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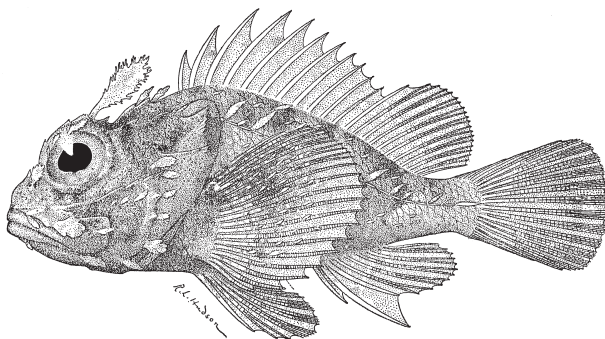
BISHOP MUSEUM OCCASIONAL PAPERS

RECORDS OF THE
HAWAII BIOLOGICAL SURVEY
FOR 2007

NEAL L. EVENHUIS

AND

LUCIUS G. ELDREDGE, EDITORS



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Cover illustration: Holotype illustration of the scorpionfish *Scorpaenopsis altirostris* Gilbert, from Moloka'i. From *Indo-Pacific Fishes* 34 (2001).

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BISHOP MUSEUM

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RECORDS OF THE HAWAII BIOLOGICAL SURVEY FOR 2007

Editors' Preface

We are pleased to present the annual compilation of *Records of the Hawaii Biological Survey*; this year for the year 2007. The number and diversity of taxa reported in these issues attest to the continuing value of the *Records* as part of the ongoing effort to accurately inventory the Hawaiian biota.

The Hawaii Biological Survey, established by the Hawaii State Legislature in 1992 as a program of Bishop Museum, is an ongoing natural history inventory of the Hawaiian Archipelago. It was created to locate, identify, and evaluate all native and nonnative species of flora and fauna within the state; and by State Law to maintain the reference collections of that flora and fauna for a wide range of uses. In coordination with related activities in other federal, state, and private agencies, the Hawaii Biological Survey gathers, analyzes, and disseminates biological information necessary for the wise stewardship of Hawaii's biological resources

Some of the highlights of *Records of the Hawaii Biological Survey for 2007* include:

- an analysis of genetic variation in endemic *Gardenia brighamii*;
- a review of the hermit crab genus *Calcinus* in Hawai'i;
- a list of the land snails of Lehua Islet; and
- new records of plants resulting from field surveys and continued curation of Hawaiian collections at the Bishop Museum and elsewhere.

An intensive and coordinated effort has been made by the Hawaii Biological Survey to make our products, including many of the databases supporting papers published here, available to the widest user-community possible through our web server. Products currently available include taxonomic authority files (species checklists for terrestrial arthropods, flowering plants, nonmarine snails, marine invertebrates, fossil taxa, and vertebrates), bibliographic databases (vascular plants, nonmarine snails, and insects), specimen databases (fungi, fish, invertebrates, portions of the insect collection) and type specimens (entomology; botany—including algae and fungi; and vertebrates), collections data (lists of holdings for select groups of flies as well as Cicadellidae and Pentatomidae), detailed information and/or images on endangered, threatened, and extinct plants and animals; as well as our staff publication lists. Additional reference databases include: the list of insect and spider collections of the world (based on Arnett, Samuelson & Nishida, 1993, *Insect and spider collections of the world*) with links to institutional web pages where known; and the historical world Diptera taxonomists list with names of over 4,840 authors who have described flies.

Our Main Web Addresses:

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Hawaii Biological Survey's "Good Guys/Bad Guys" website

<http://hbs.bishopmuseum.org/good-bad/>

World Diptera taxonomist list

<http://hbs.bishopmuseum.org/dipterists/>

The *Records of the Hawaii Biological Survey for 2007* were compiled with the assistance of Clyde Imada (botany), Fred Kraus (malacology) and other anonymous reviewers who helped referee papers; and was partially supported by funds from the John D. and Catherine T. MacArthur Foundation. Many of the new records reported here resulted from curatorial projects funded by the National Science Foundation and field surveys funded by the David and Lucile Packard Foundation, U.S. Geological Survey Biological Resources Division, U.S. Fish & Wildlife Service, and the Hawaii Department of Land and Natural Resources.

We encourage authors with new information concerning flora or fauna occurring in the Hawaiian Islands to submit their data to the editors listed below for consideration for publication in the next *Records*. Submission and format of papers must follow our guidelines. Information on submission of manuscripts and guidelines for contributors may be obtained on the web (via pdf format) at:

<http://hbs.bishopmuseum.org/guidelines.pdf>

or by mail from: Hawaii Biological Survey, Department of Natural Sciences, Bishop Museum, 1525 Bernice Street, Honolulu, Hawai'i 96817-2704, USA.

—N.L. Evenhuis &

L.G.Eldredge, editors

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RECORDS OF THE HAWAII BIOLOGICAL SURVEY FOR 2007¹

These are the *Records of the Hawaii Biological Survey for 2007* and contain the notes on Hawaiian species of plants and animals including new state and island records, range extensions, and other information.

New plant records from O‘ahu for 2007

DANIELLE FROHLICH & ALEX LAU (Hawaii Biological Survey, Bishop Museum, 1525 Bernice Street, Honolulu, Hawai‘i 96817-2704, USA; email: danielle.frohlich@bishopmuseum.org)

We document 15 new naturalized records, 1 new state record, 10 new island records, and 1 notable adventive species showing signs of naturalization. While primarily based on O‘ahu Early Detection (OED) surveys during the past year, we also include unpublished records of naturalization noted by other agencies. A total of 21 plant families are discussed. Previously documented distributions for plants included in this paper are based on the *Manual of the Flowering Plants of Hawai‘i* (Wagner *et al.* 1999) and information subsequently published in the *Records of the Hawaii Biological Survey*. Voucher specimens are deposited at Bishop Museum’s *Herbarium Pacificum* (BISH), Honolulu, Hawai‘i.

Asclepiadaceae

Calotropis gigantea (L.) W.T. Aiton

New island record

A native to several regions including India, Sri Lanka, China, Malaysia, and Indonesia, *Calotropis gigantea* is widely cultivated as an ornamental in tropical regions worldwide and has become widely naturalized in many of these areas, including northern Australia (Staples & Herbst 2005). This species has been previously documented as naturalized on both Kaua‘i and Maui. On O‘ahu, it was found naturalized in a dry, grassy road construction site, with no mature individuals in the area.

Material examined. O‘AHU: Found during North/South road survey (UTM 598437, 2360755), small shrub sapling ca 0.6 m tall, no fruits or flowers, lone individual found sprouting in dry grassy pasture in road construction area, 76.2 m, 15 Oct 2007, A. Lau & D. Frohlich 2007101508.

Cryptostegia madagascariensis Bojer ex Decne. **New island record**

Long cultivated in Hawai‘i, this species was first documented as naturalized on Moloka‘i from a collection made in 2004 in a wet mangrove habitat, where it covered about three acres (Staples & Imada 2006). On O‘ahu, it was observed sprouting out of cultivated naupaka hedges in a dry coastal setting and has persisted there through the current drought, outlasting the dead and dying *naupaka*. The species has also been observed escaping cultivation in Koko Crater, growing on barren exposed rocky soil.

Material examined. O‘AHU: Diamond Head Road, along beach parking area (UTM 623799, 2350920), woody vine with stems to 4 m long, exuding copious white sap, several plants sprouting

1. All articles in this publication constitute Contribution No. 2008-005 to the Hawaii Biological Survey.

up on both sides of road, mostly out of thick naupaka hedge, 36.5 m (120 ft), 27 Apr 2007, A. Lau & D. Frohlich 2007042702.

Bignoniaceae

Radermachera sinica (Hance) Hemsl.

New naturalized record

This species is native to Asia and was previously uncollected as naturalized in the state. It is a tree up to 10 m tall, with glabrous petioles, leaf axis, and inflorescences. Leaves are 2(or 3)-pinnately compound; leaf rachis is about 30 cm long; lateral petiolules less than 5 mm long, terminal one about 1–2 cm long; leaflets ovate to ovate-lanceolate, 4–7 x 2–3.5 cm, glabrous, base broadly cuneate, margin entire, apex caudate-acuminate, lateral veins 5 or 6 on each side of midrib. Inflorescences are paniculate, terminal, erect, 25–35 cm long; bracts are linear-lanceolate, about 10 cm long, deciduous, bractlets linear, 4–6 cm long. Calyx has 5 ovate-lanceolate teeth about 12 mm long. Corolla is white to pale yellow, campanulate-funnelform, 6–8 cm long, lobes rounded, about 2.5 cm long. Stamens 4, didynamous; staminode present, filiform. Ovules 2-rowed. Style exserted; stigma 2-lobed. Capsule is terete, nodding, angular, about 85 x 1 cm; pericarp is thin and leathery, indistinctly lenticellate; septum terete, slightly compressed. Seeds are ellipsoid, with a 2 cm x 5 mm wing (Zhang & Santisuk 1994). Several individuals were found naturalizing on O'ahu in Waimea Botanical Garden along an access road about 150 m from the accessioned tree.

Material examined. O'AHU: Waimea Botanical Garden, naturalizing along access road to water treatment facility, ca 150 m from accessioned tree, disturbed site with several pig wallows, tree seedling, ca 0.5 m, no fruit or flowers seen, several small (<1 m tall) seedlings growing along road, 2 m, 25 Jan 2007, D. Frohlich & A. Lau s.n. (BISH 725935).

Brassicaceae

Sisymbrium officinale (L.) Scop. var. *officinale* New island record

A widespread weed found most often in cultivated fields and pastures, this species was previously known from Kaua'i, Moloka'i, Lāna'i, Maui, and Hawai'i (Wagner *et al.* 1999). The following voucher was collected among other roadside weeds in the Ko'olau range of O'ahu.

Material examined. O'AHU: South Range, Schofield Barracks, along roadside, herbaceous to slightly woody, 1 m tall, no smell, 13 Mar 2007, S. Iott s.n. (BISH 726889).

Bromeliaceae

Aechmea bracteata (Sw.) Griseb.

New naturalized record

Previously uncollected as naturalized in the state, *Aechmea bracteata* can be distinguished by its very large, conspicuous sheaths that form an ellipsoid tank. The outer walls of the tank are covered in scurfy brown scales. Leaf bracts are lanceolate, drooping, entire, and reddish pink. The inflorescence is paniculate, with the lower branches elongate and divided. Floral bracts are spreading, broadly ovate, with an acuminate tip (Smith & Downs 1979). Due to its flat, smooth, ovoid seeds disseminated by birds, this epiphyte generally grows where a large branch meets the trunk on rough-barked trees (Dejean & Olmsted 1997). This species was found naturalizing about 10 m above the ground in a tree in Waimea Botanical Garden. It was planted by the garden in the notch of a nearby tree and has spread to notches in surrounding trees.

Material examined. O'AHU: Waimea Botanical Garden, growing in branches of tree, ca 10 m above ground, 2 m, 25 Jan 2007, D. Frohlich & A. Lau s.n. (BISH 725942, 725943).

Caprifoliaceae***Lonicera japonica*** Thunb.**New island record**

Japanese honeysuckle, native to Japan, Korea, and China, is common in cultivation and widely naturalized in the eastern U.S. While the clones grown in Hawai'i were believed to be incapable of setting fruit, fruiting specimens have been collected on Kaua'i, Maui, and now in Wahiawā, O'ahu. This species was previously documented as naturalized on Kaua'i, Maui, and the Big Island and is now known to be sparingly naturalized in lower Waihe'e Valley, O'ahu. Further cultivation of this species in Hawai'i should be discouraged.

Material examined. O'AHU: Waihe'e Valley, naturalized on ridge, sprawling over vegetation, 8 Dec 2007, J. Preble 2007120801.

Costaceae***Costus speciosus*** (J. König) Sm.**New island record**

Costus speciosus, or crepe ginger, native to Indo-Malesia, is widely cultivated throughout the tropics and has become naturalized in some areas (Staples & Herbst 2005). It was introduced to Hawai'i in 1860, and despite its reputation as a less-aggressive weed (Staples & Herbst 2005), has been collected as naturalized on Kaua'i, Lāna'i, Maui, and now on O'ahu, where it was collected in Waimea Botanical Garden. Individuals of this species have been seen growing throughout the valley far from the original planting.

Material examined. O'AHU: Waimea Botanical Garden, herb ca 3 m tall, 25 Jan 2007, D. Frohlich & A. Lau s.n (BISH 725952).

Cyperaceae***Cyperus sanguinolentus*** Vahl**New island record**

Previously known from the island of Hawai'i under the synonym *Pycnus sanguinolentus* (Vahl) Nees (Herbst & Wagner 1999; Wagner *et al.* 1999), this species is now known from O'ahu, at 1225 m at the Ka'ala summit parking spot in a wet, disturbed grass and sedge area.

Material examined. O'AHU: Ka'ala by parking spot outside bog fence, 1225 m, 3 Apr 2007, S. Ching USArmy 55.

Davalliaceae***Davallia fejeensis*** Hook.**New naturalized record**

First collected in Hawai'i in 1947, lacy hare's-foot fern is now widely cultivated on O'ahu, and probably on other islands as well. It is now naturalized at least in Nu'uuanu Valley, often growing epiphytically in the lower branches of large trees but sometimes trailing along logs or at soil level. There are several other *Davallia* species in cultivation, none of which have yet been documented as naturalized. *Davallia fejeensis* can be distinguished by its usually epiphytic habit; young rhizomes covered in hairy, peltate scales; fronds 30–60 cm long; blades 4–5 times pinnately compound, the ultimate segment linear and 1-veined; and sori solitary at the segment tips (Staples & Herbst 2005).

Material examined. O'AHU: Nu'uuanu (UTM 621836, 2360521), naturalizing in mesic forest, twining at top of trees and along roots, "snakeskin" scales on rhizomes, new shoots covered in dense fuzzy scales, blades infertile, 20 Mar 2007, A. Lau & D. Frohlich s.n. (BISH 726867).

Euphorbiaceae***Sauropus androgynus*** (L.) Merr.**New naturalized record**

Grown in Hawai'i since at least 1973 for its edible leaves, *Sauropus androgynus* is a 1–3 m tall shrub with alternate, shortly petiolate, 2–10 cm long, ovate to lanceolate leaves

arranged in 2 rows along lax branches. A dioecious plant, 1–4 flowers arise in clusters in the leaf axils, and the fruit is a 1.5 cm long capsule (Staples & Herbst 2005). Propagated in Hawai'i by seed (Staples & Herbst 2005) and possibly dispersed by birds, this relatively new arrival is spreading occasionally and has established itself in at least one location in Waimanalo.

Material examined. O'AHU: Frankie's Nursery, naturalizing in back part of nursery, shrub to ca 1 m tall, fruits bright yellow, ca 1 cm diam., 23 Mar 2007, D. Frohlich & A. Lau s.n. (BISH 726888).

Fabaceae

Acacia mangium Willd.

New naturalized record

Acacia mangium is native to Queensland, Australia as well as the Molucca Islands and Papua New Guinea. It has been planted and become naturalized in many Pacific island-groups, including the Cook Islands, Palau, Saipan, and Pohnpei. In Hawai'i it has been rarely cultivated in agricultural experiment stations and botanical gardens, as well as used in erosion control projects in natural areas. It is now naturalized in Kahuku and Kāne'ohe on O'ahu, spreading from sites where planted, potentially being dispersed in part by ants. The Kahuku population is currently being controlled by U.S. Army Natural Resources. *Acacia mangium* can be confused with another nonnative acacia, *A. auriculiformis*, which both have broad phyllodes, inflorescences in spikes, and coiled pods. *Acacia mangium* can be distinguished by phyllodes with prominently reticulate secondary veins (not prominent in *A. auriculiformis*), white to cream-colored spikes (yellow spikes in *A. auriculiformis*) and a pubescent calyx (calyx glabrous in *A. auriculiformis*) (Orchard & Wilson 2001).

Material examined. O'AHU: Kahuku Training Area, roadside on ridge east of Kaunala Gulch, tree 10–15 m tall, 150–200 mature trees planted, with 200+ seedlings, 122 m (400 ft), 28 Jan 2003, M. Keir s.n. (BISH 695023, 695024); Kāne'ohe, Ho'omaluhia Botanical Garden, tree to 4 m tall, infructescences dense, composed of many tightly coiled pods, 28 Jan 2007, A. Lau s.n. (BISH 731069); Kāne'ohe, 3 m tall sapling growing along side of road in strip of grass between sidewalk and street, no mature trees seen in neighborhood, 27 Sep 2007, A. Lau & D. Frohlich 2007092703.

Caesalpinia crista L.

New naturalized record

Previously known from only one cultivated collection in Hawai'i, this plant was found climbing up to 13 m in *Eucalyptus* trees, as well as smothering ground-level vegetation, occupying approximately 200 square meters of alien forest. Like other species in the genus, *Caesalpinia crista* is armed with stout, recurved prickles along its branches and leaf rachises. It can be distinguished from the other climbers in the genus by being glabrous, with bipinnate leaves 20–30 cm long, pinnae with only 2–3 pairs of coriaceous leaflets 2–5 cm long, and panicles of 1 cm long, yellow flowers (Huang & Ohashi 1993).

Material examined. O'AHU: Tantalus (UTM 621850, 2358933), plant with stout, recurved prickles climbing to 13 m on *Eucalyptus* sp. and smothering understory vegetation over approximately 200 square meters, 16 Nov 2007, A. Lau 2007111601.

Platymiscium stipulare Benth.

New naturalized record

First planted in Hawai'i by Dr. William Hillebrand and sometimes used as a street and shade species, this tree produces many wind-dispersed seeds that germinate readily. J.F. Rock, in his book *Leguminous Plants of Hawaii*, notes that hundreds of seedlings were spread throughout the Foster Estate, where the first individual was located (Staples & Herbst 2005). Because of its behavior in Hawai'i, this plant has been cited as a potential

serious invasive for the islands (Staples *et al.* 2000). *Platymiscium stipulare* can reach up to 21 m in height. Leaf petioles are 3.8–7.6 cm long, with usually 5 ovate or elliptic glossy, leathery leaflets. Inflorescences are axillary and have 1 raceme per leaf axil, with paired yellow flowers about 1.25 cm long. Fruit is ellipsoid-oblong, 1.9–2.5 x 1.25–1.70 cm, and greenish (Staples & Herbst 2005).

Material examined. O‘AHU: Kānewai Park (UTM 2355089, 623261), behind swimming pool in dry, barren walkway, single plant growing 30 m from nearest mature trees, growing against fence and adventive *Tabebuia*, small tree ca 4 m tall, no flowers or fruit seen, 16 Aug 2007, D. Frohlich & A. Lau 2007081607.

***Pueraria phaseoloides* (Roxb.) Benth.**

New state record

Native to southern China and Southeast Asia, *Pueraria phaseoloides*, or tropical kudzu, has become naturalized in many tropical areas of the world. Because of its invasive tendency, this species has been declared a noxious weed in several of these places, including Hawai‘i. This species is a perennial, twining herb. The stems are densely covered in stiff, brown hairs; leaves are trifoliate with broadly ovate leaflets. Both leaf surfaces are also covered in stiff brown hairs. This species has small, lanceolate, basifixed stipules (which distinguish it from *P. montana* var. *lobata*, which has peltate stipules). The flowers are 12 mm long, the standard and wing petals purple with white margins, situated at the top of long peduncles in axillary pseudoracemes. The pedicels are short and nodulose, with lanceolate bracts and bracteoles. Pods are linear, slender, pilose, 5–8 cm long and 4 mm wide (Huang & Ohashi 1993). This species was found spreading widely in several open areas in Kāhala‘u and Waihe‘e Valleys.

Material examined. O‘AHU: Kāhala‘u (UTM 2371107, 619769), sprawling through *Wedelia* in partial sun, growing on slope, no flowers or fruit seen, 17 Aug 2007, D. Frohlich & A. Lau 2007081708.

Malvaceae

***Hibiscus makinoi* Jôtani & Ohba**

New naturalized record

A rarely cultivated species in Hawai‘i, *Hibiscus makinoi* is native to the Ryukyu Islands and Kyushu, Japan (Jôtani & Ohba 1984). In the past, this species has been confused with *H. mutabilis*, to which it bears a strong resemblance. These two species diverge in having a different type of indumentum. Whereas *H. mutabilis* has both long glandular hairs and dense stellate hairs with long arms on the young shoots, leaves, pedicels, epicalyx, and calyx, *H. makinoi* is covered only in dense stellate hairs with shorter arms. In addition, *H. makinoi* differs in having subulate or narrowly lanceolate (not linear) epicalyx segments, and leaf lobes with obtuse (not acuminate) apices (Jôtani & Ohba 1984). Interestingly, the leaf morphology in the material examined has slightly acuminate (not blunt) tips but otherwise matches named material.

Material examined. O‘AHU: Waimea Botanical Garden, in dry area near side road, 50 m away from accessioned *H. makinoi* plants, shrub 1.5 m tall, no flowers seen on naturalizing individuals, but many seed heads per plant, producing copious seed, mostly mature fruiting individuals, 25 Jan 2007, D. Frohlich & A. Lau s.n. (BISH 725940).

Moraceae

***Ficus religiosa* L.**

New naturalized record

Ficus religiosa, or bo tree, is a widely cultivated plant worldwide, mostly due to its religious significance to both Hindus and Buddhists, because the Buddha is traditionally said

to have received enlightenment under this species. A famous specimen of *F. religiosa* grown at Foster Garden produced several adventive seedlings in the early part of 2007 (N. Hoffmann, pers. comm.). Consequently, it was discovered that the specific pollinator wasp, *Blastophaga quadraticeps*, is now present in Hawai'i. *Ficus religiosa* is a dioecious tree that lack aerial roots and has cordate to ovate leaves with petioles 3.5–15.0 cm long and a long “drip tip” at the apex. Figs are paired and sessile and are produced at the leaf axils just below the leaves. The receptacle is globose, about 1 cm in diameter, and ripens to pink, purple, or black (Staples & Herbst 2005). This species has naturalized in mesic to wet areas of Israel and Florida (Starr & Starr 2003). A naturalizing individual was found growing near a drainage pipe in a neighborhood in Kāne'ohe.

