

Recent notable plant records and rediscoveries from Kaua‘i, Hawaiian Islands

BENJAMIN NYBERG, KENNETH R. WOOD 

National Tropical Botanical Garden, 3530 Papalina Road, Kalāheo, Kaua‘i, Hawai‘i 96741, USA; email: bnyberg@ntbg.org

SCOTT HEINTZMAN, SUSAN M. DEANS

Plant Extinction Prevention Program, Pacific Cooperative Studies Unit, University of Hawai‘i, 3060 Eiwa St., Lihu‘e, Kaua‘i, Hawai‘i 96766, USA

ADAM WILLIAMS

Hawai‘i Department of Land and Natural Resources, Division of Forestry and Wildlife, 3060 Eiwa St., Līhu‘e, Hawai‘i 96766, USA

We report the rediscovery of two species previously thought extinct, having no known individuals in the wild, namely *Adenophorus periens* (Polypodiaceae) and *Hibiscadelphus woodii* (Malvaceae). Other notable plant finds on Kaua‘i include *Gouania meyenii* (Rhamnaceae), still extant on O‘ahu and rediscovered on Kaua‘i; *Isodendrion pyriformis* (Violaceae), a new island record for Kaua‘i; and *Silene lanceolata* (Caryophyllaceae), still extant on O‘ahu, Moloka‘i, and Hawai‘i, but not seen on Kaua‘i since 1840. Some of these records and rediscoveries were made possible by utilizing drone technology. This new method has proven to be valuable in botanical survey and discovery, especially in cliff habitats. The drone we have deployed collects high-resolution photos, which we have found effective for plant identification, population inventory, and, most recently, remote plant collection (La Vigne *et. al.* 2022). Drones equipped with a stabilized cutting mechanism have already had a great impact, with successful conservation collections of many critically endangered plant species on Kaua‘i. With plant extinctions quickly accelerating, it will be important to enhance funding for the further development of these efficient and effective new tools.

Caryophyllaceae

Silene lanceolata A. Gray

Island rediscovery

Previously known from Kaua‘i, O‘ahu, Moloka‘i, Lāna‘i, and Hawai‘i, *Silene lanceolata* was thought to have gone extinct on Lāna‘i and Kaua‘i. First described by Asa Gray in ca. 1854 from material collected on Kaua‘i in ca. 1840, it had not been documented on Kaua‘i until its rediscovery in 2022. While surveying dry-mesic cliff habitat above Koai‘e Canyon in the interior of Kaua‘i, rappelling techniques were used to access more vertical sections of cliff that invasive ungulates cannot reach and where diverse native vegetation communities remain. On initial discovery, five individuals of *S. lanceolata* were observed, and a cutting was collected from one individual to be grown *ex situ* (Figure 1). On a subsequent survey additional individuals were located, bringing the total to seven mature and ten immature plants in this population, and seed was collected for *ex situ* storage from one individual. While these plants were discovered without the use of drone technology, other

rare plant species in the area were found with drones, and these initial drone discoveries prompted additional targeted exploration via rappel. Nearby vertical cliff bands with native-dominated vegetation should be surveyed for additional individuals, and seed collections should be made from additional plants for *ex situ* storage and restoration. *Silene lanceolata* is still considered extinct on Lānaʻi and has not been documented there since 1930.

Material examined. LĀNAʻI: Maunalei Valley, 244 m, 05 Aug 1930, *G.C. Munro 943* (BISH). KAUAʻI: ca. 1840, *Wilkes Expedition s.n.* (GH 37956); Cliffs above Koaiʻe, Nā Pali-Kona Forest Reserve, 1,030 m, 29 Apr 2022, *S. Deans, S. Heintzman & A. Williams KP04292206* (PTBG).

Malvaceae

Hibiscadelphus woodii Lorence

& W.L. Wagner

Rediscovery

Hibiscadelphus woodii is a Kauaʻi single-island endemic flowering plant discovered in 1991 (Wood 1992; Lorence & Wagner 1995) and was known from only four individuals on the steep cliffs below Puʻu o Kila, Kalalau. The species was noted as extinct in 2011 when the last individual was found deceased (Wood 2012). Drone surveys were conducted in early 2019 with the intent of relocating the species and were successful in documenting three individuals of *H. woodii* (Figure 1). The location of the new population is on an extremely remote vertical cliff with no safe location above for utilizing rope rappelling techniques for access. Plans are to use drone technology to monitor for flowers and fruit and attempt conservation collections.

Material examined. KAUAʻI: Hanalei Distr., Kalalau rim, north of Kahuamaʻa Flat, lowland mesic cliffs, 990–1,020 m, 03 Mar 1991, *K.R. Wood, M. Query & S. Montgomery 629* (holotype, PTBG, a flower also in spirit collection; isotypes, BISH, K, Mo, NY, US).

