RECORDS OF THE HAWAII BIOLOGICAL SURVEY FOR 1997
Part 1: Articles

Editors' Preface

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

The Hawaii Biological Survey, established by the Hawaii State Legislature in 1992 as a program of the Bishop Museum, is an ongoing natural history inventory of the Hawaiian Archipelago. It was created to locate, identify, and evaluate all native and non-native species of flora and fauna within the State and 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 1997* include:

- an update of numbers of species in Hawai'i, including a review of fossil species;
- a conspectus of the grasses of Hawai'i;
- a new species of fly from Midway and a new marine amphipod from Kaua'i are described and illustrated;
- new records of plants, insects, and other invertebrates resulting from field surveys and continued curation of Hawaiian collections at Bishop Museum and elsewhere;
- a preliminary checklist of the soil mites (Oribatida) of Hawaii; a major contribution toward understanding the little-known soil biota of the islands.

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 World Wide Web server. Products currently available include taxonomic authority files (species checklists for terrestrial arthropods, flowering plants, non-marine snails, foraminiferans, and vertebrates), bibliographic databases (vascular plants, non-marine snails, and insects), specimen databases (fungi, fish, 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), detailed information and/or images on endangered, threatened, and extinct plants and animals; as well as our staff and 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 web pages where known. As a supplement to *HBS Records for 1997*, our web server also includes the long lists of various fossil taxa occurring in Hawai'i that could not be printed in these volumes due to space restrictions. These lists can be viewed at:

http://www.bishop.hawaii.org/bishop/HBS/lists/

Our Main Web Addresses:

Hawaii Biological Survey Home Page
http://www.bishop.hawaii.org/bishop/HBS/

Bishop Museum Entomology Home Page
http://www.bishop.hawaii.org/bishop/ento/

Hawaii Biological Survey Databases
http://www.bishop.hawaii.org/bishop/HBS/hbsdbhome.html

Hawaii Endangered and Threatened Species Web Site
http://www.bishop.hawaii.org/bishop/HBS/endangered/

"Insect and Spider Collections of the World" Home Page
http://www.bishop.hawaii.org/bishop/ento/codens-r-us.html

The *Records of the Hawaii Biological Survey for 1997* were compiled with the assistance of George Staples (botany), Robert Cowie (malacology), Lucius Eldredge (invertebrate zoology, marine zoology), and Gordon Nishida (entomology), who edited papers in their disciplines; and was partially supported by a grant 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 U.S. Geological Survey Biological Resources Division (formerly National Biological Service), U.S. Fish and Wildlife Service, U.S. Department of Defense Legacy Program, and the Hawaii Department of Land and Natural Resources.

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

http://www.bishop.hawaii.org/HBS/guidelines.pdf

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

——N.L. Evenhuis &
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Numbers of Hawaiian Species: Supplement 3, with Notes on Fossil Species[1]

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This is the third supplement to our earlier tabulations of species known from the Hawaiian Islands (Eldredge & Miller, 1995, 1997; Miller & Eldredge, 1996); this paper includes notes on the fossil species known to occur in the Hawaiian Islands.

Many papers in Keast & Miller (1997), especially Miller (1997), discussed the status and biogeography of terrestrial organisms in Hawai'i, in the context of the biogeography of the Pacific Basin. The Hawaiian Islands, by virtue of their geographic isolation, rich volcanic soils, and enormous topographic and climatic diversity, have produced a highly endemic biota, which includes many of the world's outstanding examples of adaptive radiation. The native biota includes more than 22,400 species (Table 1). The approximately 8,800 terrestrial and aquatic plants and animals have evolved from as few as 1,000 original colonists (Gagné, 1988; see also Sakai *et al*., 1995), although we suspect the total number of native species and colonists will increase with further study.

The Hawaii Biological Survey continually posts species checklists in searchable interfaces on the web at:

http://www.bishop.hawaii.org/bishop/HBS/

More than 15,000 species are currently available (including terrestrial arthropods, native and alien land and freshwater snails, foraminiferans, flowering plants, amphibians, reptiles, birds, and mammals; marine invertebrates are being added). Many gaps in knowledge of the biota of the Hawaiian Islands remain, and many species of protists, algae, fungi, arthropods, and parasitic helminths need to be investigated.

Recent surveys of overall biodiversity within particular geographic regions include: Bermuda (Sterrer, 1998), Galapagos (Peck, 1997), Illinois (Post, 1991), Netherlands (Nieukerken & Loon, 1995), New Guinea (Sekhran & Miller, 1996; Miller, 1997), and South Africa (Huntley, 1989, 1994). Surveys dealing only with animal diversity include India (Zoological Survey of India, 1991), and the Madeira Islands (Baéz, 1993). Miller *et al*. (1998) provided a very preliminary summary of numbers for major taxa in the Afrotropical region.

Bacteria

The current status of leptospirosis is reviewed by Katz *et al*. (1997) as it pertains to the resident military population.

Fungi

Sixteen additional species of rust fungi, including 3 endemic species, reported from Hawai'i (Gardner, 1997); Desjardin & Hemmes (1997) add 17 taxa of Hygrophoraceae,

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including 6 new species; 14 species of arbuscular mycorrhizal (AM) fungi were isolated from roots of plant from sand dunes of Kaua'i (Koske & Gemma, 1996); 1 species reported from lateral line canals of hammerhead sharks (Crow *et al*., 1995).

Lichens

The pantropical distribution of the new species *Chaenothecopsis pilosa* Tibell & Ryman, 1995, includes Hawai'i (Tibell & Ryman, 1995); 2 previously recorded species from the genus *Chiodecton* to new combinations *Syncesia hawaiiensis* (Zahlbruckner) Tehler and *S. effusa* (Fee) Tehler (Tehler, 1997).

Liverworts

Grolle (1991) changed the combination of an endemic liverwort to *Drepanolejeunea ungulata* (Steph.) Grolle.

Mosses

Eight indigenous moss species added to Hawaiian mosses (Hoe, 1979).

Flowering Plants

In our first and second supplements we did not fully account for changes in status of flowering plants that were published outside of *Records of the Hawaii Biological Survey*. In order to correct the running totals. Table 1 reports the current (March 1998) totals from a database of Hawaiian plants maintained by Dr. Warren L. Wagner at the Smithsonian Institution, in collaboration with the Hawaii Biological Survey. Because a new checklist of plants based on this database should be published in the near future, we do not provide the full documentation here. Also, forty-eight species added, including 29 grasses (Herbst & Clayton, 1998), 18 species from various groups (Flynn & Lorence, 1998; Herbarium Pacificum Staff, 1998; Herbst, 1998; Mosyakin & Wagner, 1998; Sato, 1998), and 1 fossil cotton species (Woodcock & Webb, 1998); 1 former species (*Xanthosoma roseum*) questionably included (Staples, 1998).

Protozoa: **Ciliophora**

Bryometopus hawaiiensis Foissner, 1994, previously considered endemic to Hawai'i, was reported from Spain (Olmo & Tellez, 1996).

Protozoa: **Rhizopoda**

Twenty-two species of rhizopods were collected in 1909 in the neighborhood of Honolulu (Penard, 1911), this record has been previously overlooked.

Cnidaria: **Anthozoa**

New species *Narella nuttingi* Bayer, 1997 (originally reported as *Stachyodes dichotoma* Versluys, 1906 by Nutting (1908) from *Albatross* explorations in Hawaiian waters) (Bayer, 1997); *Gardineria hawaiiensis* Vaughan, 1907, designated as type species of new scleractinian family Gardineriidae (Stolarski, 1996); new record of *Montipora turgescens* collected at Midway Atoll (Coles, 1998).

Table 1. Estimates of numbers of known species of the Hawaiian biota (based on Eldredge & Miller, 1995, 1997; Miller & Eldredge, 1996; and including this paper and other papers in this issue of the *Records*). Algae and fungi remain the same as previous editions, since the numbers are based on estimates, other categories are based on counts. NIS = non-indigenous species (i.e., not native to the region).

Taxon	Total	Endemic	NIS
Algae	811	2	5?
Other protists	1128	2?	?
Fungi	1357	?	?
Lichens	723	240	?
Flowering plants	2074	908	1051
Other plants	763	241	44
Cnidarians	356	75	10
Insects	7998	5245	2598
Other arthropods	914	269	527
Molluscs	1650	956	86
Annelids	309	80	32
Crustaceans	1195	55+	50
Echinoderms	283	150	0
Other invertebrates	1333	439	29+
Fish	1198	139	73
Amphibians	5	0	5
Reptiles	27	0	23
Birds	294	63	46
Mammals	44	1	19
Totals	22462	8864	4598

Kinochyncha

First record of members of this phylum, unidentified species of *Echinoderes* [Order Cycorhagida, Suborder Cyclorhagae, Family Echinoderidae], reported from 70 m sewage outfall, collected in 1986 (Bailenson, 1997).

Tardigrada

Thirty-one species in 10 genera and 4 families reported in 1986 (Gon *et al*., 1986).

Nematoda

Coral reef parasite, *Spirocamallanus istiblenni* Noble, 1996, redescribed (Rigby & Font, 1997); *Camallanus cotti* Fujita, 1927, redescribed from freshwater goby from Hawai‘i (Rigby *et al*., 1997).

Annelida: **Polychaeta**

Pottsipelogenia treadwelli Pettibone, 1997, proposed as a replacement name for *Psam-*

*molyce fijiensi*s Treadwell, 1906 (Pettibone, 1997); 4 species of Namanereidinae, including 2 new nonindigenous records, reported from Hawaiian waters (Glasby *et al*., 1998).

Mollusca

Gosliner & Graheim (1996) noted that 430 species of opisthobranch mollusks were known from Hawaiian waters of which 41% are thought to be undescribed; 244 species have been previously reported (Ghiselin, 1992); Kay (1979) noted some 150.

Arthropoda: **Crustacea**: **Decapoda**

New species *Pachycheles attaragos* Harvey & DeSanto, 1997 (Porcellanidae) (Harvey & DeSanto, 1997); new species *Cycloes marisrubri* Galil & Clarke, 1996 (Calapp-

Table 2. Penaeoid and sergestoid shrimps in Hawai‘i as per Pérez Farfante & Kensley (1997).

Name as Originally Described	Revised Name
PENAEOIDEA	
Aristeidae	
Aristeus armatus Bate, 1881	*Plesiopenaeus armatus* (Bate, 1991)
Bethesicymidae	
Gennadas intermedius Bate, 1888	*Bentheogennema intermedia* (Bate, 1888)
	Benthesicymus urinator Burkenroad, 1936
	Benthonectes filipes Smith, 1885
	Gennadas parvus Bate, 1881
Penaeidae	
Penaeus marginatus Randall, 1840	*Melicertus marginatus* (Randall, 1840)
	Metapenaeopsis gaillardi Crosnier, 1991
Penaeus velutinus Dana, 1852	*Metapenaeopsis velutina* (Dana, 1852)
Penaeus richtersii Miers, 1884	*Trachypenaeopsis richtersii* (Miers, 1884)
Sicyoniidae	
	Sicyonia laevis Bate, 1881
Solenoceridae	
Solenocera lucasii Bate, 1881	*Hadropenaeus lucasii* (Bate, 1881)
Haliporus obliquirostris Bate, 1881	*Hymenopenaeus obliquirostris* (Bate, 1881)
	Solenocera rathbunae Ramadan, 1938
SERGESTOIDEA	
Luciferidae	
	Lucifer chacei Bowman, 1967
Sergestidae	
	Petalidium suspiriosum Burkenroad, 1937
	Sergestes erectus Burkenroad, 1940
Sergestes bigemmeus Burkenroad, 1940	*Sergia bigemmea* (Burkenroad, 1940)
Sergestes maximus Burkenroad, 1940	*Sergia maxima* (Burkenroad, 1940)

idae), replacement name for *Cycloes granulosa* (Galil & Clarke, 1996); new species *Cinetorhynchus fasciatus* Okuno & Tachikawa, 1997 (Okuno & Tachikawa, 1997); new combinations *Cinetorhynchus hiatti* (Holthuis & Hayashi, 1967) for *Rhynchocinetes hiatti, Cinetorhynchus hendersoni* (Kemp, 1925) for *Rhynchocinetes intermedius* Edmondson (Rhynchocinetidae) (Okuno, 1997); new species *Mandibulophoxus hawaiiloa* Muir & DeFelice, 1998 (Amphipoda, Gammaridea, Phoxocephalidae) (Muir & DeFelice, 1998).

Pérez Farfante & Kensley (1997) reviewed the 7 families of penaeoid and sergestoid shrimps, providing information on 18 species, including 8 new records (see Table 2).

Arthropoda: **Insecta and Related Forms**

Nishida (1997a, 1997b) provided a full bibliography and updated checklist for the Hawaiian insects and related arthropods; particularly noteworthy publications include the symposium on Hawaiian entomology held at the XX International Congress of Entomology (Liebherr & Polhemus, 1997); plant bug genus *Nesiomiris* revised (Gagné, 1997); a handbook to the damselfly genus *Megalagrion* published (Polhemus & Asquith, 1996); milliped species reports (Shelley, 1998b, 1998c, 1998d; Shelley & Swift, 1998), 4 species deleted from fauna (Shelley, 1998a; Shelley *et a*l., 1998); Swift & Norton (1998) reported a total of 81 species of oribatid soil mites (Acari: Orbitida), including 49 new records for the Hawaiian Islands. One species of dolichopodid fly (*Thinophilus hardyi* Evenhuis & Grootaert, 1997) thought to be endemic, was recently reported from the Galapagos (Bickel & Sinclair, 1997).

Echinodermata

Mah (1998) reported 5 new records for starfishes from Hawaiian waters, all from Bishop Museum specimens.

Chordata: **Ascidiacea**

Forty-five species are reported from Hawaiian waters (Abbott *et al*., 1997); an additional one, *Symplegma reptans* (Oka), was noted as being newly introduced into Pearl Harbor (Coles *et al*., 1997).

Chordata: **Pisces**

New genus and species of labrid fish, *Ammolabrus dicrus* Randall & Carlson, 1997, from Wai‘anae, O‘ahu (Randall & Carlson, 1997).

Chordata: **Amphibia**

One species (*Eleutherodactylus coqui*) has recently been noted as established on Maui (Campbell, 1994, 1996; McKeown, 1998).

Chordata: **Reptilia**

Retroviral infections are widespread in Hawaiian green turtles (*Chelonia mydas*) in both apparently normal and those with fibropapillomas (Casey *et al*., 1997).

Chordata: **Aves**

Twenty species have been added to the checklist of Hawaiian birds since 1995 to total 294 (Pyle, 1997): 63 resident native species, 55 resident nonindigenous species, 13 breed-

Table 3. Fossil scleractinian corals from the Hawaiian Islands

Coral Species	Oahu		Midway	
	Nanakuli	Kahuku	Post-Miocene	Miocene
Acroporidae				
Acropora sp.				x
Montipora patula	x			
Agariciidae				
Pavona clavus			x	
P. duerdeni	x	x		
P. maldivensis			x	
Balanophyllidae				
Balanophylla sp.	x			
Faviidae				
Cyphastrea ocellina	x	x	x	
Favia sp. A,B,C				x
Favites cf. *chinensis*				x
Leptastrea purpurea	x			
Plesiastrea cf. *curta*				x
Agariciidae				
Leptoseris cf. *incrustans*				x
Fungiidae				
Fungia scutaria	x			
Oculinidae				
Galaxea haligena				x
Pocilliporidae				
Pocillopora damicornis	x			
P. eydouxi	x			
P. ligulata	x	x	x	
P. meandrina	x	x	x	
P. cf. *hemprichi*				x
Seriatopora cf. *hystrix*				x
Stylophora gemmans				x
S. pistillata				x
Poritidae				
Porites compressa	x	x		
P. lobata	x	x	x	
Porites sp. A,B,C				x
Thamastreidae				
Psammocora sp.	x			
Caryophylliidae				
Paracyathus gardineri	x			

ing visitor species, 163 nonbreeding visitor species; an additional 150+ nonindigenous, not established species have been sighted; Moniz (1997) provided evidence from archaeological assemblages that at least 4 additional seabirds bred historically in the Hawaiian Islands.

FOSSIL SPECIES: This compilation of fossils known from the Hawaiian Islands is preliminary and will be further updated (additional information is most welcome).

Protozoa: **Radiolaria**: Fossil

A core drilled during the Ocean Drilling Program was analyzed to contain 108 species of Quaternary, Eocene, and Cretaceous radiolarians (Hull, 1993), see the Bishop Museum web site for species.

Protozoa: **Foraminifera**: Fossil

The foraminiferans are fully enumerated in the Burch & Burch checklist and bibliography, see the Bishop Museum web site.

Flowering Plants: Fossil

One species of fossil cotton reported (Woodcock & Webb, 1998).

Cnidaria: **Scleractinia**: Fossil

A total of 27 species of fossil scleractinian corals have been reported from the Hawaiian Islands (Hagstrom, 1979; Wells, 1982) (see Table 3).

Arthropoda: **Crustacea**: **Ostracoda**: Fossil

Holden (1967) reported 35 species of ostracods from drowned terraces, 13 described as new species, many of these species are extant and are found at depths of less than 50 fathoms; Holden (1976) reported 115 taxa (25 described as new species, 10 new subspecies, 50 as "sp.") from Midway Atoll drill holes, only 8 species are considered in common with those of Holden (1967); see the Bishop Museum web page for species lists.

Mollusca: Fossil

Kay (1979) briefly reviewed the fossil history of the Hawaiian molluscan fauna, indicating that the data are "too sparse and unstudied to draw conclusions on the course of history of the marine mollusks of the Hawaiian Islands . . . " (p. 14). A number of publications list a variety of species and since many include out-of-date taxonomy, a list of species has not been compiled at this time, in addition most of the species reported from "fossil" limestone are currently found living on Hawaiian reefs. The major publications reporting fossil marine mollusks are: Ostergaard (1928, 62 gastropod and 20 bivalve species); Dall *et al*. (1938, 188 bivalve species, many reported as "new species"); and Kosuge (1969, 159 gastropod and 32 bivalve species); Hagstrom (1979, 156 gastropod and 36 bivalve species); 2 species of land snails (Endodontidae) are reported from Pleistocene limestone drill holes from Midway Atoll (Solem, 1977); 16 or more land snail species are known to have inhabited the ʻEwa Plain, Oʻahu, prior to human habitation (Christensen & Kirch, 1986).

Chordata: **Aves**: Fossil

Fifty-one species of fossil birds have been reported from the Hawaiian Islands; Olson & James (1991) reported 35 species, describing new nonpasseriform species; James & Olson (1991) described 16 new fossil passeriform species and discuss 8 possible additional new species.

Chordata: **Mammalia**: Fossil

One undescribed fossil species of bat is known (F.G. Howarth, pers. comm.).

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Notes on the grasses of Hawai‘i: New Records, Corrections, and Name Changes

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Under the auspices of a National Science Foundation Curatorial Grant awarded to the Bishop Museum, W.D. Clayton was able to spend 8 weeks (February–March 1994) in the museum's Herbarium Pacificum, curating the grasses of Polynesia, Micronesia, and parts of Melanesia. The authors presently are compiling a checklist of the grasses of these geographical areas.

The most comprehensive recent treatment of the Hawaiian grasses is the chapter on the Poaceae by Peter O'Connor in the *Manual of flowering plants of Hawai‘i* (hereafter, the *Manual*) (Wagner *et al*., 1990), which provides a modern, accurate account of the state's native and naturalized grasses. New collections and curating efforts after the cut-off date for the *Manual* project (September 1987) have resulted in a substantial number of new distributional records and detection of additional naturalized species. Also, recent publications have resulted in new taxonomic or nomenclatural changes for species that occur in the Hawaiian Islands. A number of earlier publications have provided additional information, updating O'Connor's grass treatment (Hughes, 1995; Herbarium Pacificum Staff, 1997; Herbst & Wagner, 1996; Lorence & Flynn, 1997; Lorence *et al*., 1995; Wagner & Herbst, 1995; Wagner *et al*., 1997). This paper continues in the tradition of these publications by providing records for naturalized species documented for the first time in the Hawaiian Islands, for new range extensions for naturalized and native species within the archipelago, and calls attention to taxonomic and name changes in the literature affecting species in the Hawaiian flora. These records and changes can be considered a supplement to the O'Connor chapter in Wagner *et al*. (1990).

Keys are provided along with the reports of new additions to the flora so that this paper can be used in conjunction with the *Manual* to identify the newly introduced species; the keys are modified from D. Clayton's keys in the Pacific Grass Checklist mentioned earlier in this introduction. Some species treated in the keys are known in Hawai‘i only as cultivated plants, but are included here for completeness and in anticipation that some of the species may have become naturalized in Hawai‘i, and others may in the future. Grasses are not collected systematically by most Hawaiian botanists, resulting in gaps in our knowledge of the family in Hawai‘i. We use the same definition for "naturalized" as used in Wagner *et al*. (1990: 1645).

This paper reports 12 new island distributional records for naturalized species, 12 for native species, and calls attention to 29 newly naturalized grasses in the Hawaiian Islands. We also include notes on 16 species for which the scientific name has changed, and 14 species which were misidentified in previous publications. A few additional notes on Hawaiian grasses could not be completed in time to be included in this paper; these will be published at a later date. All identifications were made by W.D. Clayton.

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1. Contribution No. 1998-005 to the Hawaii Biological Survey.

Agrostis

KEY TO THE SPECIES OF *AGROSTIS* IN HAWAI'I

1. Lemma pilose; rhachilla extension well-developed, plumose ..... **A. avenacea**
1. Lemma glabrous; rhachilla not prolonged (2).
2(1). Palea 1/2–2/3 length of lemma; lemma usually awnless (3).
2. Palea less than 1/4 length of lemma; lemma awned or awnless (4).
3(2). Ligules of vegetative shoots as long as or longer than wide; panicle contracted after flowering; stoloniferous ..... **A. stolonifera**
3. Ligules of vegetative shoots shorter than wide; panicle loose; rhizomatous .... **A. capillaris**
4(2). Panicle branches, at least the lower, naked towards the base; panicle open or contracted, lanceolate to ovate; culms ascending or decumbent; stoloniferous; awn, when present, rising near base of lemma ..... **A. canina**
4. Panicle branches bearing spikelets to the base; panicle contracted to spiciform; culms erect; tufted, without stolons; awn, when present, arising 1/2 way up lemma (5).
5(4). Leaf-blades flat, 2–8 mm wide; panicle contracted, linear to lanceolate ..... **A. exarata**
5. Leaf-blades involute, 1–2 mm wide; panicle spiciform, linear ..... **A. sandwicensis**

Agrostis capillaris L. **New state record**

A sixth species of *Agrostis* has been documented for the state of Hawai'i; the above key can assist in differentiating it from the other Hawaiian members of the genus. Two other collections of this species are at BISH, both from trial grass plots at the Hawaii Agricultural Experimental Station on Maui. The St. John/Mitchell collection cited below may have been an escape from 1 of these plots, but it is not known if the species is still extant on the island. *Agrostis capillaris* is native to Europe and temperate Asia, and has been widely introduced into other parts of the world.

Material examined: **MAUI**: East Maui, Haleakalä, Kaupö Gap, first cone south of Waikelaehia, in meadows, 6200 ft, 27 Aug 1945, *St. John and Mitchell 21,209* (BISH); Makawao, Haleakalä Substation, Hawaii Agricultural Experimental Station, 2100 ft, planted in grass garden, 9 Apr 1939, *Hosaka 2457* (BISH); Olinda, Hawaii Agricultural Experimental Station, 3500 ft, plot 20, 26 Jun 1940, *Murphy s.n.* (BISH 448124).

Agrostis sandwicensis Hillebr. **New island record**

Documented as occurring on Maui and Hawai'i (O'Connor, 1990: 1494), and reported from O'ahu (Hillebrand, 1888: 515), *A. sandwicensis* is now known from Kaua'i. The species is endemic to Hawai'i.

Material examined. **KAUA'I**: Kaua'i, Oct 1916, *Rock s.n.* (BISH 117779).

Agrostis semiverticillata (Forssk.) C. Chr. **Taxonomic change**

The taxon treated by O'Connor (1990: 1494) as *A. semiverticillata* is here considered a synonym of *Polypogon viridis* (Gouan) Breistr., a species native from S Europe to NW India.

Andropogon

Andropogon glomeratus (Walter) Britton, Sterns & Poggenb. **New state record**

Schizachyrium condensatum (Kunth) Nees has consistently been misidentified in the Hawaiian Islands as *A. glomeratus*. The true *A. glomeratus* has now been documented from the islands, based upon 5 collections from the island of Kaua'i. The species is native from southern USA to Mexico.

Material examined. **KAUA'I**: Hanalei District, Limahuli Valley, west side of ridge separating Limahuli and Hanakäpï'ai Valleys, 1600–2060 ft, 12 Oct 1987, *Flynn et al. 2179* (BISH); Wainiha Valley Road, 30.5 m, 18 Sep 1987, *Ishii s.n.* (BISH 635082); Hanalei National Wildlife Refuge, 0.5 m, 20 Nov 1989 *Wagner & Hanford 6278* (BISH); border of Hanalei and Kawaihau Districts, summit camp area of the powerline trail, 2150 ft, 3 Oct 1989, *Flynn et al. 3547* (BISH); Waimea District, Waimea Canyon State Park, Hwy 550 near hunter check-in station, 2500 ft, 27 Jan 1988, *Flynn et al. 2717* (BISH).

Anthephora

Anthephora hermaphrodita (L.) O. Ktze. **New state record**

Anthephora hermaphrodita is known from a single collection from O'ahu; it is native to tropical Central and South America.

Material examined. **O'AHU**: Makapu'u Coast Guard lighthouse, beside the road, 1 Jan 1981, *Whistler s.n.* (BISH 619115).

Aristida

Aristida adscensionis L. **Correction**

O'Connor (1990: 1482) cites *Munro 128*, collected on O'ahu in 1903, as the earliest documentation of this species in Hawai'i. The collection is the earliest, but actually was made at the American Sugar Company on Moloka'i. There is a single collection of *Aristida* from O'ahu in BISH, an unidentified species collected at Waialua, Poamoho, as a volunteer in a grass plot, on 29 Oct 1938, *Hosaka 2418*.

Bothriochloa

KEY TO SPECIES OF *BOTHRIOCHLOA* IN HAWAI'I

1. Pedicelled spikelets linear, much narrower than the sessile spikelets (2).
1. Pedicelled spikelets elliptic, about as wide as the sessile spikelets (3).
2(1). Culm nodes pubescent; sessile spikelets 4.5–7.3 mm long ..... **B. barbinodis**
2. Culm nodes glabrous; sessile spikelets 2.8–3.5 mm long ..... **B. laguroides**
3(1). Racemes borne on a central axis longer than themselves ..... **B. bladhii**
3. Racemes subdigitate or with a central axis shorter than the lowest raceme .... **B. pertusa**

Bothriochloa laguroides (DC.) Herter **New state record**

Bothriochloa laguroides is known from a single collection from the island of Maui. It is native to tropical America.

Material examined. **MAUI**: East Maui, Makawao, Hawaii Agricultural Experimental Station, in pasture, 2100 ft, 17 Jul 1941, *Hosaka 2605* (BISH).

Brachiaria

KEY TO THE SPECIES OF *BRACHIARIA* IN HAWAI'I

1.Margins of raceme rhachis tuberculate-ciliate; spikelets 4–6 mm long; glumes not separated by an internode ..... **B. brizantha**
1. Margins of raceme rhachis eciliate, sometimes the surface pilose (2).
2(1). Raceme rhachis triquetrous, without wings; spikelets 1.5–2.7 mm long ..... **B. reptans**
2. Raceme rhachis flat, ribbon-like, winged, 0.5–1.5 mm wide (3).
3(2).Spikelets paired in several untidy rows, 2.5–3.5 mm long; glumes not separated by an internode; perennial ..... **B. mutica**

3.Spikelets borne singly in 1–2 rows; glumes separated by a short internode; annual (4).
4(3). Length of spikelets 4–5.5 mm ..... **B. plantaginea**
4. Length of spikelets 2.4–3.7 mm (5).
5(4). Spikelets 2.4–3 mm long; inflorescence axis usually 0.5–2 cm long ..... **B. distachya**
5.Spikelets 3.3–3.7 mm long; inflorescence axis usually 3–10 cm long .. **B. subquadripara**

Brachiaria reptans (L.) Gard. & C.E. Hubb. **New state record**

The following collection documents a new state record for a naturalized grass. *Brachiaria reptans*, native to tropical Asia, is known from a single collection made on O‘ahu.

Material examined. **O‘AHU**: Honolulu, Bishop Museum courtyard, 4 Oct 1946, *Neal s.n.* (BISH 119991).

Bromus

KEY TO THE SPECIES OF *BROMUS* IN HAWAI‘I

1. Lemmas strongly laterally compressed and keeled ..... **B. catharticus**
1. Lemmas rounded on the back (2).
2(1).Lower glume 3–7-veined; spikelets lanceolate to ovate, tapering towards the top; lemmas awned (3).
2. Lower glume 1-veined; spikelets oblong or cuneate, gaping at the top (5).
3(2).Lemma margins inrolled below middle, the lemma 7–9 mm long; leaf-sheaths usually glabrous ..... **B. secalinus**
3. Lemma margins flat; leaf-sheaths hairy (4).
4(3). Panicle dense, erect; pedicels shorter than spikelets ..... **B. hordeaceus**
4. Panicle lax, nodding; pedicels longer than spikelet ..... **B. japonicus**
5(2). Plants perennial, rhizomatous; spikelets oblong; lemmas awnless ..... **B. inermis**
5. Plants annual; spikelets cuneate (6).
6(5). Lemmas 20–35 mm long ..... **B. diandrus**
6. Lemmas 9–20 mm long (7).
7(6). Panicle drooping, open, the branches mostly longer than spikelets (8).
7. Panicle erect, dense, the branches mostly shorter than spikelet (9).
8(7). Panicle branches simple, each bearing 1(-3) spikelets ..... **B. sterilis**
8. Panicle branches divided, each bearing at least 4 spikelets ..... **B. tectorum**
9(7). Panicle loose; branches partly visible, 10–30 mm long ..... **B. madritensis**
9. Panicle densely contracted; branches hidden, 1–10 mm long ..... **B. rubens**

Bromus catharticus Vahl **Taxonomic change**

Much of the literature concerning *Bromus catharticus* in Hawai‘i appears under its synonyms *Bromus willdenowii* Kunth and *B. unioloides* Kunth.

Bromus rigidus Roth **Taxonomic note**

Bromus rigidus Roth (O'Connor, 1990: 1508) is treated as a subspecies of *B. diandrus* by Tsvelev (1983: 324), but in the genus *Anisantha* (*Anisantha diandra* ssp. *rigida* (Roth) Tsvel). Although we agree that *B. rigidus* is probably best considered a subspecies of *B. diandrus*, the final consensus for placing the taxa in the genus *Anisantha* is yet to be determined.

Bromus hordeaceus L. **Taxonomic change**

There is much disagreement over several closely allied species of *Bromus*. In this treatment we have followed the taxonomy of Smith (1980: 187) as given in the *Flora Europaea* where *B. mollis* L. (O'Connor, 1990: 1507) is considered a synonym of *B. hordeaceus*, and *B. molliformis* Lloyd (O'Connor, 1990: 1505) becomes subsp. *molliformis* (Lloyd) Maire & Weiler.

Calamagrostis

Calamagrostis expansa (Munro ex Hillebr.) Hitchc. **New island record**

Formerly considered endemic to the island of Maui, *Calamagrostis expansa* has recently been discovered on the island of Hawai'i.

Material examined. **HAWAI'I**: South Kona District, Kohala Mts., above Honokana Nui Stream north of twin 'Äwini bogs, 4330 ft, 28 Nov 1995, *Wood and Perlman 4807* (BISH); above Honokana Nui Stream, third bog west of USGS Trail near cabin, 4300 ft, 15 Nov 1995, *Wood 4739* (BISH); 2 other collection from bogs in the area: 29 Nov 1995, *Wood and Perlman 4811* (BISH), 15 Nov 1995, *Wood 4751* (BISH).

Cenchrus

New state records published in prior papers have added species to our flora which are not included in the generic key in O'Connor (1990: 1511). The following key will aid in their identification.

KEY TO THE SPECIES OF *CENCHRUS* IN HAWAI'I

1.	Bristles or spines antrorsely barbed (2).
1.	Bristles or spines retrorsely barbed (3).
2(1).	Inner bristles ciliate, flexuous, united only at base to form a shallow disc 0.5–1.5 mm in diameter (often mistaken for *Pennisetum* if disc and basal flattening of inner bristles overlooked) ..... **C. ciliaris**
2.	Inner bristles glabrous, rigid, flattened, connate for 1/4–2/3 of their length to form a cup ..... **C. setigerus**
3(1).	Spines connate only at the base to form a shallow cup ..... **C. agrimonioides**
3.	Spines connate for at least 1/2 their length to form a globose bur (4).
4(3).	Bur subtended by whorl of finer spines at its base ..... **C. echinatus**
4.	Bur with finer spines emerging irregularly from its surface ..... **C. tribuloides**

Chloris

Chloris barbata Sw. **New island record**

The following collection documents this species from the island of Kaho'olawe. It is now known from all of the main islands.

Material examined. **KAHO'OLAWE**: Windswept plateau toward east end, 200–400 m, 14 Feb 1931, *Bryan 733* (BISH).

Chloris virgata Sw. **New island record**

Based upon the specimen cited below, *Chloris virgata* has now been documented from all the main islands except Niʻihau.

Material examined. **OʻAHU**: One mile west of Kahuku, by the road, 100 ft, Feb 1975, *Uta'i 8* (BISH).

Cymbopogon

Cymbopogon refractus (R. Br.) A. Camus **New island records**

The following collections represents new island records from the islands of Niʻihau and Länaʻi. *Cymbopogon refractus* is now known from all the main islands except Kahoʻolawe.

Material examined. **NIʻIHAU**: One half mile northeast of Kiʻekiʻe, pasture grass, 400 ft, 14 Aug 1947, *St. John 22794* (BISH); **LÄNAʻI**: Common near Puʻu Manu, 2000 ft, 8 Nov 1987, *Nagata 3716* (BISH).

Cynodon

KEY TO THE SPECIES OF *CYNODON* IN HAWAIʻI

1. Plant with stolons and underground rhizomes .....**C. dactylon**
1. Plant with stolons but no rhizomes (2).
2(1). Culms robust, woody; racemes in 2–5 whorls (rarely 1), stiff, red or purple .... **C. aethiopicus**
2. Culms soft, not woody; racemes in 1 whorl (occasionally 2), slender, green or pigmented ..... **C. nlemfuensis**

Cynodon aethiopicus Clayton & J.R. Harlan **New state record**

The following collections document this new state record from the islands of Oʻahu and Hawaiʻi; the specimens cited below had incorrectly been identified as *C. dactylon* and filed under that name. There are 3 sheets of *Cynodon* in BISH collected by Herbert Shipman on the 29 January 1963. Two of the specimens, labelled "Super Giant Bermuda," are of this species, the 3rd sheet, labelled "Giant Fuzzy Bermuda," is of *C. nlemfuensis* as reported by O'Connor (1990: 1520).

Material examined. **OʻAHU**: Hickam Field, 29 Nov 1945, *OHS* [*Otto H. Swezey*], *s.n.* (BISH 16662); **HAWAIʻI**: Kona, Honomolino near Miloliʻi Junction, James Stuart's Ranch, 1900 ft, 22 Apr 1962, *Lyman s.n.* (BISH 118470, 118472); Hawaiʻi, 29 Jan 1963, *Shipman s.n.* (BISH 118466).

Cynodon dactylon (L.) Pers. **New island record**

The following collection documents the presence of this species on the island of Molokaʻi; it has now been reported from all the main Hawaiian islands except Niʻihau.

Material examined. **MOLOKAʻI**: Moʻomomi, creeping grass on sand dune, 30 Oct 1986, *Takeuchi & Imada 3251* (BISH).

Dichanthium

Dichanthium aristatum (Poir.) C. E. Hubb. **New island record**

Formerly reported from Kauaʻi, Oʻahu, Länaʻi, and Maui (O'Connor, 1990: 1528), *Dichanthium aristatum* is here documented from the island of Kahoʻolawe for the first time.

Material examined. **KAHOʻOLAWE**: Makawao District, southwest coast near Hanakanaea, 50 ft, abundant near Navy base, 19 Mar 1992, *Wood et al. 1735* (BISH).

Dichanthium tenue (R. Br.) A. Camus **New island records**

The following collections document the presence of *Dichanthium tenue* on the islands of Oʻahu and Maui. It formerly was known only from Niʻihau and Hawaiʻi (O'Connor,

1990: 1528).

Material examined. **O'AHU**: Malaekahana, along roadways in *Leucaena* thickets, 200 ft, 21 Dec 1988, *Nagata 3934* (BISH); **MAUI**: 'Ulupalakua, Makawao, in pasture, 1940, *Ripperton s.n.* (BISH 447069).

Dichelachne Endl.

Dichelachne micrantha (Cav.) Domin **Taxonomic change**

The plant treated by O'Connor (1990: 1482) as *Dichelachne sciurea* (R.Br.) J.D. Hook. is considered conspecific with *Dichelachne micrantha* in the treatment of the genus by Veldkamp (1974: 9).

Digitaria

KEY TO THE SPECIES OF *DIGITARIA* IN HAWAI'I

1. Raceme rhachis broadly winged, flat, with rounded midrib; spikelets ternate (2).
1. Raceme rhachis with or without narrow wings, the midrib angular; spikelets paired (3).
2(1). Spikelets pubescent, often obscurely so, fruit dark brown to black ..... **D. violascens**
2. Spikelets glabrous; fruit pallid to light brown ..... **D. fuscescens**
3(1). Plants perennial (4).
3. Plants annual; spikelets pubescent (often obscurely so) to villous without conspicuous ribs (6).
4(3). Spikelets all quite glabrous, not ribbed; lower glume obvious as a triangular scale up to 1 mm long ..... **D. abyssinica**
4. Spikelets, or some of them, hairy (5).
5(4). Racemes numerous on a central axis; spikelets villous, the hairs extending 1–2 mm beyond tip ..... **D. insularis**
5. Racemes digitate or subdigitate ..... **D. eriantha**
6(3). Rhachis margins smooth; sterile lemma 5-veined, the laterals contiguous (thus apparently 3-veined); upper glume 1/3–2/3 length of spikelet ..... **D. radicosa**
6. Rhachis margins scabrid; sterile lemma 7-veined (7).
7(6). Upper glume 1/8–1/4 length of spikelet; lower glume absent; spikelets 2–3 mm long .... **D. setigera**
7. Upper glume 1/3–4/5 length of spikelet (8).
8(7). Upper glume 1/3–1/2 length of spikelet; lower glume tiny, but distinct; spikelets 2–2.5 mm long; inflorescence with a central axis up to 7 cm long ..... **D. horizontalis**
8. Upper glume(1/2–)2/3–4/5 length of spikelet; inflorescence digitate or subdigitate .... **D. ciliaris**

Digitaria abyssinica (A. Rich.) Stapf **New state record**

The collections of *Digitaria abyssinica* listed below document a new state record. Collections of the plant were made from experimental grass plots on O'ahu and Maui in 1940 and 1943, respectively, but at that time it was not known to be naturalized in Hawai'i. It is an African species.

Material examined. **KAUA'I**: Kalaheo, 29 Aug 1946, *Au, s.n.* (BISH 448776); **MAUI**: Olinda, Forestry House, 3850 ft, Mar 1979, *Hobdy 434* (BISH).

Digitaria eriantha Steud. **Taxonomic change and correction**

Digitaria pentzii Stent (O'Connor, 1990: 1530) is a stoloniferous variant of *D. eriantha* and was placed in synonymy under the latter species by Gibbs Russell *et al*. (1990: 110). Although O'Connor cites a 1963 Shipman collection from the island of Hawai'i as the earliest documentation of the species in the state, the first collection actually was from an experimental grass plot on Maui in 1939 (*Hosaka 2446*); it also was cultivated on O'ahu at about the same time. The earliest collection of the grass as a naturalized species probably was that of Fagerlund and Mitchell in 1942.

Material examined. **O'AHU**: Hawai'i Agricultural Experimental Station, Pensacola, 200 ft, 10 Aug 1940, collector unknown (BISH 448178); **MAUI**: Makawao, Haleakala Branch Agricultural Experimental Station, 9 Apr 1939, *Hosaka 2446* (BISH); **HAWAI'I**: Volcano House garden, 1 Dec 1942, *Fagerlund & Mitchell 224* (BISH).

Digitaria radicosa (J. Presl) Miq. **New island record**

The following collection documents a new island record for *D. radicosa* on the island of Kaua'i. The species formerly was known only from O'ahu.

Material examined. **KAUA'I**: Lawa'i Valley, National Tropical Botanical Garden, Bamboo Bridge area, 3 Oct 1983, *Flynn 625* (BISH).

Echinochloa

KEY TO THE SPECIES OF *ECHINOCHLOA* IN HAWAI'I

1. Ligule represented by a fringe of hairs ..... **E. picta**

1. Ligule absent (2).

2(1).Spikelets acuminate to awned, in 2-several irregular rows; longest raceme 2–10 cm long (3).

2. Spikelets acute to cuspidate; racemes seldom over 3 cm long, simple (4).

3(2).Spikelets mostly 3–4 mm long; upper floret 2–3 mm long; lowest raceme often with secondary branchlets ..... **E. crus-galli**

3.Spikelets 3.8–6.5 mm long; upper floret 3.5–5 mm long; racemes all simple..... ..... **E. oryzoides**

4(2).Racemes neatly 4-rowed, spikelets openly spaced, commonly about 1/2 their length apart, appressed to the axis, 1.5–3 mm long; lower floret male or barren ..... **E. colona**

4.Racemes crowded with plump spikelets, congested into a dense lanceolate head; spikelets 2.5–4 mm long, purple tinged; lower floret barren ..... **E. utilis**

Echinochloa oryzoides (Ard.) Fritsch **New state record, misidentification**

The 2 collections cited below represent a new state record. The species, native to the Mediterranean and Middle East, has not been collected in Hawai'i since 1930, and in all probability it is no longer in the state. The collections in BISH were originally incorrectly identified as *Echinochloa stagnina* (Retz.) P. Beauv., a species that apparently is not in Hawai'i.

Material examined. **O'AHU**: Honouliuli rice fields, 31 May 1928, *van Zwaluwenberg s.n*. (BISH 448746, 118762, 118763); Honolulu, Kapahulu Road, Parmelee's Nurseries, 17 Dec 1930, *Wilder s.n*. (BISH 118816).

Echinochloa picta (J. König) P.W. Michael **New state record, misidentification**

The following collection was originally identified by O'Connor (1990: 1534) as *Echinochloa stagnina* (Retz.) P. Beauv. It is the only known collection of *E. picta* in

Hawai‘i, and its present status is unknown. *Echinochloa picta* is native to tropical Asia.

Material examined. **O‘AHU**: Pearl Harbor Peninsula, in rice paddies, 15 ft, 30 Mar 1927, *Haddon 307* (BISH).

Echinochloa utilis Ohwi & Yabuno **New state record**

The following collection represents a new state record. Japanese millet has been cultivated on the island of Hawai‘i in the past, but this is the only record of it as a volunteer. It probably was introduced as a contaminant in the grass seed planted in the experimental plot. The status of the species in Hawai‘i is unknown, but it is included here to call attention to the possibility that the species still may occur as a member of the local weed flora. *Echinochloa utilis* is native to Japan and China.

Material examined. **MAUI**: East Maui, ‘Ulupalakua, Makawao, volunteer in experimental grass plot, 3000 ft, 13 Apr 1937, *Hosaka 1799* (BISH).

Echinochloa walteri (Pursh) Heller **Misidentification**

The collection cited by O’Connor (1990: 1534) as *E. walteri* was an incorrectly identified specimen of *E. crusgalli* (L.) P. Beauv. *Echinochloa walteri* has not been documented from the Hawaiian Islands.

Material examined. **O‘AHU**: Wai‘anae, Makaha Valley, along bank of reservoir, 100 ft, 17 Jun 1936, *Hosaka 1378* (BISH).

Ehrharta

Ehrharta erecta Lam. **New state record**

Although collections of *Ehrharta erecta* from experimental grass plots at the Hawai‘i Agricultural Experimental Station on Haleakalä were made in 1937 and 1943, this is the first documented naturalized collection of the species. It differs from *E. stipoides*, the only other species of the genus in Hawai‘i, by its often rugose, obtuse, awnless sterile lemmas. The sterile lemmas of *Ehrharta stipoides* are attenuate and awned. The species is native to Africa.

Material examined. **MAUI**: Makawao Dairy, 23 Apr 1979, *Hobdy 492* (BISH).

Ehrharta stipoides Labill. **New island record**

The following collection represents a new island record for this species. It previously was known from O‘ahu, Maui, and Hawai‘i (O’Connor, 1990: 1536), and recently was reported from Kaua‘i (Lorence *et al*., 1995: 45).

Material examined. **KAHO‘OLAWE**: Smuggler’s Cove, 25 Jan 1991, *Ellshoff 196* (BISH).

Eragrostis

KEY TO THE SPECIES OF *ERAGROSTIS* IN HAWAI‘I

1. Spikelets falling entire, ovate, 6–16 mm long ..... **E. superba**
1. Spikelets breaking up at maturity (or persistent in *E. tef*) (2).
2(1). Rhachilla fragile throughout, its internodes falling with the adjacent floret; palea keels conspicuously ciliate (3).
2. Rhachilla tough and persisting after the lemmas have fallen, at least in the lower half; palea keels glabrous or obscurely ciliolate (4).
3(2). Panicle spiciform, woolly, often more or less interrupted; lemmas, or at least the upper, with a few short stiff hairs on lower part of keel ..... **E. ciliaris**
3. Panicle open, pyramidal to elliptic, rarely contracted and linear; lemma keels glabrous... ..... **E. amabilis**
4(2). Plants annual (sometimes short-lived perennial in *E. parviflora* and *E. unioloides*) (5).

4. Plants perennial (10).
5(4). Leaf-blades with wart-like glands on the margins; spikelets pallid green to leaden grey; paleas persistent ..... **E. cilianensis**
5. Leaf-blades without glands on the margins (6).
6(5). Palea deciduous (but florets falling very tardily in *E. tef*) (7).
6. Palea persisting on rhachilla at maturity (9).
7(6). Spikelets ovate, 2–3.4 mm wide, the florets closely imbricate; panicle branches not whorled ..... **E. unioloides**
7. Spikelets linear to oblong, 0.7–2 mm wide; lowest panicle branches whorled (8).
8(7). Lemmas 2–2.7 mm long; grain oblong, 1–1.2 mm long; panicle axils glabrous or bearded ..... **E. tef**
8. Lemmas 1–1.6 mm long; grain ellipsoid, 0.6–1 mm long; panicle axils bearded..... ..... **E. pilosa**
9(6). Lowest panicle branches whorled; leaf-blades flat or involute, 2–5 mm wide . **E. parviflora**
9. Lowest panicle branches not whorled ..... **E. pectinacea**
10(4). Panicle not or scarcely emergent from basal leaves, contracted, linear; leaf-blades rigid, erect, forming a cushion 5–20 cm high ..... **E. paupera**
10. Panicle exserted well above basal leaves (11).
11(10). Upper glume as long as adjacent lemma or almost so (12).
11. Upper glume shorter than adjacent lemma (15).
12(11). Panicle open, lanceolate to ovate, the branches spreading or ascending; leaf-blades mostly flat, 2–4 mm wide (13).
12. Panicle contracted, linear, the branches appressed; leaf-blades mostly convolute, 1–2 mm wide (14).
13(12). Spikelets linear, 8–15-flowered; palea deciduous ..... **E. atropioides**
13. Spikelets oblong, 4–7-flowered; palea persistent ..... **E. deflexa**
14(12). Culms 60–100 cm high; leaves basal and cauline; panicle 15–30 cm long **E. leptophylla**
14. Culms 10–30 cm high; leaves basal; panicle 5–15 cm long ..... **E. monticola**
15(11). Leaf-blades coriaceous, stiff, 5–10 mm wide; culms robust, erect, 40–100 cm high, in a dense tuft; spikelets dark to greyish green (16).
15. Leaf-blades herbaceous; culms of moderate to slender stature (18).
16(15). Panicle contracted to spiciform, linear to lanceolate, the branches at lower nodes less than 6 cm long ..... **E. variabilis**
16. Panicle open, elliptic to ovate, the branches at lower nodes more than 6.5 cm long (17).
17(16). Glumes and lemmas glabrous ..... **E. grandis**
17. Glumes, and sometimes lemmas, long ciliate ..... **E. fosbergii**
18(15). Basal leaf-sheaths silky pubescent below and ridged ..... **E. curvula**
18. Basal leaf-sheaths glabrous (19).
19(18). Basal leaf-sheaths strongly laterally compressed; spikelets dark green, the lemma tips free giving a serrate outline ..... **E. tenuifolia**
19. Basal leaf-sheaths not flabellate; spikelets not obviously serrate (20).
20(19). Spikelets subsessile (pedicels less than 0.5 mm) in dense glomerate clusters ... **E. elongata**
20. Spikelets pedicelled (21).
21(20). Lateral pedicels 1–2 mm long, eglandular, the spikelets borne close to the primary branches ..... **E. brownii**
21. Lateral pedicels 2–15 mm long, filiform, the spikelets evenly distributed (22).
22(21). Pedicels 2–6 mm long, with an annular gland ..... **E. leptostachya**
22. Pedicels 5–15 mm long, eglandular (23).
23(22). Panicle effuse with sinuous branches; culms 60–160 cm high; spikelet oblong, the florets spreading at 30–45 degrees from the rhachilla ..... **E. trichodes**
23. Panicle moderately divided with straight branches; culms 30–40 cm long; spikelets linear, the florets appressed to the rhachilla ..... **E. mauiensis**

Eragrostis curvula (Schrad.) Nees **New state record, misidentification**

The following collections of *Eragrostis curvula* represent the 1st documentation of

the species on the northern Pacific islands. The 2 Kaho‘olawe specimens cited below were originally identified as *Leptochloa uninervia* (Presl) Hitchc. & Chase (Warren & Herbst, 1994; Warren *et al*., 1994), a species which it superficially resembles; *E. curvula* can be distinguished by the presence of minute striations and silky hair at the base of the leaf sheaths.

Material examined. **O‘AHU**: ‘Ewa, mauka of Varona Village, uncommon in abandoned sugar cane fields, 23 m, 1 Oct 1996, *Nagata 4437* (BISH); **KAHO‘OLAWE**: 1.25 mi due east of Pu‘u Muiwi, volunteer in an erosion control test plot, 305 m, 24 Apr 1989 *Aschermann s.n*. (BISH 634250); Southeast of Lua Makika in experimental planting area, 16 Jan 1990, *Warren s.n*. (BISH 634223).

Eragrostis deflexa Hitchc. **New island record**

The following collection represents a new island record from the island of Maui. *Eragrostis deflexa* was previously believed to be endemic to the islands of Läna‘i and Hawai`i.

Material examined. **MAUI**: West Maui, slopes of Lihau, 27 Jan 1987, *Hobdy 2704, 2705, 2709* (BISH).

Eragrostis grandis Hillebr. **New island record**

The following specimen is poor and scappy, but appears to fit this species, at least the low, dry area form. This endemic species of lovegrass is now known from all the main islands of Hawai‘i except Ni‘ihau.

Material examined. **KAHO‘OLAWE**: Central-western part of the island and below Lua Keälialalo, 700 ft, 22 Apr 1980, *Cuddihy & Char 364* (BISH).

Eragrostis leptophylla Hitchc. **New island record**

The following collection represents a new island record for *E. leptophylla*. It previously was believed to be endemic to the islands of Läna‘i, Maui, and Hawai‘i.

Material examined. **KAHO‘OLAWE**: Makawao District, ‘Ale‘ale Stack, near Pu‘u Koa‘e, 70 meters, 17 May 1992, *Wood et al. 1923* (BISH).

Eragrostis leptostachya (R. Br.) Steud. **New name and status**

Eragrostis leptostachya, a native of Australia, is naturalized in England and Belgium (where it was introduced with wool from Australia), and Easter Island and Hawai‘i. *Eragrostis hosakai* Degener, which was known only from the type collection on Moloka‘i, was recently cited as a new synonym of this species by Lazarides (1997: 131). The following collection represents a second record of the species in Hawai‘i.

Material examined. **MOLOKA‘I**: Makolelau, below and west of Pu‘u Kolekole, second drainage to the east of the nearby contour road, abundant on windswept ridges and slopes, 2750–2800 ft, 27 Feb 1997, *Wood 6039* (BISH).

Eragrostis molokaiensis St. John **Taxonomic change**

The holotype of this species, listed below, has been determined to be *Eragrostis brownii* (Kunth) Nees ex Steud., a species native to Australia, which is naturalized in Hawai‘i on the islands of Moloka‘i, Maui, and Hawai‘i.

Material examined. **MAUI**: East Maui, Haleakalä Crater National Park, between Hosmer’s Grove and Park Headquarters, in heath shrub, along trails only, 7000 ft, 21 Jul 1969, *Henrickson 3947* (holotype of *E. molokaiensis* St. John) (BISH).

Eragrostis pectinacea (Michx.) Nees **New island record**

Eragrostis pectinacea has been documented from the island of Moloka'i; it previously was known in the Hawaiian Islands from the islands of O'ahu, Läna'i, Maui, and Hawai'i.

Material examined. **MOLOKA'I**: East Kamiloloa Ridge, moist soil in a small erosion gully, 1200 ft, 23 Jan 1983, *Char & Hall 83.006* (BISH); Kamakou Preserve, Kawela Section, upper Onini Gulch, 2800 ft, 28 May 1982, *Cuddihy 1223* (BISH).

Eragrostis pilosa (L.) P. Beauv. **New island record, correction**

Based upon the collection cited below, *Eragrostis pilosa* is here reported for the first time from the island of Läna'i. Although O'Connor (1990: 1538) cited collections of the species from 3 islands (Moloka'i, Maui, and Hawai'i) in his distributional records for this species, these records are based upon misidentifications: the Moloka'i specimen annotated as *E. pilosa* actually is *E. monticola*, the Maui specimen is *E. pectinacea*, and the Hawaiian specimen (*Forbes 11.H*) is *E. leptophylla*. In an earlier publication, Lorence *et al* (1995: 45) reported the species from Kaua'i, thus it presently is known from 2 Hawaiian islands, Kaua'i and Läna'i. *Eragrostis pilosa* was first collected on the island of Läna'i in 1929 *(Munro 466*, BISH).

Material examined. **LÄNA'I**: Ka'a, a grass introduced some years ago, 1500 ft, 21 Nov 1929, *Munro 466* (BISH).

Eragrostis superba Peyr. **New state record**

The following record of *Eragrostis superba* represents the first state record of this species in the Hawaiian Islands. It is naturalized at least at this one locality. It is native to eastern and southern Africa.

Material examined. **HAWAI'I**: Parker Ranch, in pasture near water tanks south of highway, 16 Mar 1985, *Funk & Hall 252* (BISH).

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

The following collection citations represent a new state record for *Eragrostis tenuifolia*; it has been documented from 2 islands, O'ahu and Hawai'i. It is distributed throughout the tropics.

Material examined. **O'AHU**: Honolulu, University of Hawai'i at Mänoa, occasional in lawn, 2 Feb 1988, *Nagata 3796* (BISH); **HAWAI'I**: South Kohala District, Waimea, along road above Lindsey Subdivision to the Waimea Reservoir, 2800 ft, uncommon, 12 February 1997, *Herbst 9814* (BISH).

Hordeum

KEY TO THE SPECIES OF *HORDEUM* IN HAWAI'I

1. Rhachis tough, the spikelets persistent ..... **H. vulgare**
1. Rhachis fragile, disarticulating with the spikelets at maturity (2).
2(1). Lemma awn 18–50 mm long; weedy annual ..... **H. murinum**
2. Lemma awn 5–7 mm long; tufted perennial ..... **H. brachyantherum**

Hordeum brachyantherum Nevski **New state record**

The following collection documents a new state record; its present status in Hawai'i

is unknown. *Hordeum brachyantherum* is native to East Siberia and North America.

Material examined. **HAWAI'I**: South Kohala District, Waiki'i, rare in open pasture, 4000 ft, 18 Sep 1936, *Hosaka 1623* (BISH).

Hordeum leporinum Link **Taxonomic change**

Hordeum leporinum Link (O'Connor, 1990: 1552) is now treated as a subsp. of *H. murinum*: *Hordeum murinum* Huds. subsp. *leporinum* (Link) Arcang, following the taxonomic concepts of Humphries (1980: 205).

Hyparrhenia

Although the 3 species of *Hyparrhenia* naturalized in Hawai'i previously have been reported in the literature (O'Connor, 1990: 1554; Herbst & Wagner, 1996: 11), there is no key to assist in their identification. The following key is included to rectify this deficiency.

KEY TO THE SPECIES OF *HYPARRHENIA* IN HAWAI'I

1.	Spikelets with red hairs	**H. rufa**
1.	Spikelets with white hairs or glabrous (2).	
2(1).	Base of individual racemes in the pair filiform, unequal, glabrous or softly hairy	**H. hirta**
2.	Base of individual racemes in the pair flattened, subequal, stiffly setose	**H. dregeana**

Ischaemum

KEY TO THE SPECIES OF *ISCHAEMUM* IN HAWAI'I

1.	Lower glume of sessile spikelet distinctly winged above	**I. indicum**
2.	Lower glume of sessile spikelet not, or obscurely, winged (2).	
2(1).	Back of rhachis with a basal circular pore between internode and pedicel	**I. timorense**
2.	Back of rhachis without a distinct circular pore	**I. byrone**

Ischaemum indicum (Houtt.) Merr. **New state record**

The following collection documents a new state record. *Ischaemum indicum* is native to Africa and Tropical Asia.

Material examined. **MAUI**: Pi'ina'au Valley Road, disturbed roadside by forest reserve gate, 11 Jan 1995, *Hobdy 3726* (BISH).

Koeleria

Koeleria macrantha (Ledeb.) Schult. **Taxonomic change**

This species was incorrectly cited by O'Connor (1990: 1557) as *Koehleria nitida* Nutt., a synonym. *Koeleria macrantha* is native to Europe and temperate Asia, but has been widely introduced to other areas.

Leptochloa

Leptochloa uninervia (C. Presl) Hitchc. & Chase **Correction**

Leptochloa uninervia is presently known in Hawaiian from the islands from Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i; it was incorrectly reported from Kaho'olawe (Warren & Herbst, 1994), a record based upon misidentified specimens of *Eragrostis curvula*.

Leymus

Leymus triticoides (Buckley) Pilger **New state record**

A single collection of *Leymus triticoides* made in 1936 indicates that this species was naturalized in at least 1 locality in Hawai'i at that time; its present status is unknown.

Material examined. **HAWAI'I**: North Hilo District, Mauna Kea, Humu'ula Sheep Station, occasional in open pastures, 12 Sep 1936, *Hosaka 1605* (BISH).

Lolium

Lolium multiflorum Lam. **New island record**

The following collection extends the range of *Lolium multiflorum* to include the island of Moloka'i; it is now documented from all the main islands except Ni'ihau, Läna'i, and Kaho'olawe.

Material examined. **MOLOKA'I**: Poholua, Jun 1912, *Forbes 99.Mo* (BISH).

Melinis

KEY TO THE SPECIES OF *MELINIS* IN HAWAI'I

1. Spikelets villous with silky pink, tan, or silvery hairs, without prominent veins; leaves scentless ..... **M. repens**
1. Spikelets glabrous or occasionally pubescent, with conspicuously ribbed veins; leaves smelling of linseed oil ..... **M. minutiflora**

Melinis repens (Willd.) Zizka **Taxonomic change**

In a detailed discussion of the genera, Zizka (1988: 55) stated that the African species of *Melinis* and *Rhynchelytum* intergrade to such an extent that to maintain the separation of the genera is untenable. *Tricholaena* is accepted as a valid genus, but is not in Hawai'i. *Rynchelytrum repens* (Willd.) Hubbard, *R. roseum* Stapf & Hubbard ex Bews, *Tricholaena repens* (Willd.) Hitchc., and *T. rosea* Nees are names occurring in the Hawaiian literature for this taxon.

Muhlenbergia

Muhlenbergia mexicana (L.) Trin. **New state record**

A second species of *Muhlenbergia* is here reported for the Hawaiian Islands. It is known from a single collection made on Maui in 1933, and its present status is unknown. It differs from *Muhlenbergia microsperma*, the other species of the genus naturalized in Hawai'i by its mucronate lemmas that are about as long as the glumes, and its contracted panicle inflorescence; in contrast, *Muhlenbergia microsperma* has lemmas with a flexuous awn, the glumes are about 1/3 the length of the lemmas, and its inflorescence is an open panicle. It is native to North America and northern South America.

Materials examined. **MAUI**: Makawao, 5 Sep 1933, *St. John s.n.* (BISH 456802).

Panicum

Panicum coloratum L. **Correction**

Although O'Connor (1990: 1567) gives the distribution of this species in Hawai'i as the islands of Maui and Moloka'i, there is but 1 authentic specimen of *Panicum coloratum* in the herbarium at the Bishop Museum, a collection by Hosaka (*Hosaka 2448*, cited by O'Connor) cultivated in an experimental grass plot on Maui. A second specimen (*Takeuchi & Imada 2970*) from Moloka'i, originally identified as *P. coloratum*, appears to be an unknown species of *Panicum*. Apparently *P. coloratum* is not naturalized in Hawai'i.

Material examined. **MAUI**: Makawao, Haleakalä Branch Substation, Hawaii Agricultural Experimental Station, 4 Sep 1939, *Hosaka 2448* (BISH); **MOLOKA'I**: Mo'omomi, common bunchgrass in proposed sand-mining tract (parcel 8), 30 Oct 1986, *Takeuchi & Imada 2970* (BISH).

Panicum fauriei var. ***carteri*** **New island record**
(Hosaka) Davidse

Formerly reported from O‘ahu, Moloka‘i, and Maui, *Panicum fauriei* var. *carteri* has now been documented from Läna‘i.

Material examined. **LÄNA‘I**: Kukui Point, near sea level, 7 Mar 1993, *Hobdy et al. 3581* (BISH).

Panicum fauriei Hitchc. var. ***fauriei*** **New island record**

Based upon the following specimens, the nominate variety of *Panicum fauriei* also has now been documented from the island of Läna‘i. This variety has been documented from all the main islands except Ni‘ihau and Kaua‘i.

Material examined. **LÄNA‘I**: between Manele and Hulupo‘e Bays, uncommon in sand in *Prosopis* thickets, 1 Sep 1985, *Nagata 3359* (BISH); Manele Bay, common in acrid scrub behind Manele Bay, 100 ft, 7 Sep 1985, *Nagata 3372, 3373* (BISH).

Panicum koolauense H. St. John & Hosaka **New island record**

The following collection represents a new island record, the first record of this species outside the summit of the central Ko‘olau Mountain range on O‘ahu. The species was treated in O’Connor (1990: 1526) as *Dichanthelium koolauense* (St. John & Hosaka) C.A. Clark & Gould following the taxonomy of Clark & Gould (1978). Most botanists now accept *Dichanthelium* as a subgenus of *Panicum*.

Material examined. **MAUI**: West Maui, Keahikauö Bog, ‘Eke Trail, 3000 ft, 22 Oct 1980, *Hobdy 933* (BISH); West Maui, ‘Eke Crater, 4450 ft, 9 Nov 1982, *Medeiros et al. 321,* (BISH).

Panicum longivaginatum St. John **Taxonomic change**

In 1987, shortly before the *Manual of the flowering plants of Hawai‘i* was sent to press, St. John (1987) published 32 new species and varieties of *Panicum*. One of St. John’s new taxa, *P. lineale*, was accepted in the *Manual*; we here accept a second taxa, *P. longivaginatum*, as being sufficiently distinct to warrant recognition at the specific level. *Panicum longivaginatum* is perennial, 62–71 cm tall, the entire plant nearly glabrous; leaf sheath 5–11 cm long, pilose ciliate, blade 10–13 mm wide; panicle 11–13 cm long; spike 2.8–3.1 mm long, fusiform-elliptic; lower glume 0.3–0.6 mm long, fan–shaped. The characteristic features that set this species apart from other members of the genus in Hawai‘i are its stiff lanceolate leaves and short clasping lower glume.

Material examined. **HAWAI‘I**: South Hilo District, Upper Waiakea Forest Reserve, Power Line Road, pole 27, ca 2 mi south of the junction with the Saddle Road, 5300 ft, 21 Jul 1981, *Gustafson 2400* (BISH - type).

Panicum pellitum Trin. **New island record**

Although Hooker & Arnott (1832: 100) merely state “Sandwich Islands” for the type locality of *Panicum affine* Hook. & Arnott, the label on the holotype clearly indicates that the type locality is the island of O‘ahu. As *P. affine* is considered a synonym of *P. pellitum* (O’Connor, 1990: 1571), this specimen extends the distributional range of *P. pellitum* to O‘ahu; it also is recorded from the islands of Ni‘ihau, Läna‘i, Maui, and Hawai‘i (O’Connor, 1990: 1571).

Material examined. **O‘AHU**: a photograph of the holotype (K) in BISH.

Panicum tenuifolium Hook. & Arn. **New island record**

Based upon the following collection, *Panicum tenuifolium* has now been documented from all the main islands except Ni'ihau and Kaho'olawe.

Material examined. **KAUA'I**: Waimea Canyon State Park at the beginning of Kukui Trail, 1 Aug 1969, *Henrickson 4060* (BISH).

Paspalidium

Paspalidium distans (Trin.) Hughes **New state record**

St. John (1973: 35) lists 2 species of *Paspalidium* in Hawai'i: *P. jubiflorum* (Trin.) Hughes and *P. radiatum* Vickery; neither are mentioned in O'Connor's treatment. *Paspalidium radiatum* is now considered a synonym of *P. distans* (Simon, 1990: 80). The St John reference to *P. jubiflorum* probably comes from Rotar's compilation of Hawaiian grasses (Rotar, 1968: 285), and apparently is without documentation, but 2 specimens of *P. distans* are extant in the Bishop Museum and this species should be considered as part of the Hawaiian flora. The 2 collections documenting its presence follow:

Material examined. **NI'IHAU**: Short grass that appeared on its own on Ni'ihau, 1 Nov 1939, *Munro s.n*. (BISH 640212); Kiekie, cultivated pasture grass, 50 ft, 2 Apr 1949, *St. John 23661* (BISH).

Paspalum

KEY TO THE SPECIES OF *PASPALUM* IN HAWAI'I

1. Upper glume fringed with a ragged papery wing ..... **P. fimbriatum**
1. Upper glume wingless (2).
2(1). Spikelets with a ciliate fringe from margin of upper glume (3).
2. Spikelets glabrous to pubescent but without a ciliate fringe (5).
3(2). Racemes paired; plant stoloniferous; spikelets yellow ..... **P. conjugatum**
3. Racemes 3–20; plant tufted (4).
4(3). Racemes mostly 3–7; spikelets 2.8–4 mm long ..... **P. dilatatum**
4. Racemes 10–20; spikelets 2–2.8 mm long ..... **P. urvillei**
5(2). Upper floret brown ..... **P. scrobiculatum**
5. Upper floret pallid or yellow (6).
6(5). Spikelets borne singly; racemes paired (rarely 3–5) (7).
6. Spikelets paired (8).
7(6). Upper glume papery, glabrous; spikelets ovate-elliptic, flattened ..... **P. vaginatum**
7. Upper glume thinly coriaceous, obscurely puberulous; spikelets ovate, plump ..... **P. distichum**
8(6). Spikelets suborbicular, 1.3–1.4 mm long; racemes numerous (10-)15–60.. **P. paniculatum**
8. Spikelets elliptic, 2–2.7 mm long; racemes few 5–10(-15) ..... **P. macrophyllum**

Paspalum macrophyllum H.B.K. **New state record**

The following collection documents a new state record for *Paspalum macrophyllum*. The species is native to South America.

Material examined. **HAWAI'I**: South Kona, lands of Kapua, makai of main highway below macadamia nut orchard, 351 meters, 12 Mar 1994, *Imada, Char, & Motley 94-9* (BISH).

Pennisetum

KEY TO THE SPECIES OF *PENNISETUM* IN HAWAI'I

1. Inflorescence reduced to a cluster of 2–4 subsessile spikelets enclosed in uppermost leaf-sheath, with long protruding filaments and stigmas ..... **P. clandestinum**
1. Inflorescence a spiciform panicle, conspicuously exserted (2).
2(1). Rhachis of panicle with decurrent wings below scars of fallen involucres; upper lemma

coriaceous, shiny, readily deciduous ..... **P. polystachion**
2. Rhachis cylindrical or with angular ribs, but these not expanded into winged brackets below the scars; upper lemma firmly membranous, dull, resembling the lower (3).
3(2). Panicle oblong; spikelets 9–14 mm long; involucral bristles 40–70 mm long, plumose .... **P. villosum**
3. Panicle linear; spikelets 4–8 mm long; involucral bristles 6–40 mm long (4).
4(3). Involucres borne on a linear stipe 1–3 mm long ..... **P. setaceum**
4. Involucres without a stipe, at most with a conical or oblong foot 0.5(–1) mm long (5).
5(4). Peduncle pubescent to hirsute below panicle, involucres containing 1–5 spikelets .... **P. purpureum**
5. Peduncle glabrous below panicle; involucres containing 1 spikelet (6).
6(5). Involucres with 1 bristle noticeably longer than the rest; culms 75–200 cm high; leaf-blades 1–5 mm wide ..... **P. complanatum**
6. Involucres with the inner bristles subequal ..... **P. macrostachyum**

Pennisetum complanatum (Nees) Hemsl. **New state record**

The following collections of *Pennisetum complanatum* document the presence of this species in Hawai'i. It is known to be naturalized on the islands of O'ahu, Läna'i, and Hawai'i, and is native to Central America.

Material examined. **O'AHU**: Kailua, Ka'imi Farm, in semi-moist place in bull paddock, 13 Nov 1938, *Cooke s.n*. (BISH 120173); **LÄNA'I**: Kaiholenali'ili'i, 2000 ft, 13 Apr 1929, *Munro 404* (BISH); Ka'a, Kanepu'u, local patch in grassy pasture, 1700 ft, 13 Apr 1939, *Hosaka & St. John 1959* (BISH); **HAWAI'I**: Pu'u Kapu, Parker Ranch, planted pasture, spreading by seed, 2700 ft, 2 Jun 1932, *Ewart 203* (BISH); In old abandoned garden near Parker Ranch Headquarters, 4 Apr 1936, *Whitney H29* (BISH).

Pennisetum villosum R. Br. **New state record**

The following record of *Pennisetum villosum* represents the first state record of this species in the Hawaiian Islands. It apparently was naturalized at least at this 1 locality, but its present status is unknown. The plant is native to northeastern Africa and Arabia, and has been introduced elsewhere as an ornamental.

Material examined. **HAWAI'I**: North Kona, Hu'ehu'e, growing nicely by Mr. Stillman's house, eaten by horses, Jun 1938, *Vredenberg s.n*. (BISH 120181).

Phalaris

KEY TO THE SPECIES OF *PHALARIS* IN HAWAI'I

1. Spikelets in clusters of 6–7, only the central 1 fertile, the cluster falling as a whole .... **P. paradoxa**
1. Spikelets single, all fertile, their glumes persisting after the spikelets have fallen (2).
2(1). Sterile lemmas 2, equal, broad, chaffy, 1/2–2/3 length of fertile; annual ..... **P. canariensis**
2. Sterile lemmas 1, sometimes 2 but then markedly unequal, subulate or scale-like, less than 1/2 length of fertile (3).
3(2). Glume wings toothed or erose: sterile lemma 1, often reduced to a tiny scale; annual..... ..... **P. minor**
3. Glume wings entire; sterile lemmas 1 or 2, well developed; perennial ..... **P. aquatica**

Phalaris aquatica L. **New state record**

Apparently this species has been naturalized in Hawai'i since 1932, at least, but has consistently been misidentified; the following collections document its presence on 2 Hawaiian islands: Maui and Hawai'i. *Phalaris aquatica* is native to the Mediterranean area, but has been widely introduced to other parts of the world.

Material examined. **MAUI**: Kula, along side of Haleakalä Crater Road near homes, growing in

patches and overtopping orchard grass, 20 Jul 1982, *Hobdy 1654* (BISH); Makawao, Haleakalä Branch Station of the Hawaii Agricultural Experimental Station, cultivated, 30 May 1932, *Hosaka 2449* (BISH); **HAWAI'I**: Pu'u Kapu, Parker Ranch, 2,700 ft, 30 May 1932, *Ewart 253* (BISH).

Phalaris tuberosa var. ***stenoptera*** **Correction**
(Hack.) Hitchc.

Two of the specimens cited for the previous species (*Hosaka 2449* and *Ewart 253*) were originally incorrectly identified as *Phalaris tuberosa* var. *stenoptera*; these undoubtedly were the collections referenced by O'Connor in his treatment of Hawaiian grasses (O'Connor, 1990: 1483). There is no evidence that this taxon is in Hawai'i.

Phragmites

Phragmites australis (Cav.) Steud. **Correction**

The specimens listed as *Phragmites karka* (Retz.) Trin. in O'Connor (1990: 1483) are incorrectly identified specimens of *Phragmites australis*, a cosmopolitan species of temperate and subtropical regions.

Polypogon

KEY TO THE SPECIES OF *POLYPOGON* IN HAWAI'I

1. Glumes awnless; pedicel wholly deciduous ..... **P. viridis**
1. Glumes awned (2).
2(1). Plants perennial; glume awns 1.5–3 mm long; pedicel wholly deciduous . **P. interruptus**
2. Plants annual (3).
3(2).Glume awns 4–7 mm long, at least twice length of glume; pedicel disarticulating towards the tip, leaving a persistent stump..... **P. monspeliensis**
3.Glume awns 0.6–3 mm long, half to 1.5 · length of glume; pedicel wholly deciduous ..... **P. fugax**

Polypogon fugax Nees **New state record, correction**

The following collection was identified and cited by Hitchcock (1922: 156) in his treatment of the Hawaiian grasses as *P. lutosa* Poir. (now considered a synonym of *P. interruptus*), an incorrect determination. This specimen is the only documented record of *P. fugax* in Hawai'i, and its present status is unknown.

Material examined. **O'AHU**: Nu'uanu Pali, along face of moist cliff, 17 Jun 1916, *Hitchcock 13789* (BISH, K).

Polypogon viridis (Gouan) Breistr. **Taxonomic change**

Following the taxonomy of Tutin as prescribed in the *Flora Europaea* (Tutin, 1980: 236), *Agrostis semiverticillata* (Forssk.) C. Chr. (O'Connor, 1990: 1494) is now considered a synonym of *Polypogon viridis* (Gouan) Breistr., a species native from S Europe to NW India. *Agrostis* species, such as *Agrostis semiverticillata*, with spikelets falling entire are now included in *Polypogon*.

Rytidosperma

KEY TO THE SPECIES OF *RYTIDOSPERMA* IN HAWAI'I

1. Lemma 3-awned, the laterals 6–8 mm long; lemma with 2 marginal and sometimes 2 dorsal tufts, otherwise glabrous and shiny ..... **R. pilosum**
1. Lemma 1-awned, the lobes with or without a mucro up to 1 mm long ... **R. semiannulare**

Rytidosperma pilosum (R. Br.) Connor & Edgar **Taxonomic change**

During his study of the grass subfamily Arundinoideae in New Zealand, Zotov (1963) recognized that the Australian, Tasmanian, and New Zealand taxa formerly referred to the genus *Danthonia* formed a sufficiently distinct entity to warrant being maintained as a separate genus. He named the genus *Notodanthonia* and transferred into it the 2 species of *Danthonia* naturalized in Hawai'i, among others. Connor & Edgar (1979) transferred the species to *Rytidosperma,* an earlier name. The plant treated as *Danthonia pilosa* R. Br. by O'Connor (1990: 1522) should be considered a species of *Rytidosperma*.

In a recent paper, Linder (1997) proposed a new genus and transferred this species into it forming the new combination *Austrodanthonia pilosa* (R. Br.) H.P. Linder. It is unknown if this new taxonomic concept will be adopted by others working with the Danthonieae.

Rytidosperma semiannulare **Taxonomic change**
(Labill.) Connor & Edgar

The plant treated as *Danthonia semiannulare* R. Br. by O'Connor (1990: 1522) was transferred to the genus *Rytidosperma* following the classification of Connor & Edgar (1979).

Schizachyrum

Schizachyrium scoparium (Michx.) Nash **New island record**

Schizachyrium scoparium has been reported from Kaua'i (Lorence *et al*., 1995). The following collections document its presence as a naturalized species on O'ahu. The earliest records of the species in Hawai'i are from experimental grass plots on O'ahu and Maui (*Hosaka 2620, 2459*).

Material examined. **O'AHU**: Honolulu, Pensacola Street Hawaiian Agricultural Experimental Station, cultivated in a grass plot, 25 Nov 1941, *Hosaka 2620* (BISH); Ko'olauloa, Pupukea-Paumalu, Ko'olau Mountains, 600 ft, 5 Dec 1987, *Nagata & Takeuchi 3743* (BISH); Ko'olauloa, Pupukea-Paumalu, Ko'olau Mountains, 500 ft, 6 Dec 1987, *Nagata & Takeuchi 3750* (BISH); **MAUI**: Makawao, Haleakalä Substation, Hawaiian Agricultural Experimental Station, 2100 ft, cultivated in a grass plot, 9 Apr 1939, *Hosaka 2459* (BISH).

Setaria

Setaria parviflora (Poir.) Kerguelen **Taxonomic change**

In the classification of M. Kerguelen (1975), this is the correct name for the species referred to *S. gracilis* Kunth by O'Connor (1990: 1592).

Sorghum

KEY TO THE SPECIES OF *SORGHUM* IN HAWAI'I

1. Racemes fragile, rhizomes present ..... **S. halepense**
1. Racemes tough or tardily disarticulating, rhizomes absent (2).
2(1).Grain large, commonly exposed by the gaping glumes; sessile spikelet persistent

.....
..... **S. bicolor**
2.Grain enclosed by the glumes; sessile spikelet persistent or tardily deciduous.....

..... **S. · drummondii**

Sorghum · drummondii **New state record**
(Steud.) Millsp. & Chase

Sorghum · drummondii is the earliest hybrid name for *S. arundinaceum · S. bicolor* crosses. A segregate from this complex is widely grown as a fodder crop under the name *S. sudanense* (Piper) Stapf. It was first collected as a cultivated plant probably on O'ahu in 1913 (*Forbes s.n.*, BISH 120422).

Representative specimens examined. **O'AHU**: University of Hawai'i Mänoa, quarry area, 50 ft, 19 Mar 1966, *Herbst 25* (BISH); Ko'olau Poko, Waikane Valley, growing in ditch along Kamehameha Highway, 10 ft, 23 Jan 1988, *Nagata 3794* (BISH); Pali Highway, along roadside at runaway truck ramp, 12 Oct 1985, *O'Connor s.n.* (BISH 502873). **LÄNA'I**: Kanepu'u, 12 Nov 1929, *Munro 475* (BISH). **HAWAI'I**: Kohala, cultivated, 100 m, Sep 1924, *Barnum 48* (BISH).

Sporobolus

KEY TO THE SPECIES OF *SPOROBOLUS* IN HAWAI'I

1. Panicle branches, at least the lower, in whorls; upper glume as long as spikelet (2).
1. Panicle branches not whorled (3).
2(1). Panicle open and pyramidal at maturity; spikelets 1.6–1.8 mm ..... **S. pyramidatus**
2. Panicle spiciform, linear; spikelets 1.8–2.5 mm ..... **S. piliferus**
3(1).Leaf-blades convolute, coriaceous, stiff; panicle spiciform, sometimes untidily so; spikelets 1.5–2.5 mm long ..... **S. virginicus**
3. Leaf-blades herbaceous, flat when fresh (6).
4(3). Stamens 2 (5).
4. Stamens 3 (6).
5(4). Panicle open; spikelets 1.2–1.6 mm long ..... **S. diander**
5.Panicle branches 0.5–2 cm long, distant, appressed to the axis, densely crowded with dark green spikelets 1.5–2 mm long ..... **S. elongatus**
6(4).Panicle narrowly pyramidal; branches slender, flexuous, 5–15 cm long, spreading horizontally at anthesis; upper glume obtuse, 1/4–1/2 as long as spikelet ... **S. pyramidalis**
6.Panicle linear, contracted to spiciform; branches stiff, mostly 1–2 cm long, ascending or appressed to the axis (7).
7(6).Lemma and palea scarcely longer than top of grain at maturity, not gaping; spikelets 1.5–2 mm long; upper glume acute ..... **S. indicus**
7.Lemma and palea exceeding the grain by up to its own length, gaping open; spikelets 2.1–2.5 mm long ..... **S. africanus**

Sporobolus africanus (Poir.) Robyns & Tournay **New island record**, **correction**

All Bishop Museum specimens originally identified as *Sporobolus indicus* R. Br. collected on the island of Maui were misidentified; they are specimens of *Sporobolus africanus*. Also, the specimen of *S. indicus* (*Warren KAH-90-6*, BISH) cited by Warren

(1993) as a new island record for the island of Kaho‘olawe actually is this species. *Sporobolus indicus* has not been documented from Maui or Kaho‘olawe, but the following collection represents a new island record for *Sporobolus africanus*

Material examined. **KAHO‘OLAWE**: NE rim of Lua Makika Crater, 448 m, 19 Sep 1990, *Warren KAH-90-6* (BISH).

Sporobolus elongatus R. Br. **New state record**

The following collection documents the presence of *Sporobolus elongatus* as a naturalized species on the island of Läna‘i. Its present status is unknown. *Sporobolus elongatus* is native to Australia.

Material examined. **LÄNA‘I**: Kamoku, 1500 ft, introduced grass growing in several places on the uplands, 1 Aug 1925, *Munro 706* (BISH).

Sporobolus piliferus (Trin.) Kunth **New state record**

The following collection represents a new state record for *Sporobolus piliferus*. The species is found throughout the tropics.

Material examined. **HAWAI‘I**: Hapuna Beach State Park, on median strip in parking lot, cushiony clumping grass growing in gravelly soil, 25 Feb 1994, *Imada, Char, & Motley 94-3* (BISH).

Sporobolus pyramidalis P. Beauv. **New state record**

The following collection represents a new state record for *Sporobolus pyramidalis*, a species native to Africa and S America.

Material examined. **HAWAI‘I**: Captain Cook, Nokukano Development site makai of belt road, common on rocky substrate along the pasture roads near the wooded part of the site, *Funk s.n.* (BISH).

Trisetum

Trisetum flavescens (L.) P. Beauv. **New state record**

Trisetum flavescens was collected only once in Hawai‘i, in 1942; it is unknown if the species is still present in the state.

Material examined. **MAUI**: Makawao, Haleakala Substation of the Hawaii Agricultural Experimental Station, in pasture, 2100 ft, 17 Jul 1942, *Hosaka 2603 (BISH)*.

Trisetum inaequale Whitney **Correction**

The 6 collections cited below comprise the known collections documenting the presence of *Trisetum glomeratum* (Kunth) Trin.on the island of Läna‘i. All 6 are misidentified specimens of *Trisetum inaequale*; apparently *T. glomeratum* is not known from the island.

Material examined. **LÄNA‘I**: Waiakeakua, 18 Jul 1927, *Munro 154* (BISH); Ka‘ohai, 19 Mar 1916, *Munro 317* (BISH); Kalama, 19 Mar 1914, *Munro 317* (BISH); and 3 Munro collections without collection numbers, dates, or exact localities also in the Herbarium Pacificum (BISH 120608, 120610, 120611).

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Notes on Two Alien Taxa of *Rumex* L. (Polygonaceae) Naturalized in the Hawaiian Islands[1]

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During his stay at the National Museum of Natural History, Smithsonian Institution, Washington DC (US), in October 1995, the senior author studied specimens of alien taxa of the genus *Rumex* L. (Polygonaceae) collected in the Hawaiian Islands. As a result of these studies, 2 taxa new for the archipelago were discovered in the US collections, and among the BISH specimens sent on loan, one of which (*Rumex conglomeratus* Murray) was briefly reported in last year's *HBS Records* (Wagner *et al*., 1997). Here we report an additional subspecies of *R. crispus* naturalized in the archipelago, give descriptions of both species, and provide a revised key to all of the species of *Rumex* in the Hawaiian Islands. Abbreviations in the key follow Wagner *et al*. (1990).

Rumex conglomeratus Murray, Prodr. Stirp. Goetting: 52. 1770.

Vernacular names: clustered dock, clustered green dock.

Erect perennial herbs, normally glabrous (or occasionally lower surface of leaves indistinctly papillose along veins); stems 3–8(-12) dm long, branched in the upper 2/3 (sometimes branched with several stems from the base). Basal and lower cauline leaves oblong-lanceolate, obovate-lanceolate, or lanceolate, normally (5-)10–30 long, 2.0–6.0 cm wide; base broadly cuneate, rounded or truncate (rarely subcordate); apex subacute (occasionally obtuse); margin entire to weakly undulate. Inflorescences terminal, lax, interrupted, broadly paniculate, occupying the upper 2/3 of the stem; branches of inflorescence simple or nearly so; almost all but uppermost verticils with subtending leaves (panicle leafy at least in lower 2/3 of its length). Flowers usually perfect, ca. 10–20 in dense remote verticils. Pedicels slender, short (ca. 1–4(-5) mm long, i.e. about as long as valves, or slightly longer), articulated in the proximal 1/3 or occasionally near the middle; articulation distinctly swollen. Valves (inner tepals) at maturity oblong-lanceolate, oblong, lingulate, ca. twice as long as wide, 2–3 mm long, usually 1–1.6 mm wide; base cuneate or truncate, apex obtuse; margins entire; tubercles 3, equal or subequal in size. Nuts (achenes) dark reddish-brown, ca. 1.5–1.8 mm long, 1.0–1.4 mm broad. 2 n = 20 (Jaretzky, 1928; A. Love, 1986).

This species is native to Europe, western and southwestern Asia and northernmost Africa (Rechinger, 1958, 1964). It is also widely naturalized in many regions of the world. For example, it is comparatively widely distributed and completely naturalized in North America, mostly in the eastern part of the United States and along the Pacific Coast from southern British Columbia (Canada) to Mexico (for more details see Rechinger, 1937; Dawson, 1979). Judging from available herbarium specimens (consulted in GH, MO, NY, and US), it seems to be quite common in California, coastal regions of Oregon and Washington.

Rumex conglomeratus, together with the closely related *R. sanguineus* L., belongs to *Rumex* subgen. *Rumex* sect. *Rumex* subsect. *Conglomerati* Rech. f. (Rechinger, 1937). This subsection is very close to subsect. *Obtusifolii* Rech. f. (Rechinger, 1937). Hybrids *R. conglomeratus* · *R. obtusifolius* L. (*R.* · *dufftii* Hausskn.) and *R. conglomeratus* · *R. crispus* L. (*R.* · *sagorskii* Hausskn.) are known from Europe and could be expected in the Hawaiian Islands where the naturalized ranges overlap. *Rumex conglomeratus* is often

confused with immature specimens of *R. obtusifolius*, since young valves of the latter usually have very indistinct teeth, and their shape is similar to that of *R. conglomeratus*. Due to that occasional confusion, distribution of *R. conglomeratus* in North America is in need of additional study; some of the literature records for it may in fact refer to young specimens of the more common species, *R. obtusifolius*.

Within its native range in Eurasia *Rumex obtusifolius* is differentiated into several subspecies: the predominantly western *R. obtusifolius* subsp. *obtusifolius,* the eastern subsp. *sylvestris* (Wallr.) Rech. f., an intermediate central European subsp. *transiens* (Simonkai) Rech. f., and a montane subsp. *subalpinus* (Schur) Simonk. (for more details see Cavers & Harper, 1964; Lousley & Kent, 1981; Rechinger, 1958, 1964). As correctly noted in Wagner *et al*. (1990), only the typical subspecies is known from the archipelago so far. However, the second subspecies is occasionally known as introduced in North America, and could be found in Hawai'i in the future.

Material examined. **KAUA'I**: Koke'e State Park, Mohihi Rd. near Camp Sloggett, disturbed roadside; ca. 1100 m, 26 May 1984, *W. L. Wagner et al. 5370* (US [2]).

Rumex crispus L. subsp. ***fauriei*** (Rech. f.) Mosyakin et W. L. Wagner, **comb. et stat. nov**. *Rumex fauriei* Rech. f., in Feddes Repert. Sp. Nov. 33: 358. 1934. Type: Insula Sachalien, circa Korsakof, 28 August 1908, *Faurie 652* (holotype, G; isotypes, W, LE!).

Rumex crispus (vernacular names: curly dock, yellow dock) is notorious for its extremely wide morphological variability, high ecological plasticity, and almost cosmopolitan distribution. Originally native probably only to temperate Eurasia, now this species occurs almost everywhere in the world. Not surprisingly, numerous infraspecific taxa and segregate species were described within *R. crispus* s. l. Many of these taxa appear to represent minor or populational variation of no taxonomic significance. These variants are apparently not confined to any particular geographical area. However, there are other patterns within the overall variation within the *R. crispus* complex that are geographical and/or ecological races, and these deserve recognition at the subspecies level. For example, in the second edition of *Flora Europaea*, 3 subspecies were recognized within *R. crispus* (Stace, 1989; Rechinger, 1993). In Asian material of *R. crispus* s. l., Rechinger (1949) recognized 6 varieties; however, he did not cite any specimens of *R. crispus* from Japan, but noted that the Japanese plants with smaller, more acute valves, longer pedicels, and smaller achenes most probably belongs to *R. fauriei* Rech. f. *Rumex fauriei* was described from the southernmost part of Sakhalin Island, near Korsakov as a species closely related to *R. crispus*. As discussed below, we here treat this entity as a subspecies of *R. crispus*. According to Rechinger (1949), the diagnostic characters for distinguishing these 2 taxa are: 1) *R. crispus*: "Valvae 3.5–5(-6.5) mm longae et latae, valde variabiles, rotundato- vel oblongo-cordatae, plerumque obtusae rarius acutiusculae. Nux (2-)2.5–3(-3.5) mm longa. Pedicelli perigonio ca. duplo longiores" 2) *R. fauriei*: "Valvae 3–3.5(-4) · 2–3 mm, ovato- vel subcordato-triangulares acutae. Nux 2.5 mm longa. Pedicelli tenuissimi perigonio 2–3-plo longiores". The only specimens of *R. fauriei* cited by Rechinger in the 2 mentioned publications were the type collection and additional collection from the Kurils ("Shikotan, *Ohwi 1139*, in herb. Ups."). No particular localities of this taxon were cited for Japan or China. Apparently because of this *R. fauriei* has been generally ignored in the Japanese and Chinese floras and manuals, or, at best, cited as a synonym of *R. crispus* or *R. japonicus* Houtt. [= *R. crispus* var. *japonicus* (Houtt.) Makino; *R. crispus* subsp. *japon-*

icus (Houtt.) Kitamura]. However, *R. japonicus* is a species more closely related to *R. stenophyllus* Ledeb. than to *R. crispus*, and can be distinguished from the latter in having fruiting valves minutely but distinctly dentate in the upper half, as well as by its broader leaves with cordate or abruptly truncate base. There is no doubt that native specimens identical with *R. fauriei* are known from Japan, as well as from eastern China.

In Russian botanical literature the status of *R. fauriei* was also rather uncertain. Voroshilov (1966) accepted *R. fauriei* as a distinct species and, following Rechinger's description, distinguished it from *R. crispus* by its "valves ovate or narrowly triangular-ovate, subacute at apex; pedicels 2–3 times as long as valves" (Voroshilov, 1966: 159), when the typical *R. crispus* has "valves ovate-orbicular or broadly ovate, obtuse or subacute at apex; pedicels less than 2 times as long as valves". Subsequently (Voroshilov, 1982), he changed his opinion and reduced *R. fauriei* to synonymy of *R. crispus*. However, he noted that "plants from Sakhalin and Kuril Islands differ from the western plants [. . .] in having smaller fruiting valves 3–3.5 mm long, slightly erose at margins". The last character (erose margins of valves) is not peculiar to *R. fauriei* s. str. The species rank for *R. fauriei* in the Russian Far East was restored by Tzvelev (1987, 1989), who also reported it for the "Sino-Japanese region", evidently after consulting some East Asian specimens deposited at LE. In the key and descriptions, Tzvelev has somewhat modified diagnostic characters of *R. fauriei*, and noted its narrower leaves (as compared to those of *R. crispus* s. str.), as well as tubercle being developed usually only at 1 of the 3 fruiting valves (this character is peculiar also for *R. crispus* var. *unicallosus*).

In our opinion, the size of valves and achenes in *R. crispus* subsp. *fauriei* is not the most essential character that distinguishes it from *R. crispus* subsp. *crispus*. For example, the cultivated Hawaiian specimen (*Staples & Kadowaki 892,* BISH) and also some Japanese and eastern Chinese plants have valves ca. (3.7-)4(-4.5) mm long, more or less subacute to almost obtuse at apex. However, many native East Asian specimens of the *R. crispus* aggregate share such distinctive combinations of characters as comparatively long pedicels, lax inflorescences with remote whorls, leaves almost flat, or at least not so undulate at margins as in *R. crispus* s. str. In addition, all leaves are narrow, usually narrowly lanceolate, lanceolate-linear or even linear (especially in the inflorescence). This morphotype is strikingly different in habit from the typical European *R. crispus*, as well as from most of its ecological forms found among weedy cosmopolitan strains of the species. Individual characters of *R. crispus* s. str. and *R. fauriei* often intergrade into each other, and intermediate forms do occur in the regions where these taxa are sympatric. Because of that, we believe that species status for *R. fauriei* is hardly appropriate. At the same time, it definitely represents a morphotype (geographical race) confined to the clearly outlined geographical area in Far East, and it is therefore appropriate to treat it as a subspecies. Since it is hardly possible now to find any species of *Rumex* that is not sympatric, at least partly, with the synanthropic *R. crispus* s. str. (most probably introduced in the Far East), the intermediate forms connecting subsp. *crispus* and subsp. *fauriei* possibly developed as a result of hybridization between these taxa.

Apparently, *R. crispus* subsp. *fauriei* was introduced to Hawai'i from East Asia—either intentionally, being brought as a medicinal plant by Japanese or Chinese immigrants, or accidentally, in ship ballast, with agricultural products, seeds of cultivated plants, etc. Its present status in the Hawaiian flora is rather uncertain and needs additional study.

Material examined. **LĀNA'I**: Kaiholena, 17 Mar 1914, *G. C. Munro 284, 309* (BISH); Lalakoa,

1700 ft. 13 Jan 1930, *G. C. Munro 502* (BISH). **O'AHU**: Honolulu, Mänoa Valley, grounds of H.L. Lyon Arboretum, 3860 Mänoa Rd., cultivated in Herb Garden, said to be used medicinally by Chinese, 6 May 1993, *G. Staples & A. Kadowaki 892* (BISH).

Most of the specimens of *R. crispus* collected in the Hawaiian Islands deposited at BISH belong to the typical *R. crispus* subsp. *crispus*. However, 2 additional noteworthy specimens are discussed here.

The first specimen is represented by a small portion of fruiting inflorescence, 1 deformed basal (or lower cauline) leaf, and small young rosette with a portion of caudex. Judging from the size of fruiting valves (ca. 4.0–5.5 mm long and broad), the plant could be *R. patientia* L. However, the material is insufficient for exact identification, since specimens with comparatively large valves occasionally occur among southern forms of *R. crispus* as well.

Material examined. **LÄNA'I**: Dole Pineapple Plantation, weed in new land to be planted with pineapples in 1964, 14 Aug., *J. W. Smith, Jr. s.n.* (BISH).

The second specimen evidently belongs to *R. crispus*, but has unusually large, unequal subglobose or ovate tubercles with minutely punctate surface. The largest tubercles in most of flowers reach ca. 2.2–2.6 mm long, and are almost as broad as valves. Very large tubercles often occur in littoral (coastal) or alluvial (riparian) taxa of *Rumex*. This character may be regarded as an adaptation to hydrochory (i.e. dispersal of diaspores by water). Large tubercles, often subequal to fruiting valves, are typical for coastal docks belonging to different infrageneric taxa. For example, in the section *Axillares* Rech. f. subsect. *Salicifolii* Rech. f., very large tubercles are found in *R. pallidus* Bigel. (coastal marshes and dunes, sandy and rocky beaches from Newfoundland to Massachusetts), *R. crassus* Rech. f. (Pacific coast in California and Oregon), *R. transitorius* Rech. f. (along the Pacific coast from northern half of California to southern Alaska). Parallel forms with large tubercles are known also in the section *Rumex* subsect. *Maritimi* Rech. f.: *Rumex persicarioides* L. (coastal regions from Quebec to New York), and *R. ochotskius* Rech. f. (Far East from northern Japan to the Okhotsk Sea region, especially Sakhalin and Kuril Islands). Infraspecific taxa of *R. crispus* with large tubercles, namely subsp. *littoreus* (Hardy) Akeroyd and subsp. *uliginosus* (Le Gall) Akeroyd are known in the coastal regions of western Europe (see Lousley & Kent, 1981; Stace, 1989; Rechinger (revised by Akeroyd), 1993). The Hawaiian plant is very similar in its characters to the *R. crispus* subsp. *littoreus* and indeed may be a collection of it introduced to the archipelago.

Specimen examined. **O'AHU**: Honolulu, Liliha Street, garden of Annie Ho (plant used to cure sprains), Jun 1932, *Amy Suehiro s.n.* (BISH).

KEY TO SPECIES OF *RUMEX* IN THE HAWAIIAN ISLANDS

1. Shrubs, subshrubs, or scandent shrubs (lianas), usually woody at least near the base; stems normally with regular, leafy axillary shoots that tend to develop secondary axillary inflorescences (often overtopping primary ones) [*Rumex* subgen. *Rumex* sect. *Axillares* Rech. f.] (2).
1. Perennial herbs; stems mostly erect, solitary or several from the base, not branching below terminal paniculate inflorescence, usually without axillary shoots (4).
2(1). Leaves usually undulate, bases of lower leaves cordate (sometimes on Nihoa upper leaves with bases broadly cuneate); the 2 sides of a single arm of a mature nut subparallel, the angle very narrowly acute; margins of arms of mature nuts without a conspicuous rim; plants usually at least sparsely pubescent, sometimes glabrous; N, K, O .... *R. albescens* Hillebrand
2. Leaves flat or only slightly undulate, bases of lower leaves broadly cuneate to truncate (sometimes on Maui and Moloka'i subcordate); the 2 sides of a single arm of a mature nut

distinctly diverging, the angle ca. 45°; margins of arms of mature nuts with a conspicuous rim; plants glabrous or occasionally (Hawai'i) pubescent in the inflorescence (3).

3(2). Erect shrubs, stems 7–10 dm long; leaves thick and somewhat glossy; inflorescences green or yellowish green, relatively narrow and erect; on lava flows, H ..... *R. skottsbergii* Degener & I. Degener

3. Scandent shrubs or lianas, stems (8-)20–200 dm long; leaves not especially thick (or sometimes relatively thick in open areas and at high elevations on East Maui and Mauna Kea, Hawai'i), dull; inflorescences red or rarely green and sometimes tinged red, open and spreading, usually pendent (or often erect in high elevation populations on Maui and Mauna Kea, Hawai'i); usually in woodland or forest, Mo, M, H ..... *R. giganteus* W. T. Aiton

4(1). Plants dioecious (rarely polygamo-monoecious); flowers unisexual. Basal and lower cauline leaves normally hastate at base, with spreading acute lobes. Pedicel with evident articulation near the base of perianth segments. Inner perianth segments (valves) not enlarged at maturity, or rarely with barely visible free wing not more than 0.1–0.2 mm broader than achene; margins entire; tubercles absent. [*Rumex* subgen. *Acetosella* (Meisn.) Rech. f.] ..... *Rumex acetosella* L.

4. Plants monoecious [extremely rarely dioecious specimens occur in some species]; flowers normally bisexual, or sometimes bisexual and unisexual within the same inflorescence. Leaves usually not hastate or sagittate. Pedicel normally articulated near the middle, or in the basal half. Valves clearly enlarged at maturity, evidently broader and longer than achene; margins entire or variously dentate; tubercles present or absent (5).

5(4). Valves triangular, with 3–5 distinctly hooked teeth on each side; apex also hooked; tubercles absent, or mid-vein indistinctly swollen. *Rumex* subgen. *Rumex* sect. *Rumex* subsect. *Acrancistron* Rech. f. ..... *Rumex brownii* Campd.

5. Valves variable, margins entire, indistinctly erose, or dentate, but never with hooked teeth and apex; tubercles usually present (6).

6(5). Valves dentate at margins; teeth triangular-subulate, normally at least 0.3 mm long, or longer, often evident even in flowers. *Rumex* subgen. *Rumex* sect. *Rumex* subsect. *Obtusifolii* Rech. f. ..... *Rumex obtusifolius* L.

6. Valves entire at margins, or rarely minutely and indistinctly erose (7).

7(6). Valves oblong-lanceolate, oblong, lingulate (tongue-shaped), ca. twice as long as wide, entire at margin. [*Rumex* subgen. *Rumex* sect. *Rumex* subsect. *Conglomerati* Rech. f.] ..... *Rumex conglomeratus* Murray

7. Valves suborbicular, ovate, or ovate-triangular, ca. as long as wide (or at least always distinctly less than twice as long as wide), entire or indistinctly erose at margin. [*Rumex* subgen. *Rumex* sect. *Rumex* subsect. *Crispi* Rech. f.] ..... *Rumex crispus* L.

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The Dolichopodidae (Diptera) of Midway Atoll, with a New Species of *Dactylomyia* Aldrich, and Taxonomic Notes on the Subfamily Neurigoninae[1]

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The Leeward Chain of the Hawaiian Islands is comprised of a series of coralline atolls and rocky pinnacles stretching northwest from the high volcanic islands of Hawai'i. The Midway Group lies near its extreme end, some 1,500 nautical miles from Honolulu and quite isolated from any continental landmass.

Midway has been collected only sporadically for insects, but recent (1997) intensive sampling by Gordon M. Nishida of the Bishop Museum's Hawaii Biological Survey, as well as staff and volunteers of the U.S. Fish & Wildlife Service, Midway Atoll National Wildlife Refuge provided abundant material for this review of its dolichopodid fauna. For methods and abbreviations as well as keys, descriptions, and nomenclature to most Midway species, consult *Insects of Micronesia* (Bickel, 1995).

I. The Dolichopodidae of the Midway Group

Subfamily SCIAPODINAE

Chrysosoma globiferum (Wiedemann)

Material examined: **KURE**.: 14.IX.1964. **LAYSAN**.: (54,42): 27.IV–7.V.1959; 20–28.VII. 1959; 16–21.VI.1962. **MIDWAY**: *Sand I*. (more than 150 specimens): I–III.1957; 2. VI.1957; 11–13.V.1970; 11–13.V.1973; Roosevelt & Halsey, 17.II.1997, swept ex. flowering *Pluchea*; 1–17. V.1997, Malaise trap; 17–18.II.1997, yellow pans; Central, 28°12.760'N, 177°22.968'W, Malaise trap, 23.V–6.VI, 6–14.VI, 27–30.VI, 6–14.VII, 4–7.VIII, 11–18.VIII, 1997. *Eastern I*.: IV.1923; 13–16.V. 1997, yellow pans; IV.1923.

Remarks. *Chrysosoma globiferum* is known from China (Oriental and Palaearctic), Taiwan, the Ryukyus, and the Hawaiian Islands (including Midway, Laysan, and Kure Islands). The species is undoubtedly an accidental introduction to the main islands of Hawai'i, from which it was probably secondarily introduced to the Leeward Islands.

While examining these specimens, I noticed an additional diagnostic character on male *C. globiferum:* basitarsus III with a posterior group of 8–9 short curved and somewhat capitate short setae along the basal fifth, adjacent to join with tibia III (male secondary sexual character, MSSC).

Krakatauia micronesiana Bickel

Material examined. **MIDWAY**: *Sand I*. (hundreds of specimens): II.1953, VIII.1956; V.1957; 13–17.XII.1970; 11–13.V.1970; 11–13.V.1973; Roosevelt & Halsey, 17.II.1997, sweeping & 1–17.V.1997, Malaise trap; Dump Lake, at pond edge, 12.V.1997; Central, 28°12.760'N, 177° 22.968'W, Malaise trap, 23.V–6.VI, 6–14.VI, 27–30.VI, 6–14.VII, 4–7.VIII, 11–18.VIII, 1997. **KURE**. (4, 22): IX.1961; 14.IX.1964.

Remarks. *Krakatauia micronesiana* is confined to Micronesia, and is known from Guam, Palau, Northern Marianas, and Wake Atoll. Considering its distribution and adaptation to atoll habitats, this species could have reached Midway by natural dispersal.

Subfamily MEDETERINAE

Medetera grisescens de Meijere

Material examined: **Midway**: *Sand I.*: 44,82, 4–23.IV.1953, 26.I.1964: 4,22, 13–18.II.1997, Malaise trap; 54, 32, Roosevelt Airfield, Bunker site, 13–18.II.1997, Malaise trap; Roosevelt & Halsey, 1–17.V.1997, Malaise; 4,22, 18.II.1997, at light; 84,72, Central, 28°12.760'N, 177° 22.968'W, Malaise trap, 23.V–6.VI, 6–14.VII, 4–7.VIII, 11–18.VIII, 1997. *Spit I.*, no date.

Remarks. *Medetera grisescens* occurs widely across the Oriental and Australasian regions. It is known from the Pacific island groups of New Caledonia, Fiji, Samoa, Hawai'i (all high islands), Ryukyus, Bonin, and Saipan. The Midway population was probably established from the main Hawaiian islands rather than by dispersal across the northern Pacific.

Subfamily SYMPYCNINAE

Syntormon flexibile Becker

Material examined: **Midway**: *Sand I.*: 64,42, 17.II.1997, swept ex. *Sesuvium* & *Tournefortia*.

Remarks. *Syntormon flexibile* is a Pacific Basin littoral species, and is widely known from northwestern North America, coastal China, the Russian Far East, Bonin Is, Hawaiian Is, Tonga, New Caledonia, and Australia. In addition, it occurs on St. Helena I in the South Atlantic. Specific searches for this species will probably reveal an even wider distribution.

Subfamily DIAPHORINAE

Chrysotus sp.

Material examined: **MIDWAY**: *Sand I.*: 4, 17.II.1997, swept ex. *Sesuvium* & *Tournefortia*.

Remarks. This specimen is a headless male which represents an species unknown from the major high Hawaiian Islands. However, the genus *Chrysotus* is rich in the Pacific Basin, with many undescribed species from various archipelagoes. I have examined collections from Polynesia and Micronesia, and this damaged Midway male is closest to an undescribed species from Tonga (BPBM), whose males also have black halteres and dark brown femora.

Subfamily NEURIGONINAE

Dactylomyia vockerothi Bickel, **n. sp.** Figs. 1–2b

Type material: **MIDWAY**: *Sand I.*: Holotype 4 (BPBM 15,968), Paratypes, 24,82, Roosevelt & Halsey, 1–17.V.1997, Malaise trap, G. Nishida; Paratypes, 54,252, Central, 28°12.760'N, 177°22.968'W, Malaise trap, 23.V–6.VI, L. Patrick, 6–14.VII, N. Seto, 11–18.VIII, 1997, A. Gall (BPBM).

Description. **Male**: length: 3.3; wing: 2.8 · 1.3

Head: head wider than high; pair of short black vertical setae, pair of long black diverging ocellar setae, and short pale postvertical setae present; frons metallic green bronze with dusting of silvery pruinosity; face and clypeus with dense silvery pruinosity, and distinctly separating eyes; palp large, yellow with some short brown setae along outer margin; proboscis brown; scape and pedicel yellow; first flagellomere basally yellow and distally dark brown, short and rounded; pedicel truncate with first flagellomere; arista dorsal, bare and about as long as head height; postocular row entirely white; ventral postcranium with some strong pale setae.

Thorax: posterior slope of mesonotum distinctly flattened, even slightly concave; dorsum mostly metallic green with general dusting of silvery pruinosity, but ac band, mesonotal depression, and area laterad of median dc rows metallic bronze; pleura mostly metallic green with grey pruinosity,

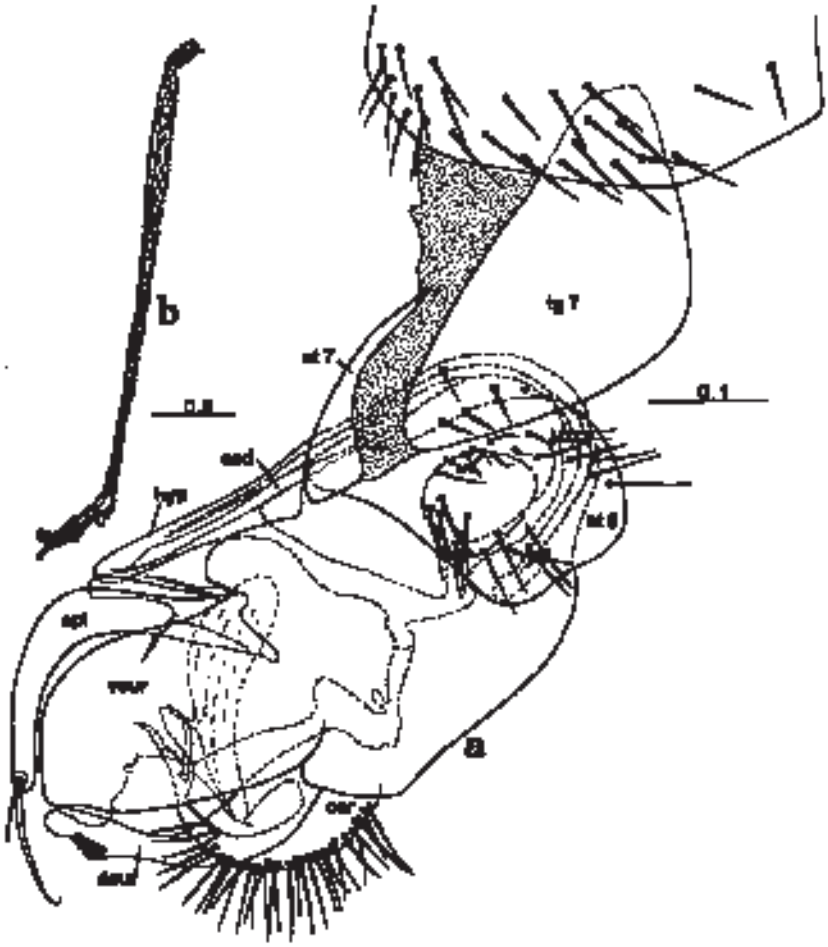

Fig. 1. *Dactylomyia vockerothi* n. sp.: (a) male postabdomen, left lateral. (b) male tibia and tarsus I, posterodorsal. Abbreviations: aed = aedeagus; cer = cercus; epl = epandrial lobe; dsur = dorsal surstylar lobe; hyp = hypandrium; tg = tergum; st = sternum; vsur = ventral surstylar lobe.

except metepimeron yellow; ac with 2 rows of 12–14 short whitish setulae ending at mesonotal depression; dc comprising 2 strong black setae bordering mesonotal depression, with shorter black seta anteriad, and with dc area expanding anterolaterally to cover most of anterior mesonotum with 5–6 irregular rows of whitish setulae, so that area from dc row laterally to margin of mesonotum comprises field of whitish setulae, which subsumes the normal position of sr setae; additional strong black setae include: 1 pa, 2 sa, 2 npl, 1 hm, and 1 pm; median scutellars strong and black, laterals as tiny pale hairs; lower proepisternum with 2 pale setae.

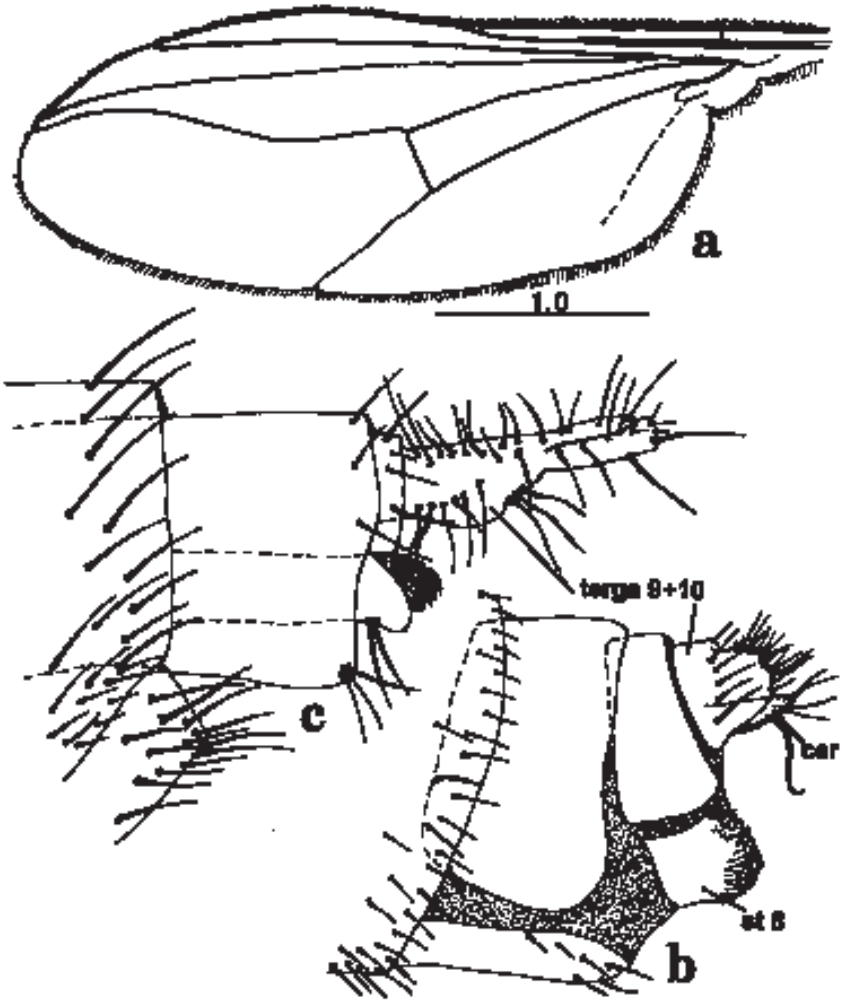

Fig. 2. *Dactylomyia vockerothi* n. sp.: (a) male wing, dorsal. (b) female oviscapt, left lateral. *Neurigona pallida* (Fallén): (c) female oviscapt, left lateral. *Neurigona pallida* Fallén: (c) female oviscapt, left lateral. abbreviations: cer = cercus; st 8 = sternum 8.

Legs: CI and CIII yellow; CII infuscated basally, becoming yellowish distad; remainder of legs yellow, except as noted; CI and CII with pale yellow anterior setae, CIII with pale lateral seta; all femora and tibiae devoid of major setae; I: 5.0; 5.5; 2.7/ 2.6/ 0.7/ 1.5/ 0.5 (Fig. 1b); TI slightly flattened dorsoventrally (MSSC); It_3 shorter than It_4, white, and with fine curved pale ventral hair (all MSSC); It_4 basally white, and dark brown distally, with some pale ventral hairs (MSSC); It_5 with black subrectangular spatulate projection, from which arises single curved claw (MSSC); II: 6.0; 6.3;

2.7/ 1.6/ 0.8/ 0.3/ 0.6; TII with very short ad setae at 1/3 and 2/3; III: 6.2; 8.6; 3.7/ 3.0/ 2.0/ 1.1/ 0.6; TIII with some very short dorsal setae.

Wing: (Fig. 2a) hyaline; Sc incomplete; vein M with smooth gentle curve toward R_{4+5}, and both veins closely subparallel in distal sixth of wing, and each joining costa anteriad of apex; CuAx ratio: 0.4; vein CuA weak, present as trace and not reaching margin; lower calypter yellow with brown rim and fan of yellow setae; halter pale yellow.

Abdomen: "pseudotergite" or membranous area between terga 1 and 2 not evident; abdominal plaques absent; setae brown with yellow reflections; terga 1 and 2 yellow except tergum 2 with dark green mid-dorsal patch; tergum 3 yellow laterally and anteriorly, but with wide dorsal metallic green band; terga 4–6 mostly metallic green with bronze reflections; segments 7–8 and entire hypopygium (except for dark brown surstyli) pale yellow; postabdomen (Fig. 1a); tergum 6 with only moderate ventral prolongation; segment 7 forming peduncle, with curved triangular sternum attached to cap-like sternum 8; epandrium subrectangular; hypandrium and aedeagus arising from base of epandrium, and both elongate and simple; epandrial lobes separate, with basal and more median lobe which bearing pedunculate seta, and with distal lobe greatly enlarged, prolonged, and arching distad of surstyli, and bearing long and short apical setae; ventral surstylar arm greatly enlarged and partially covering smaller dorsal lobe which also has medial extension; cercus subrectangular and curved, bearing enlarged apical blade-like setae.

Female: similar to male except lacks MSSC, and as noted: face only slightly wider if at all; legs entirely yellow; podomere ratios as: I: 4.5; 5.3; 3.1/ 2.0/ 1.0/ 0.7/ 0.6; It_3 longer than It_4; II: 5.5; 6.1; 5.0/ 2.3/ 1.3/ 0.6/ 0.4; III: 6.0; 8.4; 3.0/ 2.6/ 1.7/ 1.0/ 0.6; abdominal terga 1–2 mostly yellow; terga 3–4 yellow anteriorly and laterally, and metallic green dorso-posteriorly; terga 4–6 mostly metallic green, segment 7 yellow; female abdomen (Fig. 2b) apically blunt; sternum 8 distally setose; terga 9+10 short and rounded, dorsally separated, and partially covering digitiform cercus; cercus with long curved ventral seta.

Remarks. *Dactylomyia vockerothi* is known only from Midway and is the first record of the subfamily Neurigoninae from the Hawaiian Archipelago. It is an accidental introduction, ultimately from the New World tropics, and possibly also occurs on the main Hawaiian islands.

Dactylomyia vockerothi shows distinct size variation, and among 8 females taken in the same Malaise trap sample, wing length ranged from 2.3–2.9. Adult Neurigoninae are often found on tree trunks, poles, and walls.

Faunal studies are rarely as simple as they might seem. Often a species is present which reflects some larger taxonomic confusion, and its underlying systematics has to be investigated. Such is the case of *Dactylomyia*, which is discussed in Part II of this paper. *Dactylomyia vockerothi* is named in honor of J.R. Vockeroth for reasons that will become evident.

Zoogeography of the Midway Dolichopodidae

Midway comprises 2 flat exposed sandy coralline islands, Eastern and Sand, and an emergent sand bar, Spit I., surrounded by fringing reefs. Historically, Midway has been an important cable station and military airstrip. Bryan (1955) noted that when the Pacific Commercial Cable Company station was established on Sand Island, shiploads of soil were brought from Hawai'i to provide local gardens and *Casuarina* windbreaks. The transported soil along with horticultural specimens would have been ideal media in which to accidentally introduce main Hawaiian island species to Midway (also see Bickel, 1997).

Therefore, it is important to distinguish between species whose range and biology would enable colonization by dispersal from northern Pacific atolls, and those accidentally introduced by human transport from the Hawaiian main islands, in particular O'ahu. It

must be noted that many of these species were themselves accidentally introduced to Hawai'i.

A. Probable natural colonizers

i. *Krakatauia micronesiana* is found on many isolated low islands in Micronesia, and could have been transported to Midway by wind. This species is unknown from the high islands of Hawai'i.

ii. *Syntormon flexibile* is a widespread littoral species in the Pacific Basin, and is found throughout the Hawaiian chain.

iii. The genus *Chrysotus* has many undescribed species throughout the tropical Pacific and the Midway species could well be endemic, and related to the Micronesian or Polynesian faunas.

B. Accidental introductions to Midway, probably from the high volcanic Hawaiian islands

i. *Chrysosoma globiferum* from the eastern Orient is a probable accidental introduction to the main islands of Hawai'i, and a secondary introduction to the Leeward Islands.

ii. *Medetera grisescens* is widespread in the tropical Pacific, and its presence on the high Hawaiian islands could be natural. However, it is a tree trunk associate and undoubtedly was introduced to Midway in transported soil and horticultural specimens.

iii. *Dactylomyia vockerothi* was probably established on Midway in association with horticultural specimens, and is ultimately from the Neotropics. I suspect this species will also be found on O'ahu.

C. Hawaiian Island endemics

i. *Hydrophorus pacificus* Van Duzee is a coastal species endemic to the Hawaiian Islands. Although not collected on Midway, it might be expected there, as it occurs on Laysan Island (Hardy & Kohn, 1964).

II. Notes on the Subfamily Neurigoninae

When I first saw *Dactylomyia vockerothi* in the Midway collections, I thought it was a member of the widespread genus *Neurigona*. Although this genus does not occur in Polynesia or eastern Micronesia, a group of species close to the Indo-Australian *N. angulata* de Meijere occurs east to the Solomon Islands and New Caledonia. However, the *angulata* group is distinctly different in venation and thoracic chaetotaxy from both the Midway species and *Neurigona* characteristic of the Palaearctic and Nearctic fauna (the genus *Neurigona* itself requires redefinition on a world scale). The Midway species does not match any description from the Palaearctic fauna (Negrobov, 1987; Negrobov & Fursov, 1988). I studied a collection of 35 identified New World *Neurigona* species at the California Academy of Sciences, and found that the Midway specimens were close to *Neurigona lateralis* (Say), a species whose distinctiveness has always been emphasized by J. R. Vockeroth (Robinson & Vockeroth, 1980; Vockeroth, 1994), and which had been the type species of the synonymized genus *Dactylomyia* Aldrich. The re-establishment of *Dactylomyia* and its relationship to other neurigonine genera are discussed below.

Genus **DACTYLOMYIA** Aldrich, **new status**

DACTYLOMYIA Aldrich, 1894: 151. Type species, *Dactylomyia gracilipes* Aldrich, 1894 (mono.) [= *Medeterus lateralis* Say, 1829].

COELINIUM Parent, 1939. 148. Type species, *Coelinium bicolor* Parent, 1939 (orig. des.) **N. syn.**

Diagnosis:

Head: dorsal postcranium flat; head wider than high; pairs short vertical, long ocellar, and short postvertical setae present; face and clypeus distinctly separating eyes in both sexes; pedicel truncate with first flagellomere; first flagellomere short and rounded; arista dorsal.

Thorax: posterior slope of mesonotum flattened; ac with 2 rows of short setulae; 3 dc, comprising 2 strong setae bordering mesonotal depression and a shorter seta anteriad, and with only short setulae anteriormost in dc row; anterior mesonotum with 5–6 irregular rows of whitish setulae, form a field of setulae; median scutellars strong, laterals as tiny hairs; lower proepisternum with 2 pale setae.

Legs: mostly yellow; all femora and tibiae devoid of major setae; male tarsus I often modified, especially It_{3-5} (MSSC).

Wing: hyaline; Sc incomplete; vein M with smooth gentle curve toward R_{4+5}, and both veins closely subparallel in distal 1/6 of wing; vein CuA weak, present as trace and not reaching margin (Fig. 2a).

Male abdomen: "pseudotergite" or membranous area between terga 1 and 2 not evident; abdominal plaques absent; segments 7–8 and entire hypopygium (except for dark brown surstyli) pale yellow; tergum 6 with only moderate ventral prolongation; distal epandrial lobe greatly enlarged, prolonged, and arching distad of surstyli, and bearing long and short apical setae; ventral surstylar arm greatly enlarged; cercus subrectangular and curved, bearing apical blade-like setae.

Female abdomen: (Fig. 2b) apically blunt; sternum 8 distally setose; terga 9+10 short and rounded, dorsally separated, and partially covering digitiform cercus; cercus with long curved ventral seta.

Remarks. Aldrich (1894) established *Dactylomyia* for the single species, *D. gracilipes*. Subsequently, Wheeler (1899) placed *D. gracilipes* in synonymy with *Neurigona superbiens* (Loew), and decided against using Aldrich's genus because it was not distinctive enough. Aldrich (1904) placed his genus *Dactylomyia* in synonymy with *Neurigona,* and later (1905) regarded *Neurigona lateralis* (Say) as the senior synonym of the 3 nominal species.

Parent (1939) described the genus *Coelinium* with 2 included species, *C. bicolor* from Costa Rica, and *C. unicolor* from Argentina. Both his description of the thoracic chaetotaxy and figures of the wing and antenna of the type species, *C. bicolor,* indicate that it is congeneric with *Dactylomyia* as here defined. Parent thought the specimen he examined was a male with a hidden or retracted hypopygium. However, his figure of the "male postabdomen" is clearly that of a blunt female *Dactylomyia* abdomen, with the characteristic oviscapt whose cercus bears a long curved ventral seta, and a protruding setose sternum 8, a configuration of characters identical to that in found in both *D. vockerothi* and *D. lateralis* (compare Fig. 2b with Fig. 13 in Parent, 1939).

The second species, the Argentinian *Coelinium unicolor*, is similar in overall wing venation, but differs from *Dactylomyia* in several major points. It has numerous strong setae on tibiae II and III (absent on *Neurigona, Dactylomyia,* and most Neurigoninae), and 5 strong dc. The single specimen was damaged and Parent was uncertain as to its sex. In any case, the 2 species should not even be together in the same genus. Possibly *C. unicolor* is related to the monotypic genus *Argentinia* Parent (1931), which has similar venation and tibial chaetotaxy, and has been variously referred to the Medeterinae and Neurigoninae. For now, it is best to regard *Coelinium unicolor* as "Unplaced Dolichopodidae."

Aldrich (1896) described another genus, *Coelogluthus,* based on a single female, *C.*

concavus, from St. Vincent, West Indies. His wing figure is similar to that of *Dactylomyia*, otherwise the description is inadequate. