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AND
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RECORDS OF THE HAWAII BIOLOGICAL SURVEY FOR 2001–2002 Part 1: Articles

Editors' Preface

We are pleased to present the eighth annual compilation of *Records of the Hawaii Biological Survey*; this year as a double issue combining records for the years 2001 and 2002. 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 inventory the Hawaiian biota accurately.

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 2001–2002* include:

- a detailed update of numbers of species in Hawai'i, the first since our initial *Records for 1994;*
- a complete checklist of monogodont Rotifera from the Hawaiian Islands;
- new nonindigenous species reported from Hawai'i during 2001–2002;
- new records of plants, insects, and other invertebrates resulting from field surveys and continued curation of Hawaiian collections at Bishop Museum and elsewhere.
- a review of the species of the long-legged fly genus *Campsicnemus* from Kaua'i.

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, non-marine snails, marine invertebrates, foraminiferans, fossil taxa, and vertebrates), bibliographic databases (vascular plants, non-marine 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 collec-

tions 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 4,600 authors who have described flies.

Our Main Web Addresses:

Hawaii Biological Survey Home Page
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Hawaii Endangered and Threatened Species Web Site
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The *Records of the Hawaii Biological Survey for 2001–2002* were compiled with the assistance of George Staples (botany) who helped review 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 and Wildlife Service, U.S. Department of Defense Legacy Program, 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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New Plant Records from Maui and Hawai‘i Counties

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The following account documents 15 new state (including naturalized) records, 93 new island records, and 9 significant range extensions for plants in the Hawaiian Islands. Collections were made on the islands of Moloka‘i, Lāna‘i, Maui, and Hawai‘i. Additionally, there is a single report of a nomenclatural change. In all, 105 taxa in 46 families are discussed. Information regarding their previously known distribution is based on the *Manual of flowering plants of Hawai‘i* (Wagner *et al*., 1990, 1999) and subsequent reports published in the *Records of the Hawaii Biological Survey* for 1994-2000 (Evenhuis & Miller, 1995, 1996, 1997, 1998; Evenhuis & Eldredge, 1999, 2000, 2002).

Many of the records presented in this paper involve widespread, weedy taxa. Their occurrence in undocumented locations is easily anticipated, and underscores the need for more thorough collecting efforts.

The greater part of the specimens examined are deposited in the *Herbarium Pacificum* (BISH), Bishop Museum, Honolulu, with duplicates at the National Tropical Botanical Garden (PTBG), Lāwa‘i, Kaua‘i. Any specimen cited under *Materials examined* without an herbarium acronym is at both BISH and PTBG. A few collections are in only one herbarium; the acronyms for these facilities are listed after the specimen cited.

Acanthaceae

Barleria repens Nees **New island records**

Recently reported as escaping cultivation and becoming naturalized on O‘ahu (Staples *et al*., 2002: 3), this species has also started to spread on 2 other islands. It differs from *B. cristata*, the other species of *Barleria* naturalized in Hawai‘i, by its prostrate or sometimes climbing habit, salmon colored corolla, and bracts lacking spines on the margins. Staples et al. (2000: 15) listed *B. repens* as potentially invasive, dispersing mechanically and vegetatively. It frequently volunteers in gardens and waste areas, roots from discarded clippings, and is suspected of being moved as a contaminant of nursery stock.

Material examined: **LĀNA‘I:** Manele, 31–61 m, climbing *Prosopis* & *Gossypium*, 15 Apr 2001, *Oppenheimer H40126*. **MAUI:** West Maui, Lahaina Dist, Honokahua, 110 m, 14 Nov 2000, *Oppenheimer & R. Bartlett H110007*; on stream bank under mango trees, 12 m, 5 Mar 2001, *Oppenheimer H30105* (BISH); volunteers under *Casuarina* at edge of golf course, 24 m, 2 Jun 2001, *Oppenheimer H60103*; Hanaka‘ō‘ō, near sea level, growing in sand w/ *Scaevola*, 23 Mar 2001, *Oppenheimer H30129*; Wailuku Dist, ‘Īao Valley, volunteers on roadside in *Casuarina* needles, 152 m, 15 Jun 2001, *Oppenheimer H60132*; East Maui, Wailuku Dist, Kahului, in landscaped area of *Carissa* and *Phymatosorus*, 6m, 19 May 2001, *Oppenheimer H50116*; Makawao Dist, Makawao, volunteers in yard, Baldwin Ave., 488 m, 6 Jan 2001, *F. Starr & K. Martz 010106-1* (BISH); volunteers in yard, Mahanani Pl., 472 m, 16 May 2001, *F. Starr & K. Martz 010516-1* (BISH).

Dicliptera chinensis (L.) Juss. **New island record**

According to Wagner *et al*. (1990: 171), *D. chinensis* is naturalized in or near urban areas on Kaua‘i and O‘ahu but perhaps more widespread. It was recently reported from the Big

Island (Staples *et al*., 2002: 3). On West Maui, it was collected along the side of a road in a rural area not far from the center of Wailuku.

Material examined: **MAUI:** West Maui, Wailuku Dist, ʻĪao Valley, 146 m, 27 Nov 2000, *Oppenheimer H110037*.

Ruellia brevifolia (Pohl) C. Ezcurra **New island records**

[Syn. *R. graecizans* Backer]

Cultivated as an ornamental and naturalized on Kauaʻi and Oʻahu (Wagner *et al*., 1990: 174), this species is also sparingly naturalized on Molokaʻi & windward East Maui in low elevation, wet, disturbed areas. Wagner *et al*. (1999: 1856) reported the change in name.

Material examined: **MOLOKAʻI:** Hālawa Valley, 60 m, 18 Nov 2001, *Oppenheimer H110143.* **MAUI:** East Maui, Makawao Dist, Makawao, on steep bank on Brewer Rd, 488 m, 28 Jul 2001, *F. Starr & K. Martz 010728-1* (BISH); Hāna Dist, Kīpahulu, spreading from roadside plantings, 67m, 11 Jun 2001, *Oppenheimer H60116;* Kaumahina, spreading from plantings, 91 m, 11 Jun 2001, *Oppenheimer H60126.*

Ruellia prostrata Poir. **New island records**

Known to be naturalized in urban areas of Honolulu, Oʻahu (Wagner *et al*., 1990: 174), this taxon was recently collected on Molokaʻi and West Maui.

Material examined: **MOLOKAʻI:** Waialua, 3m, roadside weed w/*Asystasia*, *Thespesia*, *Terminalia*, and *Paspalum fimbriatum*, 18 Nov 2001, *Oppenheimer H110137*. **MAUI:** West Maui, Lahaina Dist, 3 m**,** Campbell Park, in lawn w/ *Calyptocarpus, Chamaesyce, Erigeron, Eragrostis***,** 13 May 2001, *Oppenheimer H50110*; Lahaina, 12 m, at edge of paved driveway, 31 Dec 2001, *Oppenheimer H120107*.

Thunbergia alata Bojer ex Sims **Range extension**

Black-eyed Susan vine is sparingly naturalized on Kauaʻi, Molokaʻi, East Maui, and Hilo and Volcano, Hawaiʻi (Wagner *et al*., 1990: 175). The following collection represents a significant range extension to West Maui, where it is also sparingly naturalized in the Nāpili and Honokahua areas.

Material examined: **MAUI:** West Maui, Lahaina Dist, Nāpili, in unnamed gulch, 37m, 4 Dec 2000, *Oppenheimer H120002*.

Thunbergia laurifolia Lindl. **New island record**

Documented from Kauaʻi, Oʻahu (Wagner *et al*., 1990: 175), and East Maui (Starr & Loope, 1999: 11), purple allamanda is common and locally abundant at least in the area north of Hilo along the Hamakua coast.

Material examined: **HAWAIʻI:** South Hilo Dist, Pāpaʻikou, along Hwy 19, 49 m, 28 Jul 2001, *Oppenheimer H70130*; road to shore at Hakalau, 24 m, 29 Jul 2001, *Oppenheimer H70136* (BISH).

Aloeaceae

Aloe vera (L.) N. L. Burm. **New island record**

Lorence *et al*. (1995: 21) first documented the naturalized status of this widely cultivated species from Kauaʻi. Subsequently, it was reported from Oʻahu (Herbarium Pacificum Staff, 1999: 3). On West Maui, it was suspected of being naturalized on Maui Pineapple

Co. lands, as some areas of Honolua Plantation were formerly used to grow *Aloe* commercially. This activity ended in the 1950s. It had been observed spreading vegetatively; vouchers from fruiting plants were recently collected.

Material examined: **MAUI:** West Maui, Lahaina Dist, ʻAlaeloa, Kaʻōpala Gulch, 49 m, 19 Jan 2001, *Oppenheimer H10129.*

Amaranthaceae

Amaranthus spinosus L. **New island record**

Previously known from Midway Atoll (Starr & Loope, 2002: 17) and all of the main islands except Niʻihau and Lānaʻi (Wagner *et al*., 1990: 189), spiny amaranth is documented here as occurring on Lānaʻi.

Material examined: **LĀNAʻI:** Hulopoʻe, 6 m, 15 Apr 2001, *Oppenheimer H40124*.

Celosia argentea L. **New naturalized record**

Hillebrand (1888: 370) treated this ornamental as a garden escape; however, Wagner *et al*. (1990: 179) saw no evidence that it had become naturalized. Staples et al. (2000: 15) listed it as potentially invasive via the adhesive fruit. A small population, consisting of dozens of randomly scattered individuals in all size classes, was recently found growing along an intermittent stream in Hilo, Hawaiʻi. It was noted that it did not appear to be under cultivation in adjacent areas. *Celosia argentea*, cockscomb, is an erect, glabrous, sparingly branched annual 1–2 m tall; leaves are simple, alternate, margins entire, somewhat fleshy, dull purple beneath, approximately 5–15 cm long × 1–2 cm wide. The inflorescence is pink to purple, axillary and spike-like, sometimes crested, and composed of numerous, tiny flowers; fruits are papery, gray, each with a single, small, black seed. *Celosia* is a genus of about 60 species from tropical Africa and America; many are weedy, with some ornamentals, mostly hybrids (Whistler, 2000: 117).

Material examined: **HAWAIʻI:** South Hilo Dist, Waiākea Stream, 18 m, 2 Aug 2001, *Oppenheimer H80105*.

Apiaceae

Coriandrum sativum L. **New island record**

Chinese parsley is known to be naturalized on Kauaʻi (Staples et al., 2002: 5) and Oʻahu (Wagner *et al*., 1990: 203); it is also sparingly naturalized on Maui.

Material examined: **MAUI:** East Maui, Makawao Dist, vicinity of Hāpapa Gulch, 793 m, volunteers in yard and nursery pots, 12 Aug 2001, *Oppenheimer H80110* (BISH).

Arecaceae

Livistona chinensis (Jacq.) R. Br. ex Mart. **New island record**

Reported to be sparingly naturalized where previously cultivated, at least in Moanalua Valley, Oʻahu but perhaps elsewhere (Wagner *et al*., 1990: 1364). This is consistent with small populations on West Maui, where it appears to be spreading from trees that apparently were formerly cultivated. Different size classes were noted in the collection locality, with many seedlings. It has also been observed to be sparingly naturalized in the Honolua Bay area, and in Hāna District on East Maui.

Material examined: **MAUI:** West Maui, Wailuku Dist, ʻĪao Valley, above road near Kepaniwai Park, 244 m, 27 Jan 2001, *Oppenheimer H10139*.

Phoenix L. **New naturalized record**

In their discussion of the Arecaceae, Read & Hodel (1990: 1361) mentioned that a presumably hybrid *Phoenix* taxon was possibly reproducing on O‘ahu, but more study was needed to assess its identity and determine its naturalized status. On Maui, *Phoenix* palms are definitely naturalized in wetland, sandy areas, mostly in the area from Kanahā Pond to Sprecklesville, but seedlings are sometimes observed elsewhere in Kahului. Volunteers have also been observed in Lahaina and seedlings have been noted in rocky coastal sites in the Mokulau area of Kaupō, East Maui. The length of the fronds (over 3 m) and the long, sharp spines on the petioles make collecting specimens difficult. This, combined with the long history of cultivation of date palms, makes determining their identity problematic. At Kanahā Pond, there seem to be two distinct types; one taller, with shorter, greener, more erect fronds, longer petioles, and shorter peduncles; the other being a shorter palm with long, arching, gray-green, glaucous fronds. Both occasionally produce basal suckers. According to a recent monograph of the genus (Barrow, 1998), these forms exhibit characters of both *P. dactylifera* L. and *P. sylvestris* (L.) Roxb., and do not key out to either species. Regarding these two species in Honolulu, Rock (1917: 15) remarked, “as they are hybridized by insects such a variety of hybrids exist that it is absolutely impossible to distinguish one from the other”. Further study should be made at all sites where *Phoenix* palms are reproducing in order to try to determine the species or hybrids involved. Although the majority of the 14 *Phoenix* taxa currently recognized (Barrow, 1998: 531) do not appear to spread, the cultivation of the taxa that escape should be discouraged, and their spread controlled. Control of *P. dactylifera* on Hawai‘i Island at Volcanoes National Park has been reported by Tunison & Zimmer (1992: 513, 518). *Phoenix* has also been observed to be naturalized at Kalaupapa, Moloka‘i.

Material examined: **MAUI:** East Maui, Wailuku Dist, Kanahā Pond Wildlife Sanctuary, in sandy soil, 6 m, 29 Oct 2000, *Oppenheimer & F. Duvall H100048*; same locality, 19 Oct 2001, *Oppenheimer & F. Duvall H100108, H100109* (BISH).

Asteraceae

Centratherum punctatum Cass. **New island record**

subsp. ***punctatum***

Recently reported as naturalized on Kaua‘i (Lorence *et al*. 1995: 23), this taxon is also sparingly naturalized on the Big Island of Hawai‘i. Known as Brazilian button flower, it is native to the Old World tropics from the Philippines to Australia, not to Brazil (Whistler, 2000: 119).

Material examined: **HAWAI‘I:** S Hilo Dist, Waiākea Stream, 37 m, 1 Aug 2001, *Oppenheimer, F. Starr, & K. Martz H80102.*

Cotula australis (Sieber ex Spreng.) **Range extension**

J. D. Hook.

This diminutive annual herb was known from Kaua‘i (Lorence *et al*., 1995: 23), O‘ahu, East Maui, and Hawai‘i (Wagner *et al*., 1990: 289). The following collection represents a significant range extension to West Maui.

Material examined: **MAUI:** West Maui, Wailuku Dist, Kepaniwai Park, 207 m, 27 Nov 2000, *Oppenheimer H110039.*

Eclipta prostrata (L.) L. **New island record**

[Syn. *E. alba* (L.) Hassk.]

Probably on all the main islands but documented only from Niʻihau, Kauaʻi, Oʻahu, Molokaʻi, Maui, and Hawaiʻi (Wagner *et al*., 1990: 309). Now it is known from Lānaʻi as well.

Material examined: **LĀNAʻI:** Hulopoʻe, in lawn near sea level, 15 Apr 2001, *Oppenheimer H40120*.

Erigeron bellioides DC **New island record**

Reported from Oʻahu and both East and West Maui (Wagner *et al*., 1990: 314; Nagata, 1995: 11; Oppenheimer & Bartlett, 2000: 2), *E. bellioides* was collected on Hawaiʻi Island, growing in landscaped areas in Kailua-Kona and as a lawn weed in Hilo. It was recently observed to be common at Kalaupapa, Molokaʻi (Staples *et al*., 2003); this population should be documented.

Material examined: **HAWAIʻI:** North Kona Dist, Kailua-Kona, near sea level, 10 Mar 2001, *Oppenheimer & S. Holt H30116*; S. Hilo Dist, UH Hilo campus, in lawn, 61 m, 1 Aug 2001, *F. Starr & K. Martz 010801-9* (BISH).

Flaveria trinervia (Spreng.) C. Mohr **New island record**

Known to be naturalized on Kauaʻi (Lorence *et al*., 1995: 24), Oʻahu (Wagner *et al*., 1990: 317), and Kahoʻolawe (Herbst & Wagner, 1996: 9–10), this widespread weed is now known from Maui where it grows in areas with sandy soil. It has been recently collected on Kure Atoll as well (Starr *et al*., 2003).

Material examined: **MAUI:** West Maui, Lahaina Dist, Honokahua, 42 m, 8 Aug 2001, *Oppenheimer H80108*; East Maui, Wailuku Dist, Kahului, just W of terminal in dirt parking lot, 12 m, 4 Feb 2000, *Starr & Martz 000204-1* (BISH); S side of Hāna Hwy 6 m, 27 Oct 2000, *Oppenheimer H100044*; empty lot on E Wakea St., locally abundant, 6 m, 23 Apr 2001, *Oppenheimer H40135*.

Lactuca sativa L. **New island record**

[Syn. *L. serriola* L.]

Documented from the islands of Kauaʻi (Wagner & Herbst, 1995: 16), Oʻahu, Lānaʻi, Maui, and Hawaiʻi (Wagner *et al*. 1990: 327), prickly lettuce is also sparingly naturalized on Molokaʻi.

Material examined: **MOLOKAʻI:** Kaunakakai, near sea level, 14 Jul 2001, *Oppenheimer H70117*.

Taraxacum officinale W. W. Weber ex F.H. Wigg. **New island record**

Common dandelion was known to be naturalized on Kauaʻi, Oʻahu, Lānaʻi, Maui, and Hawaiʻi (Wagner *et al*., 1990: 361). On Molokaʻi, it was noted to be locally common but not widespread.

Material examined: **MOLOKAʻI:** Kualapuʻu, 370 m, roadside weed near road to golf course, 18 Nov 2001, *Oppenheimer H110128*.