Polypodiaceae

Adenophorus periens L.E. Bishop

Rediscovery

A rare but broadly distributed epiphytic fern historically known from all the major islands, *Adenophorus periens* had been declining precipitously across the Hawaiian Islands for several decades. The last known plant perished in the Kahaualeʻa Natural Area Reserve on Hawaiʻi Island in 2016, and attempts at *ex situ* propagation of this delicate pendant species failed, leading to fears it may have gone extinct. Extensive surveys of its former habitat across all the main islands had failed to turn up new populations until, in the summer of 2021, a single individual in a remote valley of North Kauaʻi was rediscovered, not far from one of its historic occurrences. Subsequent surveys have now led to the discovery of additional small, remote populations around northern and eastern Kauaʻi. Sixteen individuals in five populations are currently being monitored for reproductive material, and attempts are underway to cultivate this rare species and establish *ex situ* living collections. Previously known to be epiphytic predominantly on native ʻōhiʻa (*Metrosideros polymorpha*) and hame (*Antidesma platyphyllum*) trees, most of the latest discoveries have been on other native tree species: ʻohe mauka (*Polyscias oahuensis*), kōpiko (*Psychotria* sp.), and one occurrence on hame, but none on ʻōhiʻa. The reasons for its rarity remain unknown.

Material examined. KAUAʻI: Waiʻoli Valley, E of main falls below steep cliffs, 487 m, 31 May 2021 (Figure 2); ʻIole headwaters, 975 m, 20 Oct 2021 (Figure 2); Hanalei, in side drainage just south of Kaʻāpoko, 725 m, 16 Aug 2021 (Figure 3); Wahiawa, below Kapalaoa in bottom of drainage, 741 m, 07 Apr 2022 (Figure 3); Hanalei, E side of Nāmoloakama, 640 m, 13 May 2022 (Figure 3).

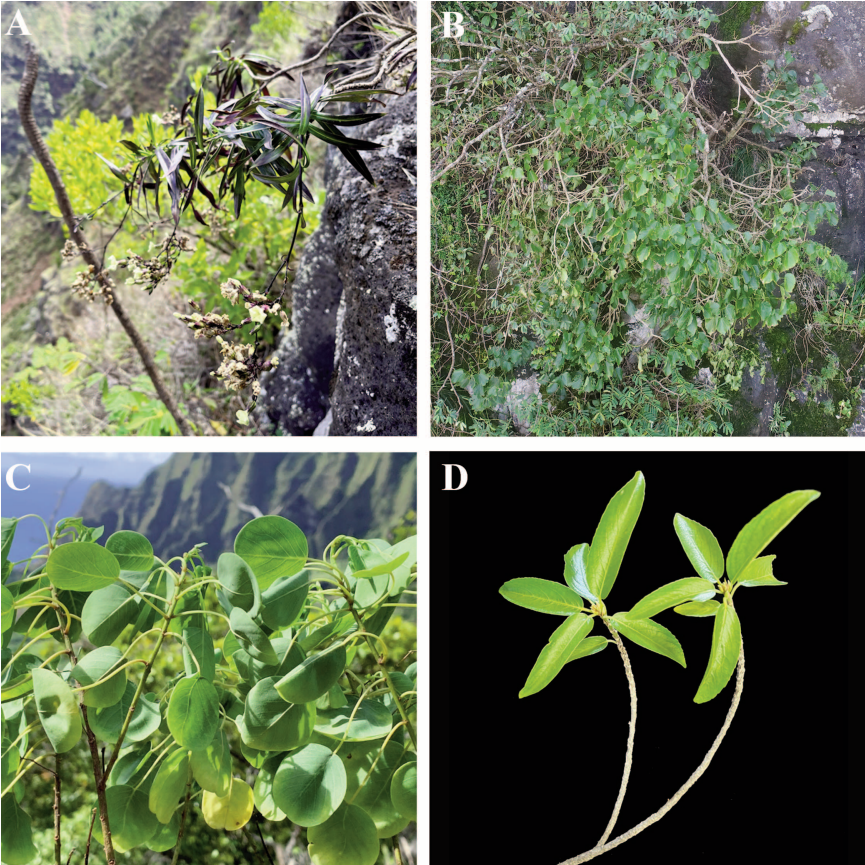


Figure 1. A, *Silene lanceolata*, Koai'e, Kaua'i, Hawai'i. B, *Hibiscadelphus woodii*, Kalalau, Kaua'i, Hawai'i. C, *Gouania meyenii*, Kalalau, Kaua'i, Hawai'i. D, *Isodendron pyrifolium*, Waiahulu, Kaua'i, Hawai'i.

Rhamnaceae

Gouania meyenii Steud.

Island rediscovery

Gouania meyenii was discovered on Kaua'i in 1991 and reported as a new island record by Lorence & Flynn (1995), after previously being considered a single-island endemic on O'ahu. The Kaua'i population was known from ca. 20 individuals restricted to two remote cliff locations in Kalalau and a single individual in Hipalau, a small valley within the Koai'e Canyon region of central Kaua'i. Plants were last observed in 1994 and concerted efforts to relocate these individuals were unsuccessful. A previously unrecorded grouping of ca. 12 plants were rediscovered in 2020 by drone survey in Kalalau Valley, below Pu'u o Kila (Figure 1), and conservation collections have now been successful.

