

Preliminary annotated checklist of the moss flora of Lower Limahuli Valley

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Abstract. A checklist of mosses of Lower Limahuli Valley was compiled using 36 historical collections from the National Tropical Botanical Garden (PTBG) and Bishop Museum (BISH) herbariums, in addition to 168 specimens collected for this project. Field surveys were focused in areas that represented the diverse array of habitats found throughout Limahuli Valley. Forty-nine species across 35 genera and 20 families were recorded from the valley at this time. Out of these species, 46 are native (15 endemic, 31 indigenous) and 3 are nonnative.

INTRODUCTION

Limahuli Preserve History and Habitats

The 3.1 mile long, 1,000-acre watershed of Limahuli Valley is located in Hāʻena on the north shore of Kauaʻi (see Fig. 1A, 1B). Separated by a waterfall, it is split into two sections: the Upper Valley, which is about 356 GIS acres (1,068 surface acres), 1.5 miles long, and ranges from 1600–3330 feet (488–1,015 meters) elevation, and the Lower Valley, which is 600 acres, 1.5 miles long starting from the coast, and reaches 984 feet (300 meters) elevation (Wood 2006; Dr. Uma Nagendra, pers. comm.) (see Fig. 1C). This checklist will focus on Lower Limahuli Valley.

As with many areas across the Hawaiian Islands, the valley was utilized for its natural resources by Hawaiians of old. Currently the National Tropical Botanical Garden maintains 1640 feet (500 meters) along the stream and 67 acres of ungulate fencing for restoration purposes within Lower Limahuli Valley. Access is restricted to the public, leaving this area rarely traversed (Dr. Uma Nagendra, pers. comm.). However, Limahuli Garden is located at the very front of the valley and is open to the public (see Fig. 1C). Its 17 acres contain restored native plant forests as well as invasive forest demonstration sites. Some moss collections were taken from Limahuli Garden, as the bryoflora is surprisingly diverse.

Lower Limahuli Valley has a diverse array of habitat types from which collections have been made. It is dominated by a matrix of invasive species with remnant pockets of native vegetation and has received an average of 81 inches of rain per year over the last three years, according to the Limahuli Garden rain gauge. The first half of the valley consists of a lowland mesic mixed canopy forest. Forest types include Coastal Hala (*Pandanus tectorius*) Forest (see Fig. 2A); Mixed Kukui (*Aleurites moluccanus*) and ʻŌhiʻa ʻAi (*Syzygium malaccense*, Mountain Apple) Forest (see Fig. 2B); pockets of

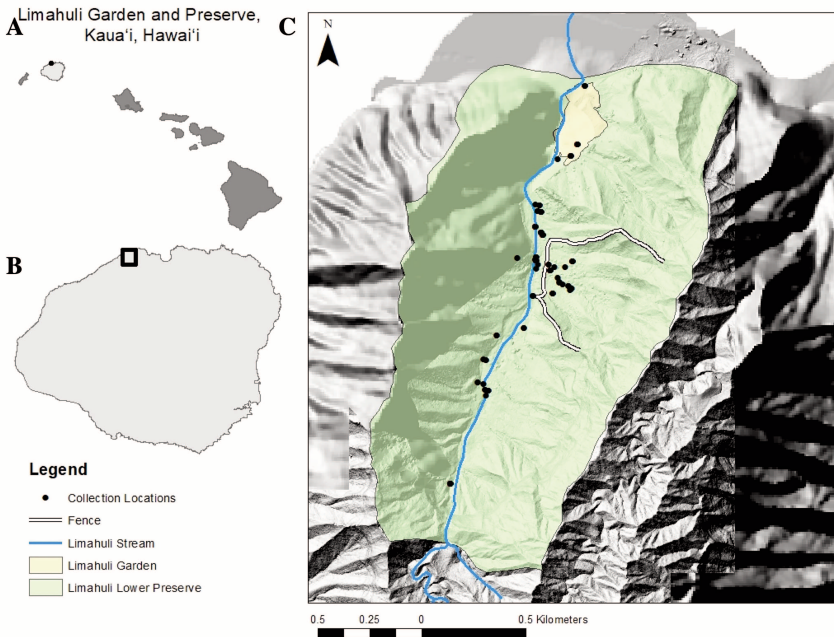


Figure 1. A. Kaua'i, westmost of the main islands B. Limahuli Valley, located on the north shore of Kaua'i. C. Lower Limahuli Valley, Garden, Ungulate Fence Restoration Area, and location of collections sites.

bamboo (*Phyllostachys nigra*) (see Fig. 2C), guava (*Psidium guajava*) (see Fig. 2D), and hau (*Hibiscus tiliaceus*) (see Fig. 2E); and riparian zones dominated by Octopus Tree (*Heptapleurum actinophyllum*) Forest (see Fig. 2F).

Mixed native forests containing the native trees *Metrosideros polymorpha*, *Diospyros sandwicensis*, and *Ceodes umbellifera* become more abundant as one moves through the valley and towards the waterfall (see Fig. 3A). Pockets of vulnerable native species such as *Charpentiera densiflora* and *Cyrtandra confertiflora* also occur towards the back of Lower Limahuli Valley (see Fig. 3B).

Collection was mainly focused in the fenced restoration area (about 0.25–1 mile from the trailhead), due to its accessibility. This area consists of a secondary growth forest dominated by a canopy of *Aleurites moluccanus* and *Syzygium malaccense* brought by Polynesian voyagers to be used in agroforestry. It tends to have rocky slopes and lacks a diverse understory. In 2019, a large flooding event occurred on the northern shore of Kaua'i, resulting in many landslides throughout the valley. These landslides affected both riparian and mesic forest habitats, with two in particular occurring within the fenced restoration zone. Sections of these two landslides have become restoration sites that contain both wild and reintroduced native species. During the winter/rainy season, water can flow throughout these landslides, causing streamlets to form.



