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## A survey of the hornworts and liverworts of Lāna‘i, Hawaiian Islands, including 63 new records<sup>1</sup>

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**Abstract.** A field and herbarium survey of the liverworts and hornworts of the island of Lāna‘i was conducted in 2022. Two hundred thirty-eight hornwort and liverwort specimens were collected and deposited at the Herbarium Pacificum (BISH), Bernice Pauahi Bishop Museum. Previous to the survey, only 17 species of liverworts and no hornworts were known from the island based on published records, the study of herbarium collections, and online records of specimens. Including the following four new state liverwort records: *Cephaloziella* aff. *microphylla*, *Lejeunea flava*, *Myriocoleopsis minutissima* subspecies *minutissima*, and *Telaranea nematodes*, sixty species of liverworts and three species of hornworts are added here, for a total of 80 liverwort and hornwort species now known from Lāna‘i.

Mosses have been relatively well-studied on Lāna‘i (55 species were recorded by Staples *et al.* 2004), but the liverworts and hornworts of the island have not been as well-surveyed. This survey represents the first attempt at a comprehensive inventory of the hornworts and liverworts of the island.

Staples & Imada (2006) provided a literature-based checklist of the hornworts and liverworts of Hawai‘i. They accepted 186 species as occurring in the state, but only three species were documented from the island of Lāna‘i (*Frullania sandvicensis*, *Jubula javanica*, and *Radula javanica*). Additionally, fourteen additional species of liverworts are known from other literature reports, online records, and our examination of specimens at the Herbarium Pacificum, Bernice Pauahi Bishop Museum (BISH), and the National Tropical Botanical Garden (PTBG) herbaria in 2022.

Fieldwork was conducted from 22–25 March 2022 and resulted in 238 numbered collections, also collected under all three authors’ names. On 24 June 2022, Bogner collected in Maunalei Gulch. Specimens are deposited in the Herbarium Pacificum (BISH), Bernice Pauahi Bishop Museum. Including the following four new state liverwort records: *Cephaloziella* aff. *microphylla*, *Lejeunea flava*, *Myriocoleopsis minutissima* subspecies *minutissima*, and *Telaranea nematodes*, 60 species of liverworts and three species of hornworts are added here, for a total of 80 liverwort and hornwort species now known from Lāna‘i

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1. Contribution 2023-005 to the Hawaii Biological Survey.

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**CHECKLIST**

Taxonomic nomenclature follows Staples & Imada (2006) and Söderström *et al.* (2016), updated through February 2023 using the TROPICOS <https://www.tropicos.org/home> database. Collections made by all three of us (Freire, Judziewicz & Bogner) are cited with the prefix “22-”. Those made by Bogner alone (her numbers 442–450) are cited with her surname and number. The full names of all other collectors and the place of deposition of their collections are fully cited. Previous records from other major islands follow the checklist of Staples & Imada (2006).

**HORNWORTS (3 species)****Anthocerotaceae**

*Folioceros fuciformis* (Mont.) D.C. Bharadw. **New island record**

Common, Maunalei Gulch. Previously known from O‘ahu, Maui and Hawai‘i.

*Material examined.* LĀNA‘Ī: Maunalei Gulch, 24 Jun 2022, *Bogner 447b, 449a, 450a.*

**Dendrocerotaceae**

*Dendroceros crispus* (Sw.) Nees

**New island record**

(Fig. 1)

Occasional, in dry forest, and only seen on the bark of *Schinus terebinthifolius*. Previously known from all other major islands.

*Material examined.* LĀNA‘Ī: Munro Trail, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-417, 22-428* in mix; Koloiki Trail, 24 Mar 2022, *22-433*; Kunoa, rare on bark of tree, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-384a.*



**Fig. 1.** *Dendroceros crispus* (hornwort with sporophytes), and small leafy liverwort *Lejeunea pacifica* on Munro Trail 0.5 miles northwest of Pu‘u Kīlea.



Fig. 2. Hornwort *Phaeoceros* cf. *carolinianus* at Lānaʻihale summit.

### Notothyladaceae

*Phaeoceros* cf. *carolinianus* (Michx.) Prosk.      **New island record**

(Fig. 2)

Uncommon. Previously known from all other major islands except Molokaʻi.

*Material examined.* **LĀNAʻĪ:** Lānaʻihale, rare, with immature horns, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-372*; Maunalei Gulch, 24 Jun 2022, *Bogner 442a*.

### LIVERWORTS (79 species)

#### Adelanthaceae

*Cuspidatula robusta* (Austin)

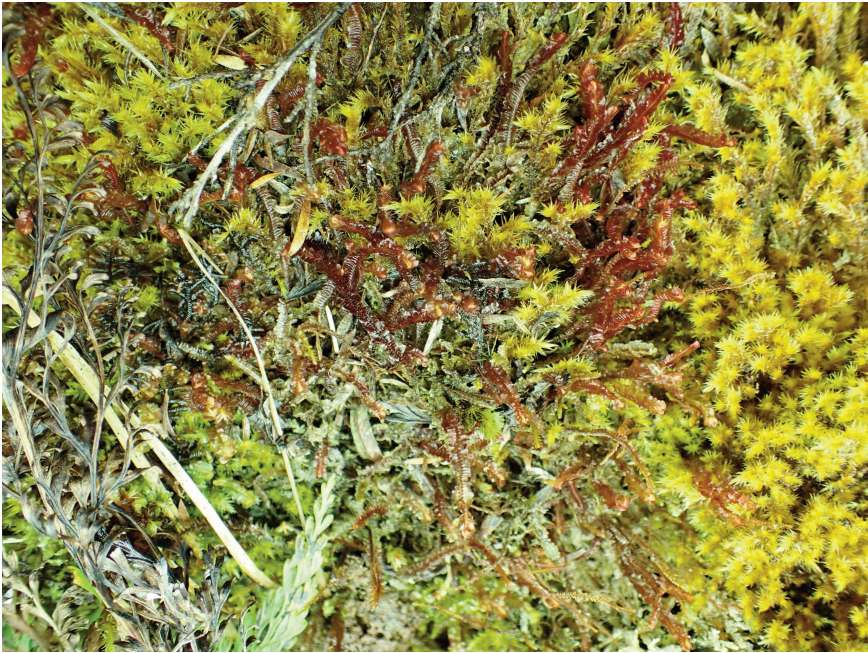
Váňa & L. Söderstr.

**New island record**

(Fig. 3)

Common, summit. Previously known from all other major islands.

*Material examined.* **LĀNAʻĪ:** Haʻalealepaʻakai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-324, 22-325*; Lānaʻihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-380b*; Kunoa, same date, *Freire, Judziewicz & Bogner 22-382b, 22-392a, 22-396, 22-399a, 22-401a*; Restoration site on Munro Trail, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-409a*; Kunoa, 25 Mar 2022, *Freire, Judziewicz & Bogner 22-464a, 22-465b, 22-467a, 22-472, 22-22-485*; Haʻalealepaʻakai, 25 Mar 2022, *Freire, Judziewicz & Bogner 22-501c*.



**Fig. 3.** Reddish leafy liverwort *Cuspidatula robusta* and yellowish moss *Acroporium fuscoflavum*, Kunoa.

### Aneuraceae

*Riccardia* species.

(Fig. 4)

Common, summit. At least three species appear to be present on the island.

*Material examined.* **LĀNA'I:** Ha'alealepa'akai, 22 Mar 2022, *Freire, Judziewicz & Bogner* 22-268, 22-274, 22-279a, 22-281, 22-285b, 22-286c, 22-291a, 22-294a, 22-298a, 22-299a, 22-301b; Lāna'ihale, 23 Mar 2022, *Freire, Judziewicz & Bogner* 22-352a, 22-354, 22-374; Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner* 22-403c; Koloiki Trail, 24 Mar 2022, *Freire & Judziewicz* 22-441; Pumping station on the NW side of Wai'apa'a Gulch, 24 Mar 2022, *Freire, Judziewicz & Bogner* 22-445, 22-452; Kunoa, 25 Mar 2022, *Freire, Judziewicz & Bogner* 22-466c, 22-476b, 22-477, 22-479, 22-481a, 22-484, 22-487c, 22-488c, 22-489e, 22-493b. Also: Upper end of Naio Gulch, 17 Sep 1963, *Degener* 28438 (MU, not examined).

### Calypogeiaceae

*Calypogea tosana* (Steph.) Steph.

**New island record**

Common, summit. Previously known from all other major islands.

*Material examined.* **LĀNA'I:** Ha'alealepa'akai, 22 Mar 2022, *Freire, Judziewicz & Bogner* 22-280b, 22-286a, 22-290, 22-294c, 22-298c, 22-299b, 22-301a, 22-333a, 22-335e, 22-337; Lāna'ihale, 23 Mar 2022, *Freire, Judziewicz & Bogner* 22-350b, 22-365, 22-371b, 22-375; Kunoa, 25 Mar 2022, *Freire, Judziewicz & Bogner* 22-466b, 22-476a, 22-481b, 22-482b, 22-486, 22-488b.



