

## Twenty additions to the naturalized flora of Lānaʻi

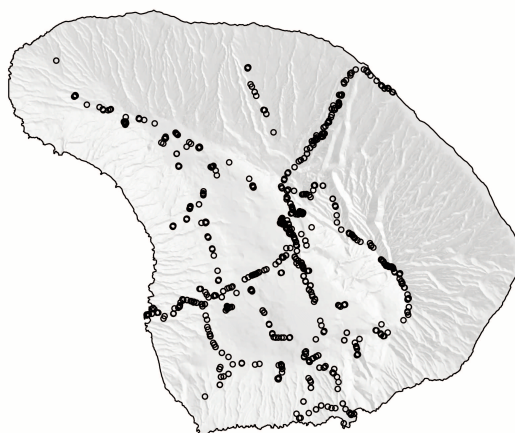
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Between June 18 and 23, 2023, roadside surveys were conducted across the island of Lānaʻi with the goal of early detection of new invasive species, as well as mapping the distribution of existing invasive species. The island was covered by surveys on foot around Lānaʻi City, on an e-bike along the paved roads, and via truck along dirt roads. Stops were made approximately every kilometer to survey the roadside on foot for several hundred meters, or when an unusual plant was spotted (Fig 1).



**Figure 1.** Map of areas visited on Lānaʻi during this survey. Each circle represents an area where data was recorded.

Weather conditions leading up to the fieldwork were suboptimal, as most of the island below 300 m [1000 ft] elevation was incredibly dry and the vegetation was dormant. However, the basins, city, and former plantation land had recently received rain and most plants were flowering. Therefore, surveys were focused on these greener areas, and future surveys below 300 m may find species that were overlooked during this work.

The grass flora of Lānaʻi is generally similar to that on the other islands. From 0–240 m [0–800 ft] the grass communities largely consisted of *Cenchrus ciliaris* monocultures on the leeward sides of the island, and *Bothriochloa pertusa* monocultures on the

windward side. Large populations of the native pili (*Heteropogon contortus*) were also observed on both sides of the island. In some areas along Keōmoku Road, pili was the dominant species.

At higher elevations, such as that of the former plantation lands, the grass flora was dominated by Guinea grass (*Megathyrsus maximus*), but a large amount of *Hyparrhenia hirta* was also found, much more than was seen on any other island. There were large areas entirely dominated by *Hyparrhenia* to the exclusion of all other grasses. On no other islands was *Hyparrhenia hirta* as dominant as it is on Lānaʻi. Sourgrass (*Digitaria insularis*) was also found as a dominant species in this zone.

On Lānaʻihale the grass density was surprisingly low, even in the fenced units with low deer density. Narrowleaf carpetgrass (*Axonopus fissifolius*) was common along the road, but few grasses were seen away from the road. *Paspalum urvillei* and *Andropogon virginicus* were the only significant grasses seen growing away from the roadside, and they were not common.

There have been no dedicated weed surveys around the island in the recent past, so many new naturalizations were found during this work that have surely been established for many decades, although opportunistic reports have been published such as Oppenheimer & Bogner 2020. In total, 18 new island records were found, along with 2 confirmations of naturalization of species previously reported only as questionably naturalized. All identifications were made by the first author. Voucher collections mentioned are housed in Bishop Museum's Herbarium Pacificum (BISH), Honolulu, Hawaiʻi.

### Amaranthaceae

#### *Atriplex muelleri* Benth.

#### New island record

*Atriplex muelleri* was found during roadside surveys naturalized at the Young Brothers shipping terminal, where about 50–100 plants were found growing from open sunny areas around equipment. Given that this species was only found at the port and had not yet spread, its introduction mechanism is clear. This species was recommended to the Pūlama Lānaʻi Conservation Department for eradication. *Atriplex muelleri* is now known to be naturalized on Oʻahu, Lānaʻi, and Maui (Imada & Kennedy 2020), although it also occurs on Molokaʻi and Hawaiʻi but has not yet been collected or published.

*Material examined.* LĀNAʻI: Kaunalapau Harbor, Young Brothers shipping terminal, open, partially shaded area next to structure, dry, about 50 plants seen, only seen at this spot, 16 m, 20.787374, -156.991107, 19 Jun 2023, K. Faccenda 3120.

### Crassulaceae

#### *Kalanchoe* × *houghtonii* D.B. Ward

#### New island record

Hundreds of plants of *Kalanchoe* × *houghtonii* were seen at the Lānaʻi Cemetery, where it has surely spread from cultivation. The plants seen were only reproducing vegetatively through plantlets, and none in the area were seen surpassing 10 cm height. *Kalanchoe* × *houghtonii* is now known to be naturalized on Kauaʻi, Oʻahu, Lānaʻi, and Maui (Faccenda 2024).