Material examined. O'AHU: Kāne'ohe (UTM 2368339, 625024), seedling coming out of crack in sidewalk near drain spout in residential area, roots to 10 cm deep, sapling ca 0.6 m tall, no flowers or fruit seen, A. Lau & D. Frohlich 2007101901.

Piperaceae

Piper betle L.

New naturalized record

Betel pepper, native to Malaysia, is occasionally cultivated in Hawai'i, presumably for use with betel nut (*Areca catechu*) and calcium oxide (Staples & Herbst 2005). This dioecious woody vine can root at its nodes and was observed in three distinct populations climbing tree trunks up to 7 m into the canopy, forming thickets over fallen vegetation, and trailing along the ground in lowland wet to mesic alien forest. This species can be distinguished from other members of the genus by its glabrous leaf margins, woody vine habit, and joined fruits that are embedded in the rachis (fruit free from rachis and each other in *P. nigrum*) (Staples & Herbst 2005).

Material examined. O'AHU: Mānoa, Nāniu'apo (UTM 624939, 2359436), climbing to 7 m into canopy, at least 3 populations, 22 Oct 2007, A. Beebe & C. Sousa OISC20071022.

Poaceae

Lolium perenne L.

New island record

Perennial ryegrass was previously known from Hawai'i (Wagner *et al.* 1999) and Maui (Starr *et al.* 2003), occurring in higher-elevation sites from 850–2830 m. Widely naturalized in temperate regions, this species was occasionally seen at 213 m in the construction site of a new, large housing development. Seeds were possibly transported on soiled heavy machinery brought in from another island.

Material examined. O'AHU: Makakilo (UTM 2362789, 595525), dry lowland housing development construction site, growing in bare soil, clump-forming grass to 0.5 m tall, 213 m (700 ft), A. Lau & D. Frohlich 2007040.

Rosaceae

Eriobotrya japonica (Thunb.) Lindl.

New island record

Loquat, native to China and Japan, was introduced to Hawai'i in 1851. It is now commonly grown in the state as an ornamental and for its fruit, which is produced best at elevations over 2500 ft [ca 300 m] (Staples & Herbst 2005). Previously collected as naturalized on Kaua'i and Maui, this species was found spreading from one mature tree in lowland mesic forest in Kalihi Valley, O'ahu.

Material examined. O'AHU: Kalihi (UTM 2362263, 620238), tree to 6 m tall, one 3 m sapling and 100+ seedlings occasional in vicinity and up to 30 m below tree, 365 m (1200 ft) (~30 m below main ridge), 12 Aug 2006, A. Lau *s.n.* (BISH 731468, 731469).

Santalaceae***Santalum album* L.****New naturalized record**

Skolmen (1980) reports over 7500 plantings of *Santalum album* throughout O'ahu's forest reserves. It was perhaps originally planted in the Diamond Head area, but recently was observed in all size classes and thoroughly established in an abandoned parking area and other empty lots on the mauka slopes surrounding the crater. *Santalum album* can be distinguished from native species of *Santalum* by its tree habit, ovate to lanceolate leaves (sometimes with glaucous new growth), and 7 mm long black drupes with a subapical receptacular ring (Wagner *et al.* 1999).

Material examined. O'AHU: Diamond Head (UTM 2352279, 623352), coastal empty residential weed lot, 3 m tall tree thoroughly established in at least the large tracts of abandoned parking and other lots, 21 m (70 ft), 27 Apr 2007, A. Lau & D. Frohlich 2007042701.

Sapindaceae***Allophylus cobbe* (L.) Raeusch.****New naturalized record**

Planted in several botanical gardens around the state, *Allophylus cobbe* has spread from its original plantings in both Waimea Botanical Garden (where it has proven to be an aggressive invader) and in Ho'omaluhia Botanical Garden, near Kāne'ohe, O'ahu. In Waimea, this plant has spread, both by seed and by root fragments, despite gardeners' efforts to control it.

Material examined. O'AHU: Waimea Botanical Garden, naturalizing throughout garden, seedling 0.5 m tall, 2 m, 25 Jan 2007, D. Frohlich & A. Lau s.n. (BISH 725941).

Urticaceae***Procris pedunculata* (J.R. Forst. & G. Forst.) Wedd.****New naturalized record**

Not commonly found in cultivation but planted in several botanical gardens on O'ahu, including Foster Garden and Waimea Botanical Garden, *Procris pedunculata* is a monoecious shrub not previously collected as naturalized in the state. This species can be identified by its leaves, which are oppositely arranged with one of the pair minute. Leaves are narrowly obovate, and cuneate at the base. Lamina are 8–15 cm long, 2.5–4.0 cm wide, with crowded elongated cystoliths. The male inflorescence is cymose, few-flowered, with a peduncle to 3 cm long. Male flowers are pedicellate, with 5 tepals. The female inflorescence is capitulate, sessile, and many-flowered. Female flowers are sessile, 1 mm long, with short, brush-like stigmas. Fruit is a 1.5 mm long achene (George 1989). In Waimea Botanical Garden, this species has spread sparingly throughout the garden and was collected growing on a moss-covered rock far from the original planting.

Material examined. O'AHU: Waimea Botanical Garden, growing on rock in thick moss with several other individuals, shrub 35 cm tall, 2 m, 25 Jan 2007, D. Frohlich & A. Lau s.n. (BISH 725938).

Verbenaceae***Verbena bonariensis* L.****New island record**

Previously collected as naturalized on Moloka'i, Lāna'i, Maui (Wagner *et al.* 1999), and Kaua'i, *Verbena bonariensis* is now known from O'ahu as well, found occasionally in a revegetation site at Castle Junction. Only two grasses (carpetgrass and kikuyu grass) were purposefully introduced as hydromulch to the site (Dacus 2007), but several other species new to the island have also sprouted in the area. Lorence & Wagner (1995) reported a very

similar situation from Kaua'i, where *V. bonariensis* came up in a newly revegetated roadside area along with *Senecio madagascariensis*, a species which also turned up at the Castle Junction site. The O'ahu Invasive Species Committee surveyed the area and removed all located *V. bonariensis* and is assisting the Hawaii Department of Agriculture in managing *S. madagascariensis*.

Material examined. O'AHU: Pali/Kamehameha Hwy Junction (Castle Junction), single plant 2 m tall in a 2 x 3 m patch with inflorescences, rooting where stem hit the ground, may have flowered previously, 10 May 2007, K. Kawelo s.n. (BISH 727457).

***Verbena rigida* Spreng.**

New island record

Previously collected only from the Parker Ranch area on Hawai'i, this species is now known from O'ahu as well, naturalized in a hydromulch site at Castle Junction. The O'ahu Invasive Species Committee surveyed the area and removed all individuals of this species.

Material examined. O'AHU: Castle Junction, in hydromulch site, extremely weedy, crowded area, sprawling herb with stiff hairs, 7–15 cm tall, flowers royal purple, in closely packed racemes, no fruits seen, OISC s.n. (BISH 727460).

***Vitex parviflora* Juss.**

New naturalized record

Vitex parviflora, a species valued as a timber product in its native range of the Philippines and eastern Indonesia, was planted widely in O'ahu forests between 1919 and 1936 (Staples & Herbst 2005). Over 7,000 trees of this species were estimated to have been planted on O'ahu, 65 of which were planted in the Waiāhole area, where several individuals of various size classes were found spreading along roadsides (Skolmen 1980). Because of its numerous, bird-dispersed fruits, this species has been cited as a potential invasive species for Hawai'i (Staples *et al.* 2000). *Vitex parviflora* is a mostly glabrous tree up to 15 m tall. Leaf petioles are 5–10 cm long, with three stalked, elliptic to oblong-elliptic leaflets 7.6–17.8 x 4.5–5.6 cm, with wavy margins. Inflorescences are in terminal, downy panicles to 20 cm long. Flowers are about 0.6 cm long, with entire calyx margins, and blue to purplish corolla. Fruit is globose and black, about 0.6 cm in diameter, with a flat, persistent calyx.

Material examined. O'AHU: Waiāhole (UTM 2376112, 617898), along roadside, tree ca 5 m tall with lavender flowers, inflorescence ca 15 cm long, copious black, round berries, several individuals of various size classes seen in area, D. Frohlich & A. Lau 2007111501.

Vitaceae

***Cissus quadrangularis* L.**

New naturalized record

Grown as a novelty ornamental in the mainland U.S., *Cissus quadrangularis* thrives in hot, dry areas and roots readily by stem cuttings (Staples & Herbst 2005). Previously, it was reported as questionably naturalized on O'ahu near Koko Crater. It has now been confirmed as naturalized in 'Aiea, along Ka'amilo Street.

Material examined. O'AHU: 'Aiea, Ka'amilo Street, lowland roadside weed area, forming thicket in *Leucaena* understory, 134 m, 26 May 2007, A. Lau & D. Frohlich 2007042603.

Adventive Species Showing Signs of Naturalization

Araliaceae

***Schefflera arboricola* (Hayata) Merr.**

This ornamental shrub or climber was introduced to horticulture in 1970 and has since become very common in Hawai'i's cultivated flora. When allowed enough space, one individual can become a massive climbing shrub 8 m tall and 13 m wide (Staples & Herbst

2005). This species was recently collected as naturalized on Maui (Starr *et al.* 2003) and has been collected growing out of the cracks in a sidewalk on O'ahu, indicating it is reproductive and capable of dispersal on this island as well. Given its biological characteristics, further cultivation of this species should be discouraged.

Material examined. O'AHU: Mariner's Ridge (UTM 2356084, 634405), lowland residential cultivated area, 60 cm tall juvenile growing out of a crack, several large *S. arboricola* trees in neighborhood, 200 m (660 ft), 29 Mar 2007, A. Lau & D. Frohlich 2007032903.

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Literature Cited

- Dacus, C. 2007. Re: Aloha from OISC. Metzler, Katy. Honolulu.
- Dejean, A. & Olmsted, I. 1997. Ecological studies on *Aechmea bracteata* (Swartz) (Bromeliaceae). *Journal of Natural History* **31**(9): 1313–1334.
- George, A.S. (ed.). 1989. *Flora of Australia*. Hamamelidales to Casuarinales. Australian Government Publishing Service, Canberra. 219 pp.
- Herbst, D.R. & Wagner, W.L. 1999. Contributions to the flora of Hawai'i. *Bishop Museum Occasional Papers* **58**: 12–36.
- Huang, T.-C. & Ohashi, H. 1993. Leguminosae, pp. 160–396. *In*: Hsieh, C.-F., T.-C. Huang, Z.-Y. Li, H.-C. Lo, H. Ohashi, C.-F. Shen, J.-C. Wang & K.-C. Yang (eds.), *Flora of Taiwan*. Vol. 3. Institute of Ecology and Evolutionary Biology, National Taiwan University, Taipei. 1084 pp.
- Jôtani, Y. & Ohba, H. 1984. *Hibiscus makinoi*. *Journal of Japanese Botany* **59**(7): 219–221.
- Lorence, D. & Wagner, W.L. 1995. Contributions to the flora of Hawai'i. III. *Bishop Museum Occasional Papers* **41**: 19–58.
- Orchard, A.E. & Wilson, A.J.G. (eds.). 2001. *Flora of Australia*. Mimosaceae Acacia Part 2. CSIRO Publishing, Melbourne & Canberra. 536 pp.
- Skolmen, R.G. 1980. Plantings on the forest reserves of Hawaii 1910–1960. Institute of Pacific Islands Forestry, U.S. Forest Service, Honolulu.
- Smith, L.B. & Downs, R.J. 1979. *Bromelioideae (Bromeliaceae)*. The New York Botanical Garden, New York. 652 pp.
- Staples, G.W. & Herbst, D.R. 2005. *A tropical garden flora*. Bishop Museum Press, Honolulu. 908 pp.
- , Herbst, D.R. & Imada, C.T. 2000. Survey of invasive or potentially invasive cultivated plants in Hawai'i. *Bishop Museum Occasional Papers* **65**: 1–35.
- , & Imada, C.T. 2006. New Hawaiian plant records for 2004. *Bishop Museum Occasional Papers* **88**: 6–9.
- Starr, F. & Starr, K. 2003. *Ficus religiosa*- bo tree: Moraceae. *Plants of Hawaii: Report*. Haleakala Field Station, Maui, Hawai'i, United States Geological Survey, Biological Resources Division.
- , Starr, K. & Loope, L.L. 2003. New plant records from the Hawaiian archipelago. *Bishop Museum Occasional Papers* **74**: 23–34.

- Wagner, W.L., Herbst, D.R. & Sohmer, S.H. 1999. *Manual of the flowering plants of Hawai'i*. Rev. ed. 2 vols. University of Hawai'i Press and Bishop Museum Press, Honolulu. 1919 pp.
- Zhang, Z.-Y. & Santisuk, T. 1994. Bignoniaceae, p. 218. In: Wu Z.-y. & Raven, P.H. (eds.), *Flora of China*. Vol. 18. Scrophulariaceae through Gesneriaceae. Science Press, Beijing & Missouri Botanical Garden, St. Louis. 449 pp.

New Hawaiian plant records from *Herbarium Pacificum* for 2007

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These previously unpublished Hawaiian plant records report 1 new state record, 8 new island records, and 1 new naturalized record affecting the flora of Hawai'i. All identification were made by the authors, except where noted in the acknowledgments, and all supporting voucher specimens are on deposit at BISH, except as otherwise noted.

Convolvulaceae

Convolvulus arvensis L.

New island record

Previously reported as naturalized on O'ahu and Maui (Wagner *et al.* 1990: 552), field bindweed is now recorded from Moloka'i. Although on the Department of Agriculture noxious weed list for the State of Hawaii (Hawaii Administrative Rules, Title 4 Subtitle 6 Chapter 68) adopted in 1992, the species is still apparently only sparingly naturalized in the state in low elevation, dry areas. It is native to Eurasia and most commonly found as a weed in temperate areas.

Material examined. **MOLOKA'I:** Ho'olehua, on Moloka'i High School track, 13 Jul 2007, S. Dunbar 398.

Cyperaceae

Cyperus involucratus Rottb.

New island record

Previously reported as naturalized on Midway Atoll, Kaua'i, O'ahu, and Maui by Wagner *et al.* (1990: 1395) under the name *C. alternifolius* subsp. *flabelliformis*, this often-cultivated wetland ornamental sedge has since been reported as a weed on Hawai'i (Imada *et al.* 2000: 11) and Moloka'i (Oppenheimer 2007: 23). Umbrella sedge is now recorded from Lāna'i growing in a seep area along a hot, dry coastal trail. It is native to tropical Africa, Madagascar, Mauritius, and the Mascarene Islands (Wagner *et al.* 1990: 1395).

Material examined. **LĀNA'I:** Mānele Bay, along coastal trail heading west, 18 m, 9 Dec 2007, C. Imada, S. James, & P. Imada 2007-18.

Eleocharis geniculata (L.) Roem. & Schult. **New island record**

Wagner *et al.* (1990: 1402) reported this pantropical wetland sedge as naturalized on Kaua'i, O'ahu, and Moloka'i; later, Oppenheimer (2003: 10) collected it on Maui. *Eleocharis geniculata* is now additionally recorded from Lāna'i growing luxuriantly in the same seep area as the *Cyperus involucratus* vouchered above, along a hot, dry coastal trail.

Material examined. **LĀNA'I:** Mānele Bay, along coastal trail heading west, 18 m, 9 Dec 2007, C. Imada, S. James, & P. Imada 2007-16.

Fabaceae

Calliandra houstoniana (Mill.) Standl.

var. *calothyrsa* (Meisn.) Barneby

New naturalized record

Native to tropical forests of Central and northern South America (Staples & Herbst 2005: 309), this attractive powderpuff shrub has previously only been collected from cultivated specimens on Kaua'i, O'ahu, and Maui. The following collection was taken from one of a number of individuals spreading outwards from a cultivated specimen into adjacent undeveloped shrub and grasslands on Lāna'i.

Material examined. **LĀNA'I:** Lāna'i City, southern end of Kaunaoa Rd, on grassy roadside bank, 538 m, 9 Dec 2007, C. Imada, S. James & P. Imada 2007-15.

Centrosema pubescens Benth.

New island record

The first verified collection in Hawai'i of this cultivated tropical American vine dates back to December 1985, when it was vouchered at the Mauka Field Laboratory of the Department of Agronomy & Soil Science, University of Hawai'i at Mānoa (*Lau 1696*). The first record of naturalization was reported in 1997 on Kaua'i (Flynn & Lorence 1998: 5), followed in 2000 by a report from East Maui (Starr *et al.* 2003: 27). In Waihe'e Valley, windward O'ahu, it was noted as a common roadside element in an alien-dominated forest of *Citharexylum*, java plum, and *Hibiscus tiliaceus*, growing with *Mimosa*, *Wedelia*, and other herbaceous roadside weeds.

Material examined. **O'AHU:** Waihe'e Valley, weedy vine clambering on alien shrubs and trees alongside main dirt road on Board of Water Supply property, ca 115 m, 21 May 2007, C. Imada, B. Kennedy, G. Ragosta, & J. Preble 2007-10.

Molluginaceae

Mollugo cerviana (L.) Ser.

New island record

Previously reported as naturalized only from low, dry areas on the island of Hawai'i (Wagner *et al.* 1990: 922) and from a single collection next to an abandoned airstrip on O'ahu (Herbst *et al.* 2004: 9), threadstem carpetweed has recently been collected on Lāna'i. The small population of low-statured but reproductive individuals was found in disturbed habitat resulting from the construction of a meteorological tower.

Material examined. **LĀNA'I:** northwestern Lāna'i, off Ka'ena Trail, 168 m, 27 Nov 2007, S.A. James & E. Guinther 2007-1.

Polygonaceae

Persicaria chinensis (L.) Nakai

New island record

Previously recorded only on Hawai'i and called *Polygonum chinense* in Wagner *et al.* (1990: 1063), *Persicaria chinensis* is now known from O'ahu. This native of tropical and subtropical eastern Asia was found as a lushly growing scandent subshrub in full flower growing with *Justicia betonica* under a tall canopy of *Trema* and *Paraserianthes*, along a country road in Kalihi Valley.

Material examined. **O'AHU:** Kalihi Valley, near end of Kalihi Valley Rd at Kokua Kalihi Valley property, ca 150 m, 17 Apr 2007, C. Imada 2007-09.

Rubiaceae***Richardia scabra* L.****Correction, New island records**

Wagner et al. (1990) recognized a single naturalized species of *Richardia* in Hawai'i, *R. brasiliensis* Gomes. Previous Hawaiian botanists had identified the weed locally as *R. scabra* L. (Hillebrand 1888 [as *Richardsonia scabra* (L.) St. Hil.]; Degener 1937). Wagner et al. (1990) however, referred to this binomial as a misapplication to *R. brasiliensis*, whose distribution in the State was given as Kaua'i, O'ahu, Lāna'i, Maui, and Hawai'i [and later recorded from Moloka'i as well (Oppenheimer 2006:13)]. Lorence et al. (1995: 50–51) subsequently reported true *R. scabra* naturalized on Kaua'i, and Oppenheimer (2003: 23) added a new record for Maui. Lorence et al. (1995) described the essential differences between the two taxa: "*Richardia brasiliensis* . . . has mericarps that are adaxially broadly and openly concave with a slim median keel, whereas those of *R. scabra* are adaxially closed to a narrow groove or sulcus. These 2 species are otherwise similar in morphology." Subsequent careful examination of specimens identified as *R. brasiliensis* in *Herbarium Pacificum* has led to the reidentification of some O'ahu, Moloka'i, and Maui vouchers as *R. scabra*. As a result, new island records of *R. scabra* are here reported for O'ahu and Moloka'i, and its current distribution now includes Kaua'i, O'ahu, Moloka'i, and Maui. The single voucher of *R. brasiliensis* from Moloka'i and all but one of those from Maui were reassigned to *R. scabra*, leaving the current distribution of *R. brasiliensis* as Kaua'i, O'ahu, Lāna'i, Maui, and Hawai'i.

The following BISH vouchers have been reassigned from *R. brasiliensis* to *R. scabra*:

Material examined. **O'AHU:** Upper Makakilo, adjacent to developed subdivision at end of Pueonani St., open area in solid *Panicum maximum* grassland, with *Waltheria indica*, *Sida fallax*, *Eleusine indica*, *Verbesina encelioides*, *Sonchus oleraceus*, 205 m (670 ft), 9 Mar 2004, C. Imada & L. Crago 2004-27. **MOLOKA'I:** Kaunakakai, along side of Forestry Rd, 500 m, 2 Apr 2004, H. Oppenheimer H40404. **MAUI:** East Maui, 26.7 km (16.6 mi) E of 'Ulupalakua Ranch on Pi'ilani Hwy. (Hwy. 31), 6 km (3.7 mi) E of Manawainui; rocky dry stream bed dominated by *Prosopis pallida* and *Leucaena leucocephala*. ca 20 m, 14 Jan 1983, W. L. Wagner & S. Mill 4739; East Maui, Hāwelewele Gulch, Kaupō, 12 m, 26 Jul 2001, F. Starr & K. Martz 010726-3; West Maui, Lahaina, 565 m (1850 ft); locally common along dirt roads, pasture, lawns and adjacent degraded areas in the vicinity of Kahoma Cabin, 13 Mar 2007, H. Oppenheimer H30706.

A single BISH voucher is representative of *R. brasiliensis* on Maui:

Material examined. **MAUI:** West Maui, Honokowai, S of Haenanui Gulch, 305 m, scattered to locally common in open areas along unpaved cane haul roads, 2 May 2007, H. Oppenheimer H50702.

