

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

Title: Updates to the Hawaiian Grass Flora and Selected Keys to Species Part 1

Author: Kevin Faccenda (faccenda@hawaii.edu)

As part of my studies looking at the history of grass invasions in Hawai'i, a critical examination was given to much of the grass material stored at herbaria across Hawai'i. Over the summer of 2021, I spent considerable time in the Herbarium Pacificum (BISH) as well as the Rock Herbarium at University of Hawai'i at Mānoa (HAW). Selected specimens were also loaned from the National Tropical Botanical Garden (PTBG). The Hawai'i Volcanoes National Park Herbarium (HAVO) was also visited.

The grass specimens in the old University of Hawai'i Agronomy Herbarium, donated to the Bishop Museum in 2004, were entirely examined and annotated over the course of this research. That collection contains ~1000 specimens of grasses collected between 1900 and 1960, many of which are from the old experimental stations. It has a mixture of endemic species, wild collected introduced species, and cultivated species from grass field trials and introduction gardens. Numerous new records were found from the wild collected material in this collection.

Additionally, limited field work and collecting by the author in the vicinity of Honolulu revealed three potential naturalizations, two new state records, two new island records, one new naturalization and many specimens supporting species which were already vouchered in herbaria. Field work consisted of collecting material from roadsides and weedy areas and was focused around Honolulu.

All identifications were made by the author unless otherwise noted. This work identified 73 new island records, 31 corrections, 22 new state records, 7 species deleted from the checklist, 5 new naturalizations, 3 potential naturalizations, one new noxious weed species, one eradication, and several notes. A breakdown of these records by island is reported in Table 1. Three species were also found to be published erroneously as occurring in Hawai'i based on misidentified material; however, vouchers of different material were found showing that those three species actually do occur in Hawai'i. The principal focus of this work was on grasses introduced post-1778; however, one new island record was found for a Hawaiian endemic species.

The following species are detected for the first time growing wild in the United States: *Capillipedium spicigerum*, *Cyrtococcum patens*, *Digitaria eriostachya*, *Digitaria orbata*, *Digitaria stricta* var. *stricta*, *Ischaemum aristatum*, *Ischaemum polystachyum*, *Melinis scabrida*, *Paspalum humboldtianum*, and *Urochloa glumaris*. Of these species, only *Ischaemum aristatum*, *Ischaemum polystachyum*, and *Urochloa glumaris* have previously been reported outside of their native range making Hawai'i the first place worldwide to experience introductions and naturalizations of most of these species.

New keys to naturalized and native species are also provided for *Aristida*, *Bromus*, *Digitaria*, *Eragrostis*, *Ischaemum*, *Leptochloa* (sensu lato), *Melinis*, *Paspalum*, *Urochloa*, and *Zoysia*. The

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

order of the characters in the couplets are arranged from most diagnostic first, to least diagnostic last.

Table 1. Summary of new grass records and corrections reported in this paper broken down by island. ¹Including questionably naturalized species. ²Not including one variety which was removed, but the species is still present on the island. ³Including one native species.

Island	New island records reported here ¹	Number of corrections (species removed from checklist)	Total introduced species now known ¹	Average year of new records
Kure	1	0	13	1961
Midway	1	2	33	1962
Lehua	1	0	6	1992
Kaua'i	10	5 ²	113	1973
O'ahu	14 ³	7 ²	145	1983
Moloka'i	9	3	93	1936
Lāna'i	4	3	67	1975
Maui	11	8	146	1983
Kaho'olawe	4	2	33	1987
Hawai'i	18	1	146	1952
Total	73	31	258	1967

During the course of this work, it was noticed that Hawai'i Island is very undercollected in terms of grasses; 18 new island records, mostly from the old Hawai'i Agronomy Herbarium collection, were discovered for Hawai'i Island. These are likely still persistent, but have not been collected recently. The average collection date of grasses from Hawai'i Island was 1952, compared to 1983 on O'ahu and Maui. The older average collection date means there is a longer lag time between when a species is collected and when it is actually reported in the literature. Future efforts should be made by botanists to collect grass specimens on Hawai'i Island and submit them to the Bishop Museum for identification.

Identification of new grasses in Hawai'i is quite difficult due to the many possible regions that new colonizers could arrive from. The following resources should help any future worker in attempting to identify new grass state records. The keys are ordered in descending usefulness in the opinion of the author. Due to historical and political factors, most new state records can be identified in the Flora of North America 24 & 25 making it the most useful reference for new state records. Relevant monographs and regional treatments should also be searched for specific grasses as these may be more up-to-date than some floristic treatments mentioned below. If the genus of the plant is not known, the keys to grass genera in Kellogg (2015) and Genera Graminum (Clayton & Renvoize 1986) should be helpful.

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

- A Key to Pacific Grasses (Clayton & Snow 2010)
- Flora of North America 24 & 25 (Barkworth et al. 1993; Barkworth et al. 2003)
- Flora of China Volume 22 (Zhengyi et al. 2006)
- Ausgrass / Flora of Australia 44a & 44b (ABRS 2005; ABRS 2009; Simon & Alfonso 2011)
- Flora of Tropical East Africa (Clayton 1970, Clayton et al. 1974; Clayton & Renvoize 1982)
- The grasses of Burma, Ceylon, India, and Pakistan (Bor 1960)
- Grasses of Southern Africa (Russell et al. 1991)

***Andropogon tenuispathus* (Nash) Nash**

Taxonomic Note

Formerly treated as *Andropogon glomeratus* var. *pumillus*, this variety is now recognized at the species level as *Andropogon tenuispathus* (Weakley et al. 2011). This species is found on Midway, O'ahu, and Hawai'i islands (Imada 2019).

Andropogon virginicus* L. var. *virginicus

Taxonomic Note

All specimens of *Andropogon virginicus* at BISH were examined and were revealed to be the variety *Andropogon virginicus* var. *virginicus* per the key in Weakley (2020).

***Aristida adscensionis* L.**

Correction

Aristida adscensionis is no longer known from O'ahu. The specimen cited by Imada (2019) has since been identified as *Aristida divaricata*.

***Aristida divaricata* Humb. & Bonpl. ex Willd.**

New State Record

Aristida divaricata is now known from O'ahu and Hawai'i. On O'ahu it was collected twice at the Poamoho experimental farm on O'ahu as a volunteer in a grass introduction garden, and at an unspecified location in the 1930s. A collection was also made on Hawai'i island in 1949 in a sheep paddock at Keamoku. No recent collections have been made and it is unknown if this species has persisted, it is perhaps best to consider this species of uncertain naturalization status unless further evidence suggests it has been established. This species represents the specimen (Hosaka 2418 BISH) referred to by Herbst & Clayton (1998) as the unidentified species of *Aristida*.

Aristida divaricata is native to the southwestern United States and ranges south through Mexico into Honduras. It tends to grow in dry areas. This is the first time this species has been detected outside of its native range.

The following description is from the Flora of North America (Barkworth et al. 2003:323).

“**Plants** perennial; cespitose. **Culms** 25-70 cm, erect or prostrate, unbranched or sparingly branched. **Leaves** tending to be basal; sheaths longer than the internodes, glabrous except at the summit; collars densely pilose; ligules 0.5-1 mm; blades 5-20 cm long, 1-2 mm wide, flat to loosely involute, glabrous. **Inflorescences** paniculate, 10-30 cm long, 6-25 cm wide, peduncles flattened and easily broken; rachis nodes glabrous or with hairs, hairs to 0.5 mm; primary

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

branches 5-13 cm, stiffly divaricate to reflexed, with axillary pulvini, usually naked on the basal 1/2; secondary branches usually well-developed. **Spikelets** overlapping, usually appressed, sometimes divergent and the pedicels with axillary pulvini. **Glumes** 8-12 mm, 1-veined, acuminate or shortly awned, awns to 4 mm; calluses about 0.5 mm; lemmas 8-13 mm long, the terminal 2-3 mm with 4 or more twists when mature, narrowing to 0.1-0.2 mm wide just below the awns, junction with the awns not evident; awns (7)10-20 mm, not disarticulating at maturity; central awns almost straight to curved at the base, ascending to somewhat divergent distally; lateral awns slightly thinner and from much to slightly shorter than the central awns, ascending to divergent; anthers 3, 0.8-1 mm. **Caryopses** 8-10 mm, light brown. **2n** = 22.”

Aristida divaricata can be distinguished from *Aristida adscensionis* via the following key:

1. Awns with obvious twist at the base; glumes equal or subequal ... *A. divaricata*
1. Awns without any twist at base; glumes unequal ... *A. adscensionis*

Material examined. **O'ahu:** Waialua, Poamoho, Volunteer in grass plot, growing nicely, 650ft [198m]. 29 Oct 1938, E.Y. Hosaka 2418 (BISH 447068). Poamoho, 03 Mar 1939, R. Lyman s.n. (BISH 782361). **Hawai'i:** South Kohala, Keamoku, rare in one dry spot in shearing paddock, 19 Jul 1949, Y. Kimora s.n. (BISH 785684).

***Arrhenatherum elatius* (L.) P. Beauv. ex J. Presl & C. Presl** **New Naturalization**

This grass has been recorded once on Hawai'i island (O'Connor 1990) and was treated as questionable in Imada (2019), however it was both vouchered in 2004 from Mauna Kea, and was also surveyed by Ainsworth & Drake (2020), suggesting that the species is, in fact, widely naturalized. This species was introduced as a pasture grass in the early 1900s (Ripperson et al. 1933).

Material examined. **Hawai'i:** Pu'u Mali, Mauna Kea, subalpine scrub/abandoned pasture, a`a substrate, 2000m, 19° 55' 4" N, 155° 25' 41" W, 23 Jul 2004, Starr, F. 040723-3 (BISH 723312). Kanaloaleonui, Mauna Kea Forest Reserve, roadside in subalpine shrubland, tall annual grass [note: this is not an annual KF], 11 June 1990, Thane Pratt s.n. (HAVO 3473a).

***Avena sativa* L.** **New Island Record**

Avena sativa is now known from Moloka'i where it was possibly planted for soil conservation purposes at Kamiloloa Heights. It has been previously collected on O'ahu, Maui, and Hawai'i (Imada 2019).

Material examined. **Moloka'i:** Kamiloloa Heights, burnt shrublands, brass 1m tall, stem glabrous, this may be a species introduced by USDA soil conservation service after fire for erosion control, 520m, 07 Mar 1992, G.D. Hughes 35 (BISH 767361).

***Bothriochloa ischaemum* (L.) Keng** **New State Record**

Bothriochloa ischaemum, commonly known as Big Ranch Bluestem on the continental United States, appears to be an escape/contaminant from pasture plantings. *Bothriochloa ischaemum*

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

is native to Southern Europe and most of Asia. This species is quite invasive in Texas where it can be very competitive in dry areas and reduce community diversity (Gabbard & Fowler 2007).

The species is very similar to the common *Bothriochloa pertusa* but differs in not having glandular pits on its glumes whereas *B. pertusa* has obvious glandular pits. *Bothriochloa ischaemum* is also quite similar to *Dichanthium annulatum* but differs in having more acute tips of its glumes and lacking a transparent line running along the axis of the spikelet pedicles and inflorescence axis (Figure 1).

The following description is from the Flora of North America (Barkworth et al. 2003:646).

“**Plants** usually cespitose, occasionally stoloniferous or almost rhizomatous under close grazing or cutting. **Culms** 30-80(95) cm, stiffly erect; nodes glabrous or short hirsute. **Leaves** tending to be basal; ligules 0.5-1.5 mm; blades 5-25 cm long, 2-4.5 mm wide, flat to folded, glabrous or with long, scattered hairs at the base of the blade. **Panicles** 5-10 cm, fan-shaped, silvery reddish-purple; rachises 0.5-2 cm, with (1)2-8 branches; branches 3-9 cm, longer than the rachises, erect to somewhat spreading from the axillary pulvini, usually with only 1 rame; rame internodes with a central groove narrower than the margins, margins ciliate, with 1-3 mm hairs. **Sessile** spikelets 3-4.5 mm, narrowly ovate; lower glumes hirsute below, with about 1 mm hairs, lacking a dorsal pit; awns 9-17 mm, twisted, geniculate; anthers 1-2 mm. **Pedicellate** spikelets about as long as the sessile spikelets, but usually narrower, sterile or staminate. **2n** = 40, 50, 60.”

Material examined. **Hawai'i:** Kailua, Hinahou, very rare, in small local patch in semi-dry pasture, 3500 ft [1066 m], 27 Oct 1950, E.Y. Hosaka 3599 (BISH 785675). Keamoku, Pue Hinai Paddock, South Kohala, local planted patches in dry place, good growth, grazed by stock, 3000 ft [914m], 4 Jul 1956, E.Y. Hosaka 4009 (BISH 785676). Ainahou Ranch House area, Hawaii Volcanoes National Park, 3000 ft [914 m], 14 May 1991, Carla D'Antonio s.n. (HAVO 6713)

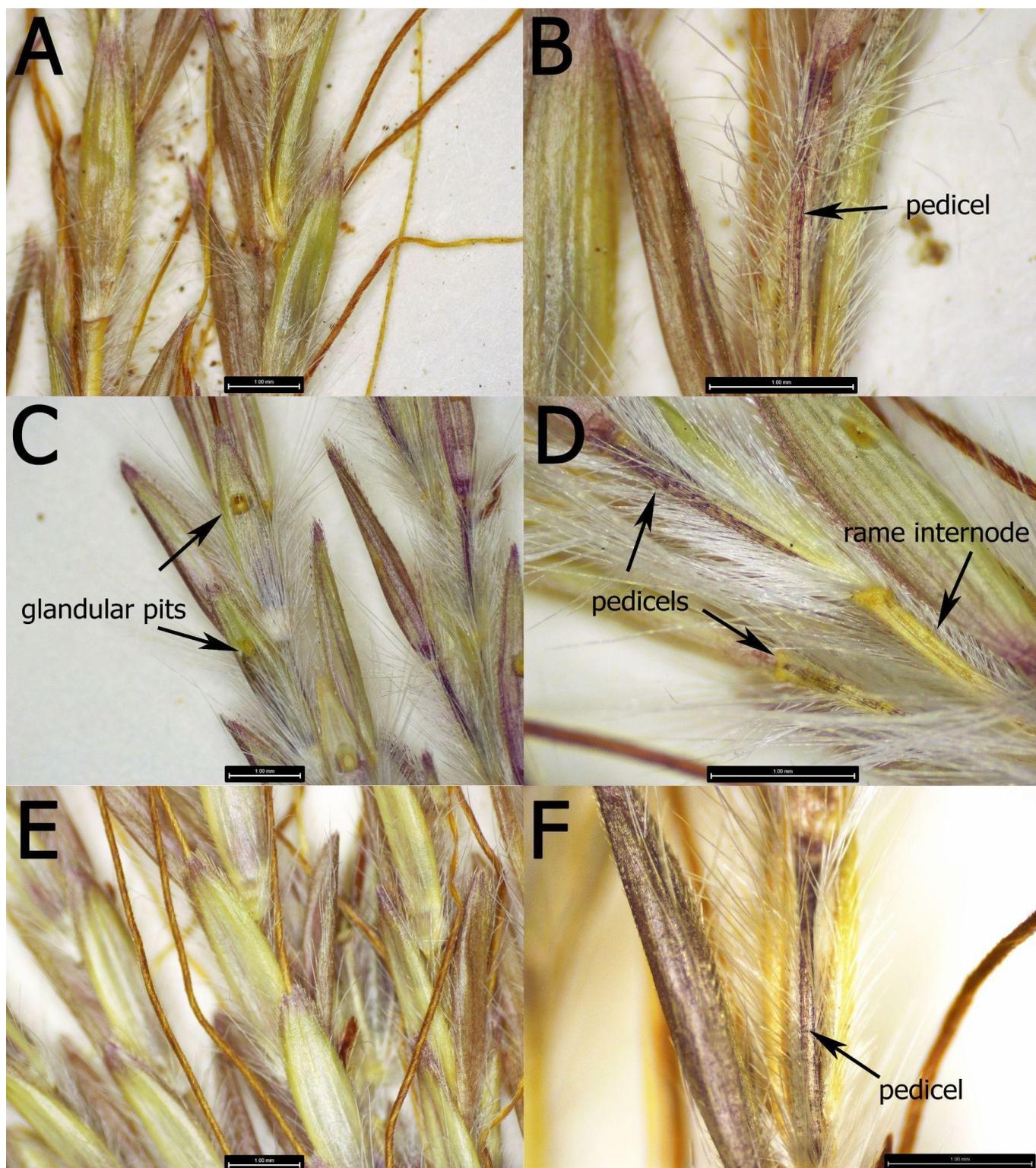


Figure 1. Comparison of similar species of bluestems. **A-B**, *Bothriochloa ischaemum* (Hosaka 4009). **C-D** *Bothriochloa pertusa* C. (W. Teraoka 291); D. (P.J. O'Connor s.n. BISH 510052). **E-F**, *Dichanthium annulatum* (Nagata 1409).

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

***Bothriochloa laguroides* (DC.) Herter**

New Island Record

This species is now known from Hawai'i Island from one collection in a "grass plot" (pasture?) collection from 1960 near Kapapala. This should be considered a questionable naturalization until it is recollected. *Bothriochloa laguroides* has previously been reported only on Maui (Imada 2019).

Material examined. **Hawai'i:** Kau, Kapapala, very rare, volunteer in grass plot, 3500ft [1066m], 13 Jun 1960, E.Y. Hosaka 4055 (BISH 785763).

***Bromus carinatus* Hook & Arn.**

New State Record

Bromus carinatus is now known from Hawai'i Island where it has been collected twice at mid to high elevations on Mauna Kea, specifically at Hamakua and Waipahoehoe Gulch. *Bromus carinatus* is native to Western North America to Central and South America, and it is also introduced in Europe. In California, it extends from sea level to 11000ft [3350m] and prefers sunny areas with well drained soils. In its native range, this species is competitive and can hold its own against invasive plants, and it also displays weedy characteristics when growing among agricultural crops (Daris 2007). The fact that this species has been established for ~80 years and has only been properly identified now may indicate it is not very weedy here.

This species is quite similar to *Bromus catharticus* and can be distinguished by the often hairy lemmas, and the lemma veins not being as prominent as on *B. catharticus*. The key presented below can distinguish it from all other species of *Bromus*.

The following description is from Flora of North America (Barkworth et al. 1993:203).

"**Plants** annual, biennial, or perennial; loosely cespitose. **Culms** 45-120(180) cm tall, usually less than 3 mm thick, erect. **Sheaths** mostly glabrous or retrorsely soft pilose, throats usually hairy; auricles sometimes present on the lower leaves; ligules 1-3.5(4) mm, glabrous or sparsely hairy, acute to obtuse, lacerate or erose; blades 8-30 cm long, 1-12 mm wide, flat or becoming involute, glabrous or sparsely pilose to pubescent on 1 or both surfaces. **Panicles** 5-40 cm, lax, open or erect; lower branches usually shorter than 10 cm, 1-4 per node, ascending to strongly divergent or reflexed, with 1-4 spikelets variously distributed. **Spikelets** 20-40 mm, shorter than at least some pedicels and branches, elliptic to lanceolate, strongly laterally compressed, not crowded or overlapping, sometimes purplish, with 4-11 florets. **Glumes** glabrous or pubescent; lower glumes 7-11 mm, 3-7(9)-veined; upper glumes 9-13 mm, shorter than the lowest lemma, 5-9(11)-veined; lemmas 10-16(17) mm, lanceolate, laterally compressed, strongly keeled distally, usually more or less uniformly pubescent or pubescent on the margins only, sometimes glabrous or scabrous, 7-9-veined, veins usually not raised or riblike, apices entire or with acute teeth shorter than 1 mm; awns 4-17 mm, sometimes slightly geniculate; anthers 1-6 mm. **2n** = 28, 42, 56."

Material examined. **Hawai'i:** South-southeast slopes of Mauna Kea, just below the silversword enclosure in the Waipahoehoe Gulch, shaded gully under mamane tree, growing in a spreading clump and reached about 80cm, (248964 E and 2192173 N, UTM zone 5Q), 9400ft [2865m],

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

[no day or month] 1998, S. Dougill s.n. (BISH 778206). Kukaiau, Hamakua, in pasture under koa trees, very good growth, 4500ft [1371m], 28 Aug 1936, E.Y. Hosaka 1536 (BISH 785772).

***Bromus diandrus* Roth**

New Island Record

Bromus diandrus is now known from Moloka'i from a single collection from 1903 from Kauluawai. It is uncertain if this species has persisted to the present day. *Bromus diandrus* has previously been reported on Kaua'i, O'ahu, Lāna'i, Maui, and Hawai'i (Imada 2019, Imada & Kennedy 2020)

Material examined. Moloka'i: Kawokekai, A single plant of this appearance at Kauluawai, 1200ft [365m], April 1903, G.C. Munro 115 (BISH 785680).

***Bromus japonicus* Thunb.**

New State Record

Bromus japonicus is now known from one collection from pasture on Hawai'i, and once from an experimental planting on Maui, both in the 1930s. Based on the fact that it was described as "rare", it may have been a contaminant in the grass plot. Similar specimens of grasses from these grass gardens often describe the specimens as cultivated and do not include any sort of abundance information which leads me to think it was a contaminant. *Bromus japonicus* should be considered questionably naturalized on both islands until more recent collections can demonstrate that it has persisted. *Bromus japonicus* is most similar to *Bromus sterilis* or *Bromus tectorum*; however, it differs in having a lower glume with more than one vein.

Bromus japonicus is a Eurasian species which has naturalized across North America and displayed invasive tendencies across the continental United States where it is especially problematic on rangelands and prairies where there is ample light and soil moisture (Howard 1994). The fact that it has not been collected in the past 70 years may indicate that this has failed to establish or it has simply been overlooked.

The following description is from the Flora of North America (Barkworth et al. 1993).

"**Plants** annual. **Culms** (22)30-70 cm, erect or ascending. **Sheaths** usually densely pilose; upper sheaths sometimes pubescent or glabrous; ligules 1-2.2 mm, pilose, obtuse, lacerate; blades 10-20 cm long, 2-4 mm wide, usually pilose on both surfaces. **Panicles** 10-22 cm long, 4-13 cm wide, open, nodding; branches usually longer than the spikelets, ascending to spreading or somewhat drooping, slender, flexuous, sometimes sinuous, often with more than 1 spikelet. **Spikelets** 20-40 mm, lanceolate, terete to moderately laterally compressed; florets 6-12, bases concealed at maturity; rachilla internodes concealed at maturity. **Glumes** smooth or scabrous; lower glumes 4.5-7 mm, (3)5-veined; upper glumes 5-8 mm, 7-veined; lemmas 7-9 mm long, 1.2-2.2 mm wide, lanceolate, coriaceous, smooth proximally, scabrous on the distal 1/2, obscurely (7)9-veined, rounded over the midvein, margins hyaline, 0.3-0.6 mm wide, obtusely angled above the middle, not inrolled at maturity, apices acute, bifid, teeth shorter than 1 mm; awns 8-13 mm, strongly divergent at maturity, sometimes erect, twisted, flattened at the base, arising 1.5 mm or more below the lemma apices; anthers 1-1.5 mm. **Caryopses** equaling or shorter than the paleas, thin, weakly inrolled or flat. **2n** = 14."

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

Material examined. **Maui:** Haleakala substation, Makawao, grass plot, occasional, 11 Apr 1939, E.Y. Hosaka 2464 (BISH 599347). Haleakala substation, Makawao, in grass garden, rare, 2000ft [609m], 10 Apr 1939, E.Y. Hosaka 2463 (BISH 447986). **Hawai'i:** Waikii, Mauna Kea, occasional in pasture, 4500ft [1371m], Sep 1937, E.Y. Hosaka s.n. (BISH 118161).

***Bromus madritensis* L.**

New Island Records

Bromus madritensis is now known from Kaua'i and Lāna'i from specimens which were previously misidentified as other *Bromus* species. *Bromus madritensis* has previously been reported from Moloka'i, Maui, and Hawai'i (Imada 2019). See further discussion under *Bromus rubens*.

Material examined. **Kaua'i:** Waimea District, Waimea Canyon, Kukui trail, near top of the trail, degraded *Grevilliea dominant* mesic forest, clumping at the beginning of the trail, flowers pubescent, inflorescence green, older dark purple. 782m, 04 Jun 2009, N. Tangalin 2027 (BISH 768106). **Lāna'i:** Wahane Gulch, locally common in open, rocky areas, vegetation: *Metrosideros*, *Diospyros*, *Dodonea*, *Pouteria*, *Nestigis*, *Leptecophylla*, *Wikstroemia*, *Psidium*, *Morella*, *Schinus*, *Lantana*, Northing 2306659; Easting 719566, 550m, 07 Feb 2013, H. Oppenheimer H21303, (BISH 763010). Awehi Road, in the *Gardenia brighamii* outplanting enclosure, locally common, 2500ft [762m], 21 Mar 2007, H. Oppenheimer H30714 (PTBG 051060).

***Bromus rubens* L.**

Correction

Bromus rubens and *Bromus madritensis* are both tetraploids in an allopolyploid species complex. Each species shares half of its DNA with *Bromus fasciculatus*, and the other half descends from *B. tectorum* and *B. sterilis* for *B. rubens* and *B. madritensis* respectively (Fortune et al. 2008). This close relationship makes identification of these two grasses quite difficult. These species are traditionally distinguished by inflorescence structure (Tutin 1980; Barkworth et al. 2003). This characteristic, however, is tricky for Hawaiian material which often has a reduced number of spikelets and does not develop the characters needed to distinguish these species based on inflorescence structure alone. However, upon a review of the literature, it was found that there are several more subtle characters which can distinguish between these two species. Ponce (1987) showed that the two species can be delimited by the *B. rubens* having a minute notch at the tip of the palea and *B. madritensis* having a rounded palea tip. Sales (1994) showed that in *B. rubens* the lemmas are imbricated and in *B. madritensis* the lemmas are distichous at maturity. Both of these characters were checked and appeared to be consistent with the material from outside of Hawai'i in the Bishop Museum world collection as well as photographs of independently verified specimens of *B. madritensis* and *B. rubens* examined online.

