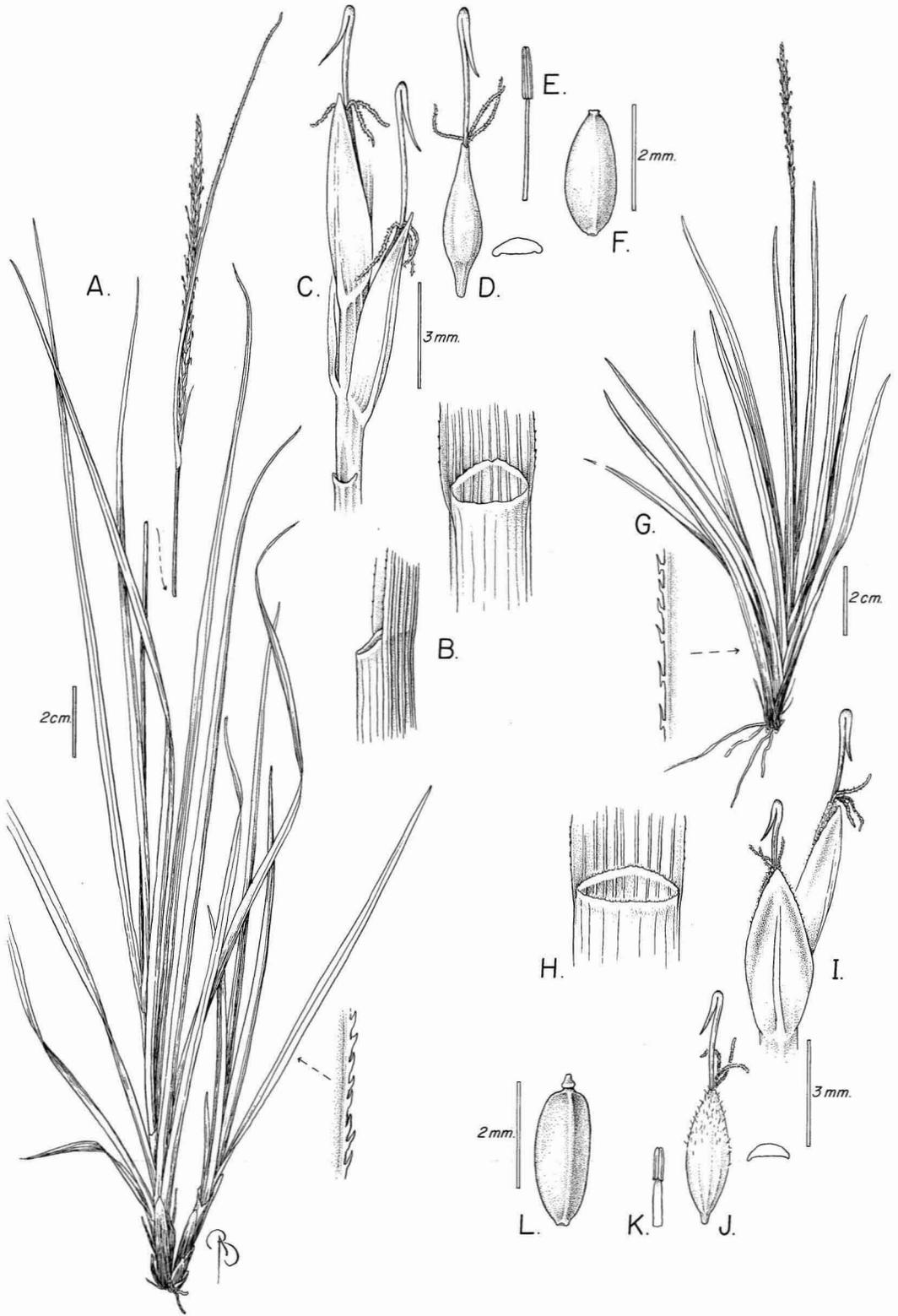
Two species occur in the Hawaiian Islands. *Uncinia uncinata* occurs in upper mesic to wet forests on Hawai'i, Maui, Moloka'i and Kaua'i, and is one of the most common species in New Zealand, being known from North, South, Stewart, and Chatham islands. The second, previously unreported species, *U. brevicaulis*, is known from a few populations at high elevations on east Maui, and also