Figure 2. A. Streamside *Pandanus tectorius*. B. Previous agroforestry area containing *Aleurites moluccanus* and *Syzygium malaccense*. C. *Phyllostachys nigra* forest. D. *Psidium guajava*, *Coffea arabica*, *Heptapleurum actinophyllum*—all invasive plant species. E. Matrix of *Hibiscus tiliaceus*. F. Section of Limahuli Stream with *Heptapleurum actinophyllum* dominating the stream banks.

The riparian habitat stretches the full 1.5 miles of the valley and is relatively accessible. Limahuli Stream consists of shallow pools and small islands that host many native and nonnative plants. The stream bank tends to be inundated by either the invasive *Heptapleurum actinophyllum*, introduced in the early 1900s, or *Hibiscus tiliaceus*, introduced by Polynesian voyagers (Little & Skolmen 1989). Water levels change based on the season, causing streamlets to occasionally dry up. Stream flow originates both from upstream flow and numerous underground aquifer and spring sources. This results in the occurrence of many seeps near springs. Native plants grow along the stream and throughout the entire valley, but are scarce compared to nonnative plant species.

BRYOPHYTE RESEARCH HISTORY

In the past, bryophytes have been understudied in Hawai‘i compared to vascular plants. Karl Müller produced the first major publication of Hawaiian bryophytes in 1896 (Müller

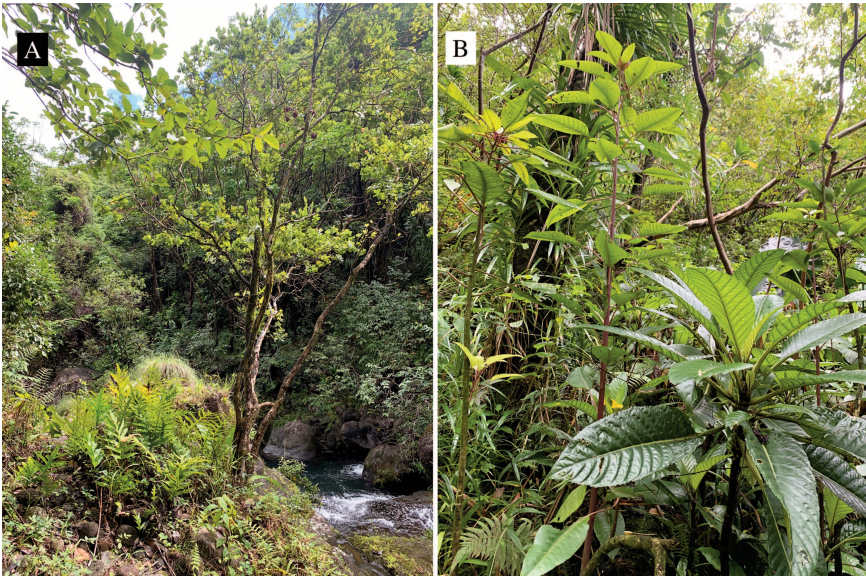


Figure 3. A. *Metrosideros polymorpha* beginning to mix with nonnative plants moving towards the waterfall. B. *Charpentiera densiflora* and *Cyrtandra confertiflora* thriving further back into the valley.

1896), detailing the known plants at the time and their descriptions, with additions made later by Viktor Brotherus in 1927 (Brotherus 1927). In 1933, Edwin Bartram published the first keys, including new additions to the flora (Bartram 1933). This book still remains the main resource for identifying moss species. Later on, William Hoe published a checklist of Hawaiian mosses (Hoe 1974) that was then revised and updated by Staples *et al.* (2004). Specifically for the island of Kaua‘i, James Shevock published a paper in 2019 with updated nomenclature, ranges, and new additions (Shevock *et al.* 2019). A variety of other publications have allowed for identification of moss taxa in specific families or genera, but an updated and comprehensive moss flora is sorely needed.

Today there is a resurgence of bryological study in Hawai‘i, including efforts to collect, analyze, and digitize specimens at organizations like Bishop Museum, Missouri Botanical Garden (with Dr. Si He), and the National Tropical Botanical Garden, to be stored and made available online. Private researchers like Emmet Judziewicz and Virginia Freire have been conducting much-needed studies on hepatics and anthoceroophytes, as well.

Many researchers have worked to catalog the vascular taxa found throughout Limahuli Valley, but few have assessed the bryoflora. Representation of mosses is very limited in local herbaria. According to the National Tropical Botanical Garden collections database,

only three researchers collected 26 taxa of moss within Lower Limahuli Valley from 1990–2015. One novel (non-duplicate) collection of the species *Floribundaria floribunda* from Limahuli Valley is stored at the Bishop Museum Herbarium, collected in 2021 by Miles Thomas (*MKT190*). It is important that the entire flora of this valley is represented as efforts to restore it continue. While this is still a preliminary checklist, it can hopefully provide insight into the diversity of moss flora that exists throughout Lower Limahuli Valley.

METHODS

Due to the terrain and large size of the valley, the majority of species examined were mainly focused in the easily accessible restoration and riparian sections. This area ranged from 30–200 meters in elevation and less than 1 mile into the valley. Collections were made over the course of two years and from a variety of habitats in order to loosely represent the valley as a whole based on elevation, light, and moisture, paying special attention to morphologically distinct specimens. On occasion, efforts were made to expand into other, less traversed areas within Limahuli Valley, extending to the waterfall and mainly staying near the stream. Species were collected, identified, and stored at PTBG. This checklist will include findings from these surveys, as well as herbarium collections from past researchers. While many of these taxa overlap, it is important to note that some species may not be currently represented in the valley.

RESULTS

In total, 201 collections of mosses were evaluated for this checklist—165 specimens collected for this project and 36 collections from other researchers. Among these vouchers, 49 species—46 native (15 endemic, 31 indigenous), 3 nonnative—were identified, spread across 35 genera and 20 families. The accepted names listed can be referenced in *A Revised Checklist of Hawaiian Mosses* (Staples *et al.* 2004), with any scientific name changes otherwise noted. Family classifications will follow those presented on the website *Classification of the Bryophyta* (Goffinet & Buck, 2020).

