

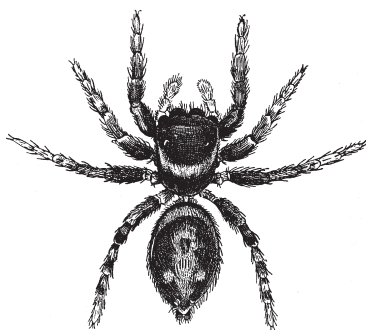
NUMBER 78, 55 pages

27 July 2004


BISHOP MUSEUM OCCASIONAL PAPERS

RECORDS OF THE
HAWAII BIOLOGICAL SURVEY
FOR 2003
PART 1: ARTICLES

NEAL L. EVENHUIS
AND
LUCIUS G. ELDREDGE, EDITORS



BISHOP MUSEUM PRESS
HONOLULU

 Printed on recycled paper

Cover illustration: *Hasarius adansoni* (Audouin), a nonindigenous jumping spider found in the Hawaiian Islands (modified from Williams, F.X., 1931, *Handbook of the insects and other invertebrates of Hawaiian sugar cane fields*).

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ISSN 0893-1348

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BISHOP MUSEUM

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RECORDS OF THE HAWAII BIOLOGICAL SURVEY FOR 2003 Part 1: Articles

Editors' Preface

We are pleased to present the ninth annual compilation of *Records of the Hawaii Biological Survey*; this year for the year 2003. 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 2003* include:

- a complete checklist of the nonmarine algae of the Hawaiian Islands;
- a checklist of arthropods associated with 'ōhi'a lehua in the Hawaiian Islands;
- part one of a series of papers reviewing the status of migratory birds in Hawai'i;
- a review of the geophilomorph centipedes of Hawai'i;
- new nonindigenous species reported from Hawai'i during 2003;
- new records of plants, insects, and other invertebrates resulting from field surveys and continued curation of Hawaiian collections at the Bishop Museum and elsewhere.

An intensive and coordinated effort has been made by the Hawaii Biological Survey to make our products, including many of the databases supporting papers published here, available to the widest user-community possible through our web server. Products currently available include taxonomic authority files (species checklists for terrestrial arthropods, flowering plants, nonmarine snails, marine invertebrates, foraminiferans, fossil taxa, and vertebrates), bibliographic databases (vascular plants, nonmarine snails, and insects), specimen databases (fungi, fish, invertebrates, portions of the insect collection) and type specimens (entomology; botany—including algae and fungi; and vertebrates), collections data (lists of holdings for select groups of flies as well as Cicadellidae and Pentatomidae), detailed information and/or images on endangered, threatened, and extinct plants and animals; as well as our staff publication lists. Additional reference databases include: the list of insect and spider collections of the world (based on Arnett, Samuelson & Nishida, 1993, *Insect and spider collections of the world*) with links to institutional web pages where known; and the historical world Diptera taxonomists list with names of over 4,630 authors who have described flies.

Our Main Web Addresses:

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World Diptera taxonomist list

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The *Records of the Hawaii Biological Survey for 2003* were compiled with the assistance of George Staples and Clyde Imada (botany), Allen Allison (vertebrate zoology), and Frank Howarth and G. Allan Samuelson (entomology) 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 & Wildlife Service, and the Hawaii Department of Land and Natural Resources.

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

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

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

—N.L. Evenhuis &

L.G. Eldredge, editors

[email: neale@bishopmuseum.org]

New Hawaiian Plant Records for 2002–2003

DERRAL R. HERBST, GEORGE W. STAPLES & CLYDE T. IMADA (Hawaii Biological Survey,
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email: dherbst@bishopmuseum.org)

These previously unpublished Hawaiian plant records report 7 new state records, 12 new island records, 2 new naturalized records, and 3 nomenclatural and taxonomic changes that affect the flora of Hawai'i. These records supplement information published in Wagner *et al.* (1990, 1999) and in the *Records of the Hawaii Biological Survey* for 1994 (Evenhuis & Miller, 1995), 1995 (Evenhuis & Miller, 1996), 1996 (Evenhuis & Miller, 1997), 1997 (Evenhuis & Miller 1998), 1998 (Evenhuis & Eldredge, 1999), 1999 (Evenhuis & Eldredge, 2000), 2000 (Evenhuis & Eldredge, 2002), and 2001–2002 (Evenhuis & Eldredge, 2003). All identifications were made by the authors except where noted in the acknowledgments, and all supporting voucher specimens are on deposit at BISH except as otherwise noted.

Amaranthaceae

Amaranthus graecizans L.

New state record

Amaranthus graecizans is an annual, prostrate or rarely ascending herb native to the western half of North America but naturalized elsewhere. In the key to the amaranths in Wagner *et al.* (1999: 186), the plant would key out to *A. dubius* but differs from that species in that it has three stamens and tepals instead of five.

Material examined. O'AHU: Honolulu, Kalihi area, 1313 Kamehameha IV Rd, weed growing on a lawn in full sun, 7 Aug 1985, *J. Lau 1304*.

Apocynaceae

Alstonia macrophylla Wall. ex G. Don

New island record

Although grown in botanical gardens on the islands of Kaua'i and O'ahu and sparingly cultivated in gardens on the island of Hawai'i, the species had become naturalized only in the Waiākea, Hilo, and Pepe'ekeo areas of Hawai'i Island (Wagner *et al.*, 1997: 51). The following collection is the first documented naturalized plant on the island of O'ahu.

Material examined. O'AHU: Off Likelike Hwy, growing with *Dicranopteris linearis*, *Schefflera actinophylla*, *Psidium cattleianum*, 750–1000 ft, 11 Apr 2003, *D. Souza s.n.* (BISH 695057).

Araceae

Xanthosoma robustum Schott

Nomenclatural change

[Syn. *X. roseum* Schott]

Previously the name *X. roseum* was provisionally taken up for a naturalized aroid species found on Kaua'i and O'ahu (Staples & Woolliams, 1997). Additional gatherings showed the species was also naturalized on Maui (Oppenheimer & Bartlett, 2000: 2) and Hawai'i (Imada *et al.*, 2000: 10). While a comprehensive revision of *Xanthosoma* has yet to be published and species concepts remain vague, a worldwide checklist of aroid taxa has unambiguously taken up a different name for the species (Govaerts & Frodin, 2002).

Asteraceae

Pseudognaphalium attenuatum (DC.)

New state record

A. Anderb.

In a recent paper reporting new records of *Pseudognaphalium* for the United States (Nesom, 2001), a new state record was included for the Hawaiian Islands of a naturalized Mexican species. There is no duplicate of the cited voucher specimen in the Bishop Museum, so we repeat the documentation here to call it to the attention of local botanists.

Material cited. **HAWAII:** Ka'ū distr., near Kohala Blvd., *makai* of the Belt Rd, Kahuku, ubiquitous at 1500 ft in small sterile *kipuka*, 10 Jan 1981, O. & I. Degener 35082 (GH, MO, SMU, TEX).

Senecio madagascariensis Poir.

New island record

This aggressive weed has previously been documented as naturalized on three islands: Kaua'i and Hawai'i (Lorence *et al.*, 1995: 24), and Maui (Starr *et al.*, 1999: 11; Oppenheimer & Bartlett, 2002: 4). The collections below document its presence on O'ahu. The species probably was inadvertently introduced to O'ahu as a contaminant in grass seed spread along road banks.

Material examined. **O'AHU:** Along Hwy 50 headed west before Hulē'ia Stream bridge, mostly located toward top of embankment on *makai* side of highway, 21°57'N, 159°25'W, ca 400 ft, 6 Feb 2001, D. Arakaki, *s.n.* (BISH 668939); Schofield Barracks, lower Wai'eli Gulch, Firing Point Halo, covering 1/2 acre with many juveniles and seedlings, 400 ft, Feb 2003, K. Kawelo *s.n.* (BISH 695026); Schofield Barracks, South Range, Firing Point Halo, in an area ca 20 m × 30 m, probably from camping and military equipment from the Big Island, 1000 ft, Feb 2003, K. Kawelo *s.n.* (BISH 695028).

Campanulaceae

Wahlenbergia Schrader ex Roth

While preparing specimens in the BISH Hawaiian collection for data entry, a discrepancy was noticed between the annotation labels on the material of *Wahlenbergia* and the name used in the Manual (Wagner *et al.*, 1990, 1999) as well as in-house curatorial aids. While the Manual uses the name *Wahlenbergia gracilis* (G. Forst.) A. DC., nearly all the vouchers had been annotated by Tom Lammers in 1992 or 1994 as *W. marginata* (Thunb.) A. DC. Consultation with Lammers (pers. comm. 2002) revealed that a recent partial revision (Pettersen, 1997) had changed taxonomic concepts for the widespread Pacific species, in part due to careful study of type specimens for the names involved in New Zealand. Comparison of the BISH specimens immediately disclosed that two quite distinctive morphologies were represented, and these correspond to Pettersen's taxonomic concepts for both *W. gracilis* and *W. marginata*. The following key is adapted from Pettersen's account. Selected specimen citations are provided to document the distribution for *W. marginata* in the Hawaiian Islands.

Key to *Wahlenbergia*

- 1. Corolla rotate, 10–20 mm in diameter; calyx teeth longer than sinus between corolla lobes *W. marginata*
- 1. Corolla deeply campanulate, 5–10 mm in diameter; calyx teeth shorter than sinus between corolla lobes *W. gracilis*

Wahlenbergia gracilis (G. Forst.) A. DC.

Taxonomic clarification

Native to New Caledonia, Norfolk Island, and Lord Howe Island (Pettersson, 1997); specimens from 'Eua, Tonga, may possibly belong here also. This species has tiny, paler blue-violet, long-tubed flowers, with the corolla tube distinctly visible above the calyx lobes when viewed from the side. Hawaiian specimens are smaller and more delicate in all parts, with stems that are erect to sprawling and fruit capsules that are campanulate and broad in comparison to their length.

Most of the Hawaiian specimens in BISH belong to this species and the distribution remains as it was published in the Manual: Moloka'i, Lāna'i, Maui, and Hawai'i (Wagner *et al.*, 1990, 1999).

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

Native to Japan (Honsu), where it extends as far as 37°N (Pettersson, 1997). The plants widespread in the Pacific and Asia that have been called *W. marginata* have not been evaluated taxonomically and may not be the same as the Japanese taxon (Pettersson, 1997). This species typically has a bright blue-violet corolla, saucer-shaped with 5 spreading, elliptic lobes that present a star-like pattern when viewed from above. Hawaiian plants are distinctly larger in all parts than *W. gracilis*, with more erect, coarser stems, and fruit capsules that are slenderly elongate and visibly ridged lengthwise.

Material examined. **HAWAII:** Hāmākua Distr, Pa'auhau *ahupua'a*, NW slopes of Mauna Kea, ca 0.7–0.1 km N of 'Auwaiakeakua Gulch, 6700 ft, 21 Jan 1980, *P.K. Higashino & C. Crivellone PKH 9520*; North Hilo Distr, Pu'u Huluhulu, near Saddle Rd, 6700 ft, 14 Oct 1981, *L.W. Cuddihy & J. Davis 903*; South Hilo Distr, along Saddle Rd in front of Mauna Kea State Park, 35 miles W of Hilo, 2000 m, 14 Mar 1988, *D.H. Lorence et al. 5900*; ca 0.1 mile SE of Mauna Kea State Park, off Saddle Rd, 6500 ft, *R. Gustafson 2743*; South Kohala Distr, Saddle Rd (Hwy 200), at mile marker 43, 1670 m, 7 Aug 1987, *T. Flynn & D. Lorence 2288*; Pōhakuoa Military Camp, on Mauna Kea NW of Pōhakuoa Gulch, 1950 m, 17 Nov 1982, *W.L. Wagner & F.R. Warshauer 4674*; Pu'u Lā'au, near hunter's cabin, 7450 ft, 18 Jan 1975, *D. Herbst 5214*; Ahumoa, 6900 ft, 21 May 1975, *D. Herbst 5340*.

Chenopodiaceae

***Salsola tragus* L.**

New island record

Previously known from Maui (Oppenheimer & Bartlett, 2002: 5), Kaho'olawe (Herbst & Wagner, 1999: 19), and Hawai'i (Wagner *et al.*, 1999: 540). The collection cited below documents its presence on O'ahu.

Material examined. **O'AHU:** On former sugarcane fields, between Renton Rd and Farrington Hwy, site of Aloun Farms, in scrub vegetation, plants 1–2 ft tall, reproducing, widely scattered in small numbers, 18 Jun 2003, *W. Char & C. Morden s.n.* (BISH 695053).

Commelinaceae

***Palisota bracteosa* C. B. Clarke**

New naturalized record

This herbaceous, shade-loving species has been cultivated as an ornamental on O'ahu since the early 1950s and has now begun to escape from cultivation in at least two widely separated locations, both near botanical gardens. Plants were found scattered in shady understory on steep slopes above planted areas in the Lyon Arboretum; the Waimea Arboretum voucher was collected from the humus-filled crotch of a monkeypod tree about eight feet above the ground. The fleshy, bright red fruit may be attractive to rats or birds, which are effectively dispersing the seeds from plantings into surrounding areas (D. Orr, pers. comm.). *Palisota* was not included in the list of potentially invasive species of culti-

vated plants in Hawai'i (Staples *et al.*, 2000), but it should be monitored closely for its potential to invade shady, mesic forest habitats.

In the key to species of *Palisota* found in the second edition of the *Flora of West Tropical Africa* (Brenan, 1968: 33, 35), *P. bracteosa* is distinguished as follows: rosette-forming herb of the forest floor; inflorescence peduncle not or scarcely tomentose; inflorescence with conspicuous ovate bracts 5–10 mm broad, bract margins long-ciliate; leaf blade elliptic to oblanceolate or narrowly obovate, ca 25–40 cm long and 5.5–14 cm wide, gradually cuneate at the base, subsessile or with a petiole to 25 cm long; flowers white (or pinkish white); fruits pilose, beaked, bright red.

Material examined. O'AHU: Honolulu Distr, Mānoa Valley, above Lyon Arboretum, on slope between 'Aihualama Stream and 'Aihualama Trail, in wet, shaded understory of *Psidium cattleianum*-dominated forest, 21 Jul 2001, C. Imada, K. Kawelo & D. Orr 2001-51.

Crassulaceae

Kalanchoe crenata (Andrews) Haw.

New state record

This is the first naturalized record for this African species in the Hawaiian Islands, although it was known in cultivation as an ornamental. Native throughout much of sub-Saharan Africa (Fernandes, 1983), *K. crenata* is a polymorphic taxon with an extensive synonymy. It is also believed to be naturalized in tropical America, India, and Malaysia. Distinctive features are the (usually) erect stems to 1 m long; opposite, crenulate leaves with distinct petioles; and spreading panicles of yellow, orange, salmon, brick, or red flowers with corolla tube longer than the lobes and anthers borne at the mouth of the corolla tube. Plants are often totally glabrous or there may be glandular indumentum on the inflorescence and flowers.

Material examined. O'AHU: Mākuā Valley, on rocky ledges, north-facing slopes of lower 'Ōhikilolo Ridge, plants seen over an area approximately 50 ft by 50 ft, but may extend farther, ca 200 ft, 7 May 2002, K. Kawelo, J. Rohrer & J. Beachy s.n. (BISH 687840).

Cyperaceae

Rhynchospora radicans subsp.

New island record

microcephala (Bert. ex Spreng.) W. Thomas

This taxon was recently reported as a new state record based upon a collection from the island of Hawai'i (Strong & Wagner, 1997: 46). The authors speculated that the species probably was inadvertently introduced by humans, as it was growing in cultivated land rather than near areas visited by waterfowl. On Maui the species appears to be much more abundant, more widely distributed, and in wetland areas where it potentially could have been brought from its native areas in Central or western South America by migrating shorebirds, such as the Pacific Golden Plover. It is more likely that the sedge was introduced to Maui, where it later could have been carried to Hawai'i Island.

Material examined. MAUI: Hāna Forest Reserve, Hāna Ranch lands mauka of Keaka'amanu, boggy area dominated by grasses, sedges, and low-growing herbs, common in the wetland, ca 1000 ft, 11 Nov 2002, C. Imada, M. LeGrande, S. Jansen & J. Crummer 2002-77; Hāna Forest Reserve, Hāna Ranch lands, slopes makai and to the north of Pu'u Kī, moist rocky gulch floor in disturbed *Psidium cattleianum* forest, common sedge rooted in wet substrate, ca 1300 ft, 12 Nov 2002, C. Imada, M. LeGrande & S. Jansen 2002-86.

Fabaceae

Indigofera hendecaphylla Jacq.

New island record

Widespread throughout the Old World tropics, *Indigofera hendecaphylla* was previously known to be naturalized on the islands of Kaua‘i, O‘ahu, Moloka‘i, Maui, and Hawai‘i (Geesink *et al.*, 1999: 675; Starr *et al.*, 2002: 20; Oppenheimer, 2003: 13). The specimen cited below documents that the species also is present on the island of Lāna‘i. In Geesink *et al.* (1999), the species was incorrectly listed as *I. spicata*, a mistake that has since been rectified (Herbst & Wagner, 1999: 21).

Material examined. **LĀNA‘I:** Lāna‘i City, mauka of Castle and Cooke Conservation headquarters, 20°49'N, 156°55'W, groundcover growing out of asphalt crack in weedy waste area, 22 Jul 2002, C. Imada 2002-42.

Stylosanthes

The *Manual* (Wagner *et al.*, 1999) included a single species of *Stylosanthes*, *S. fruticosa* (Retz.) Alston, as a naturalized element in the Hawaiian flora. A number of collections of *Stylosanthes* received in Bishop Museum between 1990 and 2003 did not fit the description of *S. fruticosa* and proved difficult to key out using the only revision of the entire genus (Mohlenbrock, 1958). Some of these new collections were made from plants cultivated at the USDA Plant Materials Center located on Moloka‘i, and others originated from wild plants growing in pastures, along roadsides, and in other seemingly naturalized places. Requests to legume specialists for identifications of the Hawaiian material were declined; *Stylosanthes* has a reputation as a taxonomically difficult genus with notoriously confused species limits. However, one specialist pointed out to us the publications of Len ‘t Mannetje (‘t Mannetje, 1984), who had worked on the genus for many years from an agricultural perspective. Our attempts to identify the Hawaiian specimens using the keys in ‘t Mannetje (1984) also proved inconclusive. Subsequently, Dr. ‘t Mannetje, now retired, agreed to try and identify the Hawaiian and Pacific material of *Stylosanthes* and the specimens were duly loaned to him for this purpose.