**Fig. 4.** Large thalloid liverwort *Dumortiera hirsuta* with smaller thalloid *Riccardia* species (arrow). Photo: Kari Bogner.

***Mnioloma fuscum*** (Lehm. & Lindenb.)

R.M. Schuster

**New island record**

Rare in mix at summit. Previously known from Maui and Hawai‘i.

*Material examined.* LĀNA‘I: Ha‘alealepa‘akai, 22 Mar 2022, Freire, Judziewicz & Bogner 22-305b.

**Cephaloziaceae**

***Cephalozia lucens*** (A. Evans) Steph.

**New island record**

Rare and inconspicuous at summit, mixed with *Riccardia*. Previously known only from Maui.

*Material examined.* LĀNA‘I Kunoa, 25 Mar 2022, Freire, Judziewicz & Bogner 22-466a.

***Cephalozia maxima*** Steph.

Rare. Previously known only from Maui. Not seen by us, but this species is reported from Kahinahina Ridge [ca. 20°49’N, 156°51’W according to Google Earth], windswept tree trunks in fog belt, 2,500 ft [762 m], 9 Sep 1963, *Degener 28411* (MU, not examined). This specimen was determined by H.A. Miller in 2018.

***Fuscocephaloziopsis connivens* (Dicks.)**

Vána &amp; L. Söderstr. subsp.

***sandwicensis* (Mont.) Vána & L. Söderstr. New island record**

Fairly common but inconspicuous in mixes at the summit. Previously known from all other major islands.

*Material examined.* **LĀNA'I:** Ha'alealepa'akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-291b, 22-298b, 22-335c*; Lāna'ihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-350c, 22-352b, 22-364b*; Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-386b, 22-391*; Kunoa, 25 Mar 2022, *Freire, Judziewicz & Bogner 22-488e*.

***Odontoschisma denudatum* (Mart.) Dumort. New island record**

Fairly common, bark and embankments, summit and foothills. Previously known from all other major islands.

*Material examined.* **LĀNA'I:** Ha'alealepa'akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-269, 22-276, 22-294b, 22-298d, 22-301c, 22-305a*; Lāna'ihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-380d*; Kunoa, 25 Mar 2022, *Freire, Judziewicz & Bogner 22-479b*.

**Cephaloziellaceae*****Cephaloziella heteroica* (C.M. Cooke) Douin New island record**

Rare and inconspicuous, disturbed soil. Previously known from Kaua'i, Moloka'i and Maui.

*Material examined.* **LĀNA'I:** Puhī'elelū Gulch parking pull-off, 20°48'18"N, 156°51'53"W, 992 m, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-302a*; Ha'alealepa'akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-338b*.

***Cephaloziella kilohanensis* (C.M. Cooke) Douin New island record**

Rare and inconspicuous in mixes at summit. Previously known from Kaua'i and Maui.

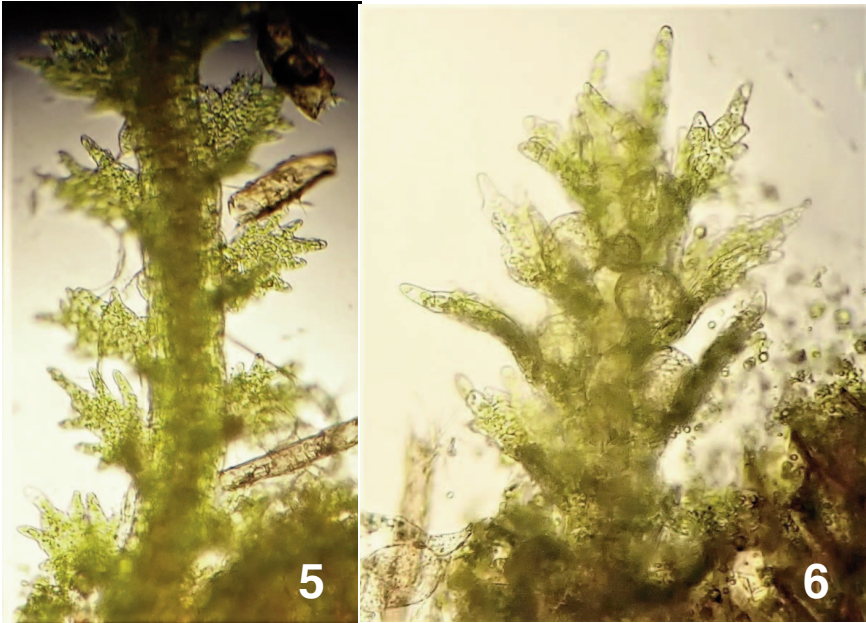
*Material examined.* **LĀNA'I:** Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-404b*; Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-487d*.

***Cephaloziella* aff. *microphylla* (Steph.) Douin New state record**

(Figs 5–6)

This is a tiny, inconspicuous species with pinnately lobed leaves only 100 μm (0.1 mm) long. It appears to very similar to *C. microphylla* (Huang & Lin, 2009) from tropical Asia, and, according to David H. Wagner, an authority on American species of *Cephaloziella* (13 April 2022 pers. comm.), it may represent an undescribed species; it is apparently indigenous. Without fertile material, we hesitate to describe this as a new species. It creeps on bark, hāpu'u stipes, can be epiphytic on hornworts, and is found on both Lāna'i and Hawai'i Islands (815–1,768 m) in wet montane forests. The stems are relatively rigid and prominent. The minute (0.1 mm long) leaves have two lobes that are pinnately divided, resembling a tiny Christmas tree. We have observed some populations with elliptical, 2-celled gemmae.

*Material examined.* **LĀNA'I:** On a wet, shaded rock wall on the south side of Munro Trail just east of Kunoa, mixed with *Symphogyna semi-involucrata*, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-403d*; Lāna'ihale, on bark, mixed with *Riccardia* sp. and *Fuscocephaloziopsis connivens* subsp. *sandwicensis*, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-352c*. **HAWAII:** Hawai'i Volcanoes National Park, East Rift Zone kīpuka, forest north of Nāpau Crater, ca. 19°22'45"N, 155°08'45"W, 815 m, 13 Apr 1984, *L.R. Pratt 1348e* (HAVO); Volcano Guest House, 19°25'31"N,



**Fig. 5–6.** *Cephaloziella* aff. *microphylla* (Freire & Judziewicz 22-403d). The leaves are approximately 0.1 mm long. **5.** Leafy stem with pinnately lobed leaf lobes. **6.** Androecial branch.

155°12'24"W, open pastured *Metrosideros polymorpha* forest, moist shaded rock, with *Fissidens elegans*, 1,045 m, 25 Dec 2020, *A.V. Freire & E.J. Judziewicz 20-1146* (BISH); same location, with *Phaeoceros carolinianus*, *Kurzia hawaica*, and *Telaranea nematodes*, 27 Oct 2021, *A.V. Freire & E.J. Judziewicz 21-945a* (BISH); Hawai'i Volcanoes National Park, trail down into Kīlauea Iki, 100-250 m west of Nāhuku Lava Tube parking lot, 19°24'46"N, 155°14'22"W, on stipes of *Cibotium glaucum*, 1,186 m, 11 Apr 2021, *A.V. Freire & E.J. Judziewicz 21-410* (HAVO); Pu'u Maka'ala N.A.R., about 1 mi [1.62 km] north of end of Amaumau Road, 19°29'N, 155°17'W, 1,340 m, 5 Feb 2022, *A.V. Freire & E.J. Judziewicz 22-215c* (BISH).

### Dumortieraceae

#### *Dumortiera hirsuta* (Sw.) Nees

(Fig. 4)

Occasional in shaded gulches on summit and in Maunalei Gulch.

*Material examined.* **LĀNA'I:** Puhi'elelū Gulch, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-307*; Maunalei Gulch, 24 Jun 2022, *Bogner 449b*. Also: *Forbes 480L* (BISH).

### Frullaniaceae

#### *Frullania apiculata* (Reinw. et al.) Nees

#### New island record

(Fig. 7)

Common, summit. Previously known from all other major islands.

*Material examined.* **LĀNA'I:** Ha'alealepa'akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-265a*; 22-339c; Lāna'ihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-345a*, 22-355a; Kunoa, 23



**Fig. 7.** *Frullania apiculata*, Munro Trail.

Mar 2022, *Freire, Judziewicz & Bogner 22-387a, 22-405*; Restoration site on Munro Trail, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-412a*; Kunoa, 25 Mar 2022, *Freire, Judziewicz & Bogner 22-467b, 22-491c*.

***Frullania hawaiiensis* H.A. Mill.**

**New island record**

Rare, summit. Previously known from O'ahu, Moloka'i and Maui.

*Material examined.* LĀNA'I: Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-468b*.

***Frullania hypoleuca* Nees.**

Fairly common, summit.

*Material examined.* LĀNA'I: Ha'alealepa'akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-270a, 22-272b, 22-289a, 22-330*; Lāna'ihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-359b*; Kunoa, 25 Mar 2022, *Freire, Judziewicz & Bogner 22-493c*; Maunalei Gulch, 24 Jun 2022, *Bogner 443c*. Also: Bog, 2,500 ft [762 m], 26 Nov 1960, *Doty 22316* (BISH).

***Frullania meyeniana* Lindenb.**

**New island record**

Fairly common, summit and foothills. Previously known from all other major islands.

*Material examined.* LĀNA'I: Ha'alealepa'akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-287, 22-298g, 22-332*; Munro Trail, 1 km northwest of Pu'u Kīlea, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-426*; Pumping station on the NW side of Wai'apa'a Gulch, 24 Mar 2022, *Freire, Judziewicz & Bogner 22-454b, 22-459b*; Kō'ele, 24 Mar 2022, *Freire & Judziewicz 22-461*.



***Frullania oahuensis*** Hampe**New island record**

Common. Previously known from all other major islands.

*Material examined.* LĀNA'I: Maunalei Gulch, 24 Jun 2022, *Bogner 442f, 443b, 444c.*

***Frullania sandvicensis*** Ångstr.

Only known from a dry forest with *Nothocestrum* in the northwestern part of the island; *Fagerlund & Skottsberg 7020* (Stockholm Herbarium, S, not examined). Not relocated by us.

**Herbertaceae*****Herbertus aduncus*** (Dicks.) Gray

Fairly common, summit.

*Material examined.* LĀNA'I: Ha'alealepa'akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-323a*; Restoration site on Munro Trail, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-408, 22-411c*; Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-492*. Also: Bog, 2,500 ft [762 m], 26 Nov 1960, *Doty 22320* (BISH).

***Herbertus gracilis*** (Mont.) Kuntze**New island record**

Abundant, summit. Previously known from all other major islands.

*Material examined.* LĀNA'I: Ha'alealepa'akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-271a, 22-289c, 22-298f, 22-331, 22-333b, 22-334, 22-339a*; Lāna'ihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-343a, 22-358a, 22-360, 22-361b, 22-362a, 22-378b*; Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-398b, 22-400, 22-401b*; Kunoa, 25 Mar 2022, *Freire, Judziewicz & Bogner 22-473, 22-478d, 22-483, 22-493a*; Ha'alealepa'akai, 25 Mar 2022, *Freire, Judziewicz & Bogner 22-501a.*

***Herbertus herpocladoides*** E.B. Scott

& H.A. Mill.

**New island record**

Uncommon, status of species uncertain; perhaps better included in *H. gracilis*. Previously known from all major islands except O'ahu.

*Material examined.* LĀNA'I: Kunoa, 25 Mar 2022, *Freire, Judziewicz & Bogner 22-464b, 22-495a.*

**Jubulaceae*****Jubula javanica*** Steph.

Rare, seen at summit in the Restoration Area forest on the Munro Trail at the base of a tree (no voucher by us).

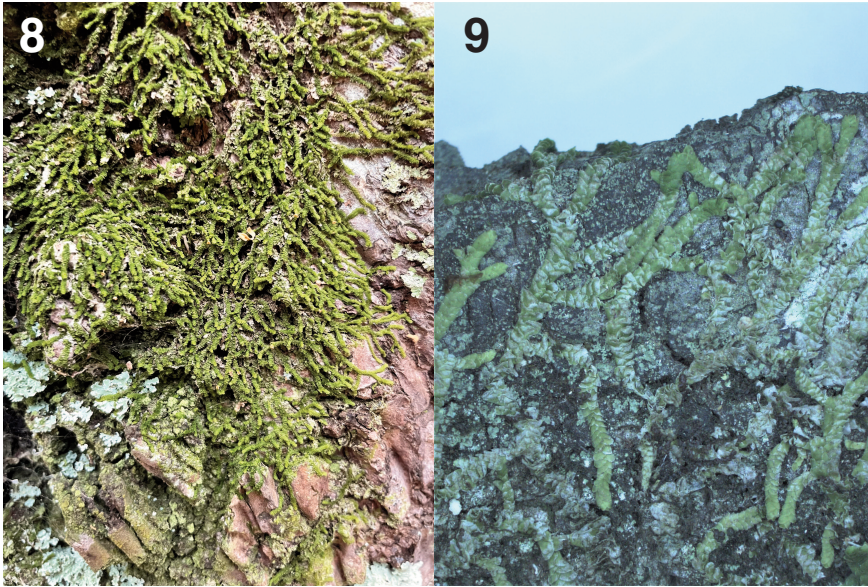
*Material examined.* LĀNA'I: Epiphytic on the fern *Vandenboschia cyrtotheca*, Sep 1917, *Forbes 485* (BISH).

**Lejeuneaceae*****Acrolejeunea sandvicensis*** (Gottsche) Steph. **New island record**

(Figs. 8, 9)

Common in Maunalei Gulch. Previously known from O'ahu and Hawai'i.

*Material examined.* LĀNA'I: Maunalei Gulch, 24 Jun 2022, *Bogner 442e, 443a, 444a.*



**Figs. 8–9.** *Acrolejeunea sandvicensis*. Maunalei Gulch. Photos: Kari Bogner.

***Cheilolejeunea decursiva*** (Sande Lac.)

R.M. Schust.

**New island record**

Uncommon at summit; inconspicuous. Previously known from all other major islands except Hawai‘i.

*Material examined.* **LĀNA‘Ī:** Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-384c*; Kunoa, 25 Mar 2022, *Freire, Judziewicz & Bogner 22-467a, 22-469a*.

***Cheilolejeunea intertexta*** (Lindenb.) Steph. **New island record**

Fairly common in foothill forests. Previously known from all other major islands.

*Material examined.* **LĀNA‘Ī:** Munro Trail, 1 km northwest of Pu‘u Kīlea, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-427*; Pumping station on the NW side of Wai‘apa‘a Gulch, 24 Mar 2022, *Freire, Judziewicz & Bogner 22-447, 22-457, 22-459a*; Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-463b*; Maunalei Gulch, 24 Jun 2022, *Bogner 443e, 444b*.

***Cheilolejeunea stenoschiza*** (Ångstr.) A. Evans **New island record**

Occasional in mixes at summit. Previously known from all other major islands except Hawai‘i.

*Material examined.* **LĀNA‘Ī:** Ha‘alealepa‘akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-272a*; Lāna‘ihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-345b, 22-347* in mix.

***Cololejeunea ceatocarpa* (Ångstr.) Steph.**

Occasional, summit.

*Material examined.* **LĀNA'I:** Lāna'ihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-284a*; Puhī'elelū Gulch, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-315b, 22-321*; Kunoa, 25 Mar 2022, *Freire, Judziewicz & Bogner 22-489c*. Also *Forbes 479, 482-484, 490, 492, 494, 495, 496* (all at BISH).

***Cololejeunea hoana* Tixier****New island record**

Occasional, Maunalei Gulch. Previously known from O'ahu.

*Material examined.* **LĀNA'I:** Maunalei Gulch, 24 Jun 2022, *Bogner 442h, 444d*.

***Cololejeunea longistylis* A. Evans****New island record**

Rare, Maunalei Gulch. Previously known from Kaua'i and O'ahu.

*Material examined.* **LĀNA'I:** Maunalei Gulch, 24 Jun 2022, *Bogner 443d*.

***Cololejeunea planissima* (Mitt.) Abeyw.****New island record**Occasional in foothill forests (rare at summit); closely appressed to bark or leaves. Previously known from Kaua'i and O'ahu (as *C. lanciloba* Steph.).

*Material examined.* **LĀNA'I:** Lāna'ihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-370d*; Koloiki Trail, 24 Mar 2022, *Freire & Judziewicz 22-443*; Pumping station on the NW side of Wai'apa'a Gulch, 24 Mar 2022, *Freire, Judziewicz & Bogner 22-454a*.

***Colura tenuicornis* (A. Evans) Steph.****New island record**

Occasional, summit. Previously known from all other major islands.

*Material examined.* **LĀNA'I:** Ha'alealepa'akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-265c, 22-278a*; Lāna'ihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-347* in mix, *22-363b*.

***Drepanolejeunea anderssonii* (Ångstr.)**

A. Evans

**New island record**

Occasional at summit, inconspicuous. Previously known from all other major islands.

*Material examined.* **LĀNA'I:** Ha'alealepa'akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-265b, 22-266b, 22-275b, 22-289b*, Lāna'ihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-363a*.