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FIGURE 1. *Uncinia uncinata* and *U. brevicaulis*. A–F, *U. uncinata*: A, habit showing inflorescence subtended by elongated basal bracts-glumes, note inset showing distinctive corneous leaf-margin structure on lower right; B, ligule structure, side and adaxial view; C, inflorescence showing two pistillate florets with subtending glumes, styles, and distinctive uncinata rachillas; glumes are deciduous, leaving distinct V- or U-shaped scar along rachis as seen at base; D, pistillate floret showing narrowly lanceoloid, glabrous, beaked utricle, styles, and uncinata rachilla; E, stamen, note narrow filament; F, nutlet showing cylindrical terminal rostellum. All from *Henrickson 4084*. G–L, *U. brevicaulis*: G, habit, note differences in leaf margin structure on lower left as compared to part A; this inflorescence had no elongated basal bracts-glumes; H, ligule, adaxial view, note minute marginal hairs; I, inflorescence showing two pistillate florets with subtending, broader, persistent glumes, styles, and uncinata rachillas; note minutely ciliate margins on glumes; J, pistillate floret showing more elliptical utricles with broader, hispid-strigose beaks, styles, and uncinata rachilla; K, stamen, note broad filament; L, nutlet showing conical rostellum. All from *Henrickson & Vogl 3894*. Magnifications as indicated; scale shown in part C holds for parts B–E, scale in part I holds for parts H–K. Delineation by Bobbi Angell.



occurs in the Juan Fernandez, Falkland, Tristan da Cunha, St. Paul's, and Amsterdam islands, and in western Chile near Valdivia to west and southern Argentina. The Hawaiian representatives can be separated by the following key:

- A. Spikes (4.5-)8-13(-16.5)[-21] cm long; pistillate glumes oblong-elliptical, narrowly elliptical to lanceolate, long acuminate to attenuate at tip, stramineous, chartaceous, or with green along midrib when immature, deciduous and leaving distinct V- or U-shaped raised scars on the rachis; utricles narrowly lanceolate in outline, with a conical-cylindrical, glabrous terminal beak; nut rostellum cylindrical; filaments slender; Hawai'i, Maui, Moloka'i, Kaua'i . . . . . 1. *Uncinia uncinata*
- AA. Spikes 2.9-5 cm long; pistillate glumes oblong-obovate to rhombic, obtuse at tip, somewhat leafy-membranous, green on back with brown and white bands along the minutely ciliate margins, persistent; utricles oblanceolate in outline, with a flattened, broad, strongly hispid-strigose beak bearing hairs 0.1-0.3 mm long; nut rostellum conical; filaments flattened; east Maui . . . . . 2. *Uncinia brevicaulis*

1. *Uncinia uncinata* (L. fil.) Kükenth. Pflanzenz. 38:62, 1909; based on *Carex uncinata* L. fil. *Suppl. Pl.* 413. 1781. *Uncinia australis* Pers. *Syn. Pl.* 2:534. 1807. See Kükenth (1909) and Hamlin (1959) for additional synonymy.

*Uncinia uncinata* var. *uliginosa* Skotts. Act. Hort. Gothob. 15:328, 1944. Type: Hawaiian Islands. West Maui: Pu'ukukui, in the summit bog, approx. 1750 m, 25 July 1938, Cranwell, Selling, & Skottsberg 3826 (syntype); in bog below summit of Pu'ukukui toward Nākalalao, 1380 m, 27 July 1938, Cranwell, Selling, & Skottsberg 3826b (syntype BISH!). Skottsberg (ibid.; 276) stated that specimens have been sent to s and GB, and will be sent to BISH; we have seen only the BISH specimen.