Balsaminaceae

Impatiens sodeni Engl. & Warb. ex Engl. **New island record**

[Syn. *I. oliveri* C.H.Wright ex Wm. Wats.]

On East Maui, this species had volunteered in a yard several years ago (Fern Duvall, pers. comm.); these plants are now 2m tall and fruiting. More plants were seen in a nearby gully dominated by *Hedychium gardnerianum*. It had previously been known to be naturalized only on Kaua‘i (Wagner *et al*., 1990: 380). Wagner *et al*. (1999: 1864) reported the taxonomic change.

Material examined: **MAUI:** East Maui, Makawao Dist, 24 Mar 2001, Olinda, 1082 m, *Oppenheimer & F. Duvall H30141*; in gulch E of Pi‘iholo Rd, 1134 m, *Oppenheimer & F. Duvall H30142*.

Bignoniaceae

Tabebuia heterophylla (DC.) Britton **New naturalized record**

Tabebuia is a genus of about 100 species of shrubs and trees native to tropical America (Whistler, 2000: 438). Pink trumpet tree is a commonly cultivated ornamental. It has smooth, palmately compound leaves, with 5 leaflets; newly germinated seedlings have simple leaves, becoming compound. The flowers are pink or lavender with 5 rounded lobes; pods are 7–16 cm long × 1cm wide. The seeds are winged and well adapted to wind dispersal like many of the Bignoniaceae. Seedlings have been observed over 100 m downwind from mature trees in areas with sufficient rainfall or irrigation. Staples *et al*. (2000: 18) listed this species as potentially invasive, with a wind dispersal mechanism. Whistler (2000: 442) reported that “it can spread rapidly by means of its winged seeds and sometimes becomes naturalized and troublesome.” This species was also noted to be sparingly naturalized around Hilo, Hawai‘i; however, no specimens were collected.

Material examined: **MAUI:** West Maui, Lahaina Dist, Honokahua, 67 m, in abandoned pineapple field, 13 Apr 2001, *Oppenheimer H40113*; ‘Alaeloa, 15 m, volunteer seedlings downwind of cultivated tree, 30 Apr 2001, *Oppenheimer H40152*.

Brassicaceae

Cardamine flexuosa With. **New island record**

Previously documented from Kaua‘i, O‘ahu, Maui, & Hawai‘i (Wagner *et al*., 1990: 402-3), then from Moloka‘i (Hughes, 1995: 2), *C. flexuosa* was recently collected on Lāna‘i. It was growing as a weed under hedges of *Bougainvillea*.

Material examined: **LĀNA‘I:** Mānele, 61 m, 15 Apr 2001, *Oppenheimer H40130*.

Lepidium africanum (N. L. Burm.) DC **New island record**

Erroneously reported from the Hawaiian Islands as *L. hyssopifolium* Desv. (Wagner & Herbst, 1995: 17), and cited from the island of Hawai‘i, this taxon is apparently widespread on Maui.

Material examined: **MAUI:** West Maui, Lahaina Dist, Honokahua, 37 m, in waste area between Honokahua Valley and Mokupe‘a Gulch, near golf course, locally common, 17 Mar 2001, *Oppenheimer H30124*; East Maui, Makawao Dist, Ka‘ono‘ulu, 1097 m, roadside weed on Waipoli Rd, 20 May 2001, *Oppenheimer H50125*.

Lobularia maritima (L.) Dev. **New island record**

In Hawai‘i, sweet alyssum is known to be naturalized on Kure and Midway Atolls, O‘ahu, Moloka‘i, and Maui (Wagner *et al*., 1990: 411; Wagner & Herbst, 1995: 17–18; Lorence *et al*., 1995: 27). On the Big Island, it was found growing as a roadside weed in and around Kamuela.

Material examined: **HAWAI‘I:** South Kohala Dist, Kamuela, 823 m, 10 Mar 2001, *Oppenheimer & S. Holt H30117.*

Caryophyllaceae

Sagina procumbens L. **New state record**

This diminutive species, known as birds-eye pearlwort, superficially resembles small clumps of grass, and is sometimes used as a “lawn” in bonsai gardening. Native to Europe, it is naturalized in many areas worldwide, including western North America from British Columbia to California, in moist lawns, roadsides, gardens, sea cliffs and pond margins at low elevations (Pojar & MacKinnon, 1994:137). In Hawai‘i it seems to be transported via contaminated nursery stock or cinders.

Material examined: **LĀNA‘I:** Mānele, 61 m, 15 Apr 2001, *Oppenheimer H40129.* **MAUI:** West Maui, Lahaina Dist; Honokowai, 6 m, weed colonizing bare ground in landscaped area, 4 Jun 2000, *Oppenheimer H60035* (BISH); Honokahua, 37 m, in cinders in resort landscaping w/ *Chamaesyce*, *Erigeron* and *Youngia*, 5 Mar 2001, *Oppenheimer H30106;* East Maui, Wailuku Dist, in nursery pots, 6 m, 30 Oct 2000, *Oppenheimer H100056*.

Chenopodiaceae

Chenopodium album L. **Range extension**

A recent introduction to Hawai‘i and sparingly naturalized in the Kula region (Wagner *et al*., 1990: 537) and on the Big Island (Staples et al., 2002: 7), the following collection represents a significant range extension to West Maui. The movement of livestock and farm vehicles between this collection site and the Kula area is probably responsible for its dispersal.

Material examined: **MAUI:** West Maui, Lahaina Dist, Honolua, in pasture between Honolua Valley and Mokupe‘a Gulch, N of Pu‘u Ka‘eo, 335 m, 27 Jun 2001, *Oppenheimer H60156.*

Combretaceae

Terminalia catappa L. **New island record**

Tropical almond is a common littoral tree on the east end of Moloka‘i. It had already been known to be naturalized on Kaua‘i, O‘ahu, Maui, and Hawai‘i (Wagner *et al*. 1990: 548); C.W. Smith had also reported its occurrence on Moloka‘i (1985: 215).

Material examined: **MOLOKA‘I:** Kawela, near sea level, 18 Nov 2001, *Oppenheimer H110145*.

Commelinaceae

Commelina benghalensis L. **New island record**

Previously documented as naturalized on Kaua‘i, O‘ahu, Maui, and Hawai‘i (Wagner *et al*., 1990: 1379), this species was collected recently on Moloka‘i. Besides the specimen cited here, it was also observed in Hālawa Valley.

Material examined: **MOLOKA'I:** Mapulehu, 10 m, roadside weed with *Rivina humilis* and *Bidens pilosa*, 18 Nov 2001, *Oppenheimer H110134.*

Convolvulaceae

Ipomoea batatas (L.) Lam. **New island record**

Sweet potato escapes cultivation and persists near abandoned homesites and dumps, probably on all the main islands but documented only from Kaua'i, O'ahu, and Hawai'i (Wagner *et al*. 1990: 555). These sites are consistent with collections from West Maui. The Alaeloa site was recently (August 2001) bulldozed during construction of a residential subdivision. *Ipomoea batatas* was also noted to occur on Midway Atoll (Wagner *et al*., 1999: 1873); however, this species was not included in Bruegmann (1999: 1–2).

Material examined: **MAUI:** West Maui, Lahaina Dist, Honolua Stream, near the intake, 244 m, 23 Jul 1998, *Oppenheimer H79806* (BISH); 'Alaeloa, N of Ka'ōpala Gulch, 24 m, in dumpsite, 21 Jan 2001, *Oppenheimer H10130*.

Ipomoea obscura (L.) Ker-Gawl. **New island record**

Naturalized in Hawai'i on the islands of Kaua'i, O'ahu, Maui, and Hawai'i (Wagner *et al*., 1990: 559), this morning glory is common on the east end of Moloka'i.

Material examined: **MOLOKA'I:** Kamalō, 10 m, common roadside weed climbing alien vegetation, 18 Nov 2001, *Oppenheimer H110132*.

Cuscutaceae

Cuscuta capestris Yuncker. **New island record**

This dodder has been documented from O'ahu and Hawai'i (Wagner *et al.*, 1990: 582). Legumes were reported as favored host plants; however, the O'ahu collection was on *Jatropha integerrima* (Euphorbiaceae). The following collection was made along a roadside; *Asystasia gangetica* (Acanthaceae) was the host plant.

Material examined: **MAUI:** West Maui, Wailuku Dist, Wailuku, 55 m, 17 May 2001, *Oppenheimer H50115*.

Cyperaceae

Cyperus meyenianus Kunth **New island record**

[syn. *Mariscus meyenianus* (Kunth) Nees]

Naturalized on Kaua'i, O'ahu (Wagner *et al*., 1990: 1421) and Moloka'i (Hughes, 1995: 4), this taxon was recently collected as a roadside weed on the island of Hawai'i.

Material examined: **HAWAI'I:** Hāmākua Dist, Āhualoa, 549 m, locally common, 28 Jul 2001, *Oppenheimer H 70134* (BISH).

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

Known to be naturalized in the Hawaiian Islands on Kaua'i, O'ahu, and Moloka'i (Wagner *et al*., 1990: 1403), this spikerush was recently collected on Maui growing in wet areas at the edge of lawns.

Material examined: **MAUI:** West Maui, Lahaina Dist, Hanaka'ō'ō, 3 m, 4 Apr 2001, *Oppenheimer H40105*; Honokahua, 24 m, growing in lawn, 26 Nov 2001, *Oppenheimer H110152*.

Fimbristylis miliacea (L.) Vahl **New island record**

First reported as a naturalized species in the Hawaiian Islands by Strong & Wagner (1997: 45); they cited specimens collected on Kauaʻi. Subsequently it was documented from the island of Hawaiʻi (Imada *et al*. 2000: 12). Recently it was collected on East Maui.

Material examined: **MAUI:** East Maui, Hāna Dist, Keʻanae, 61 m, along muddy trail behind arboretum, 12 Nov 2001, *Oppenheimer H110117*.

Kyllinga nemoralis (J. R. Forst. & G. Forst.) Dandy ex Hutch. & Dalziel **New island records**

Primarily a garden and lawn weed on Kauaʻi, Oʻahu, Maui, and Hawaiʻi but probably also on other of the main islands (Wagner *et al*., 1990: 1413), *K. nemoralis* was recently collected as a lawn weed on both Molokaʻi and Lānaʻi.

Material examined: **MOLOKAʻI:** Kaunakakai, near sea level, 14 Jul 2001, *Oppenheimer H70116*. **LĀNAʻI:** Hulopoʻe, near sea level, 15 Apr 2001, *Oppenheimer H40119*.

Euphorbiaceae

Chamaesyce hypericifolia (L.) Millsp. **New island records**

Relatively common in low elevation, dry, disturbed habitats on Kure and Midway Atolls, French Frigate Shoals, Kauaʻi, Oʻahu, Maui, and Hawaiʻi (Wagner *et al*., 1990: 610), graceful spurge was collected on both Molokaʻi and Lānaʻi under similar conditions.

Material examined: **MOLOKAʻI:** Kaunakakai, near sea level, 14 Jul 2001, *Oppenheimer H70125*. **LĀNAʻI:** Hulopoʻe, near sea level, 15 Apr 2001, *Oppenheimer H40123*.

Chamaesyce hyssopifolia (L.) Small **New island record**

In Hawaiʻi, *C. hyssopifolia* occurs on Midway Atoll, Kauaʻi, Oʻahu, Lānaʻi, Maui, and Hawaiʻi (Wagner *et al*., 1990: 610; Bruegmann, 1999: 2; Herbarium Pacificum Staff, 1999: 3). Now it is known from Molokaʻi as well.

Material examined: **MOLOKAʻI:** Kaunakakai, near sea level, 14 Jul 2001, O*ppenheimer H70115*.

Chamaesyce serpens (Kunth) Small **New island record**

Formerly confused with *C. albomarginata*, which occurs on Oʻahu, *C. serpens* was known in Hawaiʻi from only Kauaʻi (Wagner *et al*., 1997: 56). It was recently collected on West Maui.

Material examined: **MAUI:** West Maui, Lahaina Dist, Keawalua, 12 m, edge of paved road in pasture, 12 Jan 2001, *Oppenheimer H10126*.

Chamaesyce thymifolia (L.) Millsp. **New island records**

Previously documented from Kauaʻi, Oʻahu, East & West Maui, and Hawaiʻi (Wagner *et al*., 1990: 615, 617; Lorence *et al*., 1995: 35; Oppenheimer & Bartlett, 2000: 5); this taxon was recently collected as a lawn weed on both Molokaʻi and Lānaʻi.

Material examined: **MOLOKAʻI:** Kaunakakai, near sea level, 14 Jul 2001, *Oppenheimer H70112*. **LĀNAʻI:** Hulopoʻe, near sea level, 15 Apr 2001, *Oppenheimer H40118*.

Phyllanthus debilis Klein ex Willd. **New island records**

Naturalized on Kauaʻi, Oʻahu, Maui, Hawaiʻi, and perhaps other islands (Wagner *et al*., 1990: 627), this species is now documented from Molokaʻi and Lānaʻi as well.

Material examined: **MOLOKAʻI:** Hālawa Valley, roadside weed, 60 m, 18 Nov 2001, *Oppenheimer H110142*. **LĀNAʻI:** Mānele, 3 m, 15 Apr 2001, *Oppenheimer H40117*.

Fabaceae

Canavalia sericea A. Gray **New island record**

In Hawaiʻi, silky jackbean is naturalized on Kauaʻi, Oʻahu, and Maui (Wagner *et al*., 1990: 654–655; Wagner & Herbst, 1995: 19; Oppenheimer & Bartlett, 2002: 7–8). It has recently been collected on the Big Island of Hawaiʻi.

Material examined: **HAWAIʻI:** N Hilo Dist, Laupahoehoe, 2 m, near the lighthouse, 29 Jul 2001, *Oppenheimer H70135*.

Crotalaria brevidens Benth. **Range extension**

Reported to be naturalized at Ulumalu and in Makawao Forest Reserve on East Maui (Wagner *et al*., 1990: 658), this African species is locally common along roadsides and in waste areas adjacent to pineapple fields on West Maui, where it grows with *C. micans* and *C. pallida*.

Material examined: **MAUI:** West Maui, Lahaina Dist, in gully in pineapple fields between Honokōwai and Māhinahina, 290 m, 30 Jul 2000, *Oppenheimer H700131* (BISH); Moʻomoku, 366 m, 1 Jun 2001, *Oppenheimer H60102*.

Desmanthus pernambucanus (L.) Thell. **New island record**

Previously known as *D. virgatus* (L.) Willd. from Midway Atoll and probably all the main islands except Niʻihau and Lānaʻi (Wagner *et al*., 1990: 665), this taxon was recently collected on Lānaʻi, where it is locally common. Wagner & Herbst (1995: 20) reported the change in name.

Material examined: **LĀNAʻI:** along coastal trail W of Hulopoʻe Bay at edge of golf course, 31 m, 15 Apr 2001, *Oppenheimer H40128*.

Desmodium heterophyllum (Willd.) DC **Range extension**

Documented as a new state record from Molokaʻi and East Maui (Wagner & Herbst, 1995: 20) and subsequently from Hawaiʻi (Herbst & Wagner, 1999: 20–21), the following collection represents a significant range extension to West Maui.

Material examined: **MAUI:** West Maui, Lahaina Dist, Honokahua, 27 m, prostrate plants in lawn at edge of parking lot w/*D. triflorum* & *D. incanum*, 5 May 2001, *Oppenheimer H50104.*

Desmodium incanum DC **New island records**

These are the first records of Spanish clover from the islands of Molokaʻi and Lānaʻi. It was previously known from Kauaʻi, Oʻahu, Maui, and Hawaiʻi (Wagner *et al*., 1990: 667).

Material examined: **MOLOKAʻI:** Kaunakakai, 6 m, 14 Jul 2001, *Oppenheimer H70124.* **LĀNAʻI:** Hulopoʻe, near sea level, 15 Apr 2001, *Oppenheimer H40122*.

Indigofera hendecaphylla Jacq. **New island record**

[Syn. *I. spicata* Forssk.]

Naturalized in low elevation, dry, disturbed areas at least on Kaua‘i, O‘ahu, and Maui but probably also on some of the other main islands (Wagner *et al*., 1990: 676), creeping indigo was recently reported from Hawai‘i Island (Starr *et al.*, 2002: 20). Now it is also known from Moloka‘i. Wagner *et al*. (1999: 1877) reported the change in name.

Material examined: **MOLOKA‘I:** Kaunakakai, near sea level, 14 Jul 2001, *Oppenheimer H70107*.

Kummerowia striata (Thunb.) Schindl. **New island record**

[Syn. *Lespedeza striata* (Thunb.) Hook. & Arn.]

Discussed in the notes regarding the genus *Lespedeza* Michx. (Wagner *et al*., 1990: 679), this taxon was collected in a Big Island pasture in 1932. It was not considered to have persisted. Staples *et al*. (2002: 10), reported the change in taxonomy, and mentioned the need for further fieldwork regarding forage legumes. The species has either persisted or was reintroduced and was recently collected growing as a weed on West Maui. According to Bailey & Bailey (1930: 423), it is known as Japan clover, although also native to China; is an annual, and is naturalized in North America. Neal (1965: 452) described the species as an herb 18 in (48 cm) high, with 3 leaflets about 0.7 in (18 mm) long and nearly smooth; flowers 1–3, small, pink to purple; and small, pointed pods.

Material examined: **MAUI:** West Maui, Lahaina Dist, Honokahua, 24 m, in putting green at Plantation Golf Course, 2 Oct 2000, *Oppenheimer H100005*.

Macroptilium atropurpureum (DC.) Urb. **New island record**

According to Wagner *et al*. (1990: 683) this species occurs on O‘ahu, Maui, and Hawai‘i. Now it is also known from Moloka‘i, where it was noted to be common in the collection locality.

