Published online: 20 January 2023 ISSN (online) 2376-3191

Records of the Hawaii Biological Survey for 2022. Edited by Neal L. Evenhuis. *Bishop Museum Occasional Papers* 148: 107–162 (2023)

New plant naturalization records for Kaua‘i

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In this article we summarize new records of naturalization for nonnative plant species in Kaua‘i, in which most of the vouchers examined were collected during discrete whole–island surveys funded by the Kaua‘i Invasive Species Committee (KISC) and supplemented by continuous opportunistic collections by botanists at the National Tropical Botanical Garden (NTBG). We report a total of 47 new records of naturalized plants for Kaua‘i and correct the record for one species that was previously misidentified. These records include 5 records representing the first instance of naturalization in the Hawaiian archipelago, in which plants completely unknown to the state are denoted as “New state record” while those previously well-recorded in cultivation are denoted as “New naturalized record.” Another 29 records representing the first instance of naturalization on Kaua‘i are denoted as “New island record,” and an additional 13 species possibly showing signs of naturalization are listed alongside a discussion about their uncertain status. Most species that appear to be reproducing solely by vegetative means have been included in the latter category except where numerous widely-distributed occurrences exist, as we acknowledge that a single stochastic event could eliminate colonies of plants contained in a single area, even if that area is relatively large. All records are reported following the guidance offered by Brock *et al.* (2020).

KISC surveys were conducted in 2007, 2015–2017, and 2021 and mainly focused on publicly accessible roads and trails (Brock & Javier 2018). Additionally, most major nursery and landscaping businesses on Kaua‘i were also surveyed, allowing us to include notes on whether cultivated species have recently been offered for sale. Voucher specimens were collected in duplicate in most cases and minimally deposited at the NTBG

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Table 1. Herbarium code and corresponding institution name and location.

Herbarium Code	Institution	Location
AD	State Herbarium of South Australia	Adelaide, Australia
BISH	Bishop Museum	Honolulu, Hawai‘i, USA
CAS	California Academy of Sciences	San Francisco California, USA
HAST	Academia Sinica	Taipei, Taiwan
MBK	Makino Botanical Garden	Kochi, Japan
MO	Missouri Botanical Garden	Saint Louis, Missouri, USA
NY	New York Botanical Garden	Bronx, New York, USA
PTBG	National Tropical Botanical Garden	Kalāheo, Hawai‘i, USA
UBC	University of British Columbia	Vancouver, Canada
UC	University of California	Berkeley, California, USA
US	Smithsonian Institution	Washington, DC, USA

herbarium (PTBG) in Kalāheo, Kaua‘i and at the Bishop Museum’s *Herbarium Pacificum* (BISH), in Honolulu, Hawai‘i unless otherwise indicated. Additional duplicates were sent to various other herbaria and are listed in Table 1 alongside their corresponding codes. Vouchers were not collected at all detected sites, especially if reproductive material was not available to make a representative specimen or if collection required trespassing on private land. However, we discuss the location and naturalization status of unvouchered sites for each record below. Distribution maps of many of these species can be found in KISC’s technical report on the early detection of invasive plant species (Brock & Javier 2018). Photographs of plants in the field, where available, have been included primarily to illustrate the habitat and growth pattern of naturalized plants, but some have also been included as an identification aid. Additional photographs may be available from the corresponding author.

Acanthaceae

Asystasia gangetica (L.) T. Anderson

subsp. ***micrantha*** (Nees) Ensermu **New island record**

Asystasia gangetica subsp. *micrantha* is a herb that has previously been reported as naturalized on East Maui (Starr & Starr 2022) and Hawai‘i (Starr & Starr 2016), although it is possible that this plant has been overlooked on other islands due to its rank as a subspecies. At least one well-established population including hundreds or possibly thousands of plants exists on Kaua‘i, forming dense mats in a pasture over more than two hectares and climbing along fence lines in Kalāheo (Figures 1–2). This plant was likely introduced as an ornamental in the past, although it was not observed for sale during surveys of Kaua‘i nurseries during 2015–2017 (Brock & Javier 2018).

Two subspecies of *A. gangetica* are recognized, both of which have been recorded in Hawai‘i (Imada 2019). Subspecies *micrantha* is easily differentiated from the more common subsp. *gangetica* by having smaller white flowers with distinctive pink–purple blotches on the lower portion of the corolla, with corolla lobes being comparatively

Figure 1. *Asystasia gangetica* subsp. *micrantha*. Field photograph of K. Brock 801.

Figure 2. Dense infestation of *Asystasia gangetica* subsp. *micrantha* in a pasture, climbing up a fence.

Figure 3. Naturalized *Justicia spicigera* along the Hulēʻia River. Field photograph of *K. Brock 795.*

reflexed (Deng *et al.* 2011). Additionally, subsp. *micrantha* appears to be ecologically distinct, indicating that natural resource and agricultural managers should consider these organisms separately in their management plans. In Australia, where both subspecies are present, subsp. *gangetica* is considered a relatively benign garden pest and inhabitant of heavily disturbed areas, whereas subsp. *micrantha* is considered both an agricultural and environmental weed capable of reducing native biodiversity and crop yields (Westaway *et al.* 2016). Consequently, subsp. *micrantha* is targeted by invasive species outreach organizations in Australia, whereas subsp. *gangetica* is not.

Material examined. **KAUAʻI**: Kōloa Distr., northern Kalāheo, naturalized throughout a pasture along Kīkala Rd, very dense along fence lines, 21.935404°N, 159.516624°W, 275 m, 12 Apr 2016, *K. Brock 801* (PTBG, US).

Justicia spicigera Schltdl. **New island record**

Herbarium vouchers indicate that *Justicia spicigera*, commonly called Mexican honeysuckle, has been present on Kauaʻi since at least 1986, when it was noted as a possible remnant of cultivation or potentially naturalizing in Līhuʻe. This plant is cultivated in Hawaiʻi (Staples & Herbst 2005), although it was not observed during surveys of Kauaʻi nurseries during 2015–2017 (Brock & Javier 2018), indicating that it may not currently be a popular ornamental plant on Kauaʻi. More recently, this species was confirmed as naturalized in at least two locations, associated with mostly non-native vegetation, includ-

Figure 4. *Ruellia longipetiolata* naturalized on the edge of a stream. Field photograph of *K. Brock 808.*

ing in the vicinity of the Hulēʻia River and in Kalāheo. While the Kalāheo population appears sparse with approximately 10 plants observed over 2–3 ha, *J. spicigera* appears to be more common around the Hulēʻia River (Figure 3), where numerous individuals representing multiple life stages were observed by boat and from the roadside. The origin for these populations is unclear, as no obviously cultivated areas exist in the immediate vicinity, although the Kalāheo population exists near a popular, but unsanctioned, green waste dumping site within the Līhuʻe–Kōloa Forest Reserve (south section). *Justicia spicigera* has previously been reported as naturalized on Oʻahu, Molokaʻi, Maui, and Hawaiʻi (Wagner *et al.* 1990; Staples *et al.* 2002; Starr & Starr 2013; Parker & Parsons 2016).

Material examined. **KAUAʻI**: Līhuʻe Distr., Līhuʻe, along Hwy 50 just west of Līhuʻe Plantation Mill, cultivated?, apparently naturalized, 03 Apr 1986, *T. Flynn 1619* (PTBG, BISH); Līhuʻe Distr., approximately 20 mature and 7–10 immature naturalized plants scattered throughout understory, growing on south bank of Hulēʻia River, in shaded *Falcataria* and *Syzygium* dominated alien forest adjacent to *Hibiscus tiliaceus* riparian strip, 21.943500°N, 159.392578°W, 1 m, 03 Apr 2016, *K. Brock 795* (PTBG, BISH; Līhuʻe Distr., on Kīpū Rd just before Outfitters Kauaʻi office in barbed wire fence to pasture, northeast of office, steep slope down to grassy pasture and Hulēʻia Stream, with *Eucalyptus robusta*, *Mangifera indica*, *Ficus microcarpa*, *Macaranga tanarius*, *Megathyrsus maximus*, *Alocasia*, *Spathodea campanulata*, 30+ plants in area, heavily grazed by cattle and pruned into small bushes, a few climbing up *Eucalyptus robusta* that branches above level of cattle with bright orange flowers, appears to be naturalizing, 21.9503°N, 159.4208°W, 14 Jul 2021, *N. Tangalin NT5191* (PTBG).

Ruellia longepetiolata (Oerst.) Hemsl. **New island record**

[syn. *R. squarrosa* (Fenzl) Cufod.]

Ruellia longepetiolata, commonly known as creeping ruellia, is cultivated as an ornamental plant and was occasionally observed in the inventory of nurseries during 2015–2017 surveys being sold as a groundcover. Approximately 30 mature plants were observed growing along a hiking trail near the Wailua River and around the base of rocks within a small ephemeral stream (Figure 4). Since these observations in 2016, several iNaturalist users have photographed this plant along different sections of the hiking trail. *Ruellia longepetiolata* has previously been reported as naturalized on Oʻahu (Imada & Kennedy 2020) under the synonym *R. squarrosa* (Fenzl) Cufod. (Fenzl 1868, Walker 1970). However, we use *R. longepetiolata* (Oerst.) Hemsl. (Örsted, 1854, Hemsley 1882), which is the priority synonym according to the International Plant Names Index (IPNI 2022).

Material examined. **KAUAʻI**: Līhuʻe Distr., about 30 plants growing along hiking trail through native-nonnative mixed forest and in a shallow, quick-moving stream, rooted in substrate that has gathered around rock bases, 22.044250°N, 159.363400°W, 7 m, 03 May 2016, *K. Brock 808* (BISH).

Apocynaceae

Stapelia gigantea N.E. Br. **New island record**

Stapelia gigantea, commonly called Zulu giant or giant toad plant, is a cultivated ornamental in Hawaiʻi (Staples & Herbst 2005) and was occasionally observed for sale during 2015–2017 surveys of nurseries on Kauaʻi (Brock & Javier 2018). Multiple mature plants have been observed naturalizing along steep, dry slopes in *Myoporum sandwicense* shrubland habitat north of Polihale State Park (Figures 5–6). Additionally, a colony of at least several dozen plants was noted along the lower stretches of Waimea Canyon Drive in 2020 growing in rocky, degraded dry cliff habitat. This population contained multiple flowering and fruiting individuals, as well as immature plants. A few individuals have also been observed (but not vouchered) growing on rocky cliffs on the east side of Kaumualiʻi Highway at the intersection with Hanapepe Road (at 21.90906° N, 159.58473° W). *Stapelia gigantea* has previously been reported as naturalized on Oʻahu, Molokaʻi, Lānaʻi, Maui, Kahoʻolawe and Hawaiʻi (Wagner *et al.* 1990; Oppenheimer *et al.* 1999; Wysong *et al.* 2007; Oppenheimer 2010; Parker & Parsons 2012a; Starr & Starr 2017; Oppenheimer & Bogner 2019).