***Drepanolejeunea ungulata* (Steph.) Grolle****New island record**

Fairly common at summit, inconspicuous. Previously known from all other major islands.

*Material examined.* **LĀNA'I:** Ha'alealepa'akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-265d, 22-271b, 22-273b, 22-275a, 22-278b, 22-279b, 22-296b*, Restoration site on Munro Trail, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-411d*; Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-467d*.

***Lejeunea adpressa* Nees****New island record**

Uncommon, summit. Previously known from all other major islands.

*Material examined.* **LĀNA'I:** Ha'alealepa'akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-288b*.



**Fig. 10.** Exotic liverwort *Lejeunea flava* is known only from a few planted trees in the Kōʻele resort area (intersection of Kaunaʻoa Drive and Ninth Street).

*Lejeunea flava* (Sw.) Nees  
(Fig. 10)

**New naturalized state record**

We newly report this species from all major islands (0–1,340 m) except Molokaʻi, where it probably also occurs. Apparently first collected in Hawaiʻi in 1977 (from Foster Botanical Garden in Honolulu, based on a Miami University specimen that has not yet been examined), and becoming widely distributed by about 2000. This American species is now the dominant bark epiphyte in both urban and rural locations in lowland Hawaiʻi. Distinct in Hawaiian members of the genus in its large underleaves. First confirmed for Hawaiʻi in 2016 by the late Jochen Heinrichs (1969–2018) based on Kauaʻi collections annotated at both BISH and PTBG. A good description and illustration may be found in Gradstein & Ilkiu-Borges (2009: 101–102).

*Material examined.* **KAUAʻI:** Kawaihau Dist., Ca. 4.5 mi [7.3 km] up Hwy 580 between Keahou Arboretum and Wailua Experiment Station, planted *Albizia* grove along roadside, Epiphytic on trunk of *Albizia*, 13 Mar 1992, *T. Flynn 4926* (PTBG); Kealia Forest Reserve, Kahuna Valley, 174 m, 27 Jan 2018. *W. Ma, J. Shevock, T. Flynn, & A. Williams 18-9330* (PTBG). Kōloa Dist., Kalāheo, 5473C Puʻulima Road, growing on undersides of branches of *Pandanus*, 340 m, 24 Jan 2022, *T. Flynn 9279* (PTBG). Līhuʻe Dist., Terminus of road to Blue Hole, 334 m, 18 Feb 2016, *T. Flynn, J. Shevock, W. Ma & J. Game 8245, 8246, 8248, 8249* (BISH, PTBG); Agroforestry demonstration plot along Hwy 50 east of Kauaʻi Humane Society, epiphyte on lower trunk of *Macaranga tanarius*, in heavy shade, 118 m, 31 Jan 2014 (PTBG). **OʻAHU:** Waiʻanae Range, trail from Mauna

Kapu to Palikea, 811–920 m, 4 Nov 2021, *E.J. Judziewicz et al. 21-953* (BISH). Ko'olau Range, Mt. Tantalus, near Pu'u Ōhi'a Trail, bamboo forest, on yellowing leaves, 18 Jan 2022, *N. Walvoord NW-2022-005* (BISH). **LĀNA'I:** On exotic cultivated tree at corner of Kauna'oa Drive and 9<sup>th</sup> Street, Lāna'i City, Kō'ele, 540 m, 25 Mar 2022, *A.V. Freire & E.J. Judziewicz 22-460*. **MAUI:** Ko'olau Dist., Waiohū Bay coastline to Pa'akea to Kapā'ula, hala coastal wet forest, 0–50 m, 23 Sep 2021, *K. Severson 018* (BISH). **HAWAI'I:** Hilo, UH-Hilo campus, 38 m, 21 Jan 2021, *A.V. Freire & E.J. Judziewicz 21-84* (BISH); Onomea, 19°48'35"N, 155°05'40"W, on exotic trees, 30 m, 20 Nov 2019, *A.V. Freire & E.J. Judziewicz 19-150* (BISH); Nialani Forest, Volcano, 1,158 m, 29 Sep 2020, *A.V. Freire & E.J. Judziewicz 20-720* (BISH); Volcano Guest House, Volcano, 19°25'30"N, 155°12'25"W, 1,045 m, 4 Sep 2020, *A.V. Freire & E.J. Judziewicz 20-636* (BISH); Hawai'i Volcanoes National Park, employee housing area, 19°25'37"N, 155°15'23"W, 1,210 m, 28 Nov 2020, *A.V. Freire & E.J. Judziewicz 20-1011* (HAVO); Hawai'i Volcanoes National Park, Maunaulu parking lot, 985 m, 2 Aug 2020, *A.V. Freire & E.J. Judziewicz 20-552* (HAVO); Hawai'i Volcanoes National Park, small pit in open lava on trail to Pu'u Huluhulu, 1,000 m, 28 Jan 2020, *A.V. Freire & E.J. Judziewicz 20-30a* (HAVO); Hawai'i Volcanoes National Park, 'Akihi ravine, epiphyte on *Pipturus albidus*, 760 m, 11 Aug 2022, *A.V. Freire & E.J. Judziewicz 22-794a* (HAVO).

### *Lejeunea pacifica* Mont.

(Fig. 1)

Fairly common, summit.

*Material examined.* **LĀNA'I:** Puhi'eleeū Gulch, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-314, 22-315a, 22-317*; Restoration site on Munro Trail, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-415 mix, 22-416*; Munro Trail, 1 km northwest of Pu'u Kīlea, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-420b*, Koloiki Trail, 24 Mar 2022, *Freire & Judziewicz 22-434*; Pumping station on the NW side of Wai'apa'a Gulch, 24 Mar 2022, *Freire, Judziewicz & Bogner 22-450b, 22-453*; Kauna'oa Drive and 9<sup>th</sup> Street, Kō'ele, Lāna'i City, *Freire & Judziewicz 22-463a*. Also *Forbes 487-489* (BISH).

### *Lopholejeunea nigricans* (Lindenb.) Schiffn. **New island record**

Occasional at summit. Previously known from all major islands.

*Material examined.* **LĀNA'I:** Ha'alealepa'akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-264, 22-338a*; Lāna'ihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-347b*; Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-493c* in mix.

### *Lopholejeunea* aff. *nigricans* (Lindenb.) Schiffn.

Rare at summit. This collection is smaller in all respects than *L. nigricans*.

*Material examined.* **LĀNA'I:** Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-403d*.

### *Metalejeunea cucullata* (Reinw. et al.) Grolle **New island record**

Abundant but inconspicuous, summit and foothills. Previously known from all other major islands.

*Material examined.* **LĀNA'I:** N Ha'alealepa'akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-279b, 22-273a, 22-296c, 22-304b, 22-339f*; Lāna'ihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-342a, 22-356b, 22-359c*; Munro Trail, 1 km northwest of Pu'u Kīlea, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-420c*; Pumping station on the NW side of Wai'apa'a Gulch, 24 Mar 2022, *Freire, Judziewicz & Bogner 22-446b, 22-456*; Kunoa, 25 Mar 2022, *Freire, Judziewicz & Bogner 22-491d*.

***Microlejeunea lunulatiloba*** Horik.**New island record**

Occasional but inconspicuous, at summit and foothills. Previously known from all other major islands except Kauaʻi.

*Material examined.* **LĀNAʻI:** Haʻalealepaʻakai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-266a*, Koloiki Trail, 24 Mar 2022, *Freire & Judziewicz 22-435*; Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-489d*.

***Myriocoleopsis minutissima*** (Sm.) R.L. Zhu,

Y. Yu & Pócs subspecies *minutissima* **New state record**

A tiny, inconspicuous pantropical bark epiphyte that can now be reported from Oʻahu, Molokaʻi, Lānaʻi, Maui, and Hawaiʻi (540–1,768 m); indigenous. In this commoner subspecies, the leaves are nearly spherical, with the subspherical lobule nearly as long as the lobe; in subspecies *myriocarpa* (Nees & Mont.) R.L. Zhu, Y. Yu & Pócs, the leaves are slightly elliptical and the lobule is narrow and elongate (Yu *et al.*, 2014).