Solanaceae***Solanum villosum* Mill.****New state record**

This long overlooked specimen was collected by Derral Herbst in 1975 during a game bird survey on the dry subalpine slopes of Mauna Kea and positively identified by Dr. Lynn Bohs of the University of Utah in 1990. There is no documentation for any spread from this original locality. Closely related to and resembling a small-leaved form of glossy nightshade or *pōpolo* (*S. americanum* Mill.), *S. villosum* can be distinguished by its conspicuously and persistently villous or hirsute parts (vs. glabrous or glabrescent); berries reddish or yellow (vs. black); and seeds usually 1.8–2.2 mm long (vs. 1.2–1.8 mm long) (Correll & Johnston 1979). In Texas it occurs on rocky slopes and in waste places in the extreme western part of the state. Other American floras (e.g., *Intermountain Flora*, A

Flora of Utah), however, say that *S. villosum* is misapplied to *S. sarrachoides*. Zhang *et al.* (2004) cite its presence in Gansu, Qinghai, Shanxi, Xinjiang, China, on slopes, in valleys, near roads, and in shady places, from 100–1300 m. Its geographic range includes southwestern Asia and Europe.

Material examined. **HAWAII:** Pu'u Lā'au, weed growing near the hunter's cabin, 2270 m (7450 ft), 18 Jan 1975, *D. Herbst 5184*.

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Literature Cited

- Correll, D.S. & Johnston, M.C.** 1979. *Manual of the vascular plants of Texas*. Univ. Texas at Dallas, Richardson, Texas. 1881 pp.
- Degener, O.** 1937. Fl. Hawaiiensis, fam. 332. *Richardia scabra*. Publ. priv., 2 pp.
- Flynn, T. & Lorence, D.H.** 1998. New naturalized plant records for the Hawaiian Islands. *Bishop Museum Occasional Papers* **56**: 5–6.
- Herbst, D.R., Staples, G.W. & Imada, C.T.** 2004. New Hawaiian plant records for 2002–2003. *Bishop Museum Occasional Papers* **78**: 3–12.
- Hillebrand, W.** 1888. *Flora of the Hawaiian Islands: a description of their phanerogams and vascular cryptogams*. Carl Winter, Heidelberg, Germany; Williams & Norgate, London; B. Westermann & Co., New York, 673 pp.
- Imada, C.T., Staples, G.W. & Herbst, D.R.** 2000. New Hawaiian plants records for 1999. *Bishop Museum Occasional Papers* **63**: 9–16.
- Lorence, D.H., Flynn, T.W. & Wagner, W.L.** 1995. Contributions to the flora of Hawai'i. III. *Bishop Museum Occasional Papers* **41**: 19–58.
- Oppenheimer, H.L.** 2003. New plant records from Maui and Hawai'i counties. *Bishop Museum Occasional Papers* **73**: 3–30.
- . 2004. New Hawaiian plant records for 2003. *Bishop Museum Occasional Papers* **79**: 8–20.
- . 2006. New Hawai'i plant records for 2004. *Bishop Museum Occasional Papers* **88**: 10–15.
- . 2007. New plant records from Moloka'i, Lāna'i, Maui, and Hawai'i for 2006. *Bishop Museum Occasional Papers* **96**: 17–34.
- Staples, G.W. & Herbst, D.R.** 2005. *A tropical garden flora: plants cultivated in the Hawaiian Islands and other tropical places*. Bishop Museum Press, Honolulu. 908 pp.
- , **Imada, C.T. & Herbst, D.R.** 2003. New Hawaiian plant records for 2001. *Bishop Museum Occasional Papers* **74**: 7–21.
- Starr, F., Starr, K. & Loope, L.L.** 2003. New plant records from the Hawaiian Archipelago. *Bishop Museum Occasional Papers* **74**: 23–34.
- , **Starr, K. & Loope, L.L.** 2004. New plant records from the Hawaiian archipelago. *Bishop Museum Occasional Papers* **79**: 20–30.
- Wagner, W.L., Herbst, D. R. & Sohmer, S.H.** 1990. *Manual of the flowering plants of Hawai'i*. University of Hawai'i Press and Bishop Museum Press, Honolulu. 1853 pp.

Zhang, Z.-y., Lu, A.-m., & D'Arcy, W. 2004. Solanaceae in Wu, Z.-y. & Raven, P.H. (eds.), *Flora of China*. Vol. 17. Verbenaceae through Solanaceae. Science Press (Beijing) & Missouri Botanical Garden (St. Louis). 378 pp.

Genetic variation in the endemic Hawaiian *Gardenia brighamii*: conservation and horticultural implications

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Introduction

Gardenia brighamii (Rubiaceae – *nanu* or *n'au*) is one of three endemic *Gardenia* species in the Hawaiian Islands. The species was federally listed as endangered in 1985 (U.S. Fish and Wildlife Service, 1985), and with three populations totaling 11 mature individuals remaining in the wild on leeward sides of Lāna'i, and O'ahu (U.S. Fish and Wildlife Service, 2008), is considered in immediate danger of extinction. On Maui, the species is considered extirpated, and the last trees on Molokai were confirmed dead in 2005 (Perlman, 2006). Once an important component of lowland dryland forests on all the main Hawaiian Islands, the species is threatened by the loss of dryland forest habitat, urbanization, invasive plant species, and grazing and browsing domestic and feral animals.

Concern has been raised recently by managers of living collections and horticulturalists as to the identity of a "robust" form of *Gardenia brighamii* in cultivation that has larger flowers and glossy leaves in comparison to herbarium specimens and wild collected individuals in cultivation. Plant propagators have indicated that the robust form of *G. brighamii* more readily takes from cuttings than typical *G. brighamii*. The introduced *Gardenia* species, *G. taitensis* has a superficial resemblance to *G. brighamii* (e.g., U.S. Fish and Wildlife Service, 1993), and this may have resulted in some taxonomic confusion. *G. taitensis* is highly variable throughout its range (Smith, 1974; Wagner *et al.* 1999b). Indeed, H. St. John (1978, 1979) described a new species, *Gardenia weissichii*, collected from the Ko'olau Mountains, O'ahu, that was later determined to be *G. taitensis* (Wagner *et al.*, 1999).

Given the status of *Gardenia brighamii* as endangered or extinct on most of the main Hawaiian Islands, it is essential that the genetic variation within extant individuals of *G. brighamii* be determined and the identity of the robust form be confirmed. *Gardenia brighamii* has significant ornamental and horticultural value, and the robust form is particularly appealing to horticulturalists and landscape architects. This form has been widely distributed and is located in several living collections and botanical gardens. This study uses molecular fingerprinting techniques to help resolve this issue.

Materials and Methods

An initial study of the genetic variation in wild and commonly cultivated *Gardenia* species found in Hawai'i was undertaken in 2002 using the fingerprinting technique known as Randomly Amplified Polymorphic DNAs (RAPDs) (Williams *et al.*, 1990). This study, reported here, indicated that a specimen of the robust form was intermediate in genotype between *Gardenia taitensis* and *G. brighamii*. Specimens of the robust and typ-

TABLE 1. *Gardenia* specimens collected for this study, their collection location, and locality of source material, if known.

	PCMB No.	Collection Location	Original Source Locality	Form
<i>Gardenia augusta</i>				
A1	28	Propagated, O'ahu		variegated
A2	29	Propagated, O'ahu		
A3	30	Propagated, O'ahu		'White Gem Daisy'
A4	31	Propagated, O'ahu		'Winifred'
A5	32	Propagated, O'ahu		
A6	33	Propagated, O'ahu		'Gallery-Augusta'
A7	39	Propagated, Wailalae Iki Ridge, O'ahu		'Radicans'
A8	183	Propagated, Maunawili, O'ahu		'Pinwheel'
<i>Gardenia brighamii</i>				
L1	36	Kehawai, Lāna'i	Kehawai, Lāna'i	typical
L2	43	Kānepu'u Reserve, Lāna'i	Kānepu'u, Lāna'i	typical
L3	112	Koko Crater Botanic Gardens, O'ahu	Kānepu'u, Lāna'i	typical
L4	1596	Koko Crater Botanic Garden, O'ahu	Kānepu'u, Lāna'i	typical
L5	1597	Koko Crater Botanic Garden, O'ahu	Kānepu'u, Lāna'i	typical
NS1	179	Lili'uokalani Botanical Garden, O'ahu	Nānākuli -S, O'ahu	typical
NS2	180	Lili'uokalani Botanical Garden, O'ahu	Nānākuli -S, O'ahu	typical
NS3	1588	Lili'uokalani Botanical Garden, O'ahu	Nānākuli -S, O'ahu	typical
NS4	1598	Koko Crater Botanic Garden, O'ahu	Nānākuli -S, O'ahu	typical
NS5	1603	The Nature Conservancy, Kunia, O'ahu	Nānākuli -S, O'ahu	typical
NN	2787	Nānākuli Valley, north branch, O'ahu	Nānākuli -N, O'ahu	typical
PK*	1601	The Nature Conservancy, Kunia, O'ahu	Pu'u Ku'ua, O'ahu	typical
PK*	1602	The Nature Conservancy, Kunia, O'ahu	Pu'u Ku'ua, O'ahu	typical
PK1	606	Leeward Community College, O'ahu	Pu'u Ku'ua, O'ahu	robust
PK2	607	Aiea, O'ahu	Pu'u Ku'ua, O'ahu	robust
PK3	1599	Koko Crater Botanic Garden, O'ahu	Pu'u Ku'ua, O'ahu	robust
PK4	1606	Propagated, O'ahu	Pu'u Ku'ua, O'ahu	robust
U1	91	Propagated, O'ahu	unknown	robust
U2	1593	Big Island Nursery, Hawai'i	unknown	robust
<i>Gardenia mannii</i>				
GM	1595	Wahiawā Botanic Garden, O'ahu	O'ahu	
<i>Gardenia taitensis</i>				
T1	14	O'ahu		double flower
T2	24	O'ahu		
T3	35	Wailupe Peninsula, O'ahu		'Tiare'
T4	178	Kamehameha Shopping Center, O'ahu		
T5	181	University of Hawaii at Mānoa, O'ahu		
T6	182	Maunawili, O'ahu		

ical *Gardenia brighamii* forms were subsequently collected from the wild, living collections, and from propagators (Table 1), and a second genetic analysis was undertaken using the fingerprinting technique, Amplified Fragment Length Polymorphism (AFLP) (Vos *et al.*, 1995).

Specimen collection

Young leaves from cultivated *Gardenia augusta* and *G. taitensis* were collected from gardens and plant nurseries around O'ahu (Table 1). *Gardenia brighamii* was collected from wild individuals at Kānepu'u, Lāna'i, and Nānākuli Valley, O'ahu, and cultivated individuals growing in Queen Liliuokalani and Koko Crater Botanical Gardens, O'ahu. The majority of the robust individuals of *Gardenia brighamii* were traced to the now extinct Pu'u Ku'ua *G. brighamii* mother plant. Cuttings from the mother plant were sampled for the AFLP analysis. A single specimen of *Gardenia mannii* was collected from Wahiawa Botanic Garden. The cultivated voucher of *Gardenia weissichii* historically accessioned at Wahiawa Botanic Gardens was found to have died and could not be included in the analysis. Sufficient genomic DNA for RAPDs analysis was also obtained from herbarium voucher specimens of *G. augusta*, *G. brighamii*, and *G. taitensis* housed in the *Herbarium Pacificum*.

Fresh collected specimens were immediately placed within activated silica. Dried samples were stored at -20 °C. Genomic DNA was extracted from either 6–10 mg dried or 20 mg fresh plant material, ground in 95% ethanol using DNeasy Plant Mini Kits (QIAGEN Inc.) following the recommended protocol. DNA vouchers for the specimens are held within the Pacific Center for Molecular Biodiversity, Bishop Museum, Honolulu, and voucher herbarium specimens are housed within the *Herbarium Pacificum*, Bishop Museum.

RAPDs analysis

Nine ten-mer primers (University of British Columbia) were used in PCR reactions (5'-3'): 153: GAG TCA CGA G; 184: CAA ACG GCA C; 212: GCT GCG TGA C; 218: CTC AGC CCA G; 234: TCC ACG GAC G; 250: CGA CAG TCC C; 265: CAG CTG TTC A; 346: TAG GCG AAC G; 347: TTG CTT GGC G; 391: GCG AAC CTC G; 431: CTG CGG GTC A; 478: CGA GCT GGT C. PCR was performed in a volume of 15 µL containing 2 mM MgCl₂, 0.24 µM of each dNTP, 15 ng BSA, 0.36 µM primer, 0.3 ng genomic DNA, and 0.6 unit of *Taq* DNA polymerase (Promega M1861), well mixed and the surface covered with sterile mineral oil (Sigma M3516). DNA amplification was performed in a programmable thermal cycler (MJ Research Inc.) using a thermal cycle of 94 °C (1.5 min) for initial strand separation, then 40 cycles of 38 °C (2 min), 72 °C (2 min), 91 °C (1 min). Two additional steps of 38 °C (2 min) and 72 °C (5 min) were used for final extension. Amplification products were analyzed by electrophoresis (72–75 V, 60 min) in 1.5% agarose gels and detected by staining with ethidium bromide. Bands were scored as present or absent. Similarity measures were computed as presence/absence matches, divided by the maximum observed value for that character over all specimens. The 124 polymorphic loci were analyzed using principal components analysis using NTSYSpc 2.1 (Rohlf, 2000). The scores of each component were statistically compared for each species using one-way analysis of variance. Similarity between each of the individuals within the species was used to compare the variability between and within the species.

AFLP analysis

AFLP band profiles were generated following the protocol of the AFLP Analysis System I (Invitrogen Corp.). Restriction enzymes *EcoR* I and *Mse* I were used to digest 250 ng genomic DNA, and the ligation of adapters and preamplification reactions were performed following the published protocol. Selective amplification was undertaken using with five primer pairs (*Eco*ACC or *Eco*AAG with *Mse*CTA, *Mse*CAT, or *Mse*CAC where *Eco* is 5'GAC TGC GTA CCA ATT C3' and *Mse* is 5'GAT GAG TCC TGA GTA A3'). The *Eco* primers were fluorescently labeled with WellRED dyes D3-PA or D4-PA (Proligo LLC). The fluorescently labeled amplified fragments were accurately sized using the Beckman-Coulter CEQ8000 genetic analysis system with the inclusion of size standards (DNA Size Standard Kit 400, Beckman-Coulter, Inc.) for calibration. Fragments differing by <1bp were scored as present or absent, and the 156 polymorphic loci were analyzed using principal components analysis using NTSYSpC 2.1 (Rohlf, 2000).

Results

RAPDs analysis

Principal components analysis of 124 RAPDs bands separated the *Gardenia* species in ordinate space, with 36.7% and 26.5% of the variance being explained by the first and second axes, respectively (Figure 1). *G. augusta* was placed at the positive end of the first axis, *G. taitensis* to the negative end of the first axis, and *G. brighamii* at the negative end of the second axis. The average similarity between samples of *G. taitensis* was $88.8 \pm 1.5\%$, and $81.6 \pm 1.5\%$ for *G. augusta*. Average similarity between samples of *G. brighamii* was $81.7 \pm 2.9\%$, which increased to $88.6 \pm 1.7\%$ with specimen U1, an outlier, removed. The robust *G. brighamii* specimen, U1, grouped most closely with *G. taitensis* with $74.1 \pm 0.9\%$ similarity, and only $67.7 \pm 1.9\%$ similarity to *G. brighamii*. All specimens of *G. brighamii* were grouped closely, with no obvious distinction between the Lāna'i and O'ahu specimens.

AFLP analysis

Cuttings from the extinct Pu'u Ku'ua *G. brighamii* (PK*: 1601 & 1602) were different in their AFLP band profile from all the robust forms, with only 65% band similarity. As for the RAPDs analysis, the robust forms of *G. brighamii* fell between *G. brighamii* and *G. taitensis* in their AFLP profiles, having bands unique to both species. *Gardenia manii* and *G. taitensis* had a similarity of 67% and 35%, respectively, to wild collected *G. brighamii* specimens. Similarity within typical *G. brighamii* specimens ranged from 62 to 88% similarity, with specimens from living collections showing the greatest genetic variation (Figure 2).

Discussion

This study indicates that the native *Gardenia brighamii* is genetically discernable from the two most common propagated species in the Hawaiian Islands, *G. augusta* and *G. taitensis*, and the O'ahu endemic *G. manii*, using RAPDs and AFLP fingerprinting analyses. The Lāna'i and O'ahu populations of *G. brighamii* were very similar in RAPDs banding, with the 'robust' specimen, U1, falling between *G. brighamii* and *G. taitensis* in ordinate space. Similarly, all morphologically robust specimens of *G. brighamii* were intermediate between *G. taitensis* and *G. brighamii* in the AFLP analysis. The robust form of *G. brighamii* was traced to seed collected from the last remaining Pu'u Ku'ua individual formerly located in the Wai'anae Mountains, O'ahu. However, analysis of samples from cut-

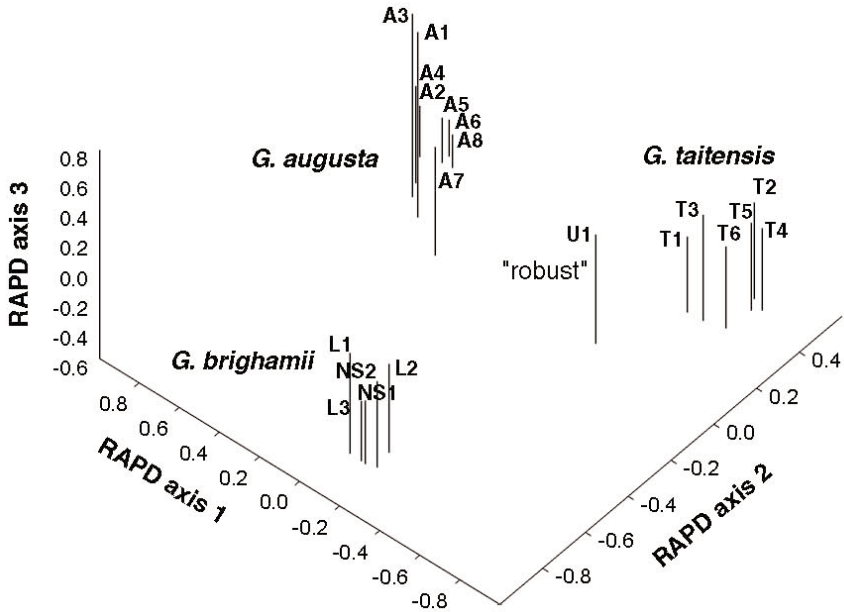


FIGURE 1. Principal Components Analysis of 124 RAPDs bands for specimens of *Gardenia augusta*, *G. brighamii*, and *G. taitensis*. Specimen details are given in Table 1.

tings directly from the last remaining Pu'u Ku'ua mother plant were significantly different in their genetic fingerprint than the robust specimens and had a greater similarity to wild collected specimens from Nānākuli Valley than to the robust individuals supposedly from the same mother plant. Given the data presented here, it appears unlikely that the robust form is true *Gardenia brighamii*. Care must be taken in restoration and augmentation projects to outplant true genotypes that are from the most appropriate population source in order to maintain the genetic integrity of the species. It is also important that the genetic variation within the endangered or extinct wild populations of *G. brighamii* from Moloka'i, Hawai'i, and Maui be determined, if specimens in cultivation can be located. This study has shown potential inconsistency between the recorded sources of propagation material and the genetic fingerprints of those individuals within living collections. Maintaining records in living collections as to the true origin and source (cutting vs. seed source) of specimens is critical for the maintenance of the genetic integrity of the species. No phylogenetic studies have, to date, been completed on the *Gardenia* species of the Pacific region, and including samples of *Gardenia taitensis* from throughout its range and other Fijian *Gardenia* species in future studies would help to clarify the ancestry of Hawaiian *Gardenia* species, and the genetic origin of the robust *G. brighamii*.

Acknowledgments

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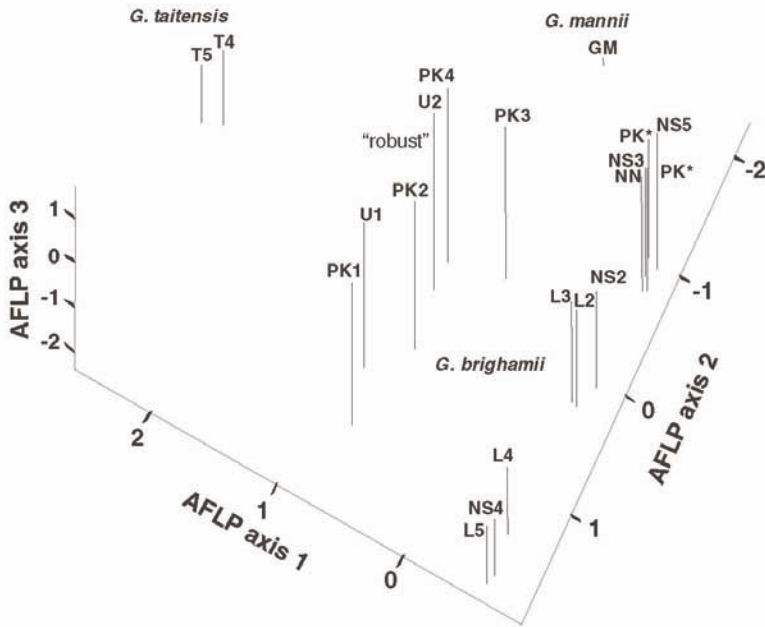


FIGURE 2: Principal Components Analysis of 17 *Gardenia brighamii* specimens from wild and cultivated sources, *G. taitensis* and *G. manii*. 156 polymorphic loci were used in the analysis. Specimen details are given in Table 1.

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Literature Cited

- Gower, J.C.** 1966. Some distance properties of latent root and vector methods used in multivariate analysis. *Biometrika* **53**: 326–338.
- Perlman, S.** 2006. National Tropical Botanical Garden, Summary of field logs for *Gardenia brighamii*, 2006. Unpublished.
- Rohlf, F.J.** 2000. NTSYSpc Numerical Taxonomy and Multivariate Analysis System Version 2.1. Exeter Software, New York.
- Smith, A.C.** 1974. Studies of Pacific Island Plants. XXVII. The genus *Gardenia* (Rubiaceae) in the Fijian Region. *American Journal of Botany* **61**: 109–128.