Material examined. **KAUAʻI**: Waimea Distr., dry rock and crumbling dirt slope in first drainage past end of Polihale Beach, 22.101858°N, 159.742783°W, 63 m, 25 Jan 2016, *S. Deans SMD023* (PTBG, BISH, US); Waimea Distr., halfway up north-facing slope of Polihale ridge in Hikimoe Valley, 22.101439°N, 159.742045°W, 134 m, 10 Jul 2016, *K. Brock 859* (PTBG).

Araceae

Syngonium podophyllum Schott **New island record**

Syngonium podophyllum, known commonly as arrowhead plant or nephthytis, is a climbing vine that is cultivated as an ornamental and was frequently observed for sale during 2015–2017 nursery surveys (Brock & Javier 2018). Although vegetative reproduction appears to

Figure 5. *Stapelia gigantea* flower. Photograph of *K. Brock 859* (PTBG, BISH).

Figure 6. *Stapelia gigantea* naturalizing in native *Myoporum* shrubland. Field photograph of *K. Brock 859.*

Figure 7. A large colony of *Syngonium podophyllum* (climbing vine at center) growing along 350 m of roadside. Field photograph of *K. Brock 879.*

be its primary method of reproduction, this plant has become common near human settlements in disturbed moist to mesic alien lowland forests on Kauaʻi. Additionally, *S. podophyllum* now occurs outside of human residential areas, including within forest reserves, possibly due to frequent dumping of yard clippings containing viable propagules. This vine often climbs large trees on Kauaʻi and forms large colonies in some areas (Figure 7). More than 10 large colonies (>250 m^3) existing outside of cultivated areas were documented during 2015–2017 KISC roadside surveys. *Syngonium podophyllum* has previously been reported as naturalized on Oʻahu and Maui (Oppenheimer 2006; Oppenheimer 2011).

Material examined. **KAUAʻI**: Wailua, side of Hwy 580, along road and in University of Hawaiʻi Wailua Experiment Station fence, 22.063056°N, 159.406944°W, 175 m, 24 May 2007, *N. Tangalin 1279* (PTBG); Kōloa Distr., Kalāheo, on forest reserve access road off Puʻuwai Rd, growing on several different tree species in alien forest, perhaps introduced from disposed yard cuttings, 21.943204°N, 159.524485°W, 322 m, 12 Apr 2016, *K. Brock 879* (PTBG, BISH, US); Waimea Distr., Waimea rim, just past roadside on rocky outcropping, 21.994800°N, 159.675680°W, 366 m, 30 Oct 2020, *S. Deans & S. Heintzman KP10302001* (PTBG).

Asparagaceae

Yucca aloifolia L. **New naturalized record**

Yucca aloifolia, commonly called Spanish bayonet or Spanish dagger, is a shrub that appears to have been historically cultivated on Kauaʻi because it is cultivated in multiple

Figure 8. *Yucca aloifolia* at Keālia Beach, spreading in *Scaevola taccada*-dominated coastal habitat.

Figure 9. Naturalized population of *Yucca aloifolia* along the coast of Hanalei Bay under *Casuarina equisetifolia*.

yards and resorts. However, 2015–2017 nursery surveys did not find this plant commonly offered for sale, with the exception of one plant that had been sourced from naturalized populations. This species is difficult to distinguish from *Y. gloriosa* (Hess & Robbins 2002; Rentsch & Leebens-Mack 2012), which shares many variable morphological characteristics and is cultivated in Hawai‘i (Staples & Herbst 2005). Kaua‘i plants were identified as *Y. aloifolia* according to Hess and Robbins (2002), based on flower and leaf characteristics. Perhaps the most helpful distinguishing characteristic in the field is its comparatively sprawling habit, which results from the proliferation of horizontal woody stems along the ground to form colonies. Contrastingly, *Y. gloriosa* tends to branch more towards the terminus of main limbs, maintaining a more upright or mounding appearance.

No herbarium records exist for *Y. aloifolia* in Hawai‘i, but plants at Keālia Beach have been present at least since the 1980s (L. Kaneholani, pers. comm.) and it has been reported in cultivation in Hawai‘i (Staples & Herbst 2005). Our surveys indicate that *Y. aloifolia* has naturalized in at least four locations on Kaua‘i, all of which occur within coastal habitats. The largest populations exist along Keālia Beach (Figure 8) and throughout a coastal residential area in ‘Aliomanu, each including numerous adult plants distributed over approximately 3 ha, with densities ranging from sporadic to over 50% cover. Three other small populations were also detected, including one naturalized population on a steep, rocky slope at Hanalei Bay (Figure 9) and another near Po‘ipū, both of which are distant from any possible areas of cultivation, while plants at the third site appear to be spreading vegetatively from a resort planting in Wailua Bay. The current distribution of *Y. aloifolia* suggests that two methods of dispersal are occurring: short-distance dispersal vegetatively by horizontal, re-rooting stems; and longer-distance dispersal, possibly by seed. Seeds are thought to be dispersed by birds, although fruits have so far not been observed. Members of the genus *Yucca* are known for having obligate mutualisms with yucca moths, which would normally prevent their naturalization in Hawai‘i without the subsequent introduction of its pollinator, but recent studies have found that *Y. aloifolia* can be effectively pollinated by more generalist pollinators such as the common honey bee (*Apis mellifera*; Rentsch & Leebens-Mack 2014).

Material examined. **KAUA‘I**: Keālia Beach Park, common and naturalized in coastal strand vegetation next to sandy beach with *Scaevola taccada*, 22.091688°N, 159.306806°W, 6 m, 22 Feb 2017, *K. Brock 947* (PTBG, BISH).

Asteraceae

Soliva sessilis Ruiz & Pav. **New island record**

Soliva sessilis, or lawn burweed, is a low-lying herb with fruits that are often dispersed by clinging to clothing, shoes, or equipment by way of sharp spines that ornament the burr-like fruiting heads (Figure 10). This plant was observed growing as a weed in at least two locations, growing along the edge of the golf course green areas (Figure 11). *Soliva sessilis* has previously been reported as naturalized on Hawai‘i Island (Wagner & Herbst 1995).

Figure 10. Plants of *Soliva sessilis* showing finely divided leaves and burr-like inflorescence heads. Photo of *D.H. Lorence 10803*.

Figure 11. Habit of *Soliva sessilis* along lawn at Kukuiolono Golf Course, Kaua‘i. Photo of *D.H. Lorence 10803*.

Figure 12. Naturalized *Harrisia eriophora* and other cacti in *Leucaena leucocephala* shrubland. Field photograph of *K. Brock 1051.*

Material examined. **KAUA‘I**: Kōloa Distr., Kukuiolono Golf Course, below (west of) picnic pavilion border of mowed lawn and weedy shrubland, growing with weedy grasses, *Erigeron bellioides*, and *Plantago lanceolata,* at edge of weedy shrubland with *Megathyrsus maximus, Leucaena, Psidium, Schinus* and *Casuarina*, perennial herb forming dense mats in lawn, spreading vegetatively, also with flowers and fruits, locally abundant in several areas, 21.911389°N, 159.529444°W, 241 m, 04 May 2020, *D.H. Lorence 10803* (BISH, PTBG, CAS, US, NY).

Cactaceae

Harrisia eriophora (Pfeiff.) Britton **New state record**

Harrisia eriophora, known as fragrant prickly apple or wild yellow dragon apple cactus, is a shrubby cactus endemic to Cuba (Franck 2016) and was first collected on Kaua‘i from a naturalized individual near Po‘ipū in 1995. It is likely an escape from a succulent garden that was established in Po‘ipū during the 1930s (according to informational signage in the garden). Two locations of naturalized plants were recently detected over 0.5 km from the garden, with each having about 10–15 mature fruiting plants alongside approximately 10 immature individuals in a fallow field dominated by *Leucaena leucocephala* and other naturalized cacti (Figure 12). More individuals likely exist but were obscured by *L. leucocephala* canopy during roadside surveys. Numerous fruits containing hundreds of seeds were observed, which are edible and may be dispersible by birds (Taylor *et al.* 2017). Plants were identified using the taxonomy of Franck (2016); *H. eriophora* is distinguishable in the field from other *Harrisia* in Hawai‘i by having 10–12 ribbed stems, rather than

Figure 13. *Poranopsis paniculata* (vine with heart-shaped leaves) growing among *Leucaena leucocephala* (koa haole) shrubland. Field photograph of *K. Brock 982.*

3–5 ribs. This plant does not appear to be common in the nursery trade on Kauaʻi, as it was not found in nurseries or observed in cultivation or in residential areas during 2015–2017 surveys of Kauaʻi.

Material examined. **KAUAʻI**: Kōloa Distr., Poʻipū, along Poʻipū Rd, between turnoffs to Sheraton Kauaʻi hotel (Kapili Rd) and Poʻipū Beach, naturalized locally, occasional, ca. 10 m, 07 Jan 1995, *D.H. Lorence 7623a* (PTBG, MO); *loc. cit,* located in a vacant, roughly 25 acre lot near Waiohai, 02 October 2003, *L. Dunn 298* (BISH, PTBG); *loc. cit,* next to Kiahūnā Plantation Drive across from the Poʻipū Shopping Village, 100 m from intersection with Poʻipū Rd, 21.879870°N, 159.459670°W, 5 m, 05 Jul 2017, *K. Brock 1051* (PTBG, BISH, US).