Bromus rubens has previously been reported on Moloka'i (Herbst & Wagner 1999) as well as Kaua'i and Maui (Imada & Kennedy 2020), but examination of the specimens showed they were all misidentifications of *B. madritensis*. *Bromus rubens* is now only known in the state from a single collection on Hawai'i Island from a "grass plot" in Waikii, Kohala.

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

Material examined. **Hawai'i:** S. Kohala, Waikii, rare in grass plot, 6000ft [1828m], 16 May 1940, E.Y. Hosaka 2521 (BISH 640511).

Bromus squarrosus* L. var. *villosus

Note

An effort was made to locate the specimen referred to by Hillebrand (1888) from Maui. GBIF was searched as well as the Berlin Herbarium index, and it was not found. It was almost certainly destroyed in the bombing of the Berlin Herbarium in 1943 with no duplicates made. Since no other collections of *B. squarrosus* have been made in Hawai'i in the nearly 150 years since then, the species was not included in the following key and is likely best considered to be extinct in Hawai'i, or a misidentification, and should be removed from the checklist.

***Bromus sterilis* L.**

Correction

Bromus sterilis was previously reported as occurring on Maui and Moloka'i (Oppenheimer 2008). These specimens were examined and found to be misidentifications of *Bromus madritensis*. *Bromus sterilis* is now only known from Hawai'i island.

Key to *Bromus* in Hawai'i

The following key is based off of the key to *Bromus* in the Flora of North America (Barkworth et al. 1993) and Clayton & Snow (2010).

1. Lemmas 20-35 mm long; awns 3-6 cm ... *B. diandrus*
1. Lemmas < 20 mm; awns < 3 cm
 2. Lower glume 3-7 veined
 3. Lemmas strongly keeled, at least near their apex; spikelets generally strongly laterally compressed; lemmas acuminate with lemma body gradually tapering into the awn and lacking lateral teeth or with very reduced teeth < 1 mm.
 4. Lemmas 9-13 veined, occasionally with hairs near the apex; veins often raised and riblike at least toward the tip of the lemma; lemma usually glabrous ... *B. catharticus*
 4. Lemmas 7-9 veined; veins usually flush with lemma surface; lemma typically pubescent, occasionally glabrous ... *B. carinatus*
 3. Lemmas rounded on the back, spikelets generally weakly compressed; lemma body two lobed at tip with an awn arising between teeth.
 5. Lemma margins inrolled, exposing the rachilla and floret bases at maturity; lemmas typically glabrous, rarely pubescent ... *B. secalinus*
 5. Lemma margins not inrolled, rachilla and floret bases obscured at maturity; lemma glabrous or pubescent
 6. Panicle open, pedicels equalling or longer than spikelets; lemma glabrous ... *B. japonicus*
 6. Panicle contracted, its pedicels shorter than the spikelets; lemma pubescent ... *B. hordeaceus*
 2. Lower glume 1 veined
 7. Panicle branches drooping; at least some panicle branches longer than spikelets
 8. Lemmas [excluding awn] 14-20 mm long; panicle branches rarely with more than 3 spikelets each ... *B. sterilis*
 8. Lemmas [excluding awn] 9-12 mm long; panicle branches often with 4-8 spikelets each ... *B. tectorum*

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

7. Panicle branches upright, not drooping; panicle branches shorter than spikelets
 9. Panicle densely contracted, panicle branches < 10 mm; lemmas typically contracted at maturity; palea apex lobed... *B. rubens*
 9. Panicle open to contracted, panicle branches 10-30 mm long; lemmas spreading at maturity; palea apex obtuse to rounded ... *B. madritensis*

***Calamagrostis arenaria* (L.) Roth**

Taxonomic Note

Formerly treated as *Ammophila arenaria* in Hawai'i, molecular evidence now shows that this species is actually a member of *Calamagrostis* (Peterson et al. 2021).

***Capillipedium spicigerum* S.T. Blake.**

New State Record

The first record of *Capillipedium* in Hawai'i has been identified after sitting unidentified for almost 70 years in the Agronomy collection. This grass was originally collected at "Pamaluu, Kane'ohe, 1200ft" O'ahu in 1954. This location is problematic as that name does not seem to exist. The closest place name I could identify is Punalu'u. The pasture which does exist there does not extend to 1200ft, however, so I suspect the elevation is erroneous. A more recent collection from 2000 at the Red Hill area confirms that the species has persisted.

Capillipedium is part of the old-world bluestem group comprising *Bothriochloa* and *Dichanthium* and is most similar to those genera in Hawai'i. *Capillipedium* can be distinguished from those genera as it has spikelets in triplets of one sessile and two pedicellate spikelets; the other species all have spikelets in pairs with one sessile and one pedicellate spikelet. *Capillipedium* also has translucent medial line in its pedicles and rachises in the same way that *Bothriochloa* does (Figure 1).

The following description is from the Flora of China (Zhengyi et al. 2006:607).

"Perennial. Culms tufted, up to 150 cm tall, unbranched, nodes bearded. Leaf sheaths usually pilose, ciliate at mouth; leaf blades 15–40 × 0.5–0.8 cm, scaberulous or pubescent, usually hispid with tubercle-based hairs toward base, base rounded, apex acuminate; ligule 0.5–1 mm. Panicle oblong-ovate in outline, 10–18 × 5–8 cm; branches untidily flexuous, pilose in axils; racemes composed of 3–7 spikelet pairs below the terminal triad, purple; rachis internodes and pedicels ciliate. Sessile spikelet 3–4 mm; lower glume oblong-lanceolate, slightly glossy, back 4–5-veined, scarcely depressed along midline, sparsely hispidulous, margins keeled, pectinate-ciliate above middle, apex narrowly obtuse; upper glume ciliate along upper margins; awn of upper lemma 1.2–1.8 cm. Pedicelled spikelet equaling the sessile and often staminate, or smaller and barren. Fl. and fr. autumn. 2n = 40."

Material examined. **O'ahu:** Pamaluu [Punalu'u?], Kaneohe, ricegrass- guava pasture, good growth, rare, 1200ft [365m], 12 Oct 1954, E.Y. Hosaka s.n. (BISH 785678). Red hill fuel storage area, a few clumps growing in middle of jeep trail along ridge, mauka of Board of Water Supply tanks, with *Desmodium incanum*, Guinea grass, and other weedy ruderal species, 21° 21' N 157° 54' W, 06 Jan 2000, W. Char s.n. (BISH 669057).

***Cenchrus x advena* (Thore) Govaerts**

New State Record

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

Cenchrus x advena (= *Cenchrus x cupreus*; *Pennisetum advena*) is now known from Maui. *Cenchrus x advena* may now be naturalizing on West Maui where it is spreading aggressively from an area by Lahainaluna highschool where it was planted for soil stabilization purposes. The grass is also known from cultivated collections on O'ahu, Maui, and Kaua'i, giving this plant a clear introduction pathway.

This is the first time that this hybrid has been recognized as occurring in Hawai'i as previously all specimens were erroneously identified as *C. orientalis* and *C. complanatum*. This grass has reddish, purple leaves and is most likely to be confused with *Cenchrus elegans* as cultivars of that species also commonly have red pigmented leaves. The two can be easily differentiated by leaf width, *C. elegans* has leaves which are 20-30 mm wide whereas *C. x advena* leaves are narrower, only 3-11 mm wide. The flowers bear resemblance to *Cenchrus complanatus* as both of these species have one bristle longer than all the other bristles, the two species can be distinguished as *C. x advena* having a panicle greater 13 cm long and having at least some ciliate bristles surrounding the florets (at least the central bristles are ciliate, other bristles are occasionally ciliate, use at least 20x magnification) compared to a panicle less than 12 cm long and all bristles being scabrous on *C. complanatus*.

This grass is sold as *Pennisetum setaceum* 'Rubrum' (Barkworth et al. 2003); however, it is not easily confused with *C. setaceum* (= *Pennisetum setaceum*) due to that species having very narrow leaves only 2-3.5 mm wide. *Cenchrus x advena* is seemingly apomictic, but can also backcross with *C. setaceus* (Simpson & Bradshaw 1969). *Cenchrus x advena* seems to be an artificial hybrid given that it does not occur outside of horticulture (Wipff & Veldkamp 1999), but has been reported as a natural species nonetheless (Wipff & Veldkamp 1999; van Valkenburg et al. 2021).

The following lucid key should be useful for identification of *Cenchrus x advena* from other cultivated *Cenchrus* <https://keys.lucidcentral.org/keys/v3/pennisetum/en/index.html>

The following description is from Flora of North America (as *Pennisetum advena*) (Barkworth et al. 2003:527).

Plants perennial, or annual in temperate climates; cespitose. **Culms** 1-1.5 m, erect, sometimes branching above, pubescent beneath the panicle; nodes glabrous. **Leaves** burgundy (rarely green); sheaths glabrous, margins ciliate; ligules 0.5-0.8 mm; blades 33-52 cm long, 6-11 mm wide, flat, antrorsely scabridulous, margins ciliate basally, midvein not noticeably thickened. **Panicles** 23-32 cm long, 30-58 mm wide, fully exerted from the sheaths, flexible, drooping, burgundy (rarely pale or whitish-green); rachises terete, pubescent. **Fascicles** 10-17 per cm, disarticulating at maturity; fascicle axes 1-2 mm, with 1-3 spikelets; outer bristles 43-68, 1.2-18.5 mm, terete, scabrous; inner bristles 4-10, 11.7-25 mm, long-ciliate; primary bristles 21.3-33.6 mm, ciliate, noticeably longer than the other bristles. **Spikelets** 5.3-6.5 mm; pedicels 0.1-0.3 mm; lower glumes 0.5-1 mm, veinless; upper glumes 1.9-3.6 mm, 0-1-veined; lower florets staminate; lower lemmas 4.7-6.1 mm, 5(6)-veined; lower paleas 4.5-5 mm; anthers 2-2.5 mm; upper florets not disarticulating at maturity; upper lemmas 5.2-6.1 mm, 5-veined; anthers 2.5-2.7 mm. **Caryopses** concealed by the lemma and palea at maturity. **2n** = 54."

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

Material examined. Maui: West Maui, Lahainaluna High School, by agriculture facility, on steep bank, associated vegetation: *Samanea saman*, *Thunbergia fragrans*, decumbent, sprawling grass 1.5m tall, purple leaves, roots at nodes, planted to stabilize steep slope, very aggressive growth, (20° 53' N, 156° 39' W), 159m, 20 Jun 2002, Starr 020620-03, (BISH 689855 [two sheets]). Makawao, growing on roadside next to retail shop, full sun in town, clumping perennial grass to 4ft tall, inflorescence purple color, may have been cultivated but store employee says it appeared on its own, (20° 51' N, 156° 18' W), 501m, 11 Aug 2000, J. Barangan s.n. (BISH 664561).

***Cenchrus complanatus* (Nees.) Morrone**

New Island record

Cenchrus complanatus may now be naturalizing on East Maui near Pi'iholo. It has previously been documented as naturalized on O'ahu, Lāna'i, and Hawai'i (Imada 2019).

Material examined. Maui: East Maui, Makawao District, Pi'iholo, growing in open field, clumping grass, bristles purple, may be naturalized or persisting from old agricultural experimental plots, (20° 50' N 156° 17' W), 2100ft [640m], 12 Jun 2003, H. Oppenheimer H603306 (BISH 709432).

***Cenchrus elegans* (Hassk.) Veldkamp**

New Island Record

Two overlooked specimens of *Cenchrus elegans* from the Bishop Museum Herbarium suggests that *Cenchrus elegans* (= *Pennisetum macrostachyum*) may be naturalized on O'ahu. *Cenchrus elegans* has been reported previously as naturalized on Hawai'i Island and is known to be cultivated on Kaua'i, O'ahu, and Hawai'i based on BISH specimens, although it is likely cultivated on other islands as well.

Material examined. O'ahu: Honolulu, Nuuanu Valley, Luakaha, edge of shaded stream, 12 Jun 1941, M.C. Neal s.n. (BISH 120143). Ko'olaupoko District, 'Ahuimanu Rd. ca. 100yds [90m] N of Okano Rd, about 5ft [1.5m] tall, on shaded road cut, 20-25ft [6-7.5m], 17 Jun 1967, D.R. Herbst 513 (BISH 452361).

***Cynodon aethiopicus* Clayton & J.R.Harlan**

New Island Record

Cynodon aethiopicus is now known from Kaho'olawe from a collection from 1978. It has previously been reported on O'ahu, Maui, and Hawai'i (Imada 2019).

Material examined. Kaho'olawe: Fenced forestry planting near Lua Makika, 23 Nov 1978, W. Char & L. Yoshida 78.044 (HAW 28101).

***Cyrtococcum patens* (L.) A.Camus**

New State Record

Cyrtococcum patens is a grass widely distributed throughout the Pacific and SE Asia, and it is now known from O'ahu from Schofield Barracks. This is the first time this species has been found outside of its native range. It is a low-growing, creeping grass which superficially resembles *Panicum* as it has small spikelets reminiscent of *Panicum* as well as a paniculate inflorescence. This grass is identifiable based on its laterally compressed spikelets and bone white lemmas. All other *Panicum*-like grasses in Hawai'i have dorsally compressed spikelets.

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

The species was identified using Clayton & Snow (2010) and confirmed using the Flora of China (Zhengyi et al. 2006). Comparison to specimens in the Bishop Museum Herbarium showed that the specimen was the closest match to material from Taiwan as the leaf pubescence was slightly different from material in other parts of the Pacific.

The following description is from the Flora of China (Zhengyi et al. 2006:513).

“Culms creeping, smooth and glabrous, 15–60 cm tall. Leaf sheaths loosely pilose with tubercle-based hairs; leaf blades lanceolate, 3–15 × 0.3–2 cm, pubescent on both surfaces or subglabrous, basal margins with a few long, stiff, tubercle-based hairs, apex acuminate; ligule 0.5–2 mm, subrounded. Panicle 5–30(–40) cm, often diffuse, branches loosely ascending to widely spreading, very slender, glabrous; pedicels filiform, longer than spikelets. Spikelets purplish at maturity, 1.3–1.8 mm, varying from glabrous to appressed-pubescent or shortly hispid with stiff, conspicuously tubercle-based hairs; glumes 3-veined, the lower ca. 1/2 spikelet length, the upper 2/3 spikelet length; lower lemma subequaling spikelet, margins ciliate, apex obtuse; upper lemma minutely pitted. Anthers ca. 0.8 mm. Fl. and fr. Sep–Feb. 2n = 18, 36.”

Material examined. **O‘ahu:** Schofield Barracks, South Range, at bottom of hill just below SR1 gate, at first road junction, on SW side of intersection, roadsides heavily impacted by mowing and heavy traffic, creeping grass ca 20cm tall, leaves ca. 4cm long, leaf sheath with fringe of hairs, inflorescence ca. 5cm long, small patch ca. 2x2 m on edge of pull off next to road, doesn't appear to be planted, (UTM 594627 2376082), 980ft [298], 12 Feb 2019, J. Beachy USARMY 509 (BISH 774979).

***Dichantherium acuminatum* (Sw.) Gould & C.A. Clark**

New State Record

The first introduced member of *Dichantherium* now joins the four endemic species on the islands. *Dichantherium acuminatum* was first collected in a pasture in Kahuku, Hawai‘i Island in 1951, and subsequently in Volcano in 1973. This grass is of the typical “*Panicum*” type and can be distinguished from the other species of native *Dichantherium* which occur here by its hairy florets as all native species have glabrous florets. It is also more likely confused with native, rather than introduced *Panicum* as all of the species of introduced *Panicum* have glabrous florets whereas several natives have hairy florets. This species has a lower glume which is $\sim\frac{1}{4}$ as long as the spikelet, compared to $\frac{1}{2}$ - $\frac{3}{4}$ as long in the native *Panicum*.

D. acuminatum is quite variable in its habitat preferences in its native habitat, ranging from forests, bog edges, prairies, beaches, roadsides, riverbanks, and others (Walsh 1995). As evidenced by its habitat preferences in North America, it can grow in dry to mesic sites, but so far has only been collected at moist to wet sites in Hawai‘i.

The following description is from the Flora of North America (Barkworth et al. 2003).

“**Plants** more or less densely cespi-tose. **Basal** rosettes usually well-differentiated; blades ovate to lanceolate. **Culms** 15-100 cm (rarely taller), usually thicker than 1 mm, weak and wiry or relatively stout and rigid, erect, ascending or decumbent; nodes occasionally swollen, glabrous or densely pubescent, often with a glabrous or viscid ring below; internodes purplish or

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

olive green or grayish-green, to yellowish-green, variously pubescent, with hairs of 2 lengths or glabrous; fall phase erect, spreading, or decumbent, usually branching extensively at all but the uppermost nodes, ultimately forming dense fascicles of branchlets with reduced, flat or involute blades and reduced secondary panicles with few spikelets. **Cauline** leaves 4-7; sheaths usually shorter than the internodes, glabrous or densely and variously pubescent with hairs shorter than 3 mm, margins ciliate or glabrous; ligules and pseudoligules 1-5 mm, of hairs; blades 2-12 cm long (rarely longer), 2-12 mm wide (rarely wider), firm or lax, spreading to reflexed or stiffly ascending, yellowish-green or grayish-green to olivaceous, densely to sparsely and variously pubescent, margins similar or occasionally whitish-scabridulous, margins often with papillose-based cilia, at least basally, bases rounded or subcordate. **Primary** panicles 3-12 cm, 1/4 - 3/4 as wide as long, usually open, well-exserted, rather dense; rachises glabrous, puberulent, or more or less densely pilose, at least basally. **Spikelets** 1.1-2.1 mm, obovoid to ellipsoid, yellowish-green to olivaceous or purplish, variously pubescent, obtuse or subacute. **Lower** glumes usually 1/4 - 1/2 as long as the spikelets, obtuse to acute; upper glumes and lower lemmas subequal, equaling the upper florets at maturity, or occasionally the upper glumes slightly shorter, not strongly veined; lower florets sterile; upper florets 1.1-1.7 mm long, 0.6-1 mm wide, ellipsoid, obtuse to acute or minutely umbonate or apiculate. **2n** = 18.”

Material examined. **Hawai'i:** Kau, Kahuku, rare in open pasture, in moist location, 3500ft [1066m], 30 Jul 1951, E.Y. Hosaka 3636 (BISH 785774). Volcano, roadside, Jade & Fourth Streets, newly bulldozed humus and lava in fog belt. 1097m; Mar 31 1971, O. Degener (BISH 630170)

***Dichanthium annulatum* (Forssk.) Stapf**

New Island Record

Dichanthium annulatum is now known from several collections from Hawai'i Island. This species was almost certainly introduced as a pasture grass. This species has previously been documented on O'ahu, Moloka'i, and Maui.

Material examined. **Hawai'i:** Magoon Ranch, July 1956, R. Hind s.n. (BISH 785677). Ka'u, Pakinik iki, Kaalualu Ranch, Rare in local patches in pasture, dry region, fair growth, 1000ft [304m], 24 Feb 1950, E.Y. Hosaka s.n. (BISH 785674). 3

***Dichanthium sericeum* (R.Br.) A.Camus**

New Island Record

Dichanthium sericeum is now known from Moloka'i at Maunaloa. This species is now known from all of the main islands except Kaua'i.

Material examined. **Moloka'i:** Maunaloa, 14 Mar 1940, T. Cooke s.n. (BISH 785765).

***Dichelachne micrantha* (Cav.) Domin.**

New Island Record

Dichelachne micrantha is now known from Maui near Olinda where it was growing in lawns and pastures. It has previously been collected on Kaua'i and O'ahu (Imada 2019).

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

Material examined. **Maui:** Olinda. Hawea Pl, on margin of lawn, a few, sticking out above other grasses, naturalized, mesic lawn and pasture, 2700ft [822m], 31 Mar 2011, F. Starr & K. Starr 110331-01 (BISH 751523).

***Digitaria bicornis* (Lam.) Roem & Schult.**

New Island Records,

Correction

Reexamination of all Hawaiian specimens of *Digitaria* revealed new island records of *Digitaria bicornis* from Lehua and Kaua'i. *Digitaria bicornis* was previously only reported from Maui. It can be distinguished from other species of *Digitaria* as its pedicilate and sessile spikelets are dimorphic, as well as having a pectinate fringe of hairs on its pedicellate spikelets, often visible without magnification on mature specimens.

The specimen cited by Imada & Kennedy (2020) as *D. bicornis* from Midway has been reidentified as *D. ciliaris* thus limiting the species to only the main Hawaiian Islands. This species can be very similar to *D. ciliaris* (Webster 1983), almost all of the specimens cited below were misidentified as *D. ciliaris*. Besides the characters in the following key, these species can also be separated by hairs at the lowest node of the of inflorescence (where the lower panicle branches all converge), on *D. ciliaris* has hairs up to 1 mm hairs and on *D. bicornis* the hairs less than 0.4 mm (Figure 2), if hairs are present in this region greater than 0.4 mm, then the plant is *D. ciliaris*. Under strong magnification the longer hairs on *D. ciliaris* are noticeable when comparing material side-by-side. When mature, *Digitaria ciliaris* can also have somewhat pectinate hairs on its spikelets (Figure 4c; Werier 2020), when spikelets like this exist they can be distinguished from *D. bicornis* by their uniform uniform venation, and "thinner" hairs compared to *D. bicornis* (Figure 4a), separating the species by the hairs on the lowest inflorescence node should also be reliable.

Material examined. **Lehua:** Small, crescent-shaped cinder cone islands (N. of Ni'i'hau) composed of volcanic tuff, elev. 0-186m; scattered to dense vegetation of shrubs (*Pluchea* spp.) and herbs (*Jacquemontia*, *Ageratum*, *Sicyos*, and grasses), perennial herb, culms decumbent, occasional on N. slope, naturalized, 10 Jan 1992, D.H. Lorence 7137 (PTBG 013678). **Kaua'i:** Barking Sands Pacific Missile Range Facility, U.S. Navy, main road between Kokole Point and base housing, common, 10ft [3m], 18 Jan 1988, T. Flynn 2701 (BISH 531223).



Figure 2. Lowest node of the inflorescence in *Digitaria*. **A**, *Digitaria bicornis* showing short, fuzzy hairs (T. Flynn 2701). **B**, *Digitaria ciliaris* showing a mixture of short and long hairs and with an arrow pointing to long hairs (G.C. Munro 47). Scale bars are 1 mm long. Photos taken at BISH.

***Digitaria ciliaris* (Retz.) Koeler**

Note

The Hawaiian *Digitaria ciliaris* (as it is currently applied) is an interesting mixture of two seemingly distinct phenotypes, each of which is approximately equally collected. These two forms were previously considered two different species until *Digitaria henryi* was synonymized with *Digitaria ciliaris* by Veldkamp (1973). The differences between *D. ciliaris* and *D. henryi* include a difference in spikelet lengths, panicle length, panicle structure, and spikelet venation. All information recorded below was based on observation of material from Hawai'i.

Approximately 20 measurements were made per trait per species, variation is reported in units of standard deviation. *Digitaria ciliaris* has spikelets ranging from 2.5-3.5 mm long (average $2.85 \pm .31$), panicles ranging from 5-17 cm long (average 10 ± 3.2), panicles which are held perpendicularly or slightly ascending, and spikelets where the veins of the sterile lemma are unevenly spaced. "*D. henryi*" has spikelets ranging from 2.1-2.7 mm long (average $2.48 \pm .12$), panicles ranging from 2-9 cm long (average 5 ± 1.8), panicle branches which are strongly ascending, and spikelets where the veins of the sterile lemma are evenly spaced. It is interesting to note that seemingly no morphological intermediates have been found. *Digitaria henryi* is still recognized by some botanists in Asia (Zhengyi et al. 2006; Huang 2000), but the majority of authors seem to synonymize it.

Examination of *D. ciliaris* specimens from Papahānaumokuākea revealed that some specimens display phenotypes which have not been collected on the Main Islands. Some specimens have glassy almost spine-like hairs on the sterile lemma (Figure 3d). Flora of North America (Barkworth et al. 2003) states that those can occur on *D. ciliaris* in the controversial variety *D. ciliaris* var. *chrysolephara* which I do not recognize here (Wilhelm 2009). Some specimens such as the specimen erroneously identified as *D. bicornis* from Midway have hairs on the spikelet which look pectinate and very similar to *D. ciliaris*, however, close examination can separate *D. bicornis* from *D. ciliaris* as *D. bicornis* has heteromorphic spikelet pairs where

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

venation or pubescence differ between the sessile and pedicilate, also see the discussion under *D. bicornis* for other differences between the species.

***Digitaria eriantha* Steud.**

New Naturalization

Digitaria eriantha has previously been reported on Kaua'i, Maui, and Hawai'i, and was listed as questionable previously reported on O'ahu from an experimental farm, and on Kaho'olawe from a single specimen of an experimental planting. It is now known to be naturalized on O'ahu from the vicinity of Kahuku, as well as Waimanalo and Makiki. It is likely more widespread than that however.

Material examined. O'ahu: Ko'olau Mountains, Kahuku Training area near Canes LZ., 27 Jul 2011, A. Lau 2011072701 (BISH 749852). Kahuku. Along roadways through abandoned sugar cane field and *Leucaena* thickets, 21 Dec 1988, K.M. Nagata 3936 (BISH 558529). Across stream from base of Sacred falls foot path, 75ft [22m], 09 May 1978, C. Corn s.n. (BISH 667066). Kahuku, Kahuku training range, 520ft [158m], 19 Oct 2011, J. Beachy 236 (BISH 751054). UH Experimental farm at Waimanalo, weed on side of road, common, 21.333892, -157.711778, Jul 10 2021, K. Faccenda 2041. Makiki Valley Loop Trail, trailhead outside of DLNR buildings, full sun, moist, large colony, 21.314658, -157.829383, 14 Jul 2021, K. Faccenda 2051

***Digitaria horizontalis* Willd.**

Correction

Digitaria horizontalis was previously reported on Lāna'i by O'Connor (1990). The specimen (Herbst 4027) was examined and it was a misidentification of *Digitaria nuda*. *Digitaria horizontalis* is now only known in Hawai'i from two collections on O'ahu.