*Material examined.* LĀNAʻI: Lānaʻi Cemetery, in partly shady, dry area growing under Cook pines, 613 m, 20.845473, -156.921296, 23 Jun 2023, K. Faccenda & J. Sprague 3221.

**Euphorbiaceae*****Euphorbia ophthalmica* Pers.****New island record**

Hundreds of plants of *Euphorbia ophthalmica* were found naturalized on roadsides and flowerbeds around Lānaʻi City. It is almost certain that this species was introduced with nursery stock, given that the majority of these plants were found in flowerbeds and plants were often found in nurseries on Oʻahu (Faccenda 2024). *Euphorbia ophthalmica* is now known to be naturalized on Kauaʻi, Oʻahu, Lānaʻi, and Maui (Faccenda 2024).

*Material examined.* **LĀNAʻI:** Lānaʻi City, Adventure Center, along roadside in disturbed areas as well as flowerbeds, common weed in landscaping beds, 546 m, 20.835424, -156.913657, 19 Jun 2023, K. Faccenda 3134.

**Malvaceae*****Sida cordifolia* L.****Note**

*Sida cordifolia*, commonly called false ʻuhaloa, was not observed during roadside surveys on any other island in Hawaiʻi, despite being listed as naturalized on all major islands except Niʻihau and Kahoʻolawe (Imada 2019). On Lānaʻi, *Sida cordifolia* was incredibly dominant across the landscape in both disturbed areas (e.g., roadsides) as well as rather undisturbed areas on western Lānaʻi or in abandoned agricultural land in the Pālāwai and Miki basins. Tens to hundreds of thousands of plants were observed on Lānaʻi, where it was often a dominant member of the community. This note is published to bring attention to the aggressive nature of this species on Lānaʻi, and the surprising fact that it does not display the same nature on other islands. It is unclear why this is the case, but it is likely that its spread on Lānaʻi is aided by wild axis deer, which very likely disperse the mericarps (armed with barbed awns) in their fur.

**Poaceae*****Aira caryophyllea* L.****New island record**

*Aira caryophyllea* was found growing from crushed stone at the base of a radio tower on Lānaʻihale. Approximately 10 plants were observed at the site and no other populations were seen. *Aira caryophyllea* is now known to be naturalized on Kauaʻi, Oʻahu, Molokaʻi, Lānaʻi, Maui, and Hawaiʻi (Imada 2019).

*Material examined.* **LĀNAʻI:** Lānaʻihale, radio infrastructure, from gravel in sunny, moist area under antenna, rare, 970 m, 20.803149, -156.864101, 23 Jun 2023, K. Faccenda & J. Sprague 3211.

***Andropogon virginicus* L. var. *virginicus*****New island record**

Hundreds of plants of *Andropogon virginicus* (broomsedge) were found naturalized across Lānaʻihale above 860 m [2800 ft] elevation. *Andropogon virginicus* is now known to be naturalized on Kauaʻi, Oʻahu, Molokaʻi, Lānaʻi, Maui, and Hawaiʻi (Snow & Lau 2010; Faccenda 2022).

*Material examined.* **LĀNAʻI:** Lānaʻihale, southern part, edge of dirt road, sunny, dry, common along road at higher elevations and going into moister areas, hundreds of plants seen along road, 868 m, 20.794941, -156.860987, 23 Jun 2023, K. Faccenda & J. Sprague 3210.

***Bothriochloa macra* (Steud.) S.T.Blake****New island record**

Thousands of plants of *Bothriochloa macra* were found growing across most of the island between 350 and 534 m (1150–1750 ft), but were generally uncommon. Most plants were found on disturbed roadsides, but were also found growing from hardpan areas on the

western part of Lānaʻi otherwise dominated by *Bothriochloa pertusa*. In the hardpan habitat these plants were rare. *Bothriochloa macra* is now known to be naturalized on Niʻihau, Oʻahu, Molokaʻi, Maui, Lānaʻi, Kahoʻolawe, and Hawaiʻi (Faccenda 2023).

*Material examined.* **LĀNAʻI:** Lānaʻi City, beginning of Keōmoku Rd near the Sensei resort, roadside, sunny, moist, occasionally mowed area, 527 m, 20.835027, -156.918655, 19 Jun 2023, *K. Faccenda 3130*; Mānele gravel construction road, about 3 km mauka of Mānele, roadside, dry sunny area, about 10 plant seen, rare in area, 371 m, 20.767933, -156.912632, 20 Jun 2023, *K. Faccenda 3141*.