- St. John, H.** 1978. *Gardenia weissichii* of Oahu Island (Rubiaceae) Hawaiian Plant Studies 70. *Phytologia* **39**: 108–110.
- . 1979. The fruit of *Gardenia weissichii* (Rubiaceae) Hawaiian Plant Studies 83. *Phytologia* **41**: 144.
- Wagner, W.L., Brueggmann, M.M. Herbst, D.M. & Lau, J.Q.C.** 1999a. Hawaii vascular plants at risk, 1999. *Bishop Museum Occasional Papers* **60**: 1–58.
- ., **Herbst, D.R. & Sohmer, S.H.** 1999b. *Manual of the Flowering Plants of Hawai'i*. 2 vols. Revised edition. University of Hawaii Press & Bishop Museum Press, Honolulu.
- U.S. Fish and Wildlife Service.** 1985. Final listing, Endangered ETWP; Determination of Endangered Status for *Gardenia brighamii* (na'u or Hawaiian Gardenia) and Withdrawal of Proposed Designation of Critical Habitat. *Federal Register* **50**: 1–4.
- . 1993. *Recovery Plan for the Hawaiian Gardenia (Gardenia brighamii)*. U.S. Fish and Wildlife Service, Portland. 69 pp.
- . 2008. *Gardenia brighamii* (Hawaiian gardenia, na'u) 5-year review summary and evaluation. U.S. Fish and Wildlife Service, Honolulu, Hawaii, 10 pp.
- Vos, P., R. Hogers, M. Bleeker, M. Reijans, T. van de Lee, M. Hornes, A. Fijters, J. Pot, J. Peleman, M. Kuiper, & M. Zabeau.** 1995. AFLP: a new technique for DNA fingerprinting. *Nucleic Acids Research* **23**: 4407–4414.
- Williams, J.G.K., A.R. Kubelik, K.J. Livak, J.A. Rafalski, & S.V. Tingey.** 1990. DNA polymorphisms amplified by arbitrary primers are useful as genetic markers. *Nucleic Acids Research* **18**: 6231–6235.

New Hawaiian plant records for 2007

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Ongoing fieldwork, collections, and research continue to produce new, previously unpublished distributional records for the Hawaiian flora. In this paper, 4 state or new naturalized records, 48 new island records, 3 notable rediscoveries, and 3 range extensions are reported. Additionally, there are notes on 2 recently described species in the endemic Hawaiian genus *Cyanea*. A total of 59 taxa (11 indigenous) in 30 plant families are discussed. Seven are pteridophytes, 3 are gymnosperms, 27 are dicotyledonous angiosperms, and 22 are monocots. Information regarding the formerly known distribution of flowering plants is based on the *Manual of Flowering Plants of Hawai'i* (Wagner *et al.* 1999a) and information subsequently published in the *Records of the Hawaii Biological Survey* from 1995 through 2007. Distribution and taxonomy of ferns follows *Hawai'i's Ferns and Fern Allies* (Palmer 2003). Voucher specimens are deposited at B.P. Bishop Museum *Herbarium Pacificum* (BISH), Honolulu, with duplicates at the National Tropical Botanical Garden (PTBG), Lāwa'i, Kaua'i. A few specimens may be at only one facility; only in these cases will the herbarium acronym be cited.

Araceae***Philodendron scandens*** K. Koch & Sello**New naturalized record**

One of the most widespread species of Araceae, native from Mexico to the West Indies and much of South America, this is also one of the most common houseplants (Staples & Herbst 2005: 610). The leaves are heart shaped, smooth; stems with long internodes; the axillary flowers have a green spathe, red at the base internally, and a white spadix. Fruit has not been observed but the species easily propagates from even short sections of discarded stem. On windward East Maui at low elevations in secondary forest it is naturalized in several areas, sprawling on the ground when younger and eventually climbing high into alien tree canopy. It is tolerant of shade.

There are now four species of *Philodendron* Schott reported as naturalized on two islands, Kauaʻi and Maui (Lorence & Flynn 2002: 14–15; Oppenheimer 2004: 9; Oppenheimer 2007: 19); a key to the most commonly cultivated species is provided by Staples & Herbst (2005: 607–608). There are likely to be other species and/or islands with naturalized occurrences in Hawaiʻi.

Material examined. **KAUAI:** Nāwiliwili, naturalized, 6 Apr 1988, *T. Flynn 2895* (BISH). **MAUI:** East Maui, Hāna Dist, Kaʻehoʻeho, naturalized, climbing 12 m or more in *Ficus* and Java plum trees, 37 m, 28 May 2007, *Oppenheimer H50735*.

Araucariaceae***Araucaria columnaris*** (Forst.) Hook.**New island record**

A widely planted forestry tree, the Cook pine was previously documented outside of cultivation from West Maui (Oppenheimer 2002: 20) and Molokaʻi (Oppenheimer 2007: 19). This tree has become a symbol of the island of Lānaʻi, and is widely planted as an ornamental, street tree, for reforestation, and to increase fog drip and groundwater recharge. Small plants appear to be browsed by axis deer. Randomly spaced spontaneous plants also occur near the southern ascent of the Munro trail near Waiakeakua.

Material examined. **LĀNAʻI:** Hoʻokio Ridge, 790 m, 5 Feb 2007, *Oppenheimer H20707*.

Asclepiadaceae***Calotropis procera*** (Aiton) W.T. Aiton**New island record**

In the family notes on Asclepiadaceae, Wagner *et al.* (1999a: 238) mention a report of *Calotropis procera* escaping cultivation in the vicinity of Keāhole Airport on Hawaiʻi Island. Wood & LeGrande (2006: 19–20) reported it from Lehua Islet, which they considered a part of Niʻihau, where it had not been previously documented. Wood (2006: 15) also reported it from Kauaʻi. On Lānaʻi it is sparingly naturalized along Keomuku Road, in sandy soil. Staples *et al.* (2000: 16) reported the species to be wind dispersed, and possibly also by vegetative means.

Material examined. **LĀNAʻI:** N of Mākāiwa, 5 m, 4 Jan 2007, *Oppenheimer, Perlman & Tangalin H10705*.

Aspleniaceae***Asplenium xflagrum*** W.H. Wagner

& D.D. Palmer

New island record

Palmer (2003: 76) and Wagner *et al.* (1999: 166) noted this spontaneous natural hybrid of *A. hobydi* W.H. Wagner and *A. normale* D. Don only from near the Pihea Trail in the Kōkeʻe area of Kauaʻi. Recently it was collected in montane wet forest on East Maui, where both parents are common. This hybrid seems to be rare, however.

Material examined. MAUI: East Maui, Hāna Dist, slopes of Kuiki between Kīpahulu and Kaupō, 1899 m, 3 Jun 2006, *Oppenheimer H60605* (BISH, HALE).

Asteraceae

Artemisia vulgaris L.

New island record

Mugwort is sparingly naturalized in disturbed areas on Kauaʻi, Oʻahu, East and West Maui, and Hawaiʻi (Wagner *et al.* 1999a: 265; Wagner & Herbst 1995: 15; Oppenheimer 2004: 9). Now it is known from Lānaʻi, where it also grows in disturbed areas.

Material examined. LĀNAʻI: Lānaʻi City, locally common in yards & waste areas, 495 m, 4 Sep 2007, *Oppenheimer & Perlman H90701*.

Emilia sonchifolia (L.) DC

New island record

var. *japonica* (N.L. Burm.) Mattf.

Known from Kauaʻi, Oʻahu (Wagner *et al.* 1999a: 312), and East Maui (Wagner *et al.* 1997: 52), this weedy herb also occurs on Lānaʻi.

Material examined. LĀNAʻI: Kānepuʻu, uncommon in open, sunny, grassy areas, 460 m, 21 Dec 2006, *Oppenheimer H120646*.

Erigeron bellioides DC

New island record

This diminutive herb seems to have spread rapidly since first observed on Oʻahu in 1977, being documented from Kauaʻi, Oʻahu, Molokaʻi, Maui, and Hawaiʻi (Wagner *et al.* 1999a: 314; Nagata 1995: 11; Oppenheimer & Bartlett 2000: 2; Oppenheimer 2003: 7; Staples *et al.* 2003: 8–9; Starr *et al.* 2004: 21). It is not surprising that it now occurs on Lānaʻi as well.

Material examined. LĀNAʻI: Hulopoʻe, in lawn, 50 m, 5 Jan 2007, *Oppenheimer, Perlman & Tangalin H10712*.

Galinsoga parviflora Cav.

New island record

An annual herb known from Kauaʻi, Oʻahu, Maui, Kahoʻolawe, and Hawaiʻi (Wagner *et al.* 1999a: 320), this species was recently collected on Lānaʻi. It is locally common in gulches in remnant dry forest and shrubland along the windward side of the island, germinating after winter rains.

Material examined. LĀNAʻI: Lōpā Gulch headwaters, 430 m, 4 Jan 2007, *Oppenheimer, Perlman & Tangalin H10706*.

Picris hieracioides L.

New island record

Known in Hawaiʻi from the islands of Lānaʻi and Hawaiʻi (Wagner *et al.* 1999a: 350), this Eurasian hawkweed is well established on Molokaʻi. Besides the collections cited here, it was also observed in the Molokaʻi Forest Reserve along a disturbed, unpaved roadside. Many plants on the leeward south side of the island appeared to have been browsed by feral goats but not devoured, and this species is apparently unpalatable and possibly poisonous to them.

Material examined. MOLOKAʻI: Kawela drainage, along switchback trail W of Kawela tunnel, 1100 m, 29 Aug 2007, *Oppenheimer & Perlman H80705*; Waiakuilani Gulch, eastern headwaters, 940 m, 30 Aug 2007, *Oppenheimer & Perlman H80708*.

Bignoniaceae

Jacaranda mimosifolia D. Don

New island record

A popular ornamental tree, Wagner *et al.* (1999a: 387) speculated it was naturalized on all of the main islands but documented only from Oʻahu, Maui, and Hawaiʻi. On Lānaʻi it is

forming local thickets in alien, secondary forest outside Lānaʻi City and was also observed near Kōʻele and at Kanepuʻu.

Material examined. **LĀNAʻI:** Keaʻaku Gulch, 440 m, 5 Jan 2007, *Oppenheimer, Perlman & Tangalin H10709.*

Cactaceae

Cereus uruguayanus* Ritter ex R. Kiesling **New island record*

A widely cultivated ornamental, hedge cactus is naturalized on southern Kauaʻi (Wagner *et al.* 1999a: 417). On leeward East Maui this arborescent cactus is found scattered on rocky substrate in dry pastures dominated by *Prosopis*, *Leucaena*, and *Cenchrus* with remnant native elements such as *Erythrina*, *Chamaesyce*, *Myoporum*, *Hibiscus*, and *Sida*.

Material examined. **MAUI:** East Maui, Wailuku Dist, Paeahu, in pasture, 232 m, 10 Jul 2007, *Oppenheimer & D. Crow H70702.*

Campanulaceae

***Cyanea duvalliorum* Lammers & H. Oppenh.**

Endemic to mesic forests on Haleakalā, East Maui, this species was recently described from flowering material collected in October 2000. Previously it was collected in a vegetative state by both C.N. Forbes and J.F. Rock in Keʻānae, Wailua Iki, and Kīpahulu; near the type locality by G.C. Munro; and more recently in 1980 by F.R. Warshauer and H. McDoldowney. A few plants persist at the latter site, but the other populations have not been relocated. Presently there are fewer than 75 mature individuals and 60 seedlings and saplings known mainly in a single, degraded area; it has already declined noticeably since its discovery in early 2000 and several plants are known to have died in the past year. Threats are severe and include feral pigs and possibly axis deer; rats; slugs such as *Derocerus* and *Limax*; and alien vegetation including quinine (*Cinchona pubescens*), strawberry guava (*Psidium cattleianum*), palmgrass (*Setaria palmifolia*), blackberry (*Rubus argutus*), *Clidemia hirta*, *Tibouchina herbacea*, Australian tree fern (*Sphaeropteris cooperi*), night-blooming cestrum (*Cestrum nocturnum*), tropical ash (*Fraxinus uhdei*), and eucalyptus (*Eucalyptus* spp.). It should be considered as a candidate for listing as Endangered. Currently it is a target of the Plant Extinction Prevention Program, with seeds collected for propagation and outplanting into suitable, secure habitat within its former range. A complete description and discussion can be found in Lammers (2004).

***Cyanea maritae* Lammers & H. Oppenh.**

This species is also endemic to Haleakalā, East Maui in mesic to lowland wet forests and occurs with *Cyanea duvalliorum* (*q.v.*) in the type locality. Previously both C.N. Forbes and J.F. Rock collected material without flowers in Honomanū, Keʻānae, and Kīpahulu; flowering material was finally collected in 2000. Approximately 50 adults are known in five populations; four of these are represented by only 1–4 individual plants. Reproduction and recruitment of new individuals is infrequent and many of the seedlings that have been observed occur on streambanks and become dislodged during high stormwater episodes. Except for the Kīpahulu population, which is under management by Haleakalā National Park, the threats are the same as for *C. duvalliorum* (*q.v.*). It should be considered as a candidate for listing as Endangered. Currently it is a target of the Plant Extinction Prevention Program, with seeds collected for propagation and outplanting into suitable, secure habitat within its former range. A complete description and discussion can be found in Lammers (2004).

***Wahlenbergia marginata* (Thunb.) A. DC New island record**

In a recent article, Herbst *et al.* (2004: 4–5) reassessed the status of the genus *Wahlenbergia* Schrad. ex Roth in the Hawaiian Islands, reporting a second naturalized species. *Wahlenbergia marginata* was previously collected only on Hawai‘i Island. Judging from the material examined, it apparently occurs at higher elevations. This is consistent with the collection cited below.

Material examined. MAUI: East Maui, Makawao Dist, Pu‘u Makua, common in cindery substrate, 1585 m, 1 Jul 2006, *Oppenheimer H70601*.

Casuarinaceae***Casuarina glauca* Siebold ex Spreng. New island record**

Wagner *et al.* (1999a: 529) reported this Australian tree to have been planted on all the main islands except Ni‘ihau but spreading via root suckers only on O‘ahu and Lāna‘i. It has also been documented from Maui and Hawai‘i (Oppenheimer & Bartlett 2000: 3) and Midway Atoll (Starr *et al.* 2002: 19). On Moloka‘i it was found mixed with *C. equisetifolia* and producing thickets from root suckers and possibly also by seed.

Material examined. MOLOKA‘I: Kalae, naturalized trees, 500 m, 2 Nov 2006, *Oppenheimer H110608*.

Combretaceae***Terminalia catappa* L. New island record**

Tropical almond is a common littoral tree and has been previously documented from Kaua‘i, O‘ahu, Moloka‘i, Maui, and Hawai‘i (Wagner *et al.* 1999a: 547–8; Oppenheimer 2003: 9). On Lāna‘i trees are scattered along the windward, eastern shore amongst *Prosopis* and *Thespesia*, but is less abundant. Seedlings are sometimes observed near cultivated plants at Mānele Bay.

Material examined. LĀNA‘I: Keōmuku Rd between Halepalaoa Landing and Kahe‘a, near sea level, 21 Mar 2007, *Oppenheimer, Perlman & Tangalin H30717*.

Cupressaceae***Juniperus bermudiana* L. New island record**

Planted in forest reserves on all islands (Little & Skolmen 1989: 74; Neal 1965: 45), Bermuda juniper is naturalized in dry to mesic areas on West Maui (Oppenheimer 2002: 21). On Lāna‘i it was noted to have escaped from what appears to be deliberate plantings. Unlike many gymnosperms, it has small, fleshy seeds and is bird dispersed.

Material examined. LĀNA‘I: between Hulopo‘e and Ho‘okio Gulches, sparingly naturalized trees in alien forest dominated by *Schinus*, *Psidium*, and *Ficus*, 600 m, 20 Dec 2006, *Oppenheimer H120641*.

Cyatheaceae***Sphaeropteris cooperi* (Hook. ex F. Muell.) R.M. Tryon New island record**

Popular in the local horticultural trade, Australian tree fern is also a serious weed species, yet it is still sold at many nurseries. It has been documented outside of cultivation on Kaua‘i, O‘ahu, Maui, and Hawai‘i (Palmer 2003: 245). On Lāna‘i it is common in yards in Lāna‘i City, and the wind-dispersed spores could have blown over Lāna‘ihale to the collection site. Alternately, the spores could have come in on the tradewinds across the channel from West Maui, where it is common in resort, commercial, and residential landscaping. All wild plants observed were destroyed.

Material examined. **LĀNA'I:** Wai'opa Gulch, 810 m, 5 Sep 2007, *Oppenheimer & Perlman H90705*.

Cyperaceae

Cyperus haspan L.

New island record

Widespread in wet areas of tropical and subtropical regions worldwide, and previously naturalized in the Hawaiian Islands on Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i (Wagner *et al.* 1999a: 1398; Hughes 1995: 4; Wood 2006: 17). Hughes also discussed the confusion regarding the spelling of the specific epithet (*haspan* vs. *halpan*).

Material examined. **LĀNA'I:** W of Hau'ola Gulch, N of Pu'u 'A'ali'i, along fenceline on ridgetop, common in degraded shrubland, with *Juncus planifolius*, 900 m, 10 May 2006, *Oppenheimer & J. Penniman H50614*.

Cyperus sphaclatus Rottb.

New state record

Roadside flatsedge is native to tropical America and tropical Africa, and introduced to Ceylon (Sri Lanka), Malesia, Queensland, Australia, and Tahiti (Koyama 1983: 186). It is also naturalized in Florida (USDA Plants website, accessed January 2008). This species is similar to *C. rotundus* L. but differs in the characters of the glumes. On Moloka'i it is common in pastures on the east end of the island.

Material examined. **MOLOKA'I:** E end, Pu'u O Hoku Ranch, vicinity Honokoi Gulch, uncommon in pasture, 260 m, 18 May 2006, *Oppenheimer et al. H50643*; Keōpukaloa, between Honokoi and Pāpio Gulches, common in pastures and waste areas, 295 m, 6 Nov 2007, *Oppenheimer H110707*.

Rhynchospora tenuis Willd. ex Link

New island record

Only recently collected in Hawai'i and reported from Kaua'i (Imada 2007: 36), this sedge also occurs on Moloka'i. Imada provided a detailed description and distribution data.

Material examined. **MOLOKA'I:** Honoulimalo'o, S of Pahualo'o, naturalized in pasture, but localized, 485 m, 25 Nov 2007, *Oppenheimer H110739*.

Scleria testacea Nees

New island record

This indigenous sedge is presently known from low-elevation wet sites near Hilo, Hawai'i, but reported by Hillebrand from higher elevations near Kīlauea, Hawai'i, and West Maui (Wagner *et al.* 1999a: 1434; Hillebrand 1888: 484–5). Hillebrand reported it from "Eeka," presumably a misspelling of 'Eke, and it is generally believed he was not actually on 'Eke but on the West Maui summit at Pu'u Kukui. Degener & Degener (1962) thought Hillebrand to be in error and considered the local range to be limited to below 610 m (2000 ft) elevation in the vicinity of Hilo. On Moloka'i it was found locally common in a pasture and apparently unbrowsed by domestic cattle, horses, or feral axis deer.

Material examined. **MOLOKA'I:** S of Pōhakupili Gulch, naturalized in pasture but localized, 385 m, 25 Nov 2007, *Oppenheimer H110738*.

Dennstaedtiaceae

Hypolepis hawaiiensis Brownsey

Range extension

var. *mauiensis* (Hillebr.) D.D. Palmer

A rare fern known only from a few collections made on West Maui (Palmer 2003: 169), this taxon is usually found on mossy ground in forest and shrubland surrounding bogs, rarely on rocky gulch headwalls. On East Maui it was collected on mossy, narrow, shady intermittent streambanks with other ferns and herbs such as *Asplenium*, *Arachniodes*,

Polystichum, *Athyrium*, *Grammitis*, *Dryopteris*, *Peperomia*, and *Pilea*. It was noted to be rare in the collection localities, and although there are many similar sites on windward Haleakalā, this taxon has not been previously documented there.

Material examined. **MAUI:** East Maui, Hāna Dist, Hanawī, E of the W fork of Hanawī Stream, rare, 1768 m, 12 Oct 2006, *Oppenheimer & L. Fox H100619* (BISH); Hanawī Stream headwaters, 1653 m, 16 Nov 2006, *Oppenheimer H110613*.

***Microlepia speluncae* (L.) T. Moore**

New island record

Widespread in Asia, Japan, Taiwan, and the Philippines to Polynesia, this large fern is indigenous in the Hawaiian Islands and known from Kauaʻi, Oʻahu, West Maui, and Hawaiʻi (Palmer 2003: 184; Oppenheimer 2004: 11). The following collection documents its occurrence on Molokaʻi, where it was found to be locally common in degraded mesic forest. *Microlepia xadulterina* W.H. Wagner, a known hybrid between this species and *M. strigosa* (Thunb.) C. Presl (Wagner *et al.* 1999: 153), was not observed but with more careful searching it may be found, as both parents are locally common.

Material examined. **MOLOKAʻI:** Kuhuaʻawi Gulch, 600 m, 17 Dec 2007, *Oppenheimer & Perlman H120712*.

Fabaceae

***Albizia lebbek* (L.) Benth.**

New island record

Siris tree has been documented outside of cultivation in low-elevation, disturbed areas on Midway Atoll, Niʻihau, Kauaʻi, Oʻahu, Maui, and Hawaiʻi (Wagner *et al.* 1999a: 645; Oppenheimer & Bartlett 2002: 7; Oppenheimer 2007: 23). Besides the collection from Molokaʻi cited below, plants were also observed at Manaʻe.

Material examined. **MOLOKAʻI:** S side of Wailoku Gulch, 90 m, 7 Nov 2007, *Oppenheimer H110713*.

***Macroptilium atropurpureum* (DC) Urb.**

New island record

This widespread Neotropical herb is naturalized on Kauaʻi, Oʻahu, Molokaʻi, Maui, and Hawaiʻi (Wagner *et al.* 1999a: 682–683; Oppenheimer 2003: 13; Lorence & Flynn 2006: 3). The following collection documents its occurrence on Lānaʻi.