DISCUSSION

This checklist will hopefully begin to provide insight into the moss diversity of Limahuli Valley, but much more still needs to be explored. Though the terrain can make areas difficult to access, surveys should be expanded into the mid-elevation sections of the Lower Valley.

Upper Limahuli Valley should also be surveyed in depth. While invasive plants still impact the habitat of the Upper Valley, much of the forest is dominated by native species. There are considerable differences in moisture and altitude, resulting in a vastly different

bryoflora. For example, *Plagiomnium rostratum* is less abundant and rarely fertile in the Lower Valley, especially as one moves from the waterfall to the coast, while in the Upper Valley it is extremely abundant and often fertile.

Given that Limahuli Valley has a mixture of habitats, specifically native vs. non-native/Polynesian-introduced, continuing surveys that note biomass could provide insight into the relationship mosses have with colonization and the surrounding environment.

Although this checklist focuses on only a single valley on Kaua'i, it may serve as a resource for other budding bryologists to gain an understanding of what mosses they may find in similar habitats. More importantly, it shines a light on these important yet all too often overlooked plants.

CHECKLIST

[Note: All vouchers are from “Hanalei District, Limahuli Valley,” unless otherwise noted.]

Anomodontaceae

Haplohymenium triste (Ces.) Kindb.

Unknown abundance, Indigenous

Substrate(s): Tree trunk (*Syzygium malaccense*)

Habitat(s): Mesic forest

Material examined. **KAUA'I:** Limahuli Garden, slopes above garden toward Limahuli Falls, Limahuli Stream, 107 m, 26 Jan 2015, *Shevock 46261* (CAS, PTBG).

Bartramiaceae

Philonotis hawaïica (Müll. Hal.) Broth.

Common, Endemic

Substrate(s): Volcanic rock

Habitat(s): Riparian/waterfall, seep

Material examined. **KAUA'I:** Lower Limahuli Preserve, seep near Limahuli waterfall, 300 m, 17 Sep 2022, *Jensen KLJ170* (PTBG).

Bryaceae

Anomobryum angustirete Broth.

Common near waterfalls, Endemic

Substrate(s): Volcanic rock

Habitat(s): Riparian (waterfall)

Material examined. **KAUA'I:** Lower Limahuli Preserve, riparian basalt rock, 147 m, 17 Sep 2022, *Jensen KLJ152* (PTBG); *loc. cit.*, splash zone of Limahuli waterfall, 300 m, 17 Sep 2022, *Jensen KLJ168* (PTBG).

***Bryum argenteum* Hedw.**

Common, Indigenous

Substrate(s): Volcanic rock

Habitat(s): Botanical garden/roadside

Material examined. **KAUA'I:** Limahuli Garden, on a rock wall along the road opposite Visitor Center, 37 m, 14 Dec 2015, *Flynn 8008* (PTBG); *loc. cit.*, volcanic rocks lining driveway near welcome sign, 34 m, 18 Feb 2021, *Jensen KLJ122* (PTBG).

Bryum caespiticium* Hedw.*New island record**

Common, Indigenous

Substrate(s): Volcanic rock

Habitat(s): Botanical garden/roadside

This taxon was first collected on Kaua'i in 1988 by Dr. David Lorence (*Lorence 5773*, PTBG, COL, HOE) but was not identified until 2012 by Dr. Mashuri Waite. Therefore, Staples *et al.* (2004) does not list it as occurring on Kaua'i.

Material examined. **KAUA'I:** Limahuli Garden, volcanic rocks lining driveway near welcome sign, 34 m, 18 Feb 2021, *Jensen KLJ121* (PTBG).

Brachytheciaceae***Donrichardsia bartramii* Ignatov & Huttunen**

Common, Indigenous

Substrate(s): Volcanic rock

Habitat(s): Riparian, partially/fully submerged in stream

Material examined. **KAUA'I:** Lower Limahuli Preserve, slopes above garden toward Limahuli Falls, Limahuli Stream, 152 m, 26 Jan 2015, *Shevock 46269* (CAS, PTBG); *loc. cit.*, 201 m, 26 Jan 2015, *Shevock 46273A* (CAS, PTBG); Lower Limahuli Preserve, Limahuli Stream, underside of rock in the splash zone of a small waterfall, 125 m, 27 Aug 2022, *Jensen KLJ145* (PTBG); *loc. cit.*, riparian basalt rock that is often submerged, 147 m, 17 Sep 2022, *Jensen KLJ153* (PTBG).

***Rhynchostegium celebicum* (Sande Lac.) A. Jaeger**

Unknown abundance, Indigenous

Substrate(s): Volcanic rock (submerged)

Habitat(s): Riparian

Material examined. **KAUA'I:** Limahuli Valley, in valley bottom, 76–82 m, 28 Dec 1990, *Flynn 4346* (AD, COLO, HOE, PTBG); Lower Limahuli Preserve, Limahuli Stream, riparian restoration, 107 m, 20 May 2021, *Jensen KLJ078* (PTBG); Lower Limahuli Preserve, hau forest after bamboo forest about 1 mile into valley, 196 m, 17 Sep 2022, *Jensen KLJ158* (PTBG).

Dicranaceae***Holomitrium seticalycinum* Müll. Hal.**

Abundant, Endemic

Substrate(s): Volcanic rock

Habitat(s): Mesic forest, riparian

Material examined. **KAUA'I:** Limahuli Valley, in valley bottom, 76–82 m, 28 Dec 1990, *Flynn 4341* (AD, COLO, HOE, PTBG); Limahuli Garden, slopes above garden toward Limahuli Falls, Limahuli Stream, 107 m, 26 Jan 2015, *Shevock 46255* (CAS, PTBG); Lower Limahuli Preserve, mesic forest fenced restoration, 145 m, 26 Mar 2022, *Jensen KLJ022* (PTBG); Lower Limahuli Preserve, riparian restoration next to streamlet, 112 m, 1 Apr 2021, *Jensen KLJ030* (PTBG); Lower Limahuli Preserve, riparian zone, 127 m, 8 Jun 2021, *Jensen KLJ103* (PTBG); *loc. cit.*, 95 m, 27 Aug 2022, *Jensen KLJ136* (PTBG); *loc. cit.*, 126 m, 27 Aug 2022, *Jensen KLJ150* (PTBG); Lower Limahuli Preserve, Limahuli waterfall, 300 m, 17 Sep 2022, *Jensen KLJ172* (PTBG).