Material examined. **KAUA'I:** Hanalei Distr., Kalalau rim, Kalāhū side below and W of first Kalalau lookout, 790 m, 20 Nov 1991, *K.R. Wood 1393* (BISH, PTBG); *loc. cit.*, 22 Nov 1991, *K.R.*



Figure 2. *Adenophorus periens*. A, Wai'oli, Kaua'i, Hawai'i. B, 'Iole, Kaua'i, Hawai'i.

Wood 1424 (BISH, PTBG, US); *loc. cit.*, 13 Mar 1992, *K.R. Wood & S. Perlman 1707* (PTBG), *1708* (PTBG, US); *loc. cit.*, 02 Aug 1994, *K.R. Wood & S. Perlman 3383* (NY, PTBG, US); *loc. cit.*, 14 Oct 1994, *K.R. Wood 3637* (BISH, NY, PTBG, US); Kalalau Valley, back of valley on cliffs below Pu'u o Kila, 725 m (2,380 ft), 10 Jun 1992, *S. Perlman, T. Flynn & K.R. Wood 12805* (PTBG, US); Waimea Distr., Waimea Canyon drainage, Koai'e Canyon, at back of Hipalau Valley, on north-facing cliff, 21 Oct 1992, *S. Perlman & K.R. Wood 13060* (PTBG, US); Kalalau, valley cliffs and slopes below Pu'u o Kila, 620 m, 18 Aug 2020, *K.R. Wood, B. Nyberg & S. Heintzman 18514* (BISH, PTBG); *loc. cit.* 16 Jul 2021, *K.R. Wood, S. Heintzman & S. Deans 18778* (PTBG).

Violaceae

Isodendrion pyriforme A. Gray

New island record

Once widely distributed across the archipelago, collections of *Isodendrion pyriforme* were made on Ni'ihau, O'ahu, Lāna'i, Moloka'i, and Hawai'i, and reported by Hillebrand from Maui (Wagner *et al.* 1999). This species was thought to be extinct for nearly 120



Figure 3. *Adenophorus periens*. **A**, Nāmoloakama, Kauaʻi, Hawaiʻi. **B**, Wahiawa, Kauai, Hawaiʻi. **C**, Kaʻāpoko, Kauaʻi, Hawaiʻi.

years until it was rediscovered on Hawaiʻi Island in 1991. More recently, a population was found on Oʻahu in mid-2016 with 60 individuals. Here we report the discovery of *I. pyriformis* on Kauaʻi, in the Waiahulu region of Waimea Canyon (Figure 1). The population, which we estimate to number around 10 individuals, was discovered via drone survey, and our specimen was also collected by drone. Material was brought to the NTBG horticultural center as cuttings (which subsequently flowered on the mist bench), and a vegetative specimen was vouchered.

Material examined. **HAWAII:** North Kona, Land of Kealakehe, 73 m, 14 Jul 1991, *K. Nagata* 4215 (BISH); *loc. cit.*, 91 m, 21 Jul 1992, *S. Perlman* 12897 (PTBG). **KAUAI:** Waiahulu, Waimea Canyon, Puʻu Ka Pele Forest Reserve, 671 m, 24 Mar 2022, *B. Nyberg et al.* BN014 (PTBG). **LĀNAI:** Jul 1870, *W. Hillebrand & J.M. Lydgate s.n.* (holotype, BISH 72088). **NIHAU:** Voyage de M.J. Rémy, 1851, *M.J. Remy* 534 (BISH, PTBG). **OʻAHU:** 1838, *Wilkes Expedition s.n.* (GH 67059, US 7693); Waiʻanae Kai, 660 m, 11 Jul 2016, *A. Loomis et al.* OA-WAI-A-0001 (BISH).

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REFERENCES

- La Vigne, H., Charron, G., Rachiele-Tremblay, J., Rancourt, D., Nyberg, B. & Lussier Desbiens, A.** 2022. Collecting critically endangered cliff plants using a drone-based sampling manipulator. *Scientific Reports* **12**(1): 1–11.
- Lorence, D.H. & Flynn T.W.** 1995. Contributions to the flora of Hawai'i. III. New additions, range extensions, and rediscoveries of flowering plants. *Bishop Museum Occasional Papers* **41**: 19–58.
- Lorence, D.H. & Wagner, W.L.** 1995. Another new, nearly extinct species of *Hibiscadelphus* (Malvaceae) from the Hawaiian Islands. *Novon* **5**: 183–187.
- Wagner, W.L., Herbst, D.R. & Sohmer, S.H.** 1999. *Manual of the flowering plants of Hawai'i*. Revised edition. University of Hawai'i Press, Honolulu. 1,918 pp.
- Wood, K.R.** 1992. New *Hibiscadelphus* found on Kaua'i. *Hawaii's Forests and Wildlife Newsletter* **7**: 115–117.
- Wood, K.R.** 2012. Possible extinctions, rediscoveries, and new plant records within the Hawaiian Islands. *Bishop Museum Occasional Papers* **113**: 91–102.