The results were surprising: there are 3 species, one comprising two varieties, of *Stylosanthes* present in the Hawaiian Islands, and none of them is *S. fruticosa*. We enumerate the 4 taxa here and cite voucher material for each, in order to provide a firm, specimen-based foundation for the taxonomic concepts we adopt. A key to identify the Hawaiian taxa of *Stylosanthes* is adapted from ‘t Mannetje (1984). It is essential to have fruiting material to use the key; flowering or sterile specimens cannot be successfully identified. The beak and upper articulation refer to the distal end of the segmented pod.

Key to *Stylosanthes* in Hawai‘i

- 1. Beak of fruit > 0.5 mm long..... *S. scabra*
- 1. Beak of fruit ≤ 0.5 mm long (2).
- 2(1).Beak distinctly coiled; upper articulation and beak glabrous or hairy *S. viscosa*
- 2. Beak uncinat (hooked or J-shaped), minute (uncurled length < 0.5 mm long); upper articulation and beak glabrous (3).
- 3(2).Pods with inconspicuous venation or weakly reticulate; inflorescence with > 4 flowers *S. guianensis* var. *guianensis*
- 3. Pods with conspicuous reticulate venation; inflorescence with up to 20 flowers *S. guianensis* var. *intermedia*

***Stylosanthes guianensis* (Aubl.) Sw.**

New state record

This species has not previously been found on any of the Hawaiian Islands. Two varieties are represented among Hawaiian collections: var. *guianensis* and var. *intermedia* (Vogel)

Hassler. The following collections document the first known occurrence for var. *guianensis* on Kaua'i and Moloka'i.

Material examined. **KAUA'I:** Along Hwy 55, outside of Kīlauea between Kīlauea and Moloa'a, 25 Oct 1985, *T. Flynn & L. Hume 1328*; Hanalei Valley, Halele'a Forest Res., Hunting Unit C, along trail near end of 'Ōhiki Road, 27 Mar 1986, *T. Flynn & L. Hume 1614*. **MOLOKA'I:** USDA Plant Materials Center, field 8A trial plot, 9 Jul 1990, *M. Evans M-61*; same loc. and date, *M. Evans M-62, M-63*.

***Stylosanthes guianensis* var. *intermedia* (Vogel) New state record**

Hassler

Material examined. **MOLOKA'I:** USDA Plant Materials Center, field 7B trial plot, 13 Jul 1990, *M. Evans M-112*.

***Stylosanthes scabra* Vogel**

Taxonomic change

[*S. fruticosa* misapplied, sensu Hawaiian authors, not of (Retz.) Alston]

This species has not previously been found on any of the Hawaiian Islands. The following collections document its occurrence on O'ahu, Moloka'i, Lāna'i, and Maui. Three of the cited vouchers (the O'ahu and Lāna'i specimens) were ambiguously identified by 't Mannetje; apparently geographic provenance is required to separate *S. fruticosa* (African, SE Asian origin) from *S. scabra* (South American origin). With cultivated material, this criterion is useless. Wild provenance can only be inferred based on historical research to determine where Hawaiian introductions originated, and that is not known in this case. Because no bona fide specimens of *S. fruticosa* were found among Hawaiian specimens identified by 't Mannetje and *S. scabra* has been confirmed from two other islands, we have applied the name *S. scabra* to O'ahu and Lāna'i material as well.

Material examined. **O'AHU:** along road to summit of Mt Ka'ala, in pasture and along road between two locked gates, 20 Sep 1985, *W. Char & G. Buelow NARS 34*. **MOLOKA'I:** USDA Plant Materials Center, field 7B trial plot, 13 Jul 1990, *M. Evans M-113*; Waiahewahewa Gulch, 500–1000 ft, in gulch bottom, 9 Feb 1973, *N. Pekelo Jr. 24*. **LĀNA'I:** Mahana, not uncommon along Keōmuku Rd, ca 900 ft, 12 Apr 1986, *K. Nagata 3475*; Kaka'alani (near Kō'ele), 1980 ft, growing in clumps along Keōmuku Rd shoulder, 13 Jun 1987, *R. Hobdy 2879*. **MAUI:** Makawao Distr., Hāmākuapoko, naturalized locally at NIFTAL site, 4 May 2002, *H. Oppenheimer & F. Duvall H50209* (BISH, PTBG).

***Stylosanthes viscosa* Sw.**

New state record

This species has not previously been found on any of the Hawaiian Islands. The following collections document the first known occurrence for *S. viscosa* on O'ahu and Maui. The first Starr specimen cited below, which has no fruits, was not identified to species by 't Mannetje; a later collection with legumes from the same locality was confirmed as *S. scabra*. We are calling both Starr specimens *S. scabra*.

Material examined. **O'AHU:** Ko'olauloa Distr, between Pūpūkea and Paumalū, in open, sunny sites, ca 500 ft, 5 Dec 1987, *K. Nagata & W. Takeuchi 3714*. **MAUI:** Wailuku Distr, Kahakuloa, Po'elua Bay, along hwy near Kahakuloa GMA/Po'elua Hunter Creek Station, 280 ft, 7 Oct 1999, *H. Oppenheimer H109904*; Papanalahoā, roadside on seaward (*makai*) side of road, 200 ft, 29 Jan 2000, *F. Starr & K. Martz 000129-1*; same loc., 280 ft, 29 Apr 2000, *F. Starr et al. 000429-1*.

Malvaceae

***Sida cordifolia* L.**

New island record

This species was formerly known from low elevation, dry, disturbed areas at Kaupō, East

Maui; on the Kona coast, Hawai'i; and in the Waimea and Kōloa Districts of Kaua'i (Bates, 1999: 897, Lorence *et al.*, 1995: 41). The following specimen documents its presence on O'ahu.

Material examined. **O'AHU:** Kunia, Pōhākea Ranch, 21°27'N, 158°4'W, upright herb 2 ft tall growing in Guinea grass, *Schinus*, *Grevillea*, *koa haole* scrub, 1200 ft, 25 Nov 2002, W. Char, S. Ching-Harbin & M. LeGrande *s.n.* (BISH 690736).

Molluginaceae

Mollugo cerviana (L.) Ser.

New island record

Previously known from low, dry areas on the island of Hawai'i, where it is well established on the northwestern side of the island, especially in the South Kohala District (Wagner *et al.*, 1999: 922). The following collection documents its presence on the island of O'ahu.

Material examined. **O'AHU:** Kahuku, next to abandoned airstrip, close to Marconi Rd, 21°42'N, 157°58'W, 10 ft, 25 May 2001, F.R. Warshauer 5180.

Plantaginaceae

Plantago debilis R. Br.

New island record

Although *Plantago debilis* has been naturalized in Hawai'i for at least 60 years, it has not been collected outside Honolulu and at that in only three localities (Wagner *et al.*, 1999: 1051). Based on the collection cited below, it is now known also from the Big Island.

Material examined. **HAWAI'I:** Hilo, in rough lawn, rosette-forming herbs with erect scapes, common in this habitat, 3 Jun 1991, W.R. Sykes 362/91.

Poaceae

Digitaria divaricatissima (R. Br.) Hughes

New naturalized record

Native to New South Wales, Queensland, and Victoria, Australia, *Digitaria divaricatissima* previously was reported from a single collection made by E.Y. Hosaka (3611, US) on Hawai'i Island in 1950 (O'Connor, 1999: 1530). Three years later the species was again collected on the island (listed below). The species has recently been collected on Lāna'i.

Material examined. **LĀNA'I:** Halulu Gulch, northeastern part of island, 20°53'N, 156°54'W, ca 700 ft, rare grass on dry, rocky slopes, growing with *Chamaecrista*, *Waltheria*, *Sida fallax*, lantana, other introduced grasses, 22 Jul 2002, C. Imada, C. Puttock, D. Stokes, S. Kahihikolo & B. Plunkett 2002-39. **HAWAI'I:** S. Kohala Distr, Ke'āmuku, Parker Ranch, very rare in dry pasture, Apr 1953, Y. Kimura *s.n.* (BISH 706198).

Eragrostis elongata (Willd.) Jacq.

New island record

Previously documented from the islands of Kaua'i, Moloka'i, and Hawai'i (Oppenheimer, 2003: 21), the species has since been found on O'ahu.

Material examined. **O'AHU:** Ko'olau Mts, Kawaihoa Training Area, Pu'u Kapu helicopter landing zone, along Drum Rd (near 'Ōpae'ula and Kawainui Rds), only one plant seen, 1250 ft, 26 Feb 2003, K. Kawelo *et al.*, *s.n.* (BISH 695029); Ko'olau Mts, military LZ west of Poamoho trailhead, on *pu'u* that is marked 1652 ft on USGS topo map, hundreds of healthy reproductive individuals seen at this time with immature fruit, doesn't look invasive, 10 Mar 2003, K. Kawelo, J. Rohrer & J. Beachy *s.n.* (BISH 695030).

Festuca arundinacea Schreb.

New island record

Previously known from Kaua'i (Wagner *et al.*, 1997: 60), East Maui (Oppenheimer, 2003: 21), and Hawai'i (O'Connor, 1999: 1547), *Festuca arundinacea* also is naturalized on O'ahu.

Material examined. O'AHU: Wai'anae Mts, Mt Ka'ala, present along Ka'ala fence line portion near the road, along both road to FAA chain link enclosure and to the radio towers, 4000 ft, 7 May 2003, K. Kawelo s.n. (BISH 704671).

***Schizachyrium condensatum* (Kunth) Nees New island record**

Previously documented from the island of Hawai'i (O'Connor, 1999: 1590), where it is common in Hawai'i Volcanoes National Park but recently found more commonly on other parts of the island. Otto and Isa Degener (1983: 128) report that it was first introduced in 1932 on O'ahu, however there is no documentation backing this statement.

Material examined. O'AHU: H-3 Freeway, Honolulu side near entrance, dense growth along ca. 300 ft stretch of highway, along both townward and Kāne'ohe sides, very little beyond, 21° 24' N, 157° 50' W, 1000 ft, 8 May 2002, K. Kawelo, J. Rohrer & J. Beachy s.n. (BISH 687841).

***Setaria sphacelata* (Schum.) Stapf & New island record**

C.E. Hubb. ex M.B. Moss

First reported from the island of Maui as a naturalized species in Hawai'i (Starr *et al.*, 2002: 23), *Setaria sphacelata* has now been documented from three additional islands: Kaua'i, O'ahu, and Hawai'i.

Material examined. KAUA'I: Hanalei National Wildlife Refuge, uncommon weedy grass on bank of dried pond, 12 Jul 2002, C. Imada & T. Perkins 2002-11. O'AHU: On roadcut above the H-3 Freeway between the Kāne'ohe and Kailua exits, above the Ho'omaluhia Botanical Garden, growing along 1 to 2 miles of the highway, 21°23'N, 157°48'W, 250 ft, 22 May 2002, K. Kawelo & J. Rohrer s.n. (BISH 687842). HAWAII: Honoka'a Sugar Company, 18 May 1979, R. Kami s.n. (BISH 427545, 516906).

ACKNOWLEDGMENTS

We thank the following taxonomic specialists for identifications: U. Eliasson (GB, Amaranthaceae), T. Lammers (OSH, *Wahlenbergia*), and L. 't Mannetje (WAG, *Stylosanthes*). Tim Flynn, Hank Oppenheimer, Forest Starr, and Kim Starr graciously allowed us to include their *Stylosanthes* collections in this paper, making it possible to assemble all relevant voucher specimens for each taxon.

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The Centipede Order Geophilomorpha in the Hawaiian Islands (Chilopoda)

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INTRODUCTION

The Hawaiian representatives of two of the four globally distributed orders of centipedes have recently been documented: Scolopendromorpha, with comments on the Scutigero-morpha (Shelley, 2000), and Lithobiomorpha (Zapparoli & Shelley, 2000). This contribution provides a corresponding review of the Geophilomorpha, the long, wormlike, epi-morphic chilopods with 14 antennomeres and at least 27 pedal segments and leg pairs. The most speciose chilopod order, it is also the most diverse in the Hawaiian islands. Our formerly limited knowledge of this fauna derived primarily from works by Silvestri (1904), Chamberlin (1920, 1926, 1930, 1953), Attems (1938a), Beardsley (1966), and Hoffman & Pereira (1991).

We studied 70 unpublished specimens from 10 different islands or atolls along with type material of *Nyctunguis bryanus* Chamberlin, *Honuaphilus alohanus* Chamberlin, and *Zelanion hawaiiensis* Chamberlin. Most of the unpublished material belongs to the Bishop Museum, Honolulu, and a few additional samples come from the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (NMNH). Except for the specimens identified as being from the latter, all material is deposited in the Bishop Museum. More Hawaiian samples undoubtedly exist in American repositories, but we have not attempted to record them during visits by one of us (RMS) to these institutions, and it is not possible to locate them now. We invite future students to issue supplements to our work as additional material is discovered.

Our investigations on Hawaiian Geophilomorpha here lead to the proposals of one new combination (*Marsikomerus bryanus* for *Nyctunguis bryanus*); and four new synonymies: one generic (*Honuaphilus* Chamberlin, 1926, under *Tuoba* Chamberlin, 1920) and three specific [*Marsikomerus pacificus* Attems, 1938, and *Lanonyx lanaius* Chamberlin, 1953, under *Marsikomerus bryanus*; and *Honuaphilus alohanus* under *Tuoba syd-neyensis* (Pocock, 1891)]. Comprehensive study is recommended for the genera *Nesomerium* and *Fusichila*, both authored by Chamberlin (1953), and five nominal species: *Mecistocephalus spissus* Wood, *M. 'maxillaris'* (Gervais), *Fusichila waipaheenas* Chamberlin, *Nesomerium hawaiiense* Chamberlin, and *Zelanion hawaiiensis*. The genera *Tygarrup* Chamberlin and *Tuoba*; and the species *Tygarrup javanicus* Attems are reported from the islands for the first time; and new records from individual islands are listed for five other species.

For each species we present the following:

- a list of references (and synonyms) that includes the original description, the most important taxonomic references, particularly ones with meaningful illustrations,

and those pertaining to Pacific islands and the Hawaiian chain specifically; synonyms never used for Hawaiian records are not cited.

- an extended diagnosis based, as far as possible, on Hawaiian specimens, along with literature data and personal observations; only the inadequate original description is available for *N. hawaiiense*.
- published records and details of new localities from the Hawaiian archipelago.
- remarks on taxonomy, overall distribution, and status of the species in the Hawaiian islands.

We also provide a practical key and pertinent illustrations to all species of Geophilmorpha known from the Hawaiian archipelago, based as far as possible on characters that can be seen without clearing or dissecting specimens (Pereira, 2000; Foddai, Minelli & Pereira, 2002).

Family Mecistocephalidae

Tygarrup javanicus Attems

New state record

Mecistocephalus spissus: Attems, 1907: 95, figs. 8–9 [non *Mecistocephalus spissus* Wood, 1862].

Tygarrup javanicus Attems, 1929: 152; 1938b: 330, figs. 294–298; 1953: 143. Verhoeff, 1937a: 236; 1939: 87. Demange, 1981: 640, figs. 8–9. Titova, 1983: 151, figs. 14–17. Lewis & Rundle, 1988: 3, figs. 1–6. Christian, 1996: 110, fig. 6c. Wang & Mauriès, 1996: 89.

Diagnosis. Length varying up to 20 mm; number of leg-bearing segments 45, invariant; body tapering caudad; color dark yellow, without dark patches. Antennae with spearlike apical sensilla, clublike sensilla on both internal and external sides of antennomeres XIV. Head trapezoid, tapering caudad, ca. 1.4 times longer than wide. Frontal line rounded, convex caudad. Clypeus with one entire plagula; clypeal setae as follows: 1 pair on lateral parts of areolate clypeus, some pairs along anterior margin of plagula (2 pairs intermediate, ca. 5 pairs lateral), 1 pair on central part of plagula. Spiculum absent. Buccae without setae. Labral mid-piece longer than wide, with one tooth; each side-piece divided into two alae, anterior ala shorter than posterior ala along internal margin, posterior margin entire. Mandible without dentate lamellae, with ca. 6 pectinate lamellae; first lamella with ca. 5 teeth, intermediate lamella with ca. 10 teeth. First maxilla coxosternum divided mid-longitudinally, without lateral lappets, anterolateral corners virtually absent; telopodite with only one article, similar to coxal projection, without lappets. Second maxilla coxosternum not divided mid-longitudinally, without separate pleurites, posterior part not areolate, metameric pores opening close to lateral margins; pretarsus of telopodite pointed, not elongate, without comblike projections. Forcipular tergum narrower than that of first leg-bearing segment, coxosternum without chitin lines, cerus absent; forcipular articles, from trochanteroprefemur to tarsungulum, with 1, 0, 1, and 0 teeth, respectively. Forcípules, when closed, extending beyond anterior margin of head. Poison calyx elongate, extending only to intermediate articles of forcípule. Sternal pores present in male only, in two paired subcircular areas. Sternal apodema present, not furcate. Sternum of ultimate leg-bearing segment shield-shaped, without posterior process. Each coxopleuron with ca. 15 ventral pores in adults, subcircular, opening independently, internalmost pores largest. Ultimate legs not sexually dimorphic, slender, covered with scattered setae; pretarsi reduced to short spines. A pair of anal pores present.

Occurrence in the Hawaiian Islands. Hawai'i, O'ahu.

Published records: None.

New records. **HAWAII:** Mauna Loa, Stainback Hwy, '*Metrosideros* to lower elevations', 22 Jan 1974, J. Jacobi. **O'AHU:** north end of Ko'olau Mountains, 9 May 1964.