Material examined. **LĀNAʻI:** Lānaʻi City, along roadside ca 1.6 km (1 mi) outside town on Kaunalapau Hwy., 450 m, 1 Nov 2007, *Oppenheimer H110704*.

***Trifolium repens* L.**

New island record

Introduced worldwide as pasturage and naturalized in Hawaiʻi on Kauaʻi, Maui, and Hawaiʻi (Wagner *et al.* 1999a: 714), white clover is also naturalized on Lānaʻi. It may be escaping from a nearby horse stable.

Material examined. **LĀNAʻI:** Kōʻele, creeping plants in grassy area along side of road to Keahikawelo, near stables, 515 m, 3 Feb 2007, *Oppenheimer H20703*.

***Zornia gemella* (Willd.) Vog.**

New island record

Recently *Zornia gemella* has been documented growing outside of cultivation in the Hawaiian Islands, on Oʻahu (Staples *et al.* 2006: 7–8). On Molokaʻi *Z. gemella* is naturalized in the area between Puʻu O Hoku and Hālawa Valley, growing in short-statured grasslands with relictual native elements.

Material examined. **MOLOKAʻI:** S of Honokoʻi Gulch, in open area near roadside, 220 m, 9 Dec 2006, *Oppenheimer H120629*; vicinity of Honokoʻi Gulch, 270 m, 8 Nov 2007, *Oppenheimer H110725*.

Hydrocharitaceae***Vallisneria americana*** Michx.**New island record**

Reported by Wagner *et al.* (1999a: 1442) under the Hydrocharitaceae discussion as tentative specimens collected from Kaua'i and Hilo, Hawai'i; it was later confirmed that this species was indeed naturalized, at least on Kaua'i (Staples *et al.* 2003: 13). On Maui it was found growing in an irrigation ditch, where it grows with *Potamogeton* and occurs sporadically but is locally dense over at least several hundred meters. It is occasionally harvested as a vegetable by people of Filipino descent.

Material examined. MAUI: West Maui, Wailuku Dist, N of O'oawa Kilika Gulch, growing in Waihe'e Ditch in shallow, flowing water, locally common, 125 m, 21 Dec 2005, *Oppenheimer & C. Brosius H120514*.

Lamiaceae***Hyptis suaveolens*** (L.) Poit.**New island record**

Cultivated by Filipino laborers for medicinal use and as a food flavoring and sparingly naturalized in dry, disturbed areas on Hawai'i (Wagner *et al.* 1999a: 802), *H. suaveolens* was more recently reported from O'ahu (Wagner & Herbst 1995: 22) and East Maui (Starr *et al.* 2006: 36). Now it is known from Moloka'i as well, also growing in dry, disturbed areas.

Material examined. MOLOKA'I: Ke'aina Gulch, occasional along unimproved road in pasture, 60 m, 9 Dec 2006, *Oppenheimer H120625*.

Liliaceae***Asparagus plumosus*** J.G. Baker**New island record**

A fairly recent addition to the naturalized flora of Hawai'i, this cultivated species has been found beyond plantings on the islands of Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i (Lorence *et al.* 1995: 40; Imada *et al.* 2000: 13; Oppenheimer & Bartlett 2000: 6; Oppenheimer & Bartlett 2002: 9; Starr *et al.* 2002: 21). Imada *et al.* also reported the change in name for the naturalized plants in Hawai'i; it was formerly confused with *A. setaceus* (Kunth) Jessop.

Material examined. LĀNA'I: Lāna'i City, occasional in waste areas, 510 m, 5 Jan 2007, *Oppenheimer, Perlman & Tangalin H10710*.

Hippeastrum striatum (Lam.) H.E. Moore**New island records**

This ornamental herb has been documented outside of cultivation on the islands of Kaua'i, Maui, and Hawai'i (Wagner *et al.* 1999a: 1463; Oppenheimer & Bartlett 2002: 9). The species was previously misidentified in Hawai'i as *H. puniceum* (Lam.) Vahl (Herbst & Wagner 1999: 23). Plants are commonly seen in disturbed and waste areas, as well as in old yards and areas of neglect, where it does not appear to be under cultivation. Its dispersal mechanism is perplexing, as seeds have not yet been observed, but the underground onion-like bulbs produce smaller bulblets that could be moved around with soil and yard waste. Staples *et al.* (2000: 23) listed an unknown dispersal syndrome but possibly vegetative.

Material examined. MOLOKA'I: S bank of Pāpio Gulch, sparingly naturalized, 200 m, 7 Nov 2007, *Oppenheimer H110721*. LĀNA'I: Lāna'i City, 500 m, 20 Mar 2007, *Oppenheimer, Perlman & Tangalin H30713*.

Lindsaeaceae***Lindsaea ensifolia*** Sw.**New island record**

First collected in Hawai'i in 1969, and naturalized on Kaua'i, O'ahu, Maui, and Hawai'i (Palmer 2003: 174), on Moloka'i this alien fern was found growing in a pasture. Although

the indigenous *Sphenomeris chinensis* (L.) Maxon was also noted to occur nearby, the interesting intergeneric hybrid *xLindsaeosoria flynnii* W.H. Wagner (W.H. Wagner 1993: 72–3) was not found.

Material examined. **MOLOKA'I:** S of Pōhakupili Gulch, naturalized in pasture but localized, 385 m, 25 Nov 2007, *Oppenheimer H110737*.

Malvaceae

Sida ciliaris L.

New island record

Only recently found as a naturalized species in Hawai'i but already documented from Kaua'i (Staples *et al.* 2003: 14–15), O'ahu (Wagner *et al.* 1997: 59), Lāna'i (Oppenheimer 2007: 26), Maui (Oppenheimer & Bartlett 2000: 6; Starr *et al.* 2004: 24), and Kaho'olawe (Starr *et al.* 2006: 36). With the following voucher specimen collected on Moloka'i, this species is now known from all of the main islands except Ni'ihau.

Material examined. **MOLOKA'I:** Kaunakakai, growing in waste areas around town, 15 m, 20 Feb 2007, *Oppenheimer H20712*.

Sidastrum micranthum (A. St. Hil.) Fryxell

New island record

Naturalized on O'ahu, Moloka'i, East Maui, and Hawai'i (Wagner *et al.* 1999a: 901; Starr *et al.* 2003: 28; Oppenheimer 2007: 27), this species has been recently collected on Lāna'i.

Material examined. **LĀNA'I:** WSW of Pu'u Māhana, uncommon in remnant dry forest, 530 m, 3 Jan 2007, *Oppenheimer, Perlman & Tangalin H10704*.

Moraceae

Ficus rubiginosa Desf.

New island record

Previously documented as naturalized on West Maui (Oppenheimer 2003: 15), this species was recently collected on Lāna'i. As on Maui, trees were exclusively terrestrial; this may or may not be an ecological character useful in distinguishing this species from the similar *F. platypoda*, which usually starts as an epiphyte. The two species share the same pollinating wasp (Staples & Herbst 2005: 410), *Pleisodontes imperialis* (Wagner *et al.* 1999a: 924), which was reared from fruits collected on Lāna'i, supporting its status as being capable of reproduction and naturalization. It is likely both bird and mammal dispersed. Another area of forestry plantings including this species exists near the Ko'ele end of the Munro Trail; this was not investigated for reproduction and spread, but occasional trees were noted in deep gulches near the old fog drip station.

Material examined. **LĀNA'I:** vicinity of Ha'alelepa'akai, naturalized, terrestrial, small trees in wet *Metrosideros/Dicranopteris* forest, 995 m, 17 Aug 2006, *Oppenheimer & K.R. Wood H80628*.

Myrtaceae

Eucalyptus creba F. Muell.

New island record

Native to eastern Queensland and New South Wales, Australia, with over 33,000 trees planted in Hawai'i between 1911 and 1941 on Kaua'i, O'ahu, and Moloka'i, where it is regenerating within the plantations (Wagner *et al.* 1999a: 953). On Lāna'i the narrow-leaved ironbark was found on a dry ridge mixed with *E. robusta*; both were locally common.

Material examined. **LĀNA'I:** Puhielelu Ridge, naturalized, common with *E. robusta* on dry ridge, 740 m, 16 Aug 2006, *Oppenheimer & K.R. Wood H80625*.

Eucalyptus pilularis Sm.

New island record

Wagner *et al.* (1999a: 957) report this species as widely planted and regenerating on

Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i. On Lāna'i this tree is common on the slopes above Lāna'i City.

Material examined. **LĀNA'I:** above Lāna'i City, 540 m, 5 Feb 2007, *Oppenheimer H20709*.

Orchidaceae

Phaius tankarvilliae (Banks ex L'Hér.) Blume **Range extension**

Chinese ground orchid has been documented outside of cultivation on Kaua'i, O'ahu, Moloka'i, Lāna'i, West Maui, and Hawai'i (Wagner *et al.* 1999a: 1474; Oppenheimer *et al.* 1999a: 9; Oppenheimer 2007: 28). Since the seeds are wind dispersed (Staples *et al.* 2000: 26) and there are no apparent obligate soil fungus associations, it is not surprising that it now occurs on all major islands where suitable wet habitat exists. It is still offered for sale in garden shops on Maui and probably elsewhere.

Material examined. **MAUI:** East Maui, Makawao Dist, Kailua Stream, E tributary, uncommon along pipeline, 866 m, 28 Mar 2007, *Oppenheimer, Perlman & Tangalin H30725*.

Pinaceae

Pinus taeda L.

New naturalized record

No species of pine tree have been previously reported as naturalized on Lāna'i, and this species has not been documented as naturalized elsewhere in Hawai'i (Oppenheimer 2002: 21; 2003: 18–19; Wysong *et al.* 2007: 6). *Pinus taeda*, loblolly pine, is native to the eastern and southern United States, from New Jersey to Texas and Oklahoma, and has been planted on Kaua'i, Moloka'i, Maui, and Hawai'i (Little & Skolmen 1989: 64). The needles are usually in bundles of three, with the sheath nearly 25 mm long and persisting; the cones have a stout prickle at the end of the scale; seed wings are up to 25 mm long (Little & Skolmen 1989: 60, 62). Different size classes have been observed in steep gulches, but the smallest and presumably most recently germinated plants seem to be in open, disturbed areas such as roadsides and landslides. The larger trees in the steep, nearly inaccessible terrain may have become established at those sites before other, more aggressive woody taxa, such as strawberry guava or ironwood, invaded and formed dense thickets. Richardson & Rejmánek (2004) reported the Pinaceae to have an exceptionally high percentage of invasive and naturalized species compared to many angiosperm families that are predominately shrubs and trees.

Material examined. **LĀNA'I:** Ho'okio Gulch, escaping from old forestry plantings into wet and mesic areas, 800 m, 5 Feb 2007, *Oppenheimer H20708*.

Poaceae

Brachiaria brizantha (Hochst. ex Rich.) Stapf **New island record**

Only recently documented in the Hawaiian Islands from Kaho'olawe (Starr *et al.* 2006: 39), this grass also occurs on East Maui. The key to the species of *Brachiaria* by Herbst & Clayton (1998: 19) includes *B. brizantha*.

Material examined. **MAUI:** East Maui, Hāna Dist, Pāpa'a'eānuī, growing near Hana Hwy., 244 m, 7 Sep 2004, *Oppenheimer & Hansen H90403* (BISH).

Bromus catharticus Vahl

New island record

Naturalized and common in Hawai'i on the islands of Midway Atoll, Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i (Wagner *et al.* 1999a: 1508; Lorence & Flynn 1997: 11), rescue grass is now known from Lāna'i, where it is found in lawns and waste areas in the Lāna'i City area. The change in name from *B. willdenowii* Kunth was reported by Herbst & Clayton (1998: 20).

Material examined. **LĀNA'I:** Lāna'i City, naturalized in lawns and waste areas, 500 m, 26 Apr 2007, *Oppenheimer H40733*.

***Bromus diandrus* Roth**

New island record

[syn. *B. rigidus* Roth]

Ripgut grass has been documented in Hawai'i from Kaua'i, East Maui, and Hawai'i (Wagner *et al.* 1999a: 1508; Herbarium Pacificum Staff 1999: 7). On Lāna'i it is locally common during wet seasons and definitely naturalized. Pavlick & Anderton (2007: 224) considered *B. rigidus* conspecific with *B. diandrus*.

Material examined. **LĀNA'I:** 'Āwehi Rd, in the *Gardenia brighamii* outplanting enclosure, locally common, 760 m, 21 Mar 2007, *Oppenheimer, Perlman & Tangalin H30714*.

***Bromus sterilis* L.**

New island records

There is a brief discussion of this species in the generic notes of *Bromus* (Wagner *et al.* 1999a: 1507). It had been known from 2 collections made in Hāmākua, Hawai'i, the earliest in 1936; its status in the Hawaiian flora had remained unknown. The following collections confirm it as naturalized on 2 additional islands. Herbst & Clayton include it in their key (1998: 20).

Material examined. **MOLOKA'I:** Waiakuilani Gulch, scattered to locally common on steep slopes in mesic forest and dry shrubland, 920 m, 5 Apr 2007, *Oppenheimer, Perlman & Tangalin H40711*. **MAUI:** West Maui, Lāhaina Dist, slopes of Helu, Kaua'ula Valley, S side, locally common grass on steep rocky mid-slope, 1000 m, 11 May 2007, *Oppenheimer H50715*.

***Eragrostis tenuifolia* (A. Rich.) Steud.**

New island record

This non-native grass has been previously reported from O'ahu, Maui, and Hawai'i (Herbst & Clayton 1998: 28; Oppenheimer 2004: 15). The following collection documents its occurrence on Lāna'i.

Material examined. **LĀNA'I:** Keōmuku Rd, roadside weed, common, 460 m, 19 Oct 2006, *Oppenheimer H100631*.

***Eragrostis uniolooides* (Retz.) Steud.**

New island record

Although originally believed to be an adventive species in Hawai'i (Wagner *et al.* 1999a: 1538), Herbst & Clayton (1998: 26) considered it to be truly naturalized, citing several specimens collected on the Big Island. The following specimen, collected in a remote area on leeward Haleakalā, documents its occurrence and naturalized status on Maui.

Material examined. **MAUI:** East Maui, Hāna Dist, Kahikinui, Wailaulau drainage basin, uncommon in grassland dominated by *Deschampsia*, *Anthoxanthum*, *Holcus*, and *Axonopus*, in degraded *Acacia/Metrosideros* montane mesic forest, 1634 m, 29 Sep 2006, *Oppenheimer H90639* (BISH).

***Eriochloa procer* (Retz.) C.E. Hubb.**

New state record

Whistler (1995: 170) reported this species to be native to the Old World tropics, and that it was first collected in the tropical Pacific in Fiji in 1944. It also occurs in Samoa, Tonga, and Guam, where it is occasional to locally common in lowland roadsides, gardens, lawns, and other disturbed places. It was expected to spread rapidly once established. It differs from *E. punctata* (L.) Desv. ex W. Ham. by the number of racemes, and its smaller, lanceolate spikelets.

Material examined. **MOLOKA'I:** Kaunakakai Wharf, weedy grass in small lawn plot, near sea level, 15 May 2006, *Oppenheimer H50627*.

Festuca rubra* L.*New island record**

Red fescue is sparingly naturalized on the islands of Kaua'i (Wagner *et al.* 1997: 60), Maui, and Hawai'i (Wagner *et al.* 1999a: 1548). The following specimen documents its occurrence on the island of Moloka'i.

Material examined. **MOLOKA'I:** Kūpā'ia Gulch, occasional clumping grass on steep slopes in mesic forest, 880 m, 3 Apr 2007, *Oppenheimer, Perlman & Tangalin H40704.*

Oplismenus compositus* (L.) P. Beauv.*Range extension**

Naturalized in Hawai'i on Kaua'i, O'ahu, Moloka'i, West Maui, and Hawai'i (Wagner *et al.* 1999a: 1565; Oppenheimer 2003: 21), the following specimen represents a significant range extension to East Maui.

Material examined. **MAUI:** East Maui, Hāna Dist, Pu'uhaoa, between Wailua and 'Ohe'o Gulches, common grass in old pasture and along stream, 31 m, 4 Dec 2005, *Oppenheimer H120501.*

Paspalum fimbriatum* Kunth*New island record**

Naturalized in moist, disturbed, open sites on Kure Atoll, Kaua'i, O'ahu, Moloka'i, East & West Maui (Wagner *et al.* 1999a: 1576; Starr *et al.* 2002: 23; Oppenheimer 2003: 21), this grass was collected recently on Lāna'i, where it was growing under similar conditions.

Material examined. **LĀNA'I:** Lāna'i City, weed at edge of lawn, 505 m, 3 Feb 2007, *Oppenheimer H20702.*

Paspalum notatum* Flügge*New island record**

Documented from Kaua'i (Lorence & Flynn 1999: 6), and Maui (Oppenheimer 2007: 29), this grass is also naturalized on Moloka'i.

Material examined. **MOLOKA'I:** Pūniu'ōhua 1, common in pastures, 370 m, 10 Aug 2006, *Oppenheimer H80605.*

Trisetum inaequale* Whitney*Notable rediscovery**

Occurring on open, grassy slopes and steep ridges and slopes in dry forest at 730–1000 m on Lāna'i and Maui (Wagner *et al.* 1999a: 1602), this species was last collected on Lāna'i in 1938. Although it is still locally common on leeward West Maui, this species is apparently rare on Lāna'i; there are no specimens from East Maui.

Material examined. **LĀNA'I:** very rare on open grassy slope, semi-dry place, Kapua, Kaohai, 15 Apr 1938, *E.Y. Hosaka & H. St. John 1974* (BISH); gulch N of Kaonohiokala Ridge, uncommon, few plants observed in severely degraded area of dry shrubland & forest, 400 m, 25 Apr 2007, *Oppenheimer H40732* (PTBG).

Pteridaceae***Pteris lidgatei* (Baker) Christ****Notable rediscovery**

Federally listed as Endangered, this fern is known from the Ko'olau Mountains of O'ahu, Moloka'i, and West Maui (Palmer 2003: 229; USF&WS 1997). Its occurrence on Moloka'i is documented by a single collection from the Oloku'i plateau made in September 1912 by C.N. Forbes. No data regarding its abundance or rarity is on the collection label, but Forbes's field notes (at BISH) may contain more details. A recent assessment of Hawaiian vascular plants considered *Pteris lidgatei* extinct on Moloka'i (Wagner *et al.* 1999b: 58). Only three locations have been documented from Maui in the past two decades, with a total of 27 plants, but one was probably destroyed in a recent landslide. On O'ahu six populations are known (J.Q.C. Lau, pers. comm.). The Moloka'i population

cited here is comprised of six reproductive sporophytes, plus two young plants; gametophytes were not searched for, and viable spores were not available for propagation and restoration. The small population size is consistent with most historic and current observations of this species. Since its discovery by Hillebrand in the mid-1800s, this species has always been considered rare with collections lacking for decades on O'ahu (Wagner 1949: 448), and well over a century on Maui.

Material examined. **MOLOKA'I:** slopes of Oloku'i, bank of stream above Wai'ehu, 915 m (3000 ft), Sep 1912, *Forbes 556Mo* (BISH, 2 sheets); Kumu'eli Gulch, W bank of stream near waterfall, 1.5–7.0 m above streambed on mossy vertical wall along overflow channel, 1030 m, 22 Feb 2007, *Oppenheimer, Perlman & Tangalin H20721*.

***Pteris vittata* L.**

New island record

Naturalized in Hawai'i since at least 1887 and now known from Kaua'i, O'ahu, Lāna'i, Maui, and Hawai'i (Palmer 2003: 229–230; Oppenheimer 2004: 17), this weedy fern is documented here from Moloka'i. Spores are easily wind dispersed, with plants commonly observed on rock walls, cliffs, and road cuts.

Material examined. **MOLOKA'I:** Kalaupapa, W end of peninsula, N bank of Waihānau Stream, nursery weed, 10 m, 30 June 2007, *Oppenheimer & B. Garnett H60728*.

Rubiaceae

***Sherardia arvensis* L.**

New island record

These small annual herbs are naturalized on East Maui and Hawai'i in dry, open, disturbed sites (Wagner *et al.* 1999a: 1171). The following collection was made on Moloka'i in wet, shady forest; all plants observed were removed.

Material examined. **MOLOKA'I:** Kawela, Pu'u Kolekole Cabin, naturalized sprawling herbs around cabin in wet forest, 1200 m, 4 Apr 2007, *Oppenheimer, Perlman & Tangalin H30706*.

Rutaceae

***Melicope volcanica* (A. Gray) T.G. Hartley
& B.C. Stone**

New island record

Previously known from Lāna'i, East Maui, and Hawai'i, where it is still common in mesic to wet forests from 610–2060 m elevation (Wagner *et al.* 1999a: 1205–1206), *M. volcanica* has not been previously reported from Moloka'i.

Material examined. **MOLOKA'I:** Wailau Valley, Kukuinui Ridge, 841 m, 18 Sep 1997, *Oppenheimer 239* (PTBG).

Santalaceae

Santalum freycinetianum* Gaud. var. *freycinetianum **New island record**

Three varieties of *S. freycinetianum* are currently recognized, with the nominate taxon occurring on O'ahu and Moloka'i (Wagner *et al.* 1999a: 1221). The following collection documents it from West Maui, where the Endangered *S. f.* var. *lanaiense* Rock also occurs. The distribution of the latter is restricted to the leeward, drier, southern half of the West Maui massif, with the typical variety occurring in the northwestern quadrant. Genetic analysis of the *S. freycinetianum*-*S. haleakalae* complex by Danica Harbaugh at Smithsonian Institution is in progress and preliminary results support this distribution pattern. More study is needed to assess the extent and overlap, if any, of each of these taxa.

Material examined. **MAUI:** West Maui, Lāhaina Dist, Honokōwai, Haenanui Gulch, 890 m, 29 Aug 2006, *Oppenheimer H80640*.