Fissidentaceae

Fissidens bryoides Hedw.

Common, Indigenous

Substrate(s): Volcanic rock

Habitat(s): Landslide restoration (2019), riparian

Material examined. **KAUA'I:** Lower Limahuli Preserve, southernmost landslide restoration area within fenced sections, 174 m, 13 Sep 2022, *Jensen KLJ182* (PTBG); *loc. cit.*, 164 m, 27 Apr 2021, *Jensen KLJ048*; Lower Limahuli Preserve, Limahuli Stream, 140 m, 16 Oct 2022, *Jensen KLJ186* (PTBG).

Fissidens delicatulus Ångstr.

Unknown abundance, Endemic

Substrate(s): Volcanic rock

Habitat(s): Mesic forest

Material examined. **KAUA'I:** Lower Limahuli Preserve, on trail in mesic forest fenced restoration, 184 m, 28 Aug 2022, *Jensen KLJ140* (PTBG).

Fissidens elegans Brid.

Unknown abundance, Indigenous

Substrate(s): Volcanic rock

Habitat(s): Landslide restoration (2019)

Material examined. **KAUA'I:** Lower Limahuli Preserve, southernmost landslide restoration area within fenced sections, 164 m, 27 Apr 2021, *Jensen KLJ048* (PTBG).

Fissidens lancifolius E.B. Bartram

Unknown abundance, Endemic

Substrate(s): Volcanic rock

Habitat(s): Landslide restoration (2019)

Material examined. **KAUA'I:** Limahuli Garden, invasive forest demonstration site, 73 m, 18 May 2021, *Jensen KLJ058* (PTBG).

Fissidens nothotaxifolius Pursell & Hoe

Common, Endemic

Substrate(s): Volcanic rock

Habitat(s): Riparian (splashed by small waterfall)

Material examined. **KAUA'I:** Lower Limahuli Preserve, Limahuli Stream, splash zone of small waterfall, 125 m, 27 Aug 2022, *Jensen KLJ143* (PTBG).

Funariaceae

Funaria hygrometrica Hedw.

Common, Indigenous

Substrate(s): Volcanic rock

Habitat(s): Mesic forest

Material examined. **KAUA'I:** Limahuli Garden, fenced restoration, secondary mesic forest, section is seasonally inundated, 140 m, 31 Aug 2022, *Jensen KLJ181* (PTBG).

Hylocomiaceae

Ctenidium stellulatum Mitt.

Abundance unknown, Naturalized?

Substrate(s): Volcanic rock, branch hanging over stream

Habitat(s): Riparian

According to Nishimura (1985), this species was originally reported from the Society Islands. It is not mentioned by Bartram (1933). It was later collected by William Hoe between the 1970s and 1980s in Mānoa Valley, O'ahu (*Hoe 2712.0*, NICH), which is highly susceptible to invasive species due to its dense human population and frequently traversed trails. Because of its late discovery and initial geographical location, it is likely that this is a naturalized species.

Material examined. **KAUA'I:** Lower Limahuli Preserve, slopes above garden toward Limahuli Falls, Limahuli Stream, 196 m, 26 Jan 2015, *Shevock 46272* (CAS, PTBG); Lower Limahuli Preserve, Limahuli Stream, 212 m, 17 Sep 2022, *Jensen KLJ159* (PTBG).

Hypnaceae

Ectropothecium decurrens (Sull.) N.Nishim.

Unknown abundance, Endemic

Substrate(s): Tree trunk (*Hibiscus tiliaceus*)

Habitat(s): Mesic forest/secondary forest

Material examined. **KAUA'I:** Limahuli Valley, in valley bottom, 76–82 m, 28 Dec 1990, *Flynn 4343a, 4345* (AD, COLO, HOE, PTBG).

Ectropothecium sandvicense (Hook. & Arn.) Mitt.

Common, Indigenous

Substrate(s): Volcanic rock

Habitat(s): Riparian (in splash zones of small waterfalls), Lower Limahuli waterfall

Material examined. **KAUA'I:** Lower Limahuli Preserve, Limahuli Stream, underside of rock in the splash zone of a small waterfall, 125 m, 27 Aug 2022, *Jensen KLJ147* (PTBG); *loc. cit.*, 216 m, 17 Sep 2022, *Jensen KLJ163* (PTBG); Lower Limahuli Preserve, splash zone of Limahuli waterfall, 300 m, 17 Sep 2022, *Jensen KLJ169* (PTBG).

Ectropothecium zollingeri (Müll. Hal.) A. Jaeger

Unknown abundance, Indigenous

Substrate(s): Volcanic rock (in stream)

Habitat(s): Riparian

Material examined. **KAUA'I:** Limahuli Garden, slopes above garden toward Limahuli Falls, Limahuli Stream, 244 m, 26 Jan 2015, *Shevock 46277* (CAS, PTBG).

Phyllodon lingulatus (Cardot) W.R. Buck[Syn. *Glossadelphus baldwinii* Broth.] (see Shevock *et al.* 2019)

Common, Indigenous

Substrate(s): Wet volcanic rock

Habitat(s): Riparian (in splash zone of streamlet), bamboo forest, mesic forest

Material examined. **KAUA'I:** Limahuli Garden, slopes above garden toward Limahuli Falls, Limahuli Stream, 152 m, 26 Jan 2015, *Shevock 46268* (CAS, PTBG); Lower Limahuli Preserve, first patch of bamboo forest on trail, 190 m, 17 Sep 2022, *Jensen KLJ179* (PTBG).

Vesicularia inflectens (Brid.) Müll. Hal.