Remarks. The genus *Tygarrup* occurs primarily in southeast Asia, from the Himalayas through Indochinese Peninsula (Thailand, Laos, Cambodia, and Vietnam) to Java; it also is found on the Seychelles and Mauritius Island in the Indian Ocean, and southern

Japanese islands (Bonato *et al.*, 2003). It has not previously been recorded from the Hawaiian Islands. The species *T. javanicus* is mainly known from the Malay Peninsula and Java but also from the Seychelle Islands (Demange, 1981); introduced specimens have been found in two European localities, the Kew Gardens, London, England, and Vienna, Austria (Lewis & Rundle, 1988; Christian, 1996). In the Hawaiian islands *T. javanicus* is probably also a human introduction.

Mecistocephalus spissus Wood

Mecistocephalus spissus Wood, 1862: 43. Haase, 1887: 101. Attems, 1903: 213; 1929: 129, fig. 142; 1938a: 365; 1947: 96. Chamberlin, 1920: 63; 1926: 94; 1953: 77, 80. Takakuwa, 1942: 18, 22. Beardsley, 1966: 168. Nishida 1997: 195; 2002: 235.

Lammonyx spissus: Cook, 1895: 61. Silvestri, 1904: 323, 326, pl. 11, figs. 5–7; 1919: 75, fig. 19.

Diagnosis. Length varying up to 70 mm; number of leg-bearing segments 45, invariant; body tapering caudad; color dark yellow-brown, without dark patches. Antennae with spearlike apical sensilla, clublike sensilla on internal and external sides of 5–7 distalmost antennomeres. Head trapezoid, tapering caudad, 1.7–1.8 times longer than wide. Frontal line rounded, convex caudad. Clypeus with two plagulae divided by mid-longitudinal areolate band, each plagula narrowing medially; areolate clypeus without clypeal insulae; clypeal setae usually 3 pairs. Spiculum present. Buccae with setae on posterior halves only. Labral mid-piece longer than wide, with one tooth; each side-piece divided into two alae, anterior ala longer than the half of posterior ala along internal margin, posterior margin entire. Mandible without dentate lamellae, with ca. 8 pectinate lamellae; first lamella with ca. 7 teeth, intermediate lamella with 15–20 teeth. First maxilla coxosternum divided mid-longitudinally, without lappets, anterolateral corners subrectangular, slightly pointed; telopodite with only one article, similar to coxal projection, without lappets. Second maxilla coxosternum not divided mid-longitudinally, without separate pleurites; posterior part areolate, metameric pores opening close to lateral margins; pretarsus of telopodite pointed, not elongate, without comblike projections. Forcicular tergum narrower than that of first leg-bearing segment, coxosternum without chitin lines, cernus absent; forcicular articles, from trochanteroprefemur to tarsungulum, with 2, 1, 1, and 2 (1 dorsal, 1 ventral) teeth, respectively. Forcicules, when closed, extending beyond anterior margin of head. Poison calyx elongate, extending to distal part of trochanteroprefemur. Sternal pores absent. Sternal apodema present, not furcate. Sternum of ultimate leg-bearing segment shield-shaped, with swollen posterior process. Each coxopleuron with ca. 40 subcircular, ventral pores in adults. Ultimate legs not sexually dimorphic, slender, with scattered setae; pretarsi reduced to short spines. A pair of anal pores present.

Occurrence in the Hawaiian Islands. Hawai'i, Maui, Moloka'i, O'ahu, Kaua'i, Necker.

Published records. Hawai'i: Ka'u (Silvestri, 1904); Kilauea (Silvestri, 1919). Maui: Haleakalā (Silvestri, 1904, 1919). Moloka'i: island in general (Silvestri, 1904). O'ahu or Kaua'i: island in general (Wood, 1862; reported as O'ahu by Silvestri, 1904). Kaua'i: Halemanu (Silvestri, 1904). Necker: island in general (Chamberlin, 1926).

New records. O'AHU: Mt. Ka'ala, bog, 1225 m, 'ōhi'a litter and soil, 25 Oct 1996, N.L. Evenhuis. KAUA'I: island in general, Jul–Aug 1917, C.N. Forbes. NECKER: Summit Hill, in rock crevices, 22 Nov 2000, G.M. Nishida.

Remarks. *Mecistocephalus spissus* is apparently endemic to the Hawaiian Islands, where it is known from most of the major islands, primarily in mountainous regions. Other nominal species of *Mecistocephalus* that are anatomically similar to *M. spissus* occur in eastern Asia from Japan (Honshu) to the Philippines; their specific status await evaluation, and some names may be placed in synonymy under *M. spissus*. This species has been erroneously reported from Himalayas, Myanmar, Sumatra, and Java based on misidentifica-

tions of specimens of *Tygarrup* spp. (Pocock, 1891a, 1894; Silvestri, 1895; Attems, 1907, 1930; Chamberlin, 1944a; Mittal & Dipta, 1977), some of which have been corrected (Silvestri, 1919; Attems, 1929; Attems, 1938b; Verhoeff, 1939; Chamberlin, 1953; Lewis & Rundle, 1988).

Mecistocephalus 'maxillaris' (Gervais)
sensu Silvestri

New island records

Lamonyx maxillaris: Silvestri, 1919: 61, fig. 9. [non *Geophilus maxillaris* Gervais, 1837].

Mecistocephalus maxillaris: Pemberton, 1925: 3, fig. 1. Illingworth, 1928: 42. Attems, 1929: 134, fig. 126; 1938a: 365. Brolemann, 1930: 81, figs. 58–66. Williams, 1931: 344. Adamson, 1932: 229. Silvestri, 1935: 132; 1939: 6. Chamberlin, 1930: 67; 1953: 78, 80. Demange & Pereira, 1985: 197, 198. Nishida, 1997: 195; 2002: 235. Foddai *et al.*, 2000: 64.

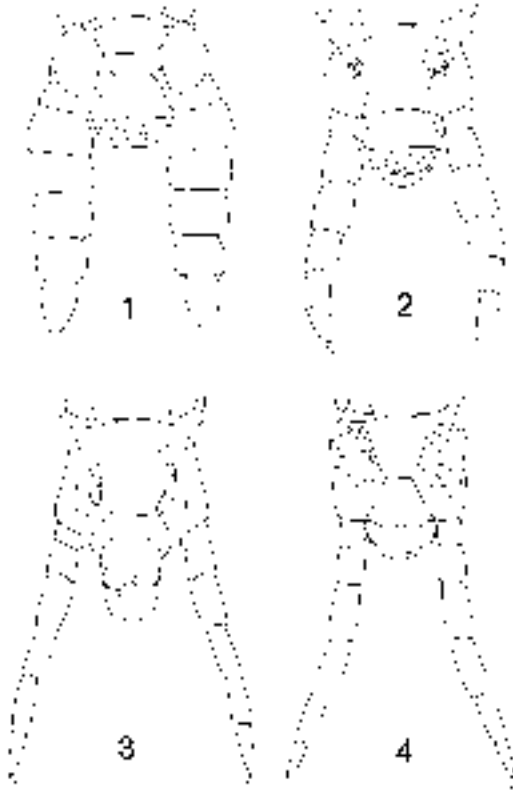
Diagnosis. Length varying up to 40 mm; number of leg-bearing segments 49, invariant; body tapering caudad; color yellow, without dark patches. Antennae with spearlike apical sensilla, clublike sensilla on both internal and external sides of 5–7 distalmost antennomeres. Head trapezoid, tapering caudad, 1.8–1.9 times longer than wide. Frontal line rounded, convex caudad. Clypeus with two plagulae divided by mid-longitudinal areolate band; areolate clypeus without insulae; clypeal setae usually 3–4 pairs. Spiculum present. Buccae with setae on posterior halves only. Labral mid-piece longer than wide, with one tooth; each side-piece divided into two alae, anterior ala as long as half of the posterior ala along internal margin, posterior margin entire. Mandible without dentate lamellae, with ca. 7 pectinate lamellae; first lamella with ca. 6 teeth, intermediate lamella with 10–15 teeth. First maxilla coxosternum divided mid-longitudinally, without lappets, anterolateral corners subrectangular, slightly pointed; telopodite with only one article, similar to coxal projection, without lappets. Second maxilla coxosternum not divided mid-longitudinally, without separate pleurites, posterior part areolate, metameric pores opening close to the lateral margins; pretarsus of telopodite pointed, not elongate, without comblike projections. Forcipular tergum narrower than that of first leg-bearing segment, coxosternum without chitin lines, cerrus absent; forcipular articles, from trochanteroprefemur to tarsungulum, with 2, 1, 1, and 2 (1 dorsal, 1 ventral) teeth, respectively. Forcípules, when closed, extending beyond anterior margin of head. Poison calyx elongate, extending to distal part of trochanteroprefemur. Sternal pores absent. Sternal apodema present, furcate, arms long, angle between them ca. 90°. Sternum of ultimate leg-bearing segment shield-shaped, usually with intermediate, weak, lateral constriction and rounded, posterior process. Each coxopleuron with ca. 40 sub-circular, ventral pores in adults. Ultimate legs not sexually dimorphic, slender, with scattered setae; pretarsi reduced to short spines. A pair of anal pores present.

Occurrence in the Hawaiian Islands. Hawai'i, Maui, Lāna'i, Midway.

Published records. Hawai'i: Hilo (Silvestri, 1919); Hāmākua, Kohala (Pemberton, 1925). Lāna'i: island in general (Illingworth, 1928).

New records. MAUI: Pu'unene, sugar cane, Dec 1927, E.H. Bryan; Ha'ikū, under stones, 20 Mar 1967, N.L.H. Krauss. MIDWAY: Sand I., litter under *Coccoloba* tree, 18 Dec 1997, G.M. Nishida; and Feb–May 1957, Y. Oshiro.

Remarks. The true identity of *Geophilus maxillaris* is inadequately known, its poor description (Gervais, 1837) being based upon specimens of uncertain origin collected in Paris and now lost; the name has been applied to different mecistocephalid species in all tropical regions. We provisionally follow the concept of Silvestri (1919), who redescribed the species based on specimens from the Hawaiian islands and other areas. In Hawai'i, *M. 'maxillaris'* is known from three major islands plus Midway and occurs in various habitats. Current knowledge of distribution is admittedly inadequate, but *M. 'maxillaris'* appears to be a widespread tropical geophilomorph (Chamberlin, 1953; Demange & Pereira, 1985; Foddai *et al.*, 2000) that was probably introduced into the Hawaiian archi-



Figs. 1–4. Ultimate leg-bearing segments, ventral views. 1, *Orphnaeus brevilibiatus*. 2, *Tuoba sydneyensis*. 3, *Marsikomerus bryanus*. 4, *Pachymerium ferrugineum*.

pelago (Chamberlin, 1930).

***Mecistocephalus waikaneus* Chamberlin**

New island records

Mecistocephalus waikaneus Chamberlin, 1953: 81. Nishida, 1997: 195; 2002: 235.

Diagnosis. Length varying up to 30 mm; number of leg-bearing segments 49, invariant; body tapering caudad; color yellow, without dark patches. Antennae with spearlike apical sensilla, clublike sensilla on internal and external sides of 5–7 distalmost antennomeres. Head trapezoid, tapering caudad, 1.7–1.8 times longer than wide. Frontal line rounded, convex caudad. Clypeus with two plagulae divided by mid-longitudinal areolate band; areolate clypeus without insulae; clypeal setae usually 3–4 pairs. Spiculum present. Buccae with setae on posterior halves only. Labral mid-piece longer than wide, with one tooth; each labrum side-piece divided into two alae, anterior ala as long as the half of posterior ala along internal margin, posterior margin entire. Mandible without dentate lamellae, with ca. 7 pectinate lamellae; first lamella with ca. 6 teeth, intermediate lamella with 10–15 teeth.

First maxilla coxosternum divided mid-longitudinally, without lappets, anterolateral corners subrectangular, slightly pointed; telopodite with only one article, similar to coxal projection, without lappets. Second maxilla coxosternum not divided mid-longitudinally, without separate pleurites, posterior part areolate, metameric pores opening close to lateral margins; pretarsus of telopodite pointed, not elongate, without comblike projections. Forcipular tergum narrower than that of first leg-bearing segment, coxosternum without chitin lines, cerrus composed of 2 paramedian rows and 2 lateral groups of setae; forcipular articles, from trochanteroprefemur to tarsungulum, with 2, 1, 1, and 2 (1 dorsal, 1 ventral) teeth, respectively. Forcípules, when closed, extending beyond anterior margin of head. Poison calyx elongate, extending to distal part of trochanteroprefemur. Sternal pores absent. Sternal apodema present, furcate, arms very short. Sternum of ultimate leg-bearing segment shield-shaped, usually with intermediate, weak, lateral constriction and rounded, posterior process. Each coxopleuron with ca. 20 subcircular, ventral pores in adults. Ultimate legs not sexually dimorphic, slender, with scattered setae, dense short setae on ventral sides; pretarsi reduced to short spines. A pair of anal pores present.

Occurrence in the Hawaiian Islands. Hawai'i, Maui, O'ahu.

Published records. Hawai'i: Waikāne (Chamberlin, 1953).

New records. **HAWAII:** island in general, 0–305 m, exotic forest, 22 Jan 1974, J. Jacobi. **MAUI:** Kīpahulu valley, near sacred pools, 50–75 m, wet *Pandanus* & misc. tree litter, 28 May 1997, S.F. Swift. **O'AHU:** Honolulu, Makiki Hts Rd, 27 Jul 1964, T. Suman; Mānoa Trail head, litter, 30 Jan 1997, S.F. Swift; slopes of Mt. Tantalus, 10 Dec 1939, R.P. Currie (NMNH); Nu'uuanu Pali Dr, stream, Norfolk pine grove, 17 Feb 1985, V. & B. Roth.

Remarks. *Mecistocephalus waikaneus* also appears to be endemic to the Hawaiian chain, where it is known from three major islands, primarily in forested habitats. Other nominal species that are anatomically close to *M. waikaneus* occur in eastern and southern Asia, but their specific status await evaluation.

Family Schendylidae

Marsikomerus bryanus (Chamberlin)

Taxonomic changes, New island records

Nyctunguis bryanus Chamberlin, 1926: 92; 1953: 75. Attems, 1938a: 365, 369. Beardsley, 1966: 168. Nishida, 1997: 195; 2002: 236.

Marsikomerus pacificus Attems, 1938a: 372–374, figs. 1–6. Hoffman & Pereira, 1991: 48–52, figs. 1–37. Shelley, 2000: 39. Nishida, 2002: 236. **New Synonymy.**

Marsicomerus [sic] *pacificus*: Attems, 1947: 128.

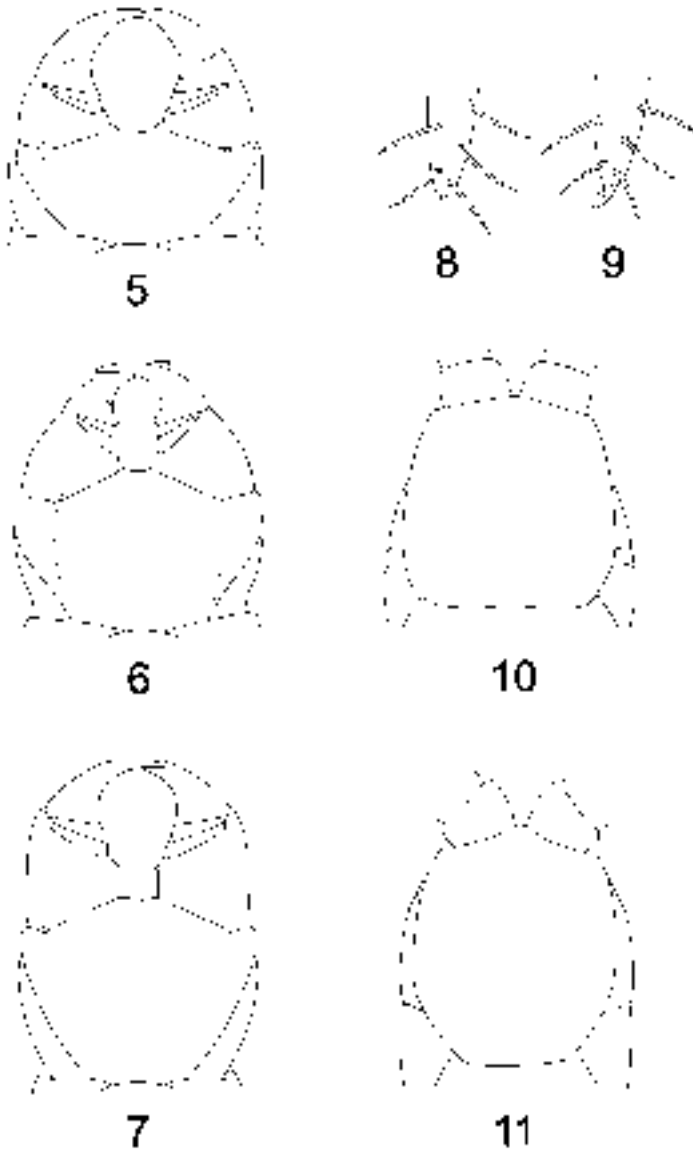
Marsukomerus [sic] *pacificus*: Chamberlin, 1953: 85.

Lanonyx lanaius Chamberlin, 1953: 75. **New Synonymy.**

Marsikomerus lanaius: Hoffman & Pereira, 1991: 52–54, figs. 38–42. Shelley, 2000: 39. Nishida, 2002: 236.