Urticaceae***Neraudia melastomifolia*** Gaud.**Notable rediscovery**

A member of a genus of five species endemic to Hawai'i, *N. melastomifolia* is known from Kaua'i, O'ahu, Moloka'i, and West Maui (Wagner *et al.* 1999a: 1304). Its occurrence on Moloka'i is documented by a single collection from the Oloku'i plateau made in 1948. In a recent assessment of Hawaiian vascular plants, it was considered extinct on Moloka'i (Wagner *et al.* 1999b: 51), with no other collections or recent observations made.

Material examined. **MOLOKA'I:** Oloku'i, 550 m (1800 ft), 6 Feb 1948, *St. John & R.L. Wilbur 23281* (BISH); Wāwā'ia Gulch, rare, single 3m tall shrub on steep slope, W side of large waterfall, 1000 m, 23 Feb 2007, *Oppenheimer, Perlman & Tangalin H20724*.

Zingiberaceae***Alpinia zerumbet*** (Pers.) B.L. Burtt
& R.M. Sm.**New island record**

A popular, widely cultivated ornamental, shell ginger was recently reported to be naturalized on Kaua'i (Flynn & Lorence 2002: 16). The collector's notes indicate the voucher specimen cited was made in lowland secondary forest composed of mainly naturalized tree species near sea level. The following vouchers document this species outside of cultivation on West Maui, and were collected in areas dominated by native vegetation. Although not yet widespread, this is a serious weed where it occurs, forming dense monotypic thickets like other naturalized species in this family. Its use as an ornamental should be strongly discouraged, and removal of cultivated plants should also be considered if they occur near suitable habitats in natural areas. Its dispersal mechanism is unknown, but Staples *et al.* (2000: 31) listed other *Alpinia* species as vegetatively propagating or possibly bird dispersed. Both methods are likely in this case since plants were observed growing on seemingly inaccessible ledges. Aquatic dispersal is also apparently occurring along streams.

Material examined. **MAUI:** West Maui, Lāhaina Dist, Pu'uki, Ke'ali'i Gulch, 732 m, 14 Mar 2007, *Oppenheimer H30709*; Kahoma Stream, locally common, forming thickets on stream banks, shady slopes, and open sunny ledges, 658 m, 19 Jun 2007, *Oppenheimer H60718*.

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Literature Cited

Degener, O. & Degener, I. 1962. *Flora Hawaiiensis*. Family 48. *Scleria testacea*. Privately published. 2 pp.

- Flynn, T., & Lorence, D.H.** 2002. Additions to the flora of the Hawaiian Islands. *Bishop Museum Occasional Papers* **69**: 14–16.
- Herbst, D.R. & Clayton, W.D.** 1998. Notes on the grasses of Hawai'i: new records, corrections, and name changes. *Bishop Museum Occasional Papers* **55**: 17–38.
- , **Staples, G.W. & Imada, C.T.** 2004. New Hawaiian plant records for 2002–2003. *Bishop Museum Occasional Papers* **78**: 3–12.
- , & **Wagner, W.L.** 1999. Contributions to the flora of Hawai'i. *Bishop Museum Occasional Papers* **58**: 12–36.
- Hillebrand, W.** 1888. *Flora of the Hawaiian Islands*. 1965 Hafner reprint, New York. 673 pp.
- Hughes, G.D.** 1995. New Hawaiian plant records. II. *Bishop Museum Occasional Papers* **42**: 1–10.
- Imada, C.** 2007. New Hawaiian plant records for 2005–2006. *Bishop Museum Occasional Papers* **96**: 34–41.
- , **Staples, G.W. & Herbst, D.R.** 2000. New Hawaiian plant records for 1999. *Bishop Museum Occasional Papers* **63**: 9–16.
- Koyama, T.** 1983. Cyperaceae. In: Dassanayake, M.D. (ed.), *A revised handbook to the flora of Ceylon*. Vol. V. Amerind Publishing Co., New Delhi. 476 pp.
- Lammers, T.G.** 2004. Five new species of the endemic Hawaiian genus *Cyanea* (Campanulaceae: Lobelioideae). *Novon* **14**: 84–101.
- Little, E.L. & Skolmen, R.G.** 1989. Common forest trees of Hawaii (native and introduced). *U.S. Department of Agriculture, Forest Service Handbook* 679, 321 pp.
- Lorence, D. & Flynn, T.** 1997. New naturalized plant records from Kaua'i. *Bishop Museum Occasional Papers* **49**: 9–13.
- , & **Flynn, T.** 1999. New naturalized plant records for the Hawaiian Islands. *Bishop Museum Occasional Papers* **59**: 3–6.
- , & **Flynn, T.** 2002. Additions to the flora of the Hawaiian Islands. *Bishop Museum Occasional Papers* **69**: 14–15
- , & **Flynn, T.** 2006. New naturalized plant records for Kaua'i and Hawai'i. *Bishop Museum Occasional Papers* **88**: 1–5.
- , **Flynn, T. & Wagner, W.L.** 1995. Contributions to the flora of Hawai'i. III. *Bishop Museum Occasional Papers* **41**: 19–58.
- Nagata, K.M.** 1995. New Hawaiian plant records. IV. *Bishop Museum Occasional Papers* **42**: 10–13.
- Neal, M.C.** 1965. *In gardens of Hawaii*. Bishop Museum Press, Honolulu. 924 pp.
- Oppenheimer, H.L.** 2002. The spread of gymnosperms on Maui: a neglected element of the modern Hawaiian flora. *Bishop Museum Occasional Papers* **68**: 19–23.
- . 2003. New plant records from Maui and Hawai'i counties. *Bishop Museum Occasional Papers* **73**: 3–30.
- . 2004. New Hawaiian plant records for 2003. *Bishop Museum Occasional Papers* **79**: 8–20.
- . 2006. New Hawaiian plant records for 2004. *Bishop Museum Occasional Papers* **88**: 10–15.
- . 2007. New plants records from Moloka'i, Lāna'i, Maui, and Hawai'i for 2006. *Bishop Museum Occasional Papers* **96**: 17–34.
- , & **Bartlett, R.T.** 2000. New plant records from Maui, O'ahu, and Hawai'i Islands. *Bishop Museum Occasional Papers* **64**: 1–10.
- , & **Bartlett, R.T.** 2002. New plant records from the main Hawaiian Islands.

- Bishop Museum Occasional Papers* **69**: 1–14.
- ., **Meidell, J.S. & Bartlett, R.T.** 1999. New plant records for Maui and Molokai. *Bishop Museum Occasional Papers* **59**: 7–11.
- Palmer, D.D.** 2003. *Hawai'i's ferns and fern allies*. University of Hawai'i Press, Honolulu, 324 pp.
- Pavlick, L.E. & Anderton, L.K.** 2007. *Bromus* L., pp. 193–237. In: *Flora of North America* Vol. 24, Magnoliophyta: Commelinidae (in part): Poaceae, Part 1. M. E. Barkworth, K.M. Capels, S. Long, L.K. Anderton, M.B. Piep (eds). Oxford University Press, Oxford and New York.
- Richardson, D.M. & Rejmánek, M.** 2004. Conifers as invasive aliens: a global survey and predictive framework. *Diversity and Distributions*. Blackwell Publishing Ltd.
- Staples, G.W. & Herbst, D.R.** 2005. *A tropical garden flora*. Bishop Museum Press, Honolulu, 908 pp.
- ., **Herbst, D.R. & Imada, C.T.** 2006. New Hawaiian plant records for 2004. *Bishop Museum Occasional Papers* **88**: 6–9.
- ., **Herbst, D.R. & Imada, C.T.** 2000. Survey of invasive or potentially invasive cultivated plants in Hawai'i. *Bishop Museum Occasional Papers* **65**: 1–35.
- ., **Imada, C.T. & Herbst, D.R.** 2003. New Hawaiian plant records for 2001. *Bishop Museum Occasional Papers* **74**: 7–21.
- Starr, F., K. Martz, & L.L. Loope.** 2002. New plant records for the Hawaiian Archipelago. *Bishop Museum Occasional Papers* **69**: 16–27.
- ., **Starr, K. & Loope, L.L.** 2003. New plant records from the Hawaiian Archipelago. *Bishop Museum Occasional Papers* **74**: 23–34.
- ., **Starr, K. & Loope, L.L.** 2004. New plant records from the Hawaiian Archipelago. *Bishop Museum Occasional Papers* **79**: 20–30.
- ., **Starr, K. & Loope, L.L.** 2006. New plant records from the Hawaiian Archipelago. *Bishop Museum Occasional Papers* **87**: 31–43.
- U.S. Fish and Wildlife Service.** 1997. *Technical/Agency draft recovery plan for four species of Hawaiian ferns*. U.S. Dep. of the Interior, Portland, Oregon, 81 pp.
- Wagner, W.H.** 1949. A reinterpretation of *Schizostege lidgatei* (Baker) Hillebrand. *Bulletin of the Torrey Botanical Club* **79**(6): 444–461.
- . 1993. New species of Hawaiian pteridophytes. *Contributions from the University of Michigan Herbarium* **19**: 63–82.
- ., **Wagner, F.S., Palmer, D.D. & Hobdy, R.W.** 1999. Taxonomic notes on the pteridophytes of Hawai'i - II. *Contributions from the University of Michigan Herbarium* **22**: 135–187.
- Wagner, W.L., Bruegmann, M.M., Herbst, D.R. & Lau, J.Q.C.** 1999b. Hawaiian vascular plants at Risk: 1999. *Bishop Museum Occasional Papers* **60**: 1–58.
- ., **& Herbst, D.R.** 1995. Contributions to the flora of Hawai'i. VI. *Bishop Museum Occasional Papers* **42**: 13–27.
- ., **Herbst, D.R. & Sohmer, S.H.** 1999a. *Manual of the flowering plants of Hawai'i*. Rev. ed. 2 vols. University of Hawai'i Press & Bishop Museum Press, Honolulu, 1919 pp.
- ., **Shannon, R. & Herbst, D.R.** 1997. Contributions to the flora of Hawai'i. VI. *Bishop Museum Occasional Papers* **48**: 51–65.
- Whistler, W.A.** 1995. *Wayside plants of the islands*. Isle Botanica, Honolulu, 202 pp.
- Wood, K.R.** 2006. New plant records and rediscoveries within the Hawaiian Islands. *Bishop Museum Occasional Papers* **88**: 15–19.

- . & LeGrande, M. 2006. An annotated checklist and new island records of flowering plants from Lehua Islet, Ni'ihau, Hawai'i. *Bishop Museum Occasional Papers* **87**: 19–29.
- Wysong, M., Hughes, G. & Wood, K.R. 2007. New Hawaiian plant records for the island of Moloka'i. *Bishop Museum Occasional Papers* **96**: 1–8.

Notes on grasses (Poaceae) in Hawai'i

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Recent collecting in Hawai'i and curatorial activities involving grasses in the *Herbarium Pacificum* (BISH) have revealed three new naturalized state and five new island records, and one nonpersisting waif identified to species for the first time seventy years after its collection. Taxonomic and nomenclatural notes are indicated for some previously reported taxa. All identifications were made by the author; supporting voucher specimens are all deposited at BISH.

Agrostis exarata Trin. var. *monolepis*

(Torr.) Hitchc.

Taxonomic note

This infraspecific taxon and several others attributed to *A. exarata* are no longer recognized by many recent publications (e.g., Soreng. & Peterson 2003; Harvey 2007a). As such, BISH is no longer recognizing *A. exarata* var. *monolepis* (Torr.) Hitchc. but rather a single polymorphic species.

Bothriochloa bladonii (Retz.) S.T. Blake

New island record

This is a widespread species in Australia and the Pacific. Prior to this record for O'ahu, *B. bladonii* was known from Kaua'i, Moloka'i, Maui, and Hawai'i.

Material examined: O'AHU: Ka'ala Natural Area Reserve, ridge between Kaimuhola and Alaihehe, gulches between access road, 396 m (1300 ft), 11 Feb 2008, *US Army* 79.

Bromus diandrus Roth

Taxonomic note

Herbst and Clayton (1998) discussed the taxonomic disagreement over the status of *Bromus rigidus* Roth at the specific or infraspecific level, and whether that name should be placed in the generic segregate *Anisantha* K. Koch. Preliminary studies provide no cladistic support in favor of segregating *Anisantha* from *Bromus* (Pillay & Hilu 1995; Catalán *et al.* 1997) and few authors presently recognize *Anisantha* (e.g., Weber & Wittman 1992). However, a consensus has emerged that *B. rigidus* should be considered conspecific with *B. diandrus* Roth (Weber & Wittman 1992; Sales 1993; Wilken & Painter 1993; Liang *et al.* 2006; Pavlick & Anderton 2007; Snow 2007; but see Pavlick *et al.* 2003). Simon (1993: 80) maintained these taxa at the subspecific level, but his key to *Bromus* in Australia (where the taxa are nonnative), and studies carried out in their native ranges (Sales 1993), together reflect their (at best) tenuous morphological differences. As such, it seems best to reduce *B. rigidus* to synonymy under *B. diandrus*.

Bromus hordeaceus* L.*Taxonomic note**

The *Herbarium Pacificum* previously has recognized *B. hordeaceus* subsp. *hordeaceus* and *molliformis* (J. Lloyd ex Billot) Maire & Weiller as occurring in Hawai'i. European workers, where the putative taxa are native, have recognized four infraspecific taxa based on characters such as culm height, lemmatal length, lemmatal awn width at base and curvature, and spikelet pubescence (e.g., Smith 1980). However, population-based studies found no evidence of DNA sequence or allozyme differentiation among individuals of the putative *B. hordeaceus* subspecies collected from their native ranges in the eastern Mediterranean, and detected considerable overlap among morphological characters traditionally used to segregate intraspecific taxa (Ainouche *et al.* 1996, 1999). Since little is to be gained by partitioning Hawaiian specimens into infraspecific taxa, BISH now recognizes one polymorphic species.

***Echinochloa esculenta* (A. Braun) H. Scholz** **Nomenclatural change**

This species was known in Hawai'i previously as *E. utilis* Owhi & Yabuno, but recent authors are now including this name in synonymy under *E. esculenta* (e.g., Zuloaga & Morrone 2003).

Eragrostis tenuifolia* (A. Rich.) Steud.*New island record**

In addition to its report here for the first time from Kaua'i, this species was first reported as naturalized in the Hawaiian Islands from O'ahu and Hawai'i (Herbst & Clayton 1998: 28), and later from Maui (Oppenheimer 2004: 15).

Material examined: **KAUAI:** Hanalei Dist, on rolling hills east of Pu'u Ka 'Ele Reservoir, ca 150 m, 27 Sep 2001, *C. Imada 2001-69*.

Glyceria notata* Chevall.*Correction**

Herbst & Wagner (1999: 27) reported *Glyceria fluitans* (L.) R. Br. for Hawai'i based on three specimens housed at US. Unprocessed duplicates of each have been found at BISH. Because Derek Clayton (K) questioned the veracity of those identifications, I re-keyed the BISH specimens based on a key provided by Clayton and confirmed his suspicion that the specimens were *G. notata*. This species still represents the only known member of this genus in Hawai'i. It is native to Eurasia, although it has become widespread elsewhere, possibly because most species in the genus are palatable to livestock.

Material examined: **MAUI:** Haleakalā Crater, west side, altitude 2,000 meters, boggy place, 3 Oct 1916, *A. S. Hitchcock 14996*. **HAWAII:** N. Kohala, Kahua Ranch, in swampy place in forest pasture, rare, local patch, 3700 ft, 9 June 1953, *Hosaka 3694*; same locality (*vide* Herbst & Clayton 1999), 15 Aug 1951, *Hosaka 3696*.

Lachnagrostis filiformis* (G.Forst.) Trin.*Nomenclatural change**

This introduced species has been known previously in Hawai'i as *Agrostis avenacea* J.F. Gmel. (Wagner *et al.* 1999; Imada *et al.* 2000). It has been recognized in *Lachnagrostis* recently in Harvey (2007b).

***Nasella cernua* (Stebbins & Loöve) Barkworth** **Nomenclatural change**

Generic boundaries in the tribe *Stipeae* Dumort. have been in flux for some time. However, recent molecular data based on reasonably comprehensive sampling regimes are upholding many generic splits based initially on morphological data (e.g., Romaschenko

et al. 2007). I here follow the generic treatment of *Stipeae* in Barkworth (2007) for the species known formerly as *Stipa cernua* Stebbins & Löve by placing it in *Nasella*.

***Piptatherum miliaceum* (L.) Coss.**

Nomenclatural change

The reasoning indicated for *Nasella cernua* (see above) regarding generic boundaries in *Stipeae* also applies here for the transfer of *Oryzopsis miliacea* (L.) Benth. & Hook. ex Asch. & Schweinf. into *Piptatherum*.

***Rytidosperma biannulare* (Zotov) Connor**

& Edgar

New state record

This naturalized species native to New Zealand and is reported here for the first time in Hawai'i. It also occurs on Maui. The native range of the species is Australia, but it has been introduced into North America and New Zealand. Among the three species now present in Hawai'i, *Rytidosperma biannulare* has a glabrous sheath, whereas the sheath of *R. pilosa* is pilose. The sheath of *R. semiannulare* is also glabrous, but this species differs from *R. biannulare* by its single row of long hairs arising on the back of the lemma arising just below the base of the central awn (illustration in Sharp & Simon 2002, as *Notodanthonia semiannularis* (Labill.) Zotov), whereas *R. biannulare* has a second row or series of tufts of long hairs below the uppermost row or line of hairs, the latter of which arise approximately at the midpoint of the lemma and decidedly below the base of the central awn.

Material examined: **MOLOKA'I:** 'Ōnini/Kūpā'ia divide, common grass along unpaved 4WD road in mesic shrubland, 21.119204°N, 156.929537°W, 1000 m, 16 May 2005, *H. Oppenheimer et al.* H50635

***Schedonorus arundinaceus* (Schreb.) Dumort.** **Nomenclatural change**

This non-native species has been known widely taxonomically and horticulturally as *Festuca arundinacea* Schreb. (e.g., Wagner *et al.* 1999; Soreng *et al.* 2001), or much less frequently as *Lolium arundinaceum* (Schreb.) Darbysh. (Darbyshire 1993). Systematic work (Soreng & Terrell 1998) indicated the species belongs in *Schedonorus*. A proposal by Soreng *et al.* (2001) to conserve the name *S. arundinaceus* over a competing name, *S. phoenix* (Scop.) Holub (Holub 1998), was approved and is now incorporated into the ICBN Code (McNeill *et al.* 2006). The key character in many keys separating this species from *S. pratensis* (next entry) is the presence of a few hairs—sometimes as few as 1 or 2—on the auricles. Before a decision is made whether auricular hairs are lacking it is important to use high magnification with bright light and check several leaves. A further diagnostic trait of this species is the (normal) presence of prickles or short hairs over much of the lemma (especially the distal portion), whereas *S. pratensis* generally has a smooth lemma or is merely slightly scabrous (bearing short prickles) distally.

***Schedonorus pratensis* (Huds.) P. Beauv.**

New state record, nomenclatural change

Like its congener above, this species was commonly placed in *Festuca* but is now placed in *Schedonorus* by most recent workers. The native range of *S. pratensis* is Eurasia. It formerly was considered good forage and thus is found in many temperate areas.

Material examined: **MAUI:** East Maui, Makawao Dist, Kahakapao, Northing: 2302751.82, Easting: 784493.95, 1280 m (4200 ft), 29 May 2007, *H. Oppenheimer* H50739.

Sporobolus elongatus* R.Br.*New island records**

Previously collected only on Lānaʻi in 1925 (Herbst & Clayton 1998), redeterminations of two *Sporobolus* vouchers held at BISH extend the range of *S. elongatus* to Oʻahu and Hawaiʻi.

Material examined: **OʻAHU:** Honolulu, University of Hawaii campus, in lawn by edge of University Drive, 12 Apr 1956, *B.C. Stone 1243*. **HAWAII:** Captain Cook, Nokukano development site makai of the belt road, common along pasture roads, Nov 1991, *E.J. Funk s.n.* (BISH 614547).

Sporobolus piliferus* (Trin.) Kunth*New island record, correction**

Previously naturalized only on Hawaiʻi (Herbst & Clayton 1998:36), this specimen, incorrectly identified as *P. pyramidalis* (see next entry), extends its presence to Oʻahu..

Material examined: **OʻAHU:** Pouhala Marsh, Waipahu, 21°21.643'N, 158° 0.324'W, growing in mucky, sticky, poorly drained soil, 24 Jan 2005, *L.M. Crago & T. Erickson 2005-028*.

Sporobolus pyramidalis* P. Beauv.*Correction**

Herbst and Clayton (1998: 36) reported this species as a new state record. However, the specimen reported therein (*E. Funk s.n.*, BISH 614547, from the island of Hawaiʻi) has been re-identified as *S. elongatus* R.Br.. There are no confirmed specimens of *S. pyramidalis* in Hawaiʻi.

Additional grass note:

A non-persisting waif of *Eragrostis sessilispica* Buckley collected in 1938 has been identified to species for the first time, seventy years after its collection. It was growing in (or adjacent to) a research plot and has not been collected since in Hawaiʻi. Since the specimen was unknown by the collector it probably was growing as a weed. In a recent treatment of *Eragrostis*, Peterson (2003) indicated the native range of this species as the southern Great Plains of the US mainland into northern Mexico. Its elevational range (0–1220 m), coupled with its apparent preference for sandy soils (Peterson 2003), suggests it could become reestablished in Hawaiʻi. The sessile spikelets on the secondary panicle branches are atypical for *Eragrostis*, which normally has paniculate inflorescences. In contrast, sessile spikelets on secondary panicle branches is typical for *Leptochloa* P. Beauv., under which the specimen had been tentatively identified. The prominent tufts of pilose hairs at the base of each panicle branch is also partially diagnostic for this species.

Material examined: **OʻAHU:** Wahiawa, Poamoho plot, 14 Oct 1938, *R. Lyman s.n.* (BISH 118095).

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Literature Cited

Ainouche, M., Misset, M.T. & Huon, A. 1996. Patterns of genetic differentiation in two annual brome grasses, *Bromus lanceolatus* and *B. hordeaceus* (Poaceae). *Plant Systematics and Evolution* **199**: 65–78.