Material examined: **MOLOKA‘I:** Kaunakakai, near sea level, 14 Jul 2001, *Oppenheimer H70110*.

Medicago sativa L. **New island record**

Known from Midway Atoll, Kaua‘i, O‘ahu, Lāna‘i, East & West Maui, and Hawai‘i (Wagner *et al*., 1990: 686; Wagner & Herbst, 1995: 20; Wagner *et al*., 1997: 57; Oppenheimer *et al*., 1999: 8), *M. sativa* was recently collected on Moloka‘i.

Material examined: **MOLOKA‘I:** Vicinity of Kapuāiwa coconut grove, roadside weed, 3 m, 18 Nov 2001, *Oppenheimer H110148*.

Mimosa pudica L. var. ***unijuga*** (Duchass. & Walp.) Griseb. **New island record**

A pantropical weed and naturalized in the Hawaiian Islands on Kaua‘i, O‘ahu, Lāna‘i, Maui, and Hawai‘i (Wagner *et al*., 1990: 687-8), sensitive plant is now known from Moloka‘i as well.

Material examined: **MOLOKA‘I:** Roadside weed near Pu‘u o Hoku, 200 m, 18 Nov 2001, *Oppenheimer H110139*.

Senna occidentalis (L.) Link **New island record**

Occurring on Niʻihau, Kauaʻi, Oʻahu, East and West Maui, and Hawaiʻi (Wagner *et al*., 1990: 700–701; Oppenheimer *et al*., 1999: 8), coffee senna is also naturalized on the island of Molokaʻi.

Material examined: **MOLOKAʻI:** roadside weed near Manawainui bridge, 100 m, 18 Nov 2001, *Oppenheimer H110130*.

Hydrocharitaceae

Egeria densa Planch. **New island record**

Reported from ponds and perhaps slow running ditches on Kauaʻi, Oʻahu, Molokaʻi, and Hawaiʻi (Wagner *et al*., 1990: 1443), this aquatic herb was collected in an unused reservoir on West Maui, where it is abundant. It was also observed in another, nearby reservoir, where it also covers most of the surface.

Material examined: **MAUI:** West Maui, Lahaina Dist, Olowalu, 15 m, 4 Nov 2000, *Oppenheimer, L. Nelson, & F. Duvall H110002*.

Lamiaceae

Leonotis nepetifolia (L.) R. Br. **New island record**

Previously known to be naturalized on the islands of Kauaʻi, Oʻahu, Maui, and Hawaiʻi (Wagner *et al*., 1990: 803), this species was collected on Molokaʻi growing as a roadside weed at the edge of a *Prosopis* thicket.

Material examined: **MOLOKAʻI:** Kaunakakai, near sea level, 14 Jul 2001, *Oppenheimer H70118*.

Liliaceae

Asparagus densiflorus (Kunth) Jessop **New island record**

Commonly cultivated, this taxon was first reported as a naturalized species in Hawaiʻi by Lorence & Flynn (1999: 4–5), who cited specimens collected on the island of Kauaʻi. Later, it was reported from West Maui (Oppenheimer & Bartlett, 2000: 6). It has also escaped cultivation and is naturalized on the Big Island, and has been observed to be spreading from plantings at Mānele Bay, Lānaʻi into irrigated, landscaped areas nearby, and will likely become established there in the near future as well.

Material examined: **HAWAIʻI:** S. Kohala Dist, ʻAnaehoʻomalu, 12 m, edge of landscaped area in *Prosopis* thicket, 11 Mar 2001, *Oppenheimer & S. Holt H30119*.

Moraceae

Ficus cf. ***platypoda*** (A.Cunn. ex Miq.) A.Cunn. ex Miq. **New island record**

First documented as a naturalized taxon in the Hawaiian Islands on Oʻahu and Maui (Oppenheimer & Bartlett 2000: 7), this banyan is also sparingly naturalized in the Kohala Mountains on Hawaiʻi. Examination of fruits collected revealed the pollinator wasp, *Pleistodontes imperialis* Saunders. Nishida (2002: 148) did not list this species from the island, and these specimens (in Bishop Museum) represent a new island record for this fig wasp. Wasps continued to emerge from the fruits for 10 days after collection. Most of the trees observed at this location were growing terrestrially and are likely the original forestry plantings, but a few were supported solely by prop roots, and probably first ger-

minated on now dead and decayed *Cibotium* tree ferns.

Material examined: **HAWAI'I:** S. Kohala Dist, near ditch trail, 945 m, 28 Jul 2001, *Oppenheimer H70131.*

Ficus rubiginosa Desf. **New naturalized record**

The Port Jackson fig, native to New South Wales, Australia (Neal, 1965: 313), had previously been reported as naturalized on O'ahu (Nagata, 1995:12), but the specimen cited was later reidentified as *F*. cf. *platypoda* (Oppenheimer & Bartlett, 2000: 7). *Ficus rubiginosa*, as it is currently defined, is naturalized at least on West Maui in and around the northwest corner of Kapunakea Preserve. Most trees observed were growing terrestrially; *F*. cf. *platypoda* often starts as an epiphyte. Berg, in his account of *Ficus* for *A tropical garden flora* (Staples & Herbst, in press) stated that the same pollinating wasp has been found in both *F. platypoda* and *F. rubiginosa*, suggesting that they are closely related, if not the same. Features of *F. platypoda* and *F. obliqua* also apparently overlap, and the three taxa may belong to a species complex. Dr. Berg has maintained all 3 species in his account of Hawaiian *Ficus* pending further study of the wild populations that have been described as distinct species.

In principle, each *Ficus* species has its own species of pollinating fig wasp. As a rule, a species grown outside its homeland cannot be pollinated and will not produce viable seed. However, the pollinators of 4 species (*Ficus carica*, *F. macrophylla*, *F*. *microcarpa*, and *F. rubiginosa*) have been introduced into Hawai'i (Wagner *et al*., 1990: 924), and the latter 3 are naturalized.

Material examined: **MAUI:** West Maui, Lahaina Dist, Honokowai, between the valley and Hā'enanui Gulch, 823 m, terrestrial trees growing in *Metrosideros*/*Dicranopteris* forest, 2 Apr 2001, *Oppenheimer, P. Bily, J. Lau,* & *L. Durand H40103.*

Myricaceae

Morella cerifera (L.) Small **Nomenclatural change**

[Syn. *Myrica cerifera* L.]

Staples *et al*. (2002: 13) previously reported the change for *Morella faya*; another taxon recently documented as naturalized in Hawai'i, *Myrica cerifera* L., has also been transferred to *Morella*. Southern wax myrtle was first reported as naturalized on West Maui by Pu'u Kukui Watershed staff in 1997 (Meidell *et al*., 1997:17). Eradication efforts are still ongoing and nearly complete.

Myrtaceae

Eucalyptus botryoides Sm. **New island record**

Previously reported to be seeding on Kaua'i and O'ahu (Wagner *et al*., 1990: 951), Skolmen (1980: 163) listed forest reserve plantings on Kaua'i and Hawai'i. Little & Skolmen (1989: 214) stated that "the bulk of the bangalay eucalyptus in Hawai'i is on Maui in several large stands belonging to Haleakala Ranch Co. . . . that were planted before 1920. It has been planted sparingly on the other islands." On West Maui, it is mixed with other *Eucalyptus* species, is reseeding itself within the planting, and is growing in adjacent areas. The East Maui plantings should be investigated.

Material examined: **MAUI:** West Maui, Lahaina Dist, Honokōwai, 579 m, *Oppenheimer H50129.*

Eugenia uniflora L. **New island record**

Surinam cherry is very sparingly naturalized at least on Kauaʻi, Molokaʻi, and several other of the main islands, but vouchers are lacking for any naturalized occurrence (Wagner *et al*., 1990: 961). On West Maui, plantings were made in the 1920s as part of the Maunalei Arboretum project (Maui Pineapple Co., unpubl.). Humans, feral pigs, and stray cattle have been spreading the fruit and seed, and plants are not uncommon in areas within, and adjacent to, the area. On East Maui it is also naturalized in the Haʻikū area. It has been recently observed to be forming locally dense thickets at Halawa Valley, Molokaʻi.

Material examined: **MAUI:** West Maui, Lahaina Dist, Honolua, Mokupeʻa Gulch, 366 m, 3 Mar 2001, *Oppenheimer H30103*; East Maui, Makawao Dist, Haʻikū, 122 m, 21 Oct 2001, *Oppenheimer H100114* (BISH); in gulch near Haʻikū School, 122 m, 25 Oct 2001, *Starr & Martz 011025-2* (BISH).

Syncarpia glomulifera (Sm.) Nied. **New naturalized record**

In their discussion of Myrtaceae, Wagner *et al*. (1990: 948) reported that 83,000 individuals of turpentine tree had been planted by state foresters on all of the main islands except Niʻihau and Kahoʻolawe, and it was noted to be reproducing and escaping into at least Kamakou Preserve, Molokaʻi. This species has also escaped from plantings in at least two locations on West Maui, is slowly spreading, and is now sparingly naturalized in adjacent areas. It appears that the seeds need disturbed areas with exposed, bare soil to germinate and establish. Long distance dispersal at the following sites does not seem to be occurring yet, although the small seeds could easily be carried by the wind, or embedded in mud on vehicles, hikers boots, or feral animals. Native to Australia (Little & Skolmen 1989: 250), it is easily recognized by the aggregate, fused capsular fruits, and pubescent leaves.

Material examined: **MAUI:** West Maui, Lahaina Dist, N of Honokōwai Valley, 408 m, 11 Nov 1999, *Oppenheimer H119912* (BISH); Wailuku Dist, E slope of Hanaʻula, between Kaʻonohua and Paleʻaʻahu Gulches, 975 m, 7 Mar 2001, *Oppenheimer, R. Platz, & C. Hill H30114*.

Nyctaginaceae

Boerhavia coccinea Mill. **New island record**

First collected on Hawaiʻi in 1974, rapidly spreading, and documented from Kauaʻi, Oʻahu, Maui, Kahoʻolawe, and Hawaiʻi (Wagner *et al*., 1990: 978). More recently, it was reported from Lānaʻi (Oppenheimer & Bartlett, 2002: 10). This common weed is now known from Molokaʻi, where it is widespread and locally abundant. Elsewhere in these *Records* it is reported from Kure Atoll (Starr *et al*., 2003).

Material examined: **MOLOKAʻI:** Kaunakakai, near sea level, 14 Jul 2001, *Oppenheimer H70108.*

Mirabilis jalapa L. **New island record**

Documented from the islands of Midway Atoll, Kauaʻi, Oʻahu, Lānaʻi, Maui, and Hawaiʻi (Wagner *et al*., 1990: 982), this species is also naturalized on Molokaʻi.

Material examined: **MOLOKAʻI:** Kamalō, 10 m, near road in shady, alien forest, 18 Nov 2001, *Oppenheimer H110131*.

Nymphaeaceae

Nymphaea ×daubenyana W.T. Baxter ex Daubeny **New naturalized record**

Two species of *Nymphaea* have recently been reported as naturalized in the Hawaiian Islands: *N. caerulea* Savigny on Hawai‘i, and *N. capensis* Thunb. on Kaua‘i (Herbarium Pacificum Staff, 1998: 11). Both species are from Africa. In making the identification for this specimen, John Wiersema at BARC commented that “the specimen (*H129901*) is *N. micrantha* or a hybrid with this species as one of the parents, the most common being *N. ×daubenyana*. The small amount of pollen remaining in the flower appears deformed and unstainable, suggesting *N. ×daubenyana*.” Whistler (2000: 331) stated that “extensive hybridization involving the cultivated species makes their taxonomy difficult.” Bailey & Bailey (1930: 501) considered the Oxford Water Lily a hybrid of the African *N. micrantha* Guill. & Perr. and another, unknown species, possibly *N. caerulea.*

This hybrid, which first arose in the Oxford Botanic Garden in 1856, spread throughout a system of manmade ditches in England that were apparently built as a flood control measure. Along with *Eichhornia crassipes* and *Ceratophyllum demersum*, it now completely dominates the usually stagnant water. With regard to water lilies in Hawai‘i, James-Palmer (1987: 170) stated that “some varieties multiply rampantly, quickly taking over, and caution should be exercised in allowing them to grow unchecked in the Hawaiian environment.” The fragrant flowers rise above the water surface and open in the morning.

Material examined: **MAUI:** West Maui, Lahaina Dist, Ukumehame, near sea level, 5 Dec 1999, *Oppenheimer H129901* (BISH); same locality, 23 Apr 2001, *Oppenheimer H40139* (PTBG).

Ochnaceae

Ochna thomasiana Engl. & Gilg **New island record**

The Mickey Mouse plant was recently confirmed as a naturalized element of the Hawaiian flora (Imada *et al*., 2000: 13), at least on O‘ahu. It was speculated that it also occurred as a weed on other islands. Staples *et al*. (2000: 25) listed this taxon as invasive or potentially invasive, being dispersed by birds, and possibly spreading vegetatively as well. On West Maui, *O. thomasiana* is commonly grown around homes in older neighborhoods and readily escapes into nearby waste areas.

Material examined: **MAUI:** West Maui, Lahaina Dist, S of Ka‘ōpala Gulch, tree to 3m tall, on steep, disturbed slope with *Casuarina, Solanum,* and *Nicotiana,* 14 Jan 1999, *Oppenheimer H19904* (NYBG); same locality, 19 Jan 2000, *Oppenheimer H10017* (BISH); Honokahua, volunteer in old pineapple field with *Tabebuia, Spathodea, Schefflera, Clusia,* and *Leucaena,* 82 m, 12 May 2001, *Oppenheimer H50108*; Wailuku Dist, ‘Īao Valley, 152 m, on steep slope under *Casuarina, Schinus,* and *Leucaena,* 5 Jun 2001, *Oppenheimer H60106.*

Oleaceae

Fraxinus griffithii C. B. Clarke **New naturalized record**

Wagner *et al*. (1990: 991) reported that only *F. uhdei* is naturalized in the Hawaiian Islands, and that *F. americana* had not been planted, although Tunison & Zimmer (1992: 516) reported on the control of the latter species at Hawai‘i Volcanoes National Park. Neal (1965: 675) discussed this one plus 2 other species cultivated in the state. Skolmen (1980: 234–240) listed 6 *Fraxinus* taxa planted in Hawaiian forest reserves; Nelson (1965: 9) list-

ed 5 taxa, with almost 700,000 trees planted. *Fraxinus griffithii*, Himalayan ash, is native to Bangladesh, China, India, Indonesia, Japan, Myanmar, Philippines, and Vietnam. It differs from *F. uhdei* by its entire leaflet margins, glandular dotted abaxial leaflet surface, bisexual flowers, and samaras broadly lanceolate-spathulate (Chang *et al*., 1996). It is so far known to be sparingly naturalized only in Makawao Forest Reserve, growing among other plantings.

Material examined: **MAUI:** East Maui, Makawao Dist, Makawao Forest Reserve, Kahakapao, 823 m, trees to 20m tall, 15 Oct 2000, *Oppenheimer & F. Duvall H100021*.

Orchidaceae

Zeuxine strateumatica (L.) Schltr. **New naturalized record**

Wagner *et al*. (1990: 1468), in the discussion of the Orchidaceae, cited a 1970 report of this species as naturalized at a single Maui location, supposedly an agricultural area. No collections were seen, and its status in Hawai‘i has been unconfirmed. New collections and observations suggest that *Z. strateumatica* (soldier's orchid) is indeed naturalized and widespread on Maui; sightings have been made at Mailepai, Wailea, and several locations in Kahului (R. Nakagawa, pers. comm.). Its diminutive stature and ephemeral nature have probably led to its obscurity. Native to Asia and Africa, it is terrestrial, 5–25 cm tall; leaves 2–9 cm long, overlapping; flowers fragrant, small, white to yellow in a dense, terminal spike. It tends to be weedy, being naturalized in lawns and wet, waste places in the southeastern U.S., and has recently been found at an oasis in Saudi Arabia (P. Cribb, pers. comm.).

Material examined: **MAUI:** East Maui, Wailuku Dist, Kahului, 6 m, growing under oleander hedge in landscaped area of shopping center, 19 Feb 2001, *Oppenheimer H20125*; Makawao Dist, Pukalani Community Center, in lawn, 400 m, 2 Jan 2002, *F. Starr & K. Martz 020102-1* (BISH).

Passifloraceae

Passiflora subpeltata Ort. **New island record**

Escaping cultivation in Hawai‘i and naturalized on Kaua‘i, O‘ahu, and Maui (Wagner *et al*., 1990: 1014), white passion flower occurs as a weed on Moloka‘i as well.

Material examined: **MOLOKA‘I:** Kala‘e, 520 m, roadside weed climbing *Psidium guajava*, 18 Nov 2001, *Oppenheimer H110122*.

Phytolaccaceae

Rivina humilis L. **New island record**

Coral berry has been documented in Hawai‘i from the islands of Kaua‘i, O‘ahu, Maui, and Hawai‘i (Wagner *et al*., 1990: 1016–1017; Meidell *et al*., 1997: 17). On Moloka‘i, it was observed in 1995 at Ili‘ili‘opae heiau, but no specimens were collected until recently.

Material examined: **MOLOKA‘I:** Mapulehu, 10 m, roadside weed, 18 Nov 2001, *Oppenheimer H110135*.

Pinaceae

With more collections and information available since the report of Oppenheimer (2002: 19–20), 1 additional species of *Pinus* was found reproducing on Maui, bringing the total known so far to have escaped cultivation to 5. The following key will help distinguish between them.