Marsikomerus bryanus: this study. **New Combination.**

Diagnosis. Length varying up to 47 mm; number of leg-bearing segments 39–57 (but 45 and 55 not yet recorded); body tapering both anterior and caudad; color yellow to orange, sometimes with two paramedian subepithelial gray bands. Antennae with spearlike apical sensilla, clublike sensilla only on external sides of antennomeres XIV. Head subrectangular, 1.1–1.3 times longer than wide; anterior margin obtusely pointed. Frontal line absent. Clypeus homogeneously areolate; clypeal setae as follows: 1 pair anterior, 6–8 pairs on an intermediate band, 1 pair posterior. Labrum with ca. 13 teeth along central arc plus 3–5 teeth on each side. Mandible with one entire dentate lamella bearing 5–8 teeth and one pectinate lamella. First maxilla coxosternum undivided, with pair of lateral lappets, anterolateral corners virtually absent; telopodite with two articles, larger than coxal projection, basal article with one external lappet. Second maxilla coxosternum not divided mid-longitudinally, with separate pleurites, metameric pores opening close to the posterior margin; pretarsus of telopodite pointed, elongate, with two rows of comblike projections. Forcipular tergum narrower than that of



Figs. 5–7. Forcipular segments, ventral views. **5,** *Orphnaeus brevilabiatus*. **6,** *Tuoba sydneyensis*; **7,** *Marsikomerus bryanus*. **Figs. 8–9.** Tips of ultimate legs, ventral views. **8,** *Tygarrup javanicus*. **9,** *Marsikomerus bryanus*. **Figs. 10–11.** Heads, dorsal views. **10,** *Tuoba sydneyensis*. **11,** *Marsikomerus bryanus*.



12



16



13



17



14

15



18

first leg-bearing segment, coxosternum without chitin lines; forcipular articles usually with one very small tooth apiece, that on trochanteroprefemur sometimes more developed. Forcípules, when closed, extending nearly to anterior margin of head. Poison calyx quite elongate, extending to intermediate articles of forcípule. Legs with anterior parunguis usually slightly longer than posterior parunguis, also with an additional, shorter, intermediate spine. Sternal pores present in both males and females in one median subcircular area. Sternum of ultimate leg-bearing segment trapezoid. Each coxopleuron with 1 ventral pore, subcircular in juveniles but longitudinally elongate in adults, females especially. Ultimate legs sexually dimorphic, very swollen in males but only weakly so in females, with scattered setae; dense short setae on ventral sides in males but only a few setae in females; pretarsi clawlike. Anal pores apparently absent.

Occurrence in the Hawaiian Islands. Hawai'i, Maui, Lāna'i, Moloka'i, O'ahu, Necker, Gardner Pinnacles.

Published records. Hawai'i: island in general (Chamberlin, 1953); Nā'ūhi Gulch (Attems, 1938a; see also Hoffman & Pereira, 1991). Lāna'i: Lāna'i Mts (Chamberlin, 1953). Necker: island in general (Chamberlin, 1926).

New records. **HAWAI'I:** Honoka'a, Hāmākua Forest Reserve, caves, 600 m, 24 May 1972, F.G. Howarth (NMNH). **MAUI:** Honokawai, Kaulewelewe, 3000 ft, 2 Oct 1979, S.L. Montgomery; Ko'olau Forest Reserve, Itanawi Stream, 5000 ft, in dead fern frond, 8 Aug 1973, T.L. Casey; Haleakalā, 5500 ft, 27 May 1945, E.C. Zimmerman; Olinda, 1 May 1932, 5 May 1932, O. Bryant. **MOLOKA'I:** North of Hanalilolilo, 3725 ft, 13 Jul 1979, J. Jacobi, P. Higashino. **O'AHU:** Kīpapa, 18 Nov 1934, E.H. Bryan Jr.; Koala, moss, 21 Jun 1967, C.M. Yoshimoto; Wiliwilinui Ridge, 1800 ft, 8 Nov 1968, W.C. Gagné; Hale'au'au, 'ōhi'a lehua tree, under bark, 29 Nov 1925, W.H. Heinecke; Mt Tantalus, 19 Mar 1940, E.C. Zimmerman; Mt Ka'ala, 4000 ft, in moss on tree, 19 May 1966, C.M. Yoshimoto; Palikea, 20 Dec 1972, C.P. Hoyt. **GARDNER PINNACLES:** under rocks, 16 Dec 2000, G.M. Nishida.

Remarks. Two nominal species of *Marsikomerus* Attems have been recorded from the Hawaiian Islands (Hoffman & Pereira, 1991; Shelley, 2000): *M. pacificus*, proposed by Attems (1938a) for an adult female from the island of Hawai'i, and *M. lanaius* (described as *Lanonyx lanaius*) by Chamberlin (1953) for a subadult male from Lāna'i; no further specimens have been referred to either. Chamberlin (1926) previously proposed *Nyctunguis bryanus* for four specimens from Necker and later recorded it from the island of Hawai'i (Chamberlin, 1953); its true identity, however, was not clear. Based on our study of the holotype and one paratype of *N. bryanus*, 18 new individuals, and an evaluation of the redescriptions of the holotypes of *M. pacificus* and *M. lanaius* by Hoffman & Pereira (1991), we conclude that only one species is recognizable. All differences between the types of *N. bryanus*, *M. pacificus*, and *M. lanaius* reflect intraspecific variation, sexual dimorphism, and/or developmental changes. In particular, the condition of the forcipular trochanteroprefemur varies from the absence of a tooth to the presence of a minute one. Furthermore, we found that the original description of *N. bryanus* contains two errors that prevented subsequent authors from recognizing its true identity: the forcipular articles are described as 'unarmed', but small stout teeth are evident on the trochanteroprefemora of both the holotype and paratype; additionally, two 'coxal pits' are described on each coxopleuron, but the two type specimens (both females) actually exhibit a single elongate

Figs. 12–13. Clypeuses, ventral views. **12,** *Pachymerium ferrugineum*. **13,** *Zelanion* sp. **Figs. 14–15.** Tips of second maxillary telopodites. **14,** *Pachymerium ferrugineum*. **15,** *Zelanion* sp. **Figs. 16–18.** Forcípular segments, dorsal views. **16,** *Tygarrup javanicus*. **17,** *Mecistocephalus spissus*. **18,** *Mecistocephalus waikaneus*.

pore there, as is typical for this sex. We provisionally maintain *Marsikomerus* as distinct from *Nyctunguis* Chamberlin, 1914, but the taxonomic relationship between them deserves thorough evaluation. *Marsikomerus bryanus* also seems to be endemic to the Hawaiian Islands where it occurs primarily in forested montane environments. It is anatomically close to congeneric species in North America (the southeastern States and northern Mexico) (Hoffman & Pereira, 1991; Foddai, Pereira & Minelli, 2000), but minor differences exist, at least with *M. texanus* (Chamberlin, 1940), the best known continental species (see Crabill, 1961; Hoffman & Pereira, 1991).

Family Oryidae

Orphnaeus brevilabiatus Newport

Geophilus brevilabiatus Newport, 1845: 436.

Orphnaeus lividus Meinert, 1870: 19, pl. 2, figs. 6–11; 1886: 231.

Orphnaeus brevilabiatus: Haase, 1887: 111, pl. 6, figs. 117a–e. Pocock, 1894: 317; 1896: 40, pl. 3, figs. 14a–d. Attems, 1903: 201; 1914: 9, 18, 48, 61; 1928: 125; 1929: 112; 1938a: 365; 1947: 93. Chamberlin, 1914: 391; 1920: 38; 1939: 6; 1944b: 190; 1950: 136; 1953: 77. Swezey, 1926: 221. Adamson, 1932: 228. Silvestri, 1935: 132. Verhoeff, 1937b: 6. Chamberlin & Wang, 1952: 177. Wang, 1955: 15; 1956: 158; 1962: 87, figs. 1–4; 1963: 93. Lewis & Wranik, 1990: 67, figs. (3) 11–15. Shear & Peck, 1992: 2267. Golovatch, 1994: 159. Nishida, 1997: 195; 2002: 236. Foddai *et al.*, 2000: 112.

Orphnaeus bilabiatus [sic]: Chamberlin, 1913: 122.

Diagnosis. Length varying up to 90 mm (85 mm in Hawaiian specimens); number of leg-bearing segments 65 to 81 (73 to 79 in Hawaiian specimens); body tapering anteriorly and caudad; color yellow, with two paramedian subepithelial gray-green bands. Antennae with proximal parts flattened, with spearlike apical sensilla, clublike sensilla on external sides of some distalmost antennomeres and internal sides of articles XIV. Head oval, about as long as wide, anterior margin obtusely pointed. Frontal line absent. Clypeal setae: several tens. Labrum with several stout teeth. Mandible without dentate lamellae, with 4–5 pectinate lamellae. First maxilla coxosternum undivided, with pair of lateral lappets, anterolateral corners virtually absent; telopodite with only one article, larger than coxal projection, with one external lappet. Second maxilla coxosternum not divided mid-longitudinally, metameric pores opening close to posterior margin; pretarsus of telopodite pointed, not elongate, with one row of comblike projections. Forcipular tergum about as wide as that of first leg-bearing segment, coxosternum without chitin lines; forcipular articles without teeth. Forcípules, when closed, not extending beyond anterior margin of head. Poison calyx short, extending only to basal part of tarsungulum. Sternal pores arranged in two anterior and two posterior subcircular areas, number of pores roughly the same on anterior and posterior parts of trunk. Sternum of ultimate leg-bearing segment trapezoid, wider than long. Coxopleuron without pores. Ultimate legs sexually dimorphic, noticeably swollen in males but only weakly so in females; short setae on ventral side, denser in males than females; pretarsi absent. Anal pores apparently absent.

Occurrence in the Hawaiian Islands. O'ahu.

Published records. O'ahu: island in general (Meinert, 1870); Waimalu Valley (Swezey, 1926).

New records: None.

Remarks. *Orphnaeus brevilabiatus* is widely distributed in tropical regions (Haase, 1887; Attems, 1929; Foddai *et al.*, 2000). Within the Pacific area, it is known from the Solomon, Samoan, Fiji, Society, Marquesas, and Galápagos Islands; a comprehensive review exists in Foddai *et al.* (2000). In the Hawaiian Islands, the species is known only from two old records from O'ahu, where it is probably adventive.

Family Geophilidae***Tuoba sydneyensis* (Pocock)****Name change, New island records**

Geophilus sydneyensis Pocock, 1891b: 219. Attems, 1903: 262; 1914: 133; 1929: 326. Chamberlin, 1920: 54.

Necrophloeophagus sydneyensis: Pocock, 1901: 461.

Tuoba sydneyensis: Jones, 1998: 334, fig. 1–11.

Honuaphilus alohanus Chamberlin, 1926: 93; 1953: 85. Attems, 1938a: 365, 369. Butler, 1961: 380. Butler & Usinger, 1963a: 4; 1963b: 269. Beardsley, 1966: 179. Nishida, 1997: 195; 2002: 235.

New Synonymy.

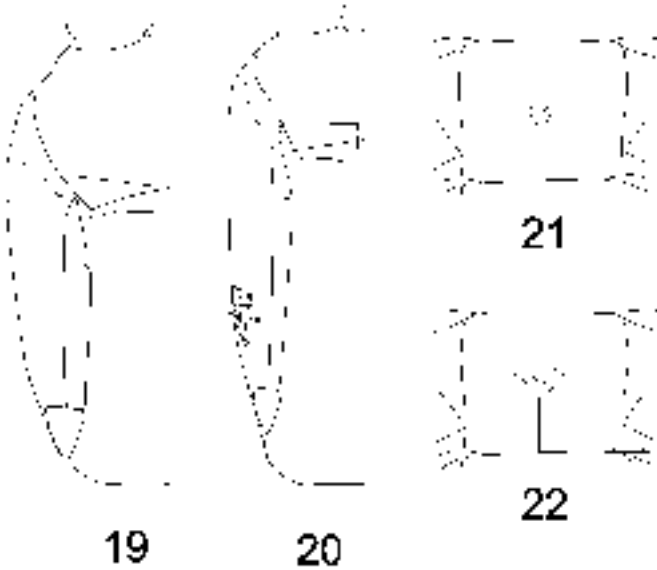
Diagnosis. Length varying up to 32 mm; number of leg-bearing segments 39–55 (43–47 in Hawaiian specimens); body tapering slightly anterior and caudad; color yellow-orange, without dark patches. Antennae 4–5 times longer than head, with spearlike apical sensilla, clublike sensilla on both internal and external sides of articles XIV; antennomeres II–XIV ca. 2 times longer than wide. Head subrectangular, about as long as wide; anterior margin obtusely pointed. Frontal line absent. Clypeus homogeneously areolate except for posterior, marginal, inareolate band. Clypeal setae: 1 pair anterior and ca. 6 pairs posterior. Each bucca with two anterior setae. Labral mid-piece wider than long, with 7–9 teeth; each side-piece entire, with 2–3 teeth on medial parts. Mandible without dentate lamellae, with one pectinate lamella. First maxilla coxosternum undivided, with pair of small lateral lappets, anterolateral corners virtually absent; telopodite with two articles, larger than coxal projection, basal article with one short external lappet. Second maxilla coxosternum not divided mid-longitudinally, metameric pores opening close to posterior margin; pretarsus of telopodite short but pointed. Forcipular tergum approximately as wide as that of first leg-bearing segment, coxosternum with almost complete chitin lines; forcipular articles, from trochanteroprefemur to tarsungulum, with 0, 0, 0, and 1 teeth respectively. Forcipules, when closed, extending nearly to anterior margin of head. Poison calyx short, extending to distal part of trochanteroprefemur. Legs with anterior parunguis longer than posterior parunguis. Sternal pores on posterior bands on anterior segments, in two paired subcircular areas on posterior ones. Carphophagus structure present on anteriormost segments, sacculus about half as wide as sternum. Sternum of ultimate leg-bearing segment trapezoid. Each coxopleuron with ca. 30 pores in adults, all opening in one pit on ventral side. Ultimate legs sexually dimorphic, swollen in males but slender in females, with scattered setae, dense short setae on ventral side in both sexes; pretarsi clawlike. A pair of anal pores present.

Occurrence in the Hawaiian Islands. Moloka'i, Laysan, Pearl and Hermes Reef, Midway, Kure.

Published records. Laysan: island in general (Chamberlin, 1926). Pearl and Hermes Reef: island in general (Chamberlin, 1926). Kure: island in general (as 'Ocean I', Chamberlin, 1926).

New records. **MOLOKA'I:** Kamiloloa, 3200 ft, rotten *Pipturus*, 19 Dec 1925, O.H. Swezey. **LAYSAN:** island in general, litter in coconut grove, 10 May 1985, W. Gagné. **PEARL AND HERMES REEF:** South-East Island, in soil, 13 Dec 1970, J.L. Gressitt. **MIDWAY:** Eastern Island, under driftwood on beach, May 1997, G.M. Nishida.

Remarks. We place *H. alohanus*, considered 'species inquirenda' by Attems (1938a), in synonymy under *T. sydneyensis* based on examinations of three syntypes of the former (from Laysan and Johnston islands; see Chamberlin, 1926) and 20 additional Hawaiian specimens. The monotypic genus *Honuaphilus* Chamberlin, 1926 therefore falls in synonymy under *Tuoba* Chamberlin, 1920 (**New Synonymy**). The original diagnosis of *Honuaphilus* and the original description of *H. alohanus* contain two relevant errors: a 'well-defined median clypeal area' is characterized, but the clypeus is actually uniformly areolate aside from a posterior marginal band; additionally, the first maxillary coxal projections are described as longer than the telopodites, but they actually are shorter.



Figs. 19–20. Right buccae, ventral views. **19,** *Tygarrup javanicus*. **20,** *Mecistocephalus spissus*.

Figs. 21–22. Sterna of 10th leg-bearing segments, ventral views. **21,** *Mecistocephalus waikaneus*. **22,** *Mecistocephalus 'maxillaris'*.

Hawaiian specimens do not differ anatomically from individuals of *T. sydneyensis* from Australia, New Caledonia, New Britain, and the Solomon Islands (Jones, 1998). The deletion of *Honuaphilus* from the Hawaiian centipede fauna is offset by the addition of *Tuoba*, a widely ranging genus in the Australian region that also occurs in the Americas, Africa, SE Asia, and the Mediterranean basin (Foddai *et al.*, 2000). *Tuoba sydneyensis* occurs primarily in littoral habitats and is a beach-dwelling species throughout its range (Chamberlin, 1953; Jones, 1998); thus, it may have reached the Hawaiian Islands without human assistance.

***Nesomerium hawaiiense* Chamberlin**

Nesomerium hawaiiense Chamberlin, 1953: 84. Nishida, 1997: 195; 2002: 235.

Diagnosis (based only on the original description). Length 45 mm; number of leg-bearing segments 69. Head subrectangular, 1.2–1.3 times longer than wide. Frontal line absent. Clypeus with one median clypeal area; clypeal setae, 1 pair located within median clypeal area. Labrum with mid-piece wider than long, with 10–12 long teeth; side-pieces almost reciprocally in touch anterior to mid-piece, entire, with teeth on medial parts. Mandible with 3–4 pectinate lamellae. First maxilla coxosternum and telopodite without lappets. Second maxilla coxosternum not divided mid-longitudinally; pretarsus of telopodite pointed. Forcipular coxosternum without chitin lines; forcipular articles, from trochanteroprefemur to tarsungulum, with 1, 1, 1, and 1 teeth, respectively. Forcipules, when closed, extending beyond anterior margin of head. Sternal pores on posterior bands. Sternum of uli-

mate leg-bearing segment trapezoid. Each coxopleuron with 1 ventral pore. Ultimate legs swollen in males except for two distalmost articles (unknown in female); pretarsi absent.

Occurrence in the Hawaiian Islands. Unknown.

Published records. Hawaiian Islands in general (Chamberlin, 1953).

New records: None.

Remarks. The genus *Nesomerium* and the species *N. hawaiiense* were proposed for only one individual; no others have subsequently been referred to either taxon. The original description is inadequate, and the validity and taxonomic placement of these putative endemic taxa await assessment. Chamberlin (1953) originally assigned them to the Geophilidae, but the described structure of the mandibles conflicts with the condition in this family and suggests that this placement is incorrect.

Pachymerium ferrugineum (Koch)

New island records

Geophilus ferrugineus Koch, 1835: pl. 2; 1847: 187.

Pachymerium ferrugineum: Verhoeff, 1924: 415. Attems, 1929, 215, fig. 202–203, 205; 1938a: 365, 369, 370. Brolemann, 1930: 134, fig. 185–192. Chamberlin, 1953: 83. Wang, 1956: 158. Nishida, 1997: 195; 2002: 235.