Caespitose, densely tufted, briefly rhizomatous perennials (2-)3-7.5 dm tall; basal sheaths light to dark brown, adaxial portion membranous, strongly veined, completely surrounding the culms, with distal margin transverse, entire, extending upward 0.5-2 mm and continuous with upper margin of the membranous ligule; ligules white, glabrous, 0.5-1.2 mm high at margin, often shorter abaxially; leaf blades (10-)25-50(-60) cm long, (1.2-)2-5(-6) mm wide, blue-green to gray-green, flat, revolute, often conduplicate along base, strongly, sharply scabrous all along margins and on upper surface with antrorse, siliceous, tapering hairs 0.1-0.2 mm long, with yellow, distinctly raised midvein beneath; spikes slender to slightly clavate, (4.5-)8-13(-16.5)[-21] cm long, 2.5-4(-8) mm wide; flowers crowded or rather lax at base; peduncles (9-)20-60 cm long, 0.7-0.9 mm in diameter, 3-angled, smooth, terminating culms; lowermost 1-3 bracts often terminating in elongate scabrous-margined, green setae 1-21.5 cm long; pistillate flower glumes oblong-elliptical, narrowly elliptical to lanceolate, (3.5-)4.5-6(-8) mm long, (0.8-)1.0-1.2(-1.5) mm wide, glabrous, narrowly acute, long acuminate to attenuate at tip, cuneate above clasping base, at margins entire, often somewhat revolute or inrolled near base or near tip, rounded across back, chartaceous, weakly nerved, tan with a green midstripe 0.2-0.3 mm wide, this occasionally bordered with narrow red stripes when young, stiffer, more chartaceous, smooth, stramineous to tan or sometimes brownish with a shiny surface varnish, with raised midvein when mature, deciduous, leaving distinctive V- or U-shaped, raised, persistent bases that encircle one-half to three-fourths around rachis; utricle compressed, narrowly lanceoloid, 4.0-5.4 mm long including a narrow basal stipe 1.0-1.2 mm long, to 1.0-1.3 mm wide, longer or shorter than subtending bract, at maturity stramineous to brownish, glabrous, somewhat chartaceous-indurate, developing shiny surface varnish, terminal beak conical-cylindrical, glabrous, nervation obscure; rachilla 7-9 mm long, exposed beyond utricle 3.5-5.2 mm, rachilla crook 1.5-2.5 mm long; nut narrowly oblong-ovoid, 2.3-2.5 mm long, 0.9-1.1 mm

wide, grayish when mature, with short terminal cuplike, cylindrical rostrum 0.1 mm long; terminal male spike 12–25 mm long, 1.3–2.2 mm wide; bracts oblong-elliptical, somewhat obovate, 4–6 mm long, 1.5–1.8 mm wide, acute at tip, clasping at base, distal margins membranous, white, entire to erose, glabrous, weakly nerved, membranous, developing a thickened, slightly keeled distal midrib, tan to dark brown; 3 stamens; filaments slender, 3–4 mm long; anther sacs yellow, 2.1–2.7 mm long. See Figure 1A–F. (Type locality: New Zealand.)

Kükenthal (1909) recognized three varieties in this species: *Uncinia uncinata* var. *uncinata* (with slender spikes, acute glumes), occurring throughout New Zealand as well as Steward and Chatham islands and in Hawai'i; var. *clavata* Kükenth. (with broadly clavate spikes to 1 cm wide); and var. *ferruginea* (Boott) Kükenth. (with dark-brown linear-lanceolate glumes twice as long as the dark brown utricles). The last two varieties occur with the type variety and are considered distinct species by Hamlin (1959) and Edgar (1970), who have more critically defined the taxa.

One additional variety has been proposed in Hawai'i. *Uncinia uncinata* var. *uliginosa* Skottsbo. (1944) has been described from bogs at Pu'ukukui in west Maui at 1500–1700 m. These are smaller plants with inflorescences often exceeding the foliage, clavate spikes 4.5–9.5 cm long, expanding to 4–5 mm in width in the distal half, glumes long-acuminate to attenuate, 6–7.2(–8) mm long, mostly longer than the subtending utricles. In their clavate inflorescence they approach var. *clavata* from New Zealand. Somewhat similar specimens occur in Kaua'i; these have spikes 6.5–12 cm long, 5–6.5(–8) mm wide, but shorter glumes only 3.8–6 mm long. Except for their expanded inflorescences, they are otherwise similar to *U. uncinata*. There are also specimens with narrow spikes and with glumes to 7 mm long [e.g., *A. S. Hitchcock* 14512 (US) from Hualālai on Hawai'i]. These plants appear to constitute a highly variable species with certain tendencies being expressed in local populations or in individuals. We see no reason to formally recognize the Hawaiian populations.