Common, Indigenous

Substrate(s): Volcanic rock

Habitat(s): Riparian on stream banks and near streamlets

Material examined. **KAUA'I:** Lower Limahuli Preserve, riparian restoration near streamlet, 112 m, 31 Aug 2022, *Jensen KLJ139* (PTBG); *loc. cit.*, riparian zone, likely becomes submerged in heavy rains, 227 m, 17 Sep 2022, *Jensen KLJ178* (PTBG).

Vesicularia perviridis (Ångstr.) Müll. Hal.

Unknown abundance, Endemic

Substrate(s): Volcanic rock

Habitat(s): Mesic forest

Material examined. **KAUA'I:** Limahuli Garden, slopes above garden toward Limahuli Falls, Limahuli Stream, 107 m, 26 Jan 2015, *Shevock 46263* (CAS, PTBG).

Leskeaceae***Claopodium whippleanum*** (Sull.) Renauld & Cardot

Uncommon, Indigenous

Substrate(s): Volcanic rock, tree branch (*Psidium guajava*)

Habitat(s): Mesic forest, riparian

Material examined. **KAUA'I:** Limahuli Garden, slopes above garden toward Limahuli Falls, Limahuli Stream, 152 m, 26 Jan 2015, *Shevock 46265* (CAS, PTBG); Lower Limahuli Preserve, mesic forest restoration, 145 m, 26 Mar 2021, *Jensen KLJ021* (PTBG); *loc. cit.*, 173 m, 27 Apr 2021, *Jensen KLJ044* (PTBG); *loc. cit.*, 170 m, 27 Aug 2022, *Jensen KLJ142* (PTBG); Lower Limahuli Preserve, secondary mesic forest, 138 m, 31 Aug 2022, *Jensen KLJ151* (PTBG).

Leucobryaceae***Campylopus umbellatus*** (Arn.) Paris var. *umbellatus*

Common, Indigenous

Substrate(s): Volcanic rock

Habitat(s): Riparian, mesic forest

Material examined. **KAUA'I:** Lower Limahuli Preserve, lowland mesic forest, 97 m, 3 Dec 2020, *Jensen KLJ004* (PTBG); *loc. cit.*, riparian restoration zone next to streamlet, 112 m, 26 Mar 2021, *Jensen KLJ029* (PTBG).

Campylopus wheeleri (Müll. Hal.) Paris

Common, Endemic

Substrate(s): Volcanic rock

Habitat(s): Riparian

Material examined. **KAUA'I:** Lower Limahuli Preserve, riparian restoration, 104 m, 20 May 2021, *Jensen KLJ070* (PTBG); Lower Limahuli Preserve, Limahuli Stream, 123 m, 8 Jun 2021, *Jensen KLJ112* (PTBG).

Dicranodontium porodictyon Cardot & Thér.

Uncommon, Indigenous

Substrate(s): Volcanic rock, tree trunk (*Heptapleurum actinophyllum*)

Habitat(s): Riparian

Material examined. **KAUA'I:** Lower Limahuli Preserve, island within Limahuli Stream, 147 m, 21 Oct 2022, *Jensen KLJ189* (PTBG).

Leucobryum gracile Sull.

Common, Endemic

Substrate(s): Volcanic rock, tree roots and trunk (*Heptapleurum actinophyllum*)

Habitat(s): Riparian, mesic forest

Material examined. **KAUA'I:** Lower Limahuli Preserve, riparian restoration 500 ft from trailhead, 95 m, 15 Mar 2021, *Jensen KLJ124* (PTBG); Lower Limahuli Preserve, riparian restoration near streamlet, 112 m, 26 Mar 2021, *Jensen KLJ028* (PTBG); Lower Limahuli Preserve, slope/ridge behind Limahuli Garden, 6 Jan 2021, *Jensen KLJ190* (PTBG).

Leucobryum seemannii Mitt. var. *seemannii*

Common, Endemic

Substrate(s): Volcanic rock, tree roots and trunk (*Heptapleurum actinophyllum*)

Habitat(s): Riparian, mesic forest

Material examined. **KAUA'I:** Lower Limahuli Preserve, slope/ridge behind Limahuli Garden, 6 Jan 2021, *Jensen KLJ191* (PTBG); Lower Limahuli Preserve, riparian restoration, 127 m, 8 Jun 2021, *Jensen KLJ088, KLJ090, KLJ096* (PTBG); Lower Limahuli Preserve, riparian zone 35 ft from stream, 123 m, 8 Jun 2021, *Jensen KLJ105, KLJ113* (PTBG).

Meteoriaceae***Aerobryopsis longissima*** (Brid.) M. Fleisch.

Common, Indigenous

Substrate(s): Volcanic rock

Habitat(s): Riparian

Specimens of *Aerobryopsis longissima* have been placed under the name *Pseudotrachypus wallichii* (Brid.) W.R. Buck in PTBG records. However, following Buck (1994), the former may be a more accurate name for this species.

Material examined. **KAUA'I:** Lower Limahuli Preserve, slopes above garden toward Limahuli Falls, Limahuli Stream, 76 m, 26 Jan 2015, *Shevock 46254, 46279* (CAS, PTBG); Lower Limahuli Preserve, riparian restoration, 107 m, 20 May 2021, *Jensen KLJ071, KLJ079* (PTBG); *loc. cit.*, 127 m, 6 Jun 2021, *Jensen KLJ099* (PTBG); *loc. cit.*, 127 m, 27 Aug 2022, *Jensen KLJ138* (PTBG); Lower Limahuli Preserve, lowland mesic forest, 104 m, 3 Dec 2020, *Jensen KLJ002* (PTBG).

Aerobryopsis subdivergens (Broth.) Broth. subsp. *scariosa* (E.B. Bartram) Nog.

Common, Indigenous

Substrate(s): Volcanic rock

Habitat(s): Riparian

Material examined. **KAUA'I:** Lower Limahuli Preserve, riparian restoration zone next to streamlet, 126 m, 7 Jan 2021, *Jensen KLJ052* (PTBG); *loc. cit.*, 126 m, 26 Mar 2021, *Jensen KLJ027* (PTBG).