Diagnosis. Length varying up to 50 mm; number of leg-bearing segments 41 to 57 (43 in a Hawaiian female); body tapering caudad; color yellow-orange, without dark patches. Antennae with spearlike apical sensilla, clublike sensilla on internal and external sides of antennomeres XIV. Head subrectangular, 1.3–1.4 times longer than wide, anterior margin straight. Frontal line absent. Clypeus with two paired clypeal areas and two paired, pigmented, weakly areolate areas close to posterior margin; clypeal setae: 1 pair anterior, 2–3 pairs intermediate (1 pair within clypeal areas), usually 1 pair posterior. Labral mid-piece wider than long, with 5–7 stout teeth and ca. 3 pairs of fimbriae external to teeth; each side-piece entire, with ca. 15 fimbriae on medial parts. Mandible without dentate lamellae, with one pectinate lamella. First maxilla coxosternum undivided, with pair of lateral lappets, anterolateral corners virtually absent; telopodite with two articles, larger than coxal projection; one external lappet on each article. Second maxilla coxosternum not divided mid-longitudinally, metameric pores opening close to posterior margin; pretarsus of telopodite pointed, not elongate. Forcipular tergum noticeably narrower than that of first leg-bearing segment, coxosternum with incomplete chitin lines; forcipular articles, from trochanteroprefemur to tarsungulum, with 1, 0 (or 1), 0, and 1 teeth, respectively. Forcípules, when closed, extending beyond anterior margin of head. Poison calyx short, extending to distal part of trochanteroprefemur. Sternal pores mainly in two postero-lateral groups, coalescent in anteriormost and ultimate segments; also located on two anterolateral groups, coalescent on ultimate segments. Carpophagus structure absent. Sternum of ultimate leg-bearing segment trapezoid. Each coxopleuron with ca. 30 subcircular pores in adults, opening independently on ventral and lateral sides of coxopleuron. Ultimate legs sexually dimorphic, swollen in males but slender in females, with scattered setae; dense short setae on ventral sides in males, only a few setae in females; pretarsi clawlike. A pair of anal pores present.

Occurrence in the Hawaiian Islands. O'ahu, Kaua'i.

Published records. O'ahu: Honolulu (Attems, 1938a).

New records. **KAUA'I:** island in general, 13 May 1969.

Remarks. *Pachymerium ferrugineum*, considered native to Europe, is now known to occur widely across the Holarctic Region (Attems, 1929; Eason, 1964); within the Pacific area it is known from Taiwan (Wang, 1956) and Easter Island (Verhoeff, 1924). In the Hawaiian Islands *P. ferrugineum* is known only from a couple of records of probably adventive specimens (Attems, 1938a; Chamberlin, 1953).

***Zelanian hawaiiensis* Chamberlin**

Zelanian hawaiiensis Chamberlin, 1953: 82–83. Nishida, 1997: 195; 2002: 235.

Diagnosis. Length 28 mm; number of leg-bearing segments 39; body tapering caudad; color brown, without dark patches. Head subrectangular, longer than wide. Frontal line not evident. Clypeus with one median clypeal area; clypeal setae: 1 pair close to postero-external margins of clypeal area, none in latter. Labral mid-piece with ca. 4 teeth; side-pieces almost reciprocally in touch anterior to mid-piece; side-pieces entire, with fimbriae on medial parts. Mandible without dentate lamellae, with one pectinate lamella. First maxilla coxosternum not divided mid-longitudinally, without lappets, antero-lateral corners virtually absent; telopodite with two articles, larger than coxal projection, basal article with one external lappet. Second maxilla coxosternum divided mid-longitudinally by faint suture, metameric pores opening close to posterior margin; pretarsus of telopodite pointed, elongate, without comblike projections. Forcipular tergum noticeably narrower than that of first leg-bearing segment, coxosternum without chitin lines; forcipular articles, from trochanteroprefemur to tarsungulum, with 1, 1, 1, and 1 teeth, respectively. Forcípules, when closed, extending beyond anterior margin of head. Poison calyx short, extending to intermediate articles of forcípule. Sternal pores a few, close to the posterior margin of sterna. Carpophagus structure absent. Sternum of ultimate leg-bearing segment trapezoid. Each coxopleuron with 15 subcircular pores in adults, all opening independently on ventral and lateral sides of coxopleuron. Ultimate legs swollen in males, unknown in females; dense short setae on ventral sides in males, unknown in females; pretarsi clawlike. A pair of anal pores present.

Occurrence in the Hawaiian Islands. Hawai'i.

Published records. Hawai'i: island in general (Chamberlin, 1953).

New records: None.

Remarks. *Zelanian hawaiiensis* was proposed for one individual from an unspecified locality on the Island of Hawai'i; no other specimens have subsequently been referred to the species. From the original description, *Z. hawaiiensis* is anatomically close to *Z. antipodum* (Pocock, 1891) from New Zealand and Australia (Archey, 1936), but it may differ in the pattern of the clypeal setae and other minor details (Chamberlin, 1953). Consequently, the validity and status of this presumed Hawaiian endemic also awaits assessment (Nishida, 1997, 2002). The one known specimen was likely adventive from Australia or New Zealand, the area to which the genus is otherwise limited.

Deletions**Mecistocephalidae*****Fusichila waipaheenas* Chamberlin**

The monotypic genus *Fusichila* Chamberlin and the species *F. waipaheenas* were proposed for one individual from Kaua'i (Waipahe'e) and were based on anomalous features of the labrum. The original description suggests that the specimen is a juvenile *Mecistocephalus* Newport with an abnormally developed labrum, so the validities of these presumed endemic Hawaiian taxa are suspect.

***Mecistocephalus tridens* Chamberlin**

Chamberlin (1922) proposed this species for specimens found at Honolulu in soil imported from Java (see also Chamberlin, 1953). There is no evidence that the species has become established, so we do not regard *M. tridens* as a component of the Hawaiian fauna.

Geophilidae

Sepedonophilus hodites Chamberlin

Chamberlin (1940) proposed this species for a male found at Honolulu in soil imported from Australia. There is no evidence that it has become established, so we do not regard *S. hodites* as a component of the Hawaiian fauna.

Key to the Geophilomorpha of the Hawaiian Islands

- 1. Coxopleura of the ultimate legs without pores (Fig. 1); forcipules without teeth (Fig. 5).....
..... *Orphnaeus brevilabiatius*
- Coxopleura of the ultimate legs with pores (Figs. 2–4); forcipules with teeth (Figs. 6–7)..... 2
- 2. Coxopleura of the ultimate legs with one large ventral pore or pit apiece (Figs. 2–3) 3
- Each coxopleuron of the ultimate legs with many independent ventral pores (Fig. 4) 5
- 3. Ultimate legs without apical claws (Fig. 8); more than 60 pairs of legs
..... *Nesomerium hawaiiense*
- Ultimate legs with apical claws (Fig. 9); less than 60 pairs of legs 4
- 4. Forcipular tarsungulum with a basal tooth, remaining articles without teeth, coxosternum with chitin lines (Fig. 6); length of head subequal to maximum width (Fig. 10)
..... *Tuoba sydneyensis*
- Forcipular tarsungulum without a basal tooth, remaining articles with or without teeth, coxosternum without chitin lines (Fig. 7); length of head greater than maximum width (Fig. 11)
..... *Marsikomerus bryanus*
- 5. Ultimate legs with apical claws (Fig. 9) 6
- Ultimate legs without apical claws (Fig. 8) 7
- 6. Clypeus with two paired clypeal areas (Fig. 12); pretarsus of second maxillary telopodite not elongate (Fig. 14)..... *Pachymerium ferrugineum*
- Clypeus with one median clypeal area (Fig. 13); pretarsus of second maxillary telopodite elongate (Fig. 15) *Zelanium hawaiiense*
- 7. 45 pairs of legs 8
- 49 pairs of legs 9
- 8. Forcipular trochanteroprefemur with one tooth (Fig. 16); buccae (i.e., cephalic pleurites) without spicula (Fig. 19) *Tygarrup javanicus*
- Forcipular trochanteroprefemur with two teeth (Fig. 17); buccae with spicula (Fig. 20).....
..... *Mecistocephalus spissus*
- 9. Forcipular cerrus with two paramedian rows and two lateral groups of setae (Fig. 18); anterior arms of sternal apodema very short (Fig. 21) *Mecistocephalus waikaneus*
- Forcipular cerrus absent (Fig. 17); anterior arms of sternal apodema long (Fig. 22).....
..... *Mecistocephalus 'maxillaris'*

DISCUSSION

The known Hawaiian geophilomorph centipede fauna consists of 4 families, 8 genera, and 10 species: 4 genera and 4 species in the Geophilidae, 2 genera and 4 species in the Mecistocephalidae, and 1 genus and species apiece in the Schendylidae and Oryidae. We consider four of these species, less than half of the fauna, to be indigenous: *Mecistocephalus spissus*, *M. waikaneus*, *Marsikomerus bryanus*, and *Tuoba sydneyensis*. Pending further investigations on their taxonomic statuses and positions, three of these are regarded as Hawaiian endemics: two exhibiting East Asian affinities (*Mecistocephalus spissus* and *M. waikaneus*) and one related to the North American fauna (*Marsikomerus bryanus*). Five species are considered human importations: two are widespread in the tropics (*Mecistocephalus 'maxillaris'* and *O. brevilabiatius*), one is native to SE Asia (*Tygarrup javanicus*), one is probably native to Australia or New Zealand (*Z. hawaiiensis*), and one has a European

Table 1. Occurrences of Hawaiian Geophilomorpha by Island.

	HA	MA	LA	MO	OA	KA	NE	GP	LY	PH	MY	KU	UN
<i>Tygarrup javanicus</i>	x				x								
<i>Mecistocephalus spissus</i>	x	x		x	x	x	x						
<i>Mecistocephalus 'maxillaris'</i>	x	x	x								x		
<i>Mecistocephalus waikaneus</i>	x	x			x								
<i>Marsikomerus bryanus</i>	x	x	x	x	x		x	x					
<i>Orphnaeus brevilabiatus</i>					x								
<i>Tuoba sydneyensis</i>			x						x	x	x	x	
<i>Nesomerium hawaiiense</i>													x
<i>Pachymerium ferrugineum</i>					x	x							
<i>Zelanion hawaiiensis</i>	x												
number of species	6	4	2	3	6	2	2	1	1	1	2	1	1

HA = Hawai'i; MA = Maui; LA = Lāna'i; MO = Moloka'i; OA = O'ahu; KA = Kaua'i; NE = Necker; GP = Gardner Pinnacles' LY = Laysan; PH = Pearl & Hermes Reef; MY - Midway; KU = Kure; UN = Unknown.

origin (*P. ferrugineum*). *Nesomerium hawaiiense* is apparently endemic to the Hawaiian islands, but its status is questionable. Before the present study, three genera and eight species were regarded as endemic to the Hawaiian chain and neighboring oceanic islands, too high a figure for a group in which genera and species with restricted ranges are uncommon, whereas dispersed taxa are frequently encountered. Our conclusion that probably no genus and only three or four species are endemic is more compatible with knowledge of global geophilomorph occurrences.

Within the archipelago, species diversity increases from west to east, thus correlating with island size rather than age (Table 1): six species have been recorded from Hawai'i and O'ahu; four from Maui; three from Moloka'i; two each from Lāna'i, Kaua'i, Necker, and Midway; and one each from Gardner Pinnacles, Laysan, Pearl and Hermes Reef, and Kure. Regarding putative indigenous species, three apiece occur on Hawai'i, Maui, Moloka'i, and O'ahu, two occupy Necker, and one each inhabits Lāna'i, Kaua'i, Gardner Pinnacles, Laysan, Pearl and Hermes Reef, Midway, and Kure. Introduced species dominate on the Island of Hawai'i and O'ahu (three each), while one adventive is known from Maui, Lāna'i, Kaua'i, and Midway. The indigenous geophilomorphs occur on more islands/atolls than the introductions; consequently, *Marsikomerus bryanus* is known from seven islands/atolls, *Mecistocephalus spissus* from six, *Tuoba sydneyensis* from five, and *Mecistocephalus waikaneus* from three. Of the putatively introduced species, *Mecistocephalus 'maxillaris'* occurs on four islands/atolls, *Tygarrup javanicus* and *P. ferrugineum* on two, and the other three species on one island apiece. The fact that *N. hawaiiense* has been recorded only once further suggests that it is allochthonous rather than indigenous.

ACKNOWLEDGEMENTS

The authors are very grateful to Sabina Swift, Tino Gonsalves, and Gordon Nishida (formerly at the Bishop Museum, Honolulu), G. Allen Samuelson (Bishop Museum, Honolulu), and Jonathan Coddington (National Museum of Natural History, Washington) for the loan of type specimens and new samples. We also thank Neal L. Evenhuis (Bishop Museum) for assisting us in bibliographic search. Cheryl Bright, Dana DeRoche, and

David Furth (National Museum of Natural History) assisted us with loans of specimens.

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Arthropods From 'Ōhi'a *Lehua* (Myrtaceae: *Metrosideros polymorpha*), With New Records for the Hawaiian Islands

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INTRODUCTION

This paper presents new records, range extensions, and a checklist of arthropod species found associated with the most common and widespread native tree in the Hawaiian Islands, 'ōhi'a *lehua* (Myrtaceae: *Metrosideros polymorpha* Gaudichaud-Beaupré). *Metrosideros polymorpha* is found on all the main islands, naturally occurs from sea level to tree line (>2000 m), in dry, mesic, and wet forests, and is the canopy dominant in old growth and the first woody colonist on recent basaltic lava flows (Dawson & Stemmerman, 1990). Numerous insect species use 'ōhi'a *lehua* as a resource for either food or habitat space, and it may have the largest fauna of any native plant (Southwood, 1960; Stein, 1983). *Metrosideros* is an important, year-round nectar resource for native bees, moths, thrips and other insects, and for native nectarivorous birds, such as the 'apapane (*Himatione sanguinea*), 'i'iwi (*Vestiaria coccinea*), and 'akohekohe (*Palmeria dolei*). *Metrosideros* also provides important habitat for birds that forage for arthropod prey in the foliage (e.g., 'akepa [*Loxops coccineus*]) and bark (e.g., Hawai'i creeper [*Oreomystis mana*]). It can be argued that *M. polymorpha* is the backbone of Hawaiian forests and one of the most important resources for the long-term stability of ecosystems and watersheds in the islands.

There is a rich history of entomological work on *Metrosideros polymorpha* in the Hawaiian Islands. Wayne Gagné pioneered pyrethrum fogging as a method for sampling arthropods in forest canopies as part of the Island Ecosystems unit of the International Biological Program. Gagné studied *Metrosideros polymorpha* and *Acacia koa* along the Mauna Loa elevational gradient and provided the first detailed lists of arthropods associated with these trees (Gagné, 1976, 1979, 1981; Gagné & Howarth, 1981). Stein (1983) later compiled these lists with anecdotal host information reported by Swezey (1954) and others (e.g., Zimmerman, 1978). Since those descriptive studies, there have been several quantitative studies of *Metrosideros* arthropods to assess food resources for insectivorous birds at Hakalau Forest National Wildlife Refuge on Hawai'i Island (Peck, 1993; Fretz, 2000). These studies focused on biomass and abundance of potential bird prey types without the taxonomic detail of earlier work. Additional studies have examined endemic psyllids (Homoptera: Trioziidae), many of which are host-specific gall-formers on *Metrosideros*, and their herbivory (Nishida *et al.*, 1980; Lee, 1981). Most recently, Swift & Goff (2001) assessed in detail the mite fauna sampled from *Metrosideros* and its various microhabitats at two sites on Kaua'i.

In this contribution, I report 9 new state records and range extensions for 43 additional taxa collected from *Metrosideros*. The Hawaiian terrestrial arthropod checklist (Nishida, 2002) was the primary reference used to assess known island distributions. I do not list collections by other investigators beyond the scope of this *Metrosideros* survey, with the exception of several new state records. In addition to the species accounts, a com-

plete checklist of all recorded species from trees at sites on Kaua'i, Moloka'i, and Hawai'i is included. The checklist includes biogeographic status, feeding guild assignments, collections by site, and determiner.

SITES AND METHODS

Arthropods were collected from *Metrosideros polymorpha* at 11 sites on Hawai'i, Moloka'i, and Kaua'i during 1996–2001 (Table 1). Six of these sites, widely distributed within Hawaii Volcanoes National Park, were sampled in pilot qualitative canopy fogging studies in October 1996. A heated suspension of pyrenone 100 (1% pyrethrins, 5% piperonyl butoxide, and 94% isoparaffinic petroleum) was projected from the ground using a Curtis Dyna-Fog® Golden Eagle™ fogging machine. Stunned arthropods dropped for one hour onto an array of white sheets or collecting trays beneath the canopy, where they were collected into 70% ethanol. In contrast to all later collections, trees were not sampled with standardized, quantitative methods, and all arthropods were collected opportunistically. If a species is not reported for the 1996 collections, it does not imply that species was not collected. New records and range extensions are reported preferentially.

Collections from 1997 and later were designed for quantitative ecological studies (Table 1). Every specimen collected was scored, logged, and labeled with unique specimen codes in Biota database software (Colwell, 1997), and identified consistently across arthropod orders. The sites used for fogging in 1997 were situated adjacent to ongoing ecosystem research sites selected for optimal similarity in climatic and forest structural variables (Crews *et al.*, 1995; Gruner & Polhemus, 2003). These five sites on Hawai'i, Moloka'i, and Kaua'i were in mature mesic forests (2500 mm average annual precipitation) at approximately 1200 m elevation and dominated in the canopy by *Metrosideros polymorpha*. In addition, foliage clipping samples were taken over three years (1998–2001) on the 1881 historical pāhoehoe flow near the Tree Planting Road, Mauna Loa, in the Upper Waiākea Forest Reserve on Hawai'i Island. This site is wetter than the other sites (~4000 mm a.a.p.), and the small statured vegetation is comprised of a depauperate mix of early successional shrubs, ferns, and fern allies, along with *M. polymorpha* (Gruner, 2004).