KEY TO THE SPECIES OF *PINUS* REPRODUCING ON MAUI

1. Needles in bundles of 2 ……..……..……. *P. pinaster*
1. Needles in bundles of 3 (2)
2(1). Needles pendant or drooping ……..……. *P. patula*
2. Needles erect or spreading (3)
3(2). Bark and needles vanilla or lemon scented when crushed ……..... *P. jeffreyi**
3. Bark and needles not vanilla or lemon scented (4)
4(3). Needles 10-15cm long ……...…..……...…….....….. *P. radiata*
4. Needles 15-25cm long ……...…...…… *P. caribaea*

* unvouchered record

Pinus caribaea Morelot var. ***hondurensis*** (Seneclauze) W.H. Barrett & Golfari **New naturalized record**

This taxon is native to the Caribbean coast of Central America, from Belize to Nicaragua. It is commonly used in forestry plantations in Australia and many Pacific islands. Caribbean pine has escaped from plantings on Maui and has been observed to be spreading in French Polynesia as well.

Material examined: **MAUI:** West Maui, Lahaina Dist, Kuholilea, near Kahoma Cabin, 549 m, spreading from plantings, 6 Apr 2000, *Oppenheimer et al. H40008* (BISH); East Maui, Makawao Dist, Makawao F.R., near Pi‘iholo Water Treatment plant, 866 m, naturalized from forestry plantings, 15 Jul 2001, *H. & M. Oppenheimer & F. & R. Duvall H70127* (BISH).

Poaceae

Axonopus compressus (Sw.) P. Beauv. **New naturalized record**

A second species of carpetgrass is naturalized in the Hawaiian Islands. It is a common lawn weed, often forming dense patches that dominate large areas. This species differs from *A. fissifolius* by its wider leaves, hairy on the margins; pubescent nodes; and short flowering culms, usually surrounded by the leaf sheath (Smith, 1979: 333). It is native from the southern U.S. to South America. Reference to *A. compressus* in Hawai‘i was earlier made by Hitchcock (1922: 222) who noted a Shipman collection from Kona. Whistler (1995: 153) described *A. compressus* as common on all of the main tropical Pacific island groups, and mentioned a recent report of its occurrence in Hawai‘i without further detail. Recent observations reveal that this taxon is more widespread than the following collections suggest. It probably occurs on all the main Hawaiian Islands as well.

Material examined: **MOLOKA‘I:** Pālā‘au Park, 500 m, lawn weed at picnic area, 18 Nov 2001, *Oppenheimer H110126.* **MAUI:** West Maui, Lahaina Dist, ‘Alaeloa, 15 m, in lawn, 8 Jul 2001, *Oppenheimer H70106*; Mahinahina, mat forming grass at edge of pineapple field, near gate to road to Kaulalewelewe, 408 m, 17 Oct 2001, *Oppenheimer* & *E. Romanchak H100106*; Honokahua, in lawn, 24 m, 3 Nov 2001, *Oppenheimer H110102;* in lawn, 6 m, 3 Nov 2001, *Oppenheimer H110103*; East Maui, Makawao Dist, Makawao, growing in lawn at corner of Ukiu Rd and Baldwin Ave., 488 m, 5 Nov 2001, *Starr & Martz 011105-1* (BISH); Hāna Dist, Ke‘anae, in lawn, 2 m, 12 Nov 2001, *Oppenheimer H110112*.

Brachiaria mutica (Forssk.) Stapf **New island record**

According to Wagner *et al*. (1990: 1504), California grass is naturalized on the Hawaiian Islands of Midway Atoll, Kauaʻi, Oʻahu, Lānaʻi, Maui, and Hawaiʻi. Smith (1985: 208) noted its occurrence on Molokaʻi, but did not consider it a pest there. The following collection documents its occurrence on Molokaʻi; it was also observed to be fairly common at low elevations on the east end of the island.

Material examined: **MOLOKAʻI:** Kalaʻe, 520 m, 18 Nov 2001, *Oppenheimer H110123*.

Chloris divaricata R. Br. var. ***cynodontoides*** **New island record**
(Balansa) Lazarides

This variety of stargrass was previously known only from the islands of Kauaʻi and Oʻahu (Wagner *et al*., 1990: 1514–1515). It was recently collected as a lawn weed on West Maui.

Material examined: **MAUI:** West Maui, Lahaina Dist, ʻAlaeloa, 37 m, in lawn N of Kaʻōpala Gulch, 1 Nov 2001, *Oppenheimer H110101*.

Chloris radiata (L.) Sw. **New island record**

Previously documented from the islands of Kauaʻi, Oʻahu, Lānaʻi, Maui, and Hawaiʻi (Wagner *et al*., 1990: 1515), the following collection represents a new record for this species on Molokaʻi.

Material examined: **MOLOKAʻI:** Kalaʻe, 520 m, 18 Nov 2001, *Oppenheimer H110124*.

Cynodon nlemfuensis Vanderyst **New island record**

Herbst & Wagner (1999: 25–26) reassessed the status of this taxon, considering it to be naturalized instead of adventive. It had been known to occur on the islands of Molokaʻi and Hawaiʻi. Recently it was collected on West Maui, where it appears to be at least locally naturalized.

Material examined: **MAUI:** West Maui, Wailuku Dist, Wailuku, 61 m, growing in sandy soil on weedy roadside with *Verbesina*, *Bidens*, *Eragrostis*, *Cenchrus*, 16 Dec 2001, *Oppenheimer H120102*.

Eragrostis amabilis (L.) Wight & Arn. **New island record**

[Syn. *E. tenella* (L.) P. Beauv. ex Roem. & Schult.]

Naturalized on Midway Atoll, Niʻihau, Kauaʻi, Oʻahu, Molokaʻi, Maui, and Hawaiʻi (Wagner *et al*., 1999: 1545, 1909; Hughes, 1995: 8–9; Lorence *et al*., 1995: 45), this small annual has now been collected on Lānaʻi. Elsewhere in this years *Records* it is also reported from Kure Atoll (Starr *et al*., 2003).

Material examined: **LĀNAʻI:** near sea level, common in lawns at Hulopoʻe and Mānele, 15 Apr 2001, *Oppenheimer H40115*.

Eragrostis curvula (Schrad.) Nees **New island record**

Previously misidentified in Hawaiʻi as *Leptochloa uninervia*, and occurring on Oʻahu and Kahoʻolawe (Herbst & Clayton, 1998: 26), *E. curvula* was recently collected on Maui, where it was growing at the edge of a lawn.

Material examined: **MAUI:** East Maui, Makawao Dist, Pukalani, 415 m, occasional, 8 Jun 2001, *Oppenheimer H60109*.

Eragrostis elongata (Willd.) J. Jacq. **New island record**

O'Connor (1990: 1538) considered this species to be adventive on Kaua'i and Hawai'i. Lorence *et al*. (1995: 45) later considered it to be definitely naturalized at least on Kaua'i. On Moloka'i, it is also naturalized and locally common.

Material examined: **MOLOKA'I:** along road to Hālawa Valley at Alanuipuhipaka Ridge, 140 m, growing in cinders, 18 Nov 2001, *Oppenheimer H110140*.

Eriochloa punctata (L.) Desv. ex Ham. **New island records**

Ni'ihau and O'ahu were the only two Hawaiian islands where *E. punctata* was previously known to occur as a weed (Wagner *et al*., 1990: 1546). Now it is known from Moloka'i and Maui as well. On both islands it was growing in dry areas adjacent to sites that are occasionally flooded.

Material examined: **MOLOKA'I:** Kaunakakai, 6 m, 14 Jul 2001, *Oppenheimer H70119*. **MAUI:** West Maui, Lahaina Dist, Lahaina, 6 m, 25 Sep 2000, *Oppenheimer H90002*.

Festuca arundinacea Schreb. **New island record**

In his discussion of the genus *Festuca*, O'Connor (1990: 1547) noted this species to be adventive on the island of Hawai'i. It was later reported from Kaua'i (Wagner *et al*., 1997: 60). The following collection represents a new record for Maui.

Material examined: **MAUI:** East Maui, Makawao Dist, weedy slope on N side of Kahakapao Reservoir, 1292 m, 24 Mar 2001, *Oppenheimer* & *F. Duvall H30138.*

Leptochloa fusca (L.) Kunth subsp. ***uninervia*** **New island record**
(J. Presl) N. Snow

Known from Midway Atoll, Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i (Herbst & Clayton, 1998: 29; Starr & Martz, 2000: 11), the change in taxonomy was reported by Imada *et al*. (2000: 14). On Lāna'i, it was abundant around the margins of a stagnant, brackish water pond.

Material examined: **LĀNA'I:** Hulopo'e, near sea level, 15 Apr 2001, *Oppenheimer H40121*.

Oplismenus compositus (L.) Beauv. **New island record**

Naturalized and usually common in shaded sites and mesic valleys and forests on Kaua'i, O'ahu, Moloka'i, and Hawai'i (Wagner *et al*., 1990: 1565), *O. compositus* has now been collected on West Maui.

Material examined: **MAUI:** West Maui, Lahaina Dist, Honolua Bay, 9 m, in shady, alien, coastal forest, 3 Sep 2001, *Oppenheimer H90107* (BISH).

Paspalum fimbriatum Kunth **New island record; Range extension**

Previously documented from Kure Atoll, Kaua'i, O'ahu, and East Maui (Wagner *et al*., 1990: 1576; Starr *et al.*, 2002: 23), the following specimens document a new island record for Moloka'i, as well as a significant range extension to West Maui.

Material examined: **MOLOKA'I:** Waialua, 3 m, roadside weed with *Asystasia*, *Thespesia*, *Terminalia* and *Ruellia prostrata*, 18 Nov 2001, *Oppenheimer H110138*. **MAUI:** West Maui, Wailuku Dist, 'Īao Valley, roadside near Kepaniwai Park, 244 m, 27 Jan 2001, *Oppenheimer H10137*.

Paspalum vaginatum Sw. **New island record**

Naturalized in brackish water and on brackish sand on Kauaʻi, Oʻahu, Maui, and Hawaiʻi (Wagner *et al*., 1990: 1577-8; Herbarium Pacificum Staff, 1999: 7-8), seashore paspalum is common in similar sites along the south shore of Molokaʻi.

Material examined: **MOLOKAʻI:** near sea level, vicinity of Kapuāiwa coconut grove, with *Batis*, 18 Nov 2001, *Oppenheimer H110147*.

Pennisetum purpureum Schumach. **New island record**

This African grass is naturalized on Kauaʻi, Oʻahu, Lānaʻi, Maui, and Hawaiʻi (Wagner *et al*., 1990: 1579, 1581), but had been reported by Wester (1992: 122) as occurring on Molokaʻi. It is not uncommon at low elevations on the east end of the island.

Material examined: **MOLOKAʻI:** Pūkoʻo, 10 m, 2–3m tall grass forming dense stands, 18 Nov 2001, *Oppenheimer H110144*.

Sorghum bicolor (L.) Moench **New island record**

This robust, African grass was collected in a thicket of *Syzygium cumini*, on a steep slope adjacent to a golf course. It was previously known to be sparingly naturalized on Kauaʻi, Oʻahu, and Hawaiʻi.

Material examined: **MAUI:** West Maui, Lahaina Dist, Nāpili, 37 m, 4 Dec 2000, *Oppenheimer H110004*.

Proteaceae

Grevillea robusta A. Cunn. ex R. Br. **New island record**

Probably naturalized on all the islands where it was planted, and documented from Kauaʻi, Oʻahu, Lānaʻi, Maui, and Hawaiʻi (Wagner *et al*., 1990: 1086; Herbarium Pacificum Staff, 1999: 8). It was previously reported as quite widespread in dry areas on all major islands (Smith, 1985: 191). Staples (2001: 90) considered it to be probably planted and naturalized on all main islands and Holt (1992: 528) had listed it from Kamakou Preserve. The following collection represents a new island record for Molokaʻi.

Material examined: **MOLOKAʻI:** Kualapuʻu, 340 m, common in pastures, roadsides, and alien vegetation, 18 Nov 2001, *Oppenheimer H110129*.

Rhizophoraceae

Rhizophora mangle L. **Range extension**

American mangrove had been reported as naturalized on Kauaʻi, Oʻahu, Molokaʻi, Lānaʻi, and Hawaiʻi (Wagner *et al*., 1990: 1100); later it was cited from Keālia Pond on West Maui (Herbarium Pacificum Staff, 1999: 8). On East Maui, there is a small but solid population at the mouth of Kailua Stream near Baldwin Beach Park. It has also been observed at the mouth of Hāhākea Stream in Lahaina District, West Maui.

Material examined: **MAUI:** East Maui, Wailuku Dist, Kailua Gulch, near sea level, 28 Jan 2001, *Oppenheimer H10142*.

Rosaceae

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

Native to China, the peach is a commonly planted fruit tree at higher elevations in Hawaiʻi and is sparingly naturalized in the Kula region of East Maui. It has also been observed

growing wild in Makawao Forest Reserve, in gulch bottoms of the Waiohiwi and Kahakapao drainages. Wagner *et al*. (1990: 1100, 1102) previously considered the peach in the wild on Oʻahu and Hawaiʻi islands as persisting plantings or escapes. Humans, intermittent stream flow, domestic cattle, and feral ungulates are probably spreading the seeds. It is also locally naturalized in the eastern U.S., California, and soutghern Ontario, Canada (Little, 1980: 471–472). *P. persica* is a small, shrubby tree with deciduous, lanceolate, toothed leaves; solitary pink flowers have rounded petals, are sessile on the stem and appear before the leaves; the fleshy fruit is 5.0–7.5cm in diameter and covered with velvety hairs, with a large pitted stone (Neal, 1965: 395–396; Little, 1980: 471). According to Skolmen (1980: 361), 13 individuals of a *Prunus* species were planted in Kula Forest Reserve in 1943. One of the collections cited may be from the offspring of these plantings; there are far more than 13 individuals, although none appeared to have spread very far.

Material examined: **MAUI:** East Maui, Makawao Dist, Kalialinui, 640 m, lanky trees in gully bottom below waterfall, 29 Apr 2001, *Oppenheimer H40143*; Kula Foerst Reserve, Waiohuli, 1951 m, in degraded subalpine shrubland, 20 May 2001, *Oppenheimer H50121*.

Rubiaceae

Paederia foetida L. **Range extension**

[Syn. *P. scandens* (Lour.) Merr.]

Naturalized on Kauaʻi, Oʻahu, East Maui, and Hawaiʻi (Wagner *et al*., 1990: 1160; Starr *et al*., 1999: 14), *maile pilau* has now been collected on West Maui. Plants were observed climbing fences and trees at a small resort and also sprawling across a lawn, with many seedlings. Recently it appears that efforts have been made, with mixed results, to rid the property of this species, but young plants have now appeared across the road at a private residence.

Material examined: **MAUI:** West Maui, Lahaina Dist, ʻAlaeloa, 15 m, 28 Oct 2000, *Oppenheimer H100045*.

Richardia scabra L. **New island record**

First reported as naturalized in the Pacific, Lorence *et al*. (1995: 50–51) cited specimens collected on Kauaʻi. Recently this species has been collected on Maui.

Material examined: **MAUI:** West Maui, Lahaina Dist, Moʻomoku, at edge of pineapple field, 366 m, 29 Mar 2001, *Oppenheimer & G. Shea H30147*.

Spermacoce assurgens Ruiz & Pav. **New island records**

Spermacoce has not been previously reported from Molokaʻi nor Lānaʻi. *S. assurgens*, however, has been previously documented from the islands of Kauaʻi, Oʻahu, Maui, and Hawaiʻi (Wagner *et al*., 1990: 1173).

Material examined: **MOLOKAʻI:** Kaunakakai, near sea level, growing in lawn near the wharf, 14 Jul 2001, *Oppenheimer H70111*. **LĀNAʻI:** Mānele Bay, near sea level, in lawn near the harbor, 15 Apr 2001, *Oppenheimer H40116*.

Spermacoce prostrata Aubl. **New island record**

Formerly misidentified as *P. ovalifolia* (M. Martens & Galeotti) Hemsl. which does not occur in the Hawaiian Islands (D. Lorence, pers. comm.), and documented from the islands

of Oʻahu (Wagner *et al*., 1997: 61) and Hawaiʻi (Lorence *et al*., 1995: 51–52), this species has also been collected on Maui. At the West Maui location, all plants were destroyed, with only a single mature plant found; monitoring of the site is ongoing.

Material examined: **MAUI:** West Maui, Lahaina Dist, Kaulalewelewe, in gravel road, 908 m, 20 Feb 2001, *Oppenheimer H20127* (BISH); East Maui, Hāna District, Koʻolau F.R., near dirt road along Koʻolau Ditch, vicinity of Hanawī Stream, 396 m, degraded *Metrosideros*/*Dicranopteris* forest, 22 Aug 1999, *Oppenheimer H89929* (PTBG); Nāhiku, on jeep roads near Kūhiwa well, 396 m, 8 May 2001, *Starr & Martz 010508-3* (BISH).

Rutaceae

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

Queensland maple was introduced to all of the main islands by the Division of Forestry, but naturalized only in Waiākea Forest Reserve on the island of Hawaiʻi (Wagner *et al*., 1990: 1175). On West Maui, one of these plantings is producing viable seed, and the species is reproducing extensively within the planted area. The winged, wind dispersed seeds are also slowly spreading into adjacent, disturbed sites. It is also reproducing and spreading in the Makapipi Rd area of Nāhiku, in Hāna District on East Maui.

Material examined: **MAUI:** West Maui, Wailuku Dist, Waiheʻe, Kānoa Ridge, 427 m, 10 Dec 2000, *Oppenheimer H120008*.