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

Stapf var. *annulatum*

**New island record**

Hundreds of plants of *Dichanthium annulatum* var. *annulatum* were found along mowed roadsides between 370 and 500 m [1200–1600 ft] elevation around Lānaʻi City, the basins, and Keōmoku Road. *Dichanthium annulatum* var. *annulatum* is now known to be naturalized on Kauaʻi, Oʻahu, Molokaʻi, Lānaʻi, Maui, Kahoʻolawe, and Hawaiʻi (Faccenda 2023).

*Material examined.* **LĀNAʻI:** Airport road (Rt 440) about 3 km makai of Lānaʻi City, roadside, sunny, rather dry, mowed annually, uncommon, this patch about 5 m wide, 460 m, 20.806193, -156.937910, 19 Jun 2023, *K. Faccenda 3126*; Keōmoku Rd, about 5 km from ocean, roadside, dry sunny area, rare on roadside, only about 10 plants seen, 542 m, 20.860490, -156.912664, 20 Jun 2023, *K. Faccenda 3156*.

***Digitaria radicata* (J.Presl) Miq.**

**New island record**

*Digitaria radicata*, a common garden weed, was found naturalized on Lānaʻi in gardens and roadsides in Lānaʻi City, where hundreds of plants were found. *Digitaria radicata* is now known to be naturalized on Kauaʻi, Oʻahu, Molokaʻi, Lānaʻi, Maui, and Hawaiʻi (Imada 2019; Imada & Kennedy 2022; Faccenda 2023).

*Material examined.* **LĀNAʻI:** Lānaʻi City, weed in garden bed, uncommon, about 5 plants seen, also in other gardens throughout the city, 495 m, 21 Jun 2023, *K. Faccenda 3166a*.

***Eragrostis barrelieri* Daveau**

**New island record**

Many tens of thousands (potentially hundreds of thousands!) of plants of *Eragrostis barrelieri* were observed on Keōmoku Road, where it was codominant with *Cenchrus ciliaris* and filled in gaps between the *C. ciliaris* plants. In other areas with no other grasses, it formed a uniform carpet across shallow rocky soil from 0–400 m [0–1200 ft] elevation. Plants were also seen in both Pālāwai and Miki basins, Mānele, and the Young Brothers terminal. *Eragrostis barrelieri* is now known to be naturalized on Kauaʻi, Oʻahu, Molokaʻi, Lānaʻi, Maui, and Kahoʻolawe (Faccenda 2022; Faccenda 2023). It very likely also occurs on Hawaiʻi Island but has yet to be collected.

*Material examined.* **LĀNAʻI:** Rt 440, outside gate of landfill, roadside, mowed area, full sun, dry, about 50 plants seen, more found makai from this spot, 283 m, 20.793662, -156.967604, 19 Jun 2023, *K. Faccenda 3123*; Keōmoku Rd, about 500 m from ocean, extremely dry, sunny, rocky soil along road and also seen in less disturbed areas, dominant in certain areas where the soil was shallow and *Bothriochloa pertusa* was not growing, tens of thousands of plants seen in area, 56 m, 20.899047, -156.889521, 20 Jun 2023, *K. Faccenda 3150*.

***Eragrostis pilosa* (L.) P.Beauv. var. *pilosa*                      New island record**

*Eragrostis pilosa*, an easily overlooked annual weed, was found growing on mowed roadsides along the road to Mānele in the Pālāwai Basin, where hundreds of plants were found. *Eragrostis pilosa* var. *pilosa* is now known to be naturalized on Kauaʻi, Oʻahu, Molokaʻi, Lānaʻi, Maui, and Hawaiʻi (Imada 2019; Faccenda 2023). It was previously reported on Lānaʻi by Herbst & Clayton (1998), but this was found to be a misidentification and was withdrawn (Faccenda 2022).

*Material examined.* LĀNAʻI: Keōmoku Rd, about 1 km N of Lānaʻi City, roadside, moist, sunny soil recently disturbed by construction, uncommon on roadside in this area but common on roadsides near Pālāwai Basin, 536 m, 20.839320, -156.919439, 20 Jun 2023, K. Faccenda 3159.

***Lolium multiflorum* Lam.    New island record**

*Lolium multiflorum* was found growing along Mānele Road, 500 m south of Lānaʻi City, where one plant was seen on the roadside. *Lolium multiflorum* is now known to be naturalized on Kauaʻi, Oʻahu, Molokaʻi, Lānaʻi, Maui, and Hawaiʻi (Imada 2019).