Sampling methods certainly influenced the taxonomic composition obtained in the studies. There are no known methods that produce unbiased samples of complete arthropod communities (Basset *et al.*, 1997). Following Gagné, most of the species reported herein were obtained by pyrethrum canopy fogging (Gruner & Polhemus, 2003), which produces large, taxonomically comprehensive snapshots of arthropod communities that are useful for reliable comparisons across forested sites (Stork & Hammond, 1997). However, this method is biased against extremely active species, some endophagous species, and some groups that are bound to the substrate. For instance, case-bearing moth caterpillars (e.g., Cosmopterigidae: *Hyposmocoma* spp.), immature gall-formers (e.g., Homoptera: Triozidae), and web-building spiders (e.g., Araneidae: *Cyclosa*) were under-represented. Even so, pyrethrum fogging flushes out many internal feeders, such as wood-boring Coleoptera (e.g., Scolytidae, Aglycyderidae: *Proterhinus*), which were obtained in large numbers. An additional problem with fogging is that it is difficult to avoid by-catch from different tree species situated nearby. *Metrosideros* dominates the canopy at all of the sites used in these studies (Gruner & Polhemus, 2003), greatly alleviating this problem. Table 1 lists all the sites and personnel for the fogging studies.

Other samples were obtained by branch clipping and shaking (Johnson, 2000), which is a more directed, although spatially restricted, technique for sampling arthropods from

Table 1. Localities, dates, method and collectors for *Metrosideros polymorpha* arthropod studies.

Site	Locality	Lat. (N) [§]	Long. (W) [§]	Elev. (m)	Date(s)	Method	Collector(s) [‡]
Hawaii							
HP	Hilina Pali & Chain of Craters	19.3790°	155.2379°	1055	21–22.x.1996	fogging	DSG, DAP, DF
KI	Kipuka Ki, Mauna Loa Rd	19.4438°	155.3190°	1305	24–25.x.1996	fogging	DSG, DAP, DF
ML	Keānoku flow, Mauna Loa Rd	19.4764°	155.3647°	1725	24.x.1996	fogging	DSG, DAP
OL	‘Ōla’a tract, Wright Rd	19.4640°	155.2472°	1170	25.x.1996	fogging	DSG, DAP, KNM
BP	Near Bird Park, Mauna Loa Rd	19.4328°	155.2981°	1200	25.x.1996	fogging	DSG, DAP
VO	Thurston Lava Tube & Escape Rd.	19.4156°	155.2354°	1200	23.x.1996	fogging	DSG, DAP, DF
VO	Thurston Lava Tube & Escape Rd.	19.4156°	155.2354°	1200	6–8.x.1997	fogging	DSG, DAP
TP	Upper Waiākea Forest Reserve, Tree Planting Rd, 188 I flow	19.6642°	155.2836°	1280	†	clipping	DSG
LA	Laupāhoehoe Forest Reserve, Blair Rd	19.9277°	155.2958°	1220	3–5.vi.1997	fogging	DSG, DAP
LA	Laupāhoehoe Forest Reserve, Blair Rd	19.9277°	155.2958°	1220	6.xi.1997	fogging	DSG, ISF, LSS
KH	Kohala Forest Reserve	20.0519°	155.6812°	1150	12–14.x.1997	fogging	DSG, DAP
Molokai							
MO	TNC Kamaok Preserve, Kolekole	21.1053°	156.9000°	1185	22–24.x.1997	fogging	DSG, DAP
Kauai							
KA	Nāpali-Kona Forest Reserve	22.1422°	159.6264°	1130	29–30.x.1997	fogging	DSG, DAP

The first six sites, all sampled in 1996, were located in Hawaii Volcanoes National Park and were sampled qualitatively only (presence/absence). Beginning with the second sampling near Thurston Lava Tube in 1997, all remaining localities were sampled with quantitative methods.

§ North American Datum 1983.

‡ Collectors: DSG = Daniel S. Gruner, DAP = Dan A. Polhemus, DF = David Foote, KNM = Karl N. Magnacca, ISF = J. Scott Fretz, LSS = Lou S. Santiago.

† Upper Waiākea Forest Reserve site was sampled on multiple dates: 25–28.viii.1998, 24.vi.1999, 30.vii.1999, 30.viii.1999, 29.ix.1999, 31.x.1999, 14.xii.1999, 12.v.2000, 1.vi.2000, 16–16, 24–25.iv.2001, 1–3.v.2001.

plants. In this method, described in detail elsewhere (Fretz, 2002; Gruner, 2004), branches are quickly clipped, bagged, shaken in the laboratory, and all arthropods collected with an aspirator. Although endophages may be undersampled, branch clipping is equally effective for both sessile and mobile arthropods and across all orders that occupy terminal branches. This technique also is more useful in assessments of the fauna tightly bound with the host species, either directly or through its other inhabitants (e.g., parasitoids). However, branch clipping was used only on an early successional historical lava flow on Hawai'i Island (Table 1). Plant and arthropod communities were depauperate at this site relative to sites in mature forest used for fogging studies (Gruner, 2004).

Bulk material and most voucher specimens, unless otherwise noted, are deposited at the Bishop Museum (BPBM). Additional voucher specimens are deposited at the Canadian National Collection of Insects and Arachnids, Ottawa, Ontario, Canada (CNCI), Cornell University (CIUC), Illinois State University (ISUC), Natural History Museum, London (BMNH), National Museum of Natural History (USNM), United States Department of Agriculture, Systematic Entomology Laboratory (USDA), and the University of Tasmania School of Zoology (UTSZ). With new records for which few specimens are known, I also list unique numeric specimen codes that can be used to locate specimens at BPBM or the other institutions listed. The "scratch" notation indicates opportunistic, non-quantitative collections not assigned accession codes.

RESULTS AND DISCUSSION

Altogether, more than 50,000 individual arthropods from at least 23 orders, approximately 130 families, and 711 species in 280 genera were recovered from *Metrosideros polymorpha* at the 11 sites (see Appendix¹). All specimens were identified to species where possible; determiners are listed also in the Appendix. Of the 711 species listed, there were 497 native taxa (495 endemic, 2 indigenous), 118 adventive, 11 intentionally introduced, and 85 of undetermined origin. New state and island records are listed and annotated below. Numerous putative new species were collected and are listed in the Appendix, but were not treated as new records pending formal description by colleagues. Except in the case of those cryptogenic invaders that were confirmed by appropriate specialists as new introductions, species identified to genus were not recognized as legitimate records for the Hawaii Biological Survey. In addition, range extensions of endemic taxa were not reported as such in cases where only singletons were collected. Moreover, I did not attempt to identify several taxonomic groups beyond morphospecies. For example, the acari fauna on *Metrosideros* is diverse (Swift & Goff, 2001) but poorly known, and systematic resources are too scarce to justify the considerable effort necessary to understand this group.

For some species or localities, only immatures were recovered (e.g., Heteroptera: Pentatomidae: *Oechalia*), or I was unable to associate juveniles with adults (e.g., Psocoptera: Psocidae: *Ptycta*), males with females (e.g., Hymenoptera: Chalcidoidea) or females with males (e.g., Orthoptera: Gryllidae: *Trigonidium*). This problem was especially acute with Lepidoptera. Caterpillars were identified to the lowest level possible, which for many groups was the family level. Most described endemic moth species are known only from adults, but I ignored adult moths and did not attempt rearing studies. Although some may use nectar opportunistically, moths are not considered feeding members of the *Metrosideros polymorpha* food web (i.e., they are tourists *sensu* Moran & Southwood, 1982). In addition, several endemic lineages are extraordinarily diverse, but

1. Appendix. List of arthropod species collected from *Metrosideros polymorpha* during 1996–2001. [Archived at: <<http://hbs.bishopmuseum.org/data/gruner-app.pdf>>]

current taxonomy is unsatisfactory, in dire need of revision, or incomplete. Three lineages were particularly abundant and diverse in my collections but were not identified beyond morphospecies designations: *Proterhinus* (Coleoptera: Aglycyderidae), *Sierola* (Hymenoptera: Bethyridae), and *Kilauella* (Psocoptera: Elipsocidae). I describe details of the latter two below.

There are 179 described species of bethylid wasps in the genus *Sierola*, but the current taxonomy can be questioned on numerous grounds. Fullaway (1920) added 170 species to the fauna based on the examination of only 500 specimens, 65% (111) of which were based on single specimens. A striking 87% of the fauna are species described by Fullaway as single island endemics from either O'ahu or Hawai'i. The remaining 23 species, either found on a different island or distributed on two or more islands, include all 9 species described by earlier authors. Many characters Fullaway selected are in fact quite variable, as one discovers when examining a series of specimens. In my examination of over 240 specimens, there was no indication that Kaua'i or Moloka'i samples were more or less diverse than Hawai'i. Thus, I rejected Fullaway's systematics and hypothesized that wider sampling beyond O'ahu and Hawai'i would have revealed fewer species with larger ranges.

Psocids in the genus *Kilauella* provide a contrasting case. In total, there are only 7 described species in this endemic genus, but Thornton (1981) believed there are at least 145 species in the islands. In the current study from 11 sites on three islands, only one of the 19 morphospecies (*K. micramaura*) can be reconciled with existing descriptions. *Kilauella* is a hyperdiverse genus that has been virtually ignored and underappreciated to this point. Less extreme but qualitatively similar situations exist with the native psyllids (Homoptera: Triozidae) and other groups.

The checklist presented (Appendix) cannot be regarded as definitive proof of intimate plant-arthropod associations. Feeding preferences for most species, gathered from the literature, personal observation, and communication with systematists, are listed in the Appendix. Although many of the phytophagous insects (chewer, gall-former, sap-sucker [xylem, phloem, or mesophyll], seed-feeder, wood-borer) collected in these studies are host specific to *Metrosideros*, other records from 'ōhi'a *lehua* may indicate chance encounters of mobile arthropods more common in other areas of the forest. Species known to be incidental or nonfeeding on *Metrosideros*, or with unknown or highly omnivorous feeding habits, were recorded as tourists. Members of other guilds (e.g., detritivores, fungivores, predators) may be more loosely associated with the tree than herbivores. Relative abundance information and the numbers of immatures recovered, not presented here, helped to assess the importance of *M. polymorpha* for particular taxa.

Class Arachnida: Order Araneae

Araneidae

Neoscona crucifera (Lucas)

New island record

This large-bodied adventive orb weaver was recently reported from Kaua'i and O'ahu (Beatty *et al.*, 2000).

Material examined: HAWAII: Laupāhoehoe Forest Reserve, Blair Rd, 800 m, iii.1997, in vegetation along side of road (not collected from *Metrosideros polymorpha*), DSG (1 female).

Linyphiidae

Tenuiphantes tenuis (Blackwall)

New island record

Formerly known as *Lepthyphantes tenuis* (Blackwall, 1852), this immigrant species was previously recorded only from Hawai'i.

Material examined: **MOLOKA'I:** Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (2 specimens: 0339-003, 0426-004).

Theridiidae

***Argyrodus argentatus* Cambridge**

New island record

Beatty *et al.* (2000) recently recorded this adventive species from Hawai'i. No species in this genus have previously been reported for Moloka'i.

Material examined: **MOLOKA'I:** Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (2 specimens: 0339-002, 0387-004).

***Theridion mauense* Simon**

New island record

This endemic species was previously reported only from Maui.

Material examined: **MOLOKA'I:** Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (3 specimens: 0143-001 imm., 0285-001, 0426-003).

Class Insecta: Order Coleoptera

Ciidae

***Apterois variegatus* Perkins**

New island record

This distinctively marked endemic species was described from Maui but was abundant in samples from Moloka'i tree canopies. Two similar specimens were also collected from the Kohala Mountains but were sufficiently distinct to be excluded from this record pending systematic study.

Material examined: **MOLOKA'I:** Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (51 specimens).

***Cis nigrofasciatus* Blackburn**

New island records

This endemic species, light brown with lightly impunctate elytra and a black head, was known only from Lāna'i collections by R.C.L. Perkins and Rev. T. Blackburn.

Material examined: **HAWAI'I:** Laupāhoehoe Forest Reserve, Blair Rd, 3–5.vi.1997, DSG & DAP (2 specimens: 4050-001, 4093-001), 6.xi.1997, DSG, JSF & LSS (2 specimens: 5176-001, 5176-002); Kohala Forest Reserve, nr. Parker Ranch, 12–14.x.1997, DSG & DAP (1 specimen: 0698-001). **MOLOKA'I:** Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (2 specimens: 0010-002, 0373-002).

***Cis pacificus* Sharp**

New island record

This robust-bodied endemic species was reported only from O'ahu.

Material examined: **HAWAI'I:** Hawaii Volcanoes National Park, Thurston Lava Tube and Escape Rd, 6–8.x.1997, DSG & DAP (1 specimen: 1069-001); Kohala Forest Reserve, nr. Parker Ranch, 12–14.x.1997, DSG & DAP (7 specimens: 0519-008, 0531-007, 0531-008, 0619-008, 0619-011, 0659-001, 0659-002).

***Cis porcatius* Sharp**

New island record

Cis porcatius was the most common ciid species collected from *Metrosideros* in this study but was reported previously only from Hawai'i, Lāna'i, O'ahu, and Kaua'i. The collections from Moloka'i mark the first time it has been recorded from that island.

Material examined: **HAWAI'I:** Hawaii Volcanoes National Park, Thurston Lava Tube and Escape Rd, 6–8.x.1997, DSG & DAP (14 specimens); Upper Waiākea Forest Reserve, Tree Planting Rd, 1881 flow, 25.viii.1998, 17.iv.2001, 01.v.2001, DSG (4 specimens); Laupāhoehoe Forest Reserve, Blair Rd, 3–5.vi.1997, DSG & DAP (10 specimens), 6.xi.1997, DSG, JSF & LSS (6 specimens); Kohala Forest Reserve, nr. Parker Ranch, 12–14.x.1997, DSG & DAP (126 specimens); **MOLOKA'I:** Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (42 specimens); **KAUA'I:**

Nāpali-Kona Forest Reserve, Alaka'i swamp trail, 29–30.x.1997, DSG & DAP (24 specimens).

***Cis setarius* Sharp**

New island record

This endemic species was recorded previously from Hawai'i, O'ahu, and Kaua'i. Specimens collected from Moloka'i in this study mark the first record for that island.

Material examined: **HAWAI'I:** Laupāhoehoe Forest Reserve, Blair Rd, 3–5.vi.1997, DSG & DAP (10 specimens), 6.xi.1997, DSG, JSF & LSS (5 specimens); Kohala Forest Reserve, nr. Parker Ranch, 12–14.x.1997, DSG & DAP (40 specimens); **MOLOKA'I:** Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (8 specimens).

Hydrophilidae

***Cercyon* sp. nr. *lividulus* Orchymont**

New state record

There are two *Cercyon* species recorded from the Hawaiian Islands: *C. laminatus* Sharp and *C. quisquilius* (Linnaeus). However, Hansen (1993: 281) briefly noted a third species collected by F.X. Williams from Lulumahu Valley on O'ahu in 1937. It was never identified thus was not reported in Nishida (2002). This species fits Hansen's (1993) description and matches voucher specimens at the University of Hawai'i, most notably by lacking a black head and by having transverse, crescent-shaped light swaths on the elytra. Although the species was not identified, Hansen (1993) considered the Lulumahu specimens to be closely related to *C. lividulus* Orchymont from southern India. The genus has not been revised recently, and it is probable that this species is undescribed (M. Fikacek, pers. comm.).

Material examined: **HAWAI'I:** Laupāhoehoe Forest Reserve, Blair Rd, 6.xi.1997, DSG, JSF & LSS (1 specimen: 5008-001); **O'AHU:** Lulumahu Valley, ex rotting banana stems, F.X. Williams, 1937 (2 specimens: University of Hawai'i [UH]).

Lathridiidae

***Aridius nodifer* (Westwood)**

New island record

Although this is the first published record from Kaua'i, this adventive species was considered widespread before the turn of the 20th century (Blackburn & Sharp, 1885). *Aridius nodifer* was previously recorded from Hawai'i, Maui, Lāna'i, and O'ahu.

Material examined: **HAWAI'I:** Kohala Forest Reserve, nr. Parker Ranch, 12–14.x.1997, DSG & DAP (1 specimen: 0485-003); **KAUAI:** Nāpali-Kona Forest Reserve, Alaka'i swamp trail, 29–30.x.1997, DSG & DAP (1 scratch specimen).

Nitidulidae

***Epuraea ocularis* Fairmare**

New island record

Formerly known as *Haptoncus ocularis* (Fairmaire) (Ewing & Cline, 2004), this adventive species was reported previously from Kaua'i, O'ahu, Lāna'i, Maui, and Hawai'i.

Material examined: **MOLOKA'I:** Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (1 specimen: 0292-001).

Ptiliidae

***Acrotrichis discoloroides* Johnson**

New island record

Two species, *A. africana* Johnson and *A. discoloroides* Johnson, are recorded as adventives to the islands, but their distributions are not recorded. The two species belong to different subgenera, *Acrotrichis* Motschulsky and *Ctenopteryx* Flach, respectively, distinguished primarily by pronotal and genitalic characters. All the current specimens match

descriptions of *A. discoloroides*. Native to the Afrotropical Region, this species has become cosmopolitan in distribution and has been recorded from Madagascar, the Cape Verde and Seychelles archipelagoes, Sri Lanka, Trinidad, New Guinea, and the Galápagos, Society, and Marquesas island groups (Johnson, 1985).

Material examined: **HAWAI'I:** Hawaii Volcanoes National Park, Thurston Lava Tube and Escape Rd, 6–8.x.1997, DSG & DAP (7 specimens: 0797-001, 0947-001, 1015-002, 1042-005, 1042-006, 1042-007, 1069-002); Laupāhoehoe Forest Reserve, Blair Rd, 6.xi.1997, DSG, JSF & LSS (1 specimen: 5182-005).

Order Diptera

Cecidomyiidae

Monardia recondita Hardy

New island record

This endemic lestreminiine species was known previously from O'ahu and Hawai'i. Collection made on Moloka'i during this study marks the first record of this species from that island.

Material examined: **HAWAI'I:** Hawaii Volcanoes National Park, Thurston Lava Tube and Escape Rd, 6–8.x.1997, DSG & DAP (1 specimen: 1102-005); Laupāhoehoe Forest Reserve, Blair Rd, 6.xi.1997, DSG, JSF & LSS (1 specimen: 5172-006); Kohala Forest Reserve, nr. Parker Ranch, 12–14.x.1997, DSG & DAP (1 specimen: 0575-009); **MOLOKA'I:** Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (1 specimen: 0300-009).