Floribundaria floribunda (Dozy & Molk.) M. Fleisch.

Common, Indigenous

Substrate(s): Volcanic rock

Habitat(s): Landslide restoration (2019), riparian

Material examined. **KAUA'I:** Lower Limahuli Preserve, southern landslide within fenced restoration, 176 m, 5 Apr 2021, *Jensen KLJ053* (PTBG); *loc. cit.*, 179 m, 5 Apr 2021, *Jensen KLJ056* (PTBG); *loc. cit.*, 183 m, 27 Aug 2022, *Jensen KLJ141* (PTBG); Lower Limahuli Preserve, bamboo forest, 200 m, 17 Sep 2022, *Jensen KLJ155* (PTBG).

Trachypus bicolor Reinw. & Hornsch.

Very abundant, Indigenous

Substrate(s): Volcanic rock

Habitat(s): Riparian

Material examined. **KAUA'I:** Lower Limahuli Preserve, Limahuli stream, riparian restoration, 107 m, 20 May 2021, *Jensen KLJ081* (PTBG); *loc. cit.*, in splash zone of small waterfall, 125 m, 27 Aug 2022, *Jensen KLJ192* (PTBG).

Mniaceae***Plagiomnium rostratum*** (Schrad.) T.J. Kop.

Uncommon, Indigenous

Substrate(s): Volcanic rock, silt

Habitat(s): Riparian

Material examined. **KAUAʻI:** Limahuli Valley, in valley bottom, 76–82 m, 28 Dec 1990, *Flynn 4343, 4357* (AD, COLO, HOE, PTBG); Limahuli Garden, slopes above garden toward Limahuli Falls, Limahuli Stream, 201 m, 26 Jan 2015, *Shevock 46274* (PTBG); Lower Limahuli Preserve, riparian zone, halfway to the waterfall, 215 m, 26 Mar 2021, *Jensen KLJ055* (PTBG); Lower Limahuli Preserve, Limahuli Stream, riparian restoration, 140 m, 3 May 2021, *Jensen KLJ119* (PTBG); Lower Limahuli Preserve, Limahuli Stream, in the splash zone of a small waterfall, 125 m, 27 Aug 2022, *Jensen KLJ146* (PTBG); Lower Limahuli Preserve, riparian zone, 214 m, 17 Sep 2022, *Jensen KLJ161* (PTBG); Lower Limahuli Preserve, Limahuli waterfall, in splash zones of main waterfall and several waterfalls, 300 m, 17 Sep 2022, *Jensen KLJ177* (PTBG).

Neckeraceae

Baldwiniella kealeensis (Reichardt) E.B.Bartram

Common, Endemic

Substrate(s): Volcanic rock

Habitat(s): Riparian, bamboo forest

Material examined. **KAUAʻI:** Limahuli Garden, slopes above garden toward Limahuli Falls, Limahuli Stream, 152 m, 26 Jan 2015, *Shevock 46267* (CAS, PTBG); Lower Limahuli Preserve, Limahuli Stream, underside of rock in the splash zone of a small waterfall, 125 m, 27 Aug 2022, *Jensen KLJ144* (PTBG); Lower Limahuli Preserve, Limahuli Stream, 214 m, 17 Sep 2022, *Jensen KLJ162* (PTBG); Lower Limahuli Preserve, Limahuli streambank in a section that is seasonally inundated, 212 m, 17 Sep 2022, *Jensen KLJ160* (PTBG); Lower Limahuli Preserve, bamboo forest, newly cut trail, 185 m, 21 Oct 2022, *Jensen KLJ188* (PTBG).

Homaliodendron flabellatum (Sm.) M. Fleisch.

Very abundant, Indigenous

Substrate(s): Volcanic rock

Habitat(s): Mesic forest, riparian

Material examined. **KAUAʻI:** Limahuli Garden, slopes above garden toward Limahuli Falls, Limahuli Stream, 107 m, 26 Jan 2015, *Shevock 46262* (CAS, PTBG); Lower Limahuli Preserve, Limahuli Stream, riparian restoration, 95 m, 23 Nov 2020, *Jensen KLJ005, KLJ006* (PTBG); Lower Limahuli Preserve, Limahuli Stream, wet forest fenced restoration, 165 m, 26 Mar 2021, *Jensen KLJ017* (PTBG); Lower Limahuli Preserve, Limahuli Stream, mesic forest fenced restoration, 145 m, 5 Apr 2021, *Jensen KLJ025* (PTBG); *loc. cit.*, 173 m, 27 Apr 2021, *Jensen KLJ037* (PTBG); Lower Limahuli Preserve, Limahuli Stream, riparian restoration near streamlet, 107 m, 20 May 2021, *Jensen KLJ076* (PTBG); Lower Limahuli Preserve, Limahuli Stream, riparian restoration, 112 m, 1 Apr 2021, *Jensen KLJ032* (PTBG); *loc. cit.*, 107 m, 20 May 2021, *Jensen KLJ080* (PTBG); *loc. cit.*, 127 m, 8 Jun 2021, *Jensen KLJ087* (PTBG); *loc. cit.*, 123 m, 8 Jun 2021, *Jensen KLJ107* (PTBG).

Neckeropsis obtusata (Mont.) M. Fleisch.

Unknown abundance, Indigenous?

Substrate(s): Volcanic rock

Habitat(s): Landslide restoration (2019)

Olson (1999) postulated that this taxon is introduced due to its small range, proximity to horticultural development and transplanting zones, and confinement to Kauaʻi. It is listed

in the Staples *et al.* (2004) checklist as naturalized. I feel that this may be incorrect, as it has also been found on O‘ahu in a privately accessed native forest, with no transplants, by Miles Thomas (*MKT 455*, BISH).

Material examined. **KAUA‘I:** Lower Limahuli Preserve fenced restoration, northern landslide within fence, restoration zone, 175 m, 28 Sep 2022, *Jensen KLJ185* (PTBG).

Octoblepharaceae

Octoblepharum albidum Hedw.