*Material examined.* LĀNAʻI: Mānele Rd about 500 m S of intersection with Kaumalapau Hwy, roadside, moist, sunny, occasionally mowed area, rare, only this one plant seen on entire island, 446 m, 20.812735, -156.915546, 20 Jun 2023, K. Faccenda 3147.5.

***Lolium perenne* L.    New island record**

Two plants of *Lolium perenne* were found naturalized on roadsides in the vicinity of Lānaʻi City. *Lolium perenne* is now known to be naturalized on Kauaʻi, Oʻahu, Lānaʻi, Maui, and Hawaiʻi (Imada 2019; Faccenda 2023).

*Material examined.* LĀNAʻI: Lānaʻi City, near Sensei resort and Adventure Center, roadside, sunny, moist, often mowed area, rare, only 2 plants seen in area, 538 m, 20.835602, -156.914809, 19 Jun 2023, K. Faccenda 3133.

***Microlaena stipoides* (Labill.) R.Br.    New island record**

A small colony of several hundred plants of *Microlaena stipoides* (syn. *Ehrharta stipoides*) was found at the northern part of Lānaʻihale, about 1 km S of Keōmoku Road. *Microlaena stipoides* is now known to be naturalized on Kauaʻi, Oʻahu, Molokaʻi, Lānaʻi, Maui, and Hawaiʻi (Imada 2019; Faccenda 2023).

*Material examined.* LĀNAʻI: Lānaʻihale, northern part about 1 km from Keōmoku Rd, roadside, shady, dry, small patch of about 200 plants only seen at this one spot, 585 m, 20.843623, -156.913621, 23 Jun 2023, K. Faccenda & J. Sprague 3215.

***Panicum coloratum* L.    New island record**

*Panicum coloratum* was found to be widely naturalized on Lānaʻi along roadsides and abandoned agricultural land, especially in the vicinity of the Pālāwai Basin. Thousands of plants were observed. *Panicum coloratum* was imported approximately 30 years ago for use as a forage grass and for hay production (Zane Dela Cruz, pers. comm.). *Panicum coloratum* is now known to be naturalized on Lānaʻi and Hawaiʻi (Faccenda 2022; Faccenda 2023).

*Material examined.* LĀNAʻI: Airport road (Rt 440) about 1.5 km makai of Lānaʻi City, roadside, sunny, rather dry, mowed annually, uncommon, several patches about 50 m long, but overall a minimal component of the vegetation, leaves glaucous, 448 m, 20.808766, -156.931434, 19 Jun 2023, K. Faccenda 3127.

***Paspalum notatum* Flügge****New island record**

*Paspalum notatum* was found growing on roadsides and pastures on Lānaʻi, where it was widely distributed across the island above 440 m [1460 ft]. The population size was difficult to determine given the clonal nature of this species, but at a minimum several hundred colonies were seen. *Paspalum notatum* is now known to be naturalized on Kauaʻi, Oʻahu, Molokaʻi, Lānaʻi, Maui, and Hawaiʻi (Imada 2019; Imada & Kennedy 2020; Faccenda 2022).

*Material examined.* **LĀNAʻI:** Lānaʻi City, near Sensei resort and Adventure Center, roadside, sunny, moist, often mowed area, common on roadside in this area, also seen in nearby pasture where it was dominant and was likely planted, 526 m, 20.834309, -156.915790, 19 Jun 2023, *K. Faccenda 3132*.

***Pentapogon micranthus* (Cav.)**

P.M.Peterson, Romasch. & Soreng

**Confirmation of naturalization**

*Pentapogon micranthus* (syn. *Dichelachne micrantha*) was previously reported as adventive on Lānaʻi based on a single specimen from 1938 (O'Connor 1990), but is certainly established as about 20 plants were found on the northern end of Lānaʻihale. *Pentapogon micranthus* is now known to be naturalized on Kauaʻi, Lānaʻi, and Maui (Imada 2019; Faccenda 2022).

*Material examined.* **LĀNAʻI:** Lānaʻihale, northern part about 2 km from Keōmoku Rd, roadside, sunny, dry, growing from eroded soil on slope, patch of about 20 plants seen only in this area, 535 m, 20.847848, -156.907514, 23 Jun 2023, *K. Faccenda & J. Sprague 3217*.

***Sporobolus elongatus* R.Br.****Confirmation of naturalization**

*Sporobolus elongatus* was previously reported as a questionable naturalization on Lānaʻi based on a single specimen from 1925 (Herbst & Clayton 1998). This species has persisted on the island, as it was found to be rather common in Lānaʻi City and plants were also found in Mānele. *Sporobolus elongatus* is now known to be naturalized on Kauaʻi, Oʻahu, Molokaʻi, Lānaʻi, Maui, and Hawaiʻi (Snow 2008; Faccenda *et al.* 2024).

*Material examined.* **LĀNAʻI:** Lānaʻihale, northern part about 2 km from Keōmoku Rd, from sunny, open hardpan soil in eroded area, uncommon, with *Bothriochloa pertusa*, 535 m, 20.847844, -156.907497, 23 Jun 2023, *K. Faccenda & J. Sprague 3218*; Mānele Harbor, edge of parking lot, dry, sunny, about 40 plants in area, 3 m, 20.741425, -156.889259, 20 Jun 2023, *K. Faccenda 3140*; Keōmoku Rd, about 1 km N of Lānaʻi City, roadside, unmowed area with tall herbs, sunny, moist, uncommon, <20 plants seen, 532 m, 20.837963, -156.918796, 20 Jun 2023, *K. Faccenda 3162*.

***Sporobolus fertilis* (Steud.) Clayton****New island record**

*Sporobolus fertilis* was found naturalized on Lānaʻi in the vicinity of Lānaʻi City, where it was rather rare. *Sporobolus fertilis* is now known to be naturalized on Kauaʻi, Oʻahu, Molokaʻi, Lānaʻi, Maui, and Hawaiʻi (Faccenda *et al.* 2024).

*Material examined.* **LĀNAʻI:** Keōmoku Rd, about 1 km N of Lānaʻi City, roadside, unmowed area with tall herbs, sunny, moist, uncommon, <20 plants seen, 532 m, 20.837967, -156.918799, 20 Jun 2023, *K. Faccenda 3161*; Lānaʻi City, Dole Park, frequently mowed turf grass in partial shade of Cook pines, uncommon in this area and also across entire island, 495 m, 20.825452, -156.919697, 22 Jun 2023, *K. Faccenda 3196*.

***Zoysia matrella* (L.) Merr.****Questionable new island record**

Populations of *Zoysia matrella* were found at two pull-off areas along the Munro Trail on Lāna‘ihale between 856 and 1000 m [2800–3280 ft] elevation. It is assumed that each patch represents a single plant spreading clonally. It is unclear if these plants are reproducing sexually, and as such are reported as a questionable naturalization. *Zoysia matrella* was previously reported as naturalized on Kaua‘i and O‘ahu (Faccenda 2023), where it was found in coastal areas. The difference in habitat is rather surprising and could suggest that this population was founded by rhizome fragments stuck to vehicle undercarriages, rather than seed dispersal as observed in the coastal areas.

*Material examined.* LĀNA‘I: Lāna‘ihale, along Munro Trail, from compressed soil in open, sunny, moist area where cars pull off the road to park, covering <1 square meter, one larger patch also seen further down the road, almost certainly spread with vehicle tires given that it was only found in pull-off areas, 1007 m, 20.810022, -156.868899, 23 Jun 2023, K. Faccenda & J. Sprague 3213.

**Pteridaceae*****Pteris* cf. *tremula* R.Br.****New island record**

A single plant of *Pteris tremula* was found growing from the edge of the road about 1 km mauka of the Young Brothers terminal, where it appeared to be naturally irrigated by water running off the road. This fern likely dispersed naturally to Lāna‘i via the trade winds from the naturalized populations on Maui. As the plant found was sterile, the identification is not 100% certain. Thank you to Miles Thomas (BISH) for help with identification of this plant. *Pteris tremula* is now known to be naturalized on Lāna‘i and Maui (Oppenheimer 2007).

*Material examined.* LĀNA‘I: Rt 440, 1 km mauka of Young Brothers terminal, 164 m, 20.788104, -156.977862, 19 Jun 2023, K. Faccenda 3122.

**Scrophulariaceae*****Verbascum thapsus* L.****Note**

A single, immature plant of *Verbascum thapsus* was found growing under the stairs of the Pūlama Lāna‘i natural resource management building. During roadside surveys no other plants were found. It is likely that this plant was brought over on the boots of somebody returning to Lāna‘i from Hawai‘i. However, a note is made in the unlikely chance that a population exists on Lāna‘i but was undetected.

*Material examined.* LĀNA‘I: Lāna‘i City, Pūlama Lāna‘i natural resource management office, under staircase in shady, moist area, 469 m, 20.818701, -156.919532, 20 Jun 2023, K. Faccenda 3163a.

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