***Digitaria nuda* Schumach.**

New State Record

Digitaria nuda has been collected since 1930 but had been erroneously identified as *Digitaria ciliaris* or *Digitaria setigera*. *Digitaria nuda* is now known from Kure Island, Kaua'i, O'ahu, Lāna'i, Maui, Kahoolowe, and Hawai'i. This species is unique in having no lower glume, spikelets < 2.5mm, and an upper glume $\frac{2}{5}$ - $\frac{4}{5}$ as long as the lemma. A key is included for its identification.

Digitaria nuda is an African and Southeast Asian native which has become naturalized throughout Central and South America. This species is similar to the common *Digitaria ciliaris* in its weedy tendencies (especially as a weed in agriculture) but grows more slowly (Souza et al. 2012). *Digitaria nuda* is allelopathic and has resistance to certain herbicides which kill the more common *D. ciliaris* (Dias et al. 2007; Hugo et al. 2014).

The following description is from the Flora of North America (Barkworth et al. 2003:378)
“**Plants** annual or of indefinite duration. **Culms** 20-60 cm, glabrous, decumbent, rooting and branching from the lower nodes, geniculate above. **Sheaths** glabrous or with long hairs near the base; ligules 0.8-2.5 mm; blades 2-13.5 cm long, 1.5-2.5 mm wide, glabrous on both surfaces or the adaxial surface with a few long hairs near the base. **Panicles** with 3-8 spikelike primary branches, these digitate or with rachises to 2 cm long; lower panicle nodes with hairs at least 0.4 mm; primary branches 4-15.5(20) cm long, 0.4-0.8 mm wide, axes wing-margined, wings

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

more than 1/2 as wide as the midribs, proximal portions of the branches often with scattered 1-4 mm hairs, bearing spikelets in unequally pedicellate pairs on the lower and middle portions of the branches; secondary branches absent; pedicels not adnate to the branches. **Spikelets** homomorphic, 1.7-2.8 mm long, 0.5-0.8 mm wide. **Lower** glumes absent or to 0.2 mm; upper glumes 1-2.2 mm, 0.4-0.8 times as long as the spikelets; lower lemmas about as long as the spikelets, 7-veined, veins smooth, lateral veins usually equally spaced, sometimes the inner lateral veins more distant from the other 2, intercostal regions adjacent to the midveins glabrous, those between the lateral veins with 0.5-1 mm hairs, hairs initially appressed, sometimes strongly divergent at maturity; upper lemmas yellow to gray when immature, becoming brown at maturity; anthers 0.3-0.6 mm. **2n** = unknown.”

Material examined. **Kure:** Kure Atoll, weed around quarters, 12 Sep 1961, C.H. Lamoureux 1865 (HAW 28328). **Kaua'i:** Weed along haul cane road off dirt banks of sugar cane fields, On Lihue plantation land between Hanamaulau and Hanahanapuni cone, 21 Aug 1937, S. Ishikawa 285 (BISH 403244). Hanalei, in moderately wet pineapple field, 01 Aug 1931, E.Y. Hosaka 480 (BISH 118676). [no location], Dec 1946, C.W. Schwartz 1145 (BISH 785762). Lehue, along ditches and around sugar cane fields, 5 Jun 1994, C. Morden 1187 (HAW 44252 [in HPDL collection]). **O'ahu:** Mountains back of Punaluu, forest. 01 Mar 1936, L.D. Whitney 4074 (BISH 785766). Makiki Heights, 12 Jan 1936, L.D. Whitney 4018 (BISH 785760). Honolulu, Pensacola St., 24 Apr 1936, L.D. Whitney 4181 (BISH 785759). Honolulu, Keeaumoku St., 05 Jan 1936. L.D. Whitney 4013 (BISH 785761). Honolulu, Dowsett highlands, weed in yard, 10 Sep 1950, E.H. Bryan Jr. s.n. (BISH 22079). Wheeler airbase. Common weed of pineapples, 07 Jan 1976, J.T. Swarbrick H.61 (BISH 410139). Grounds of H.S.P.A. Experiment station, Keeaumoku St., 27 Dec 1947, P.W. Weber s.n. (BISH 118667) Pali Highway, vicinity of the Queen Emma Summer Palace, Growing from lawn, Common, 21.335811, -157.839828, 29 May 2021, K. Faccenda 1938. Honolulu, Bishop Museum Campus, Weed along road behind Castle Building. Partial sun, Uncommon, 21.333245, -157.871761, 24 Jun 2021, K. Faccenda 2007. Honolulu, end of Queen St. at harbor, Weed in irrigated flower bed. Partial sun, Only a few plants seen, not growing from full sun, 21.308597, -157.864211, 07 Aug 2021, K. Faccenda 2077. **Lāna'i:** Palawai Basin, along road in pineapple field, common tufted grass, 1100ft [335m], 11 Jun 1974, D.R. Herbst 4027 (BISH 405251). **Maui:** West Maui, Lahaina District, Honokahua, between Kahauiki and Honolua, 04 Aug 2019, H. Oppenheimer H81902 (BISH 778865). Central Maui, Kahului, forestry nursery, 24 Jun 1938, R.W. Hobdy 1774 & 1775 (BISH 450163 & 450162). E. Maui, Makena, ¼ mile inland from Makena Beach, very dry conditions with *Cenchrus echinatus*, *Eragrostis*, bunchgrass to 5inch height, 40ft [12m], 17 Jan 1976, Resnick 299b & 322 (HAW 28257 & HAW28249). **Kaho'olawe:** Transect C4 - along secondary road that runs from main road to lighthouse, *Prosopis* with *Tragus* groundcover [this was a mixed collection with *D. ciliaris*], 500ft [152m], 25 Nov 1978, W.P. Char 78.064 (BISH 779123). **Hawai'i:** South Kohala District, east of Queen Ka'ahumanu Highway between Mauna Lani Drive and Pauko turn off, dry area with scant vegetation, open grassland with scattered *Prosopis pallida*, 04 Feb 1991, E.J. Funk s.n. (BISH 662889). South Kona District, Napopoo Rd & Kanele St., S of Capt. Cook, roadside weed, dry, partly shaded area, frequent weed along the road, 19.464792, -155.900923, Mar 02 2022, K. Faccenda 2276.

***Digitaria orbata* Hughes**

New State Record

A new species of *Digitaria* for Hawai'i was recently identified from material collected 30 years ago on Lāna'i. After consulting Henrard (1950), Webster (1983), and photographed material on the Australian Virtual Herbarium site, it was identified as *Digitaria orbata*. *Digitaria orbata* is an Australian native, and this is the first time this species has been found growing wild outside of Australia. Its native habitat consists of rainforest and subtropical woodlands Webster (1983), and no other information can be found regarding its ecology.

This species is unique among all species of *Digitaria* known to occur in Hawai'i as it is an upright, clump forming plant without stolons, has spikelets < 2 mm long, lacks a lower glume, has a minute upper glume about .25x as long as the spikelet, and has a very roughly textured fertile lemma (Figure 6).

The following description is from Webster (1983:196):

"Nodes on erect culm, 3 to 5. (7) Mid-culm nodes glabrous (setaceous hairs occasionally present on lower nodes). (8) Axillary inflorescences normally absent from lower nodes. (9) Mid-culm leaf sheath glabrous. (10) Mid-culm leaf blade 60 to 250 mm long. (11) Mid-culm leaf blade 1.8 to 5.5 mm wide <average 3.0>. (12) Adaxial surface of leaf blade glabrous <nerves scabrous>. (13) Spicules well developed on leaf margins to poorly developed on leaf margins. (14) Papillose-based hairs absent or rare in throat of collar region. (15) Ligule 1.6 to 4 mm long <average 2.4>. (22) Lowermost primary branch 70 to 160 mm long. (25) Pronounced spicules present on margins of primary branches. (26) Lowermost pulvinus glabrous or hairs shorter than 0.4 mm long. (30) Spikelets imbricate to not imbricate. (31) Spikelets elliptic (approaching obovate) . (32) Spikelets 1.3 to 1.8 mm long <average 1.6>. (33) Spikelets 0.47 to 0.8 mm wide <average 0.70>. (35) First glume 0 to 0.15 mm long <mostly absent>. (37) Second glume 0.2 to 0.6 mm long (average 0.4). (38) Second glume glabrous. (39) Nerves on second glume, 0 (not distinctly nerved). (40) Ratio of second glume length to spikelet length, 0.12 to 0.34 (mostly under 0.25). (41) Lower lemma 1.1 to 1.6 mm long. (42) Lower lemma shorter than upper lemma <tip of grain protruding>. (45) Nerves of lower lemma anastomosing apically. (46) Nerves on lower lemma, 3 to 5 (mostly 3). (47) Nerves of lower lemma of lowermost spikelet per node spaced to produce a relatively wide first interspace and narrow second interspace; or equidistant. (48) Lower lemma with scattered fine pubescence to glabrous . (55) Upper lemma muricate at maturity, papillae pronounced. (56) Upper lemma acute."

Material examined. Lāna'i: Ca. 1 mile north on Kaunalapau Hwy. Leucaena-Dodonaea-Panicum maximum scrub, occasional, 1000-1100 ft, 1990, R.W. Hobdy s.n. (BISH 767427)

Digitaria stricta* Roth var. *stricta

New State Record

Digitaria stricta var. *stricta* is now known from O'ahu where it is now widely distributed across the island and has been present since at least 2003. This grass is native to India and South East Asia; this is the first time this grass has been detected outside of its native range. Little information is available about habitat preferences or ecology of this plant. It is morphologically quite similar to *Digitaria violascens* but differs in having very hairy florets and having a corona of hairs at the apex of the pedicel (Figure 3a).

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

The following description is from the Flora of China (Zhengyi et al. 2006:544).

“Annual. Culms tufted, slender, erect, 20–40 cm tall. Leaf sheaths loose, keeled, glabrous or papillose-pilose, especially at mouth; leaf blades linear, soft, 5–20 × 0.3–0.5 cm, adaxial surface tuberculate-hispid in lower 1/3, apex finely acuminate; ligule 1–1.5 mm. Inflorescence subdigitate, axis 1–3 cm; racemes 2–8 or more, 5–12 cm; spikelets ternate; rachis triquetrous, narrowly winged, margins scabrous; pedicels scabrous, tips slightly dilated with overtopping spicules up to 1 mm. Spikelets elliptic, 1.2–1.4 mm, hairs clavate, rarely glabrous; lower glume absent; upper glume variable, 1/4–1/2 as long as spikelet, rarely vestigial or absent, veinless or 1–3-veined; lower lemma slightly shorter than spikelet, 3–5-veined, intervein spaces and margins sparsely pubescent to villous; upper lemma chestnut brown to purplish black with a paler, apiculate, slightly protruding apex. Anthers ca. 0.3 mm. Fl. and fr. autumn.”

Material examined. **O‘ahu:** Waikiki, along Ala Moana Blvd., weed in irrigated flower bed, full sun, caespitose, common in this flower bed [initially a mixed collection with *D. violescens*], 21.284578, -157.837214, 22 Jun 2021, K. Faccenda 2003.5. Kahuku training area, Oio Gulch. Gravel pile by NIKE site, RS-KTA-01, naturalized, UTM 604933 2396374. 600ft, 30 Jan 2018, K. Kawelo US ARMY 474 (BISH 768530) Schofield Barracks East Range. Roadside vegetation, 01 Oct 2003, K. Kawelo s.n. (BISH 704712). Ala Moana Park, west portion near harbor and volleyball courts, mowed, irrigated grass, locally common in this portion of the park, but not seen outside of this colony, spikelets with clavate hairs, 21.291860, -157.854915, Feb 02 2022, K. Faccenda 2218. Road which connects the Nuuanu Pali lookout the Pali Hwy. towards Honolulu, roadside weed, mowed area, sunny, moist, uncommon, 21.365379, -157.796837, Feb 05 2022, K. Faccenda 2223.

***Digitaria eriostachya* Mez.**

New State Record

Digitaria eriostachya was first collected on Hawai‘i Island in 2001 and was not correctly identified until recently. Three collections have been made, all in the Volcano area from roadsides; it appears the species is now locally common. *Digitaria eriostachya* is most similar to *D. eriantha* but differs in having panicle branches which are triangular with no wings as well as *D. eriostachya* having no lower glume and an upper glume which is as long as the spikelet. *Digitaria eriostachya* is native to Paraguay and Argentina (Webster & Hatch 1990). This is the first time this has been reported outside of its native range. Little information exists about its ecology or weed potential.

The following description is from Webster & Hatch (1990):

“Description: Plants perennial; stoloniferous; rhizomatous or lacking rhizomes. Nodes glabrous. Sheath auricles 1 - 2 mm long. Sheaths glabrous. Ligule 1 - 3 mm long. Leaf blades flexuous; spreading; 3~ 20 cm long; 3 - 8 mm wide; glabrous on the lower surface; glabrous on the upper surface; with the midrib not obviously differentiated. Main axis 20 - 40 mm long; with quaquaversal primary branches. Primary branches appressed to the main axis to spreading; not whorled; 4 - 7 on the main axis; 0.2 - 0.3 mm wide. Pedicels 2 - 3 mm long. Cleistogamous inflorescence absent. Spikelets 36 - 60 on a typical primary branch; lanceolate or elliptic; (2.2 - 2.4 - 2.9 mm long; 0.6 - 0.8 mm wide. First glume absent (occ. present as a minute scale ca. 0.

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

1 mm long). Second glume 1 times spikelet length; 3 to 5 -nerved; hairy; acuminate to acute. Lemma of lower floret 7-nerved; acuminate to acute; hairy. Lower lemma hairs overtopping the upper floret (by 0.2 - 0.5 mm); white. Upper floret 0.92 - 1 times the length of the lower floret. Lemma of upper floret grey or yellow; acuminate. Distribution: Paraguay and Argentina.”

Material examined. **Hawai'i:** Puna District, Wright Road, 3-4 mile marker, along roadside, along the highway, wet open disturbed, mixed with other non-native plant species, ~4000ft [~1219m], 06 Oct 2006, K.F. Bio #03-0016-01 (BISH 735637). Hawai'i Volcanoes National Park, Crater Rim Road, between entrance and Research Center turn off, Ka'u District, rare on side of road in disturbed vegetation adjacent to *Metrosideros polymorpha* forest, tall grass with green inflorescences, 1200 m, 23 Jul 2001, L.W. Pratt 3261 (HAVO 16385). Volcano, junction of Volcano Rd. and Kalaninauli Rd, Moist roadside, Common, rhizomatous or some plants appearing caespitose, 19.433951, -155.225701, Mar 02 2022, K. Faccenda 2262

Key to *Digitaria* in Hawai'i

Florets of all species are photographed in Figures 3-6 for reference. The inflorescence consists of a panicle of two to many branches arranged digitately or racemosely.

1. Spikelets ternately arranged (in groups of 3) at least in the lower part of the panicle branches; spikelets < 2 mm long
 2. Plants decumbent with stolons; florets entirely glabrous; inflorescence branches 2-3 per flowering stem; fertile lemma white to tan... *D. fuscescens*
 2. Plants upright caespitose; florets with minute or conspicuous hairs; inflorescence branches 2-9 per flowering stem; fertile lemma dark brown to violet, occasionally lighter colored when immature
 3. Apex of pedicel without any hairs; florets with minute hairs, these sparse and barely visible under magnification ... *D. violescens*
 3. Apex of pedicel with a corona of hairs; sterile lemma with conspicuous clavate hairs ... *D. stricta* var. *stricta*
1. Spikelets paired; spikelets typically > 2 mm long
 4. Perennials; plants upright clump forming and without stolons
 5. Spikelets long hairy with brown and white hairs clearly visible to the naked eye ... *D. insularis* (in part)
 5. Spikelets glabrous to pubescent, lacking brown hairs
 6. Lower glume absent; spikelets < 2 mm long ... *D. orbata* (in part)
 6. Lower glume present; spikelets > 3 mm long
 7. Panicle branches barren on the lower $\frac{1}{4}$ to $\frac{1}{3}$; spikelets remotely spaced above and typically not overlapping ... *D. divaricatissima* (in part)
 7. Panicle branches with spikelets uniformly distributed from base to apex; spikelets typically close and overlapping ... *D. eriantha* (in part)
 4. Perennials or annuals; typically with stolons or laying on ground, if lacking stolons then soft based annuals.
 8. Panicle branches triangular and lacking wings of green tissue on the edges (Figure 3D).
 9. Spikelet entirely glabrous; panicle branches typically < 4 cm long ... *D. abyssinca*
 9. Spikelets with white hairs; panicle branches > 4 cm long ... *D. eriostachya*

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

- 8.. Panicle branches triangular with wings of green tissue coming from the three edges
- 10.. Sessile and pedicellate spikelets dimorphic (check the middle to apex of the panicle branches), the sessile spikelet with nerves equally spaced, and pedicellate spikelet with nerves close to margins; pedicellate spikelets often with fimbriate hairs when mature, these hairs not present on immature material (Figure 4) ... *D. bicornis*
 - 10. Spikelets not dimorphic
 - 11. Wings of the panicle branches smooth ... *D. radicata*
 - 11. Wings of the panicle branches scabrous
 - 12. Lower glume present as distinct scale ≥ 0.4 mm on **all** spikelets, typically acute or sometimes rounded at apex
 - 13. Sterile lemma veins unequally spaced ... *D. ciliaris* (in part)
 - 13. Sterile lemma veins equally spaced
 - 14. Panicle branches 2-8 cm long; panicle branches clustered together and erect; spikelets 2.2-2.8 mm ... *D. ciliaris* (in part, henryi form)
 - 14. Panicle branches typically 5-25 cm long, typically > 9 cm, panicle branches spreading from each other, spikelets 2.8-3.5 mm long ... *D. eriantha*
 - 12. Lower glume absent **or** a minute scale typically < 0.3 mm, typically with a truncate or emarginate apex if present
 - 15. Upper glume $< \frac{1}{3}$ spikelet length; sterile lemma veins unequally spaced; papillose based hairs never found on inflorescence branches ... *D. setigera*
 - 15. Upper glume $> \frac{1}{3}$ spikelet length; sterile lemma veins equally spaced; long papillose based hairs occasionally present on inflorescence branches
 - 16. Upper leaf surface evenly hairy; leaf sheaths usually with scattered hairs; inflorescence branches with scattered long hairs ... *D. horizontalis*
 - 16. Upper leaf surface glabrous or with scattered hairs near base; leaf sheaths with few hairs near base; inflorescence branches never with long hairs ... *D. nuda*

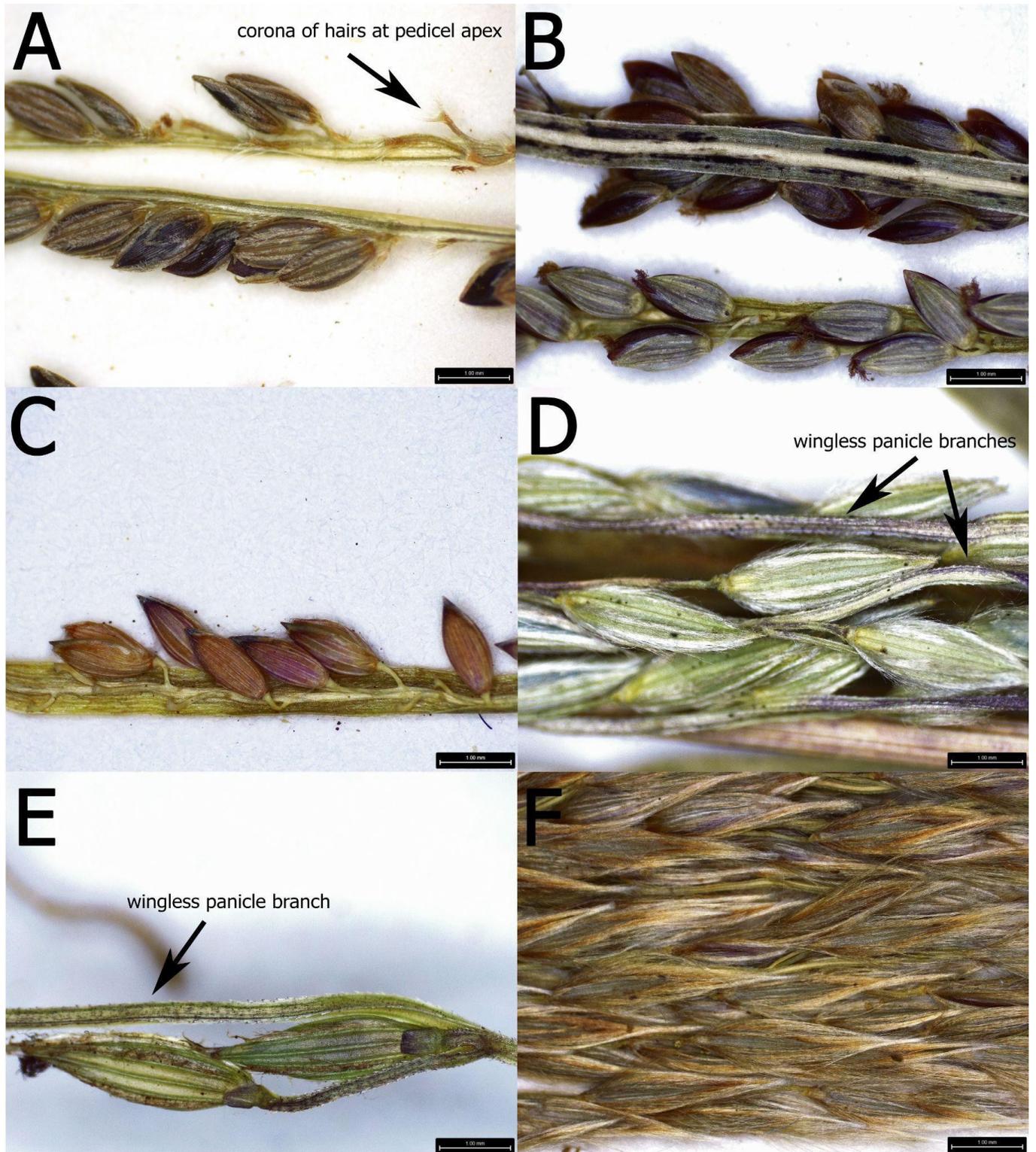


Figure 3. *Digitaria* spikelets. **A**, *Digitaria stricta* (Kawelo s.n.). **B**, *Digitaria violascens* (T. Flynn 2720). **C**, *Digitaria fuscescens* (D.R. Herbst 248). **D**, *Digitaria eriostachya* (K.F. Bio 03-0016-01). **E**, *Digitaria divaricatissima* (C. Imada 2002-39). **F**, *Digitaria insularis* (F.R. Fosberg 29542). All scale bars are 1 mm long. All photos were taken at BISH at 20x.

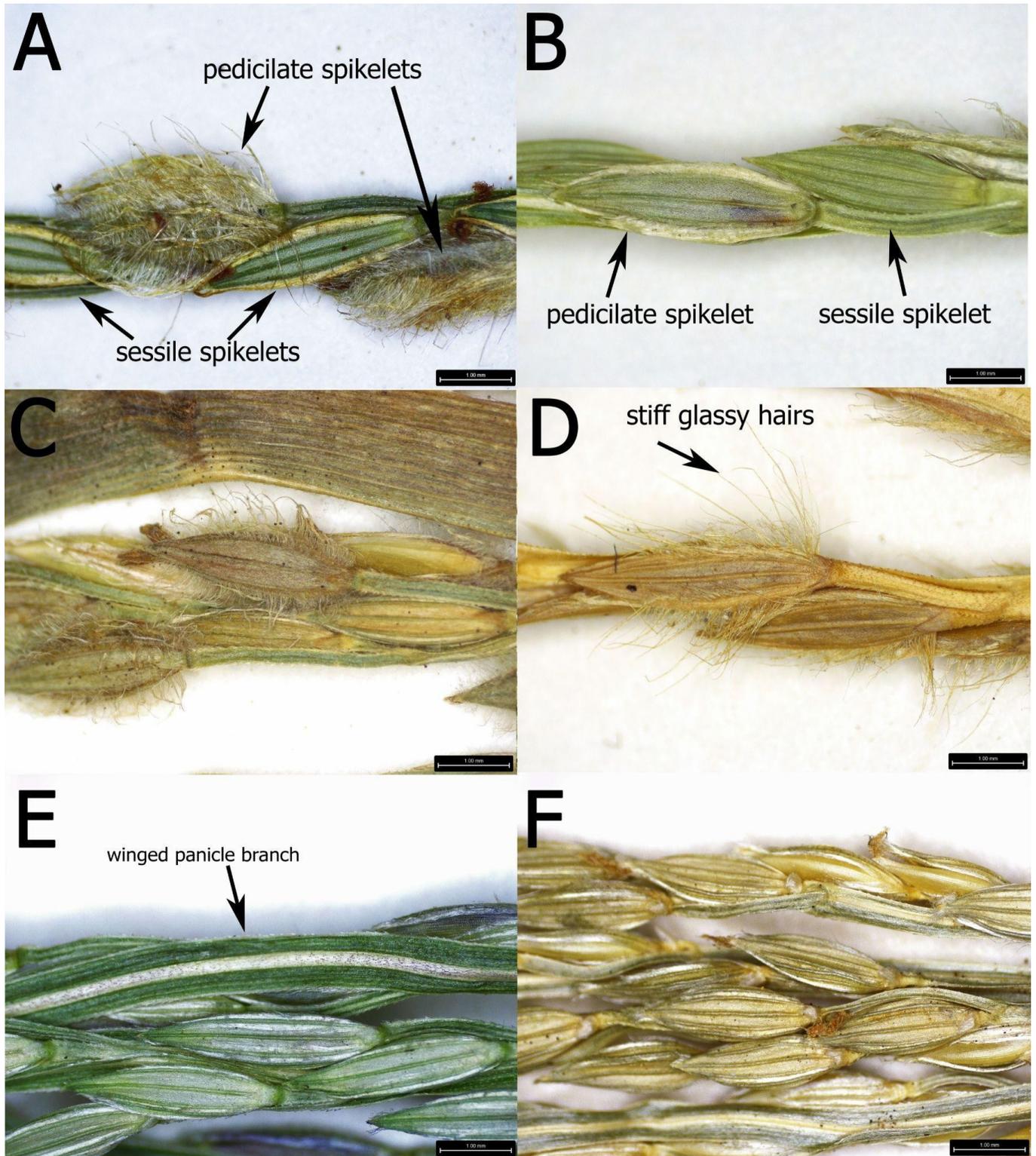


Figure 4. *Digitaria* spikelets. **A-B, *Digitaria bicornis*** A. Spikelets at maturity with fimbriate hairs (Starr 020112-1); B. spikelets not yet mature (T. Flynn 2701). **C-F, *Digitaria ciliaris*** C. mature spikelets resembling *D. bicornis* (Starr 05334-18); D. form with glassy hairs on the florets which

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

is only found in the NW islands (Cornelison s.n. BISH 118638); E. typical form (A. Ainsworth WNR005) F. "*D. henryi*" form (Stone 1241). All scale bars are 1 mm long. All photos were taken at BISH at 20x.