- , **Bayer, R.J., Gourret, J.P., Defontaine, A. & Misset, M.T.** 1999. The allotetraploid invasive weed *Bromus hordeaceus* L. (Poaceae): genetic diversity, origin and molecular evolution. *Folia Geobotanica* **34**: 405–419.
- Barkworth, M.E.** 2007. *Nasella* (Trin.) E. Desv., pp. 170–177. In: Barkworth, M.E., K.M. Capels, S. Long, L.K. Anderton & M.B. Piep (eds.), *Flora of North America*. Vol. 24: Magnoliophyta: Commelinidae (in part): *Poaceae*, part 1. Oxford University Press, New York. 911 pp.
- Catalán, P., Kellogg, E.A. & Olmstead, R.G.** 1997. Phylogeny of Poaceae subfamily Pooideae based on chloroplast *ndhF* gene sequences. *Molecular Phylogenetics and Evolution* **8**: 150–166.
- Darbyshire, S.J.** 1993. Realignment of *Festuca* subgenus *Schedonorus* with the genus *Lolium* (Poaceae). *Novon* **3**: 239–243.
- Harvey, M.J.** 2007a. *Agrostis* L., pp. 633–662. In: Barkworth, M.E., K.M. Capels, S. Long, L.K. Anderton & M.B. Piep (eds.), *Flora of North America*. Vol. 24: Magnoliophyta: Commelinidae (in part): *Poaceae*, part 1. Oxford University Press, New York. 911 pp.
- . 2007b. *Lachnagrostis* Trin., pp. 694–696. In: Barkworth, M.E., K.M. Capels, S. Long, L.K. Anderton & M.B. Piep (eds.), *Flora of North America*. Vol. 24: Magnoliophyta: Commelinidae (in part): *Poaceae*, part 1. Oxford University Press, New York. 911 pp.
- Herbst, D., & Clayton, W.D.** 1998. Notes on the grasses of Hawai'i: new records, corrections, and name changes. *Bishop Museum Occasional Papers* **55**: 17–38.
- . & **Wagner, W.L.** 1999. Contributions to the flora of Hawai'i, VII. *Bishop Museum Occasional Papers* **58**: 12–36.
- Holub, J.** 1998. Reclassification and new names in vascular plants 1. *Preslia* **70**: 97–122.
- Imada, C.T., Staples, G.W. & Herbst, D.R.** 2000. New Hawaiian plant records for 1999. *Bishop Museum Occasional Papers* **63**: 9–16.
- Liang, L., Guanghua, Z. & Ammann, K.H.** 2006. *Bromus* L., pp. 371–386. In: Zhengyi, W, P.H. Raven & H. Deyuan (eds.), *Flora of China*. Vol. 22. Science Press, Beijing & Missouri Botanical Garden Press, St. Louis. 733 pp.
- McNeill, J., Barrie, F.R., Burdet, H.M., Demoulin, V., Hawksworth, D.L., Harhold, K., Nicolson, D.H., Prado, J., Silva, P.C., Skog, J.E., Wiersema, J.H. & Turland, N.J. (eds.)**. 2006. *International Code of Botanical Nomenclature (Vienna Code)*. A.R.G. Gantner Verlag: Ruggell, Liechtenstein. 568 pp.
- Oppenheimer, H.L.** 2004. New Hawaiian plant records for 2003. *Bishop Museum Occasional Papers* **79**: 8–20.
- Pavlick, L.E., Planchuelo, A.M., Peterson, P.M. & Soreng, R.J.** 2003. *Bromus* L., pp. 154–191. In: Soreng, R.J., P.M. Peterson, G. Davidse, E.J. Judziewicz, F.O. Zuloaga, T.S. Filgueiras & O. Morrone (eds.), *Catalogue of New World Grasses (Poaceae): IV. Subfamily Pooideae. Contributions from the United States National Herbarium* **48**: 1–730.
- . & **Anderton, L.K.** 2007. *Bromus* L., pp. 193–237. In: Barkworth, M.E., K.M. Capels, S. Long, L.K. Anderton & M.B. Piep (eds.), *Flora of North America*, Vol. 24: Magnoliophyta: Commelinidae (in part): *Poaceae*, part 1. Oxford University Press, New York. 911 pp.
- Peterson, P.M.** 2003. *Eragrostis* Wolf, p. 65–105. In: Barkworth, M. E., K. M. Capels, S. Long, & M. B. Piep. (eds.), *Flora of North America*. Vol. 25: Magnoliophyta: Commelinidae (in part): *Poaceae*, part 2. Oxford University Press, New York. 783 pp.

- Pillay, M. & Hilu, K.W.** 1995. Chloroplast-DNA restriction site analysis in the genus *Bromus* (Poaceae). *American Journal of Botany* **82**: 239–249.
- Romaschenko, K., Peterson, P.M., Garcia-Jacas, N., Soreng, R.J. & Alfonso, S.** 2007. A phylogeny of *Stipeae* (Poaceae) based on nuclear DNA (ITS) sequence data. Abstract 2734, BOTANY 2007. Chicago.
- Sales, F.** 1993. Taxonomy and nomenclature of *Bromus* sect. *Genea*. *Edinburgh Journal of Botany* **50**: 1–31.
- Sharp, D. & Simon, B.K.** 2002. *AusGrass. Grasses of Australia*. CD-ROM plus Users Guide. CSIRO Publishing, Collingwood, Victoria.
- Simon, B.K.** 1993. *A Key to Australian Grasses*. Second edition. Queensland Department of Primary Industries, Brisbane.
- Smith, P.M.** 1980. *Bromus* L., pp. 182–189. In: Tutin, T.G., V.H. Heywood, N.A. Burges, D.M. Moore, D.H. Valentine, S.M. Walters & D.A. Webb (eds.), *Flora Europaea. Vol. 5. Alismataceae to Orchidaceae (Monocotyledons)*. Cambridge University Press, Cambridge. 452 pp.
- Snow, N.** 2007. *Checklist of Vascular Plants of the Southern Rocky Mountain Region* (Version 2). 308 pp. Available at: http://www.southernrockiesflora.org/checklist/SRMRChecklist_2007_Version2_Final.pdf
- Soreng, R.J. & Peterson, P.M.** 2003. *Agrostis* L., pp. 42–89. In: Soreng, R.J., P.M. Peterson, G. Davidse, E.J. Judziewicz, F.O. Zuloaga, T.S. Filgueiras & O. Morrone (eds.), *Catalogue of New World Grasses (Poaceae): IV. Subfamily Pooideae. Contributions from the United States National Herbarium* **48**: 1–730.
- . & **Terrell, E.E.** 1998 [1997]. Taxonomic notes on *Schedonorus*, a segregate genus from *Festuca* or *Lolium*, with a new nothogenus, *xSchedolium*, and new combinations. *Phytologia* **83**: 85–88.
- , **Terrell, E.E., Wiersema, J. & Darbyshire, S.J.** 2001. (1488) Proposal to conserve the name *Schedonorus arundinaceus* (Schreb.) Dumort. against *Schedonorus arundinaceus* Roem. & Schult. (Poaceae: Poaeae). *Taxon* **50**: 915–917.
- Wagner, W.L., Herbst, D.R. & Sohmer, S.H.** 1999. *Manual of the flowering plants of Hawai'i*. Rev. ed. 2 vols. University of Hawaii Press, Honolulu. 1918 pp.
- Weber, W.A. & Wittmann, R.A.** 1992. *Catalog of the Colorado flora: a biodiversity baseline*. University Press of Colorado, Niwot, Colorado.
- Wilken, D.H. & Painter, E.L.** 1993. *Bromus*, pp. 1239–1243. In: J. C. Hickman (ed.), *The Jepson manual: higher plants of California*. University of California Press, Berkeley. 1400 pp.
- Zuloaga, F.O. & Morrone, O.** 2003. *Echinochloa* P. Beauv., pp. 215–224. In: Zuloaga, F.O., Morrone, O., Davidse, G., Filgueiras, T.S. Peterson, P.M., Soreng, R.J. & Judziewicz, E. (eds.), *Catalogue of New World Grasses (Poaceae): III. Subfamilies Panicoideae, Aristidoideae, Arundinoideae, and Danthonioideae. Contributions from the United States National Herbarium* **46**: 1–662.

New plant records from the Hawaiian Archipelago

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The following contributions include 10 new records of plants located on the islands of Maui and Moloka'i. The records are comprised of 3 new state records, 3 new naturalized records, 2 new island records, and 2 range extensions. Nine of the records are from Maui and 1 from Moloka'i. All of the records are for nonnatives. Images of most of the material examined can be seen at <http://www.hear.org/starr/>. Voucher specimens are housed in the Bishop Museum's *Herbarium Pacificum* (BISH), Honolulu, Hawai'i.

Boraginaceae

Myosotis azorica H.C. Watson

New naturalized record

Myosotis azorica (Azores forget-me-not) was previously known from a single collection at a park residence within Hawai'i Volcanoes National Park on the island of Hawai'i (BISH 2006) and is now also known from upland East Maui, where it was wild collected in the dark, moist understory of an *Acacia mearnsii* (black wattle) forest in Kula. *Myosotis azorica*, native to the Azores, Canary Islands, and Algeria, is a perennial herb cultivated in beds and borders for its numerous small, attractive, 5-parted flowers, bright blue in color with white centers, in bractless, narrow clusters at stem tips. Some forms may have pink or white flowers. Stems below are prostrate and have white hairs that are bent backward. Stems above rise in height 30–46 cm (12–18 in). Basal leaves are 8–10 cm (3–4 in) long, broadest near rounded tips and tapering into their stems. Stem leaves are alternate, oblong, and stemless. Each flower has a small burlike calyx and a short tubular corolla 0.6 cm (0.25 in) in diameter (Neal 1965). This collection represents a new naturalized record for the state of Hawai'i from the island of Maui.

Material examined: MAUI: East Maui, Kula, Waiakoa Gulch, growing at a biocontrol release site in *Acacia mearnsii* (black wattle) and *Passiflora tarminiana* (banana poka) forest, collected by Mach Fukada, 1219 m (4200 ft), 9 May 2006, Starr, Starr & Fukada 060509-01.

Cupressaceae

Cupressus macrocarpa Gordon

New naturalized record

Cupressus macrocarpa (Monterey cypress), native to a small area in coastal California, is widely cultivated throughout the world as a windbreak or hedge plant and in reforestation (Staples & Herbst 2005). On Maui, *C. macrocarpa* has been observed spreading in upland areas of East Maui near forestry plantings into nearby gulches and pastures. In Hawai'i, *C. macrocarpa* is said to be the most common cypress and is often observed as large trees at old homestead sites (Little & Skolmen 1989). It was also widely used as a forestry tree, with over 200,000 trees planted in forest reserves between 1910 and 1960 (Little & Skolmen 1989). *Cupressus macrocarpa* are medium to large-sized aromatic evergreen trees with small, scalelike leaves. The trunk is straight, to 34 m (110 ft) in height and typically 0.8 m (2.5 ft) in diameter. The crown is conical or spreading in shape. The bark is

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dark gray, rough, thick, and furrowed into flat ridges. The inner bark is light brown with an outer dark brown layer, slightly bitter and resinous. Twigs are slender and 4-angled. Leaves are paired, scalelike, overlapping in 4 rows against twigs, blunt-pointed, 1.5–3 mm (1/16–1/8 in) long, dark green, and without glands. Female (seed-bearing) cones are clustered on short stalks, rounded, 2.5–4 cm (1–1.5 in) in diameter, brownish, maturing in the second year and remaining attached. Cone-scales number 8–14, are shield-shaped, rounded at the edges, with a raised point in the center. Seeds number about 140 per cone, are 5 mm (3/16 in) long, light brown, angled, with several gland-dots and a narrow wing. Male (pollen) cones on same tree are oblong, 3 mm (1/8 in) long, and yellow (Little & Skolmen 1989). This collection represents a new naturalized record for the state of Hawai'i from the island of Maui.

Material examined: **MAUI:** East Maui, Kahakapao Gulch, Haleakala Ranch, spreading in pastures and gulches from plantations, in association with *Pennisetum clandestinum* (kikuyu grass) 1219 m (4000 ft), 18 Aug 2005, *Starr & Starr 050818-01*.

Ericaceae

***Erica lusitanica* Rudolphi**

New state record

Erica lusitanica (Portuguese or Spanish heath), native to southwestern Europe (Weeds Australia 2007), is a garden escape in Australia in lowland grassland, grassy woodland, dry and wet forest, and streamside vegetation of New South Wales, South Australia, Tasmania, and the Australian Capitol Territory, and in California in disturbed open sandy areas of north coastal Humboldt County (Weeds Australia 2007; Jepson Flora Project 1993). According to Richardson & Richardson (2007), in Australia this species is highly invasive and able to completely dominate the shrub canopy of native ecosystems. On Maui, *E. lusitanica*, which looks similar to *Leptecophylla tameiameiae* (pukiawe), was found as scattered plants in Haleakala Ranch pastures below Crater Road, just above a large eucalyptus grove. *Erica lusitanica* is an erect evergreen woody shrub up to 200 cm (79 in) tall. The leaves are crowded in rings of 3 or 4 on brittle, woody stems that are densely covered with simple hairs. The flowers are white to pink in pendulous clusters of 3–4 on the ends of short side branches. The fruit is a capsule about 3 mm (0.1 in) long, containing numerous dustlike seeds that are spread by wind, water, and on the coats of animals. Seeds remain viable in the soil for several years and it is reported that a single plant may produce nine million seeds each year. Fire appears to create suitable conditions for germination and seeding establishment (Weeds Australia 2007). This collection represents a new state record for Hawai'i from the island of Maui.

Material examined: **MAUI:** East Maui, Wai'ale Gulch, Haleakala Ranch, scattered plants in pasture, in association with *Eucalyptus* sp. and *Leptecophylla tameiameiae* (pukiawe), 1767 m (5800 ft), 16 Aug 2005, *Starr & Starr 050816-01*.

Fabaceae

***Leucaena diversifolia* (Schltdl.) Benth.**

New naturalized record

Leucaena diversifolia (upland koa haole, red leucaena) is native from eastern and central Mexico (Veracruz and Puebla) south through Guatemala, Honduras, and into Nicaragua (Bray & Sorensson 1992), where it prefers frost-free, submontane habitats with high cloud cover (Cook *et al.* 2005). This nitrogen-fixing tree has been extensively grown in places such as Hawai'i, Australia, the Caribbean, Africa, and Southeast Asia for agronomic and animal production trials and is commonly used as a forage tree, shade tree for coffee, and

timber tree (Bray & Sorensson 1992; Cook *et al.* 2005). Unlike the more commonly known *L. leucocephala* in Hawai'i, *L. diversifolia* prefers cooler, wetter, and higher elevations ranging from 700–2500 m (2297–8202 ft). *Leucaena diversifolia* was observed on the south slope of East Maui at approximately 792 m (2600 ft), where it was planted in a row next to a strawberry and green onion farm in a pastoral setting on Ulupalakua Ranch. Seedlings and saplings were observed nearby in disturbed soils. This species can be distinguished from *L. leucocephala* by having leaves with a high number of small leaflets and styles that extend past the anther halo (Bray & Sorensson 1992). *Leucaena diversifolia* is a small to medium-sized tree 5–20 m (16–66 ft) tall with an open, spreading crown rising from a single stem 20–50 cm (8–20 in) in diameter. Leaves are bipinnate with 16–24 (occasionally 14–28) pairs of pinnae, each pinna with 48–58 pairs of leaflets 4.5–7.0 mm (0.15–0.30 in) long, linear-oblong in shape, and hairless except at the margins; petioles (pinnular rachis) are covered with white hairs. Petiole gland is highly variable in size and shape. Flower heads vary in color from pale pink to bright pink, or occasionally bright scarlet, and are 11–15 mm (0.4–0.6 in) in diameter, in groups of 1–5, developing in the leaf axils of actively growing, intermediate shoots. Pods are narrowly linear-oblong and flat, 10–13 cm (4–5 in) long, 13–16 mm (0.5–0.6 in) wide. There are 1–6 pods per flower head, each containing 6–20 seeds. Pods are papery in texture, dark brown or reddish brown, and are sometimes lustrous. Pods may be hairless or covered in dense velvety hairs, opening along both sides. Seeds are small, 4.3–5.5 mm (0.17–0.22 in) wide and 2.7–3.4 mm (0.11–0.13 in) long (Cook *et al.* 2005). This collection represents a new naturalized record for the state of Hawai'i from the island of Maui.

Material examined: MAUI: East Maui, 'Ulupalakua, Ulupalakua Ranch, strawberry farm, spreading from plantings into nearby disturbed soils along 4WD road, in association with *Acacia koa* (koa) and *Amaranthus spinosus* (spiny amaranth), 743 m (2600 ft), 25 Sep 2004, Starr & Starr 040925-02.

Geraniaceae

Pelargonium capitatum (L.) L'Hér. ex Aiton **New state record**

Pelargonium capitatum (rose-scented geranium) is native to South Africa, where it grows in coastal dunes and sandy hills from the southwestern Cape to southern Natal (PlantNet 2007; Plants for a Future 2000). It is cultivated for its rose-scented oil used in perfumes, for use in aromatherapy and potpourri, as a remedy for digestive disorders, and as an emollient for skin rashes (Plant for a Future 2000). *Pelargonium capitatum* is naturalized in coastal areas of California and Western Australia (PLANTS 2007; FloraBase 1996). It is also naturalized in Spain, where it is included in a list of plant invaders (Dana *et al.* 2001) and is included in the highest (most dangerous) of the invasive categories. This fragrant shrub is now also known from Maui, where it is naturalized, being found on the walls of Wai'ale Gulch and in many other nearby pastoral locations. *Pelargonium capitatum* is a shrubby perennial to 100 cm (39 in) in height. Stems are villous with non-glandular hairs. Roots are not tuberous. Leaves are alternate or opposite, with ovate to cordate laminae 2–8 cm (0.8–3 in) long and wide, deeply 3–7-lobed, lobes toothed, surfaces villous; petioles are 2–6 cm (0.8–2.4 in) long. Umbels are 7–12-flowered; peduncles are 3–12 cm (1–5 in) long; and pedicels are up to 4 mm (0.16 in) long. Calyx lobes are 5–6 mm (0.2–0.24 in) long, and sepal spurs are 3–4 mm (0.12–0.16 in) long. Petals are about 10 mm (0.39 in) long, pink, with deeper markings on the posterior petals. There are usually 7 fertile stamens. Fruit are about 7 mm (0.28 in) long; with mericarps villous and

about 5 mm (0.2 in) long (PlantNet 2007). This collection represents a new state record for Hawai'i from the island of Maui.

Material examined: **MAUI:** East Maui, Aapueo, Wai'ale Gulch, scattered on gulch wall and in pastures, in association with *Melinis minutiflora* and *Ulex europaeus*, 1341 m (4400 ft), 16 Aug 2005, *Starr, Starr, Bio & Javar 050816-3*; side tributary of Wai'ale Gulch, Haleakala Ranch, wild in this area, in association with *Pennisetum clandestinum* (kikuyu grass), 1341 m (4400 ft), 22 Nov 2005, *Starr & Starr 051122-01*; tributary of Kalialinui Gulch, Haleakala Ranch, wild in this area, in association with *Lantana camara* (lantana) and *Opuntia ficus-indica* (panini), 975 m (3200 ft), 22 Nov 2005, *Starr & Starr 051122-02*.

Malvaceae

***Malvastrum americanum* (L.) Torr.**

New island record

Malvastrum americanum (Indian Valley false mallow) was previously known from coastal O'ahu (Wagner *et al.* 1999), and is now known from the island of Moloka'i, where it was found scattered in the upland sand dunes of Mo'omomi. This collection represents a new island record for the island of Moloka'i.

Material examined: **MOLOKA'I:** Mo'omomi, here and there in the sand dunes, in association with *Prosopis pallida* (kiawe) and *Sporobolus virginicus* ('aki'aki), 182 m (600 ft), 19 May 2005, *Starr, Starr & Naeole 050519-02*.

Onagraceae

***Oenothera biennis* L.**

New state record

Oenothera biennis (common evening primrose) is grown as a wildflower, in herb gardens, and for medicinal purposes. It is believed to be native to parts of Canada and North America and is commonly naturalized in temperate and subtropical areas of the world in disturbed sites, roadsides, and fields. *Oenothera biennis*, previously unknown from Hawai'i, was observed by Patti Welton in June 2005 along Crater Road, on the mauka side of the road near the 1097 m (3600 ft) elevation area. A small patch 5 x 5 m (16 x 16 ft) with about a dozen plants of all size classes was observed. *Oenothera biennis* is a biennial herbaceous forb 3–25 dm (12–98 in) tall. Stems are erect, sometimes branching near the top, and can be covered with hairs. The stem has alternate, lanceolate leaves 2.5–15 cm (1–6 in) long, shallowly toothed with wavy edges. Basal leaves form a rosette, are usually hairy, and are 10–30 cm (4–12 in) long. Flowers have a bright yellow to gold corolla, which are 2–5 cm (5–13 in) wide, and 4 petals (Immel 2003). Flowers are fragrant and last about 1–2 days. The family is so-named because the flowers are partially to fully closed during the day and open in the evening (Immel 2003). This collection represents a new state record for Hawai'i from the island of Maui.

Material examined: **MAUI:** East Maui, Kula, Crater Road, about a dozen plants of all size classes on side of road showing vigorous growth, in association with *Pyracantha* sp. (firethorn) and *Bocconia frutescens* (tree poppy), 1097 m (3600 ft), 15 Jun 2005, *Starr & Starr 050615-01*.

Poaceae

***Ehrharta erecta* Lam.**

Range extension

Ehrharta erecta (panic veldtgrass) was previously collected at 488 m (1600 ft) in the vicinity of Makawao, Maui by R. Hobdy in 1979. This collection was reported as a new state record by Herbst & Clayton (1998). *Ehrharta erecta* has recently been collected near the summit of Haleakalā at 3048 m (10000 ft) elevation, representing a range extension and high elevation record for this species on Maui.