*Material examined.* **OʻAHU:** Mānoa, Kūkaʻōʻō, 2 Feb 1903, *C.M. Cooke, Jr. s.n.* (BISH). **MOLOKAʻI:** Between Maunahui and Waikolu Canyon, 3,000–3,500 ft [914–1,067 m], Jul 1903, *C.M. Cooke, Jr. 15* (BISH). **LĀNAʻI:** Pumping station on the NW side of Waiʻapaʻa Gulch, 710 m, 24 Mar 2022, *Freire, Judziewicz & Bogner 22-454c*; Kaunaʻoa Drive and 9<sup>th</sup> Street, Kōʻele, Lānaʻi City, 540 m, 24 Mar 2022, *Freire & Judziewicz 22-462*; Maunalei Gulch, 24 Jun 2022, *Bogner 442i*. **MAUI:** West Maui, Maunahoʻoma, Jun 1910, *C.N. Forbes s.n.* (BISH). **HAWAIʻI:** Manukā N.A.R., epiphylllic on leaves of *Ochna serrulata*, 600 m, 9 Jan 2022, *A.V. Freire & E.J. Judziewicz 22-59, 69b* (BISH); Hawaiʻi Volcanoes National Park, Kīpukapuau, on decorticate log in koa-mānele forest, 1,210 m, 27 May 2021 (HAVO); Puʻu Makaʻala N.A.R., near old Mauna Loa Boys School, south kīpuka, 19°34ʻ45″N, 155°20ʻ00-07″W, 1,760 m, 19 Aug 2021, *A.V. Freire & E.J. Judziewicz 22-655a* (BISH), north kīpuka, 19°35ʻ00-08″N, 155°21ʻ00-03″W, 1,768 m, 25 Aug 2021, *A.V. Freire & E.J. Judziewicz 22-699a* (BISH).

***Spruceanthus planiusculus*** (Mitt.) X.Q. Shi, R.L. Zhu & Gradst.

Fairly common, foothills; uncommon, summit.

*Material examined.* **LĀNAʻI:** Puhīʻelelū Gulch, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-309, 22-312*; Munro Trail, 1 km northwest of Puʻu Kīlea, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-420a*; Koloiki Trail, 24 Mar 2022, *Freire & Judziewicz 22-431a*; Pumping station on the NW side of Waiʻapaʻa Gulch, 24 Mar 2022, *Freire, Judziewicz & Bogner 22-446a, 22-448a, 22-450a*. Also East Kunoa, 8 Jan 2008, *Wood et al. 12763b* (BISH, PTBG).

***Spruceanthus polymorphus*** (Sande Lac.) Verd. **New island record**

(Fig. 11)

Fairly common, foothill. Previously known from Kauaʻi and Oʻahu.

*Material examined.* **LĀNAʻI:** Munro Trail, 1 km northwest of Puʻu Kīlea, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-418, 22-425, 22-22-428*; Koloiki Trail, 24 Mar 2022, *Freire & Judziewicz 22-442a*.

**Lepidoziaceae*****Acromastigum integrifolium*** (Austin) A. Evans **New island record**

Common in mixes from the summit. Previously known from all other major islands except Hawaiʻi.

*Material examined.* **LĀNAʻI:** Haʻalealepaʻakai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-323b, 22-339e*; Lānaʻihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-342b, 22-344a, 22-346a, 22-378d, 22-379, 22-380a*; Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-388, 22-390*; Kunoa, 25 Mar 2022, *Freire, Judziewicz & Bogner 22-467e*.



**Fig. 11.** *Spruceanthus polymorphus* (yellowish leafy liverwort in center) on Christmas berry, *Dendroceros crispus* (dark green hornwort on right), Munro Trail 0.5 miles north-west of Pu‘u Kīlea.

***Bazzania brighamii* (Austin) A. Evans**                      **New island record**

Occasional, summit. Previously known from all other major islands.

*Material examined.* LĀNA‘Ī: Ha‘alealepa‘akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-291a, 22-292d.*

***Bazzania cordistipula* (Mont.) Trevis.**

Fairly common, summit.

*Material examined.* LĀNA‘Ī: Ha‘alealepa‘akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-297, 22-300, 22-303*; Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-385*. Also: Kahinahina Ridge [ca. 20°49’N, 156°51’W according to Google Earth], windswept tree trunks in fog belt, 2,500 ft [762 m], 9 Sep 1963, *Degener 28411* (MU, not examined).

***Bazzania didericiana* (Steph.) Steph.**                      **New island record**

Occasional, summit. Previously known from all other major islands.

*Material examined.* LĀNA‘Ī: Ha‘alealepa‘akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-296a*; Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-386a.*

***Bazzania emarginata* (Steph.) C.M. Cooke**                      **New island record**

Abundant, summit. Previously known from all other major islands.

*Material examined.* **LĀNAʻĪ:** Haʻalealepaʻakai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-267, 22-292c, 22-323c, 22-339d*; Lānaʻihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-349, 22-353, 22-356a, 22-358b, 22-361a, 22-373, 22-378c*; Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-383, 22-387b, 22-392b, 22-393b, 22-394b*; Restoration site on Munro Trail, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-407*; Munro Trail, 1 km northwest of Puʻu Kīlea, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-419a*; Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-474a, 22-478a, 22-496b, 22-498*.

***Bazzania minuta*** (Austin) A. Evans

**New island record**

Rare in mix. Previously known from all other major islands except Oʻahu.

*Material examined.* **LĀNAʻĪ:** Lānaʻihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-343b*.

***Bazzania sandvicensis*** (Steph.) Steph.

**New island record**

Rare, summit. Previously known from all other major islands.

*Material examined.* **LĀNAʻĪ:** Haʻalealepaʻakai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-306*.

***Kurzia hawaica*** (C.M. Cooke) Grolle

**New island record**

Fairly common but inconspicuous in mixes from the summit. Previously known from all other major islands.

*Material examined.* **LĀNAʻĪ:** 22-294d, 22-298e, 22-335d, 22-386c, 22-465a, 22-478c, 22-481d, 22-488d, 22-494a.

***Telaranea nematodes*** (Austin) M. Howe

**New naturalized state record**

We newly report this species as present on all major islands except Molokaʻi (0–1860 m). This tiny, filamentous looking liverwort (Gradstein & Ilkiu-Borges 2009: 28–29) had not been noted in Hawaiʻi prior to this study, even though it is now widespread and locally common in Hawaiʻi Volcanoes National Park. The plants grow in tiny, dense mats on soil or rotted bark, often associated with other leafy liverworts and in apparent association with blue-green colored cyanobacteria. The stem has an apparent hyalodermis and trifid leaves, each lobe with two paired cells at the base and tipped with a uniseriate series of 4–5 more cells. Widespread on the American mainland, Africa, and western Europe, this species apparently first appeared in Hawaiʻi about 2000; we have examined numerous liverwort mixtures from prior to 2000 and have not found this species in any of them.

*Material examined.* **KAUAI:** Nā Pali-Kona Forest Reserve, Pihea Trail, in tiny bog by trail, 1,109–1,231 m, 24 Sep 2014, *W. Ma, J. Shevock, T. Flynn 14-5912* (PTBG); Waimea Dist., Alakaʻi Wilderness Preserve, northeast of *Platanthera* bog along small tributary of Kawaiikoi Stream, *Metrosideros* dominated wet forest w/*Cibotium*, *Sticherus*, *Melicope*, *Dubautia*, and *Labordia*, 28 Apr 2016, *T. Flynn 8370* (BISH, PTBG). **OʻAHU:** Summit of Puʻu Kaʻala, 1,220 m, terrestrial on steep, moist, partially shaded roadsides, in *Metrosideros polymorpha*-dominated forest, 17 May 2022, *M.K. Thomas, S.N. Ching et al. 371b, 403b* (BISH). **LĀNAʻĪ:** Haʻalealepaʻakai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-294e*; Lānaʻihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-358c, 22-364c*; Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-385* in mix; Restoration site on Munro Trail, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-407* in mix, 22-410, 22-411 in mix; Koloiki Trail, 24 Mar 2022, *Freire & Judziewicz 22-439b*; Kunoa, 25 Mar 2022, *Freire, Judziewicz & Bogner 22-471* in mix, 22-478b, 22-481c, 22-482a, 22-487b, 22-488a, 22-497 in mix. **MAUI:** Hana Dist., East Maui, Koʻolau Forest Reserve, Kopiliula drainage basin, *Metrosideros/Acacia* montane wet forest, 771 m, 20 Sep 2016, *H. Oppenheimer 91264* (PTBG). **HAWAII:** Volcano Guest House, 11-3733 Ala ʻŌhiʻa Street, 19°25'31" N, 155°12'24" W, shaded moist crevice in tumulus in



pasture with scattered *Metrosideros polymorpha*, with *Cephaloziella microphylla*, *Phaeoceros carolinianus*, and *Kurzia hawaiiica*, 1,045 m, 27 Oct 2021, *A.V. Freire & E.J. Judziewicz 21-945d* (BISH); Hilo, Ka'ūmana Cave, 290 m, 17 Feb 2021, *A.V. Freire & E.J. Judziewicz 20-167b* (BISH); Niaulani Forest, Volcano, 1,160 m, 26 Dec 2020, *A.V. Freire & E.J. Judziewicz 20-1153* (BISH); Ka'ū Dist., Kaihohena Reserve, 19°10'40" N, 155°34'15" W, 820 m, 9 Dec 2020, *A.V. Freire & E.J. Judziewicz 20-1092a* (BISH); Hawai'i Volcanoes National Park, Kīpukapuauulu, 1,210 m, 27 Jan 2021, *A.V. Freire & E.J. Judziewicz 21-94* (HAVO); Hawai'i Volcanoes National Park, Kīpukakī, 1,335 m, 12 Jan 2021, *A.V. Freire & E.J. Judziewicz 21-33a* (HAVO); Hawai'i Volcanoes National Park, east of Escape Road, on *Cibotium stipe*, 1,112–1,128 m, 30 June 2020, *A.V. Freire & E.J. Judziewicz 20-409* (HAVO); Hawai'i Volcanoes National Park, Halema'uma'u Trail adjacent to Volcano House, 1,160 m, 4 Feb 2020, *A.V. Freire & E.J. Judziewicz 20-75a* (HAVO); Hawai'i Volcanoes National Park, 'Akiki ravine, 762 m, 11 Aug 2022, *A.V. Freire & E.J. Judziewicz 22-793a* (HAVO); Hawai'i Volcanoes National Park, Kāhuku Unit, waterholes, 19°13'36" N, 155°38'00" W, 1,860 m, 9 Aug 2022, *A.V. Freire & E.J. Judziewicz 22-674* (HAVO).