Sapindaceae

Alectryon macrococcus Radlk. **Range extension**

var. ***macrococcus***

Two varieties of Hawaiian *Alectryon* are recognized, but only var. *auwahiensis* was previously known from East Maui, with var. *macrococcus* occurring on Kauaʻi, Oʻahu, Molokaʻi, and West Maui (Wagner *et al*., 1990: 1225). Robert Hobdy and Tori Haurez of the Division of Forestry and Wildlife first discovered a single tree in Makawao Forest Reserve in September 2000. Two more *māhoe* trees were recently found; these represent a significant range extension for this taxon. More comprehensive survey work is needed to better assess the size of the population.

Material examined: **MAUI:** East Maui, Makawao Dist, Kahakapao Gulch, 872 m, 15 Jul 2001, *H. & M. Oppenheimer & F. & R. Duvall H70126*.

Filicium decipiens (Wight & Arn.) Thwaites **New island records**

A popular ornamental, the fern tree was listed by Staples *et al.* (2000: 29) as potentially invasive, and was reported as such, at least on Oʻahu (Staples *et al*., 2002: 15). Recent collections document its naturalized occurrence on two other islands. Seedlings are common under cultivated, mature trees, and frugivorous birds are undoubtedly spreading the seeds well beyond plantings. *Filicium* has also been observed to be sparingly naturalized along the lower portions of ʻĪao Stream. Neal (1965: 537) reported *F. decipiens* as a native of India, whereas Whistler (2000: 219) considered it native to southeastern Africa from where it was introduced to India long ago.

Material examined: **MAUI:** West Maui, Lahaina Dist, Honokōwai Valley, 91 m, 24 Mar 2001, *Oppenheimer H30134*. **HAWAIʻI:** S. Hilo Dist, Hilo, common in secondary, alien forest near Waiākea Stream, 37 m, 31 Jul 2001, *Oppenheimer H70139*.

Koelreuteria elegans (Seem.) A.C. Sm. subsp. ***formosana*** (Hayata) F.G. Mey **New naturalized record**

The golden-rain tree, a native of Taiwan (Neal 1965: 536), was listed by Staples *et al.* (2000: 29) as potentially invasive. As with other Sapindaceae that have papery, inflated capsules, it is well designed for wind dispersal. The taxon is spreading from single, mature, cultivated trees in at least two locations in ʻĪao Valley, with numerous seedlings and saplings in surrounding areas. According to Skolmen (1980: 275), 447 of these trees were planted in forest reserves on Kauaʻi, Oʻahu, Molokaʻi, Maui, and Hawaiʻi; a total of 15 of these were planted in ʻĪao Valley in 1955 and 1957. The tree has a spreading crown; the leaves are bipinnate; flowers yellow in panicles; and usually 3 small, round, black seeds in a three-parted, ovoid, pinkish orange capsule 4 cm long.

Material examined: **MAUI:** West Maui, Wailuku Dist, ʻĪao Valley, near Kepaniwai Park, 244 m, 27 Jan 2001, *Oppenheimer H10141*.

Sapotaceae

Chrysophyllum oliviforme L. **New island record**

Satinleaf was first documented as a naturalized species in Hawaiʻi by Lorence *et al*. (1995: 54); they cited collections made on Kauaʻi. Wagner *et al*. (1997: 62) later reported it from the islands of Oʻahu and Hawaiʻi. On West Maui, it was planted in the 1920s on Maui Pineapple Co. lands as part of Maunalei Arboretum (Maui Pineapple Co., unpubl.). In recent years numerous seedlings have been observed amongst the plantings, and mature, fruiting trees with thousands of seedlings and saplings have been found in two widely separated locations over 400 m away. It is believed that feral pigs have dispersed the fruits. Efforts are already underway to eradicate all known plants, as well as the animals. On East Maui, *C. oliviforme* is known from several sites, including Haʻikū, Twin Falls, and Keʻanae.

Material examined: **MAUI:** West Maui, Lahaina Dist, Honolua Valley, W slope below Puʻu Kaʻeo, 476 m, 17 Nov 2000, *Oppenheimer H110012*; Mokupeʻa Gulch, 335 m, 15 May 2001, *Oppenheimer H50114*; East Maui, Makawao Dist, Haʻikū, Kauhikoa Rd, 305 m, 28 Nov 2000, *F. Starr & K. Martz 001128-4* (BISH); Haʻikū, Kauhikoa Hill, intergrading with *C. mexicanum* T. Brandegee, forming dense stands, 366 m, 21 Oct 2001, *Oppenheimer H100111*.

Scrophulariaceae

Lindernia crustacea (L.) F. v. Muell. **New island record**

Known to be naturalized on Oʻahu and Hawaiʻi (Wagner *et al.*, 1990: 1242), this taxon recently appeared on Maui as volunteers in nursery pots. All known plants were destroyed, except for the following voucher specimen.

Material examined: **MAUI:** West Maui, Lahaina Dist, ʻAlaeloa, 37 m, 25 Aug 2000, *Oppenheimer H80044* (BISH).

Solanaceae

Nicotiana glauca Graham **New island record**

Naturalized on Oʻahu, Lānaʻi, Maui, Kahoʻolawe (Wagner *et al*., 1990: 1262) and Hawaiʻi (Wagner & Herbst, 1995: 26), tree tobacco was recently collected on Molokaʻi. It is fairly common along the south side of the island at least from Kaunakakai to Kamalō. This alien species is a known host plant for the endangered Hawaiian sphinx moth, *Manduca*

blackburni, on Maui, Kahoʻolawe, and Hawaiʻi (A.C. Medeiros, pers. comm.). However, a survey of several dozen Molokaʻi plants on two occasions revealed no eggs, larva, or feeding damage.

Material examined: **MOLOKAʻI:** Kaunakakai, near sea level, 14 Jul 2001, *Oppenheimer H70113.*

Physalis angulata L. **New island record**

Only known in the Hawaiian Islands from near Hanalei, Kauaʻi (Wagner *et al*., 1990: 1265), and more recently from Oʻahu (Imada *et al.*, 2000: 15), *P. angulata* was noted to be naturalized, though uncommon, around Hilo.

Material examined: **HAWAIʻI:** S Hilo Dist, Waiākea Stream, 18 m, 2 Aug 2001, *Oppenheimer H80106.*

Sterculiaceae

Sterculia apetala (Jacq.) Karst. **New naturalized record**

A tall, deciduous tree, native to tropical America (Neal, 1965: 579), *S. apetala* (Panama tree, French peanut) was planted in Honokōhau Valley in 1937 and 1939 (Maui Pineapple Co., unpubl.). Numerous seedlings and saplings are now growing in areas adjacent to the plantings, and slowly spreading. This species has large, alternate leaves with five lobes; yellow flowers with purple spots; large, woody follicles with up to five divisions, lined with irritating hairs, and black seeds. *Sterculia* is a tropical genus of about 200 species, some used for timber, gums, edible seeds, and as ornamentals (Whistler, 2000: 431). This species is also invasive in Puerto Rico (Francis & Liogier, 1991).

Material examined: **MAUI:** West Maui, Lahaina Dist, Honokōhau Valley, 49 m, 6 Jul 1999, *Oppenheimer H79906* (BISH); same locality, 37 m, 13 Jun 2001, *Oppenheimer & R. Bartlett H60129*.

Verbenaceae

Citharexylum caudatum L. **New island record**

Naturalized on Oʻahu (Wagner *et al*., 1990: 1317) and East Maui (Starr *et al*., 1999: 14), *C. caudatum* was noted to be escaping from roadside plantings and invading open fields and pastures on Hawaiʻi island.

Material examined: **HAWAIʻI:** S. Hilo Dist, along Hwy 19, 159 m, 29 Jul 2001, *Oppenheimer H70137*; near UH Hilo campus, 60 m, 1 Aug 2001, *Starr & Martz 010801-2* (BISH).

Stachytarpheta jamaicensis (L.) Vahl **New island record**

A nearly pantropical weed, and naturalized in Hawaiʻi on the islands of Midway Atoll, Kauaʻi, Oʻahu, Lānaʻi, Maui, and Hawaiʻi (Wagner *et al*. 1990: 1322). The following collection represents a new record for Molokaʻi.

Material examined: **MOLOKAʻI:** Along road into Hālawa Valley at Alanuipuhipaka Ridge, 140 m, 18 Nov 2001, *Oppenheimer H110141.*

Zingiberaceae

Zingiber zerumbet (L.) Sm. **New island record**

A Polynesian introduction, *ʻawapuhi* or shampoo ginger has been documented from Kauaʻi, Oʻahu, Molokaʻi, Lānaʻi, and Maui (Wagner *et al*., 1990: 1623-4). It was recently collected on the island of Hawaiʻi, where it forms dense patches in shady, alien, low-

land forest. The foliage dies off in the late fall and winter, leaving only the rhizomes; this may be one reason the species had not previously been collected on the Big Island.

Material examined: **HAWAI'I:** S Hilo Dist, along UH Hilo mountain bike trail, 61 m, 1 Aug 2001, *Oppenheimer H80103*.

Zygophyllaceae

Tribulus terrestris L. **New island record**

Sparingly naturalized on Kaua'i, O'ahu, Maui, and Hawai'i (Wagner *et al*., 1990: 1344), puncture vine is now known to occur on Moloka'i as well.

Material examined: **MOLOKA'I:** Kaunakakai, 6 m, 14 Jul 2001, *Oppenheimer H70123.*

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A Reassessment and New State Records of Trichoptera Occurring in Hawai‘i with Discussion on Origins and Potential Ecological Impacts

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Introduction

The caddisflies (Order Trichoptera) are a group almost invariably aquatic in their immature stages, although a few are wholly terrestrial (see Wiggins, 1996 for a general overview of the order and their biology). The order is not native to the Hawaiian fauna, but several species have appeared in this last century (Zimmermann, 1957). The first specimens were taken in Honolulu in 1940 (Zimmerman, 1943) and subsequently identified by H.H. Ross as *Oxyethira maya* Denning (Ross, 1948). A second species, *Cheumatopsyche analis* Banks was reported by Beardsley (1966). The third species, first reported as *Hydroptila* sp. by Joyce (1969) was subsequently identified as *H. arctia* Ross by Denning & Blickle (1971). Additional material of *Hydroptila* was submitted to the senior author in 1988 by Kumashiro, which turned out to be the recently described *H. potosina* Bueno-Soria (Bueno-Soria, 1984). This species is closely related to *Hydroptila arctia*, and as a consequence a re-examination of the identity of the originally collected material of *Hydroptila* was undertaken, which verified that *H. arctia* was at that time a misidentification for the undescribed species later described as *H. potosina*. In this paper we report on a new record for the state of Hawai‘i, the occurrence of yet another nonindigenous microcaddisfly, *Hydroptila icona* Mosely.

Material in the following collections was examined in the course of this study: Bernice P. Bishop Museum, Honolulu (BPBM); Hawaii Department of Agriculture, Honolulu (HDAH); National Museum of Natural History, Smithsonian Institution, Washington, DC (NMNH).

Family Hydroptilidae

Hydroptila potosina Bueno-Soria **Name change** Figs. 1–8

Hydroptila potosina Bueno-Soria, 1984: 95.

Hydroptila arctia nec Ross: Beardsley, 1971: 15. Denning & Blickle, 1971: 164. Blickle, 1979: 47 (Hawaiian records all misidentifications).

Several examples of the original collection of *Hydroptila* from Hawai‘i that were sent to Denning & Blickle and identified as *H. arctica* were re-examined in this study and the male is unquestionably *potosina*. Thus, the record of *H. arctia* is to be erased from the Hawaiian list and be replaced by *potosina*.

Although *H. arctia* is common and widespread in the western United States and Mexico, *H. potosina* has a much smaller known range. It is confined to the northeastern Mexican states and adjacent Texas. The species is known from the following Hawaiian islands: Kaua‘i (NMNH), O‘ahu (NMNH, BPBM), Maui (BPBM), Moloka‘i (BPBM), Hawai‘i (BPBM, NMNH).

Because the original description of the species is in a journal not widely available, new figures of the male genitalia are given here. In the male, the species is quickly dif-

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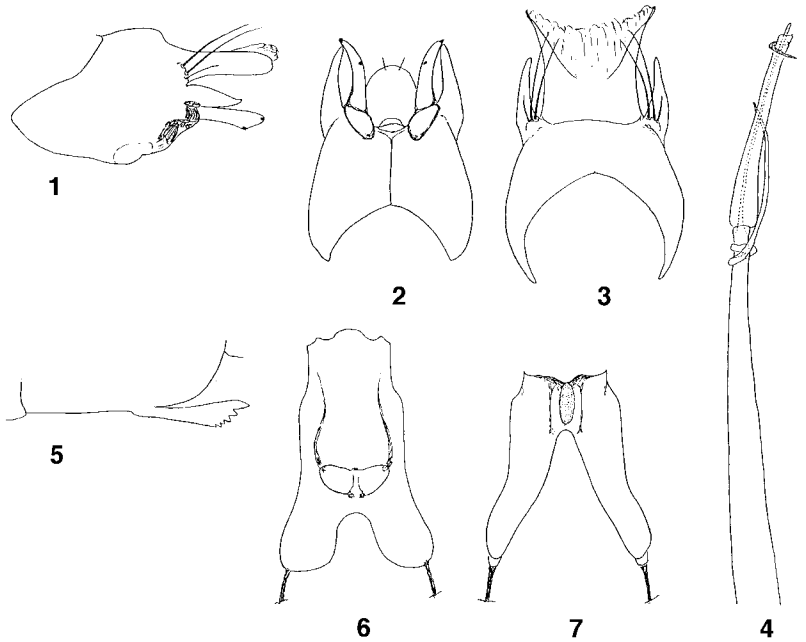


Figs. 1–7. *Hydroptila potosina* Bueno-Soria. **1**, male genitalia, lateral; **2**, same, ventral; **3**, same, dorsal; **4**, phallus, dorsal; **5**, seventh sternum and process, lateral; **6**, female eighth sternum; **7**, same, eighth tergum.

ferentiated from *Hydroptila arctia* by the process on the seventh sternum which is large, arcuate and serrate on its outer margin. This process in *arctia* is much smaller, sharply pointed and lacks all serrations. We also here figure the female genitalia for the first time to facilitate the separation of the two Hawaiian *Hydroptila* species in this sex.

The cases of the immature stages of the two *Hydroptila* species are easily distinguished. The case of *H. potosina* is silken with many, very small, sand grains embedded in its surface. It also appears rather smooth and regular (Fig. 10). In contrast the case of *H. icona*, also basically of silk and purse-shaped, contains embedded fragments of algal filaments arranged in oval bands and the entire case has a "fuzzier" appearance. *Hydroptila potosina* appears to be the most abundant hydroptilid in Hawai'i, with medium to high densities of larvae observed in most streams.

Material examined. **O'AHU:** Honolulu Apt., 20 May 1968, C.R. Joyce, light trap, 1 male; same, but 28 May 1968, 1 male; same, but 24 Jun 1968, 1 female (NMNH). Mililani, 17 Apr 1988, J. Michishima, at light in garage, 2 males, 1 female (NMNH), 1 male (HDAH). Honolulu, University of Hawaii, 25 Apr 1969, J.W. Beardsley, 1 male, 1 female (HDAH). **KAUA'I:** Keālia Str., 15 Mar 1979, J. Maciolek, 2 male, 2 females (NMNH). **HAWAI'I:** Waipi'o Valley, BPBM Survey Site #4a/5, 4 m, 14 Mar 2001, R.A. Englund, N.L. Evenhuis & D.J. Preston, MV bulb, 2 females (BPBM); same, but Site # 5 (5 m), light trap off sheet, 3 female (BPBM); same but Site #6 (30 m), brushed off boulders, 25 larvae, 1 male metamorphotype, 8 pupae (BPBM, NMNH); same but 15 Mar, Site #6, 40 m,

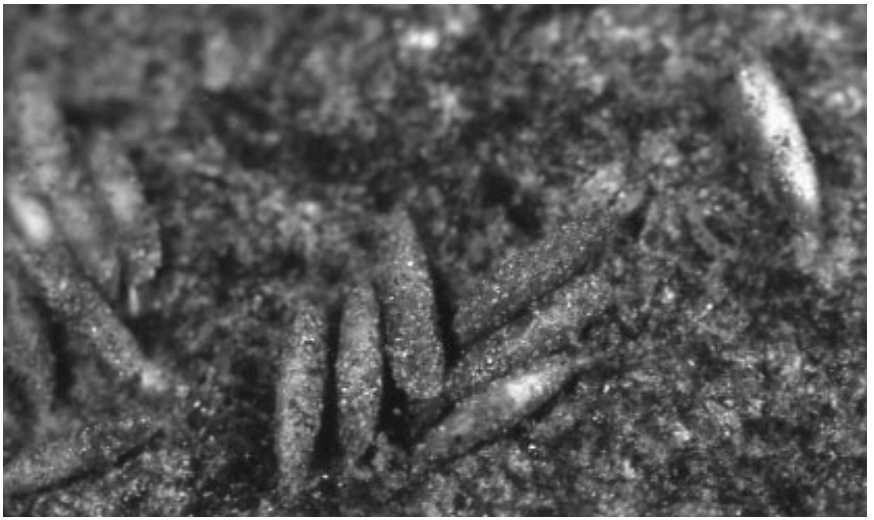


Fig. 8. *Hydroptila potosina* Bueno-Soria, larval and pupal cases from in Wailoa River, Waipi‘o Valley, Hawai‘i Island, 42 m elevation. Photo: R.A. Englund & D.J. Preston.

1 larva, 2 male metamorphotypes, 14 pupae (BPBM, NMNH). **MAUI:** Olowalu Stream, 21 Jul 1994, 365 m, l larva, 1 male, D.A. Polhemus (BPBM); ‘Īao Stream, 19 Dec 2001, 280 m, 3 larvae, R.A. Englund & D.J. Preston (BPBM).