There exist other specimens basically similar to *Uncinia uncinata* that differ conspicuously in their dark-brown, obtuse- to rounded-tipped, broadly oblong-ovate glumes 5–6.5 mm long, 1.6–2.3 mm wide, which are distinctly longer than the utricles. The utricle characteristics are similar to those of *U. uncinata*, being glabrous, narrowly lanceoloid, compressed with a long basal stipe, and cylindrical to conical beak, although they are more dark brown in color. The nuts also are similarly oblong-ovate, 2.5 mm long with short cuplike, cylindrical rostrum. Only four specimens having these characters were observed in this study. Two are from the Wilkes expedition: a sheet from GH where it is mixed with a specimen of typical *U. uncinata* and has penciled indications that it was collected on west Maui; and one, at US, is without specific location data beyond "Sandwich Island." A third specimen from the Hillebrand herbarium at GH is without data and again mixed with typical *U. uncinata*; and a fourth Hillebrand-J. M. Lydgate collection at BISH has similar oblong, obtuse-rounded glumes, but with a prominent midvein. None of these specimens has adequate locality data, two are mixed with typical *U. uncinata*; the status of this taxon is presently uncertain. In its glume characteristics it is sufficiently distinct to be recognized nomenclaturally, but it may well be a mere sporadically occurring forma.

REPRESENTATIVE SPECIMENS: Hawai'i: Ins. Owhyhee, ad montem Kaah, June 1825, *Macrae s.n.* (GH); Monna Kea, 1838–1842, *Wilkes Expedition* (GH); Waimea woods, Parker Ranch, 9 July 1909, *J. F. Rock* 4160 (BISH); Kohala, 10 June 1910, *J. F. Rock* 8401 (BISH); Kalanilehua, Kīlauea, 1911, *J. F. Rock* 12729 (BISH); Hanehane, Kona, 16 June 1911, *C. N. Forbes* 180H (BISH, 3 sheets); above Kīpuka'āhiu, 23 June 1915, *C. N. Forbes* 922H (BISH, 2 sheets); Waimea, 26 August 1916, *A. S. Hitchcock* 14379 (US); Hualālai Mt., 5000 ft, 1 September 1916, *A. S. Hitchcock* 14512 (US); Kīlauea Volcano, August 1928, *M. C. Neal s.n.* (BISH); near 29 mi, Kīlauea, 30 June 1929, *O. Degener* 8209 (NY); Hilo entrance to park, 23 May 1943, *G. O. Fayerlund & A. L. Mitchell* 563 (BISH); end of Kūlanī Prison

road, 3 mi past Kūlani Prison (Honor) Camp, 21–22 August 1966, *C. L. Newell & F. R. Fosberg 515* (BISH). Maui: west Maui, 1838–1842, *Wilkes Expedition* (GH); Maui, 1851–1855, *Voyage de M. J. Remy 140* (GH); Pu‘ukukui, 4000–5000 ft, 24–26 September 1916, *A. S. Hitchcock 14755* (US); Haleakalā, 24 April 1918, *G. C. Munro 474* (BISH); ‘Ukulele, 13 July 1919, *C. N. Forbes 733M* (BISH); east slope of Haleakalā, 20 August 1919, *C. N. Forbes 1199M* (BISH, 2 sheets); along Olinda pipeline trail, 14 June 1927, *O. Degener 8212* (NY, US); ridge north of Pōhakea Gulch, 23 July 1927, *O. Degener 8217* (NY); on way to Mt. ‘Eke from northwest side; 29 August 1927, *O. Degener 8215* (NY); swamp on ridge, Nākalalooa, 4500 ft, 6 February 1930, *H. St. John 10240* (BISH, US); Haleakalā, Palikū, 5 August 1939, *O. Degener et al. 12560* (BISH, GH, NY, US); Wai‘ānapanapa, Haleakalā, Kīpahulu-Kūhiwa divide, 6600 ft, 14 August 1945, *H. St. John & A. L. Mitchell 21010* (BISH). Moloka‘i: east of Pēpē‘ōpoe Bog, 9 May 1928, *O. Degener 8211* (NY, 3 sheets). Kaua‘i: Waimea drainage basin, west side, 3 July–18 August 1917, *C. N. Forbes 884K* (BISH); Kōke‘e, wet, shaded rocky gully, 26 June 1926, *O. Degener 2188* (GH, NY); Waieke Swamp, Kōke‘e, 28 June 1926, *O. Degener 2186* (GH, NY).

2. *Uncinia brevicaulis* Thouars Esquisse fl. Tristan d’Acugna 35, t. VI, 1811. See Kükenthal (1909) for additional synonymy.