### Lophocoleaceae

#### *Chiloscyphus laceratus* Steph.

#### New island record

Rare, summit. Previously known from Moloka'i, Maui, and Hawai'i.

*Material examined.* **LĀNA'I** Lāna'ihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-378a*; Kunoa, 25 Mar 2022, *Freire, Judziewicz & Bogner 22-468a*.

#### *Cryptolophocolea ciliolata* (Nees) L. Söderstr.,

Crand.-Stotl., Stotler & Váňa

#### New island record

Occasional at summit. Previously known from all other major islands.

*Material examined.* **LĀNA'I**: Ha'alealepa'akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-277, 22-301d*; Restoration site on Munro Trail, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-411b*.

#### *Lophocolea autoica* Steph.

#### New island record

Occasional in foothills, uncommon at summit. Previously known from O'ahu and Hawai'i.

*Material examined.* **LĀNA'I**: Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-394b*; Koloiki Trail, 24 Mar 2022, *Freire & Judziewicz 22-436, 22-441* in mix; Pumping station on the NW side of Wai'apa'a Gulch, 24 Mar 2022, *Freire, Judziewicz & Bogner 22-455*; Ha'alealepa'akai, 25 Mar 2022, *Freire, Judziewicz & Bogner 22-501b*.

#### *Lophocolea baldwinii* Steph.

#### New island record

Occasional at summit, especially at Kunoa. Previously known from all other major islands.

*Material examined.* **LĀNA'I**: Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-382a, 22-404* in mix; Kunoa, 25 Mar 2022, *Freire, Judziewicz & Bogner, 22-471*.

#### *Lophocolea bartlettii* H.A. Mill.

#### New island record

Uncommon at summit. Previously known from Moloka'i, Maui, and Hawai'i.

*Material examined.* **LĀNA'I**: Ha'alealepa'akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-285a*; Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-395a*; Restoration site on Munro Trail, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-409b*.



**Fig. 12.** Thalloid liverworts *Marchantia crenata* (large) and *Symphyogyna semiinvolucrata* (small), rock wall on Munro Trail east of Kunoa.

***Lophocolea hawaiiica* Steph.**

**New island record**

Occasional in foothills. Previously known from Kauaʻi, Molokaʻi, and Hawaiʻi.

*Material examined.* LĀNAʻI: Haʻalealepaʻakai, 22 Mar 2022, Freire, Judziewicz & Bogner 22-280, 22-286b; Puhiʻelelū Gulch, 23 Mar 2022, Freire, Judziewicz & Bogner 22-311; Koloiki Trail, 24 Mar 2022, Freire & Judziewicz 22-439.

***Lophocolea kilauensis* (Steph.) H.A. Mill.**

**New island record**

Uncommon at summit and in foothills. Previously known from Oʻahu and Hawaiʻi.

*Material examined.* LĀNAʻI: Haʻalealepaʻakai, 22 Mar 2022, Freire, Judziewicz & Bogner 22-292b; Pumping station on the NW side of Waiʻapaʻa Gulch, 24 Mar 2022, Freire, Judziewicz & Bogner 22-449.

**Marchantiaceae**

***Marchantia crenata* Austin**

**New island record**

(Fig. 12)

Occasional on wet embankments at summit. Previously known from all other major islands except Molokaʻi.

*Material examined.* LĀNAʻI: Lānaʻihale, 23 Mar 2022, Freire, Judziewicz & Bogner 22-366; Kunoa, 23 Mar 2022, Freire, Judziewicz & Bogner 22-404a.



**Fig. 13.** *Marchantia marginata*. Note gemmae cups. Maunalei Gulch. Photo: Kari Bogner.

*Marchantia marginata* Steph.

**New island record**

(Fig. 13)

Locally common in Maunalei Gulch. Previously known from all other major islands except Hawai'i.

*Material examined.* **LĀNA'I:** Maunalei Gulch, 24 Jun 2022, *Bogner 446a, 447a, 449d.*

#### **Metzgeriaceae**

*Metzgeria furcata* (L.) Corda

**New island record**

Rare, summit. Previously known from all other major islands.

*Material examined.* **LĀNA'I:** Restoration site on Munro Trail, on exotic tree trunk, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-415.*

#### **Notoscyphaceae**

*Notoscyphus lutescens* (Lehm. & Lindenb.) Mitt.

Occasional, wet roadside embankments, summit, occasionally in foothills,

*Material examined.* **LĀNA'I:** 22-377, 22-397, 22-431b, 22-499a, 22-500. Also: Kaiholena Ridge, wall of irrigation tunnel, 17 Aug 1957, *Degener 24324* (MU, not examined).

**Pallaviciniaceae*****Symphyogyna semiinvoluta*** Austin**New island record**

(Fig. 12)

Occasional, wet ground, summit and Maunalei Gulch. Previously known from all other major islands.

*Material examined.* **LĀNA'I:** Lāna'ihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-364a, 22-367*; Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-402, 22-403a*; Maunalei Gulch, 24 Jun 2022, *Bogner 449c*.

**Plagiochilaceae*****Chiastocaulon combinatum*** (Mitt.) S.D.F. Patzak,M.A.M. Renner, Schäf.-Verw. & Heinrichs **New island record**

Uncommon at summit. Previously known from all other major islands.

*Material examined.* **LĀNA'I:** Lāna'ihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-381*; Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-398a*; Restoration site on Munro Trail, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-413*.

***Plagiochila conduplicata*** Steph.**New island record**

Occasional, summit. Previously known from all major islands except Maui.

*Material examined.* **LĀNA'I:** Ha'alealepa'akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-282a, 22-283a, 22-327*.

***Plagiochila convoluta*** Steph.**New island record**

Common, summit. Previously known from Kaua'i, O'ahu, and Hawai'i.

*Material examined.* **LĀNA'I:** Ha'alealepa'akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-288a, 22-304a, 22-335e*; Lāna'ihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-341, 22-362b, 22-376b*; Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-384b, 22-389*; Kunoa, 25 Mar 2022, *Freire, Judziewicz & Bogner 22-467c*.

***Plagiochila gracillima*** A. Evans.**New island record**

Rare. Trigones small for this species. Previously known Moloka'i, Maui, and Hawai'i.

*Material examined.* **LĀNA'I:** Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-389*.

***Plagiochila grossipina*** Steph.

Uncommon; just below summit.

*Material examined.* **LĀNA'I:** Puhi'elelū Gulch, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-316, 22-320*. Also Hau'ola Gulch, 800–850 m, 11 Aug 2021, *Oppenheimer H82112* (BISH).

***Plagiochila mauiensis*** Steph.

Rare. Previously known from all major islands.

*Material examined.* **LĀNA'I:** Hau'ola Gulch, 800–850 m, 11 Aug 2021, *Oppenheimer H82110* (BISH).



Fig. 14. *Plagiochila remyana*, Puhi‘elelū Gulch.

***Plagiochila remyana* Steph.**

**New island record**

(Fig. 14)

Rare, just below summit. Previously known from all major islands except Moloka‘i.

*Material examined.* LĀNA‘Ī: Puhi‘elelū Gulch, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-319*.

**Radulaceae**

***Radula acutangula* Steph.**

Occasional, foothills forest.

*Material examined.* LĀNA‘Ī: Puhi‘elelū Gulch, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-313, 22-322*; Pumping station on the NW side of Wai‘apa‘a Gulch, 24 Mar 2022, *Freire, Judziewicz & Bogner 22-458*. Also: Kaiholena Ridge, tree in shrubby forest, 10 Aug 1957, *Degener 24329* (MU, not examined).