Hydroptila icona Mosely **New state record** Figs. 9–10

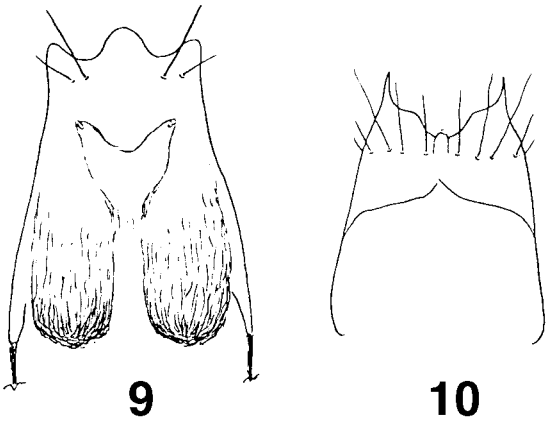
Hydroptila icona Mosely, 1937: 161. Ross, 1944: 154. Harris & Holzenthal, 1999: 38.

This species is newly discovered in the Hawaiian Islands, but already seems widely distributed, having been collected on Moloka‘i (BPBM, NMNH), O‘ahu (NMNH), and Maui (NMNH). It was originally described from Chiapas and Sinaloa in Mexico and subsequently recorded from Honduras, Nicaragua, Costa Rica, and USA (Texas, Oklahoma, New Mexico, Arizona, and California).

The male genitalia have been well figured by Mosely (1937), Ross (1944), and Harris & Holzenthal (1999). The female terminalia have not been previously figured. We provide figures of the female terminalia here for comparison with those of *H. potosina*.

As mentioned above, the larval cases of this species are easily distinguished from those of *H. potosina*. In *H. icona* they are silken with embedded bits of algal filaments arranged in concentric, oval rings with the entire case appearing a bit shaggy.

Hydroptila icona was first collected in Pelekunu Stream, Moloka‘i during annual surveys conducted in 2001. This species had not been observed during earlier monitoring of this stream in either 1991 or 2000 (Englund, 2001), and was collected in stream habitats just above the ocean to approximately the 30 m elevation level, but no higher. By 2002 *H. icona* was found in Pelekunu Stream to the highest elevation surveyed of over



Figs. 9–10. *Hydroptila icona* Mosely. **9**, female eighth sternum; **10**, same, eighth tergum.

260 m above sea level, and thus appears to have successfully invaded the entire Pelekunu watershed. *Hydroptila icona* was found in high densities during both 2001 and 2002 in Pelekunu Stream riffles. The center-channel areas were the primary habitat preferred by this species, in the mid-channel areas of the most heavily flowing water. Of particular concern is the ability of *H. icona* to tolerate the high water velocities found in the v-shaped area at the beginning, or upstream end of cascades in riffles; these are areas of the stream containing the greatest water volume. The highest water velocities of Hawaiian streams are also the most favored by native aquatic insect species (Howarth & Polhemus, 1991).

This species has likely been present on O‘ahu for several years, but published or unpublished reports regarding the occurrence of *H. icona* on this island have not been found. It is undoubtedly widely distributed throughout O‘ahu.

Material examined. **MOLOKA‘I**: Pelekunu Stream, 23 May 2001, R. Englund, sea level, fast riffle, 1 male, 2 female metamorphotypes, 14 pupae (BPBM, NMNH); same, but 20–30 m, 3 larvae, 1 male metamorphotype, 5 pupae, many empty cases (BPBM). Pelekunu Stream, R.A. Englund, 28 May 2002, upstream of Papaiki camp, 150 m, 29 May 2002, 6 larvae; Pelekunu Stream, 260 m (Pilipililau Tributary), 3 larvae (BPBM). **O‘AHU:** S. Fork Kaukonahua Stream, 10 Sep 2002, 304 m, riffles, above Canon Dam, 2 larvae; Punalu‘u Stream (BPBM), 5-100 m, riffles, 30 larvae, R.A. Englund & D.J. Preston, 4–7 Nov 2002 (BPBM). **MAUI:** West Wailua Iki Stream, 22 Jan 2003, 490 m, riffles, 20 larvae, many empty cases (BPBM, NMNH).

Oxyethira maya Denning

Oxyethira maya Denning, 1947:16. Zimmerman, 1943: 350; 1957: 173. Ross, 1948:257. Kelley & Morse, 1982: 262.

This was the first caddisfly reported from the islands and is now quite widespread throughout Hawai‘i. Because of its small size *Oxyethira maya* is frequently overlooked in Hawaiian streams, and is more often collected light trapping around streams at night than observed in the stream benthos. There seems to be no doubt as to the identity of this species. It has not

been encountered frequently on the continent, being known from the southeastern states as far west as Texas. The senior author has also seen it in abundance from Barro Colorado Island, Panama (unpubl. observ.).

There are good published figures of the male genitalia of this species in Zimmerman (1957), and of the female genitalia in Kelley & Morse (1982). Larvae are found in transparent whitish cases about 3 mm long that are made of extremely fine silk, with no rocks attached; these cases are elongate, flattened, and narrowed at the posterior end (Beardsley, 1971).

The species was first reported from O‘ahu (BPBM), and is also known from Kaua‘i (NMNH, BPBM), Maui (BPBM), and Hawai‘i (BPBM).

Material examined. **KAUA‘I**: Keālia Str., 15 Mar 1979, J. Maciolek, 1 male, 3 females (NMNH). **HAWAI‘I**: Waipi‘o Valley, BPBM Survey Site #4a/5 (4 m), 14 Mar 2001, N. Evenhuis, R.A. Englund & D.J. Preston, MV bulb, 1 female (BPBM). **MAUI:** Hanawī Stream, Malaise trap, 915 m, 12 Nov 1992, D.A. Polhemus & R.A. Englund, 1 male, 1 female (BPBM).

Family Hydropsychidae

Cheumatopsyche analis (Banks) **Name change**

Hydropsyche analis Banks, 1903: 243.
Hydropsyche pettiti Banks, 1908: 265.
Cheumatopsyche analis (Banks). Ross, 1944: 112 [*pettiti* as junior synonym]. Beardsley, 1966: 145.- Denning & Beardsley, 1967: 56

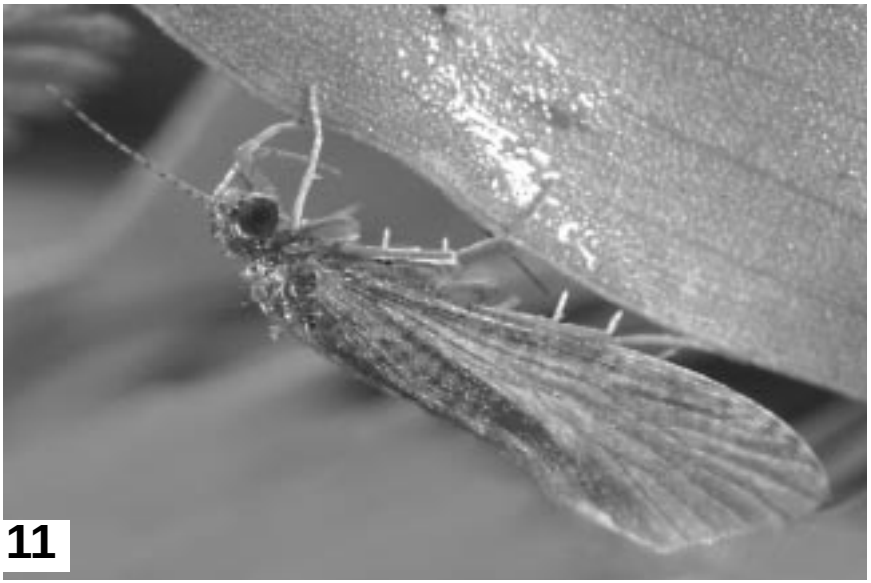
The name *analis* has had a controversial history in the last decades. Ross (1944), although stating that the type was damaged, felt sure that he was able to recognize the species on the remaining characteristics of the male genitalia. However, Gordon (1974), because the genitalia was incomplete, relegated *analis* to a *nomina dubia* status and resurrected *pettiti* for the same taxon. We consider Ross (1944) in his treatment of the group, which was the first large revision of the North American species in the genus, established the identity of *analis* on the basis of First Revisor, and will continue to use the name with *pettiti* placed as a junior synonym.

Although several species closely related to *analis* have been described (i.e., *smithi* Gordon, *rossi* Gordon), the examples from Hawaii do not seem to be either of these forms. It is rather doubtful, in fact, if either of these falls outside the normal level of variation found in *analis*. This is, in North America, a confusing genus of many very similar species whose validity will need some type of molecular testing to substantiate.

The larval case of *C. analis* is a loosely woven aggregation of relatively large pebbles, with the cases sometimes forming silken tunnel retreats for the larvae. When compared to the other Hawaiian caddisfly species the larvae are much larger (15–18 mm) and more common, forming the predominant aquatic insect biomass within the substrate of Hawaiian streams, while the hydroptilid species are generally less important because of their much smaller size.

This is one of the most widespread and ubiquitous caddisflies in North America, and the most widely distributed species in the Hawaiian Islands. It is found from the Atlantic to the Pacific in both the United States and Canada. The species has also become widespread across the islands, with records from Kaua‘i (BPBM), O‘ahu (NMNH, BPBM), Moloka‘i (BPBM), Maui (NMNH), Hawai‘i (NMNH, BPBM).

Material examined. **O‘AHU**: U[niversity] H[awaii] Campus, Hon[olulu], Aug 1966, J.W. Beardsley, 2 female (NMNH). Public Health Dep. light trap, Jun 1966, J.W. Beardsley, 2 male (NMNH). **MAUI:** ‘Īao Valley St. Pk., 160 m, 6 Dec 1976, D. & M. Davis, 1 male (NMNH). **HAWAI‘I:**



Figs. 11–12. *Cheumatopsyche analis* Banks **11**, Adult *Cheumatopsyche analis*, Wailoa River, Waipi‘o Valley, Hawai‘i Island, 4 m; **12**, Larval *Cheumatopsyche analis*, Waiāhole Stream, O‘ahu Island, near sea level. Photos: R.A. Englund & D.J. Preston.

14 mi. W. Hilo, Stainback Hwy, 400 m, 10 Dec 1976, D. & M. Davis, 1 female (NMNH). 10.4 mi. NW. Hilo, 19 Sep 1972, O.S. & C.M. Flint, 8 male, 2 female (NMNH). Waipiʻo Valley, BPBM Survey Site #5 (4 m elev), 14 Mar 2001, N. Evenhuis, R.A. Englund & D.J. Preston, MV light trap, 3 male, 5 female (BPBM); same but Site #6, 40 m, brushed off boulders, 3 larvae (BPBM). Honoliʻi Stream, 8 Feb 2002, R.A. Englund, D.J. Preston, G.A. Samuelson, 975 m, 1 adult male. **MOLOKAʻI:** Pelekunu Stream, 23 May 2001, R.A. Englund, sea level, fast riffle, 1 larva (BPBM). **KAUAʻI**: Koaiʻe Stream, 8 Jan 1999, R.A. Englund & D.J. Preston, 1160 m, Surber sample #3 by USGS stream gage, 6 larvae (BPBM).

Discussion

With the discovery of a fourth species of caddisfly on the Hawaiian Islands, which originally harbored no species of this order, it becomes possible to speculate on the source of these immigrants. *Hydroptila potosina* is the species with the most limited native home range and is presently known only from the northeastern states of Mexico and Texas. *Hydroptila icona* and *Oxyethira maya* both occur in this same area with *H. icona* extending a bit further into the USA and throughout Central America, while *O. maya* extends along the Gulf Coast of the USA and south to Panama. *Cheumatopsyche analis* is found throughout the U.S. and Canada and does enter Texas but not Mexico. Assuming that all four species have a similar origin, a site in Texas seems to be a probable source location. Even if these four caddisfly species had different origins, sites along the western Gulf coast in the U.S. or Mexico would still be likely source areas.

How the caddisflies might have been transported to Hawaiʻi is less certain than determining possible origins. The caddisfly *Cheumatopsyche analis* was first collected at light traps in 1965 in various locations throughout Oʻahu (Denning & Beardsley, 1967). Species in this genus are found in lotic habitats or fast-flowing areas of streams (Merritt & Cummins, 1996). Although it seems possible that this species could have inadvertently been introduced into Hawaiʻi during unsuccessful attempts in the early 1960s to establish several species of mayfly [Ephemeroptera] to serve as forage for sport fish in Kauaʻi streams (see Usinger, 1972), this appears unlikely. Several lines of evidence appear to corroborate *C. analis* coming in with aquarium plants, mainly because adult caddisflies are short-lived and would likely not survive transport as would the eggs or perhaps larvae. Also, the first record of *C. analis* was from light-traps on Oʻahu; J.W. Beardsley had been regularly checking light traps from all the Hawaiian Islands since the late 1950s (J.W. Beardsley, pers. comm.), and believed it was much more likely that *C. analis* eggs or larvae were transported into Hawaiʻi with aquatic vegetation or some other aquatic substrate. The first record of *C. analis* from Kauaʻi, the island with the attempted mayfly introductions in 1961, was 1971 (Kawamura ,1974).

Prior to 1985, most aquatic plant shipments originated from the mainland U.S., with California, Texas, and Florida having the greatest shipments to Hawaiʻi (Domingo Cravalho, Hawaii State Department of Agriculture, pers. comm.). Since that time, most aquatic plants entering Hawaiʻi originate from Singapore, with the state a major trans-shipment point for plants destined for the mainland U.S.; however, some aquatic plants such as *Elodea* spp. and *Cabomba* spp. still enter Hawaiʻi from California, with lesser amounts from Texas and Florida (Domingo Cravalho, Hawaii State Department of Agriculture, pers. comm.).

The pattern of caddisfly introductions into the Hawaiian Islands is exemplified by *C. analis*, which after its initial Oʻahu introduction in 1965 spread rapidly to the other islands, and was found on all the major islands by 1971 (Table 1). It is likely that the small *Hydroptila potosina* was present earlier on Kauaʻi, Maui, and Hawaiʻi islands but was overlooked and not reported to occur on these islands until the 1990s.

Table 1. First collection record by Hawaiian island of four currently known introduced caddisfly species.

Caddisfly Species	Island	First Collected	First Reference
Cheumatopsyche analis	O‘ahu	1965	Denning and Beardsley (1967)
	Moloka‘i	1969	Joyce (1970)
	Kaua‘i	1971	Kawamura (1974)
	Hawai‘i	1971	Shiroma (1972)
	Maui	1971	Denning and Blickle (1971)
Oxyethira maya	O‘ahu	1940	Zimmerman (1957)
	Hawai‘i	1957	Adachi (1958)
	Kaua‘i	1959	Beardsley (1960)
	Maui	1970	Beardsley (1971)
Hydroptila potosina	O‘ahu	1968	Joyce (1969)
	Kaua‘i	1979	J. Maciolek specimen (NMNH)
	Hawai‘i	1990	Polhemus (1995)
	Maui	1994	Polhemus (1995)
Hydroptila icona	Moloka‘i	2001	This study
	O‘ahu	2002	This study
	Maui	2003	This study

Because most native Hawaiian aquatic insects have evolved from marine shoreline areas and dwell in highly turbulent riffle, cascade, and waterfall areas (Howarth and Polhemus 1991), the establishment of caddisflies in Hawaiian streams may also have in some cases either led to the successful establishment of several species of non-indigenous fish, or at the very least provided a more favorable food base for introduced fish species than was previously available in Hawaiian streams. For example, Englund & Polhemus (2001) found that *C. analis* comprised nearly 20% of the diet for naturally reproducing introduced rainbow trout (*Onchorhynchus mykiss*) in Kaua‘i streams. Similarly high percentages in the diet of the highly predatory introduced smallmouth bass (*Micropterus dolomieui*) on Kaua‘i have also been found for *C. analis* (R.A. Englund & D.J. Preston, unpubl. data).

Although cause and effect data are difficult to obtain, *C. analis* (and other introduced caddisflies) has likely adversely influenced native aquatic invertebrate populations, perhaps through competition for space and resources, or simply because of its large size and great abundance in Hawaiian streams. By their sheer numbers introduced caddisflies are likely having some impacts on the native aquatic insect fauna, for example, in upper elevation Kaua‘i streams *C. analis* accounted for 57% (by number) of the stream benthos during Surber sampling (Englund *et al*., 2000). Although no hard evidence is currently available, the late J.W. Beardsley (pers. comm.) speculated that the decline of the giant endemic freshwater chironomids in the genus *Telmatogeton* spp. appeared to be correlated with the introduction of caddisflies in the late 1960s. Of the 57 perennial streams on O‘ahu, only four streams (Englund & Polhemus, unpubl.) are currently known to have populations of the formerly common *Telmatogeton* while caddisflies now inhabit every O‘ahu stream.

Acknowledgments

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New Species and Records of Xenasteiidae (Diptera) from the Australian and Oceanian Regions

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The family Xenasteiidae has, so far, been known from the Mediterranean coast and the islands of the Indian and Pacific Oceans (Papp, 1998). It was originally described by Hardy (1980) who included seven newly described species in the genus *Xenasteia* Hardy. Papp (1980) described the family Tunisimyiidae later in the same year and this was synonymized with Xenasteiidae by Papp (1984). McAlpine (1989) synonymized *Tunisimyia* with *Xenasteia*. Freidberg (1994) subsequently added a second Palaearctic species in the genus *Xenasteia*. Papp (1998) retained a division between *Xenasteia* (without an anal cell and cross-vein r-m very basal in position) and *Tunisimyia* (with an anal cell and cross-vein r-m more distal in position). *Tunisimyia* contains the two Palaearctic species and *Xenasteia* is known from the Pacific and Indian Oceans. Since the publication of Hardy's original paper (1980), further material from the Australian and Oceanian Regions has accumulated. This paper describes new species and extensions of the known distribution of the family. McAlpine (1998) recorded the genus *Xenasteia* from Papua New Guinea and it was also reported from Australia by inclusion in keys (Colless & McAlpine, 1991), but not formally added to the fauna.