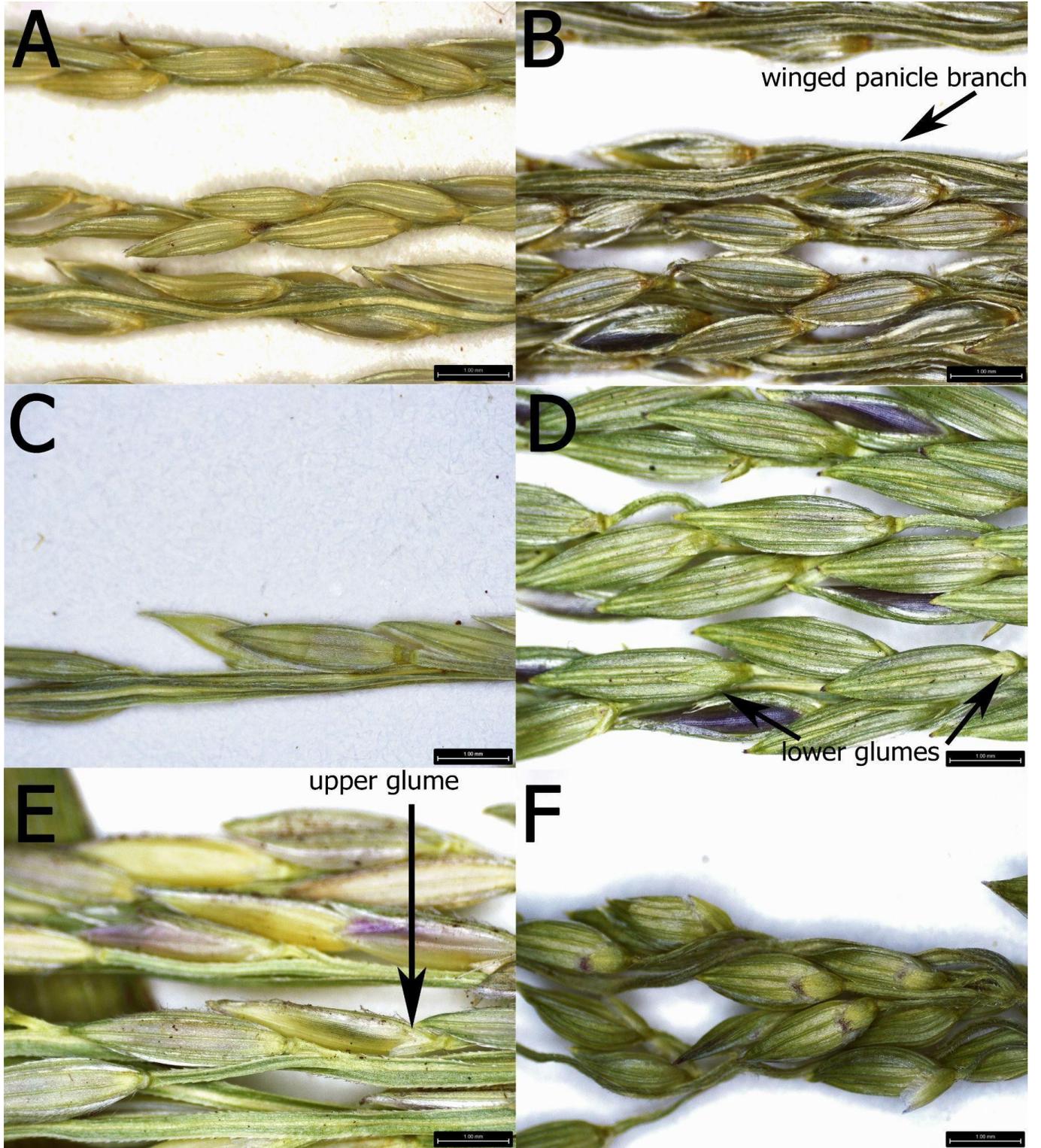


Figure 5. *Digitaria* spikelets. **A**, *Digitaria horizontalis* (D.R. Herbst 696). **B**, *Digitaria nuda* (D.R. Herbst 4027). **C**, *Digitaria radicata* (T. Flynn 625). **D**, *Digitaria eriantha* (T. Flynn 6134).

E, *Digitaria setigera* (K.M. Nagata 3854). **F**, *Digitaria abyssinica* (R.W. Hobdy 3888). All scale bars are 1 mm long. All photos were taken at BISH at 20x.



Figure 6. *Digitaria* spikelets. **A-B**, *Digitaria orbata*. (R.W. Hobdy s.n., BISH 767427) All scale bars are 1 mm long. All photos were taken at BISH at 20x.

***Echinochloa oryzoides* (Ard.) Fritsch**

New Island Record

Echinochloa oryzoides has been collected once on Moloka'i, 120 years ago. It may not have persisted and should be treated as questionably naturalized unless it is recollected. This species has previously been collected on O'ahu (Imada 2019).

Material examined. Moloka'i: Au. Sug. Co. A plant of this grew last year in a Japanese yard, it seeded a number of plants "au" [sic] then now it seeds quickly, 800ft [243m], Feb 1903, G.C. Munro 92 (BISH 785771).

***Elymus repens* (L.) Gould**

Correction

Elymus repens was previously published for the state by Oppenheimer (2016); however, the specimen supporting this (Oppenheimer H50609 BISH) was examined and it represents a misidentification of *Dactylis glomerata*. Serendipitously, new specimens were found to replace it in the BISH unidentified Poaceae folder. *Elymus repens* is now known from East Maui from the vicinity of Hosmer grove based on two collections from 1989 and 1991 which were only recently deposited at BISH. *Elymus repens* (as the synonym *Elytrigia repens*) is listed as a state noxious weed (State of Hawai'i 1992).

Material examined. Maui: Haleakala National Park, near Hosmer Grove in dump area, 6900ft [2103m], 27 Nov 1989, B. Gagne s.n. (BISH 582449 & 58448 [2 sheets]) Haleakala National Park, near Hosmer Grove, 3 Jan 1991, B. Gagne 1036 (BISH 778156).

***Eragrostis barrelieri* Daveau**

New State Record

Eragrostis barrelieri has been collected from O'ahu, Maui, and Kaho'olawe and has been present on the islands since 1977. This species is widespread on O'ahu occurring in dry low

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

elevation areas. This species is a short annual species with abundant glands throughout the inflorescence and is most easily confused with *E. leptostachya* as that is what almost all specimens were misidentified as. The two species can be separated with *E. barrelieri* being an annual with rounded seeds and *E. leptostachya* being a perennial with grooved seeds.

The Hawaiian vouchers of *E. barrelieri* were not able to be correctly identified in Flora of North America 25 (Barkworth et al. 2003) due to an error on the *Eragrostis* key. The key states that *E. barrelieri* does not have glands on the pedicels, however Hawaiian material consistently has glandular pedicels. Other authors recognize that *E. barrelieri* has glandular pedicels (Cope 1982).

Eragrostis barrelieri is a European, African, and West Asian species which has become widely naturalized though the Americas and Australia. This species is a weed of disturbed habitat including roadsides, gardens, and agriculture.

The following description is from the Flora of North America (Barkworth et al. 2003:83)
“**Plants** annual; tufted, without innovations. **Culms** (5)10-60 cm, erect or decumbent, much-branched near the base, with a ring of glandular tissue below the nodes, rings often shiny or yellowish. **Sheaths** hairy at the apices, hairs to 4 mm; ligules 0.2-0.5 mm, ciliate; blades 1.5-10 cm long, 1-3(5) mm wide, flat, abaxial surfaces glabrous, adaxial surfaces glabrous, sometimes scabridulous, occasionally with white hairs to 3 mm, margins without crateriform glands. **Panicles** 4-20 cm long, 2.2-8(10) cm wide, ovate, open to contracted, rachises with shiny or yellowish glandular spots or rings below the nodes; primary branches 0.5-6 cm, diverging 20-100° from the rachises; pulvini glabrous; pedicels 1-4 mm, stout, stiff, divergent, without glandular bands. **Spikelets** 4-7(11) mm long, 1.1-2.2 mm wide, narrowly ovate, reddish-purple to greenish, occasionally grayish, with 7-12(20) florets; disarticulation acropetal, paleas persistent. **Glumes** broadly ovate, membranous, 1-veined; lower glumes 0.9-1.4 mm; upper glumes 1.2-1.6 mm; lemmas 1.4-1.8 mm, broadly ovate, membranous, apices acute to obtuse; paleas 1.3-1.7 mm, hyaline, keels scabrous, scabridities to 0.1 mm, apices obtuse to acute; anthers 3, 0.1-0.2 mm, reddish-brown. **Caryopses** 0.4-0.7 mm, ellipsoid, not grooved, smooth to faintly striate, light brown. **2n** = 40.”

Material examined. **O'ahu:** Honolulu, bus stop at intersection of S. King and Punchbowl, weed from crack in sidewalk, 2 plants seen, 21.305297, -157.858628, 27 Aug 2021, K. Faccenda 2096. Ka'ena Point State Park, parking lot on the Waianae side, edge of parking lot, sunny, common weed, 21.565131, -158.263067, 11 Nov 2021, K. Faccenda 2161. Pali Highway, vicinity of Kawanānakoā Pl, from crack between road and curb, sunny area, infrequent on road, 21.326033, -157.847672, 29 May 2021, K. Faccenda 1937. Base of highrise at University Ave. and Kapiolani Blvd. moist, cool shaded area, cold air was blowing out of a vent in this area artificially lowering the temperature, 21.286967, -157.826406, 08 May 2021, K. Faccenda 1793. Former Air Naval Station Barbers Point, Northern Trap & Skeet Range, outplanting site on firebreak scrape, 28 Apr 2021, BISH staff BP006 (BISH 779225). Barber's Point, near storage tanks by harbor, 26 May 1977, W. Char 77.057 (HAW 28583). **Maui:** East Maui, Makawao district, Paia, sidewalk crack, 40ft [12m], 20 Jan 2010, H. Oppenheimer H11009 (BISH 747234).

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

West Maui, Lahaina District, Launiupoko, unpaved road below the reservoirs, 840ft [256m], 02 Apr 2002, H. Oppenheimer H40701 (BISH 731936). West Maui, Wailuku District, vicinity of Waihe'e Ditch, foot of KaunO'ahua Ridge, locally common in dry area formerly grazed, 320ft [97m], 17 Apr 2009, H. Oppenheimer 40925 (BISH 747646). **Kaho'olawe:** Honokanaia, at base camp, 20ft [6m], 20 Jan 2004, H. Oppenheimer H10404 (BISH 709362).

***Eragrostis elongata* (Willd.) J.Jacq. Naturalization**

Correction; New

E. elongata has previously been listed as adventive on Hawai'i island, recent collections now show that it is now widely naturalized on the windward side of the island. *Eragrostis elongata* was previously described as occurring on Moloka'i (Oppenheimer 2003), this specimen (Oppenheimer H110140) was redetermined to *E. brownii*. *Eragrostis elongata* is now known only from Kaua'i, O'ahu, and Hawai'i.

Material examined. **Hawai'i:** Mauna Kea, herb along roadside of Saddle Road, (UTM 264933, 2179397), 950m. 01 Jun 2008, C. Angelo 002 (HAW 28448). N. Kulani Road, Olaa, assoc. with *Hypericum mutilum*, flat tufts, inflorescence with purplish cast, 1500ft [457m], 15 Dec 1975, D.R. Herbst 5591 (BISH 409836). Keaau, along dirt road on south side of old sugar mill, 04 Apr 1997, E.J. Funk s.n. (BISH 767375). South Hilo District, Waiakea, buffer zone collections along Stainback highway, 3000ft [914m], 15 Jul 1998, E.J. Funk s.n. (BISH 662851). Saddle road, approximately 30 km mauka from Hilo, Roadside weed in a moist, open area, Uncommon, clump forming, flower bright purple, florets breaking apart from apex to base, 19.677200, -155.329180, Mar 04 2022, K. Faccenda 2303.

***Eragrostis leptostachya* (R. Br.) Steud Correction**

New Island Record,

This species was erroneously published for O'ahu & Kaho'olawe (Imada & Kennedy 2020); the specimens supporting these records were all misidentifications of *E. barrelieri*. Most specimens from BISH previously identified as *E. leptostachya* from Maui were also actually *E. barrelieri* with only one specimen representing true *E. leptostachya*.

Eragrostis leptostachya is now known from Kaua'i at Hanapepe and East Maui at Ulupalakua. It was previously reported only from Moloka'i (Imada 2019).

Material examined. **Kaua'i:** Hanapepe, in pasture, local patch, dry place, 250ft [76m], 31 Oct 1936, E.Y. Hosaka 1647 (BISH 448600). **Maui:** East Maui, Ulupalakua, adjacent to Tedeschi Winery, NW of Pu'u Mahoe, open mesic slope with overstory of *Acacia mearnsii*, *Grevillea robusta* ... groundcover dominated by *Bryophyllum pinnatum*, occasional bunchgrass growing with *Cyperus gracilis*, 20° 38' N 156° 23' W, ca. 2100 ft, 16 Jul 2003, C.T. Imada (BISH 687874).

***Eragrostis multicaulis* Steud Note**

New State Record,

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

Eragrostis multicaulis is now known from Hawai'i Island from Volcanoes National Park growing from a driveway. The 80 year old specimen has remained misidentified as *E. pectinacea* and has not been recollected yet and should be treated as questionable until recollected. This species is quite similar to *Eragrostis pilosa* and likely has similar ecology, being a weed of moist disturbed areas, especially urban areas and paddy fields (Chang & Kim 1990; Kim 1998) and has not been reported as an environmental weed.

Eragrostis multicaulis is a species with a contested taxonomy which I reviewed during the course of identifying this specimen. Some authors recognize it as a valid species (Hitchcock & Chase 1950; Scholz 1988; Huang 2000; Veldkamp 2002; Hohla 2006; Zhengyi et al. 2006), and others treat it as a variety, form, or entirely synonymous with *Eragrostis pilosa* (Koch 1974; Tsvelev 1983; Ryves et al. 1996; Barkworth et al 2003). Various characteristics have been used to separate *E. multicaulis* and *E. pilosa* including axils of inflorescence branches lacking hairs (Shouliang & Peterson 2006, Kuoh & Chen 2000, Tsvelev 1983, Veldkamp 2002), the leaf sheath mouths (collars) lacking hairs (Shouliang & Peterson 2006, Kuoh & Chen 2000, Veldkamp 2002; Fernald 1950, Scholz 1988), the pedicles of the spikelets being shorter than the spikelets (Shouliang & Peterson 2006, Veldkamp 2002, Hohla 2006), the panicle being less than 3cm wide (Veldkamp 2002), pedicles appressed to secondary panicle branches (divergent in *E. pilosa*) (Koch 1974), more delicate panicle branches (Hohla 2006), and indistinct lemma lateral nerves (Hohla 2006). Some of these characters have more utility than others for reliable identification. Van der Meijden & Weeda (1982) discuss the differences between *E. multicaulis* and *E. pilosa*, they note that the type specimen of *E. multicaulis* has an almost naked leaf collar, but other specimens have significant variation in this character, with some having hairy and almost naked sheath mouths on the same individual. Hugin (1999) clarifies this and says that only the leaf collar of the uppermost leaf should be examined for hairs and that lower leaf collars can be variable. Jauzein (1995) also clarifies that the axils of the inflorescence may have 1-2 long hairs.

The following description is from the Flora of China (Zhengyi et al. 2006).

“Annual. Culms tufted, erect or ascending, geniculate at base. Leaf sheaths glabrous at summit or with a few short hairs, compressed; ligules a line of hairs, 0.2–0.1 mm; leaf blades usually flat, 3–9 cm × 0.5–2.5 mm, glabrous. Panicle open, 4.5–9 × 1.5–3 cm; branches solitary or in pairs but base branches nearly whorled, glabrous in axils; pedicels usually shorter than spikelets. Spikelets dark green, 2.5–4.5 mm, 3–10-flowered. Glumes membranous, falling off at maturity, lower glume narrow, veins obscure, ca. 0.6 mm, upper glume oblong-ovate, 1-veined, ca. 1 mm. Lemmas membranous, semi-ovate in side vein, ca. 1.5 mm, middle vein keeled, falling off at maturity. Palea membranous, ca. 1 mm, apex blunt, along 2 keels ciliate, persistent or tardily falling off at maturity. Stamens 3; anthers ca. 0.2 mm. Caryopsis ca. 0.8 mm, striate. Fl. and fr. late summer. $2n = 40$.”

Material examined. **Hawai'i:** Plants of Hawai'i National Park, Kilauea, several clumps found in driveway of Obs. & Nat. Building, 20 Aug 1943, G.O. Fagerlund & Mitchell 818 (BISH 119046).

Eragrostis parviflora (R. Br.) Trin
island Records

Correction, New

In the process of writing the key to species for *Eragrostis* it was noticed that there were no distinguishable features between *E. pectinacea* and "*E. parviflora*" (*sensu* the key in Herbst & Clayton 1998) besides for the presence of scattered glands on the leaves. Communication with Dave Albrecht at the Australian National Herbarium revealed that the three Hawaiian specimens identified as "*E. parviflora*" did not match Australian material.

The only character which delimits these sheets from *E. pectinacea* is the presence of scattered glands on the leaves (Herbst 1998; Faccenda pers. obs.). Glands are not found on the culms, sheaths, or anywhere in the inflorescences. In his monograph of the *Eragrostis pilosa* complex Koch (1974) states that *E. pectinacea* does not have glands. However, I believe that based on the lack of any other features which distinguish these specimens for *E. pectinacea*, they are simply aberrant specimens of *E. pectinacea*. Paul Peterson (pers. comm.) has also supported this opinion. *Eragrostis parviflora* was first published as naturalized by Flynn & Lorence (1998) based on two specimens from Kaua'i, a specimen from O'ahu was published (Imada & Kennedy 2020). All of these specimens were misidentifications of *E. pectinacea* var. *pectinacea*.

Serendipitously, two specimens which actually represent *E. parviflora* were discovered from Ka'a and Koele Lāna'i as well as from Kahuku Hawai'i. Therefore, *E. parviflora* is now only known from Lāna'i and Hawai'i. The presence of glands on *E. parviflora* is a variable trait, only the minority of individuals seem to have them scattered along the abaxial leaf veins and along the sheaths (Dave Albrecht pers. comm).

As no description for this plant was provided when it was first, erroneously, published by Flynn & Lorence (1998), one is provided here from ABRS (2005:387):

"Annuals or short-lived perennials. Culms erect to decumbent, terete or lower internodes compressed, 30-90 (-135) cm high. Leave with ribbed sometimes glandular veins, mostly glabrous and smooth; ligule a ciliate membrane, 0.3-0.6 mm long; blade flat and to 4.5 mm wide or convolute, straight, with capillary apex. Panicles loose or open, sometimes drooping, 20-60 cm long, 11-30 cm wide, scabrous; axils glabrous or bearded; lower branches usually ±whorled; branches divided, naked in the lower 1-4 cm. Spikelets pedicilate, linear to oblong, (2.5-) 4.5-9 (-16) mm long, 0.8-1.5 mm wide, olive-green when young, sometimes cleistogamous; rachilla flexuosa; florets (3-) 7-15 (-30), soon loosely overlapping, usually falling entire; apical floret vestigial. Glumes unequal, hyaline; lower glumes ovate to triangular, 0.7-1.5 mm long; upper glume lanceolate, 1.2-1.8 mm long. Lemma lanceolate, 1.5-2 mm long, obtuse, membranous; lower lemma often longer than upper lemmas. Palea hyaline; body spathulate, entire or notched by short keels, apically ciliate; keels sparsely scaberulous; flaps ±as wide as body. Stamens 3; anthers 0.2-0.3 mm long. Grain terete to trigonous, flat or slightly concave on the back, oblong ellipsoid, 0.4-1 mm long, sometimes striate-reticulate, reddish to dark brown with a minute stipe."

Material examined. Lāna'i: Koele, 1740 ft [530 m], Dec 20 1929, G.C. Munro 552 (BISH 120667) Ka'a, a grass introduced some years ago, 1500 ft [450 m], Nov 21 1929, G.C. Munro

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

446 (BISH 120678) **Hawai'i**: Kahuku Ranch, rare, local patch in rocky pasture, 2500ft [762m], 29 Sept 1950, E.Y. Hosaka 3613 (BISH 785775).

***Eragrostis pectinacea* var. *miserrima* (E.Fourn.) Reeder**

Correction

The specimen identified as by Snow (2010) has been redetermined to be *E. leptostachya* based on the presence of abundant glands. There are now no known occurrences of *E. pectinacea* var. *miserrima* from Hawai'i and this variety should be removed from the checklist

***Eragrostis pectinacea* var. *pectinacea* (Michx.) Nees**

Correction

Eragrostis pectinacea var. *pectinacea* was previously published for Kaho'olawe (Oppenheimer 2006), however this represented a misidentification of *E. barrelieri*. *Eragrostis pectinacea* was also previously published for Lāna'i (O'Connor 1990). The Lāna'i specimens were a misidentification of *E. parviflora*. No specimens are known from Lāna'i or Kaho'olawe. *Eragrostis pectinacea* is now only documented from Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i Islands.

Eragrostis pilosa* (L.) P. Beauv var. *pilosa

Correction; Note

Eragrostis pilosa is no longer known from Lāna'i as the only specimen documenting its presence on the island was a misidentification of *E. parviflora*. *Eragrostis pilosa* var. *pilosa* is therefore now only known from Kaua'i and O'ahu.

All specimens examined represent *Eragrostis pilosa* var. *pilosa*. No specimens of the glandular variety (*E. pilosa* var. *perplexa*) have been collected in Hawai'i.

***Eragrostis sessilispica* Buckley**

Correction

Eragrostis sessilispica was noted by Snow (2008) as a waif record from an agriculture experimental station and the species was then incorporated into the Imada (2019) checklist. Over the course of this research, I examined many specimens collected at such stations and believe that this label is consistent with cultivated material from grass introduction gardens rather than a weed or contaminant. Many plants which were cultivated at these gardens were not initially identified to species by their collectors which Snow (2008) uses as justification that it wasn't planted. This species has been excluded from the following key to *Eragrostis* species and should be removed from the naturalized checklist.

***Eragrostis tef* (Zuccagni) Trotter**

Note

Eragrostis tef was collected once on O'ahu (Hitchcock 14123 S) and has eluded the recent checklists of *Eragrostis* despite being published in 1922 (Hitchcock 1922). The collection was a naturalization at an experimental farm. It is likely extinct but was included in the key in case new specimens are discovered.

***Eragrostis uniolooides* (Retz.) Nees ex Steud.**

Correction

Eragrostis uniolooides was previously reported from Maui (Oppenheimer 2008). This was a misidentification of *E. brownii* (Oppenheimer H90639 BISH). There are no other known

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

occurrences of *E. uniolooides* on Maui and *E. uniolooides* appears to be only found on Hawai'i island at this time.

Key to *Eragrostis* in Hawai'i

The following key is presented for *Eragrostis* in Hawai'i and is based on modifications from the keys presented in Clayton & Snow (2010) as well as O'Connor (1990). For native species, the islands they are currently known from are indicated, the distributions are not presented for introduced species as they are likely present on more islands than have been reported as of the writing of this key. *Eragrostis* has been described as "a large and cumbersome genus that can present insurmountable difficulties" (Cope 1999). In Hawai'i, identification of *Eragrostis* is, by far, the most difficult of all the genera of grasses. Identification is particularly challenging, due to the diversity of species and often subtle differences between species. Identification of this genus is greatly aided by having mature material with well developed seeds/caryopses (referred to as grains in this key) and also having spikelets which have begun to break up. Annual and perennial grasses can often be distinguished by their bases, perennial species typically retain dead leaves at their bases and are often branched below the soil line.

As mentioned by Snow (2010), the endemic Hawaiian *Eragrostis* species are in need of revision, and many specimens examined during the production of this key are intermediate between two species as they currently are defined. They may not key out easily in this key, as was also the case for the previous keys by O'Connor (1990) and Clayton & Snow (2010), due to somewhat fuzzy species concepts.