***Radula cavifolia* Gottsche, Lindenb. & Nees** **New island record**

Occasional, summit. Previously known from Kaua‘i, Maui, and Hawai‘i.

*Material examined.* LĀNA‘Ī: Ha‘alealepa‘akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-328, 22-339g*; Lāna‘ihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-343c, 22-359a, 22-378e*.

***Radula cordata* Mitt.**

(Fig. 15)

Common, summit.

*Material examined.* LĀNA‘Ī: Ha‘alealepa‘akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-326, 22-329*; Lāna‘ihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-340, 22-368, 22-369*; Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-399d*; Restoration site on Munro Trail, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-411a*; Kunoa, 25 Mar 2022, *Freire, Judziewicz & Bogner 22-470, 22-476c*. Also: East Kunoa, 8 Jan 2008, *Wood et al. 12763a* (PTBG).



**Fig. 15.** *Radula cordata*. Lāna‘ihale summit.

*Radula gracilis* Mitt. ex Steph.

**New island record**

(Fig. 16)

Fairly common, summit. Previously known from all other major islands.



**Fig. 16.** *Radula gracilis*. Kunoa, on summit ridge.

*Material examined.* LĀNA'I: Kunoa, 23 Mar 2022, Freire, Judziewicz & Bogner 22-382c, 22-387c, 22-393a, 22-394a, 22-395b; Kunoa, 25 Mar 2022, Freire, Judziewicz & Bogner 22-474b, 22-496d.

***Radula javanica*** Gottsche

Uncommon, summit.

*Material examined.* **LĀNA‘Ī:** Lāna‘ihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-347a, 22-371*. Also: Northwestern part of Munro Trail, dark gulch in rain forest, 29 Jul 1963, *Degener 28285* (MU, not examined).

**Scapaniaceae*****Anastrophyllum esenbeckii*** (Mont.) Steph. **New island record**

Occasional in mixes from the summit. Previously known from all other major islands except O‘ahu.

*Material examined.* **LĀNA‘Ī:** Ha‘alealepa‘akai, 22 Mar 2022, *Freire, Judziewicz & Bogner 22-339b*; Lāna‘ihale, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-344b, 22-346b*; Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-399c*; Kunoa, 25 Mar 2022, *Freire, Judziewicz & Bogner 22-491b, 22-496c*.

**Solenostomataceae*****Solenostoma micrantha*** (Mitt.)

Vaña, Hentschel & Heinrichs

**New island record**

Rare, summit embankments; also Maunalei Gulch. Previously known from all other major islands.

*Material examined.* **LĀNA‘Ī:** Kunoa, 23 Mar 2022, *Freire, Judziewicz & Bogner 22-403b*; Maunalei Gulch, fairly common, 24 Jun 2022, *Bogner 447c, 450d*.

**DISCUSSION**

The first hepatic collections on Lāna‘i were made by Bishop Museum botanist Charles N. Forbes (1883–1920), who collected some specimens in 1917. Otto Degener (1899–1988) collected a few from 1957 to 1963, and, in the 21st century, Kenneth R. Wood and Hank Oppenheimer collected some hepatics on the island.

Below are the liverwort species known from Lāna‘i prior to our fieldwork. Except for *Cephalozia maxima* and *Frullania sandvicensis*, all species were relocated during the current study.

*Bazzania cordistipula* (*Degener 28411*, Miami University, Ohio, MU, not examined), *Cephalozia maxima* (**not relocated in this survey**, but identification needs checking; *Degener 28411*, MU, not examined).

*Cololejeunea ceatocarpa* (*Forbes 479, 482–484, 490, 492, 494, 495, 496* in Sept. 1917, all at BISH).

*Dumortiera hirsuta* (*Forbes 486*, BISH).

*Frullania hypoleuca* (Miller, “bog” at 2,500 ft [762 m] elev., BISH; *Doty 22316*, BISH).

*Frullania sandvicensis* (reported as *F. neurota*, **not relocated in this survey**; *Fagerlund & Skottsberg 7020*, Stockholm Herbarium, S, not examined).

*Herbertus aduncus* (reported as *H. sanguineus*; *Doty 22320*, BISH; *Wood 12757*, PTBG).

*Jubula javanica* (reported as *J. hutchinsiae*; *Forbes 485*, BISH).

*Lejeunea pacifica* (*Forbes 487–489*, BISH).

*Notoscyphus lutescens* (*Degener 24324*, MU, not examined).

*Plagiochila grossipina* (Hau‘ola Gulch, 800–850 m, *Oppenheimer 82112*, BISH).

*Plagiochila maiuensis* (Hau‘ola Gulch, 800–850 m, *Oppenheimer 82110*, BISH).





**Fig. 17.** Bryologically rich site on Munro Trail at head of Kunoa Gulch, el. 3,000 ft, 25 March 2022. This is the most diverse liverwort site on Lāna‘i, with 39 species. Of 80 species of liverworts and hornworts known from Lāna‘i, 65 are known from the summit ridge at elevations 2,500 ft or higher.

*Radula acutangula* (Degener 24329, MU, not examined).

*Radula cordata* (Wood et al. 12763a, PTBG).

*Radula javanica* (Degener 28285, MU, not examined).

*Riccardia* sp. (Degener 28438, MU, not examined).

*Spruceanthus planiusculus* sp. (Wood et al. 12763b, PTBG).

Four main habitats were surveyed in 2022: The summit ridge, with remnant wet indigenous forest and indigenous fern understories; a mesic leeward gulch with indigenous trees, shrubs, and ferns; “foothills” dry-mesic to mesic forests, dominated by exotic trees but with some remnant indigenous species; and Maunalei Gulch, with lowland exotic and indigenous forest along an intermittent stream. We also explored Lāna‘i City and found just one liverwort species there, the exotic *Lejeunea flava*.

#### **Lāna‘ihale summit ridge with exotic and remnant indigenous forests and indigenous fern understories**

Approximately 4 km of the summit ridge of Lāna‘i, from about 760–1,030 m along the Munro Trail, are windswept, often rain- and mist-enshrouded open forests of Cook pine

(*Araucaria columnaris*), strawberry guava (*Psidium cattleianum*), mānukā (*Leptospermum scoparium*) and occasional indigenous small trees of ‘ōhi‘a (*Metrosideros polymorpha*) (as cloud forest; Hobdy 1993); the understory is often dominated by dense mats of the indigenous uluhe ferns *Dicranopteris linearis* and *Diplazium pinnatum*. This area has the richest liverwort and hornwort diversity on the island; of 80 species of liverworts and hornworts known from Lāna‘i, 65 are known from the summit ridge at elevations of about 750 m or higher. The richest site is at the head of Kunoa Gulch, elev. 914 m; this is the most diverse single liverwort site surveyed on Lāna‘i, with 39 species (Fig. 17). Along the ridge top from northwest to southeast (the “summit”), these sites were surveyed:

1. Restoration Site (with picnic shelter), 20°49'33"N, 156°53'26"W, 847 m: 18 species seen, but incompletely surveyed; collections *Freire, Judziewicz & Bogner 22-406 to 22-416*.
2. Head of Kunoa Gulch (Fig. 17), 20°49'15"N, 156°52'48"W, 907–925 m: 39 species (richest location on Lāna‘i); collections *Freire, Judziewicz & Bogner 22-382 to 22-395 and 22-464 to 22-500*.
3. Lāna‘ihale (summit), 20°48'45"N, 156°52'24"W, 1,020–1,030 m: 26 species; collections *Freire, Judziewicz & Bogner 22-340 to 22-381*.
4. Munro Trail, 20°48'36"N, 156°52'08"W, 1,006–1,021 m: 24 species; *Freire, Judziewicz & Bogner 22-323 to 22-339*.
5. Ha‘alealepa‘akai, 20°48'23"N, 156°51'54"W, 975–1,006 m: 30 species; *Freire, Judziewicz & Bogner 22-264 to 22-306 and 22-501*.

The most widespread (but not necessarily the most conspicuous) liverworts found on the summit ridge sites were:

<i>Acromastigum intregrifolium</i>	<i>Herbertus gracilis</i>
<i>Bazzania cordistipula</i>	<i>Kurzia hawaica</i>
<i>Bazzania emarginata</i>	<i>Metalejeunea cucullata</i>
<i>Calypogeia tosana</i>	<i>Odontoschisma denudatum</i>
<i>Cololejeunea ceatocarpa</i>	<i>Plagiochila convoluta</i>
<i>Cuspidatula robusta</i>	<i>Radula cordata</i>
<i>Drepanolejeunea ungulata</i>	<i>Riccardia</i> species
<i>Frullania apiculata</i>	<i>Telaranea nematodes</i> (naturalized)
<i>Herbertus aduncus</i>	

### **Puhi‘elelū Gulch, a mesic leeward-facing gulch with indigenous trees, shrubs, and diverse ferns**

Puhi‘elelū Gulch (850–885 m) is a mesic gulch fenced from herbivores with a rich native vascular flora. Māmaki (*Pipturus albidus*) was dominant in the overstory and the liverworts were associated with many ferns in the understory including *Diplazium sandwichi-anum* and *Tectaria gaudichaudii*. These liverwort species were present (*Freire, Judziewicz & Bogner 22-307 to 22-322*):



**Fig. 18.** Branch of Christmas berry with diverse assemblage of lichens, liverworts, and the hornwort *Dendroceros crispus*. Munro Trail about 0.5 miles northwest of Pu‘u Kīlea.