Caespitose, densely tufted, briefly rhizomatous perennials 1.5–3.5 dm tall, forming colonies 1–3 dm in diameter; basal leaf sheaths dark brown, adaxial portion membranous, strongly veined, completely surrounding culm, with distal margin transverse, curved, extending upward 0.5–2.5 mm and continuous with upper margin of membranous ligule; ligules 0.1–0.2 mm high, white, membranous, of uniform height, weakly ciliate with hairs to 0.05 mm long; leaf blades 10–17(–29) cm long, 2–3.7 mm wide, yellow-green, flat, revolute-margined, often conduplicate in lower half, strongly scabrous along margins and upper surface with siliceous, antrorse or forked hairs 0.1–0.2 mm long,

with distinct yellow, raised midvein beneath; spikes slender, 2.9–5.0 cm long, 2.2–3.0 mm wide; borne within or well above foliage; flowers relatively crowded; peduncle 5.5–19 cm long, 0.7–1.0 mm in diameter, 3-angled; lowermost bract often terminating in elongate, scabrous-margined, triquetous, green, leafy setae 4–50 mm long; pistillate glumes oblong-ovate to rhombic-ovate, 3.7–5.0(–6.2) mm long, 1.9–2.6 mm wide, obtuse at tip, broadly clasping at base, persistent, at margins entire, ciliate with white hairs to 0.05 mm long, rounded, glabrous across back, green except for dark-brown band bordering white margins when young, at maturity straminous-tan across back with brown and ultimately white margins, midvein sometimes prominently raised or with faint-green midstripe to 0.2 mm wide; utricles concavo-convex, becoming plano-convex at maturity, oblanceolate in outline, 3.9–5.2 mm long, 1.2–1.4 mm wide, acute, somewhat flattened at tip, cuneate above a flattened stipe 0.5–0.8 mm long at base, membranous, reddish-tan (usually having short, reddish lines scattered throughout walls), densely hispid-strigose on both faces in distal one-half to one-third with antrorse, straight hairs 0.1–0.25 mm long, mostly slightly longer than subtending bracts, venation obscure; rachilla 5.5–6.5 mm long, exposed beyond utricle 1.7–3.0 mm, rachilla crook 1.1–1.4 mm long; nut narrowly oblong-ovate in outline, 2.7–2.9 mm long, 1.1–1.4 mm wide, dark brown when mature; terminal beak conical, 0.2 mm long; terminal male spikes 4–8 mm long, 1.1–1.3 mm in diameter; bracts oblong-ovate, 2.5–3.2 mm long, 1.4–1.6 mm wide, obtuse-rounded at tip, clasping at base, margins membranous, ciliate, often fragmenting, back brown, midvein sometimes prominent; 3 stamens; filaments flattened, 1.4–3.0 mm long, 0.3–0.4 mm wide; anthers 1.1–1.5 mm long. See Figure 1 *G–L*. (Type locality: Tristan da Cunha.)

*Uncinia brevicaulis* was initially found by C. N. Forbes in ‘Ukulele and Ke‘anae on Haleakalā, east Maui, in 1919. His specimens were labeled at BISH as a new variety of *U. brevicaulis*, but the name was never published. Additional collections were made by Henrickson and Vogl in 1969 in disturbed areas in the

*Deschampsia* grassland on the northeastern edge of the Haleakalā crater along the trail from near Pōhakupālahā toward lakes Wai'ānapanapa and Wai'ele'ele (Henrickson 1971), and by Herbst in 1973 in the Hāna Forest Reserve below Pōhakupālahā. These plants apparently are of limited distribution on east Maui and appear to be relatively recent introductions from the southern hemisphere.

Kükenthall recognizes four varieties and one forma of *Uncinia brevicaulis* that differ primarily in growth habit and inflorescence size: var. *brevicaulis* has culms 10–30 cm long, spikes 4–12 cm long, 3–4 mm wide; var. *rigida* (Boeck.) Kükenth. has strong culms, subclavate spikes; var. *laticarpa* Kükenth. has short culms, subclavate spikes, glumes that are green dorsally with brownish margins and slightly shorter than the utricles; and var. *macloviana* (Gaudich.) C. B. Clarke, the most mesic taxon, has culms to 40 cm long, narrow spikes with utricles longer than the subtending glumes. Variety *macloviana* has a forma *montana* (Phil.) Kükenth. with short culms and spikes to 2 cm long. Interestingly, varieties *brevicaulis* and *macloviana* as well as forma *montana* all co-occur in the Valdivia area, but var. *brevicaulis* also occurs on Tristan da Cunha, var. *macloviana* also occurs in the Falkland and Juan Fernandez islands (Skottsberg 1953) and elsewhere in Chile, and forma *montana* also occurs in southern Argentina. We suspect that these varieties may be polyphyletic, merely representing populations locally adapted to specific microhabitats that affect the size of the plants.