Material examined: **MAUI:** East Maui, summit, Haleakalā National Park, Red Hill, by trail near parking area, scattered plants, in association with the *Argyroxiphium sandwicense* subsp. *macrocephalum* (Haleakalā silversword), 3048 m (10000 ft), 13 Aug 2004, *Starr & Starr 040813-01*.

Rosaceae

Pyracantha angustifolia (Franch.) C.K. Schneid. **New island record**

Pyracantha angustifolia (firethorn) was previously known from Kaua'i (Wagner *et al.* 1999), and is now also known from upland East Maui, where scattered plants were found in pastures above residential Kula. This collection represents a new island record for the island of Maui.

Material examined: **MAUI:** East Maui, Kula, Keāhuaiwi Gulch, scattered plants in pasture, in association with *Pennisetum clandestinum* (kikuyu grass), *Senecio madagascariensis* (fireweed), and *Cotoneaster pannosus* (cotoneaster), 1219 m (4000 ft), 17 Aug 2005, *Starr; Starr; Chimera & Spencer 050817-01*.

Sapindaceae

Koelreuteria elegans (Seem.) A.C. Sm.

subsp. *formosana* (Hayata) F.G. Meyers **Range extension**

Koelreuteria elegans subsp. *formosana* (golden rain tree) was previously known from West Maui (Oppenheimer 2003), and is now also known from East Maui, where it has begun spreading from planted trees in multiple areas around the town of Makawao. This collection represents a range extension to East Maui.

Material examined: **MAUI:** East Maui, Makawao, Baldwin Ave, spreading from parent trees into nearby scrub and pineapple fields, in association with *Panicum maximum* (Guinea grass), 484 m [1590 ft], 14 Aug 2006, *Starr & Starr 060814-01*; Makawao Ave, St. Joseph Church, in scrub near parking lot, coming up under hedges and in lot across street, in association with *Podranea ricasoliana* (podranea), *Schefflera arboricola* (miniature octopus tree), and *Passiflora suberosa* (huehue haole), 487 m [1600 ft], 14 Aug 2006, *Starr & Starr 060814-03*.

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Literature Cited

- Bishop Museum (BISH).** 2006. Online herbarium. Bishop Museum, Honolulu. Available at: <http://www2.bishopmuseum.org/natscidb/> (Accessed: 1 August 2007).
- Bray, R.A. & Sorensson, C.T.** 1992. *Leucaena diversifolia* - fast growing highland NFT species. NFT Highlights, NFTA Factsheet 92-05. Forest, Farm, and Community Tree Network (FACT Net). Available at: <http://www.winrock.org> (Accessed: 15 February 2006).
- Cook, B.G., Pengelly, B.C., Brown, S.D., Donnelly, J.L., Eagles, D.A., Franco, M.A., Hanson, J., Mullen, B.F., Partridge, I.J., Peters, M. & Shultze-Kraft, R.** 2005. Tropical forages: an interactive selection tool. CSIRO, DPI & F (Qld) CIAT and ILRI, Brisbane, Australia. Available at: <http://www.tropicalforages.info> (Accessed: 15 February 2006).

- Dana, E.D., Cerrillo, M.I., Sanz-Elorza, M., Sobrino, E. & Mota, J.F.** 2001. Contribución al conocimiento de las xenófitas en España: catálogo provisional de la flora alóctona de Almería. *Acta Botanica Malacitana* **26**: 264-276. Available at: <http://www.ual.es/personal/edana/alienplants/checklist.pdf> (Accessed: 2 August 2007).
- FloraBase.** 1996. The western Australia flora: *Pelargonium capitatum*. Department of Environment and Conservation, Western Australia and Western Australian Herbarium. Available at: <http://florabase.calm.wa.gov.au/browse/flora?f=167&level=s&id=4343> (Accessed: 2 August 2007).
- Herbst, D.R. & Clayton, W.D.** 1998. Notes on grasses of Hawai'i: new records, corrections, and name changes. *Bishop Museum Occasional Papers* **57**(1): 17–38.
- Immel, D.L.** 2003. Plant guide: *Oenothera biennis*. USDA, NRCS, National Plant Data Center, University of California, Davis, CA. Available at: <http://www.plants.usda.gov> (Accessed: 17 February 2006).
- Jepson Flora Project.** 1993. Ericaceae: *Erica lusitanica*. Regents of the University of California. Available at: http://ucjeps.berkeley.edu/cgi-bin/get_JM_treatment.pl?3449,3559,3560 (Accessed: 2 August 2007).
- Little, E.L. & Skolmen, R.G.** 1989. *Common forest trees of Hawaii*. Agriculture Handbook No. 679. United States Department of Agriculture, Washington, D.C. 321 pp.
- Neal, M.C.** 1965. *In gardens of Hawaii*. Bishop Museum Press, Honolulu. 924 pp.
- Oppenheimer, H.L.** 2003. New plant records from Maui and Hawaii counties. *Bishop Museum Occasional Papers* **73**(1): 3–30.
- PlantNet.** 2007. New South Wales flora online. National Herbarium of New South Wales and Royal Botanic Gardens & Domain Trust, Sydney Australia. Available at: <http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Pelargonium~capitatum> (Accessed: 2 August 2007).
- Plants for a Future.** 2000. Species database. Available at: http://www.ibiblio.org/pfaff/cgi-bin/arr_html?Pelargonium+capitatum (Accessed: 2 August 2007).
- PLANTS (National Plants Database).** 2007. Online database. United States Department of Agriculture, Natural Resources Conservation Services, National Plant Data Center, Baton Rouge, LA. Available at: <http://plants.usda.gov> (Accessed: 2 August 2007).
- Richardson, R.G. & Richardson, F.J.** 2007. WI (Weed Information). Plant Protection Quarterly, Australia. Available at: http://weedinfo.com.au/wd_erlus.html (Accessed: 2 August 2007).
- Staples, G.W. & Herbst, D.R.** 2005. *A tropical garden flora*. Bishop Museum Press, Honolulu.
- Starr, F., Martz, K. & Loope, L.L.** 2002. New plant records for the Hawaiian archipelago. *Bishop Museum Occasional Papers* **69**(2): 16–27.
- , **Martz, K. & Loope, L.L.** 2003. New plant records for the Hawaiian archipelago. *Bishop Museum Occasional Papers* **74**(2): 23–34.
- Wagner, W.L., Herbst, D.R. & Sohmer, S.H.** 1999. *Manual of flowering plants of Hawai'i*. 2 vols. Rev. ed. University of Hawai'i Press & Bishop Museum Press, Honolulu.
- Weeds Australia.** 2007. Weed identification. Spanish heath (*Erica lusitanica*). National Weeds Strategy, Australian Weeds Committee. Available at: <http://www.weeds.org.au/cgi-bin/weedident.cgi?tpl=plant.tpl&ibra=all&card=E43> (Accessed: 2 August 2007).

The land snails of the island of Lehua, Hawaiian Islands

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The crescent shaped island of Lehua (1.1 km²) lies just over 1 km north of the northernmost point of Ni'ihau. It is a tuff-cone crater that formed during a volcanic rejuvenation period that followed the formation of the 5-My old Ni'ihau shield volcano. Its highest point (N22°01'90.2", W160°09'80.9") is 213 m. The climate is extremely dry. Vegetation is sparse and dominated by nonnative grasses, herbs and shrubs (Wood & LeGrande 2006).

The land snail fauna of Lehua has never been reported and there were until now no collections at the Bishop Museum. Not surprisingly, given the small size of Lehua, which probably limits the possibility of evolutionary radiation, none of the species here recorded is endemic to the island. In fact, three of the four species are widespread across the Hawaiian Islands (*Lamellidea gracilis*, *Tornatellides procerulus*, *Succinea caduca*), while the fourth (*Lyropupa perlonga*) is represented by the nominotypical subspecies on O'ahu and the present subspecies on Kaua'i and Ni'ihau (Cowie *et al.* 1995). However, with the exception of *L. gracilis*, which is also known from Wake (Cowie *et al.* 1995), all are endemic to the Hawaiian Islands.

Collections were made by the authors on 12 September 2007 by collecting leaf litter and surface soil from a dry gulch on the south side of the island and sifting material back at the camp. The site was 200 m east of Lehua Camp, 15 m elevation, and the vegetation was dominated by nonnative species including *Cenchrus ciliaris*, *C. echinatus*, *Setaria verticillata*, *Ageratum conyzoides*, *Chenopodium murale*, *Portulaca oleracea*, *Pluchea indica*, *P. carolinensis* and *P. x fosbergii*. Nearby native plant species included *Jacquemontia ovalifolia*, *Waltheria indica* and *Cyperus javanicus*. Snail identifications were made by comparison with type and other material in the Bishop Museum (BPBM) Malacology collection, where all the collected material is deposited. Catalog numbers are BPBM Malacology Collection numbers. Latitude and longitude coordinates were recorded by GPS using the WGS 84 map datum.

Achatinellidae

Lamellidea gracilis (Pease)

New island record

This species was described by Pease (1871) from Kaua'i (no further details). It has since been recorded from all the other main Hawaiian Islands (Ni'ihau, O'ahu, Moloka'i, Lāna'i, Maui and Hawai'i), from the Northwestern Hawaiian Islands of Kure, Laysan, Lisianski and Nihoa, and from Wake (Cowie *et al.* 1995).

Material examined: LEHUA: leaf litter and surface soil in dry gulch, (N22°01'55.1", W160°09'54.9"), R.H. Cowie, K.R. Wood, 12 Sep 2007 (271961, 3 dead shells).

Tornatellides procerulus (Ancey)

New island record

Ancey (1904) described this species from Maui. Cowie *et al.* (1995) listed it in addition

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from Ni'ihau, Kaua'i, O'ahu, Moloka'i, Lāna'i and Hawai'i.

Material examined: LEHUA: leaf litter and surface soil in dry gulch, (N22°01'55.1", W160°09'54.9"), R.H. Cowie, K.R. Wood, 12 Sep 2007 (271962, 5 dead shells).

Succineidae

Succinea caduca Mighels

New island record

Described from O'ahu (Mighels 1845), *Succinea caduca* was also listed from Moloka'i and Lāna'i by Cowie *et al.* (1995) and subsequently from Kaua'i, Maui and Hawai'i by Holland & Cowie (2007, 2008).

Material examined: LEHUA: leaf litter and surface soil in dry gulch, (N22°01'55.1", W160°09'54.9"), R.H. Cowie, K.R. Wood, 12 Sep 2007 (271963, 1 dead shell).

Pupillidae

Lyropupa (Mirapupa) perlonga filocostata (Cooke & Pilsbry) New island record

The nominotypical subspecies was described by Pease (1871) from O'ahu. The present subspecies was described from Limahuli on Kaua'i by Cooke & Pilsbry in Pilsbry & Cooke (1920). Cowie *et al.* (1995) also listed it from Ni'ihau (misspelled as "*filicostata*").

Material examined: LEHUA: leaf litter and surface soil in dry gulch, (N22°01'55.1", W160°09'54.9"), R.H. Cowie, K.R. Wood, 12 Sep 2007 (271964, 2 dead shells).

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Literature Cited

- Ancey, C.F. [1904]. Études sur la faune malacologique des Iles Sandwich. *Journal de Conchyliologie* **51**(4): 295–307, pl. 12. [Incorrect date given by Cowie *et al.* (1995). This is the last issue for 1903, published 28 April 1904; see back wrapper of volume 52, issue 1].
- Cowie, R.H., Evenhuis, N.L. & Christensen, C.C. 1995. *Catalog of the native land and freshwater molluscs of the Hawaiian Islands*. Backhuys Publishers, Leiden. vi + 248 pp.
- Holland, B.S. & Cowie, R.H. 2006. New island records of an endemic Hawaiian land snail species, *Succinea caduca* Mighels (Gastropoda: Pulmonata: Succineidae). *Bishop Museum Occasional Papers* **88**: 58–60.
- . & Cowie, R.H. 2007. A geographic mosaic of passive dispersal: population structure in the endemic Hawaiian amber snail *Succinea caduca* (Mighels, 1845). *Molecular Ecology* **16**: 2422–2435.
- Mighels, J.W. 1845. Descriptions of shells from the Sandwich Islands, and other localities. *Proceedings of the Boston Society of Natural History* **2**: 18–25.
- Pease W.H. 1871. Catalogue of the land-shells inhabiting Polynesia, with remarks on their synonymy, distribution, and variation, and descriptions of new genera and species. *Proceedings of the Zoological Society of London* **1871**: 449–477.
- Pilsbry, H.A. & Cooke, C.M., Jr. 1920 [1918–1920]. *Manual of Conchology. Second*

series: *Pulmonata*. Vol. XXV. Pupillidae (Gastrocoptinae, Vertigininae). Academy of Natural Sciences, Philadelphia. ix + 401 p., 34 pls.

Wood, K.R. & LeGrande, M. 2006. An annotated checklist and new island records of flowering plants from Lehua Islet, Ni'ihau, Hawai'i. *Bishop Museum Occasional Papers* 87: 19–29.

The hermit crab *Calcinus isabellae* Poupin (Crustacea: Decapoda: Anomura: Diogenidae), a new record for the Hawaiian Archipelago, including a review of the genus *Calcinus* Dana in Hawai'i

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The diogenid hermit crabs of the genus *Calcinus* are widespread in tropical and subtropical areas. They are common in littoral zones and shallow coral reef habitats, and can be facultatively associated with some corals (e.g., *Pocillopora* & *Acropora*). Forty-two species are now identified, most of which were described during the last 20 years from the Indo-West Pacific (Haig & McLaughlin, 1984; Wooster, 1984; Morgan, 1991; Gherardi & McLaughlin, 1994; Poupin, 1997; Poupin & McLaughlin, 1998; Asakura & Tachikawa, 2000). This increasing number of species is a result of a better attention paid to color patterns of live and recently preserved specimens. The rapid loss of coloration in preservatives does not allow this characteristic to be used when examining museum material.

A comprehensive examination of the genus *Calcinus* from the main Hawaiian Islands was published by Haig & McLaughlin (1984). This taxonomic treatment of these shallow water hermit crabs provided the description of two new species. One of these new species was *Calcinus hazletti*, which was only known from Hawaii at that time. This species has subsequently been described from the Ogasawara (Bonin) Islands of Japan (Asakura & Tachikawa, 2003). The other *Calcinus* species described was *Calcinus laurentae*, which remains classified as an endemic to the Hawaiian Archipelago. Haig & McLaughlin (1984) recorded another seven species: [*Calcinus laevimanus* Randall, *Calcinus seurati* Forest, *Calcinus gaimardii* (Milne Edwards), *Calcinus elegans* (Milne Edwards), *Calcinus latens* Randall, *Calcinus haigae* Wooster and *Calcinus guamensis* Wooster]. Additionally, *Calcinus argus* Wooster is also present in the Hawaiian Archipelago and was recorded by Titgen (1987).

Unpublished reports have mentioned two new records of *Calcinus* from the Hawaiian Archipelago, *Calcinus isabellae* Poupin and *Calcinus revii* Poupin & McLaughlin. The presence of *C. revii* is tentative but the presence of *C. isabellae* has now been verified from material collected from the Main Hawaiian Islands and the Northwestern Hawaiian Islands.

Diogenidae***Calcinus isabellae*** Poupin**New state record**

Hermit crabs from the genus *Calcinus* were collected in support of studies focused on the phylogeography and biodiversity of coral reef macroinvertebrates within the Hawaiian Archipelago. Collections were conducted in both the Northwestern Hawaiian Islands and the Main Hawaiian Islands in 2006 by the Hawaii Institute of Marine Biology (HIMB) and by the National Oceanic and Atmospheric Administration, Pacific Island Fisheries Science Center, Coral Reef Ecosystem Division under the auspices of the Census of Coral Reefs (CReefs), which is a program designated under the Census of Marine Life.

Calcinus isabellae was collected during HIMB phylogeographic studies within the Main Hawaiian Islands on the island of Hawaii at Puako in March 2006 and at French Frigate Shoals in the Northwestern Hawaiian Islands in May 2006. A single specimen of *C. isabellae* was collected during the CReefs effort in October 2006.

This new record belongs to the group of *Calcinus* that are differentiated from their congeners by a dense brush of setae located on the dactyls and propodi of the third pereopods (Asakura, 2002). Three other *Calcinus* identified from the Hawaiian Archipelago (*C. elegans*, *C. argus*, and *C. gaimardii*) also possess this trait. *Calcinus isabellae* differs noticeably from the other *Calcinus* species of the Hawaiian Archipelago in the live coloration of the second and third pereopods and morphology of the chelipeds. The proximal one third of the propodi and carpi of the second and third pereopods have a red band that is adjoined to a black band located centrally on both segments. Black bands are also located centrally on the dactyls and meri of the second and third pereopods but with no adjoining red band; while the remaining area of all segments is cream white. The chelipeds are olive brown proximally with scattered white tubercles and spines, and the distal portion and both fingers are white. The outer face of the left cheliped has a large medial groove, and the palm is not convex. This is a definitive character for the left cheliped, as the other *Calcinus* in the Hawaiian Archipelago with the brush of setae have a convex palm and no medial groove. Additionally, there are characteristic conical protuberances associated with the fixed finger, dactyl and palm of the left cheliped.

Material examined: **FRENCH FRIGATE SHOALS:** FFS-FR5_2, forereef rubble CReefs, coll. G. Paulay, Oct 2006, female (BPBM-S13246, Marine Invertebrate Collections). **HAWAII:** Puako, forereef, HIMB Phylogeography, coll. I. Baum, Mar 2006, male (06-2542, HIMB Marine Invertebrate Collections).

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Literature Cited

- Asakura, A. 2002. Hermit crabs of the genus *Calcinus* Dana, 1851 (Crustacea: Decapoda: Anomura: Diogenidae) with a brush of setae on the third pereopods, from Japanese and adjacent waters. *Tropical Zoology* 15: 27–70.
- . & Tachikawa, H. 2000. A new hermit crab of the genus *Calcinus* from Micronesia, including new information on *C. revii* (Decapoda: Anomura: Diogenidae).

- Journal of Crustacean Biology* **20** (Special number 2): 266–280.
- Forest, J.** 1951. Remarques sur quelques Paguridae du genre *Calcinus* à propos de la description de deux espèces nouvelles de Polynésie Orientale: *Calcinus seurati* et *Calcinus spicatus*. *Extrait du Bulletin de la Société Zoologique de France* **76**(1-2): 83–89.
- Gherardi, F. & McLaughlin P.A.** 1994. Shallow water hermit crabs (Crustacea: Decapoda: Anomura: Paguridea) from Mauritius and Rodrigues islands, with a description of a new species of *Calcinus*. *Raffles Bulletin of Zoology* **42**(3): 613–656.
- Haig, J. & McLaughlin, P.A.** 1984. New *Calcinus* species (Decapoda: Anomura: Diogenidae) from Hawai‘i, with a key to the local species. *Micronesica* **19**(1-2): 107–121.
- Milne Edwards, H.** 1836. Observations zoologiques sur les pagures et description d'un genre nouveau de la tribu des Paguriens. *Annales des Sciences Naturelles, Zoologie* (2) **6**: 257–288.
- . 1848. Note sur quelques nouvelles espèces du genre *Pagure*. *Annales des Sciences Naturelles, Zoologie* (3) **10**: 59–64.
- Morgan, G.J.** 1991. The hermit crabs (Decapoda: Anomura: Diogenidae, Paguridae) of southwestern Australia, with description of two new species. *Records of the Western Australian Museum* **14**(3): 391–417.
- Poupin, J.** 1997. Les pagures du genre *Calcinus* en Polynésie française avec le description de trois nouvelles espèces (Crustacea: Decapoda: Diogenidae). *Zoosystema* **19**(4): 683–719.
- . & **McLaughlin, P.A.** 1998. Additional *Calcinus* (Decapoda: Anomura: Diogenidae) from French Polynesia with three new species and a key to Indo-West Pacific species. *Crustacean Research* **27**: 9–27.
- Randall, J.W.** 1840. Catalogue of the crustacea brought by Thomas Nuttall and J.K. Townsend, from the west coast of North America and the Sandwich Islands, with description of such species as are apparently new, among which are included several species of different localities, previously existing in the collection of the Academy. *Journal of the Academy of Natural Sciences of Philadelphia* **8** (1): 106–147.
- Titgen, R.H.** 1987. New decapod records from the Hawaiian Islands (Crustacea: Decapoda). *Pacific Science* **41**(1-4): 141–147.
- Wooster, D.S.** 1984. The genus *Calcinus* (Paguridea: Diogenidae) from the Mariana Islands including three new species. *Micronesica* **18**(2): 121–162.

Erratum and further notes on *Erinna newcombi* (Mollusca: Lymnaeidae) in Hanakoa, Kaua‘i, Hawai‘i

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FIGURE 1. Adult *Erinna newcombi* with young (Hanakoa, Kaua‘i, Hawai‘i).

The front cover photograph and Figure 1 on page 53 of Volume No. 96 (*in* Records of the Hawaii Biological Survey for 2006—Part 2: Notes) represents the Hawaiian endemic *Lymnaea aulacospira* Ancey (Lymnaeidae) and not *Erinna newcombi* Adams & Adams (R.H. Cowie pers. comm. 2008; Hubendick 1952; Boynton & Wood 2007). The correct image representing the Hanakoa, Kaua‘i population of *E. newcombi* is included below (see Figure 1). Further research indicates that there are three separate sub-populations of *E. newcombi* located on the walls of fast-flowing perennial natural spring waterfalls in Hanakoa Valley. Sites range between 250 and 370 m and each site covers approximately 20 m² with densities of 5–7 snails per square meter.

Literature Cited

- Boynton, D. & Wood, K.R.** 2007. *Erinna newcombi* Adams & Adams (Mollusca: Lymnaeidae): a rediscovered population in Hanakoa, Kaua‘i, Hawai‘i. *Bishop Museum Occasional Papers* **96**: 52–54.
- Hubendick, B.** 1952. Hawaiian Lymnaeidae. *Bishop Museum Occasional Papers* **20**: 307–328.

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