*Bazzania cordistipula*  
*Cololejeunea ceatocarpa*  
*Dumortiera hirsuta*  
*Lejeunea pacifica*  
*Lophocolea hawaiiica*

*Plagiochila grossispina*  
*Plagiochila remyana* (only Lāna‘i site)  
*Radula acutangula*  
*Spruceanthus planiusculus*

It is likely that other mesic gulches harbor liverworts and hornworts not documented in this survey.

#### “Foothills” mesic to dry-mesic forests

Mesic to dry-mesic forests occur from approximately 530–700 m elevations on the drier leeward side of Lāna‘ihale and are composed primarily of exotic species such as *Eucalyptus* species, *Psidium cattleianum* (strawberry guava), *Schinus terebinthifolius* (Christmas berry), *Cinnamomum burmannii* (cinnamon), *Toona ciliata* (Australian red cedar) and *Casuarina glauca* (ironwood), with some indigenous species such as *Nestegis sandwicensis* (olopua). However, Christmas berry, in particular, hosts many species of indigenous liverworts as well as the hornwort *Dendroceros crispus*. We visited three sites of this type: Munro Trail, 1 km northwest of Pu‘u Kīlea (collections Freire, Judziewicz & Bogner 22-417 to 22-430) (Fig. 18); southern Koloiki Trail (Freire & Judziewicz 22-431

to 22-443); and the pumping station on the northwest side of Wai'apa'a Gulch (*Freire, Judziewicz & Bogner 22-445 to 22-459*). While far less diverse than the summit forests of Lāna'i, these forests do host the following 17 species of liverworts, mainly as bark epiphytes:

<i>Cheilolejeunea intertexta</i>	<i>Microlejeunea lunulatiloba</i>
<i>Cololejeunea planissima</i>	<i>Myriocoleopsis minutissima</i>
<i>Frullania meyeniana</i>	<i>Notoscyphus lutescens</i>
<i>Frullania sandvicensis</i> (historical)	<i>Radula acutangula</i>
<i>Lejeunea pacifica</i>	<i>Riccardia species</i>
<i>Lophocolea autoica</i>	<i>Spruceanthus planiusculus</i>
<i>Lophocolea hawaiiica</i>	<i>Spruceanthus polymorphus</i>
<i>Lophocolea kilauensis</i>	<i>Telaranea nematodes</i> (naturalized)
<i>Metalejeunea cucullata</i>	

### Maunalei Gulch

Maunalei Gulch is Lāna'i's largest and deepest gulch, and was surveyed by Bogner (numbers 442–450) on 24 June 2022, 20°49'56.2"–50°40.1"N, 156°53'27.5–42.7"W, at elevations from 300–448 m. At the beginning of the gulch where the paved Keōmuku Road ends, the habitat is dominated by kiawe (*Prosopis pallida*) that transitions to a mixed forest of wiliwili (*Erythrina sandwicensis*) and koa haole (*Leucaena leucocephala*), with Christmas berry (*Schinus terebinthifolia*) comprising much of the vegetation on the steep slopes of the gulch. The gulch then transitions towards a more mesic forest environment at the old pump house, where a lo'i is being restored by Pūlama Lāna'i's Cultural and Historic Preservation Department. Mauka of the lo'i the canopy is predominantly kukui (*Aleurites moluccanus*) mixed with tī (*Cordyline fruticosa*) and strawberry guava (*Psidium cattleianum*). At its back, the gulch opens into a small hame (*Antidesma pulvinatum*) forest with several other native plant species present (*Metrosideros polymorpha*, *Carex wahuensis*, *Pittosporum confertiflorum*, and *Boehmeria grandis*). There are several steep waterfalls in the back of Maunalei that periodically flow throughout the year. We found 12 species of liverworts and two hornworts at this site:

<i>Acrolejeunea sandwicensis</i>	<i>Marchantia marginata</i>
<i>Cheilolejeunea intertexta</i>	<i>Myriocoleopsis minutissima</i> subspecies <i>minutissima</i>
<i>Cololejeunea hoeana</i>	<i>Phaeoceros</i> cf. <i>carolinianus</i>
<i>Cololejeunea longistylis</i>	<i>Riccardia species</i>
<i>Dumortiera hirsuta</i>	<i>Solenostoma micrantha</i>
<i>Folioceros fuciformis</i>	<i>Symphyogyne semi-involucrata</i>
<i>Frullania hypoleuca</i>	
<i>Frullania oahuensis</i>	

### Lāna'i liverwort and hornwort diversity in a regional context

We added 63 species of liverworts and three species of hornworts for a total of 80 liverwort and hornwort species now known from Lāna'i, or about 43% of the 186 liverwort

and hornwort species documented from Hawai'i (Staples & Imada 2006). With the exception of a possible undescribed species of *Cephaloziella* aff. *microphylla* (discussed above), nearly all species found on Lāna'i are also found on at least three other Hawaiian islands, and none are endemic to Lāna'i.

Bryophytes are an often overlooked and poorly inventoried component of embryophyte (land plant) diversity; the Lāna'i embryophyte flora (now 497 species) consists of 362 vascular plants (Gustafson *et al.* 2014; 72%), 55 mosses (Staples *et al.* 2004; 12%), 77 liverworts (16%), and three hornworts (1%); bryophytes thus comprise 27% of the land plant diversity of the island. Based on the literature-based Staples & Imada (2006) paper, these are the total number of species of liverworts and hornworts known from each major Hawaiian Island:

Kaua'i	106
O'ahu	110
Moloka'i	86
Lāna'i (this study)	80
Maui	134
Hawai'i Island	110
Hawai'i	190

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#### LITERATURE CITED

- Gradstein, S.R. & Ilkiu-Borges, A.L.** 2009. Guide to the plants of Central French Guiana. Part 4. Liverworts and hornworts. *Memoirs of the New York Botanical Garden* 76: i–v + 1–140.
- Gustafson, R., Herbst, D.R. & Rundel, P.W.** 2014. *Hawaiian plant life: vegetation and flora*. University of Hawai'i Press, Honolulu. 336 pp.
- Hobdy, R.** 1993. Lāna'i—a case study: The loss of biodiversity on a small Hawaiian island. *Pacific Science* 47: 201–210.
- Huang, S.-F. & Lin, S.-H.** 2009. Materials to [sic] the bryophyte flora of Taiwan (I) – *Cephaloziella microphylla* (Steph.) Douin. *Taiwania* 54: 97–99.
- Söderström, L., Hagborg, A., von Konrat, M., Bartholomew-Began, S., Bell, D., Briscoe, L., Brown, E., Cargill, D.C., Costa, D.P., Crandall-Stotler, B.J., Cooper, E.D., Dauphin, G., Engel, J.J., Feldberg, K., Glenny, D., Gradstein, S.R., He, X., Heinrichs, J., Hentschel, J., Ilkiu-Borges, A.L., Katagiri, T., Konstantinova, N.A., Larrain, J., Long, D.G., Nebel, M., Pócs, T., Puche, F., Reiner-Drehwald, E., Renner, M.A., Sass-Gyarmati, A., Schäfer-Verwimp, A., Segarra Moragues, J.G., Stotler, R.E., Sukkharak, P., Thiers, B.M., Uribe, J., Váña, J., Villarreal, J.C., Wigginton, M., Zhang, L. & Zhu, R.-L.** 2016. World checklist of hornworts and liverworts. *PhytoKeys* 59: 1–828.

- Staples, G. W., Imada, C.T., Hoe, W.J., & Smith, C.W.** 2004. A revised checklist of Hawaiian mosses. *Tropical Bryology* **25**: 35–69.
- Staples, G.W. & Imada, C.T.** 2006. Checklist of Hawaiian antherocerotes and hepatics. *Tropical Bryology* **28**: 15–47.
- TROPICOS.** March 2023. Available at: <https://www.tropicos.org/home> (Accessed 1 Mar 2023).
- Yu, Y., Pócs, T. & Zhu, R.-L.** 2014. Notes on early land plants today. 62. A synopsis of *Myriocoleopsis* (Lejeuneaceae, Marchantiophyta) with special reference to transfer of *Cololejeunea minutissima* to *Myriocoleopsis*. *Phytotaxa* **183**(4): 293–297.