Uncommon, Indigenous

Substrate(s): Tree roots and trunk (*Pandanus tectorius*)

Habitat(s): Riparian, mesic forest

Material examined. **KAUA‘I:** Lower Limahuli Preserve, riparian restoration west bank, 102 m, 6 May 2021, *Jensen KLJ046* (PTBG).

Orthotrichaceae

Macromitrium brevisetum Mitt.

Common, Endemic

Substrate(s): Volcanic rock

Habitat(s): Botanical Garden (invasive forest), mesic forest

Material examined. **KAUA‘I:** Limahuli Garden, invasive forest demonstration site, 73 m, 18 May 2021, *Jensen KLJ064* (PTBG).

Macromitrium incurvifolium (Hook. & Grev.) Schwägr.

Unknown abundance, Indigenous

Substrate(s): Volcanic rock

Habitat(s): Botanical garden, open grassy slope

Material examined. **KAUA‘I:** Limahuli Garden, 46 m, 6 Nov 1995, *Flynn 5864* (COLO, PTBG).

Macromitrium microstomum (Hook. & Grev.) Schwägr.

Abundant, Indigenous

Substrate(s): Volcanic rock, tree trunk (*Heptapleurum actinophyllum*)

Habitat(s): Riparian

Material examined. **KAUA‘I:** Limahuli Garden, Limahuli stream, riparian restoration next to streamlet, 112 m, 1 Apr 2021, *Jensen KLJ035* (PTBG); Limahuli Garden, riparian zone, 127 m, 8 Jun 2021, *Jensen KLJ100* (PTBG); Limahuli Garden, Limahuli Stream, riparian restoration, 125 m, 27 Aug 2022, *Jensen KLJ148* (PTBG).

Macromitrium piliferum Schwägr.

Abundant, Endemic

Substrate(s): Tree trunk and roots (*Pandanus tectorius*)

Habitat(s): Riparian, mesic forest

Material examined. **KAUA'I:** Limahuli Garden, lower Limahuli Preserve, slopes above garden toward Limahuli Falls, Limahuli Stream, 76 m, 26 Jan 2015, *Shevock 46258* (CAS, PTBG); Lower Limahuli Preserve, on trail in fenced restoration section, 145 m, 26 Mar 2021, *Jensen KLJ019* (PTBG); Lower Limahuli Preserve, Limahuli Stream, riparian restoration near streamlet, 112 m, 1 Apr 2021, *Jensen KLJ036, KLJ051* (PTBG); Lower Limahuli Preserve, Limahuli Stream, riparian, 127 m, 8 Jun 2021, *Jensen KLJ094* (PTBG); Lower Limahuli Preserve, Limahuli Stream, riparian restoration, 123 m, 8 Jun 2021, *Jensen KLJ110* (PTBG); Lower Limahuli Preserve, 30 feet from trailhead on trail, 68 m, 27 Aug 2022, *Jensen KLJ133* (PTBG); Lower Limahuli Preserve, on trail 30 feet uphill from stream, 92 m, 27 Aug 2022, *Jensen KLJ134* (PTBG); Lower Limahuli Preserve, fenced restoration section, 140 m, 27 Aug 2022, *Jensen KLJ137* (PTBG); Lower Limahuli Preserve, Limahuli Stream, riparian restoration, 126 m, 27 Aug 2022, *Jensen KLJ149* (PTBG).

Pottiaceae

Barbula indica (Willd. ex Schrad.) Spreng.

Uncommon, Naturalized

Substrate(s): Volcanic rock

Habitat(s): Riparian/waterfall

Material examined. **KAUA'I:** Lower Limahuli Preserve, splash zone of Limahuli waterfall, 300 m, 17 Sep 2022, *Jensen KLJ171* (PTBG).

Chionoloma angustatum (Mitt.) M. Menzel

[Syn. *Pseudosymblypharis angustata* (Mitt.) Hilp.] (see Alonso *et al.* 2019)

Common, Endemic

Substrate(s): Volcanic rock

Habitat(s): Riparian (waterfall)

Material examined. **KAUA'I:** Lower Limahuli Preserve, Limahuli waterfall, 300 m, 17 Sep 2022, *Jensen KLJ167* (PTBG); Lower Limahuli Preserve, Limahuli Stream, 140 m, 16 Oct 2022, *Jensen KLJ187* (PTBG).

Hyophila involuta (Hook.) A. Jaeger

Common, Indigenous

Substrate(s): Volcanic rock

Habitat(s): Riparian, roadside

Material examined. **KAUA'I:** Limahuli Garden, slopes above garden toward Limahuli Falls, Limahuli Stream, 107 m, 26 Jan 2015, *Shevock 46281* (CAS, PTBG); Limahuli Garden, volcanic rocks lining driveway near welcome sign, 34 m, 18 Feb 2021, *Jensen KLJ120* (PTBG); Lower Limahuli Preserve, Limahuli Stream, riparian restoration, 244 m, 20 May 2021, *Jensen KLJ069* (PTBG); Lower Limahuli Preserve, southernmost landslide restoration area within fenced sections, 164 m, 1 Sep 2022, *Jensen KLJ183* (PTBG); Lower Limahuli Preserve, Limahuli waterfall, 300 m, 17 Sep 2022, *Jensen KLJ166* (PTBG); Lower Limahuli Preserve, splash zone of Limahuli waterfall, 300 m, 17 Sep 2022, *Jensen KLJ175* (PTBG); Lower Limahuli Preserve, southernmost landslide restoration area within fenced sections, 163 m, 22 Sep 2022, *Jensen KLJ184* (PTBG).

Pylaisiadelphaceae*Taxithelium mundulum* (Sull.) E.B. Bartram

Unknown abundance, Indigenous

Substrate(s): Tree branch (*Hibiscus tiliaceus*)

Habitat(s): Secondary mesic forest

Material examined. **KAUA'I:** Limahuli Valley, in valley bottom, 76–82 m, 28 Dec 1990, *Flynn 4354* (AD, COLO, HOE, PTBG).