1. Lower glume longer than first lemma on at least some spikelets
 2. Inflorescence very narrowly contracted and spikelike typically < 1 cm wide
 3. Plants often with hard rhizomes, but also often without; leaves primarily cauline; panicles primarily > 15 cm long; flowering stems typically > 50 cm tall; inflorescence axis scabrous or smooth (Lāna'i, Maui, Hawai'i) ... *E. leptophylla*
 3. Plants never with hard rhizomes; leaves primarily basal; panicles 5-15 cm long; flowering stems typically < 30 cm tall; inflorescence axis smooth; (Moloka'i, Lāna'i, Maui, Hawai'i) ... *E. monticola*
 2. Inflorescence wider, often still contracted, but more at least a slightly open panicle typically > 2 cm wide
 4. Pedicels of spikelets often > 1 cm [only known from one collection as a contaminant at an agriculture experimental station on O'ahu; likely extirpated] ... *E. trichodes*
 4. Pedicels of spikelets < 1 cm
 5. Leaves > 4 mm wide, flat; spikelets with 8-15 florets; lemma apex often obtuse (O'ahu, Moloka'i, Lāna'i, Maui, Hawai'i) ... *E. atropioides*
 5. Leaves < 4 mm wide, folded or flat; spikelets with 4-7 florets; lemma apex often acute (O'ahu, Moloka'i, Lāna'i, Maui, Hawai'i) ... *E. deflexa*
1. Lower glume shorter than or almost equaling first lemma
 6. Plants with obvious woody rhizomes when culm is removed from ground, the rhizomes mostly short creeping and the plants still caespitose; leaves strongly scabrous on upper surface
 7. Glumes and sometimes lemmas long ciliate (O'ahu, slopes of Ka'ala) ... *E. fosbergii*

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

7. Glumes and lemmas without cilia.
 8. Panicle typically contracted; lower panicle branches < 6 cm; spikelets clustered along branches; panicle branches typically narrowly diverging from panicle rachis and ascending upwards (All islands and well distributed in Papahānaumokuākea) ... *E. variabilis*
 8. Panicle typically wide; lower panicle branches typically > 6 cm; panicle branches typically diverging from panicle rachis widely and often perpendicularly. (All main Hawaiian islands except Ni'ihau) ... *E. grandis*
6. Plants lacking strong rhizomes; leaves scabrous or not; plants of various heights
 9. Plants with glands on clumps, leaves, sheaths, inflorescence, and/or lemma keels (see Figure 7)
 10. A single glandular band present in each inflorescence below lowest whorl of branches, no other glands present; lowest inflorescence branches whorled; leaf sheaths glabrous or hairy with papillose based hairs; seeds grooved ... *E. trichophora*
 10. Glands not as above; lower inflorescence branches various; leaf sheaths without papillose based hairs; seeds grooved or not
 11. Palea keels long ciliate these cilia typically visible without dissecting florets, glands present on inflorescence branches and/or as a weak annular ring of circular glands below the culm nodes ... *E. amabilis* (in part)
 11. Palea keels not long ciliate; glands various
 12. Plants without annular rings of glands below culm nodes, glands scattered mainly on sheaths ... *E. parviflora* (in part)
 12. Plants with annular rings of glands on below culm nodes
 13. Glands present on lemma keels; spikelets 2-4 mm wide; annuals; nodes typically very darkly colored *E. cilianensis*
 13. Glands absent on lemma keels; spikelets typically < 2 mm wide; duration various; nodes various
 14. Perennials; seeds deeply grooved; plants 30-60 cm tall... *E. leptostachya*
 14. Annuals; seed rounded, not grooved; plants 5-20 cm tall ... *E. barrelieri*
9. Plants without glands
 15. Plants typically < 20 cm tall; leaves firm, needlelike; spikelets often > 15 mm long
 16. Culms < 20 cm long, erect; spikelets typical straight; (indigenous, Papahānaumokuākea) ... *E. paupera*
 16. Culms > 20 cm long, often trailing; spikelets often curved ... *E. dielsii*
 15. Plant height various; leaves softer; spikelets < 20 mm long (may be longer in *E. brownii*)
 17. Spikelet rachilla breaking up from the apex downward at maturity; pedicles < 3 mm long
 18. Panicle branches < 2 cm long, panicle contracted with all florets clustered and aggregated; spikelets 3-7 mm long ... *E. elongata*
 18. Panicle branches 2-7 cm, panicle more open with spikelets not closely aggregated; spikelets 4-40 mm long... *E. brownii*
 17. Spikelet rachilla persistent after spikelets fall; pedicles various
 19. Spikelets ≥ 2 mm wide; spikelets ~ 2x as long as wide
 20. Spikelets 2.5-9 mm wide, spikelets falling as a whole unit at maturity ... *E. superba*

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

- 20. Spikelets 2-4 mm wide, spikelets breaking up at maturity ... *E. uniolooides*
- 19. Spikelet < 2 mm wide, if wider, spikelets > 3x as long as wide
 - 21. Palea keels ciliate, these cilia typically visible without dissecting florets; florets typically < 3mm long
 - 22. Inflorescence a contracted spike like panicle ... *E. ciliaris*
 - 22. Inflorescence an open panicle ... *E. amabilis* (in part)
 - 21. Paleas keels smooth or scabrous, never ciliate; florets typically > 3 mm long (sometimes < 3 mm long in *E. pilosa*)
 - 23. Lower glume acuminate, 2 mm long, almost as long as lowest lemma; (known from low elevations on Maui and Lānaʻi, last collected in 1838, presumed extinct) ... *E. mauiensis*
 - 23. Not as above **[over left]**
- 24. Plant perennial; grain dorsally **or strongly** laterally compressed; grain strongly to weakly grooved or without groove
 - 25. Panicles without substantial secondary branches (inflorescence appearing to be of racemes); spikelets with pedicel < 1 mm; (easily confused with *Eragrostis*) ... *Diplachne fusca* ssp. *uninervia*
 - 25. Panicles with secondary branches; pedicels typical > 1 mm; lemma apex
 - 26. Axils of inflorescence branches pilose; grain strongly laterally compressed and grooved. lower glume .5 - 1 mm long; grain strongly laterally compressed; basal leaf sheaths glabrous at the soil line ... *E. tenuifolia*
 - 26. Axils of inflorescence branches glabrous; grain dorsally compressed and grooved; basal leaf sheaths pubescent at the base of the plant near the soil line (this character is unreliable for young plants) ... *E. curvula*
- 24. Plant annual or short-lived perennial; grain weakly laterally compressed; grain without a groove (sometimes younger seeds may contract unevenly when drying and seem to have a groove, be careful when using immature seeds from dried material)
 - 27. Lemmas 1.6 - 3 mm long, acuminate; grains brown to white; grains falling before lemmas and glumes; lemmas eventually falling after [only known as a weed at agricultural experimental stations on Oʻahu, likely extirpated] ... *E. tef*
 - 27. Lemmas 1 - 2.2 mm long, acute; grains brown; glumes shortly deciduous, falling before lemmas, lemmas falling before seed.
 - 28. Lemma with very obscure lateral veins; primary panicle branches without hairs in axils (in part) ... *E. parviflora*
 - 28. Lemmas with clearly visible lateral veins; primary panicle branches with or without hairs in axils
 - 29. Lower glume > ½ the length of the lowest lemma; lower glume 0.5 - 1.5 mm; lower panicle branches typically single or paired; palea persistent after lemmas fall ... *E. pectinacea* var. *pectinacea*
 - 29. Lower glume < ½ the length of the lowest lemma; lower glume 0.3 - .6 mm; lower panicle branches typically whorled; palea shortly deciduous after lemmas fall
 - 30. Collars all pilose; axils almost all inflorescence branches pilose with multiple hairs, pedicels > 3 mm ... *E. pilosa* var. *pilosa*
 - 30. Collar of the uppermost leaf sheath on each culm glabrous; axils of inflorescence branches typically glabrous or with 1-2 hairs; pedicels < 3 mm ... *E. multicaulis*

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

Alternate key to *Eragrostis*

This keys Hawaiian *Eragrostis* to groups of similar species using less technical characteristics than the key above.

1. Plants typically < 20 cm tall; leaves stiff, needlelike; spikelets often > 15 mm long
 - E. paupera*
 - E. diesii*
1. Not as above
 - 2. Spikelets > 2 mm wide
 - E. superba*
 - E. unioloides*
 - E. cilianensis*
 - 2. Spikelets < 2 mm wide
 - 3. Panicle contracted and spike-like at maturity, < 1.5 cm wide
 - E. leptophylla*
 - E. monticola*
 - E. elongata* (in part)
 - E. ciliaris*
 - 3. Panicle wider than 1.5 cm at maturity
 - 4. Mature culms with silky white hairs at the soil line (these typical absent on immature material)
 - E. curvula* (in part)
 - 4. Bases of mature culms without silky hairs
 - 5. Plants clump forming perennials, with distinct woody rhizomes [natives]
 - 6. Inflorescence 2-6 cm wide
 - E. variabilis*
 - E. atropoides*
 - E. fosbergii*
 - 6. Inflorescence > 6 cm wide
 - E. grandis*
 - 5. Plants without woody rhizomes
 - 7. Sheaths with papillose based hispid hairs
 - E. trichophora*
 - 7. Sheaths without papillose based hairs
 - 8. Plants without hairs from axils of any primary panicle branches
 - 9. Spikelet pedicles < 3 mm
 - E. brownii*
 - E. elongata*
 - E. multicaulis*
 - E. trichodes*
 - E. curvula* (in part)
 - 9. Spikelet pedicles > 3 mm
 - E. parviflora*
 - E. mauiensis*
 - E. barrelieri*
 - E. tef* (in part)
 - 8. Plants with hairs from axils of at least some primary panicle branches
 - 10. Annuals
 - E. amabilis*

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

E. pilosa var. *pilosa*

E. pectinacea var. *pectinacea*

E. tef (in part)

10. Perennials

E. tenuifolia

E. leptostachya (hairs in axils more subtle than most species)

E. deflexa

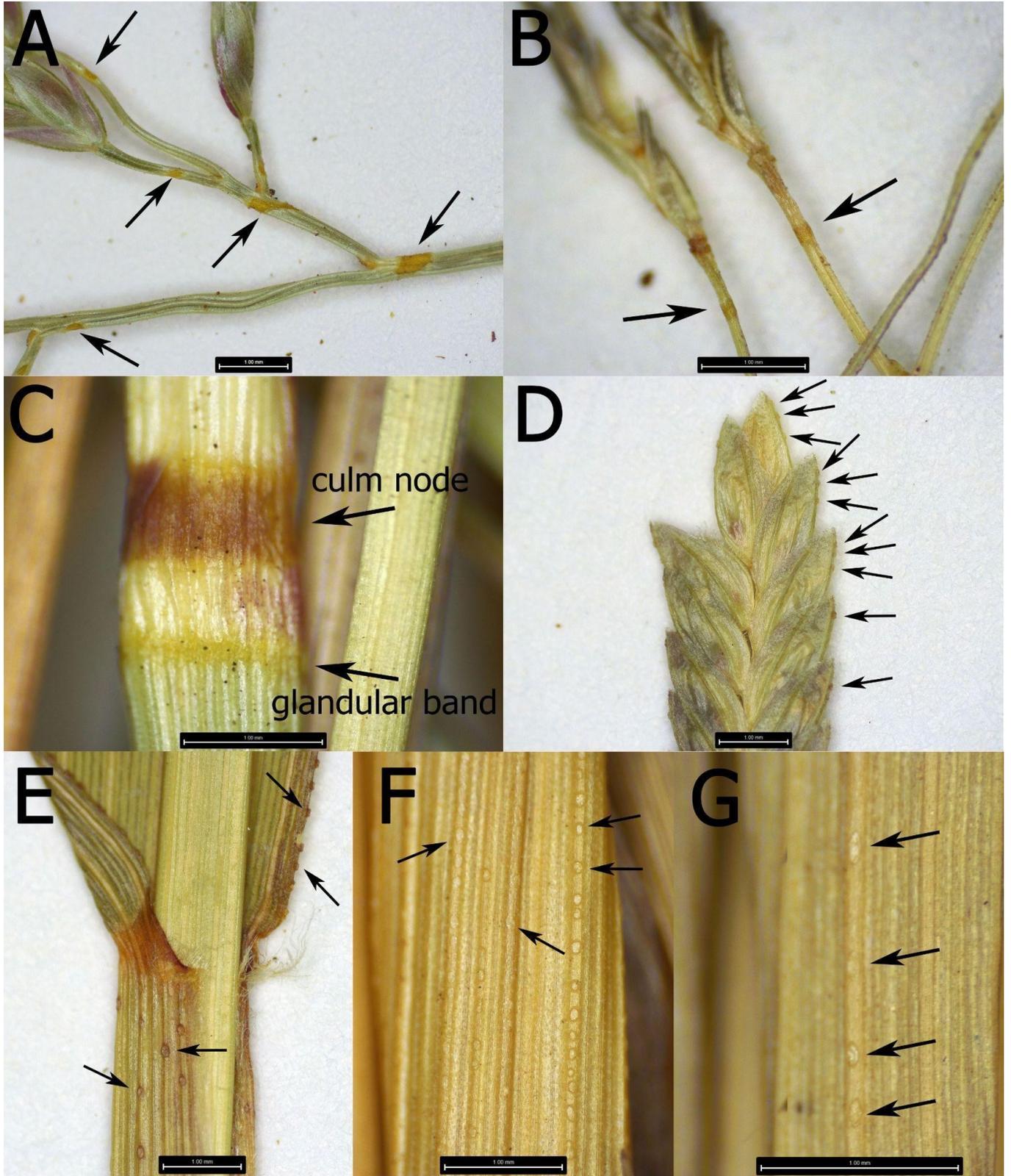


Figure 7. Glands on *Eragrostis*. **A**, *Eragrostis barrelieri* (H. Oppenheimer H40701) glands on inflorescence (not all glands are indicated with arrows). **B-C**, *Eragrostis leptostachya* (C. Imada 2002-24) B. glands on inflorescence; C. glandular band below culm nodes. **D-E**,

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

Eragrostis cilianensis (anon s.n. BISH 59338) D. glands on lemma keels (all glands on the right side are indicated with arrows); E. glands in the collar region on sheath and leaf margins, not all glands are indicated with arrows. **F-G, *Eragrostis parviflora*** (G.C. Munro 446) F. glands on leaf sheath (not all indicated with arrows); G. glands on lead midvein on abaxial surface (all glands indicated with arrows). All material photographed from BISH, all scale bars 1 mm long.

***Eremochloa ophiuroides* (Munro) Hack.**

Potentially

Naturalizing

A population of Centipede grass, *Eremochloa ophiuroides*, was observed by the author growing on the Mau'umae trail near Kaimuki, Honolulu. The population consisted of only what appeared to be one individual, covering an area of about 2 m². The habitat was a dry, fully exposed ridge top, within a *Osteomeles anthyllidifolia*, *Dodonaea viscosa*, and weed dominated area. This grass was also growing within 5 meters of the large patch of *Zoysia matrella* var. *pacifica* described at the end of this paper and this proximity raises questions of whether these populations were planted. The area was not especially open or flat, and is not somewhere where a lawn would be desirable along the trail. But, as this grass has never been observed naturalizing before, and only one population exists, it is best to consider this questionably naturalized until demonstration of reproduction is observed.

This grass is a well-known lawn grass (Staples & Herbst 2005) where it has earned the name centipede grass in reference to its expansive creeping rhizomes. It has been extensively used as a lawn grass around Hawai'i (Staples & Herbst 2005).

Material examined. O'ahu: Mau'umae trail, about 600 m mauka the trailhead, dry, sunny, exposed ridge top, small colony less than 2 m wide strongly rhizomatous, in proximity to *Zoysia pacifica*, 21.302178, -157.781373, 23 Jan 2022, K. Faccenda 2212

***Gastridium ventricosum* (Gouan) Schinz & Thell.**

New Island Record

Gastridium ventricosum is now known from one collection from Waiakoa, Moloka'i from 1937. This species is also known from Kaua'i, Maui, and Hawai'i (Imada 2019).

Material examined. Moloka'i: Waiakoa, 13 Apr 1937, L.D. Whitney 4479 (BISH 785767).

***Hordeum murinum* L.**

New Island Record,

Correction

Hordeum murinum is now known from a single collection from Kauluwai, Moloka'i. As this was collected in 1903, this should be treated as an questionably naturalized record unless it is recollected.

The BISH, NTBG, HAW, and S herbaria were all examined for specimens of this species from O'ahu, but none were found. This species was listed as occurring on O'ahu by O'Connor (1999), but as no specimens exist, this species should be removed from the checklist for O'ahu. This species is now known from Moloka'i, Maui, Lāna'i, and Hawai'i islands.

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

Material examined. Moloka'i: Au Sugar Co., annual growing in limited quantity at Kauluwai evidently introduced, would like to know if of any value as a pasture grass, 15 Feb 1903, G.C. Munro 61 (BISH 785679).

***Imperata cylindrica* (L.) Raeusch.**

Note, Eradication

Imperata cylindrica (Cogongrass) was detected as spreading via rhizomes up to 3m away from a cultivated plant in Kane'ohe, O'ahu in 2007. As of 2021, the individual from Kane'ohe was eradicated and has been for over 10 years (Danielle Frohlich & Alex Lau pers. comm. 2021). This species was never published as it was never truly naturalized. This note serves as a warning that this species may appear again and should be promptly controlled. Cogongrass is one of the world's 10 worst weeds (Global Invasive Species Database 2021), and its naturalization in Hawai'i could be catastrophic.

This plant is sold as *Imperata cylindrica* cv. 'Red Baron' or "Japanese Bloodgrass" which is a form with leaves which are a bright red on the upper half or so of the leaf, and green at the base of the leaf. This coloration is unique as other grasses with red leaves (e.g. *Cenchrus spp.*) are uniformly red in color. It can also be identified as having leaf midveins which are often located off-center. Cogongrass and its seed heads have also been reported at ports of entry being used as a bulk packing material, giving this plant a second potential introduction pathway (Alex Lau pers. comm. 2021).

Material examined. O'ahu: Kaneohe, in landscaped area in front of house, escaping into lawn, grass ~ 1ft [0.3m] tall, red tinged at tip, sterile, 'Red Baron' cultivar?, 20 Aug 2007, D. Frohlich & A. Lau 20070920030 (BISH 731446).

***Ischaemum aristatum* L.**

New State Record

Ischaemum aristatum was first collected on East Maui at Kipahulu in 1994, but the specimen was only very recently deposited at BISH for identification. No description of the population size was reported on the voucher. This species can be distinguished from other *Ischaemum* via the key below.

I. aristatum is native to East Asia, from Korea and Japan through Eastern China and Vietnam. It has shown aggressive tendencies in Japan where it can become dominant in wetlands (Nishimoto 2016). This grass has shown aggressive tendencies in Trinidad and Tobago where it grows vigorously, even on very poor soils (Smith 1950). It can spread by runners, but is mainly clump forming (Smith 1950).

The following description is from the Flora of China (Zhengyi et al. 2006:610).

"Perennial. Culms loosely tufted, erect or geniculately ascending, 40–80 cm tall, simple or branching, nodes glabrous. Leaf sheaths glabrous or pilose; leaf blades linear-lanceolate, 5–25 × 0.4–1 cm, glabrous or thinly pilose, margins smooth becoming scabrid toward apex, base attenuate or contracted, apex acuminate; ligule 2–3 mm. Racemes terminal, paired, appressed back to back, 4–7 cm; rachis internodes clavate, triquetrous, scabrid or ciliate along outer angle, inner angles glabrous or shortly ciliate. Sessile spikelet oblanceolate to obovate, 5.5–8 × 2–2.3

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

mm; lower glume leathery with rounded flanks below middle, herbaceous, broader and 2-keeled above, 5–7-veined, keels narrowly to broadly winged, wing margin scabrid; upper lemma awnless or shortly awned; awn well developed or imperfect, up to 1.2 cm. Pedicelled spikelet dorsally compressed, resembling sessile, asymmetrical, 2-keeled, keels winged, one wing incurled. Fl. and fr. Jul–Oct. $2n = 56, 72$ ”

Material examined. Maui: East Maui, Kipahulu, below three sisters in Kaumakani pasture, 300ft [91m], 05 May 1994, P. Welton 1855-002 (BISH 731446)

***Ischaemum polystachyum* J. Presl**

New State Record

First collected in 1961, *Ischaemum polystachyum* is now widespread on Hawai'i Island. It has been collated from both Kona, Pahoia, Orchidland, and near Honomu. This species was first identified as *I. polystachyum* by J.F. Veldkamp in 2011 (as the synonym *I. digitatum*) when the specimen was of uncertain naturalization status; a later collection by Hobdy in 2012 shows that not only is the species naturalized, but it is displaying invasive tendencies by forming monotypic stands. Further collections by the author expand the known range of this species with two more populations found on the windward side of Hawai'i. This grass was noted as occurring in Hawai'i with the earliest date of occurrence as 1955 (under the synonym of *I. digitatum*; Rotar 1968). Frustratingly, the date is the only specific information provided and no citation is given.

This grass is quite similar to *Urochloa mutica*, as both are very hairy, strongly rhizomatous grasses to about 1.5 tall and have overlapping habitat preference, evidenced by them often growing sympatrically. The two can be differentiated easily by their inflorescence structure (Figure 8), but both flower infrequently. Vegetatively, *I. polystachyum* has reddish-purple internodes on the lower culm nodes whereas *U. mutica* seems to be consistently greenish. The ligule also differs as *U. mutica* has a ligule of hairs, whereas *I. polystachyum* has a membranous ligule.

I. polystachyum, commonly called Paddle Grass, is native to Africa, Indian, South East Asia and Australia. It has become naturalized on several other Pacific Islands including Pohnpei, Vanuatu, and New Caledonia. On Pohnpei, it has become common in disturbed areas (Space & Falanruw 1999) and grows in full sun to partial shade in moist to wet areas where it is ubiquitous and forms monotypic stands. The grass also accumulates large amounts of fuel and is a significant fire hazard (Dana Lee Ling pers. comm. <https://www.youtube.com/watch?v=zV2YkcZ7vIA>).

The following description is from the Flora of China (Zhengyi et al. 2006:611).

“Perennial, rhizomatous. Culms loosely tufted, sometimes stoloniferous and rooting at lower nodes, 60–100 cm tall, nodes bearded or glabrous. Leaf sheaths glabrous or sparsely to densely pilose with tubercle-based hairs; leaf blades broadly linear, 5–20 × 0.5–1.5 cm, pubescent, rarely glabrescent, base rounded to subcordate, apex acute; ligule 1–2 mm. Racemes (2–)3–6 or more, mostly terminal, subdigitate, 2–9 cm; rachis internodes and pedicels broadly linear, triquetrous, ciliate on outer angle, shortly ciliate on inner angles. Sessile spikelet lanceolate, 4–5 × 1.2–1.4 mm; lower glume leathery with expanded rounded flanks below

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

middle, herbaceous, strongly veined and sharply 2-keeled above, glabrous or villous, keels usually winged, apex 2-toothed; upper glume attenuate into mucro or awnlet to 2 mm; awn of upper lemma 1.2–1.5 cm. Pedicelled spikelet laterally compressed, similar to sessile, upper lemma awned.”

Material examined. **Hawai'i:** Kona, Ed Johnston's place, Jan 1961, E.L. Guenther s.n. (BISH 19539). Puna, Pahoia Town, nearly monotypic in wet pastures over large areas west of Pahoia County Park forming dense stands 1 to 2 m tall from stock, reddish, decumbent stems that form thick mats, 25 Jul 2012, R.W. Hobdy 4342 (BISH 763642). Highway 130 between Pahoia and Kalapana, mile marker 11-12, Puna District, uncommon on side of road in disturbed vegetation, low growing spreading grass with pink and green inflorescences, 800 m, 19 May 2005, L.W. Pratt s.n. (HAVO 16499b). Outside Akaka Falls State Park, Roadside, just outside park, forming a large colony c.a. 20 m wide, Rhizomatous, internodes reddish, to about 1.5 m tall. Forming a monoculture, 19.854089, -155.151909, Mar 06 2022, K. Faccenda 2349. Puna, Orchidland subdevelopment, Orchid Land Dr. and 38th Ave, Disturbed roadside, sunny, moist, Large colony c.a. 20 m long along the road, monotypic, about 1.5 m tall, strongly rhizomatous, rhizome internoded red. On the other side of the road, climbing up through Uluhe and shrubs up to 3 m. , 19.551769, -155.008837, Feb 28 2022, K. Faccenda 2253

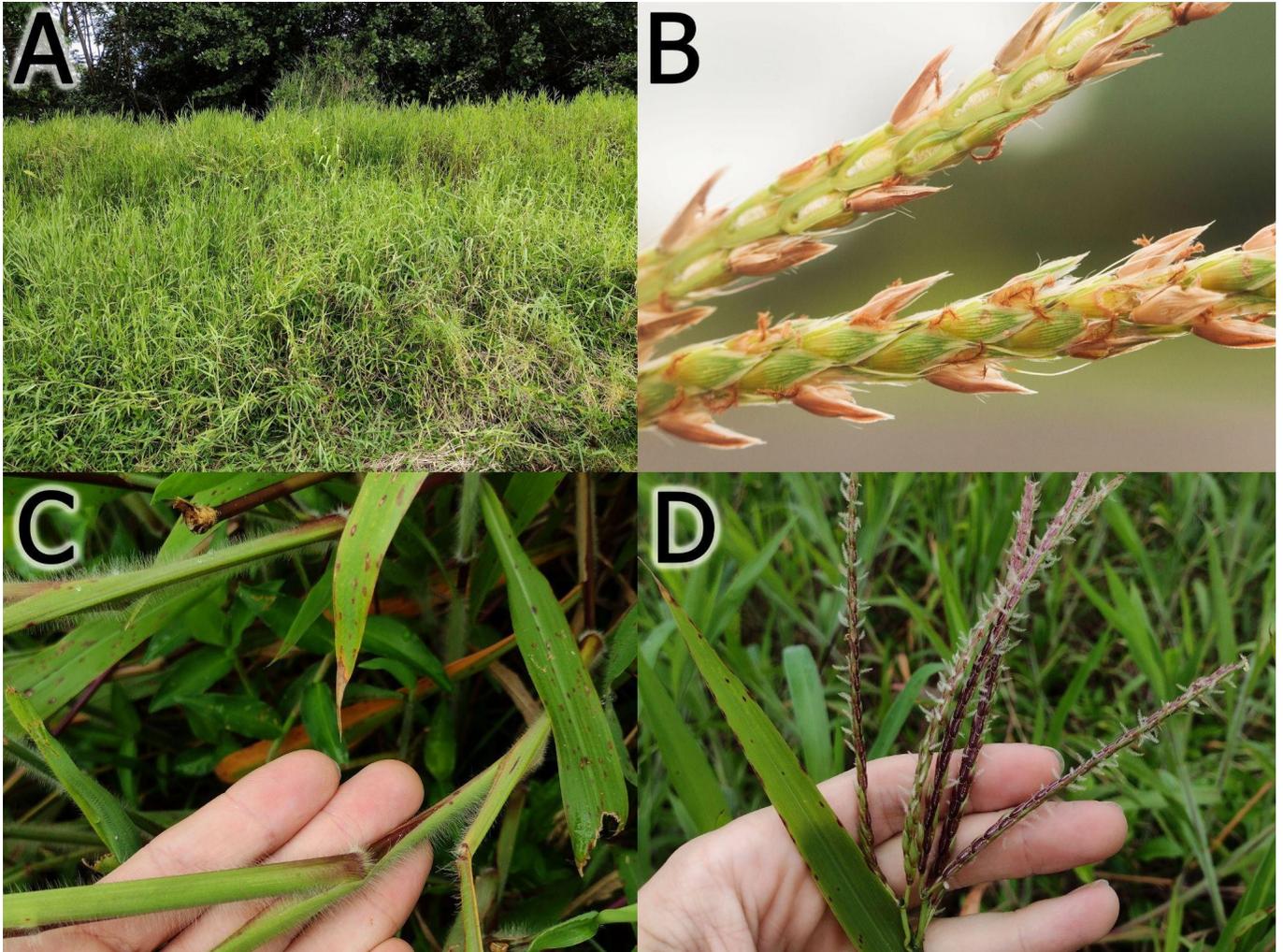


Figure 8. *Ischaemum polystachyum* photographed at Pāhoā District Park . **A**, Habit. **B**, Spikelets. **C**, Lower culm nodes and internodes. **D**, Inflorescence.

***Ischaemum timorense* Kunth**

Correction

Examination of Hawaiian specimens identified as *Ischaemum ciliare* and *Ischaemum timorense* at BISH revealed no consistent differences between each other. Further analysis revealed they are the same species and are best treated as *Ischaemum ciliare*. There are now no known collections of *Ischaemum timorense* in Hawai'i and this species should be removed from the checklist. *Ischaemum ciliare* is currently known only from Maui.

Key to *Ischaemum* species in Hawai'i

1. Inflorescences with > 2 racemes ... *I. polystachyum*
1. Inflorescences with exactly 2 racemes
 2. Inflorescences very hairy; at least some awns > 1.5 cm [native] ... *I. byrone*
 2. Inflorescences shortly hairy only on edges of pedicles; awns < 1cm or absent
 3. Leaves glabrous; spikelets with minute awns which barely exceed the florets; florets 5-6 mm long ... *I. aristatum*

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

3. Leaves tuberculate villous; spikelets with obvious awns 0.5 to 1.5mm long; florets 3-4 mm long on Hawaiian material ... *I. ciliare*

***Ixophorus unisetus* (J.Presl) Schldl.**

New Island Record

Ixophorus unisetus is now known from a single collection from Hawai'i Island at Kamuela in 1928. This species should be treated as questionably naturalized until it is recollected. This species is now treated as questionably naturalized on Kaua'i, O'ahu, Lāna'i, and Hawai'i.

Material examined. **Hawai'i:** Kamuela. 17 Jul 1928. R.A. Goff 7 (BISH 785768).

Key to *Leptochloa sensu lato*

After *Disakisperma dubia* (= *Leptochloa dubia*) was published by Snow & Davidse (2011), no key was provided to distinguish it from other members of *Leptochloa sensu lato*; the following key is provided to resolve this.

1. Lemmas apex acute
 2. Panicle branches (including spikelets) 0.5-1 mm wide; panicle elongate; leaf sheaths papillose hispid; annual ... *Leptochloa panicea* subsp. *brachiata*
 2. Panicle branches (including spikelets) 2-4 mm wide; panicles slightly elongate to digitate; leaf sheaths glabrous; perennial ... *Leptochloa virgata*
1. Lemmas apex obtuse to blunt, emarginate, or blunt mucronate
 3. Ligule 1-2 mm long, ciliate; ... *Disakisperma dubium*
 3. Ligule 2-8 mm long, membranous and shredding to fibers at maturity ... *Diplachne fusca* subsp. *uninervia*

***Lolium temulentum* L.**

New Island Records

Lolium temulentum was collected on Kaua'i and Maui in 1903; there are no recent collections, and it is quite possible that it is now extirpated and should therefore be treated as questionably naturalized. This species is a serious weed of wheat, and it is possible that the decline in wheat production may have eliminated the core populations.

Material examined. **Kaua'i:** Makaweli, Feb 1903, D.L. Van Dine s.n. (BISH 785681). **Maui:** Makawao, Mar 1903, L. Von. Tempsky 16 (BISH 785682).

***Melinis scabrida* (K.Schum.) Hack.**

New State Record

A new species of *Melinis* was observed growing sympatrically with *Melinis repens* and *Melinis minutiflora* on the southern side of Kaluakauila Gulch in the Waianae Mountains on O'ahu. I observed a population of about 20-50 plants along a fence line, but I did not do an exhaustive search of the area and likely overlooked many plants. The habitat was dry, dominated by *Melinis minutiflora*, *Schinus terebinthifolius*, *Leucaena leucocephala*, *Megathyrsus maximus*, and other weeds.

This grass was identified as *Melinis scabrida* using the key in the Flora of Tropical East Africa (Clayton & Renvoize 1982), as well as the key in The Flora of Tropical Africa (Oliver 1920). *Melinis scabrida* is identified by the the palea of the lower floret being aborted or < 1 mm long and with scabrous keels, the lower floret is also barren and the anthers are held in the upper

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

floret. This grass is quite similar to *Melinis repens*; however, that species has a well developed lower palea ~ 2 mm long with ciliate keels. On Hawaiian material observed by the author, the lower floret of *M. repens* also contains 3 anthers and the upper floret is bisexual, although Clayton & Renvoize (1982) also report that the lower floret may be barren, but the palea is never aborted.

This species is recognized by Zizka (1988) in his monograph of the tribe Melinideae, however I must wonder whether it would be more parsimonious to assume that this is an extreme morph of *Melinis repens*, rather than assuming that this species somehow made it from Africa to O'ahu with no clear dispersal vector. But, as the species is currently circumscribed, the population of plants from O'ahu is a clear match.

The following description from the Flora of Tropical East Africa (Clayton & Renvoize 1982:511): "Loosely tufted perennial; culms 30-60 cm high, geniculately ascending. Leaf-blades flat 5-15 cm long; pedicles glabrous or pilose. Spikelets oblong, 2-3 mm long, pubescent to pilose with hairs exceeding the tip by up to 1mm; lower glume a little oblong scale 0.3-0.5 mm long, inserted close to the upper glume; upper glume gently curved on the back, thinly chartaceous with a membranous tip, scaberulous on the margins, emarginate, with or without an awn up to 2mm long; lower floret barren, with or without a palea (its keel scaberulous) the lemma similar to the upper glume with an awn 2-7 mm long."

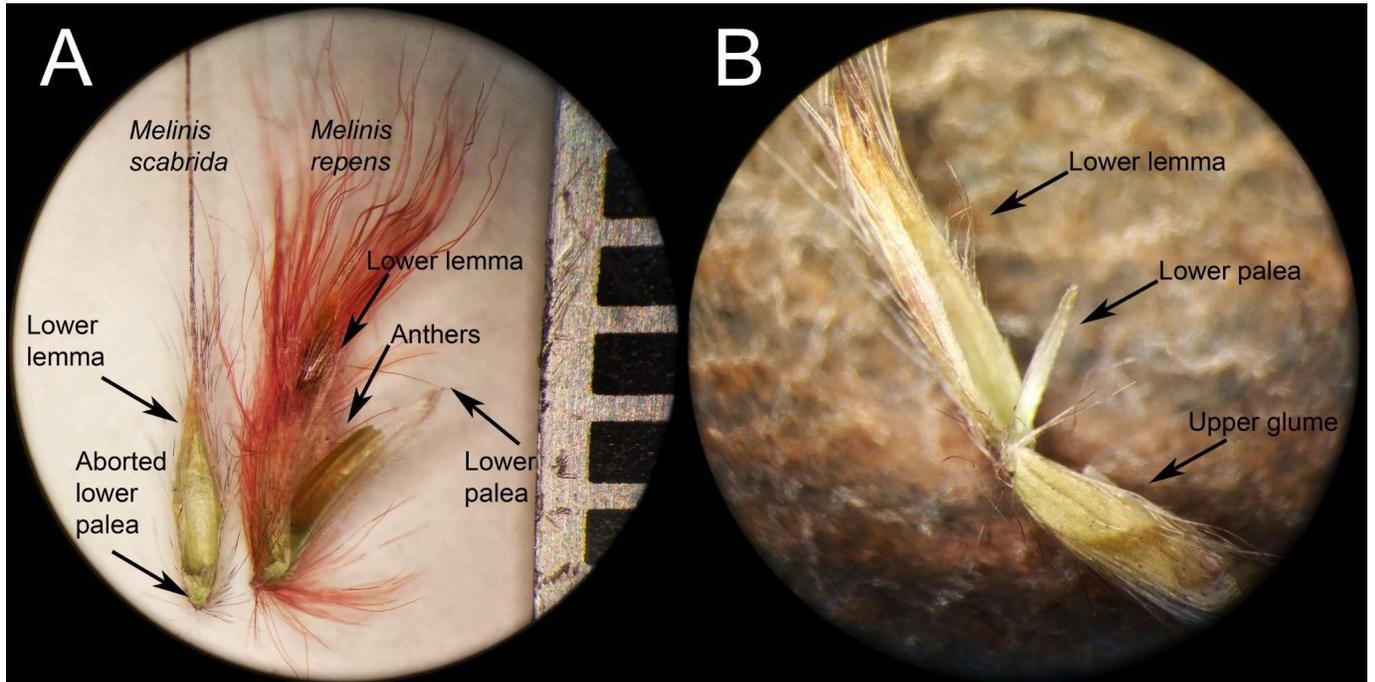


Figure 9. **A**, Comparison of the spikelets of *Melinis repens* and *Melinis scabrida*; note that on *M. repens* the arrow is pointing to the tip of the lower palea (palea of the sterile floret); the divisions on the scale are 1 mm. **B**, A dissected spikelet of *Melinis scabrida* with the upper (fertile) lemma and palea removed, in this floret the lower palea is well developed and is approximately 1 mm long. Parts A and B were taken at different magnifications. The florets of *Melinis scabrida* in

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

both parts A and B were both taken from the same inflorescence, the florets with where the lower palea was aborted were much more common than those without aborted lower paleas.

Material examined. **O'ahu:** Kaluakauila Gulch, North facing side of gulch along fenceline, Sunny, dry area dominated by weeds including *Melinis minutiflora*, *Schinus*, *Leucaena*, *Megathyrsus*, uncommon, around 20-50 plants observed while walking along the fence line, but the population likely extended beyond the fence, growing in close proximity to both *Melinis repens* and *Melinis minutiflora*, detailed observations of the specimen reveal that the plant is not intermediate, but is much closer to *M. repens* 21.545697, -158.223786, 11 Dec 2021, K. Faccenda 2180.

Key to *Melinis* in Hawai'i

1. Florets glabrous; pedicles glabrous ... *M. minutiflora*
1. Florets hairy; pedicles hairy at least at their apex
 2. Basal leaves bristle-like, in rolled, 2-3 mm wide [questionably naturalized as of 2022] ... *M. nerviglumis*
 2. Basal leaves flattened, > 4 mm wide
 3. Lower floret sterile, its palea reduced or developed; sterile lemma with an awn from 2-7 mm long ... *M. scabrida*
 3. Lower floret male or sterile, its palea clearly developed; sterile lemma typically with awn < 3 mm, rarely longer ... *M. repens*

Microlaena stipoides (Labill.) R.Br.

Taxonomic note

Previously referred to in Hawai'i as *Ehrharta stipoides*, this species is best referred to as *Microlaena stipoides* (Edgar & Connor 2010). The generic placement of this grass has been controversial, but in its native range, the genera *Microlaena* and *Ehrharta* are well defined, and the generic placement by Edgar & Connor (2010) is followed here.

Oloptum miliaceum (L.) M. Röser & H.R. Hamasha

Taxonomic note;

New Island Record

Formerly known as *Piptatherum miliaceum*, molecular evidence has now placed this grass in a new genus, *Oloptum* (Hamasha et al. 2012). *Oloptum miliaceum* was also recently collected on East Maui in Kaonoulu for the first time. This species is now known from Maui and Hawai'i Islands.

Material examined. **Maui:** East Maui, Kaonoulu along Kawehi Road, dry soil along roadside, erect culms to 1m tall in loose clumps, 3400ft [1036m], 20 Jan 2010, R.W. Hobdy s.n. (BISH 763644).

Oryza sativa L.

Questionable

Naturalization

Rice, *Oryza sativa* is now known from two collections on O'ahu where it was likely growing from erosion control logs which were assumed to be filled with rice hulls. As it is unlikely that this population of domestic rice will persist out of cultivation, this species is best treated as

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

questionably naturalized. Rice displays the same non-persistent naturalization status displayed by millet (*Panicum mileacum*) where all known records from Hawai'i are from waif individuals, spilled birdseed, or other ephemeral populations.

The following description is from the Flora of North America (Barkworth et al. 1993).

“**Plants** usually annual, sometimes perennial; caespitose, not rhizomatous. **Culms** 0.3-2 m tall, 4-20 mm thick, erect or ascending, branching at the base, usually rooting at both the lower and submerged upper nodes. **Sheaths** smooth, glabrous, lowest sheaths usually longer than the internodes, upper sheaths shorter than the internodes; auricles often present, 1-5 mm; ligules (4)10-36 mm, acute; blades 20-70 cm long, 5-20 mm wide, glabrous, sometimes scabrous. **Panicles** 10-50 cm long, 1-8 cm wide, often nodding; branches 2-13 cm, ascending or divergent; pedicels 1-7 mm. **Spikelets** 6-11 mm long, 2.5-4 mm wide, broadly elliptic, sometimes with obvious rows of white papillae, persistent, obliquely articulated with the pedicels. **Sterile** florets 1.5-3(10) mm long, 1/4 - 1/2 (9/10) as long as the spikelets, 0.5-1.5 mm wide. **Functional** florets: lemmas 6-11 mm long, 2-3 mm wide, glabrous or with stiff hairs to 1.5 mm, apices beaked, beaks 0.3-1(2) mm, rigid, usually unawned, sometimes awned, awns to 6(15) cm; paleas 1-1.7 mm wide, acute to acuminate or mucronate to 0.5 mm; anthers 1-2.5 mm, white or yellow; styles white, yellow, red, or blackish-purple. **Caryopses** 4.5-8 mm long, 2-3.5 mm wide, broadly elliptic or broadly oblong, brown, tan, or white; embryos 1.4-1.7 mm. **Haplome** A. **2n** = 24.”

Material examined. **O'ahu:** Drum Road - Erosion control area, 24 Apr 2007, J. Gustine USArmy 51 (BISH 727527). Waianae Kai-Kumaipo ridge, growing out of erosion control log, the state installed erosion control logs along Kumaipo Ride after a burn destroyed vegetation; the logs are now sprouting with this rice grass, 07 Oct 2004, J. Beachy USARMY 3 (BISH 710694).

***Panicum capillare* L.**

New State Record

Panicum capillare (Witchgrass) is now known from Hawai'i Island from a single collection from 1951 collected at Waimea. The label states that it was found in a seeded pasture and was likely a seed contaminant. *Panicum capillare* is native to North America, but has been widely introduced across Europe and South America. This plant can be identified via the key in Snow & Clayton (2010). It differs from other species of naturalized *Panicum* by being an annual, having a diffusely branched panicle, presence of both terminal and axillary panicles, and profusely hairy leaves and leaf sheaths. *Panicum capillare* is a weed of disturbed areas including pastures, roadsides, gardens, and agriculture, but has not been reported as an environmental weed (Clements et al. 2004).

The following description is from the Flora of North America (Barkworth et al. 2003:457).

“**Plants** annual; hirsute or hispid, hairs papillose-based, often bluish or purplish. **Culms** 15-130 cm, slender to stout, not woody, erect to decumbent, straight to zigzag, simple to profusely branched; nodes sparsely to densely pilose. **Sheaths** rounded, hirsute or hispid, hairs papillose-based; ligules membranous, ciliate, cilia 0.5-1.5 mm; blades 5-40 cm long, 3-18 mm wide, linear, spreading. **Panicles** 13-50 cm long, 7-24 cm wide, usually more than 1/2 as long as the plants, included at the base or exserted at maturity, disarticulating at the base of the peduncles

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

at maturity and becoming a tumbleweed; branches spreading; pedicels 0.5-2.8 mm, scabrous, pilose. **Spikelets** 1.9-4 mm, ellipsoid to lanceoloid, often red-purple, glabrous. **Lower** florets sterile; lower glumes 1/3– 1/2 as long as the spikelets, 1-3-veined; upper glumes 1.8-3.1 mm, 7-9-veined, midveins scabridulous; lower lemmas 1.9-3 mm, extending 0.4-1.1 mm beyond the upper florets, often stiff, straight, prominently veined distally; upper florets stramineous or nigrescent, sometimes with a prominent lunate scar at the base, often disarticulating before the glumes, leaving the empty glumes and lower lemmas temporarily persisting on the panicles. **2n** = 18.”

Material examined. **Hawai'i:** North Kohala, Waimea, rare in seeded pasture, 16 Aug 1951, E.Y. Hosaka 3647 (BISH 785776).

***Panicum coloratum* L.**

New Island Record

Panicum coloratum is now known from Hawai'i Island from a pasture at Ka'alaulu Ranch. This species is now known from both Moloka'i, Maui, and Hawai'i (Imada & Kennedy 2020).

Material examined. **Hawai'i:** Kau, Naalehu, occasional in pasture (Kaalaulu Ranch) in semi-moist section, upright, 1.5 to 2ft [.45 to .6m] tall, 02 Oct 1950, E.Y. Hosaka 3602 (BISH 782363).

***Pappophorum bicolor* E. Fourn**

New State Record

Pappophorum bicolor (called Pink Pappusgrass in the continental United States) is now known from one collection on Maui from the Kanounou point area. This is the first collection of this genus in Hawai'i, and it was identified using the key in Reeder & Toolin (1989). This grass is identifiable by the fact that it is a bunchgrass with a spike-like panicle and lemmas with 11 to 15 awns. It would be most likely to be confused with a *Cenchrus*, but *Cenchrus* has bristles which arise below the florets rather than bristles (awns) which arise from the tips of the florets. This species is native from Texas to Northern Mexico and has not been introduced elsewhere. It prefers dry habitats with 10-20 inches [25-50cm] of rain per year (Lloyd-Reilly 2010).

The following description is from the Flora of North America (Barkworth et al. 2003:286).

“**Plants** perennial, caespitose. **Culms** 30-80(100) cm. **Sheaths** mostly glabrous, apices with a tuft of hairs on either side; ligules about 1 mm; blades 10-20(30) cm long, 2-5 mm wide, flat to involute. **Panicles** 12-20 cm, narrow but usually with some slightly spreading branches, pink- or purple-tinged. **Spikelets** with the lower 2 or 3 florets bisexual, distal 1-2 florets sterile. **Glumes** 3-4 mm, thin, glabrous, apices acute or minutely notched and mucronate; lemmas somewhat firm, usually faintly 7-veined, with 11-15 awns; lowest lemma bodies 3-4 mm, midveins and margins pubescent from the base to about midlength, awns about 1.5 times as long as the lemma bodies; paleas subequal to the lemma bodies or slightly longer. **Caryopses** about 2 mm. **2n** = 100.”

Material examined. **Maui:** Northern West Maui, Kanounou Point, west side, about 20-30 plants on a grassy slope above cliffs, densely tufted, 40-50cm tall; inflorescence a spikelike panicle tapering to a narrow point; florets with 2 pubescent glumes [note by KF, glumes are glabrous on

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

specimen]; lemmas separating into several awnlike points, 200ft [60m], 15 Aug 2008, R.W. Hobby 4300 (BISH 763811).

***Paspalum humboldtianum* Flüggé**

New State Record

Paspalum humboldtianum was collected once on Kaua'i in 1953. It is unknown if the population has persisted and should be treated as a questionable record until recollected. It was keyed out using Chase (1929). It can be identified by its spikelets having ciliate to setose hairs around the circumference of the spikelet. It is most similar to *Paspalum fimbriatum* in outward appearance, but *P. fimbriatum* has no hairs on the spikelets.

This species is native to Central and South America, and this introduction in Hawai'i is apparently the first time this plant has been found outside of its native range. Little information is known about its ecology and none about its invasive potential. Chase (1929) states that it grows in "stony open or brushy slopes in the highlands from Mexico to Argentina."

The following description is taken from Chase (1929:22):

"A tufted perennial, erect or ascending from a woody decumbent base, and sometimes producing strongly scaly rhizomes; culms 40 to 80 cm., rarely nearly 1 meter, tall, commonly branching from the lower and sometimes middle nodes; nodes from densely bearded with appressed white hairs to glabrate; sheaths mostly overlapping, papillose-pilose along the margin and usually toward the summit, sometimes throughout, rarely nearly glabrous; ligule membranaceous, brown, 1 to 2 mm. long; blades flat, firm, spreading, 8 to 18 cm. long, 6 to 15mm. wide, slightly narrowed toward the base, acuminate into a stiff more or less involute point, the midnerve prominent beneath (the lower blades and those of the branches small, the uppermost reduced to a mere point) sparsely to rather densely pubescent to glabrate on the upper surface, the epidermis loosely cellular, a fringe of stiff white hairs back of the ligule, appressed - pubescent beneath with occasional long stiff hairs intermixed, the margins usually prominently papillose -ciliate; panicles consisting of 2 to 5 rarely 7 or 8, ascending to nodding, lax glistening silky racemes, 5 to 10 cm. long, about 7 mm. wide, 1 to 3 cm. distant on a slender flattened axis; rachis narrowly winged, 2 to 3 mm. wide, minutely scabrous or glabrous and with a tuft of long white hairs at the base; spikelets commonly solitary toward both ends of the raceme (the secondary spikelet undeveloped), in pairs in the middle, excluding the cilia about 3.2 mm. long, 1.1 mm. wide, elliptic, abruptly pointed; glume and sterile lemma equal, the glume 3-nerved, pubescent and edged with a fringe of glistening white hairs arising from papillae, at maturity becoming thick and corky, the hairs radiating like a corona, the lemma 3-nerved strigulose or glabrous, papery and wrinkled toward the base; fruit about 2.8 mm. long, narrowly obovoid, smooth and shining."

Material examined. **Kaua'i:** Kahaleo, one single clump on road-bank in semi-moist area, 18 Nov 1953, E.Y. Hosaka s.n. (BISH 785764).

***Paspalum lindenianum* A. Rich**

Correction

Paspalum lindenianum was initially published as occurring on Kaua'i by Wagner et al. (2005) and then incorporated into the checklist by Imada (2019). This species does not exist in the

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

Hawaiian flora and was accidentally added to the checklist due to a confusion with a synonym of *Paspalum longifolium*.

***Paspalum malacophyllum* Trin.**

New Island Record

Paspalum malacophyllum is now known from Hawai'i Island in the vicinity of Keaau at low elevations based on a collection from 1951. *Paspalum malacophyllum* has previously been documented on Maui (Imada 2019).

Material examined. **Hawai'i:** Keaau, growing in W. Shipman's Keaau place, local clumps in moist places, 10ft [3m], 23 Jul 1951, E.Y. Hosaka 3637 (BISH 785770).

***Paspalum mandiocanum* var. *mandiocanum* Trin.**

New Island Record;

Note

Paspalum mandiocanum var. *mandiocanum* has now been detected on Kaua'i from the parking lot area at Pu'u Hinahina. It has previously been collected on O'ahu, Moloka'i, and Maui (Imada 2019).

The key to *Paspalum* in Snow (2008) has an error in it regarding this species, the key says that this species has spikelets borne singly, the spikelets are actually borne in pairs on all specimens in the BISH collection.

Material examined. **Kaua'i:** Canyon Trailhead parking area, Pu'u Hinahina, Clumping grass along flat grassy borders of parking lot 3600ft [1097m], 12 Aug 2004, K.R. Wood 10915 (PTBG 048111).

***Paspalum notatum* Flügge**

New Island Record

Paspalum notatum is now known from multiple collections in the vicinity of Honolulu. *Paspalum notatum* had previously been planted as a pasture grass on O'ahu (Lyman s.n. BISH) giving the grass a clear introduction pathway. *Paspalum notatum* has previously been collected on Kaua'i, Moloka'i, Maui, and Hawai'i.

Material examined. **O'ahu:** Honolulu, along King St between Punahou and Ke'eaumoku St., in irrigated turf grass, large colony ca. 5 m wide, 21.298333, -157.839436, 22 Jun 2021, K. Faccenda 1998. Honolulu, intersection of Ke'eaumoku St. & Nehoa St., edge of road, mowed grass, colony ca. 2 m wide, not seen in other locations along road, 21.307809, -157.833200, 14 Jul 2021, K. Faccenda 2053. Diamond Head (Le'ahi) Crater, edge of visitor parking lot, sunny, irrigated mowed grass, common, large patch, confined to irrigated areas, 21.263603, -157.805378, 15 Jul 2021, K. Faccenda 2056. U.H. Pasture near residence, back of office, 26 Nov 1938, R. Lyman s.n. (BISH 782364).

***Paspalum pilosum* Lam.**

New Island Records

Previously identified on Moloka'i, this grass was found by the author growing as an abundant weed along the Mau'umae trail near Pololo on O'ahu. The population consists of thousands of plants and extends from about 0.5 mile from the trailhead, all the way to the Ko'olau summit

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

occupying approximately 2 miles of the ridgeline and ranging from approximately 1000 to 2400 ft [300-730 m] of elevation. The grass displays a concerning tolerance to different environmental conditions, the lowest elevation populations were growing amongst dry *Osteomeles*, *Casuarina*, and *Dodonaea* dominated habit, through intermediate moisture areas, and the grass was successfully competing with *Dicranopteris* in the wet native dominated high elevation areas. It ranged from common to abundant throughout the entire length of the trail. Based on its behavior in this area, this grass has the potential to be a significant environmental weed.

P. pilosum is also now known from Kaua'i based on a specimen which was previously misidentified as *P. unispicatum* by Snow & Davidse (2011).



Figure 10. *Paspalum pilosum* along the Mau'umae trail on January 23, 2022.

Material examined. **Kaua'i:** Halalei, Okolehao Trail, 22° 11' N, 159° 28' W, 175-325 ft [50-100 m], 30 Jun 2009, Stevenson 35 (BISH 746803) **O'ahu:** Mau'umae Trail, ca. 1.5 km from trailhead, dry area, uncommon along trail at this elevation, 21.304104, -157.779649, 15 Aug 2021, K. Faccenda 2083. Mau'umae Trail, ca. 1 km from trailhead, along trail, common, dominant grass along trail from this elevation upward, 21.305392, -157.778211, 15 Aug 2021, K. Faccenda 2084.

***Paspalum plicatulum* Michx**

New State Record

Paspalum plicatulum (known as Brownseed Paspalum in North America) is now known from Kaua'i from a single specimen which was previously identified as *Paspalum longifolium*. *Paspalum plicatulum* is native from the Southern United States through most of South America. This grass has previously been introduced to Asia and New Guinea. Its effects as an invasive do not seem to have been reported. It can be distinguished from other species of *Paspalum* by the key below. In the Southeastern United States *P. plicatulum* occurs in wet meadows, roadsides, ditches, and prairies, where it can become abundant (USGS 2021).

The following description is from the Flora of North America (Barkworth et al. 2003:581).

“**Plants** perennial; shortly rhizomatous, often indistinctly so. **Culms** 30-110 cm, stout, erect; nodes glabrous. **Sheaths** glabrous; ligules 2-3 mm; blades to 35 cm long, 2-5.4 mm wide, conduplicate (rarely flat). **Panicles** terminal, with 2-7 racemously arranged branches; branches 1.6-7.1 cm, usually divergent, rarely merely ascending; branch axes 0.6-1.1 mm wide, glabrous, terminating in a spikelet. **Spikelets** 2.5-3 mm long, 1.5-2.2 mm wide, paired, appressed to the branch axes, elliptic-ovate, light to dark brown. **Lower** glumes absent; upper glumes usually with short, appressed pubescence, rarely glabrous, 5-veined, margins entire; lower lemmas with short, appressed pubescence or glabrous, 3-veined, margins entire; upper florets dark glossy brown. **Caryopses** 1.4-1.6 mm, brown. **2n** = 20, 40, 60.”

Material examined. **Kaua'i:** Koloa District; Kahili Mountain Park, common along roadside and in mown “lawn” area, clump forming with erect inflorescences, 800 ft, 14 Jul 2000, T. Flynn 6727 (BISH 666248).

***Paspalum setaceum* Michx**

Correction

Examination of specimens from Maui previously published by Oppenheimer (2007) reveals that all BISH specimens from Maui were misidentifications of *Paspalum mandiocanum*. *Paspalum setaceum* is now only known in Hawai'i from Midway Island.

***Paspalum sumatrense* Roth**

Taxonomic Note;

Corrections; New Island Record

The name *Paspalum longifolium* Roxb. has been replaced by *Paspalum sumatrense* Roth. as *P. longifolium* is a *nomen nudum* (Middleton et al. 2019). Therefore, any material previously called *P. longifolium* in Hawai'i is now best referred to as *P. sumatrense*.

Paspalum sumatrense (as the synonym *P. longifolium*) was published for Maui by Oppenheimer (2004), but the same specimen (Oppenheimer H70202) was then reidentified as *P. mandiocanum* var. *mandiocanum* by Snow & Davidse (2011) and published as a new island record without retracting the *P. sumatrense* island record for Maui. *Paspalum longifolium* was also published for Kaua'i (Staples et al. 2003) however, this represented a misidentification of *P. plicatulum*. *Paspalum sumatrense* is therefore not known to occur on Maui or Kaua'i as no other specimens have been seen.

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

Paspalum sumatrense is now known only from O'ahu from the islet of Moku'auia based on a new specimen discovered in the HAW herbarium.

Material examined. **O'ahu:** Moku'auia, common grass, in sand, 16 May 1964, C.R. Long 1731 (HAW 47184).

Paspalum unispicatum (Scribn. & Merr.) Nash

Correction

While making a key to *Paspalum*, it was noticed that there was no observable difference between *Paspalum pilosum* and "*Paspalum unispicatum*". Further research revealed that the specimen previously published by Snow & Davidse (2011) is actually *P. pilosum* based on the presence of dimorphic lower glumes. True *P. unispicatum* is not known from Hawai'i and should be removed from the checklist.

Key to *Paspalum* in Hawai'i

The inflorescence of *Paspalum* is a panicle composed of one to many spike-like branches, simply referred to as branches in this key.

1. Inflorescences both terminal and axillary on the same culm (often manifesting as 2 inflorescences which *appear* to arise terminally since they arise out of the same leaf sheath but are not united at the base); each panicle composed of 1-2 (rarely 3-6) branches
 2. Each inflorescence composed of one solitary branch; lower glumes dimorphic between paired spikelets, acute and ~1.5 mm on lower spikelet and absent or reduced to a minute rim 0.1 mm long on upper spikelet ... *P. pilosum*
 2. Each inflorescences with 1-4 branches; lower glumes absent on all spikelets [only known from Midway as of 2022] ... *P. setaceum*
1. Inflorescence terminal, never axillary; each panicle composed of 2-70 branches
 3. Panicle with a terminal **pair** of branches, occasionally with one additional branch below the pair; plants long rhizomatous or stoloniferous
 4. Spikelets 1-2 mm long; upper glume pilose around the edges ... *P. conjugatum*
 4. Spikelets > 2 mm long; upper glume without hairs concentrated on its edges
 5. Short rhizomatous with leaves concentrated at tip of rhizome; rhizomes thick 3-8mm wide; spikelets ovate, rounded at apex ... *P. notatum*
 5. Long stoloniferous, leaves evenly distributed along stolon; stolons thin, 1-3mm wide; spikelets elliptic-lanceolate, acute at apex;
 6. Spikelets 2.4-3.2 mm long; upper glume obscurely hairy ... *P. disticum*
 6. Spikelets 3-4.5 mm long; upper glume glabrous ... *P. vaginatum*
 3. Panicle with > 2 branches, these **not paired** at the apex of the raceme; plants caespitose, rarely with rhizomes/stolons
 7. Panicle with 3-10 branches
 8. Upper glume fringed with hairs or a lacerate wing
 9. Upper glume fringed with a lacerate, papery wing ... *P. fimbriatum*
 9. Upper glume fringed with hairs
 10. Upper glume fringed with stiff, spreading hairs; spikelets 2.5-2.8 mm long ... *P. humboldtianum*
 10. Upper glume fringed with soft, hairs; spikelets 2.3-5 mm long
 11. Leaves < 1 cm wide; panicle branches < 6; hairs on spikelets long and wispy, at least some > 1 mm... *P. dilatatum*

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

11. Leaves > 1 cm wide; panicle branches > 6; hairs on spikelet short and erect, < 0.7 mm ... *P. virgatum* (in part)
8. Upper glume without fringe of hairs or lacerate wing around its edge
 12. Spikelets borne singly ... *P. scrobiculatum*
 12. Spikelets borne in pairs (the lower of the pair may be aborted in some parts of the inflorescence)
 13. Leaves < 9 mm wide; leaves glabrous; leaves linear, their width uniform or tapering from base
 14. Spikelets 1.7-2.5 mm long; spikelets neatly and closely arranged; fertile lemma pale yellow; rachis widely winged, 1.5-3 mm wide ... *P. sumatrense*
 14. Spikelets 2.5-3 mm long; spikelets loosely and disorderly arranged; fertile lemma dark glossy brown; rachis weakly winged, ~1 mm wide ... *P. plicatum* (in part)
 13. At least some leaves > 10 mm wide; leaves often pilose or hispid; leaves lanceolate, their width greatest towards middle
 15. Leaf margins scabrous or smooth, without cilia; spikelets glabrous or with limited hairs on edge of glume; leaves oppressed pilose ... *P. mandiocanum*
 15. Leaf margin ciliate; spikelets evenly pubescent on glume; leaves glabrous or pubescent... *P. macrophyllum*
7. Panicle with > 10 branches
 16. Spikelets ~1 mm thick, with a noticeable bulge in the central portion; spikelets of dried material often bicolored with a brown center portion and green rims ... *P. plicatum* (in part)
 16. Spikelets ~0.5 mm thick, relatively uniform in thickness, or hemispherical in *P. paniculatum*; color uniform
 17. Spikelets entirely glabrous
 18. Sterile lemma ribbed over the veins; both glumes lacking; weaker grasses with culms typically < 6 mm in diameter at base ... *P. malacophyllum*
 18. Sterile lemma smooth; upper glume present; robust grasses with large culms ~ 1 cm diameter at base ... *P. arundinaceum*
 17. Spikelets with at least some hairs visible under 10x magnification
 19. Spikelets evenly pubescent on glume; spikelets small, 1-1.3 mm in long ... *P. paniculatum*
 19. Spikelets with hairs concentrated on glume edge; spikelets larger, 2-3 mm long
 20. Glume with a long ciliate fringe around their edge, this obvious without magnification ... *P. urvillei*
 20. Glume with a short ciliate fringe around the edge, the hairs only visible under magnification ... *P. virgatum* (in part)

***Rytidosperma caespitosum* (Gaudich.) Connor & Edgar**

Correction

Rytidosperma caespitosum was previously reported for the state by Darbyshire et al. (2010) based on two specimens (E.Y. Hosaka 1767 BISH 488643 & E.Y. Hosaka 2472 BISH 593346). Examination of these two specimens reveals that they are no different from *Rytidosperma biannulare* after consulting keys in AusGrass2 (Simon & Alfonso 2011), Flora of New Zealand (Edgar & Connor 2000), and the key within Darbyshire et al. (2010). In all of these keys the

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

specimens previously annotated as *R. caespitosum* keyed to *R. biannulare*. Therefore, there are now no known records of *R. caespitosum* for the state and the species should be removed from the checklist.

***Setaria distans* (Trin.) Veldkamp New Island Record**

Taxonomic Note,

Formerly treated as *Paspalidium distans*, molecular work now shows the entire genus of *Paspalidium* to be embedded within *Setaria* (Morrone et al. 2014). Therefore, *Paspalidium distans* is now a synonym of *Setaria distans*.

Previously recorded from Ni'ihau, *Setaria distans* is now known from Moloka'i at Pauwalu. It is quite similar in outward appearance to *Echinochloa colona*, but differs in having a ciliate ligule, a rugose lemma, glabrous spikelets, and inflorescence branches which end in a small spine rather than a spikelet.

Material examined. Moloka'i: Pauwalu, occasional in open pasture, forming tufts, grazed by animals, 19 Apr 1937, E.Y. Hosaka 1858 (BISH 785686).

***Setaria italica* (L.) P.Beauv.**

New State Record

Setaria italica has previously been collected from cultivated occurrences on Hawai'i Island and O'ahu during the 1920s. It is now known to be naturalized on Kaua'i. Two duplicates of this specimen were independently identified by both W.D. Clayton (BISH specimen) in 2001 and Zelda V. Akulova-Bartow (PTBG specimen) in 2002. These specimens have sat in the herbarium collections, unrecognized as a new state record until now.

Setaria italica is a species of human origin which is now found almost worldwide. It is cultivated as a grain used in bird seed which may have been its introduction pathway. As a weed, it is mainly found in disturbed areas including roadsides, pastures, and agriculture (Barkworth et al. 2003; Li & Brutnell 2011)

The following description is from the Flora of North America (Barkworth et al. 2003:556).

“**Plants** annual. **Culms** 10-100 cm. **Sheaths** mostly glabrous, margins sparsely ciliate; ligules 1-2 mm; blades to 20 cm long, 1-3 cm wide, flat, scabrous. **Panicles** 8-30 cm, dense, spikelike, occasionally lobed below; rachises hispid to villous; bristles 1-3, to 12 mm, tawny or purple. **Spikelets** about 3 mm, disarticulating between the lower and upper florets. **Lower** glumes 3-veined; upper glumes 5-7-veined; lower paleas absent or 1/2 as long as the lower lemmas; upper lemmas very finely and transversely rugose to smooth and shiny, exposed at maturity. **2n** = 18.”

Material examined. Kaua'i: Kawaihau District. Hwy 56 in Wailua between Halelio and Kapaa bypass roads, ruderal vegetation with *Chloris*, *Macroptilium*, and *Panicum*, clumping grass of 3ft [0.9m] with nodding heads, only seen in this location, 10ft [3m], 31 Jul 1997, T. Flynn 6195 (BISH 658179).

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

***Sorghum halepense* (L.) Pers.**

New Island Record

Sorghum halepense was collected on Moloka'i, but the only specimen existed at HAW and was only recently identified to species. It is now known from all the main islands except for Kaho'olawe.

Material examined. Moloka'i: In marshy ground near mouth of Halawa Valley, 5ft [1.5m], 02 Mar 1968, C.H. Lamoureux & A.C. Smith 4103 (HAW 29958)

***Sporobolus jacquemontii* Kunth**

Correction

Sporobolus jacquemontii was initially entered into the Smithsonian Flora of the Hawaiian Islands online checklist by Wagner et al. (2005), and that record was then incorporated into the Imada (2019) checklist. This species does not exist in the Hawaiian flora and was added in error due to confusion with a synonym of *Sporobolus pyramidalis* (Warren Wagner pers. comm.).

***Sporobolus piliferus* (Trin) Kunth.**

Correction

Sporobolus piliferus was published as occurring on O'ahu and Midway by Snow (2008) where it was distinguished from *Sporobolus pyramidalis* by having a closed panicle. Field observations by the author have shown that plants with open and closed panicles grow side-by-side. Examination of the specimens of *S. piliferus* from Hawai'i species shows that they do not match photographed material of that species from its native range and that their habitat is also not as published in the literature; in Hawai'i, specimens identified as *S. piliferus* all come from saline coastal areas whereas in their native range, *S. piliferus* only occurs above 1300 m (Giraldo-Cañas & Peterson 2009). Examination of photographed specimens of *Sporobolus pyramidalis* from the National Herbarium (US) confirms that that species often has a closed spike and grows in coastal habitats. Therefore it must be concluded *Sporobolus piliferus* does not occur in Hawai'i and was a misidentification of *S. pyramidalis*.

***Trisetum inaequale* Whitney**

New Island Record

This work primarily focused on introduced species; however, one new range extension for a native species was discovered. *Trisetum inaequale* is now known from O'ahu from a single collection from Palikea which was only recently identified. This species is now from O'ahu, Lāna'i, and Maui (O'Connor 1990).

Material examined. O'ahu: Waianae District, Palikea, ridge between Nanakuli and Lualualei, lowland mesic forest and cliffs, collected on cliff, 330° NW aspect, rare, 815 m., 19 May 1992, K.R. Wood 1934 (PTBG 014647).

***Urochloa brizantha* (A.Rich.) R.D.Webster**

Correction

Urochloa brizantha was reported from O'ahu by Imada & Kennedy (2020). This is based on a misidentification of *Urochloa eminii*. These two species are difficult to separate, so the following key should prove useful to future workers; however, comparison to verified material at BISH is highly recommended as the species are so similar. *Urochloa brizantha* has been cultivated at experimental farms on O'ahu, but no wild material was found for this species from O'ahu. Therefore, *U. brizantha* is now only known to be naturalized on Maui.

***Urochloa distachya* (L.) T.Q. Nguyen**

New Island

Records; Correction

This species is known to be well established on Kaua'i, O'ahu, and Maui. It is now known from a single collection on Hawai'i island from 1938.

O'Connor (1990) lists *U. distachya* (as the synonym *U. subquadripara*) as occurring on Moloka'i. No specimens from US, HAW, PTBG, or BISH support this record and it should be removed from the checklist.

Material examined. **Hawai'i:** North Hilo, Humuula, Humuula Sheep Station, occasional in rocky places, 6600ft [2011m], 13 Jun 1938, E.Y. Hosaka 2341 (BISH 785685)

***Urochloa eminii* (Mez) Davidse**

Taxonomic Note

The species formerly treated as *Urochloa decumbens* in Hawai'i has now been lumped with *Urochloa eminii* and *Urochloa ruzizensis* as all three of these species overlap morphologically as well as not being distinct molecularly (Sosef 2016; Lizo 2021). As *U. eminnii* was published first, that name must be the accepted name due to priority.

***Urochloa glumaris* (Trin.) Veldkamp**

New State Record

Urochloa glumaris (syn. *Brachiaria paspaloides*) has been collected by the author in the vicinity of the University of Hawai'i campus in Mānoa and around Honolulu. The grass was found exclusively in urban areas, mostly in lawns and edges of sidewalks and no plants were found in any wildland situations. The population is well established and many thousands of plants exist in lawns and flowerbeds in moist to dry areas throughout the campus where it grows as a weed.

This grass is outwardly most similar to *Urochloa distachya* but differs in having a distinct mucro on the sterile lemma and having a lower glume that is 0.75 - 0.8x as long as the spikelet (the lower glume is 0.33 - 0.5x as long as the spikelet in *U. distachya*).

U. glumaris is native to India, SE Asia, and much of the Pacific. In its native range, this species is common in disturbed areas at low elevations (Veldkamp 1996). It has also been documented as a weed of corn when grown in the dry season in the Philippines (Pamplona 1988). The following description from Flora of China describes it as an annual, but it can also grow as a perennial (Veldkamp 1996).

The following description is from the Flora of China (Zhengyi et al. 2006:523) under the synonym *Urochloa paspaloides*:

“Annual. Culms slender, spreading, branching and rooting at lower nodes, 20–60 cm or more tall, nodes pubescent. Leaf sheaths glabrous or loosely pilose; leaf blades linear, 5–20 × 0.3–0.8 cm, thinly pilose on both surfaces with tubercle-based hairs, apex acuminate; ligule ca. 1 mm. Inflorescence axis 1.5–4 cm; racemes 2–4, 2–5 cm, rather stiffly ascending; rachis narrow, triquetrous, scabrous; spikelets usually paired, loosely overlapping. Spikelets lanceolate, 3.5–4 mm, glabrous, sharply acute; lower glume lanceolate, 2/3–3/4 spikelet length, 5–7-veined, acute

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

and apiculate; upper glume 5–7-veined, sharply acute; lower lemma obscurely 5-veined, palea very small; upper lemma elliptic-oblong, only slightly shorter than spikelet, finely rugulose, mucro 0.4–0.5 mm. Fl. and fr. May–Oct. $2n = 36$.”



Figure 11. *Urochloa glumaris* growing at the UH Mānoa campus. A, *U. glumaris* growing in turf grass, which is mowed weekly, with *Axonopus*. B, *U. glumaris* forming a mound about 40 cm tall in a sunny, neglected area.

Material examined. O‘ahu: UH Mānoa Campus near Varney Circle, in flower bed, weed, several clumps which were each about 0.7 m wide, 21.300325, -157.818564, 06 Jul 2021, K. Faccenda 2027. UH Mānoa, vicinity of Gilmore Hall, shaded lawn, not recently mowed, infrequent, 21.292435, -157.815396, 08 May 2021, K. Faccenda 1763 UH Mānoa campus, weed in lawn in the vicinity of the basketball court by Hale Wainani, mowed grass, sunny area, moist, not recently mowed, abundant, 21.293010, -157.813672, 19 May 2021, K. Faccenda 1834. UH Mānoa Campus, lower campus road by trailers, sunny waste areas, abundant, somewhat trailing grass to almost 30 cm tall, 21.293782, -157.819850, 19 May 2021, K. Faccenda 1839. Makiki Heights Dr. & Mott Smith Dr., sunny, weedy areas, common, 21.312340, -157.833388, 22 May 2021, K. Faccenda 1842. Honolulu, Lili‘uokalani Botanical Garden, weed in mowed grass, partly sunny, irrigated, uncommon, 21.318367, -157.856317, 12 Jun 2021, K. Faccenda 1978.

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

Urochloa reptans (L.) Stapf

New Naturalization

This grass was not listed as naturalized by Imada (2019) due to only being known from one collection in the Bishop Herbarium as of 2019. However, this grass has persisted and was recollected from several localities around O'ahu. One population was observed by the author in the lawn in the Lili'uokalani Botanical Garden in Honolulu. The grass was forming one large clump ~2 m across in a shaded lawn. No other populations were found despite considerable effort by the author in searching urban Honolulu, although one was found online on iNaturalist in the vicinity of Kaimuki at 3770 Sierra Drive (<https://www.inaturalist.org/observations/63451538>). This Kaimuki population has not yet been vouchered, but the photos are of sufficient quality to make a confident identification. Yet another population is known from Kailua discovered in the HAW herbarium.

An older record from 1936 was also found in the Agronomy Collection, setting the first known collection of this grass 10 years earlier than has previously been reported by Herbst & Clayton (1998). The Kamehameha Boys School was located on the Bishop Museum Campus, making this locality the same as the 1946 specimen.

Material examined. **O'ahu:** Mauka of Kawainui Swamp Regional Park, Kailua, several small patches, HPDL#317, 27 Oct 1994, C. Morden 1221 (HAW 44321 [in HPDL collection]). Honolulu, Lili'uokalani Botanical Garden, N. edge of garden, Weed at edge of mowed grass, partly sunny, moist area, Only one colony seen. Colony ca. 1m wide, 21.320464, -157.855306, 12 Jun 2021, K. Faccenda 1984. Honolulu, lawn of Kamehameha boy's school 06 Nov 1936, L.D. Whitney 4463 (BISH 785683).

Key to *Urochloa* in Hawai'i

1. Margins of primary panicle branches rachises tuberculate ciliate
 2. Racemes solid, crescent shaped, 0.5-1.2 mm wide; inflorescence branches 2-16; clump forming, without stolons; spikelets *often* appearing in 1 row on racemes [do not make identification solely based on the last character as it is not always reliable] ... *U. brizantha*
 2. Racemes flat, ribbonlike (may be curled and appearing crescent shaped), 1-1.7 mm wide; inflorescence branches 3-10; *often* with stolons; spikelets often appearing in 2 rows on racemes ... *U. eminii* (= *U. decumbens*)
1. Margins of primary panicle branches rachises scabrous to pubescent, not tuberculate
 3. Strongly stoloniferous; perennial; robust, typically 90-200 cm tall; panicles often with secondary branches; panicles with spikelets often disorderly arranged; nodes villous ... *U. mutica*
 3. Stoloniferous or not; annual or perennial; smaller, typically < 90 cm tall; panicles rarely with secondary branches; spikelets neatly arranged in panicles; nodes glabrous or villous
 4. Primary panicle branch rachises triquetrous (three angled), without wings
 5. Spikelets 1.5-2.2 mm long; spikelets glabrous ... *U. reptans*
 5. Spikelets 3-4 mm long; spikelets pubescent ... *U. mollis*
 4. Primary panicle branch rachises flattened or crescent shaped, often winged
 6. Fertile lemma with a short mucro ~1 mm long; lower glume > 0.7x as long as the spikelet ... *U. glumaris*

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

6. Fertile lemma without a mucro; lower glume < 0.5x as long as the spikelet;
7. Spikelets 4-5.5mm long; panicle branches 2-11 cm long; primary axis of panicle 10-20 cm long ... *U. plantaginea*
7. Spikelets 2.4-3.7mm long; panicle branches 1-6 cm long; primary axis of panicle 3-10 cm long ... *U. distachya* (= *U. subquadrifera*)

***Zoysia matrella* (L.) Merr.**

Potentially

Naturalizing

Zoysia matrella is a species of lawn grass widely planted across Hawai'i and now may be potentially naturalizing on O'ahu, where it has been collected along a road, a canal, a trail, and from exposed limestone at Lā'ie point. No evidence of sexual reproduction has been observed, however, and these populations are spreading purely vegetatively, although they flower prolifically.

A population of *Zoysia matrella* was observed along the Mau'umae trail where it was growing on a flat section of the trail about 2 x 3 m in size which is probably used for camping. Based on the presence of this grass in one of the only flat spots on this region of the trail, it is distinctly possible that the population was planted, but it is also possible that seeds stuck to the bottom of tents helped move it.

A single small clump of *Z. matrella* was observed by the author at Lā'ie point growing from a fully exposed area on almost bare limestone. It seems unlikely that this was planted given the extreme dry, exposed, and saline conditions. The plant observed was not reproductive, but a section was removed and cultivated until flowers appeared for positive identification. Another specimen was collected in 1984 on a roadside in Kahuku which may have also been naturalized.

Another population was observed in the Kawainui marsh near Kailua; this population was growing on the edge of flowing water on a hillside in full sun. The population was about 4 m long by 1-2 m wide and ran parallel along the stream.

Material examined. O'ahu: Kahuku Point, 1 mile East along Marconi Road, Jun 1984, Joanne Barta s.n. (BISH 471879). Mau'umae trail, about 1200 m mauka the trailhead, dry, sunny, exposed ridge top, small flat area on the right side of trail when ascending, one of the few flat areas along trail, probably used for camping, colony about 2 x 3 m in size, strongly rhizomatous, 21.305494, -157.778067, 23 Jan 2022, K. Faccenda 2213. La'ie point, sand on exposed limestone, full sun, saline, this was not flowering in habitat so a piece was taken and cultivated in Makiki Honolulu until it flowered so it could be identified it was collected in situ 15 Jul 2021, 21.648275, -157.912970, 26 Nov 2021, K. Faccenda 2169. Kawainui marsh, along walking path on North side of Marsh, growing on bank of stream South of the path., Sunny, moist due to proximity to water., Dense turf-forming grass covering an area about 2 x 4 m in area. Only this one colony observed, 21.402154, -157.755680, 09 Jan 2022, K. Faccenda 2192

***Zoysia pacifica* (Goudsw.) M.Hotta & Kuroki** **Potentially Naturalizing**

Taxonomic Note;

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

Formerly treated in Hawai'i as *Zoysia matrella* var. *pacifica*, this taxon is now generally accepted at the species level based on molecular and morphological traits (Anderson 2000, Chandra et al. 2017).

Zoysia pacifica, a common lawn grass, has now been found potentially naturalized on O'ahu where it has been collected along the Mau'umae trail. However, there is not currently strong evidence that this species is reproducing and therefore fully naturalized, as this patch may be either planted, or the signs of a newly naturalizing species. This note is published to bring awareness to the species on O'ahu so more evidence can be obtained.

A population / ramet was observed along the Mau'umae trail near Kaimuki, Honolulu was seen by the author. The population was about 20 meters long and about 2-4 m wide. It grew along both sides of the trail where the trampled areas were matt-forming, about 1-2 cm. tall, as it grew down from the ridge trail, the grass started mounding and grew up to 20 cm. tall. This population / ramet was within three meters from the clump of *Eremochloa ophiuroides* described above, and the proximity suggests they could have been planted together, but the difference in size between the two means they are of vastly different age. There was only one colony seen, and it was spreading entirely vegetatively with no satellite colonies observed.

Material examined. O'ahu: Mau'umae trail, about 600 m mauka the trailhead, dry, sunny, exposed ridge top along trail, large colony ca. 10 m long by 2-4 m wide following the trail, growing as a turf where trampled, and forming mounds to 20 cm tall in *Osteomeles* where not trampled, 21.302178, -157.781373, 23 Jan 2022, K. Faccenda 2213.

Key to *Zoysia* in Hawai'i

This key is based entirely on the key in Anderson (2000).

1. Inflorescences with < 15 spikelets; leaves < 0.5 mm wide ... *Z. pacifica*
1. Inflorescences with > 15 spikelets; leaves > 0.5 mm wide
 2. Pedicels > 1.75 mm long; leaf blades 2-4 mm wide when flattened (not yet known to be naturalized) ... *Z. japonica*
 2. Pedicels < 1.75 mm long; leaf blades < 2 mm wide when flattened ... *Z. matrella*

Acknowledgments

I thank the Herbarium Pacificum staff, especially Barbara Kennedy, Clyde Imada, and Nick Walvoord for their help in the herbarium. Thank you to Tim Flynn for providing photos and a loan of materials from the National Tropical Botanical garden. Thank you to Curt Daehler for encouraging me to undertake this work.

References

- ABRS** (2005). Flora of Australia (Vol 44b) Poaceae 3. Australian Biological Resource Study: Canberra; and CSIRO Publishing: Melbourne.
- ABRS** (2009). Flora of Australia (Vol 44a) Poaceae 2. Australian Biological Resource Study: Canberra; and CSIRO Publishing: Melbourne.

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

- Ainsworth, A., & Drake, D.R.** (2020). Classifying Hawaiian plant species along a habitat generalist-specialist continuum: Implications for species conservation under climate change. *PLoS one*, **15**(2), e0228573.
- Anderson, S.J.** (2000). Taxonomy of *Zoysia* (Poaceae) morphological and molecular variation. Texas A&M University.
- Barkworth, M.E., Capels, K.M., & Long, S.** (Eds.). (1993). Flora of North America, North of Mexico: Volume 24: Magnoliophyta: Commelinidae (in Part): Poaceae, Part 1 (Vol. 24). Oxford University Press on Demand.
- Barkworth, M.E., Capels, K.M., Long, S., Piep M.B.** (Eds.). (2003). Flora of North America, North of Mexico: Volume 25: Magnoliophyta: Commelinidae (in Part): Poaceae, Part 2 (Vol. 25). Oxford University Press on Demand.
- Bor N.L.** (1960). The grasses of Burma, Ceylon, India, and Pakistan. Pergamon Press 1960
- Chandra, A., Milla-Lewis, S., & Yu, Q.** (2017). An overview of molecular advances in zoysiagrass. *Crop Science* **57**(S1): S-73.
- Chang, N.K., & Kim, E.** (1990). Analysis of vegetation on the pavements and under the street trees in Seoul. *The Korean Journal of Ecology* **13**(4): 331-342.
- Chase, A.** (1929). *The North American species of Paspalum* (Vol. 28, No. 1). US Government Printing Office.
- Clayton, W.D. (Milne-redhead, E., Polhill, R.M. Eds.)** (1970). Flora of Tropical East Africa. Gramineae (Part 1) Crown agents for overseas governments and administrations .
- Clayton, W.D., Phillips S.M., Renvoize S.A., (Polhill, R.M. eds)**. (1974). Flora of Tropical East Africa Part 2. ISBN 0855920289.
- Clayton, W.D. Renvoize S.A, (Polhill, R.M. eds)**. (1982). Flora of Tropical East Africa Part 3 A.A. Balkema Rotterdam. ISBN 9061913039.
- Clayton, W.D., Renvoize. S.A.** (1986). Genera Graminum. Grasses of the World. Her Majesty's Stationery Office, London. ISBN 0-11-250006-4.
- Clayton, W.D., & Snow, N.** (2010). A Key to Pacific grasses. Royal Botanic Gardens, Kew.
- Clements, D.R., DiTommaso, A., Darbyshire, S.J., Cavers, P.B., Sartono, A.D.** (2004). The biology of Canadian weeds. 127. *Panicum capillare* L. *Canadian journal of plant science* **84**(1): 327-341. <https://cdnsciencepub.com/doi/pdf/10.4141/P02-147>
- Cope, T.A.** (1982). Flora of Pakistan, No. 143: Poaceae (E. Nasir and S.I. Ali, eds.). Pakistan Agricultural Research Council and University of Karachi, Islamabad and Karachi, Pakistan. 678 pp.
- Cope T.** (1999). Flora Zambesiaca Vol. 10 Part 2. Royal Botanical Gardens, Kew
- Darbyshire, S.J., Connor, H.E., & Ertter, B.** (2010). The Genus *Rytidosperma* (Poaceae) in the United States of America. *Journal of the Botanical Research Institute of Texas* **4**(2): 663-676.
- Daris, D.** (2007). California Brome Plant Factsheet. USDA. https://plants.usda.gov/DocumentLibrary/factsheet/pdf/fs_brca5.pdf
- Dias, A.C.R., Carvalho, S.J.P., Nicolai, M., Christoffoleti, P.J.** (2007). Problemática da ocorrência de diferentes espécies de capim-colchão (*Digitaria* spp.) na cultura da cana-de-açúcar. *Planta Daninha* **25**: 489-499.
- Edgar, E., & Connor, H.E.** (2000). Flora of New Zealand: Grasses vol V: Grasses. Manaaki Whenua Press. Lincoln, New Zealand

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

- Fernald M.L.** (1950). Gray's manual of botany. 8th ed. New York: American Book Co. Ixiv+1632 p.
- Flynn, T. and D.H. Lorence.** (1998). New naturalized plant records for the Hawaiian Islands. Bishop Museum Occasional Papers **56**: 5-6. <http://hbs.bishopmuseum.org/pdf/op56.pdf>
- Fortune, P.M., Pourtau, N., Viron, N., & Ainouche, M.L.** (2008). Molecular phylogeny and reticulate origins of the polyploid *Bromus* species from section *Genea* (Poaceae). *American Journal of Botany* **95**(4): 454-464.
- Gabbard, B.L., & Fowler, N. L.** (2007). Wide ecological amplitude of a diversity-reducing invasive grass. *Biological Invasions* **9**(2): 149-160.
- Giraldo-Cañas, D., & Peterson, P.M.** (2009). Revision of the genus *Sporobolus* (Poaceae: Chloridoideae: Sporobolinae) for northwest South America: Peru, Ecuador, Colombia, and Venezuela. *Caldasia* **31**(1): 41-76.
- Global Invasive Species Database** (2021) Species profile: *Imperata cylindrica*. Downloaded from <http://www.iucngisd.org/gisd/species.php?sc=16>
- Hamasha, H.R., von Hagen, K.B., & Röser, M.** (2012). *Stipa* (Poaceae) and allies in the Old World: molecular phylogenetics realigns genus circumscription and gives evidence on the origin of American and Australian lineages. *Plant Systematics and Evolution* **298**(2): 351-367.
- Henrard, J.T.** (1950). Monograph of the genus *Digitaria*. Universitaire Pers Leuven, Leiden, Netherlands.
- Herbst, D.R., & Clayton, W.D.** (1998). Notes on the grasses of Hawai'i: new records, corrections, and name changes. *Bishop Museum Occasional Papers* **55**(1): 17-38. <http://hbs.bishopmuseum.org/pubs-online/pdf/op55.pdf>
- Herbst, D.R., Wagner, W.L.** (1999). Contributions to the flora of Hawai'i: VII. *Bishop Museum Occasional Papers* **58**: 12–36. <http://hbs.bishopmuseum.org/pdf/herbst&wagner99.pdf>
- Hitchcock, A.S.** (1922). The grasses of Hawai'i. Bishop Museum Press.
- Hitchcock, A.S., & Chase, A.** (1950). Manual of the grasses of the United States: Revised by Agnes Chase. US Government Printing Office.
- Hohla, M.** (2006). Neues über die Verbreitung von *Eragrostis albensis*, *E. multicaulis* und *E. pilosa* in Österreich. *Linzer biol. Beitr* **38**(2): 1233-1253
- Howard, J.L.** (1994). *Bromus japonicus*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). <https://www.fs.fed.us/database/feis/plants/graminoid/brojap/all.html> [2021, November 5].
- Huang, T.-C.** (Ed). (2000). Flora of Taiwan volume 5 (2nd ed.). Taipei.
- Hügin, G.** (1999). Anmerkungen zur Unterscheidung von *Eragrostis multicaulis* und *Eragrostis pilosa*. *Bot. und Nat. in Hessen* **11**: 91-93.
- Hugo, E., Morey, L., Saayman-Du Toit, A.E., & Reinhardt, C.F.** (2014). Critical periods of weed control for naked crabgrass (*Digitaria nuda*), a grass weed in corn in South Africa. *Weed Science* **62**(4): 647-656.
- Imada, C.T.** (2019). Hawaiian naturalized vascular plant checklist (February 2019 update). *Bishop Museum Technical Reports, Honolulu, Hawai'i*. <http://hbs.bishopmuseum.org/publications/pdf/tr69.pdf>

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

- Imada, C.T., & Kennedy, B.H.** (2020) New Hawaiian plant records from Herbarium Pacificum for 2019. . *Bishop Museum Occasional Papers* **129**: 67–92.
<http://hbs.bishopmuseum.org/pubs-online/pdf/op129p67-92.pdf>
- Jauzein, P.** (1995). *Flore Des Champes Cultives*. INRA, Paris. 898 p.
- Kellogg, E.A.** (2015). *Flowering plants. Monocots: Poaceae* (Vol. 13). Springer.
- Kim, H.H., & Pyon, J.Y.** (1998). Weed occurrence and yield loss due to weeds in different direct-seeded rice paddy fields. *Korean Journal of Weed Science* **18**(1): 12-19.
- Koch, S. D.** (1974). The *Eragrostis pectinacea-pilosa* complex in North and Central America (Gramineae: Eragrostoideae) **48**. Urbana, University of Illinois Press.
- Kuoh, C-S., Chen, C-H.** (2000). Pooideae In Huang, T.-C. (Ed) *Flora of Taiwan* volume 5 (2nd ed.). Taipei.
- Lazarides, M.** (1997). A revision of *Eragrostis* (Eragrostideae, Eleusininae, Poaceae) in Australia. *Australian Systematic Botany* **10**(1): 77-187.
- Li, P., & Brutnell, T.P.** (2011). *Setaria viridis* and *Setaria italica*, model genetic systems for the Panicoid grasses. *Journal of experimental botany* **62**(9): 3031-3037.
- Lloyd-Reilley, J.** 2010. Plant guide for pink pappusgrass (*Pappophorum bicolor*). USDA-Natural Resources Conservation Service, E. “Kika” de la Garza Plant Materials Center. Kingsville, TX. https://plants.usda.gov/DocumentLibrary/plantguide/pdf/pg_pabi2.pdf
- Mallet, K.** (ed.) (2005). *Flora of Australia*, volume 44B: Poaceae 3. CSIRO Publishing. Melbourne
- Masters, L.** (2021) Diversity and evolution in *Urochloa* grasses for the application in sustainable tropical forage systems. Masters Thesis, Queen Mary University of London
<https://doi.org/10.34885/ava5-x886>
- Middleton, D.J., Leong-Škornicková, J., Lindsay, S.** (Eds.) (2019). *Flora of Singapore* 7: Poales 1-525. Singapore Botanic Gardens.
- Morrone, O., Aliscioni, S.S., Veldkamp, J.F., Pensiero, J.F., Zuloaga, F.O., & Kellogg, E.A.** (2014). Revision of the Old World species of *Setaria* (Poaceae: Panicoideae: Paniceae). *Systematic Botany Monographs* **96**: 1-161.
- Morales-Nieto, C.R., Álvarez-Holguín, A., Santellano-Estrada, E., Villarreal-Guerrero, F., & Corrales-Lerma, R.** (2020). Reducing *Eragrostis lehmanniana* populations by preparing seedbeds with unconventional tillage implements and seeding in a semiarid grassland. *Invasive Plant Science and Management* **13**(4): 266-275.
- Nishimoto, T.** (2016) Vegetation changes over 20 years following transplantation from a natural to an artificial wetland. *Bull. Okayama Pref. Nature Conservation Center* **23**: 19-36.
https://www.researchgate.net/profile/Takasshi-Nishimoto-2/publication/301608121_Vegetation_changes_over_20_years_following_transplantation_from_a_natural_to_an_artificial_wetland/links/571c7c2d08ae7f552a481b6d/Vegetation-changes-over-20-years-following-transplantation-from-a-natural-to-an-artificial-wetland.pdf
- O'Connor, P.J.** (1990). Poaceae. In: Wagner W.L., Herbst D. R. & Sohmer S. H. (Eds.), *Manual of the flowering plant of Hawai'i* Vol 2. (pp. 1481-1604). University of Hawai'i Press & Bishop Museum Press, Honolulu.
- Oliver, D.** (1920) *Flora of tropical Africa*. Vol. 9. No. 4. L. Reeve and Company
- Oppenheimer, H.** (2003). New Plant Records from Maui and Hawai'i Counties. *Bishop Museum Occasional papers*, 73, 3-30 <http://hbs.bishopmuseum.org/pubs-online/pdf/op73.pdf>

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

- Oppenheimer, H.** (2004). New Hawaiian plant records for 2003. *Bishop Museum Occasional Papers* **79**: 8-20. <http://hbs.bishopmuseum.org/pubs-online/pdf/op79.pdf>
- Oppenheimer, H.** (2006). New Hawai'i Plant Records for 2004. *Bishop Museum Occasional Papers* **88**: 10-15. <http://hbs.bishopmuseum.org/pubs-online/pdf/op88.pdf>
- Oppenheimer, H.** (2007). New plant records from Moloka'i, Lāna'i, Maui, and Hawai'i for 2006. *Bishop Museum Occasional Papers*, **96**, 17-34
<http://hbs.bishopmuseum.org/pubs-online/pdf/op96.pdf>
- Oppenheimer, H.** (2008). New Hawaiian plant records for 2007. *Bishop Museum Occasional papers* **100**: 22-38. <http://hbs.bishopmuseum.org/pubs-online/pdf/op100.pdf>
- Oppenheimer, H.** (2016). New Hawaiian Plant Records for 2015. *Bishop Museum Occasional Papers* **118**: 23-28. <http://hbs.bishopmuseum.org/pubs-online/pdf/op118p23-28.pdf>
- Pamplona, P.P.** (1988, June). Weed control management in corn in the Philippines. In *Asian Regional Maize Workshop* **3**: 148-149.
- Peterson, P.M., Soreng, R.J., Romaschenko, K., Barberá, P., Quintanar, A., Aedo, C., Saarela, J.M.** (2021) Phylogeny and biogeography of *Calamagrostis* (Poaceae: Pooideae: Poaeae: Agrostidinae), description of a new genus, *Condilorachia* (Calothecinae), and expansion of *Greeneochloa* and *Pentapogon* (Echinopogoninae). *Journal of Systematics and Evolution*. <https://doi.org/10.1111/jse.12819>
- Reeder, J. R., & Toolin, L. J.** (1989). Notes on *Pappophorum* (Gramineae: Pappophoreae). *Systematic Botany* **15**(3): 349-358.
- Ripperton, J.C., Goff, R.A., Edwards, D.W., Davis, W.C.** (1933). Range grasses of Hawai'i. *Bulletin of the Hawai'i Experiment Station* **65**.
- Rivas Ponce, M.A.** (1988). Nuevos datos para la diagnosis de *Bromus rubens* L. y *B. madritensis* L. (Poaceae). *Lagasalia* **15**(1): 89-93.
- Rotar, P.P.** (1968). Grasses of Hawai'i. University of Hawai'i Press.
- Russell G.G.E., Watson, L, Koekemoer, M, Smook, L, Barker, N.P, Anderson, H.M, Dallwitz, M.J.** (1991). Grasses of Southern Africa. National Botanic Garden.
- Ryves, T.B., Clement, E.J., Foster, M.C.** (1996): Alien grasses of the British Isles. Botanical Society of the British Isles, London, 181 pp.
- Sales, F.** (1994). A Reassessment of the *Bromus madritensis* Complex (Poaceae): A Multivariate Approach. *Israel Journal of Plant Sciences* **42**(3): 245–255.
<https://doi.org/10.1080/07929978.1994.10676577>
- Scholz, H.** (1988). Zwei neue Taxa des *Eragrostis pilosa*-Komplexes (Poaceae). *Willdenowia*, **18**(1), 217-222.
- Shouliang, C., Peterson, P.M.** (2006) *Eragrostis* IN Zhengyi, W., Raven, P. H., Deyuan, H. (Eds.) (Eds.) *Flora of China*, Volume 22: Poaceae. Missouri Botanical Garden Press. St. Louis
- Simon, B.K. & Alfonso, Y.** (2011). AusGrass2. <http://ausgrass2.myspecies.info/> accessed on 2021-06-12.
- Simpson, C. E., & Bashaw, E. C.** (1969). Cytology and reproductive characteristics in *Pennisetum setaceum*. *American Journal of Botany* **56**(1): 31-36.
- Smith, R. B.** (1950). Tabaquite grass. *Ischaemum aristatum*. *Proceedings of the Agricultural Society of Trinidad and Tobago* **50**: 335-40.

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

- Snow, N.** (2010). Notes on grasses (Poaceae) in Hawai'i: 2. *Bishop Museum Occasional Papers* **107**: 46-60. <http://hbs.bishopmuseum.org/pubs-online/pdf/op107.pdf>
- Snow, N., Davidse, G.** (2011). Notes on grasses (Poaceae) in Hawai'i: 3. *Bishop Museum Occasional Papers* **110**: 17–22. <http://hbs.bishopmuseum.org/pubs-online/pdf/op110p17-22.pdf>
- Sosef, M.S.** (2016). Taxonomic novelties in central African grasses (Poaceae), Paniceae 1. *Plant Ecology and Evolution* **149**(3): 356-365.
- Souza, R.C., Dias, A.C., Figueiredo, M.R.A., Obara, F.E.B., Christoffoleti, P.J.** (2012). Growth of the crabgrass species *Digitaria ciliaris* and *Digitaria nuda*. *Planta Daninha* **30**: 317-325.
- Space, J.C., & Falanruw, M.** (1999). *Observations on invasive plant species in Micronesia*. US Department of Agriculture, Forest Service, Pacific Southwest Research Station, Institute of Pacific Islands Forestry. http://www.hear.org/AlienSpeciesInHawaii/articles/pier/pier_micronesia_report.pdf
- Staples, G.W. and D.R. Herbst.** (2005). *A Tropical Garden Flora: Plants Cultivated in the Hawaiian Islands and Other Tropical Places*. Bishop Museum Press, Honolulu.
- Staples, G.W., Imada, C.T. & Herbst, D.R.** (2003). New Hawaiian plant records for 2001. *Bishop Museum Occasional Papers* **74**: 7–21. <http://hbs.bishopmuseum.org/pubs-online/pdf/op74.pdf>
- State of Hawai'i.** (1992). Hawai'i Administrative Rules Title 4, Department of Agriculture Subtitle 6, Division of Plant Industry Chapter 68, Noxious Weed Rules <https://hdoa.hawaii.gov/pi/files/2013/01/AR-68.pdf>
- Tiwari, A.P., & Landge, S.N.** (2021). *Capillipedium mistryi* (Andropogoneae, Poaceae): a new remarkable species from central India. *Phytotaxa* **498**(1): 51-57.
- ТSvelev, N.N.** (1983). *Grasses of the Soviet Union*. Oxonian Press Pvt. Ltd.
- Tutin, T. G.** (1964). *Flora Europaea Volume 5 Alismataceae to Orchidaceae (Monocotyledones)*. Cambridge: University Press.
- Uchytel, R.J.** (1992). *Eragrostis lehmanniana*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: <https://www.fs.fed.us/database/feis/plants/graminoid/eraleh/all.html> [2021, November 9].
- USGS** (2021). *Paspalum plicatulum*, Plants of Louisiana. <https://warcapps.usgs.gov/PlantID/Species/Details/3525>
- Van der Meijden, R., & Weeda, E.J.** (1982). *Eragrostis pilosa* (L.) Beauv. en E. minor Host in Nederland. *Gorteria* **11**(5): 106-113.
- Van Valkenburg, J.L.C.H., Costerus, M., & Westenberg, M.** (2021). *Pennisetum setaceum* or *Pennisetum advena* cultivars, what ornamental do we have in our garden. *Ecology and Evolution* **11**(16): 11216-11222.
- Veldkamp, J. F.** (1973). A revision of *Digitaria* Haller (Gramineae) in Malesia. JJ Groen en Zoon.
- Veldkamp, J. F.** (1996). *Brachiaria, Urochloa* (Gramineae-Paniceae) in Malesia. *Blumea: Biodiversity, Evolution and Biogeography of Plants* **41**(2): 413-437.
- Veldkamp, J. F.** (2002). Revision of *Eragrostis* (Gramineae, Chloridoideae) in Malesia. *Blumea: Biodiversity, Evolution and Biogeography of Plants*, **47**(1): 157-204.

PRE-PRINT DRAFT. NOT YET PEER REVIEWED.

- Veldkamp, J. F.** (2014). A revision of *Cenchrus* incl. *Pennisetum* (Gramineae) in Malesia with some general nomenclatural notes. *Blumea-Biodiversity, Evolution and Biogeography of Plants* **59**(1): 59-75.
- Wagner, W.L., Herbst D.R., & Lorence D.H.** (2005–). Flora of the Hawaiian Islands website. <https://naturalhistory2.si.edu/botany/Hawaiianflora/>.
- Walsh, R.A.** (1995). *Dichanthelium acuminatum*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). <https://www.fs.fed.us/database/feis/plants/graminoid/dicacu/all.html>
- Weakley, A.S., LeBlond, R.J., Sorrie, B.A., Witsell, C.T., Estes, L.D., Gandhi, K., Mathews, K.G., Ebihara, A.** (2011). New combinations, rank changes, and nomenclatural and taxonomic comments in the vascular flora of the southeastern United States. *Journal of the Botanical Research Institute of Texas* **5**(2): 437-455.
- Weakley, A.S.** (2020). Flora of the Southeastern United States. University of North Carolina at Chapel Hill Herbarium
- Webster, R.D.** (1983). A revision of the genus *Digitaria* Haller (Paniceae: Poaceae) in Australia. *Brunonia* **6**(2): 131-216.
- Webster, R.D., & Hatch, S.L.** (1990). Taxonomy of *Digitaria* section *Aequiglumae* (Poaceae: Paniceae). *SIDA, Contributions to Botany* **14**(2): 145-167.
- Werier, D.** (2020) The Nonnative Crab Grasses (Genus *Digitaria*) of New York <https://nyflora.org/the-nonnative-crab-grasses-digitaria-of-new-york/>
- Whitney, L.D., Hosaka, E.Y., & Ripperton, J.C.** (1939). Grasses of the Hawaiian Ranges. *Bulletin of the Hawai'i Agricultural Experiment Station* **82**.
- Wilhelm, T.** (2009). *Digitaria ciliaris* in Europe. *Willdenowia* **39**(2): 247-259.
- Wipff, J. K., & Veldkamp, J. F.** (1999). *Pennisetum advena* sp. nov. (Poaceae: Paniceae): a common ornamental grass throughout the southern United States. *SIDA, Contributions to Botany*, **18**(4), 1031-1036.
- Zhengyi, W., Raven, P. H., Deyuan, H.** (Eds.) (2006). Flora of China, Volume 22: Poaceae. Missouri Botanical Garden Press. St. Louis.
- Zizka, G.** (1988). Revision der Melinideae Hitchcock. E. Schweizerbart'sche Verlagsbuchh.