Trisopsis oleae Kieffler

New island record

This adventive species, known previously from O'ahu, is easily recognized by the eyes which are divided into three distinct patches. On O'ahu, *T. oleae* larvae were reported feeding on *Pedronia* scales on *Dicranopteris* ferns (Hardy, 1960).

Material examined: **MOLOKA'I:** Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (4 specimens: 0047-010, 0090-006, 0171-010, 0311-011).

Drosophilidae

Scaptomyza univitta Hardy

New island record

Reported previously from O'ahu and Kaua'i, this species is predominantly yellow with 6 rows of acrostichal setae, a single brown median vitta and distinctively blunt male claspers and other genitalic features (Hardy, 1965). Similar but questionable specimens from Hawai'i Island, currently designated *Scaptomyza* nr. *univitta*, were not included with this record.

Material examined: **KAUAI'I:** Nāpali-Kona Forest Reserve, Alaka'i swamp trail, 29–30.x.1997, DSG & DAP (1 specimen: 1326-001); **MOLOKA'I:** Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (26 specimens).

Ephydriidae

Hydrellia tritici Coquillett

New island record

This is an adventive species known previously from Hawai'i, Kaho'olawe, Maui, and Kaua'i. This species was common and abundant at two sites on Hawai'i Island but comparatively uncommon on Moloka'i where it is recorded here for the first time.

Material examined: **HAWAI'I:** Hawaii Volcanoes National Park, Thurston Lava Tube and Escape Rd, 6–8.x.1997, DSG & DAP (53 specimens); Laupāhoehoe Forest Reserve, Blair Rd, 3–5.vi.1997, DSG & DAP (58 specimens), 6.xi.1997, DSG, JSF & LSS (31 specimens); **MOLOKA'I:** Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (3 specimens: 0201-001, 0321-011 + 1 scratch).

Limoniidae***Libnotes* n. sp. nr. *trukensis* Alexander****New state record**

This species is cryptogenic but presumed adventive, since it is larger (males: 12–15 mm body length, 15–17 mm wings) and more conspicuous than *L. perkinsi* or any native *Dicranomyia* and was found at three sites. This species is an undescribed species, most closely resembling *L. trukensis* Alexander from Micronesia (G.W. Byers, pers. comm.). The basal radial cell of the wing is broader apically than in *Libnotes perkinsi*, with the radial sector (R_3) nearly straight across the junctions with distal cells, rather than deeply arched at the first radial cell.

Material examined: **HAWAI'I:** Hawaii Volcanoes National Park, 'Ōla'a Tract, Wright Rd, 25.x.1996, DSG, KNM & DAP (1 scr. specimen); Hawaii Volcanoes National Park, Thurston Lava Tube and Escape Rd, 6–8.x.1997, DSG & DAP (1 specimen: 0853-001); Kohala Forest Reserve, nr. Parker Ranch, 12–14.x.1997, DSG & DAP (3 specimens: 0585-010, 0651-003, 0774-004); **MOLOKA'I:** Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (1 specimen: 0120-002).

Phoridae***Diplonevra peregrina* (Wiedemann)****New island record**

This distinctively marked adventive species is widespread throughout the islands but had not yet been recorded for Moloka'i. The first, the anterior half of the second, and sixth abdominal terga are yellow, all the rest are dark but with a small yellow triangular marking in the center.

Material examined: **MOLOKA'I:** Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (1 specimen: 0171-008).

Psychodidae***Trichomyia hawaiiensis* Quate****New island record**

This endemic species was previously known from Hawai'i and Maui. The specimens collected in this study mark the first record from Moloka'i. This species is distinguished from *T. oahuensis* by the broken R_{2+3} vein near its base (Hardy, 1960).

Material examined: **HAWAI'I:** Hawaii Volcanoes National Park, Thurston Lava Tube and Escape Rd, 6–8.x.1997, DSG & DAP (42 specimens); Laupāhoehoe Forest Reserve, Blair Rd, 3–5.vi.1997, DSG & DAP (8 specimens); Kohala Forest Reserve, nr. Parker Ranch, 12–14.x.1997, DSG & DAP (2 specimens); **MOLOKA'I:** Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (25 specimens); **KAUA'I:** Nāpali-Kona Forest Reserve, Alaka'i swamp trail, 29–30.x.1997, DSG & DAP (1 specimen).

Sciaridae***Sciara prominens* Hardy****New island records**

Sciara prominens is readily identifiable by a conspicuous submedian spine on the internal margin of the male claspers. This endemic species was previously known only from Hawai'i and O'ahu. Collections from Moloka'i and Kaua'i during this study mark the first records from those islands.

Material examined: **HAWAI'I:** Hawaii Volcanoes National Park, Thurston Lava Tube and Escape Rd, 6–8.x.1997, DSG & DAP (19 specimens); Laupāhoehoe Forest Reserve, Blair Rd, 3–5.vi.1997, DSG & DAP (1 specimen: 4318-001); **MOLOKA'I:** Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (18 specimens); **KAUA'I:** Nāpali-Kona Forest Reserve, Alaka'i swamp trail, 29–30.x.1997, DSG & DAP (12 specimens).

Plastosciara adrostylata* Hardy*New island record**

Plastosciara is differentiated from other sciarids by two segmented palpi, with the second segment minute. This endemic species was known previously from O‘ahu and Hawai‘i.

Material examined: **HAWAI‘I:** Hawaii Volcanoes National Park, Thurston Lava Tube and Escape Rd, 6–8.x.1997, DSG & DAP (7 specimens); Kohala, Parker Ranch, Kemola, 4000 ft, 31.v.1977, J.W. Beardsley (13 specimens); **KAUA‘I:** Nāpali-Kona Forest Reserve, Alaka‘i swamp trail, 29–30.x.1997, DSG & DAP (1 specimen: 1306-001).

Order Heteroptera**Reduviidae*****Haematoloecha rubescens* Distant****New island record**

This conspicuous red and black adventive species was recorded previously from Kaua‘i, O‘ahu, and Maui. *Haematoloecha rubescens* probably is present on all the main islands.

Material examined: **HAWAI‘I:** Kohala Forest Reserve, nr. Parker Ranch, 12–14.x.1997, DSG & DAP (1 specimen: 0535-005 [USNM]); Kohala, Parker Ranch, Kemola, 4000 ft, 31.v.1977, J.W. Beardsley (1 specimen); Upper Waiākea Forest Reserve, Tree Planting Rd, 1881 flow, 27.v.1999, DSG (1 specimen).

Order Homoptera**Aphididae*****Greenidea formosana* (Maki)****New island records**

Reported to feed on guava, also in the Myrtaceae, this aphid was locally abundant on *Metrosideros* at several sites. This adventive species from Asia was recorded recently for O‘ahu (Beardsley, 1995) and in unpublished records for Hawai‘i, Moloka‘i, and Mau‘i (Heu, 2003). Interestingly, males were also collected but were not known previously for this species (Blackman & Eastop, 2000). Aphid males are more often collected from high elevation sites in Hawai‘i than in the lowlands (B. Kumashiro, pers. comm.), and may be present only in the autumn months because of the aphid annual reproductive cycle (M. Stotzel, pers. comm.).

Material examined: **HAWAI‘I:** Hawaii Volcanoes National Park, Hilina Pali and Chain of Craters, 21–22.x.1996, DSG, DF & DAP (11 specimens); Hawaii Volcanoes National Park, Kīpuka Kī, Mauna Loa Rd, 24–25.x.1996, DSG, DF & DAP (15 specimens); Hawaii Volcanoes National Park, ‘Ōla‘a Tract, Wright Rd, 25.x.1996, DSG, KNM & DAP (200+ females, 7 males); Upper Waiākea Forest Reserve, Tree Planting Rd, 1881 flow, 30.viii.1999, 14.xii.1999, 12.v.2000, 1.vi.2000, 17–18,25.iv.2001, 1–3.v.2001, DSG (80 specimens); Laupāhoehoe Forest Reserve, Blair Rd, 3–5.vi.1997, DSG & DAP (4 specimens), 6.xi.1997, DSG, JSF & LSS (505 specimens); Kohala Forest Reserve, nr. Parker Ranch, 12–14.x.1997, DSG & DAP (64 specimens); **MOLOKA‘I:** Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (1 specimen).

Idiopterus nephrolepidis* Davis*New island record**

Zimmerman (1948b) believed this introduced species to be much more widely distributed than “current records indicate.” It feeds on ferns, including *Elaphoglossum* and *Asplenium*, both of which were growing on *Metrosideros* trees at this location. This species was recorded previously from O‘ahu, Maui, and Hawai‘i.

Material examined: **KAUA‘I:** Nāpali-Kona Forest Reserve, Alaka‘i swamp trail, 29–30.x.1997, DSG & DAP (1 specimen: 1454-002).

Cercopidae***Philaenus spumarius*** (Linnaeus)**New island record**

This adventive froghopper is listed only from Hawai'i. *Philaenus spumarius* feeds on various grasses, and is recorded on 'ōhi'a lehua as an incidental.

Material examined: **HAWAI'I:** 'Ōla'a Tract, Wright Rd, 25.x.1996, DSG, KNM & DAP (1 specimen); Laupāhoehoe Forest Reserve, Blair Rd, 6.xi.1997, DSG, JSF & LSS (1 specimen: 5107-001). **KAUAI:** Nāpali-Kona Forest Reserve, Alaka'i swamp trail, 29–30.x.1997, DSG & DAP (1 specimen: 1460-005 [USNM]).

Delphacidae***Leialoha lehuae*** (Kirkaldy)**New island record**

This apparently widespread *Metrosideros* specialist is known from every high island except Moloka'i, Kaho'olawe, and Ni'ihau. In this study, it was collected only on Moloka'i, marking the first record of this species from that island.

Material examined: **MOLOKA'I:** Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (1 adult, 32 nymphs).

Triozidae***Kuwayama minuta*** Crawford**New island record**

This endemic *Metrosideros* specialist was known previously from Hawai'i and Kaua'i.

Material examined: **HAWAI'I:** Hawaii Volcanoes National Park, Thurston Lava Tube and Escape Rd, 6–8.x.1997, DSG & DAP (3 specimens); Upper Waiākea Forest Reserve, Tree Planting Rd, 1881 flow, 30.viii.1998, 16,18,25,30.iv.2001, 2–3.v.2001, DSG (29 specimens); Laupāhoehoe Forest Reserve, Blair Rd, 3–5.vi.1997, DSG, JSF & LSS (33 specimens), 6.xi.1997, DSG, JSF & LSS (16 specimens); Kohala Forest Reserve, nr. Parker Ranch, 12–14.x.1997, DSG & DAP (79 specimens); **MOLOKA'I:** Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (3 specimens); **KAUAI:** Nāpali-Kona Forest Reserve, Alaka'i swamp trail, 29–30.x.1997, DSG & DAP (2 specimens).

Order Hymenoptera**Agaonidae*****Odontofroggata galili*** Wiebes**New island record**

This adventive *Ficus* gall wasp, like its sibling species *Odontofroggata ishii* Wiebes, was recorded only from O'ahu. This species is distinguished from *O. ishii* by the serrate antennae in the female, the shorter, broader head across the ocelli, and by propodeal characters (Wiebes, 1980).

Material examined: **HAWAI'I:** Upper Waiākea Forest Reserve, Tree Planting Rd, 1881 flow, 18.iv.2001, DSG (1 specimen: 7139-004).

Braconidae***Leiophron*** sp.**New state record**

Leiophron Nees, a cosmopolitan euphorine genus (except Australia) with 19 described North American and many undescribed Neotropical species, has not been recorded from the Hawaiian Islands. The following characters distinguish the genus: the tergum and sternum of the petiole are totally separate ventrally, the occipital carina is incomplete dorsally, and the wing venation is often reduced such that the first submarginal and discal cells are open apically (Shaw, 1997). Most known *Leiophron* parasitize late instar nymphs and adults of Miridae (Shaw, 1997). *Leiophron* sp. is a minute (1.5 mm), undescribed, cryptogenic species (H. Goulet, pers. comm.).

Material examined: **HAWAII:** Kohala Forest Reserve, nr. Parker Ranch, 12–14.x.1997, DSG & DAP (2 specimens: 0474-006, 1 scratch [CNCI]); Laupāhoehoe Forest Reserve, Blair Rd, 6.xi.1997, DSG, JSF & LSS (1 specimen: 5133-009).

Diapriidae

Trichopria subtilis (Perkins)

New island record

Trichopria subtilis (Perkins) is the only described species with 3 apical segments of the female antennal club expanded and nearly equal in width. As with most endemic *Trichopria*, this species was known previously only from O'ahu.

Material examined: **HAWAII:** Upper Waiākea Forest Reserve, Tree Planting Rd, 1881 flow, 27.iv.1998, 1.vi.2000, DSG (2 specimens: 2279-001, 2945-003).

Encyrtidae

Hypergonatopus sp.

New island record

No species in the endemic genus *Hypergonatopus* Timberlake, 1922 have been recorded from Kaua'i. These wasps are hyperparasitoids on dryinids, presumably *Dicondylus perkinsi* (Ashmead) and others (Beardsley, 1976a, 1976b). The wasps are black, and the wings are often reduced in size with a transverse infuscate streak.

Material examined: **KAUAI:** Nāpali-Kona Forest Reserve, Alaka'i swamp trail, 29–30.x.1997, DSG & DAP (2 specimens: 1307-004 [BPBM], 1449-002 [BMNH]).

Rhopus sp.

New island record

Although the specific identity of these specimens has not been confirmed, no species from the genus *Rhopus* Förster have previously been recorded from Kaua'i. There are six described endemic and one adventive species in the islands, the majority of which are recorded only from O'ahu. *Rhopus* are mealybug parasitoids.

Material examined: **KAUAI:** Nāpali-Kona Forest Reserve, Alaka'i swamp trail, 29–30.x.1997, DSG & DAP (2 specimens: 1298-006 [BMNH], 1351-001 [BPBM]).

Tetracnemoidea brevicornis (Girault)

Name change, New island record

This species was introduced into Hawai'i intentionally for biological control of mealybugs, but there is no record of its establishment and current distribution. *Tetracnemoidea pretiosus* (Timberlake), presently considered a junior synonym of *T. brevicornis*, is listed in the latest Hawaiian arthropod checklist (Nishida, 2002) without a known island distribution. The male has spectacular ramose antennae.

Material examined: **KAUAI:** Nāpali-Kona Forest Reserve, Alaka'i swamp trail, 29–30.x.1997, DSG & DAP (1 male: 1359-007).

Eulophidae

Asecodes sp.

New state record

The genus *Asecodes* Förster is in taxonomic turmoil. Species formerly described in the genus *Asecodes* have since been reassigned to numerous genera, 4 of which have representatives in Hawai'i (*Ceranisus*, *Diglyphus*, *Neochrysocharis*, *Pediobius*). The specimens reported here do not belong in these genera (Michael Gates, pers. comm.), but the specific identity could not be determined. *Asecodes* wasps parasitize Lepidoptera larvae, in particular those that are leafminers.

Material examined: **HAWAII:** Hawaii Volcanoes National Park, Thurston Lava Tube and Escape Rd, 6–8.x.1997, DSG & DAP (2 females: 0885-003, 0885-005).

Elachertus advena Timberlake**New island record**

Elachertus advena is an adventive species well established on O'ahu, Maui, and Midway.

Material examined: **HAWAI'I:** Hawaii Volcanoes National Park, Kīpuka Kī, Mauna Loa Rd, 24–25.x.1996, DSG, DF & DAP (1 specimen).

Pauhiana swezeyi Yoshimoto**New island record**

This variable species attacks native psyllids (Homoptera: Trioizidae) and their galls on *Metrosideros*, emerging from galls after chewing a round hole through the leaf surface. It was abundant in collections at every site except Laupāhoehoe on Hawai'i Island, but like the native psyllids, was less abundant on Moloka'i and Kaua'i. *Pauhiana swezeyi* was previously unrecorded from Kaua'i.

Material examined: **HAWAI'I:** Hawaii Volcanoes National Park, Hilina Pali and Chain of Craters, 21–22.x.1996, DSG, DF & DAP (3 specimens); Hawaii Volcanoes National Park, Kīpuka Kī, Mauna Loa Rd, 24–25.x.1996, DSG, DF & DAP (8 specimens); Hawaii Volcanoes National Park, Thurston Lava Tube and Escape Rd, 6–8.x.1997, DSG & DAP (13 specimens); Upper Waiākea Forest Reserve, Tree Planting Rd, 1881 flow, 26–28.viii.1998, 24.vi.1999, 29.ix.1999, 31.x.1999, 14.xii.1999, 1.vi.2000, 16–18, 24–25.iv.2001, 1–3.v.2001, DSG (192 specimens); Kohala Forest Reserve, nr. Parker Ranch, 12–14.x.1997, DSG & DAP (46 specimens); **MOLOKA'I:** Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (5 specimens); **KAUA'I:** Nāpali-Kona Forest Reserve, Alaka'i swamp trail, 29–30.x.1997, DSG & DAP (9 specimens: 1246-005, 1298-003, 1380-005, 1380-006, 1380-007, 1380-008, 1398-005, 1441-002, 1494-004).

Eupelmidae***Eupelmus***

This large endemic complex of species has not been revised since Perkins added 46 species (Perkins, 1910). Many species were described from single specimens, the vast majority biased to collections on O'ahu and Hawai'i Islands. Although these wasps appear to be ubiquitous in forest ecosystems, few workers have attempted to identify native *Eupelmus* since the turn of the century. Many species probably more widely distributed and new island records are not surprising. I examined all the type holdings at BPBM and compared these specimens to descriptions and keys (Perkins, 1910). Males could not be associated with females and were not identified, and several possible range extensions are not reported for single specimens. These wasps probably parasitize Lepidoptera.

Eupelmus axestias Perkins**New island record**

The species was described and known only from O'ahu.

Material examined: **HAWAI'I:** Hawaii Volcanoes National Park, Thurston Lava Tube and Escape Rd, 6–8.x.1997, DSG & DAP (1 female: 1153-009); **MOLOKA'I:** Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (3 females: 0050-006, 0050-008, 1 scratch).