Racopilaceae*Racopilum cuspidigerum* (Schwägr.) Ångstr.

Very abundant, Naturalized?

Substrate(s): Volcanic rock, soil (clay & silt), tree trunk/branch/roots, fallen logs

Habitat(s): Mesic forest, riparian, wet forest

The status of this taxon is uncertain and may be a Polynesian introduction (Staples et al, 2004).

Material examined. **KAUA'I:** Lower Limahuli Preserve, slopes above garden toward Limahuli Falls and Limahuli Stream, 76 m, 26 Jan 2015, *Shevock 46256* (CAS, PTBG); Lower Limahuli Preserve, fenced restoration, 173 m, 27 Apr 2021, *Jensen KLJ045* (PTBG); Lower Limahuli Preserve, mesic forest restoration, 104 m, 3 Dec 2020, *Jensen KLJ001* (PTBG); Limahuli Garden native forest walk and loulou feature, 82 m, 15 Mar 2021, *Jensen KLJ010, KLJ011* (PTBG); Lower Limahuli Preserve, fenced restoration, 165 m, 26 Mar 2015, *Jensen KLJ015* (PTBG); *loc. cit.*, 145 m, 4 Apr 2021, *Jensen KLJ024* (PTBG); *loc. cit.*, 173 m, 27 Apr 2021, *Jensen KLJ038, KLJ040* (PTBG); Lower Limahuli Preserve, riparian restoration near streamlet, 112 m, 1 Apr 2021, *Jensen KLJ031, KLJ034* (PTBG); Limahuli Garden invasive forest demonstration site, 73 m, 18 May 2021, *Jensen KLJ057* (PTBG); Lower Limahuli Preserve, riparian restoration, 107 m, 20 May 2021, *Jensen KLJ072, KLJ073, KLJ074* (PTBG); Lower Limahuli Preserve, riparian zone, 127 m, 8 Jun 2021, *Jensen KLJ091* (PTBG); *loc. cit.*, 123 m, 8 Jun 2021, *Jensen KLJ106, KLJ109* (PTBG).

Rhizogoniaceae*Pyrrhobryum spiniforme* (Hedw.) Mitt.

Abundant, Indigenous

Substrate(s): Volcanic rock, tree trunks/roots, fallen trees, and logs

Habitat(s): Riparian, mesic forest

Material examined. **KAUA'I:** Lower Limahuli Preserve, riparian restoration near streamlet, 112 m, 26 Mar 2021, *Jensen KLJ026* (PTBG); Lower Limahuli Preserve, mesic forest fenced restoration, 173 m, 27 Apr 2021, *Jensen KLJ041* (PTBG); Lower Limahuli Preserve, riparian restoration west bank, 107 m, 20 May 2021, *Jensen KLJ067* (PTBG); Lower Limahuli Preserve, riparian zone, 127 m, 8 Jun 2021, *Jensen KLJ092* (PTBG); *loc. cit.*, 123 m, 8 Jun 2021, *Jensen KLJ114* (PTBG).

Sematophyllaceae***Sematophyllum hawaiiense*** (Broth.) Broth.

Common, Indigenous

Substrate(s): Volcanic rock

Habitat(s): Riparian, botanical garden (invasive forest)

Material examined. **KAUA'I:** Lower Limahuli Preserve, riparian restoration, 112 m, 7 Jan 2021, *Jensen KLJ050* (PTBG); Limahuli Garden invasive forest demonstration site, 73 m, 18 May 2021, *Jensen KLJ066* (PTBG); Lower Limahuli Preserve, Limahuli Stream, riparian basalt rock that is often submerged, 147 m, 17 Sep 2022, *Jensen KLJ154* (PTBG); Lower Limahuli Preserve, riparian zone that is submerged in rainy season, 216 m, 17 Sep 2022, *Jensen KLJ164* (PTBG).

Sematophyllum subpinnatum (Brid.) E. Britton

Common, Indigenous

Substrate(s): Volcanic rock

Habitat(s): Riparian

Material examined. **KAUA'I:** Lower Limahuli Preserve, slopes above garden toward Limahuli Falls and Limahuli Stream, 107 m, 26 Jan 2015, *Shevock 46259* (CAS, PTBG); Lower Limahuli Preserve, riparian restoration, 95 m, 5 Mar 2021, *Jensen KLJ123* (PTBG).

Thuidiaceae***Thuidium cymbifolium*** (Dozy & Molk.) Dozy & Molk.

Very abundant, Indigenous

Substrate(s): Volcanic rock

Habitat(s): Secondary mesic forest, riparian, bamboo forest

Material examined. **KAUA'I:** Limahuli Valley, Limahuli Valley, in valley bottom, 76–82 m, 28 Dec 1990, *Flynn 4358* (AD, COLO, HOE, PTBG); Lower Limahuli Preserve, eastern side-gulch, 195 m, 22 Mar 2010, *Wood 14143* (PTBG); Limahuli Garden, slopes above garden toward Limahuli Falls, Limahuli Stream, 107 m, 26 Jan 2015, *Shevock 46264* (CAS, PTBG); Lower Limahuli Preserve, ungulate proof fence zone, 165 m, 26 Mar 2021, *Jensen KLJ014* (PTBG); Lower Limahuli Preserve, mesic forest fenced restoration, 145 m, 5 Apr 2021, *Jensen KLJ023* (PTBG); *loc. cit.*, 173 m, 27 Apr 2021, *Jensen KLJ039* (PTBG); Lower Limahuli Preserve, riparian restoration near streamlet, 112 m, 1 Apr 2021, *Jensen KLJ033* (PTBG); Lower Limahuli Preserve, riparian restoration zone, 107 m, 20 May 2021, *Jensen KLJ068* (PTBG); *loc. cit.*, 127 m, 8 Jun 2021, *Jensen KLJ097* (PTBG); *loc. cit.*, 123 m, 8 Jun 2021, *Jensen KLJ108* (PTBG); Lower Limahuli Preserve, second patch of bamboo forest on trail, 200 m, 17 Sep 2022, *Jensen KLJ156* (PTBG).

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