In Hardy (1980) the key separates four of the Pacific Ocean species of *Xenasteia* on the basis of the concolorous scutum and the presence of dark markings on the dorsal part of the pleura. Under *X. palauensis* Hardy and *X. divergens* Hardy, further specimens from the Pacific were discussed and the comment was made that "These species with a generally reddish coloration of the body obviously form a complex from over the Pacific area". The two new species described below are considered to form part of this complex. The key used other color characters that may depend on the state of maturation and preservation of the specimens. In contrast the characters of the male genitalia used by Hardy and those used in the present work appear to separate the species more reliably. In this paper the taxonomic separation of the species is based largely on the male genitalia though color and other characters are included in descriptions. The type material is restricted to male specimens whose genitalia have been examined and the remaining specimens listed under further material. The head width was measured across the outer margins of the compound eyes and the wing length measured from the basicosta to the wing tip.

The male genitalia appear to be of very similar structure throughout the family. The aedeagus is small in all species and in the two species described here could not be distinguished with a compound microscope. The cercus is large and separate and the surstylus is elongate in many species and narrow. There appear to be two processes of the hypandrium, but authors have used differing terminologies. The more anterior process is here termed the anterior gonopod after Papp (1998) and is the gonopod of Freidberg (1994) and the anterior lobe of the hypandrium of Hardy (1998). It has two setae near the tip in all species that have been examined or illustrated. The posterior process is here termed the posterior gonopod and is the paramere of Freidberg (1994) and the posterior lobe of the hypandrium of Hardy (1980). The abbreviations for museums are: AM, Australian Museum, Sydney; ANIC, Australian National Insect Collection, Canberra; BMNH, The

Natural History Museum, London; BPBM, Bishop Museum, Honolulu; UMO, Hope Entomological Collections, Oxford University Museum of Natural History, Oxford; USNM, Smithsonian Institution, Washington.

Pacific fauna

Xenasteia hardyi Ismay **new species** Figs. 1–2, 5–6, 8

Holotype ♂: Hawaii, O'ahu, S. of Hau'ula, 29.1.1994, J.W. Ismay, coast. Deposited in BPBM. *Paratypes:* 5// Henderson Island, 24° 04' S, 129° 07' W, NW beach, 12–20.v. 1987, W.N. Mathis (USNM). Further material: 2♀♀, same data as holotype (BPBM, UMO); 5♂♂, 16♀♀, same data as paratypes(USNM).

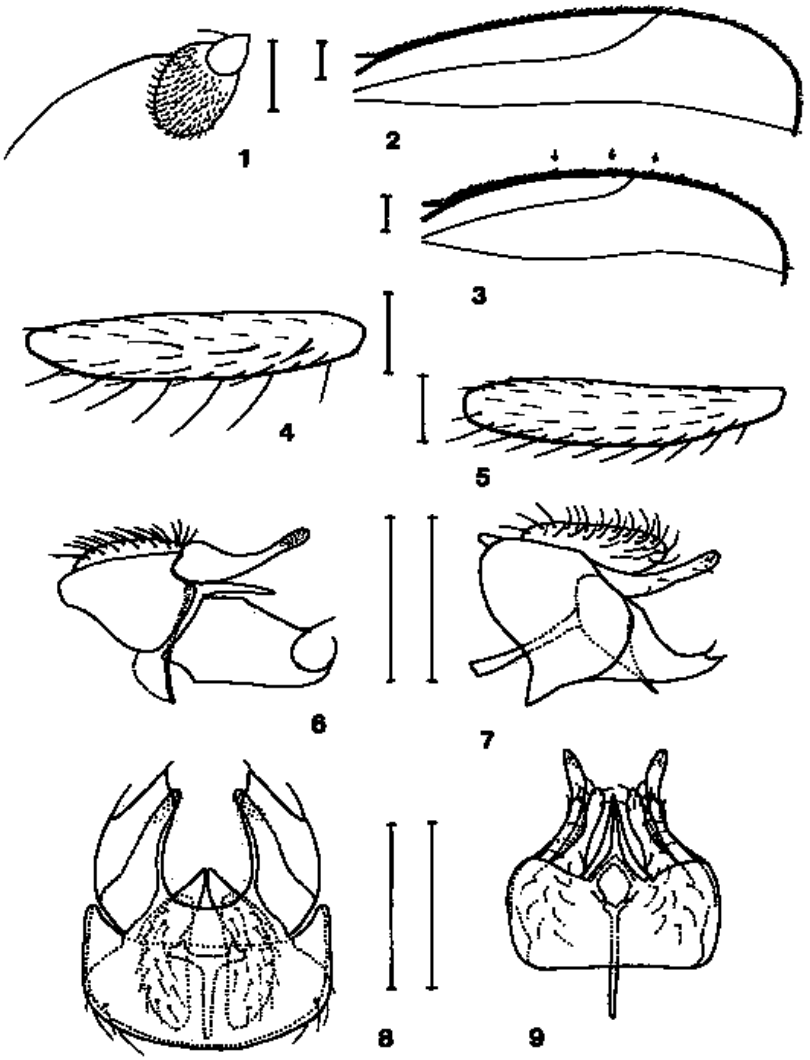
Description: ♂: Frons, scutum, scutellum and abdomen dark brown, paler on anterior margin of scutum, with a paler band extending from postpronotal lobe to base of scutellum along dorsal margin of pleura. More than ventral half of anepisternum and anepimeron darker brown than scutum. Setae and setulae brown. First flagellomere of antenna (Fig. 1) with long microtrichia, longer than diameter of an ocellus. Scutellum dulled by dense microtrichia. Frons, scutum and abdomen with metallic reflections. Legs almost wholly yellow, anterior and posterior femora faintly darkened. Wing with crossvein r-m close to fork of R_{2+3} and R_{4+5}, distance from fork to r-m about length of r-m. Costal ratio (R_1 - R_{2+3} / R_{2+3} - R_{4+5}) = 1.6. Costa of wing with setulae uniform (Fig. 2). Halter distinctly darkened. Palpus and proboscis yellow. Anterior femur with posteroventral setae becoming only slightly longer distally (Fig. 5).

Male genitalia figured in lateral view (Fig. 6) and ventral view (Fig. 8) with surstylus broad at base, narrowed to finger-like process for about apical half of length, apex rounded. Anterior gonopod broad basally to about two-thirds length, with strong seta at two-thirds length on posterior margin and curved seta at apex, excavated on posterior margin for remainder of length between these two setae. Posterior gonopod short and broad, convergent and meeting in mid-line, much shorter than the other processes. Cerci very short, scarcely extending beyond bases of surstyli.

Head width 0.76mm, wing length 1.7mm (holotype).

Remarks. The species runs to *X. palauensis* Hardy in Hardy (1980), but the halter is darkened in *X. hardyi* and the male genitalia are different. In *X. palauensis* the anterior gonopod is narrow at the tip, with the two setae smaller and placed apically, the surstyli are slightly divergent, the posterior gonopods are separated apically and the aedeagus is well developed for this family. In *X. hardyi* the anterior gonopod is large and broad, with the two setae well separated and a concave space between them, the surstyli are distinctly convergent, the posterior gonopods are approximated in the mid-line and the aedeagus was not distinguished. In Fig. 5 the anterior femur is drawn from a lateral aspect. The ventral setae are longer apically, but this does not show on the figure because the longer apical setae are also directed more laterally and consequently appear foreshortened.

The holotype was collected by beating dead hanging *Pandanus* leaves. The type specimens of *X. palauensis* were also collected on dead leaves of *Pandanus*. The species is named after the late Dr. D. Elmo Hardy in recognition of his original work on this family and many other groups of Diptera. A further female specimen, Pitcairn Island, 25° 04' S, 130° 06' W, Adamstown, 22–26.v.1987, W. Mathis is probably this species but a male specimen is needed to confirm the record.



Figures 1–9, *Xenasteia* species. **1**, *Xenasteia hardyi*, n. sp., pedicel and first flagellomere of antenna, lateral view, **2**, *X. hardyi*, n. sp., costa between ends of veins R_1 and R_{4+5}. **3**, *X. lansburyi*, n. sp., ditto. **4**, *X. lansburyi*, n. sp. anterior femur, lateral view. **5**, *X. hardyi*, n. sp., ditto. **6**, *X. hardyi*, n. sp., male genitalia, lateral view. **7**, *X. lansburyi*, n. sp., male genitalia, lateral view. **8**, *X. hardyi* n. sp., male genitalia, ventral view. **9**, *X. lansburyi*, n. sp., male genitalia, ventral view. Scale lines = 0.1 mm.

Xenasteia lansburyi Ismay, **new species** Figs. 3–4, 7, 9

Holotype ♂: Papua New Guinea, Madang Province, Nagada Harbour, MVLT [Mercury Vapour Light Trap] water trap, 7.v.1992, 6–8 pm, I. Lansbury. Deposited in UMO. Paratypes, 2♂♂, same data but water trap, 1–2.v.1992; 2♂♂, same data but 16–17.v.1992; 1♂, same data but 4.v.1992, nr greenhouse; 2♂♂, same data but 9–10.v.1992. In UMO, BPBM, BMNH, USNM. Further material: 1♀, same data as holotype but water trap, 1–2.v.1992; 1♀, same data as holotype but 16-17.v.1992; 1♀, same data as holotype but 30.v.1992, 6–8 pm. In UMO.

Description. ♂: Frons, scutum, scutellum and most of abdomen brown; abdomen yellow centrally on syntergite 1+2 at base. Antenna dark yellow, palpus, proboscis and legs yellow. Pleura yellow with dark band across most of anepisternum and anepimeron, leaving only ventral margins yellow. Microtrichia on first flagellomere of antenna longer than diameter of an ocellus. Anterior femur (Fig. 4) with about 3 longer posterior setae and 6-7 much longer posteroventral setae, longest longer than depth of femur. Posterior femur with distinct lateral preapical seta. Capitulum of halter entirely darkened. Wing with few larger setulae in costal fringe (arrowed in Fig. 3) and membrane slightly darkened. Costal ratio 1.1.

Male genitalia figured in lateral view (Fig. 7) and ventral view (Fig. 9), with well developed cerci extending more than half length of surstylus, with long setae. Surstylus narrow throughout, narrowing apically, rounded at apex, slightly divergent. Anterior gonopod slightly broader than surstylus, nearly parallel, in lateral view (Fig. 7) with a dorsomedian seta in a subapical position and the ventroapical seta present but greatly reduced in size. Posterior gonopod slender, strongly approximated and apically pointed.

Head width 0.7mm, wing length 1.3 mm (holotype).

Remarks. This species also runs closest to *X. palauensis* in Hardy (1980), but like *X. hardyi* it also has a darkened halter and different male genitalia. In *X. palauensis* the surstylus is similar to that of *X. lansburyi*, but in *X. palauensis* the anterior gonopod is slightly longer than the surstylus and the ventroapical seta is well developed, the posterior gonopods are widely separated apically and truncate at the apex and the aedeagus is well developed. In *X. lansburyi* the anterior gonopod is slightly shorter than the surstylus, the posterior gonopods are closely approximated apically and are slender and pointed apically and the aedeagus was not distinguished.

The type series was collected by water traps with or without an ultra-violet light source close to the sea. It is named after Mr. Ivor Lansbury, the collector. The series was identified from the male genitalia in spirit, but has been extracted from spirit via 2-ethoxyethanol (overnight) and ethyl acetate (1 hour).

The Australian fauna

Colless & McAlpine (1991) included Xenasteiidae in keys to families of Australian Diptera but the specimens were not identified to species level. Three Australian specimens, which were not in perfect condition, were available for this study and hence no new species are described here. The following notes are given to encourage further collection of the family.

Xenasteia sp. 1

Material examined: ?♂ [Australia] Queensland, 1 km W of Cooktown, 15.28° S, 145.15° E, 13.v.1981, Malaise trap, D.H. Colless. In ANIC.

Description. Mainly black species, only tibiae and tarsi yellow. Halter stem pale, capitulum black. All setae and setulae on head, thorax and abdomen black. First flagellomere with long microtrichia on margin, longer than the diameter of an ocellus. Wing with middle part of costa with some longer, stronger setulae directed more dorsally than remainder. Costal ratio 1.19.

Remarks. The single specimen is in good condition but slightly obscured by lepidopterous scales. It agrees with the description of *X. sabroskyi* in most characters but the first flagellomere of the antenna has long microtrichia, while the illustration in Hardy (1980) of *X. sabroskyi* shows a first flagellomere with very short microtrichia. The character of stronger setulae in the costal fringe is found in several other families of acalyptrate Diptera such as Heleomyzidae and also in the other genus of Xenasteiidae, *Tunisimyia*. *Tunisimyia*, *Xenasteia sabroskyi* and *X.* sp. 1 are mainly black species, in contrast to the remainder of the species of *Xenasteia* which are partly yellow. However, *X. lansburyi* has these setae and is a mainly brown species.

Xenasteia sp. 2

Material examined: 1♀ [Australia] N. Queensland, Moa Island, 2.ii.1980, over rubbish bin, from food scraps, including fish, S.F. McEvey. In AM. 1♂ [Australia] Q[ueensland], Hinchinbrook Island, 26.viii.1979, E.N. Marks, *Melaleuca* flat, tidal zone. All in ANIC.

Description. Frons brown, scutum brown with anterior half yellow, scutellum brown, abdomen brown with broad yellow base extending centrally to middle of abdomen. Halter yellow with distinct black spot on outer surface of capitulum. Legs yellow. First flagellomere with marginal microtrichia longer than diameter of an ocellus, brown-yellow. Wing without an admixture of stronger setulae on middle part of costa. Costal ratio 1.6. Pleura yellow with dorsal half darkened. Proboscis and palpus yellow.

Remarks. These two specimens are similar to the species known from New Guinea and may prove to be conspecific when a longer series of males is available. The Hinchinbrook Island specimen differs from the Moa island specimen in having a much higher costal ratio (2.1) but is otherwise similar. Both specimens have a much more distinct dark mark on the capitulum of the halter than in the other species of *Xenasteia* studied.

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Two New Introduced Species of Trigonidiinae Recorded from Maui and Hawai‘i (Grylloidea, Gryllidae, Trigonidiinae)

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Introduction

In the summer of 2002 one of us (TdC) collected crickets thought to belong to the genus *Trigonidium* with the goal to compare the courtship behavior among species belonging to different clades. Crickets collected in roadside weeds along the Hāna Road (halfway between mileposts 5 and 6) showed distinctly different courtship behavior. Examination of the morphology indicated that this is specifically distinct from the known Hawaiian species (Otte, 1994); the shape of the male genitalia is so distinctive that we place it into a new genus. Examination of the image database at the Academy of Natural Sciences in Philadelphia results in no close matches with other Trigonidiinae (Otte, 2003).

While searching for members of the genus *Laupala* one of us (KS) discovered a small, beautiful cricket residing within the long, strip-like leaves of the ginger thickets that surrounded a *kīpuka*. We know this audibly conspicuous cricket is a new arrival to this locality; despite numerous visits on previous occasions, we had never encountered it before.

We surmise that these crickets have been introduced from the western Pacific region, but are unable to identify them using the image database at the Academy of Natural Sciences which consists of digitized images of all known figured species. We therefore place each into a new genus and species.

Systematics

Subfamily Trigonidiinae

Anele Otte, Carvalho & Shaw, **new genus**

Type species: *Anele ulia* Otte, Carvalho & Shaw, n. sp.

Etymology. —*"Anele"* is the word for "angel" in the Hawaiian language; *"ulia"* is the word for "accident" or "accidental" in the Hawaiian language.
Diagnosis for genus. — See diagnosis of *Anele ulia*, n. sp.

Anele ulia Otte, Carvalho & Shaw**, new species** Figs. 1–3

Types. Holotype male, 5 paratype males, and 2 paratype females from: **MAUI**: Hāna road between mile marker 5 and 6 on the Hāna Rd (within 2 mi of Pāpa‘a‘ea Reservoir), 156° 13.001' W, 20° 53.824' N, 8 Aug 2002 (T. de Carvalho). Specimens deposited in Bishop Museum, Honolulu (BPBM).

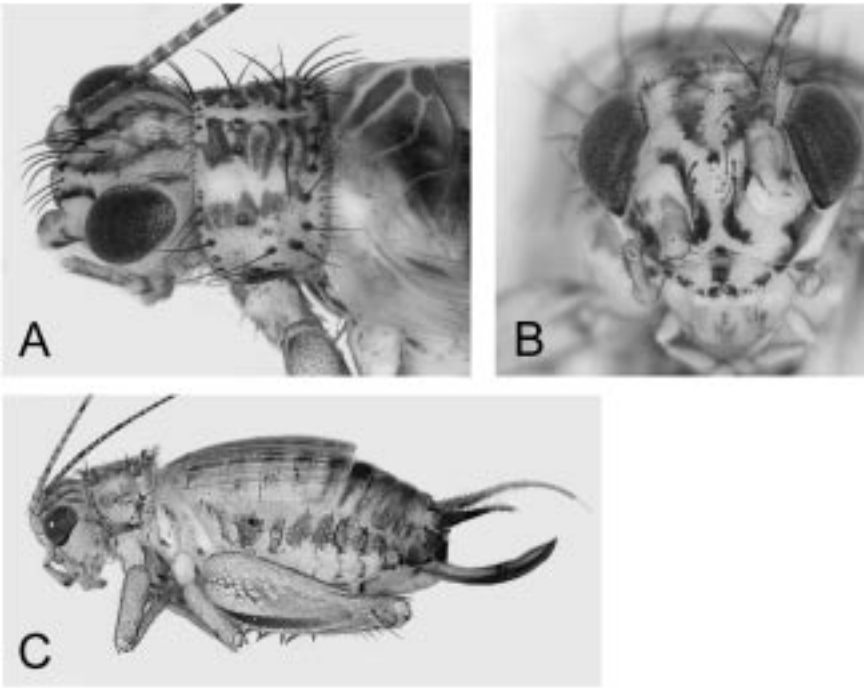

Fig. 1. *Anele ulia.* **A**, head and pronotum of male holotype. **B**, face of male holotype. **C**, portrait of female paratype.