Eupelmus chloropus Perkins**New island record**

This species was described and known only from O'ahu. This record includes two specimens that may represent a new species.

Material examined: **KAUA'I:** Nāpali-Kona Forest Reserve, Alaka'i swamp trail, 29–30.x.1997, DSG & DAP (3 females: 1229-003, 1398-003, 1459-002).

Eupelmus xanthotarsus Perkins**New island record**

This species was described and known only from O'ahu.

Material examined: **MOLOKA'I:** Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (2 females: 0367-003).

***Eupelmus xestias* Perkins**

New island record

Eupelmus xestias was known previously only from Hawai'i.

Material examined: **KAUA'I:** Nāpali-Kona Forest Reserve, Alaka'i swamp trail, 29–30.x.1997, DSG & DAP (2 females: 0119-008, 0367-003).

Mymaridae

***Polynema pyrophila* Perkins**

New island record

Polynema pyrophila is an endemic species previously known from Hawai'i and Moloka'i.

Material examined: **HAWAII:** Hawaii Volcanoes National Park, Hilina Pali and Chain of Craters, 21–22.x.1996, DSG, DF & DAP (2 specimens); Hawaii Volcanoes National Park, 'Ōla'a Tract, Wright Rd, 25.x.1996, DSG, KNM & DAP (1 specimen); Hawaii Volcanoes National Park, Thurston Lava Tube and Escape Rd, 6–8.x.1997, DSG & DAP (21 specimens); Kohala Forest Reserve, nr. Parker Ranch, 12–14.x.1997, DSG & DAP (1 specimen: 0454-004); **KAUA'I:** Nāpali-Kona Forest Reserve, Alaka'i swamp trail, 29–30.x.1997, DSG & DAP (4 specimens: 1229-002, 1239-004, 1267-002, 1403-001).

Platygastridae

***Aphanomerus rufescens* Perkins**

New state record

Perkins (1905) described four species in the genus *Aphanomerus* from Queensland, Australia. These minute wasps parasitize eggs of fulgoroid leafhoppers and planthoppers, and were described as part of an exploration for natural enemies of sugarcane pests. *Aphanomerus pusillus* Perkins, listed incorrectly under the family Scelionidae in Nishida (2002), is the only species of the genus previously recorded from the Hawaiian Islands. *Aphanomerus pusillus* was purposely introduced to the Hawaiian Islands to control the introduced flatid *Siphanta acuta* and is known from Hawai'i, Maui, Moloka'i, and O'ahu. However, the thorax and abdomen of *A. pusillus* are uniformly yellow or lightly ferruginous, whereas all the specimens reported here have a black head and thorax, and the abdomen is dark to moderately ferruginous, which identify it as *A. rufescens*. Antennal and other characteristics also match the holotype specimen (BPBM) and description of *A. rufescens* in Perkins (1905). This species may be adventive in Hawai'i, or it may have been purposely introduced but without record in the heyday of biological control in the early part of the 20th century.

Material examined: **HAWAII:** Upper Waiākea Forest Reserve, Tree Planting Rd, 1881 flow, 27.viii.1998, 18.25.iv.2001, 2.v.2001, DSG (21 specimens: 2289-001, 7100-004, 7111-003 [9], 7111-007, 7111-008, 7111-009, 7111-010, 7111-011, 7111-012, 7139-001, 7139-005, 7208-002, 7680-001); Kohala Forest Reserve, nr. Parker Ranch, 12–14.x.1997, DSG & DAP (1 specimen: 0564-005).

Pteromalidae

***Toxeuma nubilipennis* Ashmead**

New island records

Previously known from Kaua'i, Lāna'i, and Maui, specimens of *Toxeuma nubilipennis* were collected on Moloka'i and several sites on Hawai'i.

Material examined: **HAWAII:** Kohala Forest Reserve, nr. Parker Ranch, 12–14.x.1997, DSG & DAP (6 specimens); Hawaii Volcanoes National Park, Thurston Lava Tube and Escape Rd, 6–8.x.1997, DSG & DAP (4 specimens); **MOLOKA'I:** Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (10 specimens); **KAUA'I:** Nāpali-Kona Forest Reserve, Alaka'i swamp trail, 29–30.x.1997, DSG & DAP (6 specimens).

Zolotarewskya sp.**New state record**

This is the first state record of this exceptional cleonymine genus, otherwise restricted to the Australasian, Oriental, Afrotropical, and Palearctic Regions. The dentate hind margins of the metafemora distinguish this genus from other Cleonymini genera. There are eight described species, but these specimens represent a new species of obscure origin (Gibson, 2003). The male has spectacular ramose antennae: the flagellum has a single anellus and 6 funicular segments prolonged into ramae, each approximately the same length as the 7th segment and ovoid clava together. The female has a distinct finger-like projection extending from the apical funicular segment along the clava. Host records for this genus are not definitive, but it is suspected that *Zolotarewskya* species parasitize wood-boring beetles in the families Anobiidae, Buprestidae, Curculionidae, and Scolytidae (Gibson, 2003).

Material examined: **HAWAII:** Hawaii Volcanoes National Park, Hilina Pali and Chain of Craters, 21–22.x.1996, DSG, DF & DAP (1 male); Hawaii Volcanoes National Park, Kīpuka Kī, Mauna Loa Rd, 24–25.x.1996, DSG, DF & DAP (1 female); **MOLOKA:** Mapulehu nr. Iliiopae Heiau, 60 ft [18 m], 19.viii.–02.ix.1995, yellow sticky board traps, WD Perreira (1 male); Pālā'au State Park, 1500 ft [460 m], 1–15.ix.1995, W.D. Perreira (1 female).

Scelionidae**Baesus persordidus** Perkins**New island record**

This minute (<1 mm), wingless adventive species has been in Hawai'i for more than a century (Perkins, 1910) but was recorded previously only from O'ahu. It is apparently widespread on Hawai'i Island.

Material examined: **HAWAII:** Hawaii Volcanoes National Park, Thurston Lava Tube and Escape Rd, 6–8.x.1997, DSG & DAP (2 specimens: 1109-012, 1148-001); Upper Waiākea Forest Reserve, Tree Planting Rd, 1881 flow, 18.iv.2001, DSG (1 specimen: 7164-005); Kohala Forest Reserve, nr. Parker Ranch, 12–14.x.1997, DSG & DAP (1 specimen: 0589-002).

Trimorus sp.**New state record**

Trimorus Foerster is a Holarctic genus with over one hundred described species. This species could not be placed to a definitive species identity. The specimen is shining black with a green metallic tinge, a broad head, densely reticulate scutum, sparse body setation, and a single strong epinotal spine.

Material examined: **HAWAII:** Laupāhoehoe Forest Reserve, Blair Rd, 6.xi.1997, DSG, JSF & LSS (1 female: 5227-005).

Signiphoridae**Chartocerus dactylopii** (Ashmead)**Name change, New island record**

Recorded in Nishida (2002) as *Thysanus dactylopii* (Ashmead, 1900), this adventive species was previously recorded only from O'ahu and Moloka'i.

Material examined: **HAWAII:** Upper Waiākea Forest Reserve, Tree Planting Rd, 1881 flow, 24–25.iv.2001, DSG (2 specimens: 7111-006, 7459-004).

Signiphora aspidioti Ashmead**New island records**

Recorded in Nishida (2002) as *Thysanus aspidioti* (Ashmead, 1900), this adventive species was recorded previously from O'ahu and Necker.

Material examined: **HAWAII:** Hawaii Volcanoes National Park, Thurston Lava Tube and Escape Rd, 6–8.x.1997, DSG & DAP (1 specimen: 1070-002); Upper Waiākea Forest Reserve, Tree

Planting Rd, 1881 flow, 18.iv.2001, DSG (1 specimen: 7266-001); Kohala Forest Reserve, nr. Parker Ranch, 12–14.x.1997, DSG & DAP (1 specimen: 0615-002); **MOLOKA'I**: Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (1 specimen: 0050-005).

Order Psocoptera

Ectopsocidae

Ectopsocus briggsi McLachlan

New state record

This species is recorded in the checklist (Nishida, 2002) as adventive but not confirmed as established. Collection of a specimen in the Kohala mountains confirms that this species is established on the Big Island.

Material examined: **HAWAI'I**: Kohala Forest Reserve, nr. Parker Ranch, 12–14.x.1997, DSG & DAP (1 specimen: 8082-008).

Elipsocidae

Kilauella micramaura (Perkins)

New island record

This minute (~1 mm) endemic species has distinctively marked wings, with patterned infuscations, the pterostigmal boundaries thickened, and the areola postica completely fused with the media (Zimmerman, 1948a). It was known previously only from Hawai'i and O'ahu, but it is not surprising to find range extensions and many new species in this neglected but hyperdiverse genus.

Material examined: **HAWAI'I**: Hawaii Volcanoes National Park, Thurston Lava Tube and Escape Rd, 6–8.x.1997, DSG & DAP (2 specimens); Kohala Forest Reserve, nr. Parker Ranch, 12–14.x.1997, DSG & DAP (12 specimens). **MOLOKA'I**: Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (20 specimens).

Philotarsidae

Haplohallus sp.

New state record

This is the first record for Philotarsidae in the Hawaiian Islands. The specimen did not match descriptions for congeneric Pacific species *H. boninensis*, *H. fuscistigma*, or *H. orientalis*. It is either a new species or it originates from outside the Pacific basin (E. Mockford, pers. comm.).

Material examined: **MOLOKA'I**: Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (1 specimen: 8001-009).

Class Malacostraca: Order Amphipoda

Talitridae

Platorchestia sp.

New island record

Although this species was abundant underneath 'ōhi'a *lehua* tree bark and within mosses in Kamakou Preserve, no talitrids have been recorded formally from Moloka'i (Nishida, 2002). However, Wayne Gagné collected examples of this species in Upper Kawela Gulch in 1981, and reported informally the widespread occurrence of talitrids on all main islands but Hawai'i (Gagné, 1975). Although this species is close to *Platorchestia lanipo* Richardson, further study probably will reveal this to be a distinct new species (A.W.W. Richardson, pers. comm.). An additional species from the genus *Hawaiiorchestia* was collected by fogging on Kaua'i that will probably prove to be novel (A.W.W. Richardson, pers. comm.).

Material examined: **MOLOKA'I**: Upper Kawela Gulch, 1200 m, 5.i.1981, sweeping vegetation, W.C. Gagné (1 specimen), 6.i.1981, on mossy trees, W.C. Gagné (7 specimens); Kamakou Preserve, Kolekole, 22–24.x.1997, DSG & DAP (355 specimens [10 to UTSZ]).

Acknowledgements

I thank the Division of Forestry and Wildlife of the State of Hawai'i, Hawaii Volcanoes National Park, the Joseph Souza Center at Koke'e State Park, Parker Ranch, and the Nature Conservancy of Hawai'i for access to field sites. Dan Polhemus was an essential colleague for the pyrethrum fogging studies, and David Foote offered logistical assistance for all components. I am particularly grateful to all specialists who identified or verified species: Alastair M.M. Richardson, Amy Vandergast, Bernarr R. Kumashiro, Catherine A. Tauber, Curtis P. Ewing, Dan A. Polhemus, Diana M. Percy, Ed L. Mockford, Gary A.P. Gibson, G.A. Samuelson, George W. Byers, Joe A. Beatty, Jessica E. Garb, Jim K. Liebherr, John S. Noyes, John T. Huber, Keith T. Arakaki, Ken Y. Kaneshiro, Lubomir Masner, Manfred Asche, Miquel A. Arnedo, M. Lee Goff, Michael W. Gates, Neil J. Reimer, Neal L. Evenhuis, Rosemary G. Gillespie, Ray J. Gagné, Steve L. Montgomery, Todd A. Blackledge; and to Tracie McKenzie, Sabrina Cowan, Tino Gosalves, Neal Evenhuis and the staff of the Bishop Museum Natural Sciences Department for their hospitality. Kirsten Heckmann, Lauren Wilson, Sierra McDaniel, and Emahlie McDaniels provided invaluable assistance with field and/or laboratory work. Paul D. Krushelnycky and Frank G. Howarth kindly provided comments on the manuscript. Research was supported by NSF training grants DGE-9355055 and DUE-9979656 to the Center for Conservation Research and Training of the University of Hawai'i at Mānoa, the U.S. E.P.A. Science to Achieve Results (STAR) program, Sigma Xi, the Hawai'i Audubon Society, the Watson T. Yoshimoto Foundation, the ARCS Foundation, and NSF doctoral dissertation improvement grant DEB-0073055.

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***Gordionus longistriatus*, a New Species of Nematomorpha from Hawai‘i**

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INTRODUCTION

Horsehair worms or Nematomorpha are long and slender worms, the majority (300 species) live in freshwater and five species are known from the sea. As adults, nematomorphs can be found free-living in water (pools, ditches, even artificial or temporary waters). They copulate and from the eggs hatch microscopic larvae which infect aquatic hosts. In few aquatic hosts, development can continue, but most use it as a parathenic host and develop only further when the host is eaten by a terrestrial arthropod. In these hosts, larvae grow to the final adult size of several centimeters and finally leave their host (see Schmidt-Rhaesa, 2001a).

Two species of freshwater Nematomorpha (Gordiida) have been described from Hawai‘i: *Gordius robustus* and *Paragordius varius*. The specimens assigned to *Gordius robustus* were originally described as *G. agassizi* by Montgomery (1898) and as *G. flavus* by Linstow (1906), which was later transferred to *G. hawaiiensis* by Heinze (1933). The original descriptions do not show significant deviations from the description of *Gordius robustus* and are therefore regarded as synonyms of this species (Schmidt-Rhaesa *et al.*, 2003). *Gordius robustus* was found in Waiehu-Maui (Linstow, 1906) and *Paragordius varius* in a river near Wailuku, Maui (Camerano, 1901). Here, a new species is described from Kaua‘i.

SYSTEMATICS

***Gordionus longistriatus* Schmidt-Rhaesa, new species**

Fig. 1

Diagnosis. This nematomorph species is recognized by longitudinal rows of cuticular bristles.

Description. Three complete females and two fragments of a fourth female were available for investigation. The complete specimens measured 7, 9 and 10 cm in length and had diameters of 0.5, 0.5 and 0.6 mm, respectively. All specimens are very pale in color, ranging from a creamy white to very light yellowish brown. The anterior end is slightly tapering. The anterior tip is white, followed by a broad dark collar. The posterior end is round, the terminal cloacal opening is surrounded by a dark coloration of the cuticle.

The cuticle contains no distinct areoles (which are elevated structures typical for many other nematomorph species). There are numerous short (maximal 3 μ m) bristles arranged in longitudinal rows (Fig. 1A,B). The cuticle between these rows of bristles is smooth. The bristles may appear in deeper grooves (Fig. 1B). The longitudinal arrangement in one specimen is disturbed by scratches in an angle of 20–40°, but this is assumed to be due to mechanical damage of the cuticle.

Holotype: 1 female, collected from type locality on 10 Jan 1999 by R. Englund & D. Preston deposited in Bishop Museum.

Paratypes: 2 females from type locality.

Type locality: Hawaiian Islands: KAUA‘I: Waiakoali Stream above Camp 10 Rd (22°07.586'N, 159°37.225'W), 1035 m.

Discussion: The cuticle in most freshwater nematomorph species is structured by

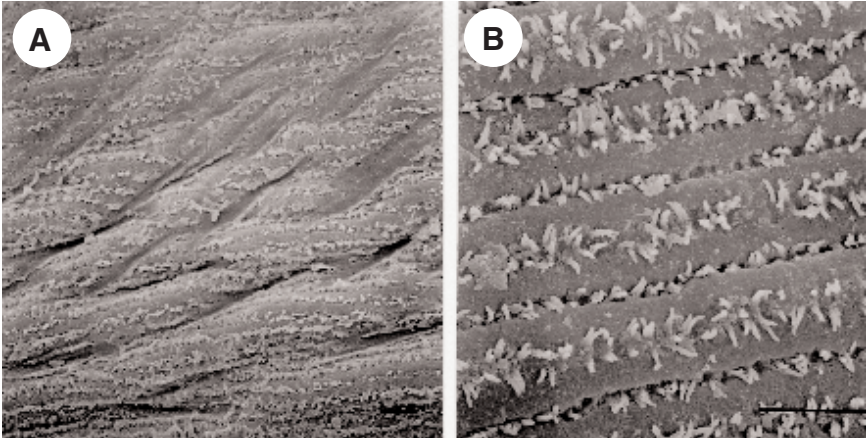


Fig. 1. *Gordionus longistriatus* Schmidt-Rhaesa, n.sp. **A.** Cuticle of one female paratype at lower magnification showing longitudinal rows of bristles. **B.** Cuticle of female holotype in higher magnification. All scales: 10 μ m.

numerous elevated structures called areoles (see, e.g., Schmidt-Rhaesa, 2002). Between these areoles, spines or bristles can be present. In some species of the genus *Gordius*, the cuticle is devoid of further structures or may contain only scattered bristles (Schmidt-Rhaesa, 1997). The lack of areoles but the presence of interareolar bristles is known to date only from two further species: *Gordionus wolterstorffii* and *Beatogordius brieni*. In *G. wolterstorffii*, areoles are lacking only in some specimens, while in others they are present, but fuse into longitudinal rows (Schmidt-Rhaesa, 2001b). This allows the interpretation that areoles are reduced in this species, leaving only interareolar structures. In *B. brieni*, areoles are also absent, but interareolar structures are not simple bristles, but branched structures which somehow resemble structures present in other species of *Beatogordius* (Schmidt-Rhaesa & de Villalobos, 2002). The exact assignment of the new species to a genus is not possible with certainty, because many characters diagnostic for the genus are found in the posterior end of the males and these were not present in this investigation. However, the cuticular pattern with the absence of areoles and longitudinal rows of unbranched bristles resembles closest that of *Gordionus wolterstorffii* and therefore the new species is placed in this genus.

ACKNOWLEDGMENTS

Many thanks to Ron Englund from the Bishop Museum, Honolulu, for giving me the opportunity to investigate this new species.

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