The Hawaiian plants occur in exposed, open *Deschampsia* grassland habitats. They are relatively short in stature, with thickened leaves, and, due to their short stature, appear referable to var. *brevicaulis* or to forma *montana* of var. *macloviana*. In floral characters they are completely referable to var. *macloviana* (adequate material was available for comparison), but the spikes in the Hawaiian plants are much shorter. With their relatively short inflorescences and thickened leaves, the Hawaiian populations could be considered a new variety, but the plants undoubtedly have been introduced from somewhere, probably from the Juan Fernandez Islands. Their re-

duced growth habit may be a reflection of the open, exposed grassland habitat in which they occur, i.e., a phenotypic adaptation rather than a genetically based difference. Skottsberg (1953) recognized no varieties of *Uncinia brevicaulis* in his checklist of the Juan Fernandez and Easter islands. We feel that it is best to use a broad species concept in these widely dispersed species and consider the Hawaiian collections to represent *U. brevicaulis* s.l.

ADDITIONAL COLLECTIONS: Maui: east of 'Ukulele, July 1919, *C. N. Forbes 861m* (BISH, 2 sheets); Ke'ānae, south of Halehaku, Haleakalā, 3 August 1919, *C. N. Forbes 1047M* (BISH, 2 sheets); northeast outer slope of Haleakalā, 1.25 mi north-northeast of Palikū Cabins along trail at east end of grassland along Pali, infrequent along trail from 7200 to 7800 ft, with *Deschampsia*, *Luzula*, 21 June 1969, *J. Henrickson & R. Vogl 3642b* (BISH, RSA, and to be distributed); Kalāpawili Ridge above northeast end of Haleakalā Crater, frequent in *Deschampsia* grassland along trail from near Pōhakupālahā toward Wai'ānapanapa, mostly in somewhat disturbed areas; leaves yellow-green, 7300–7700 ft, 18 July 1969 *J. Henrickson 3894* (BISH, RSA, to be distributed); Hāna Forest Reserve, in open wet area below Pōhakupālahā at about 7050 ft, foliage dark green, clump forming, occasional throughout area, 4 August 1973, *D. Herbst 3040* (BISH, and to be distributed).

The two species belong to different sections of subgenus *Uncinia*. *Uncinia brevicaulis* occurs in section *Platyandrae* C. B. Clarke, which is characterized by persistent glumes, broadly dilated filaments, and hispid utricles. *Uncinia uncinata* is in section *Uncinia* (= section *Stenandrae* C. B. Clarke), which has mostly deciduous glumes, slender filaments, and mostly glabrous utricles. In addition to the characteristics presented in the key, the two taxa differ in overall size, the structure of the ligules, the nature of the sharp marginal leaf trichomes, utricle shape, and a myriad of other minor characteristics.

As noted above, both *Uncinia uncinata* and *U. brevicaulis* are widely dispersed, and both show some degree of morphological diversity

in their respective southern hemisphere ranges of New Zealand and southern South America. From this it would appear reasonable to assume their disjunct occurrences on the Hawaiian Islands came about from separate long-distance dispersal events, and that the Hawaiian populations represent derivative populations. The fruits of *Uncinia* are highly vagile, dispersed by the uncinata rachillas firmly attached to the fruit, and present a tightly clasping distal hook. The hook provides for effective mechanical attachment to a vector. The most probable vectors providing transport over these considerable distances are migrating birds (Hamlin 1959). The potential candidates are pelagic seabirds or shorebirds; no present-day terrestrial birds migrate between the Hawaiian Islands and islands or mainland areas of the South Pacific. Several species of pelagic petrels, the kermadec petrel (*Pterodroma neglecta*), white-necked petrel (*P. externa*), Cook's petrel (*P. cooki*), and Stejneger's petrel (*P. longirostris*), nest in burrows on islands throughout the Pacific, including New Zealand and the Juan Fernandez Islands. They migrate northward during the southern winter, where they may have been attracted to colonies of the Hawaiian, or dark-rumped, petrel (*P. phaeopygia*), which at one time formed large colonies in the Hawaiian Islands. The lesser golden-plover (*Pluvialis dominica*), a shorebird, also makes long-distance migratory flights between the far northern and southern latitudes with stopovers in the Hawaiian Islands.

The wider distribution of *Uncinia uncinata* on four of the Hawaiian Islands would appear

to indicate a longer period since establishment on the islands, providing opportunities for secondary interisland dispersal.

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