Diagnosis. —The essential features of this species are shown in Figs. 1–3. Face: no Hawaiian *Trigonidium* possesses the same facial banding patterns as in *A. ulia* [see numerous illustrations in Otte (1994)]. Particularly noticeable is the median dark band on the clypeus. Furthermore, in the Hawaiian *Trigonidium*, which possess dorsal dark headbands, there is usually a central dark band in the vicinity of the eyes, not two lateral bands as in *A. ulia*. Also no *Trigonidium* possesses 6 longitudinal dark bands on the pronotum. Genitalia: Epiphallus with relatively short lateral arms; ectophallic lobes robust, almost glove-shaped; endophallus ending in a distinct virga.

Description. — Male: Head: Top of head with 4 dark bands; face with 4 dark bands in upper part and 3 in lower part (at level of clypeus). Pronotum with 6 longitudinal dark bands — two broad ones on upper face, two narrower ones along the shoulders, and two along the lower margins of the lateral lobe. Forewing slightly pigmented, cells darkest in basal area, at median end of the file and in the apical area. Spacing of file teeth as in Fig. 2 F, G. Tibia-1with tympana on outer face only. Femur-3 with a distinct dark band on the outer face. Tibia-3 mostly pale.

Measurements (mm).— Of holotype and female paratype: Body length: 7 and 7.6; forewing length: 4.5, 3.5; femur-3 length: 4.5, 4.6; ovipositor length: 2.2. Number of stridulatory file teeth: 97.

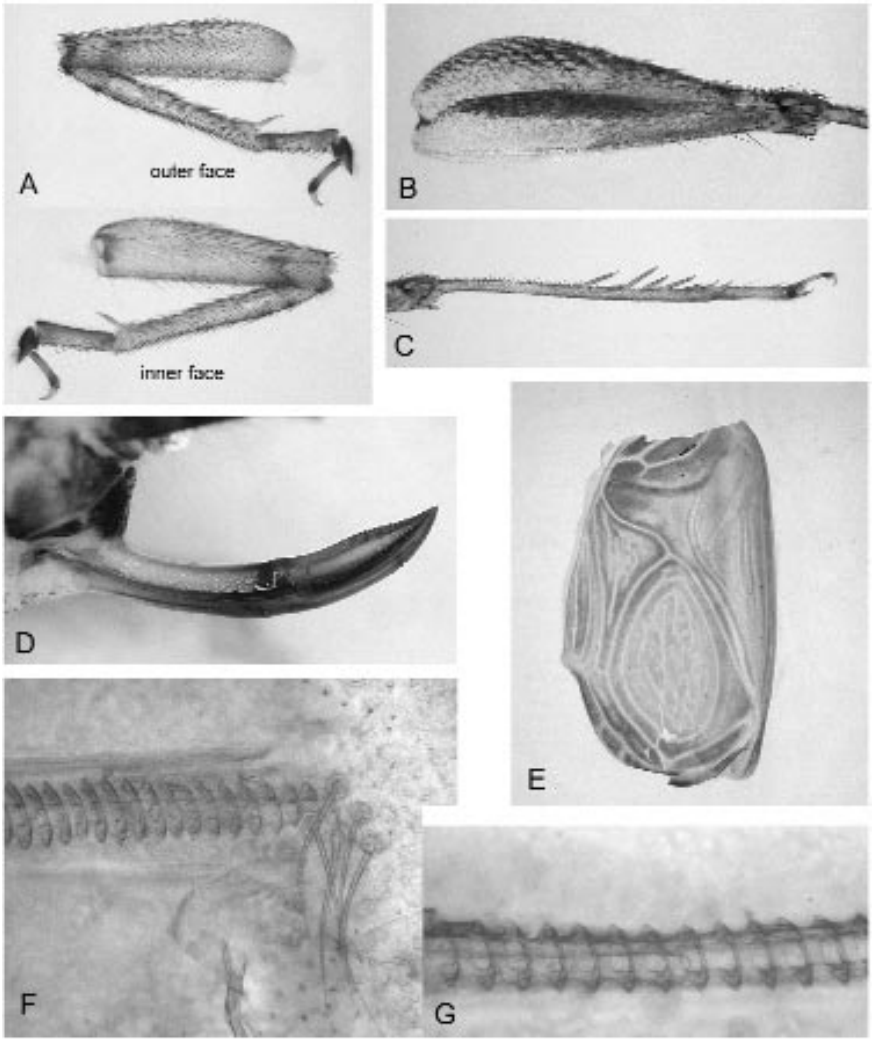

Fig. 2. *Anele ulia***. A**, leg-1 of male holotype showing inner and outer faces. **B**, leg-3 of male holotype.**C**, tibia-3 of male holotype (outer face). **D**, ovipositor of female paratype. **E**, forewing of male holotype. **F**, median end of stridulatory file in male holotype. **G**, central section of same file.

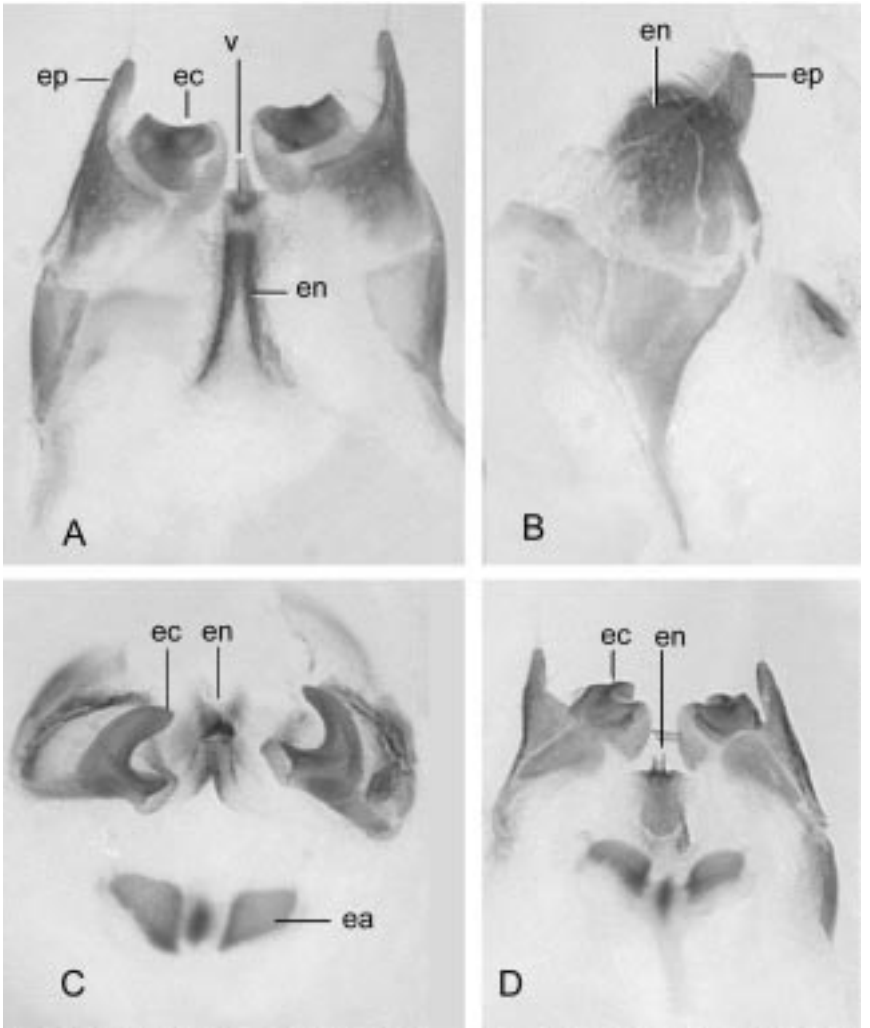

Fig. 3. *Anele ulia*, genitalia of holotype male. **A**, dorsal view. **B**, lateral view. **C**, rear view. **D**, ventral view. Abbreviations: ep, epiphallus; ec, ectophallus; en, endophallus, v, virga, ea, endophallic apodeme.

Habitat. —All specimens of this species were collected in non-native ground-cover, just along side the asphalt of the Hāna Rd.

Song. — The songs of four males consisted of trills, which range from 0.36 to 6.04 seconds in duration (average 1.6). The pulse rate ranged from 37 to 55.6 pulses per sec-

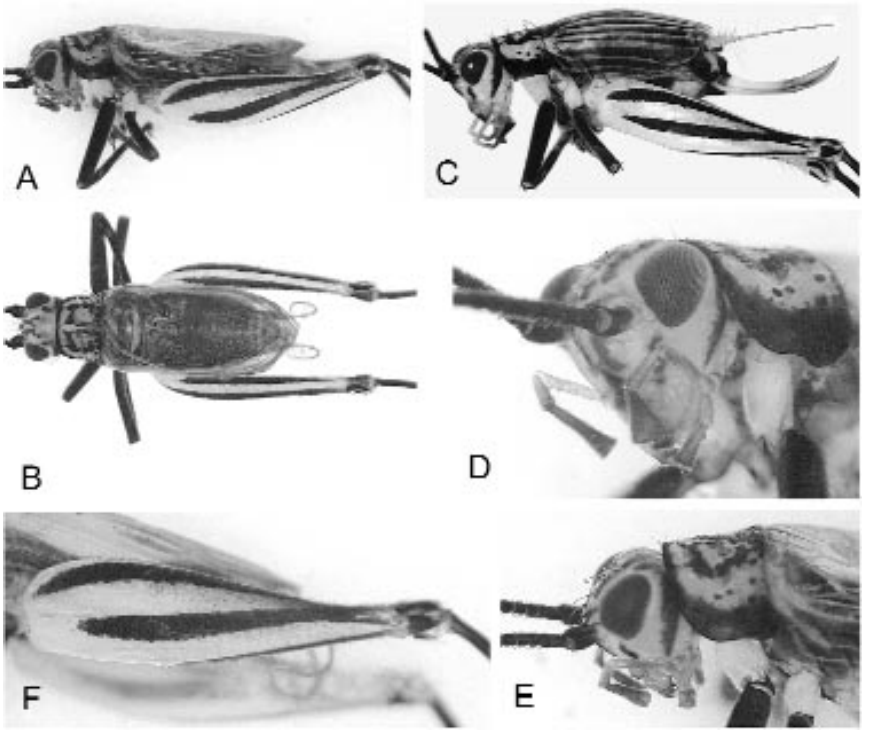

Fig. 4. *Nanixipha nahoa.* **A**, portrait of male. **C**, portrait of female. **D**, face of male. **E**, head and pronotum of male. **F**, femur-3 of male.

ond. One of the males (#44) had a somewhat different song. Perhaps his song was a transition to courtship.

Behavior. — The essential differences in courtship between this species and those in the genus *Trigonidium* are as follows: *Trigonidium* species typically produced multiple spermatophores during one courtship bout. These spermatophores are uniform in size and contain sperm. *Anele ulia* also produced multiple spermatophores, however they differed in size and content. They produced two different types of spermatophores in alternating sequence, beginning with small, spermless spermatophores (microspermatophores) followed by larger sperm-containing spermatophores (macrospermatophores). Macrospermatophores were approximately 2.63 larger in diameter than microspermatophores. Three males were observed, they produced 4–5 spermatophores during each courtship bout.

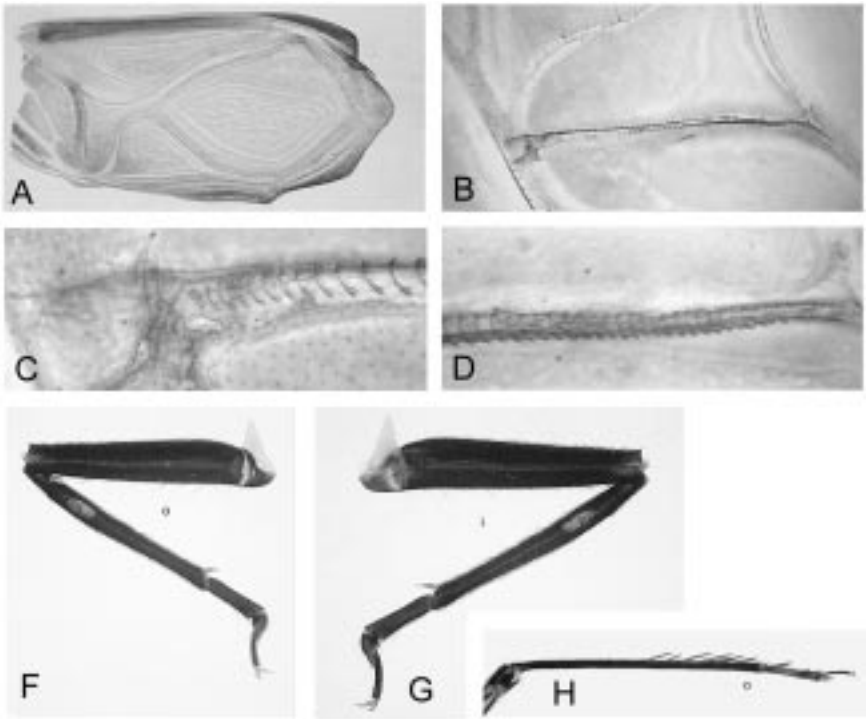

Fig. 5. *Nanixipha nahoa*. **A**, forewing of male. **B**, stridulatory file of male. **C**, median end of stridulatory file. **D**, lateral end of stridulatory file. **F**, outer face of leg-1 showing tympanal opening. **G**, inner face of leg-2 (although tympanum is visible it does not open onto this face). **H**, tibia-3 outer face.

Nanixipha Otte, Carvalho & Shaw, **new genus**

Type species: *Nanixipha nahoa*, n. sp.

Etymology. —"*Nani"* is the Hawaiian word for beautiful; *xipha* is derived from the Latin word *xiphias* (= sword-shaped) and is applied to many genera of sword-tailed crickets (or Trigonidiinae). "*Nahoa*" is the Hawaiian word for bold. Thus the name in full means: the bold beautiful sword-tail. In English "*xipha*" should be pronounced "ziffa".

Diagnosis. — See diagnosis of *Nanixipha nahoa*.

Nanixipha nahoa Otte, Shaw & Carvalho**, new species** Figs. 4–6

Types. — Holotype male, two paratype females. **HAWAI'I**: Puna District, ca. 1400 ft, 19° 26.2' N, 154° 57' W, 14 Aug 2002 (K.L. Shaw). Specimens deposited in BPBM.

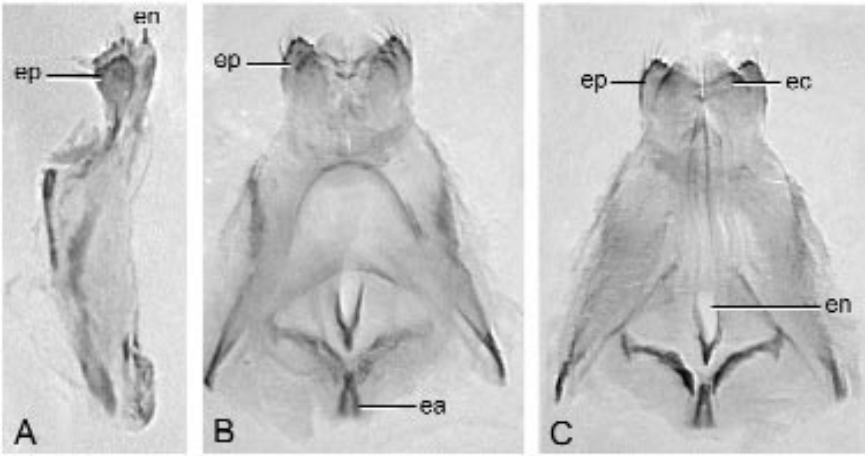

Fig. 6. Male genitalia of *Nanixipha nahoa*. **A**, lateral view. **B**, dorsal view. **C**, ventral view. Abbreviations: ep, epiphallus; ec, ectophallus; en, endophallus; ea, endophallic apodeme.

Diagnosis. — Genitalia: epiphallus with short, lumpy lateral lobes, which bear long bristles; ectoparameres flat, wide, extending beyond epiphallic lobes. Leg-1 and -2 black; femur-3 pale green, with two strong longitudinal black bands; tibia-3 black; pronotum with two square dark patterns on upper face; black in lower half of lateral lobes.

Measurements (mm). — Holotype male and paratype female. Body length: 6.3, 6.5; forewing length: 4.2, 5.0; femur-3 length: 4.7, 5.4; ovipositor length: 2.5 mm; stridulatory file with 70 teeth.

Song. — No recordings were made. One of us (KS) recalls the song to be a non-musical fast trill.

Habitat. — A population was found at the forest edge in a semi-dry understory with moderate light-levels, in thick low-lying, non-native vegetation (principally, ginger thickets). Individuals were collected by sweeping a net through this vegetation.

Literature Cited

Otte, D. 1994. *The crickets of Hawaii. Origin, systematics and evolution*. The Orthopterists' Society, Academy of Natural Sciences, Philadelphia. 396 p.

———. 2003. Images of world crickets. Unpublished database, Academy of Natural Sciences, Philadelphia.

Records of the Hawaii Biological Survey for 2001–2002
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