Convolvulaceae

Poranopsis paniculata (Roxb.) Roberty **New island record**

Poranopsis paniculata, commonly called bridal bouquet or snow creeper, is a vine that is cultivated as an ornamental, although it was not observed for sale during nursery surveys from 2015–2017, and one nursery manager said that he had stopped selling it because he now considers it a pest (Figure 13). This plant appears to be a pest of fruit growers and to those maintaining infrastructure, as dense mats were observed growing over cultivated mango trees and along utility lines in Līhuʻe. Although this plant appears to be reproducing primarily by vegetative means, 10 non-cultivated locations were recorded during KISC surveys, some of which occupy more than 0.5 ha (Brock & Javier 2018). Due to their distance from obviously cultivated areas, it is unclear if they were dispersed to these

Figure 14. *Coccinia grandis* displaying vining habit. Photo credit L. Kaneholani.

locations by seed or if they arose from dispersed vegetative propagules (likely by humans). Alternatively, some of these colonies may be remnants of previously cultivated areas where the vegetation has become so overgrown that it no longer resembles a purposely landscaped area. *Poranopsis paniculata* has previously been reported as naturalized on East Maui (Starr *et al.* 2004) and Hawai‘i (Parker & Parsons 2012a).

Material examined. **KAUA‘I**: Līhu‘e Distr., Puhi/Kīpū, Ha‘ikū Valley Rd no. 2, off of Hulemalu Rd and Kaumuali‘i Hwy, climbing up to 20 ft and covering trees, 26 Sep 2007, *N. Tangalin & C. Trauernicht 1558* (PTBG, MBK, US); Kawaihau Distr., Keālia/Kapa‘a, off of Ka‘ao Rd, 22.10319°N, 159.30608°W, 30 m, 09 May 2017, *K. Brock 982* (PTBG, BISH, US).

Cucurbitaceae

Coccinia grandis (L.) Voigt **New island record**

Coccinia grandis, commonly called ivy gourd, is a vine that is sometimes cultivated as a food plant, although it was not observed for sale during 2015–2017 nursery surveys, possibly because nursery managers now recognize this plant as a formidable pest of landscaped areas. This plant appears to have been naturalized on Kaua‘i for more than a decade but is not well-vouchered for herbaria. More than 30 widely distributed locations of this plant exist on Kaua‘i, with all sites existing in disturbed lowland areas. These sites have been controlled by KISC since 2002, but new non-cultivated populations continue to appear (Figure 14). Recurring detection of this plant suggests that *C. grandis* should be considered naturalized on Kaua‘i, and its status may be revisited in the future if eradication efforts are successful. *Coccinia grandis* has previously been reported as naturalized

Figure 15. *Callitris columellaris* fruits. Field photograph of *K. Brock 1042*.

Figure 16. Sapling recruitment of *Callitris columellaris* next to a forestry planting.

on Oʻahu, Lānaʻi, Maui, and Hawaiʻi (Wagner *et al.* 1990; Starr *et al.* 1999; Oppenheimer & Bartlett 2000; Oppenheimer 2007).

Material examined. **KAUAʻI**: Līhuʻe Distr., Līhuʻe, NW side of Ahukini Rd, across from the airport and in grass parking area for Jack Harder Helicopters, 21.975410°N, 159.507126°W, ca. 30 m, 30 Dec 2010, *N. Tangalin 2468* (PTBG, BISH, NY, UC, US).

Cupressaceae

Callitris columellaris F. Muell. **New island record**

Callitris columellaris is a conifer occasionally cultivated as a forestry tree in Hawaiʻi (Skolmen 1980), and 2015–2017 nursery surveys suggest that is not present (or at least not common) in the nursery trade on Kauaʻi. Common names include white cypress-pine, Murray River cypress-pine, and northern cypress-pine. *Callitris columellaris* in Hawaiʻi has been mistaken for *C. muelleri* (Parl.) Benth. & Hook. f. ex F. Muell., a distinct species that is probably not in cultivation here (Staples & Herbst 2005), and some herbarium collections have been misidentified as the latter. We observed this species naturalizing on Kauaʻi, originating from a forestry plot in a forest reserve. The majority of the offspring from these plantations appear to remain directly under the parent trees within *C. columellaris* plantations (Figures 15–16). However, hundreds of naturalized individuals of multiple age classes were found colonizing the understory of adjacent forestry plots (*Eucalyptus*) and on open, grassy hillsides and disturbed slopes up to 1 km from the original forestry planting site. *Callitris columellaris* has previously been reported as naturalized on Oʻahu and Maui (Oppenheimer 2002; Frohlich & Lau 2012).

Material examined. **KAUAʻI**: Waimea Distr., Puʻu Ka Pele Forest Reserve where Mānā Ridge Rd splits into Kolo Rd, 3.5k m SW from Lua Reservior, 22.071390°N, 159.704560°W, ca. 740 m, 26 Jun 2017, *K. Brock 1042* (PTBG, BISH, US); Waimea Canyon State Park, southern edge of Makaha Ridge at end of forestry road through pine plantations, in area called "Forestry Tree Trial Area," regenerating abundantly under parent trees, 580 m, 28 April 1997, *D.H. Lorence 7983* (BISH, PTBG, US).

Euphorbiaceae

Euphorbia tithymaloides L.

subsp. ***padifolia*** (L.) V.W. Steinm. **New island record**

[syn. *Pedilanthus tithymaloides* subsp. *padifolius* [L.] Dressler]

Naturalized populations of this plant, also referred to as devil's-backbone, exist in at least two locations on Kauaʻi. The westernmost population located northwest of Kekaha is small, consisting of approximately 10 mature plants. However, the population at Māhāʻulepū (east of Poʻipū) is large and well-established, with hundreds of plants (Figure 17–18) forming the dominant vegetation cover along the coast alongside *Lycium sandwicense* (ʻōhelo kai) and *Scaevola taccada* (naupaka) and beneath *Leucaena leucocephala* (koa haole) further away from shore. *Euphorbia tithymaloides* subsp. *padifolia* was reported by longtime resident and Māhāʼulepū preservationist David Chang to have been planted in 1975 at Māhāʼulepū around the movie set for *Islands in the Sun* (B. Blaich,

Figure 17. *Euphorbia tithymaloides* subsp. *padifolius* flowers. Field photograph of *K. Brock 1050.*

Figure 18. *Euphorbia tithymaloides* subsp. *padifolia* naturalizing in coastal area. Field photograph of *K. Brock 1050.*

pers. comm.). Naturalized plants on Kauaʻi were identified to subspecies using the taxonomy of Cacho and Baum (2012), and this plant was frequently observed for sale in nurseries, although subsp. *tithymaloides* (including variegated forms), was more common. Given that other subspecies are present in cultivation in Hawaiʻi (Staples & Herbst 2005) but only subsp. *padifolia* has been reported as naturalized (Imada 2019), it is possible that this subspecies may be more prone to naturalization. *Euphorbia tithymaloides* subsp. *padifolia* has previously been reported as naturalized on Oʻahu (Frohlich & Lau 2012).

Material examined. **KAUAʻI**: Kōloa Distr., Māhāʾulepū, between Kawailoa Bay and Pākamoi, on cliff above ocean with *Scaevola* and *Lantana*, ca. 6 m, 02 Sep 1986, *T. Flynn 1879* (PTBG); *loc. cit.,* between Kāmala Point and Paoʻo Point, shrubby coastal vegetation with *Scaevola taccada* and *Sida fallax* on coastal dunerock, invaded by *Lantana camara*, naturalized locally forming dense clump 20 m in diam., 20 m, 26 Apr 2006, *D. H. Lorence 9512* (BISH, MO, NY, PTBG, US); *loc. cit.,* north side of Kawailoa Bay, dense naturalized population, at least 0.5 ha, forming the dominant vegetation cover in coastal area and forming a dense understory below *Leucaena* shrubland, 21.893070°N, 159.407930°W, ca. 3 m, 05 Jul 2017, *K. Brock 1050* (BISH, US).

Fabaceae

Clitoria ternatea L. **New island record**

Clitoria ternatea, known as blue pea or butterfly pea, was observed naturalizing near Kekaha alongside an irrigation ditch. Multiple plants were observed forming a loose, vining mat among nonnative grasses alongside at least 500 m of the length of the ditch. Additionally, one wild-growing plant was observed from the roadside near Kīlauea (not vouchered). This species was observed for sale during 2015–2017 KISC nursery surveys. *Clitoria ternatea* has previously been reported as naturalized on Oʻahu, Lānaʻi, and Maui (Wagner *et al.*1990; Oppenheimer & Bartlett 2000; Starr *et al.* 2010).

Material examined. **KAUAʻI**: Waimea Distr., Kekaha, near intersection with Kekaha Rd and Akialoa Rd, near irrigation ditch, 21.975352°N, 159.720089°W, ca. 21 m, 17 Oct 2015, *K. Brock 739* (PTBG, BISH).

Crotalaria juncea L. **New island record**

Crotalaria juncea, commonly known as sunn hemp, Indian hemp, or Madras hemp, was observed naturalizing along roadsides and irrigation ditches on Kauaʻi, particularly near where it has been planted as a nitrogen-fixing cover crop. Three locations of wild-growing plants were observed: one near Lāwaʻi and two northwest of Kekaha more than 5 km apart. Less than 5 mature plants were observed in a roadside ditch near Lāwaʻi, while more than 50 mature plants were observed along roadsides and irrigation ditches at each of the Kekaha locations (Figures 19–20). *Crotalaria juncea* has previously been reported as naturalized on Maui (Staples *et al.* 2003) and Hawaiʻi, and questionably naturalized on Oʻahu (Wagner *et al.*1997).

Material examined. **KAUAʻI**: Waimea Distr., north of Kekaha, along an agricultural access road between Old Mānā Rd and Kekaha town limits and west of Kōkeʻe Rd, 21.979930° N, 159.722990° W, ca. 10 m, 24 May 2017, *K. Brock 996* (PTBG, BISH, US).

Figure 19. Close-up of *Crotalaria juncea* flower. Field photograph of *K. Brock 996*.

Figure 20. *Crotalaria juncea* (erect herb, middle) growing with other weeds near roadside. Field photograph of *K. Brock 996*.

Figure 21. *Crotalaria verrucosa* (low, blue-green shrub) growing with nonnative grasses in a pasture.

Crotalaria verrucosa L. **New island record**

Crotalaria verrucosa, commonly called blue rattlepod or blue-flower rattlepod, was first vouchered on Kauaʻi in 2014 from a naturalized population near Kālepa Ridge (Figure 21), and in follow-up surveys in 2018 where at least 500 plants were observed growing throughout a pasture. Although it is sometimes used as a nitrogen-fixing cover crop (Ventosa-Febles 2017), it did not appear to have been purposefully introduced at this location, as the plant was not evenly distributed throughout the pasture as you would expect with mechanical seed broadcasting techniques. Instead, *C. verrucosa* was observed forming the dominant vegetation cover along fence lines and on soils that were highly disturbed due to livestock trampling. *Crotalaria verrucosa* has previously been reported as naturalized on Oʻahu (Wagner & Herbst 1995).

Material examined. **KAUAʻI**: Līhuʻe Distr., between Kālepa Ridge and Hwy 56, with *Urochloa*, *Parthenium*, *Malvastrum*, and *Crotalaria* spp., ca. 20 m, 30 Apr 2014, *T. Flynn 7793* (PTBG, BISH, NY, UC, US).

Flemingia macrophylla (Willd.) Kuntze ex Merr.**New island record**

Flemingia macrophylla, commonly called large-leaf flemingia, is a small tree or shrub that is cultivated throughout the tropics, usually as a cover crop to improve soil fertility (Blair *et al.* 2005). On Kauaʻi there are three recorded sites of *F. macrophylla*, all of them within a 2 km radius of the Kauaʻi Agricultural Research Station, where it was likely cultivated in the past. One site is located at the research station, where it is no longer cultivated but can be seen occasionally in unmaintained areas on the station grounds and along

Figure 22. Habit of *Flemingia macrophylla* in weedy vegetation. Photo by L. Kaneholani, 2014 (KISC staff).

Figure 23. *Flemingia macrophylla* flowers and fruits. Photo by L. Kaneholani, 2014 (KISC staff).

the adjacent Kuamoʻo Road (Figures 22–23). A second site is located 1.5 km east of the research station in a patch of alien forest in Wailua Homesteads, and a third site is located 2 km to the south, naturalized along the edge of an alien forest. *Flemingia macrophylla* has previously been reported as naturalized on Hawaiʻi Island (Parker & Parsons 2012b).

Material examined. **KAUAʻI**: Kawaihau Distr., Wailua Homestead area near Wailua Rise, atop a hillside on side slope of an old road cut, 22.059886°N, 159.383978°W, 99 m, 25 Nov 2013, *KISC s.n.* (PTBG 67519 , BISH 664145, US); Līhuʻe Distr., on an unnamed gravel road accessed from Hwy 583, approximately 2 km south of Wailua Reservoir, 22.049316°N, 159.403732°W, ca. 160 m, 28 Oct 2015, *K. Brock 747* (PTBG, BISH, US).

Heliotropiaceae

Heliotropium amplexicaule Vahl **New island record**

Heliotropium amplexicaule, or blue heliotrope, is naturalized on Oʻahu, Molokaʻi, Maui, and Hawaiʻi (Wagner *et al.*1990). It was first collected on Kauaʻi in 2004 near Līhuʻe Airport and noted to be "locally common." It was recollected in 2021 in the Lydgate State Park area near the Wailua River mouth, where about twenty plants were observed growing in lawn grass between boulders. At Lydgate, this mat-forming herb occurs in clumps, indicating spread by rhizomes, as well as by seed. Flowers are attractive; violet blue with white and yellow centers.

Material examined. **KAUAʻI**: Līhuʻe Distr., behind airport runway near Division of Forestry and Wildlife (DOFAW) Shearwater release pen, locally common, secondary vegetation with *Boerhavia*, *Malvastrum*, *Heliotropium*, and *Panicum maximum*, 24 m, 08 Jun 2004, *T. Flynn 7123*

Figure 24. *Gladiolus dalenii* (with peach-colored flower, center) growing along roadside with other weeds in Kōkeʻe State Park. Field photograph of *K. Brock 1035*.

(PTBG, BISH, AD, MO, NY, US); Kawaihau Distr., Lydgate State Park and across street in Hikinaakalā Heiau, Wailua River State Park, ca. 15 plants in 20 clumps growing in lawn grass between parking lot boulders and pōhaku near heiau, 22.04222°N, 159.33556°W, 6 m, 25 Jun 2021, *N. Tangalin NT5187a* (PTBG).

Iridaceae

Gladiolus dalenii Van Geel **New island record**

Gladiolus dalenii, often simply called gladiolus as a common name, is an herb cultivated as an ornamental on Kauaʻi, although it was not observed for sale during nursery surveys on Kauaʻi between 2015 and 2017. This plant was observed naturalizing at two locations in Kōkeʻe: along Camp 10 Road (Figure 24) and in disturbed areas surrounding cabins. In both locations, more than 15 mature plants were observed scattered among other weeds common to disturbed soils in the area. *Gladiolus dalenii* has previously been reported as naturalized on Oʻahu, Maui, and Hawaiʻi (Starr *et al.* 2004; Oppenheimer 2007; Frohlich & Lau 2014).

Material examined. **KAUAʻI**: Waimea Distr., Kōkeʻe State Park, on Camp 10 Rd, approximately 2.5 km from Hwy 550, 22.130510°N, 159.639630°W, 1,140 m, 25 Jun 2017, *K. Brock 1035* (PTBG, BISH, US).

Figure 25. Vining form of *Volkameria inermis*, climbing up vegetation along a stream near ʻAnini Beach. Field photograph in the vicinity of *N. Tangalin 1406.*

Figure 26. Thick-leaved, shrubby form of *Volkameria inermis*, growing in a large, dense stand along rocky coastline. Field photograph of *K. Brock 832.*

Figure 27. *Torenia glabra* (blue-flowered herb) naturalizing along the Kuilau Trail west of Wailua Homesteads. Field photograph of *K. Brock* 1045.

Lamiaceae

Volkameria inermis L. **New naturalized record**

Volkameria inermis, commonly called glory bower, is widely cultivated as an ornamental on Kauaʻi and was commonly encountered for sale during 2015–2017 nursery surveys, where it is marketed as a salt-tolerant hedge. This plant occurs as two distinct morphs on Kauaʻi, although it is unclear whether these differences reflect environmental variation among sites or genetic distinctions. The first morph is a dense, more upright shrub with thick, bright green leaves, while the second has a more vining habit with thinner leaves. These differences reflect the polymorphic habit of this species in its native range, which is described as an "erect, spreading, or sometimes scandent shrub or small tree to 5 m high or a liana" (Smith 1991). Despite vegetative differences in Kauaʻi plants, floral and fruit characteristics are consistent in both morphs and were identified according to descriptions and dichotomous keys provided by Munir (1989) and Smith (1991). Both morphs of this plant were observed growing in coastal areas, with the vine-like morph naturalizing along a stream near ʻAnini Beach (Figure 25) and the thick-leaved morph naturalized at 3 other sites near Poʻipū, Līhuʻe, and south of Wailua (Figure 26). The Poʻipū population appeared to be crowding out *Scaevola taccada* in remnant native coastal strands. It was also observed growing with *Scaevola taccada* along the beach fronting the Waiohai Beach Resort at Poʻipū, where both species were presumably planted for erosion control.

Material examined. **KAUAʻI**: Kawaihau Distr., ʻAnini Rd, on makai side at east end of ʻAnini Beach Park, lining dry stream bed, 22.223524°N, 159.445616°W, 23 m, 08 Jun 2007, *N. Tangalin*

Figure 28. *Pleiostachya pruinosa* on the edge of an alien forest in Wailua Homesteads.

1406 (PTBG, BISH, NY, US); Kōloa Distr., Poʻipū, in empty lot along coastline, large thicket growing in dry, salt-sprayed area along rocky coast with *Scaevola taccada*, 21.868960°N, 159.444860°W, 7 m, 25 Aug 2016, *K. Brock 832* (PTBG, BISH).

Linderniaceae

Torenia asiatica L. **New island record**

[syn. *T. glabra* Osbeck]

Torenia asiatica, or wishbone flower, is a low, sprawling herb sometimes cultivated as an ornamental. This plant was first collected from a naturalized population in 2017 on Kauaʻi, and was subsequently observed growing in damp, disturbed areas, including a large population along Kuamoʻo Road and its adjoining trails (Powerline Trail and Kuilau Trail; Figure 27), and near Kīlauea. We have followed the treatment of *Torenia* by Fischer *et al.* (2013), where *T. glabra* is subsumed under *T. asiatica*, although Kauaʻi specimens were originally identified as *T. glabra* by having 1–4 flowers per axil and a corolla tube paler than corolla lobes, as indicated by Staples & Herbst (2005). *Torenia asiatica* has previously been reported as naturalized on Oʻahu and Hawaiʻi (Wagner *et al.* 1990; Oppenheimer 2003).

Material examined. **KAUAʻI**: Kawaihau Distr., west of Wailua Homesteads, growing along Kuilau Trail near trailhead off Kuamoʻo Rd, throughout Keāhua Arboretum and roads around Hanahanapuni Crater, 22.071580°N, 159.416490°W, 170 m, 05 Jul 2017, *K. Brock 1045* (PTBG, BISH, US); Kawaihau Distr., Wailua above Keāhua Arboretum and Steps or Loop Rd Powerline Trail from the east side, forming mats on side of trail and growing up into uluhe, flowers purple with a

Figure 29. Mature *Muntingia calabura* growing in an overgrown irrigation ditch. Field photograph of *K. Brock 999.*

lighter white color towards center of corolla, stems intertwined on ground rooting at nodes, 22.08382° N, 159.42665° W, 12 May 2021, *N. Tangalin 5187* (PTBG, BISH).

Marantaceae

Pleiostachya pruinosa (Regel) K. Schum. **New island record**

Pleiostachya pruinosa, or wheat calathea, is a perennial herb cultivated as an ornamental in Hawai‘i. Approximately 30 plants were observed scattered in wet areas and along forest edges (Figure 28) at multiple locations over a large area (at least 30 ha) in Wailua Homesteads, apparently dispersed from cultivated individuals in the area. *Pleiostachya pruinosa* has previously been reported as naturalized on O‘ahu (Daehler & Baker 2006).

Material examined. **KAUA‘I**: Kawaihau Distr., Wailua Homesteads, sparingly naturalizing along forest edges and disturbed streams and ditches, 21.06115°N, 159.39744°W, 130 m, 15 Feb 2017, *K. Brock 950* (PTBG, BISH).

Muntingiaceae

Muntingia calabura L. **New naturalized record**

Muntingia calabura, or Jamaican cherry, is a shrub that is cultivated as an ornamental and for its edible fruits. This plant is present in cultivation on Kaua‘i, and was observed during surveys of Kaua‘i’s nurseries. Naturalized individuals of this plant have been observed on the west side of Kaua‘i, growing in disturbed areas such as agricultural fields, along irrigation ditches, and at the base of eroding cliff sides (Figure 29). *Muntingia calabura* has previously been reported as questionably naturalized on O‘ahu (Wagner *et. al.* 1990).

Figure 30. *Dendrobium* hybrid naturalizing with native/nonnative mixed vegetation with fruit. Field photograph of *N. Tangalin 3847.*

Material examined. **KAUA'I**: Waimea Distr., Kekaha, growing along water dike in neighborhood, 21.966111°N, 159.711389°W, 17 m, 29 Oct 2007, *C. Trauernicht 228* (PTBG, BISH, TAMU); Waimea Distr., northwest of Kekaha, north of Hwy 50, growing in an irrigation ditch, at least 40 mature individuals seen scattered over a broad area near Kekaha, apparently naturalized in disturbed areas, 21.984930° N, 159.737250° W, 10 m, 24 May 2017, *K. Brock 999* (PTBG, BISH).

Orchidaceae

***Dendrobium* hybrid** **New island record**

Dendrobium is a large genus of orchids that have been introduced as ornamentals and have been extensively interbred to produce new hybrid species. Here we report a highly variable hybrid swarm of *Dendrobium* that has naturalized on Kaua'i (Figures 30–31). About 10–20 adult plants with fruit were observed over a distance of 140 m while hiking in the Moloa'a Forest Reserve. These plants were found in a native-non-native mixed shrubland with no cultivated plants nearby, and the closest residential area being >800 m away. Unfortunately, we were unable to determine the parentage of these individuals, but like the population previously reported on O'ahu (Ackerman *et al*. 2011), our collections appear to be categorizable as "antelope-type" or "semi-antelope-type" *Dendrobium*. These orchids are characterized by two erect, twisted petals that give the appearance of antelope horns; however, the length and twisting of the petals varied among our plants as well as among flowers on the same plant. Ten specimens were collected to represent variation in color and morphology among individuals.

Figure 31. Sampling of floral variation observed in *Dendrobium* hybrid swarm. Field photos of *N. Tangalin 3842* (top left), *3848* (top right), *3850* (bottom left), and *3852* (bottom right).

Material examined. **KAUA‘I:** Kawaihau Distr., Anahola, Moloa‘a Forest Reserve, east and south-east side of trail in *Osteomeles-Wikstroemia* shrubland, 21.16° N, 159.33° W, 20 Jun 2014, *N. Tangalin NT3842–3851* (BISH, PTBG, US, UC).

Polystachya concreta (Jacq.) Garay & H.R. Sweet **New island record; Correction**

Polystachya concreta, commonly known as the yellow helmet orchid, has been recorded as naturalized on O‘ahu (Staples *et al.* 2003), West Maui (Oppenheimer 2013), and Moloka‘i (Oppenheimer 2016). Both Kaua‘i collections were found growing on mossy branches of *Metrosideros polymorpha* in lowland wet windward forest. The area between the two collections is largely inaccessible and only occasionally visited by botanists, and thus the distribution and density of the population remain unclear. *Polystachya concreta*

Figure 32. *Phyllanthus urinaria* habit. Photo of *D.H. Lorence 10743*.

Figure 33. *Phyllanthus urinaria* showing underside of stems with subsessile female flowers and fruits. Photos of *D.H. Lorence 10743*.

was initially collected in 2017 but misidentified as *Habenaria rodeiensis*. A second collection in 2018 and a reexamination of the original collection confirm it to be *Polystachya concreta*. These orchids are separated by habitat, with *H. rodeiensis* being terrestrial and *P. concreta* being epiphytic. Additionally, the inflorescence of *H. rodeiensis* is a raceme with flower labellums having a nectar spur, while the inflorescence of *P. concreta* is a panicle with the labellum lacking a nectar spur. Thus, we recommend that this report supersede the new island record reported by Imada and Kennedy (2020), as we know of no naturalized records of *H. rodeiensis* yet collected on Kauaʻi.

Material examined. **KAUAʻI:** Līhuʻe Distr., banks of north fork of Wailua River, adjacent to trail that leads to Blue Hole, epiphytic in moss on branch of *Metrosideros polymorpha,* 387 m, 28 Jan 2015, *A.M. Williams, T. Flynn, & J. Shevock AMW118* (BISH, PTBG: previously identified as *Habenaria rodeiensis*); Kōloa Distr., Kāhili Mountain Range, epiphytic on mossy branch of *Metrosideros polymorpha,* 5 individuals observed, 21.965833° N, 159.498793° W, 04 Oct 2018, *N. Tangalin & S. Walsh NT4982* (PTBG).

Phyllanthaceae

Phyllanthus urinaria L. **New state record**

Phyllanthus urinaria, or leafflower, is a herbaceous plant widely introduced throughout the tropics and subtropics, where it occurs as a weed of crops and human settlements (Wehtje *et al.* 1992). It differs from the other two naturalized herbaceous *Phyllanthus* species in Hawaiʻi (*P. debilis* and *P. tenellus*) by its purple-red tinged stems, sessile or subsessile pistillate flowers and fruits, and transversely ribbed seeds (Figures 32–33). We report the first naturalized occurrence of this plant for the Hawaiian archipelago (Imada 2019).

Material examined. **KAUAʻI**: Kōloa Distr., National Tropical Botanical Garden, McBryde Garden in Lāwaʻi Valley, Biodiversity Trail, naturalized and abundant locally along trail by gymnosperms area, 21.901167° N, 159.506572° W, 27 m, 23 Apr 2018, *D.H. Lorence 10743* (BISH, CAS, NY, PTBG, UC, US).

Plantaginaceae

Veronica plebeia R. Br. **New island record**

Veronica plebeia, or trailing speedwell, is a low, sprawling herb sometimes cultivated as an ornamental. Naturalized individuals of this plant were observed spreading throughout moist–mesic *Metrosideros*-dominated forest and in disturbed soils around cabin sites (Figures 34–35) in Kōkeʻe State Park. One cabin owner noted that it has become a common nuisance in flower beds at multiple cabin sites in the area. *Veronica plebeia* has previously been reported as naturalized on Maui and Hawaiʻi (Wagner *et al.*1990).

Material examined. **KAUAʻI**: Waimea Distr., Kōkeʻe, several patches growing as a weed in disturbed areas around cabin, fence posts, and in pasture, 22.107100° N, 159.676590° W, 1,030 m, 23 Jun 2016, *K. Brock 1025* (PTBG, BISH, US); *loc. cit.,* off of Camp 10 Rd, between ʻElekeniui Stream and Kawaikōī Campground, growing in dense shade under mixed *Metrosideros* forest next to cleared, open area, 22.133040° N, 159.633870° W, 1,100 m, 21 Nov 2016, *K. Brock 931* (PTBG, BISH, US).

Figure 34. *Veronica plebeia* specimen vouchered as *K. Brock 1025.*

Figure 35. *Veronica plebeia* beneath *Metrosideros polymorpha* in Kōkeʻe. Field photograph of *K. Brock 931.*

Figure 36. Naturalized *Platycerium bifurcatum* (epiphytic fern at center) along the Wai Koa Loop trail near Kīlauea.

Polypodiaceae

Platycerium bifurcatum (Cav.) C. Chr. **New island record**

Platycerium bifurcatum, or staghorn fern, is frequently cultivated as an ornamental. Approximately 35 naturalized plants were observed in moist alien forest on the north side of Kauaʻi, growing as epiphytes on *Casuarina equisetifolia* (Figure 36) and *Leucaena leucocephala*. *Platycerium bifurcatum* has previously been reported as naturalized on Oʻahu, Maui, and Hawaiʻi (Palmer 2003).

Material examined. **KAUAʻI**: Hanalei Distr., south of Princeville, ca. 2.3 km up ʻŌhiki Rd next to Hanalei National Wildlife Refuge, epiphytic on *Leucaena leucocephala* in roadside alien forest and throughout adjacent fields to the south, 10–15 individuals, 22.191330° N, 159.468770° W, 15 m, 18 May 2017, *K. Brock 993* (PTBG, US).

Rosaceae

Prunus persica (L.) Batsch **New island record**

Prunus persica, or peach, is a tree frequently cultivated for its edible fruits. Dozens of naturalized individuals were encountered during 2015–2017 surveys throughout Kōkeʻe along roadsides and hiking trails (Figure 37), where it has apparently spread from cultivated sites near cabins. *Prunus persica* has previously been reported as naturalized on Maui, and is questionably naturalized on Oʻahu and Hawaiʻi (Wagner *et al.* 1990; Oppenheimer 2003).

Figure 37. Naturalized *Prunus persica* in mesic *Acacia koa* (koa) forest.

Material examined. **KAUA‘I**: Waimea Distr., Waimea Canyon State Park, along Hwy 550 near mile 10.5, ca. 0.2 miles past Waimea Canyon lookout, *Acacia koa*-dominated forest with *Lantana*, *Psidium*, and *Myrica*, 20 Apr 1989, *T. Flynn 3339* (PTBG); Waimea Distr., Kōke‘e, Nualolo Trail near *Xylosma crenatum* exclosure, 1,021 m, 24 Jun 2005, *N. Tangalin & S. Perlman 401* (PTBG, US); Waimea Distr., Kōke‘e State Park, in the ditch along Mākaha Ridge Road, about 500 m from intersection with Hwy 550, 22.11307° N, 159.67318° W, 1,020 m, 06 Oct 2017, *K. Brock 1062* (PTBG, BISH, US).

Rosa laevigata Michx. **New island record**

Rosa laevigata, commonly called Cherokee rose, is a climbing shrub that is occasionally cultivated as an ornamental in Hawai‘i. It was first collected from a roadside in Kōke‘e in 1987 from a purposely planted individual, illuminating its cultivation history as an ornamental for highway beautification in this area. Thus, it is difficult to determine which plants in Kōke‘e represent planted versus naturalized individuals, especially since plants can become quite large if not maintained, and appear to spread vegetatively as well as by seed. Nonetheless, we contend that the detection of individuals along Camp 10 Road (in addition to Hwy 550), as well as in disturbed clearings or open forests, indicates that this plant should now be considered naturalized on Kaua‘i (Figure 38). Dense blankets of this plant can be observed climbing over trees, including native species, and throughout the understory of *Eucalyptus* plantations. *Rosa laevigata* has previously been reported as naturalized on O‘ahu, Lāna‘i, and Hawai‘i (Nagata 1995; Parker & Parsons 2012a; Frohlich & Lau 2014).

Figure 38. *Rosa laevigata* along roadside native koa-dominated forest (*Acacia koa*) in Kōkeʻe. Field photograph of *K. Brock 959.*

Material examined. **KAUAʻI**: Waimea Distr., Kōkeʻe State Park, ca. 0.5 miles S of Kōkeʻe Natural History Museum and lodge along Hwy 550, 24 Apr 1987, *D.H. Lorence 5255* (PTBG); Waimea Distr., Kōkeʻe, Camp 10 Rd, past Noe Stream, growing along roadside, clambering up adjacent vegetation, 22.12773° N, 159.64971° W, 1,100 m, 21 Nov 2016, *K. Brock 930* (BISH, PTBG, US); Waimea Distr., Kōkeʻe, Hwy 550, south of Puʻu Hinahina lookout, 22.10801° N, 159.67151° W, 1,070 m, 15 Mar 2017, *K. Brock 959* (PTBG, BISH, US); Waimea Distr., road to Kōkeʻe, collected along roadside, 19 Oct 2007, *C. Trauernicht 219* (BISH, NY, PTBG).

Rutaceae

Flindersia brayleyana F. Muell. **New island record**

Flindersia brayleyana, or Queensland maple, is a large tree growing up to 45 m tall that is cultivated in the tropics as a source of high-value timber (Staples & Herbst 2005). A naturalized population of *F. brayleyana* was observed arising from cultivated trees in Keāhua Arboretum, including more than 70 non-cultivated, mature trees of varying age classes, plus hundreds of saplings (Figures 39–40). The majority of the trees were detected immediately surrounding the arboretum and along Keāhua Stream (which runs through the arboretum), although at least 5 mature trees (and numerous saplings) were also observed over 2 km away from the arboretum alongside other non-native forest species. *Flindersia brayleyana* has previously been reported as naturalized on Maui and Hawaiʻi (Wagner *et al.* 1990; Oppenheimer 2003; Starr *et al.* 2004).

Figure 39. Naturalized *Flindersia brayleyana*, showing multiple age classes.

Figure 40. Naturalized *Flindersia brayleyana* along Keāhua stream, with red arrows showing large flowering trees.

Material examined. **KAUA‘I**: Kawaihau Distr., Wailua, west of Wailua Homesteads at end of Kuamo‘o Rd, about 70 trees of various age classes plus numerous saplings naturalized around Keāhua Arboretum, 22.068863° N, 159.416681° W, 160 m, 22 Mar 2016, *K. Brock 794* (PTBG).

Salicaceae

Dovyalis hebecarpa (Gardner) Warb. **New island record**

Dovyalis hebecarpa, commonly called Ceylon gooseberry, is a spiny shrub or small tree usually cultivated for its sour fruits (Staples & Herbst 2005). Two sites of naturalized plants exist on Kaua‘i: one in northern Kalāheo near the Līhu‘e–Kōloa Forest Reserve (Figures 41–42) and another in nonnative-dominated mesic forest next to a golf course in south-central Kalāheo. This distribution pattern, alongside observations of weediness and frugivory of *D. hebecarpa*, indicate that seeds are likely being dispersed by birds (Staples *et al.* 2000). This plant has previously been reported as naturalized on O‘ahu (Frohlich & Lau 2014) and Hawai‘i (Herbst 1998).

Material examined. **KAUA‘I**: Kōloa Distr., Kalāheo, along upper Pu‘uwai Rd, past junction with Pu‘ulima Rd, ca. 60 m beyond junction, secondary forest with *Eucalyptus*, *Heliocarpus*, *Schinus*, *Pennisetum*, and *Sphagneticola*, 21.942484° N, 159.522034° W, 335 m, 19 Jun 2012, *T. Flynn 7502* (PTBG, BISH, NY, US); Kōloa Distr., Kalāheo, Kukuiolono Golf Course, hillside above Papalina Rd and east of main golf course, non-native forested area with planted and naturalized species of *Eucalyptus* and *Casuarina*, with naturalized *Leucaena, Psidium, Schinus, Aleurites*, and weedy understory, naturalized, one large adult and one juvenile seen locally, 21.917778° N, 159.541944° W, 260 m, 26 May 2020, *D.H. Lorence 10809* (PTBG, BISH); *loc. cit*., in fruit, naturalized locally, many juveniles seen, 25 Jan 2021, *D.H. Lorence 10839* (BISH, PTBG, US).

Figure 41. Naturalized tree of *Dovyalis hebecarpa* (center) growing on hillside in secondary vegetation above Papalina Road in Kalāheo. Photo of *D.H. Lorence 10809*.

Figure 42. Stem with leaves and fruit, *Dovyalis hebecarpa*. Photo of *D.H. Lorence 10809*.

Figure 43. Floating mats of *Salvinia molesta* on the the Kīlauea River. Photo of *K. Brock 709*.

Salviniaceae

Salvinia molesta D. Mitch. **New island record**

Salvinia molesta, commonly known simply as salvinia, is a floating aquatic fern that is cultivated as an ornamental. This plant has naturalized in at least three waterways on Kauaʻi, including Puʻukumu Stream, Kapaʻa Stream, and Kīlauea River. The densest infestation of this plant occurs in Kīlauea River, where it forms a dense, persistent mat along the banks that is often anchored to the shoreline by intertwining *Urochloa mutica* (California grass) that encroaches over open water (Figure 43). Kauaʻi plants were differentiated from similar species within the *S. auriculata* complex, according to keys provided in Forno (1983). *Salvinia molesta* has previously been reported as naturalized on Oʻahu and Hawaiʻi (Palmer 2003; Wilson 2003).

Material examined. **KAUAʻI**: Hanalei Distr., Kīlauea Stream, 1.5 km upstream from beach, growing in slow-moving stream and accumulating most densely along inside edges of meander /bend where water is moving slowest, 22.210865° N, 159.394459° W, 1 m, 09 Sep 2015, *K. Brock 709* (PTBG, BISH); Kawaihau Distr., mouth of Kapaʻa Stream, Keālia Beach, found at margins of estuarine zone at Kapaʻa Stream mouth, close to Kūhiō Hwy overpass, floating in shallow water mixed with water hyacinth and California grass along sandy banks of stream, 22.093889° N, 159.306667° W, 1 m, 09 Sep 2015, *A.M. Williams AMW217* (PTBG).

Figure 44. Naturalized *Citharexylum spinosum* (small tree at right). Field photograph of *K. Brock 1006.*

Verbenaceae

Citharexylum spinosum L. **New island record**

Citharexylum spinosum, or large-leaf fiddlewood, is a shrub or small tree that is cultivated as an ornamental, especially as a street tree. Several naturalized individuals of *C. spinosum,* including individuals of all life stages, have been observed along roadsides near Anahola and in nonnative-dominated ecosystems in an abandoned field near Līhuʻe Airport on Kauaʻi (Figure 44). *Citharexylum spinosum* has previously been reported as naturalized on Oʻahu, Molokaʻi, and Maui (Herbarium Pacificum Staff 1998; Starr *et al.* 2002; Starr *et al.* 2006).

Material examined. **KAUAʻI**: Kawaihau Distr., Anahola, common on sides of Hwy 560 and in pastures, 22.140275° N, 159.308983° W, 40 m, 07 Oct 2007, *N. Tangalin & C. Trauernicht 1604A* (PTBG, BISH, MBK, MO, NY, UC, US); Līhuʻe Distr., Līhuʻe Airport, just south of airport in an abandoned golf course, 21.969720° N, 159.339890° W, 35 m, 01 Jun 2017, *K. Brock 1006* (PTBG, BISH, US).

Zingiberaceae

Alpinia mutica Roxb. **New island record**

Alpinia mutica, also known as small shell ginger or false cardamom, is a large herb that is cultivated as an ornamental (Staples & Herbst 2005). Hundreds of plants were observed in Hāʻena Beach Park on Kauaʻi, spreading along a stream for several hundred meters and into the adjacent nonnative-dominated wet forest (Figure 45). It is unclear where these

Figure 45. *Alpinia mutica* (grass-like herb with red fruits) naturalizing under nonnative forest in Hāʻena State Park. Field photograph of *K. Brock 980.*

plants originated. The naturalized status of this plant on Kauaʻi has been discussed before by Staples and Herbst (2005), who note that it was reported from Hāʻena in 1988, although we were unable to track down herbarium specimens that reflect this date. *Alpinia mutica* has previously been reported as naturalized on Oʻahu (Wagner *et al.*1990).

Material examined. **KAUAʻI**: Hanalei Distr., Hāʻena, along Kūhiō Hwy (560), at intersection with Limahuli Stream, in wet, shady alien-dominated forest, apparently naturalized, many individuals present on both sides of hwy, spreading along stream and into forest understory, 22.22018° N, 159.5763° W, 10 m, 09 May 2017, *K. Brock 980* (BISH, PTBG).

Plants Existing Outside of Cultivation and Possibly Naturalizing

Apocynaceae

Carissa macrocarpa (Eckl.) A. DC.

Carissa macrocarpa, commonly called natal plum, is a spiny shrub native to South Africa that is frequently cultivated as a hedgerow plant in Hawaiʻi, and was found to be present in inventories of multiple nurseries. On Kauaʻi, about 10 large, mature plants were found growing in native/nonnative mixed coastal scrub vegetation (Figure 46). Although numerous fruits were visible on these plants, it is unclear whether these individuals originated from seeds or if they established vegetatively from trimmings discarded from nearby cultivated plants. These non-cultivated plants were detected approximately 10–15 m away from a 6 m tall rock wall that formed the perimeter of a golf course, in which hundreds of

Figure 46. *Carissa macrocarpa* growing in coastal scrub vegetation. Field photograph of *K. Brock 1064.*

plants were being cultivated as a hedgerow. *Carissa macrocarpa* has previously been reported as naturalized on Oʻahu (Lau & Frohlich 2012).

Material examined. **KAUAʻI**: Līhuʻe Distr., Māhāʻulepū Trail next to Poʻipū Bay Golf Course, small, adventive population growing in coastal area, 21.87983° N, 159.42981° W, 1 m, 06 Jul 2017, *K. Brock 1064* (BISH, CAS, PTBG).

Commelinaceae

Dichorisandra thyrsiflora J.C. Mikan

Dichorisandra thyrsiflora, or blue ginger, is native to southeastern Brazil and cultivated throughout tropical regions as an ornamental (Staples & Herbst 2005). This tall herb occurs in multiple colonies off of Kuamoʻo Rd below Keāhua Stream. The area is utilized for unauthorized green waste dumping and could be the source of these introductions. It appears to be spreading slowly and locally by vegetative reproduction, with new shoots evident. It has persisted for >5 years and flowers every summer (*N. Tangalin NT5189*). This species has not previously been reported as naturalized in Hawaiʻi (Imada 2019).

Material examined. **KAUAʻI**: Kawaihau Distr., Wailua, Loop Rd or Steps at Keāhua Arboretum, before bridge and Keāhua Stream on mauka side of road, disturbed wet lowland forest with *Falcataria moluccana, Sphagneticola trilobata, Hibiscus tiliaceus, Ludwigia octovalvis, Hedychium coronarium, Commelina diffusa, Cordyline, Megathyrsus maximus, Clidemia hirta, Rubus rosifolius, Psidium guajava,* 22.071777° N, 159.417657° W, 12 May 2021, *N. Tangalin NT5189* (PTBG); Kawaihau Distr., Wailua Homesteads, on north side of road just before Kuilau

Figure 47. *Costus woodsonii* (erect canes) potentially naturalizing in a wet field near Hanalei. Field photograph of *K. Brock 1047*.

Ridge Trail and Keāhua Arboretum, large clump ca. 30 × 20 ft, plants going up a hillside, 22.07088° N, 159.41592° W, 15 Jul 2021, *N. Tangalin NT5196* (PTBG, BISH, CAS); Kawaihau Distr., before Loop Rd and Keāhua Arboretum, just off of road in hau bushes before Kuilau Trail, patch 25 × 15 ft possibly going down the slope under the hau bush, 22.07134° N, 159.41657° W, 15 Jul 2021, *N. Tangalin NT5197* (PTBG, BISH, UBC).

Costaceae

Costus woodsonii Maas

Costus woodsonii, or scarlet spiral flag, is a tall herb that is cultivated as an ornamental and was occasionally observed for sale during nursery surveys. This species appears to spread locally via rhizomes and canes in wet areas, and has formed colonies in at least four areas on Kauaʻi, including along tributaries to the Wailua River, and in Hanalei, Kīlauea, and Moloaʻa. The colony at Hanalei is the largest (Figure 47), where hundreds of stems occupying at least 1 ha were visible from the roadside. *Costus woodsonii* has previously been reported as naturalized on Oʻahu (Daehler & Baker 2006) and Maui (Oppenheimer 2004).

Material examined. **KAUAʻI**: Hanalei Distr., Hanalei, wet coastal road bank, just W of Hanalei Bay, naturalized along roadside, 17 m, 08 Oct 2007, *C. Trauernicht 186* (PTBG, BISH); Hanalei Distr., Kīlauea, Kuawa Rd, driving toward Guava Kai Plantation, on west side of road, planted and spreading along roadside, 125 m, 08 Jun 2007, *N. Tangalin 1410* (PTBG, US); Hanalei Distr., Hanalei, unnamed road directly south of Waiʻoli River mouth, south of Kūhiō Hwy, naturalized behind cemetery and along roadside, 22.197920° N, 159.507070° W, 10 m, 05 Jul 2017, *K. Brock 1047* (PTBG, BISH, US).

Figure 48. *Sesbania grandiflora* (small tree at center) potentially naturalizing in a fallow agricultural field. Field photograph of *K. Brock 855*.

Fabaceae

Sesbania grandiflora **(**L.) Poir.

The white-flowered form of *Sesbania grandiflora*, also known as sesban, agati, dok khae, or katuray, is cultivated for its edible flowers and leaves. Although this plant appears to be widely cultivated across Kaua‘i, only one location in Kekaha appears to be producing viable offspring that mature into fruiting plants (Figure 48). About twenty non-cultivated individuals were observed scattered throughout an abandoned agricultural field, apparently dispersed by seed from plants being cultivated in a nearby yard. The non-cultivated individuals included both saplings as well as mature flowering and fruiting plants that had dispersed approximately 300 m from the cultivated source plants. We propose that this species be considered as potentially naturalizing rather than fully naturalized on Kaua‘i, as it appeared that all non-cultivated individuals may be the first generation of offspring from cultivated plants, and that more time is needed to determine if these non-cultivated individuals will persist to reproduce and form a self-sustaining population. *Sesbania grandiflora* has not previously been reported as naturalized or questionably naturalized in Hawai‘i, according to Imada (2019).

Material examined. **KAUA‘I**: Waimea Distr., Kekaha, along irrigation ditch near intersection of Akialoa Rd and Kekaha Rd, in overgrown vegetation next to irrigation ditch, about 5 cultivated plants and ca. 20 apparently naturalized individuals visible (both mature and sapling age classes) on both sides of irrigation ditch, 21.975884° N, 159.721143° W, ~0 m, 14 Jun 2017, *K. Brock 855* (PTBG, BISH, US).

Tamarindus indica L.

Tamarindus indica, or tamarind, is a tree that is cultivated for its edible fruit and as an ornamental. Although this plant is widely cultivated on Kaua‘i, individuals planted in dry, leeward areas can produce viable saplings, and approximately 5 mature fruiting plants were observed in a pasture near Waimea. We suggest that *T. indica* be considered as potentially naturalizing rather than fully naturalized on Kaua‘i, as it appeared that all non-cultivated individuals were the first generation of offspring from cultivated plants, and that more time is needed to determine if these non-cultivated individuals will persist to reproduce to form a self-sustaining population. This plant has previously been reported as naturalized on O‘ahu (Lau & Frohlich 2012) and Moloka‘i (Wysong *et al.* 2007).

Material examined. **KAUA‘I**: Waimea Distr., 2 km north of Waimea, growing in pasture next to Menehune Rd, approximately 25 trees (~5 mature/fruiting) visible spreading throughout pasture and along ditch from 3 planted trees along roadside, 21.977250° N, 159.657070° W, 25 m, 05 Dec 2016, *K. Brock 942* (PTBG, BISH).

Geraniaceae

Pelargonium ×domesticum L.H. Bailey

Cultivars within the genus *Pelargonium* have arisen from a long and complex history of hybrid breeding, making plants variable in their morphology and difficult to identify. The plants discussed here were identified as *P. ×domesticum* according to Staples & Herbst (2005), which belongs to the *Pelargonium* “Regal Group” originating from crosses with *P. grandiflorum* Willd. In particular, these plants are distinguishable from *P. ×hybridum* (L.) L’Hér. (syn. *P. ×hortorum* L.H. Bailey) by having toothed leaf margins and larger upper petals with darker stripes when compared to lower petals (Figure 49). Herbarium collections indicate that this plant has been cultivated on Kaua‘i at least since 1988, and recent collections from non-cultivated plants reveal that, although plants appear to be reproducing vegetatively, *P. ×domesticum* is capable of spreading extensively where propagules are introduced. This plant was found in Kōke‘e spreading throughout a field of grass from what looked to be an abandoned cabin site, where it occupied almost one hectare and formed a significant portion of the plant biomass (>50% cover) alongside nonnative grasses (Figure 50). However, due to its detection at only a single site so far and the possibility that it is reproducing only by vegetative reproduction, we propose that this plant be considered to be questionably naturalized or potentially naturalizing until follow-up visits can determine whether this plant is capable of dispersing and persisting. *Pelargonium ×domesticum* has not previously been reported as naturalized or questionably naturalized in Hawai‘i (Imada 2019). However, Wagner *et al.* (1990) mention “species in the genus *Pelargonium*” as “persisting and rarely escaping in such places as dump sites and roadsides in Kōke‘e State Park”, with this report substantiating the inclusion of “*Pelargonium* sp.” as questionably naturalized on Kauai in the most recent checklist (Imada 2019). As only *P. ×domesticum* was found during surveys of every roadside in Kōke‘e, we propose that the *Pelargonium* sp. on the checklist be replaced with *P. ×domesticum*. Although, we acknowledge that other *Pelargonium* species are cultivated in the

Figure 49. *Pelargonium ×domesticum* showing morphological characteristics of the corolla. Field photograph of *K. Brock 1063.*

Figure 50. *Pelargonium ×domesticum* forming dense stands in an open field. Field photograph of *K. Brock 1063*.

Figure 51. *Clerodendrum buchananii* (flowering shrub at center) potentially naturalizing in a treed area. Field photograph of *K. Brock 983*.

area and may naturalize in the future and the possibility that already-naturalized populations of other species may have gone undetected.

Material examined. **KAUA‘I**: Waimea Distr., Kōke‘e State Park, Sloggett Rd at State Enforcement Cabin, cultivated, 28 Jan 1988, *T. Flynn 2731* (PTBG, BISH); Waimea Distr., Kōke‘e State Park, growing at an abandoned cabin site near where Mākaha Ridge Rd meets Hwy 550, spreading, apparently vegetatively, from an abandoned cultivation site through an open field among tall grass, 22.111190° N, 159.673470° W, 1,070 m, 07 Jun 2017, *K. Brock 1063* (PTBG, BISH, US).

Lamiaceae

Clerodendrum speciosissimum Jacob-Makoy

[syn. *C. buchananii* (Roxb.) Walp. var. *fallax* (Lindl.) Bakh.]

Clerodendrum speciosissimum, or red clerodendrum, is a mid-sized shrub that is cultivated as an ornamental, and commonly sold in nurseries on Kaua‘i. Approximately six adult flowering plants were observed along a roadside in Kapa‘a (Figure 51). These plants did not appear to be purposefully cultivated because no gardens or landscaped areas were located in the vicinity, and instead may have dispersed there by seed, as birds likely eat and transport their fleshy fruits. However, we suggest that *C. speciosissimum* be considered as potentially or questionably naturalizing rather than fully naturalized on Kaua‘i, because despite the presence of numerous cultivated plants throughout the island, non-cultivated individuals were only found once. Given that members of the genus *Clerodendrum* are readily propagated from cuttings (Riffle 1998), it is possible that the

Figure 52. *Plectranthus verticillatus* growing vegetatively near Kalāheo in nonnative forest. Field photograph of *K. Brock 804.*

observed plants arose from dumped yard trimmings rather than from seed, as plants were observed <5 m from a roadside where dumping is likely to occur. Unlike vines, which are regularly trimmed and dumped in unauthorized areas on Kauaʻi, it is unclear whether this form of dispersal is sufficient to establish multiple, long-lasting populations. *Clerodendrum speciosissimum* has previously been reported as naturalized on Maui (Starr *et al.* 2006) and Hawaiʻi (Parker & Parsons 2010), and questionably naturalized on Oʻahu (Frohlich & Lau 2007; Wagner *et al.* 2012).

Material examined. **KAUAʻI**: Kawaihau Distr., Kapaʻa, plants sparsely distributed along unnamed road running north of, but parallel to, Kapaʻa Stream in Kapaʻa, six mature plants visible from roadside, 22.103050° N, 159.321050° W, 20 m, 09 May 2017, *K. Brock 983* (PTBG, BISH, US).

Plectranthus verticillatus (L.f.) Druce

Plectranthus verticillatus, or Swedish ivy, is a crawling herb that is cultivated as an ornamental and was observed for sale during nursery surveys. This plant appears to reproduce vegetatively and can spread by this mechanism over large distances. For instance, it has spread over 50 m from where vegetative propagules were apparently dumped in a forest reserve near Kalāheo (Figure 52). Two locations comprising large colonies of plants were observed in Kalāheo, and another smaller colony was observed near Moloaʻa. All locations appear to be arising from cultivated remnants or human-dispersed vegetative propagules. *Plectranthus verticillatus* has previously been reported as naturalized on Oʻahu and Maui (Starr *et al.* 2004).

Figure 53. *Vitex trifolia* (dense shrub, left) colonizing eroded soil next to a highway.

Material examined. **KAUA‘I**: Kōloa Distr., North Kalāheo, in Līhu‘e-Kōloa Forest Reserve, naturalizing under *Araucaria* plantation and through illegal dumping site, 21.943500° N, 159.392578° W, 275 m, 13 Apr 2016, *K. Brock 800* (PTBG, US); Kōloa Distr., Kalāheo, north of Hwy 50 on Wāwae Rd, escaped vegetatively from adjacent yard, 21.943500° N, 159.392578° W, 275 m, 13 Apr 2016, *K. Brock 804* (PTBG).

Vitex trifolia L.

Vitex trifolia, or blue vitex, is a shrub that is commonly sold in nurseries and cultivated as an ornamental on Kaua‘i, especially as a hedgerow plant. The plants referred to here may be identified as *V. trifolia* var. *subtrisecta*, a variety recognized by other authors for having both simple and compound leaves, with the terminal leaf being sessile and lateral leaflets often reduced (Staples & Herbst 2005). However, we follow de Kok’s (2007) treatment of the species here, who proposes that petiole length varies too widely within the species to characterize distinct varieties.

Many instances of this plant have been observed persisting after cultivation and spreading as a dense clump on Kaua‘i, apparently by vegetative reproduction, with some of these occurrences forming large thickets. For instance, one colony near Barking Sands beach occupies an area approximately 30×20 m and has begun to spread into adjacent *Prosopis pallida* (mesquite) forest. Plants near Kapa‘a Beach Park occur in at least three disjunct patches in dry, disturbed soil along approximately 500 m of coastline, perhaps suggesting that it is beginning to naturalize in this area (Figure 53). However, we propose

that this plant be considered questionably or possibly naturalized on Kauaʻi, due to the heavy anthropogenic activities associated with the Kapaʻa bike path nearby. Although these plants were observed growing among non-cultivated vegetation, it is possible that the observed distributional pattern may be due to some mixture of failed, overgrown cultivation sites planted to beautify the bike path, followed by vegetative reproduction rather than multiple generations of offspring forming a self-replacing population. Fruits were observed on vouchered plants, although it is unclear whether viable offspring are produced. More monitoring is needed to determine if this plant will persist as a naturalized component of our flora, or if replacement is dependent on cultivated or once-cultivated plants. *Vitex trifolia* has previously been reported as naturalized on Oʻahu (Lau & Frohlich 2012) and Molokaʻi (Wysong *et al.* 2007).

Material examined. **KAUAʻI**: Kawaihau Distr., Kapaʻa, bike path in Kapaʻa just north of Kapaʻa Beach Park, located between bike path and ocean and between bike path and Hwy 56, apparently naturalized, occurring in 3 dense patches along 500 m of bike path, coastal habitat with mostly alien but some indigenous plants, dry, full sun, adjacent plants appear stunted, presumably from wind and salt spray, 22.085159°N, 159.309433°W, 10 m, 17 Aug 2016, *K. Brock 876* (PTBG, BISH, US).

Meliaceae

Cedrela odorata L.

Cedrela odorata, or West Indian cedar, is a tree commonly cultivated around the world for its valuable wood, and was planted on forest reserves in Hawaiʻi during the early 1900s on all of the main islands (Skolmen 1980). On Kauaʻi, one mature plant was found growing on the edge of a dense alien-dominated forest on private land, and did not appear to be cultivated or a remnant of cultivation. Additionally, more than 10 immature plants, ranging from 1–3 m tall, were observed scattered throughout the area. However, as only one mature tree was detected, it is unclear whether this plant has formed a naturalized population on Kauaʻi. More surveys are needed to search for additional plants. *Cedrela odorata* has previously been reported as naturalized on Maui (Starr *et al.* 2006**)**.

Material examined. **KAUAʻI**: Kawaihau Distr., Wailua Homesteads, on Hindu Monastery land, growing on edge of alien-dominated moist–mesic forest, one mature tree found as well as >10 saplings of different size classes, 22.06260°N, 159.39642°W, 130 m, 29 Nov 2017 *K. Brock 1077* (PTBG, BISH, US).

Oleaceae

Jasminum polyanthum Franch.

Jasminum polyanthum, or pink jasmine, is a woody vine (Figure 54) that is cultivated as an ornamental, although it was not detected during nursery surveys. Three occurrences of this plant were noted on Kauaʻi during 2015–2017 surveys, with the largest patch existing at a cabin site in Kōkeʻe, where it was cultivated by the previous owner of the property and has since become a weed managed by the current owners. The size of this patch covers approximately 0.25 hectares, and appears to have spread mainly by vegetative means. The other two locations are less than 10 × 10 m in area, including one in Kalāheo

Figure 54. *Jasminum polyanthum* climbing trees. Field photograph of *K. Brock 1021*.

that is likely a cultivated remnant that has grown into the alien-dominated forest nearby, and another growing along Camp 10 Road in Kōkeʻe, which may not have originated as a cultivated plant. Due to the small number of sites detected and the likely cultivated history for all but one occurrence, we suggest that this species be considered questionably or possibly naturalizing on Kauaʻi until more data on the persistence of these populations are collected. Searches of the literature have yielded no information on the frequency of seed

set in this species outside of its native range, and thus, follow-up surveys should be conducted to see if long-distance dispersal events by seed can occur. *Jasminum polyanthum* has previously been reported as naturalized on Hawai‘i Island (Imada 2007).

Material examined. **KAUA‘I**: Waimea Distr., Kōke‘e State Park, along Camp 10 Rd, found growing along roadside, climbing up nonnative vegetation, 22.127800° N, 159.649390° W, 1,089 m, 21 Nov 2016, *K. Brock 937* (BISH); Waimea Distr., Kōke‘e State Park, cabins north of Camp Hale Koa, once cultivated but now abandoned and has since spread over 0.25 ha, climbing over once landscaped vegetation and into nonnative forest, 22.107390°N, 159.677430°W, 1,010 m, 23 Jun 2017, *K. Brock 1021* (PTBG, BISH).

Rutaceae

Triphasia trifolia (Burm.f.) P. Wilson

Triphasia trifolia, or limeberry, is a shrub or small tree often cultivated as an ornamental, especially as a hedgerow species or for bonsai (Staples & Herbst 2005). It was first vouchered on Kaua‘i as a cultivated plant in Lāwa‘i Valley in 1989, and approximately 10–12 non-cultivated plants have recently been observed in the same area, apparently dispersed from the cultivated parent plant by seed. *Triphasia trifolia* has previously been reported as naturalized on O‘ahu (Lau & Frohlich 2012).

Material examined. **KAUA‘I**: Kōloa Distr., Lāwa‘i Valley, National Tropical Botanical Garden, Lāwa‘i Kai, in fairly heavy shade, cultivated, 19 Apr 1989. *T. Flynn 3336* (PTBG); *loc. cit*., Allerton Garden (Lāwa‘i Kai), on west side of Lāwa‘i Stream just south of palmetum, growing on cliff along road, in secondary vegetation with *Hibiscus tiliaceus, Leucaena, Rivina, Hylocereus, Lantana, Eugenia uniflora*, establishing locally with individuals of different size classes including seedlings observed, 21.893430° N, 159.503260° W, 28 July 2021, *D.H Lorence 10864* (BISH, US, NY, MO).

Scrophulariaceae

Buddleja paniculata Wall.

Buddleja paniculata, or butterfly bush, is a large, woody shrub that is cultivated as an ornamental (Staples & Herbst 2005). It was first vouchered as a cultivated plant in Kōke‘e, Kaua‘i in 1999, although recent surveys indicate that this plant is spreading in this area. Non-cultivated plants were noted during 2015–2017 surveys of Waineki Swamp, Kōke‘e, where it has formed a few large, impenetrable clumps (Figure 55). No seeds have been observed, and the plants appeared to be spreading vegetatively, although it is unclear how it was initially dispersed to Waineki Swamp. Two scenarios seem likely: that seeds were dispersed from nearby cultivated plants in private yards, or that propagules were introduced as improperly disposed yard cuttings. Given that this plant has only been detected outside of cultivation in a small area so far, we propose that this species be considered questionably or potentially naturalized until more surveys are conducted to determine if it will spread and persist. *Buddleja paniculata* has not previously been reported as naturalized in Hawai‘i (Imada 2019).

Material examined. **KAUA‘I**: Waimea Distr., Kōke‘e State Park, by Camp Sloggett just S of Mōhihi Rd, planted ornamental tree and shrub species surrounded by *Acacia koa* mesic forest, 991 m, 27 Mar 1999, *D.H. Lorence 8402* (PTBG, BISH, HAST, MO, US, NY); Waimea Distr., Kōke‘e,

Figure 55. *Buddleja paniculata* (silver shrub at middle) establishing in Waineki Swamp.

along Camp 10 Rd, Waineki Swamp, does not appear to be cultivated, growing along roadside and spreading to lowest-lying area of swamp, 22.125849° N, 159.652160° W, 21 Nov 2016, *K. Brock 923* (PTBG, BISH, UC, US).

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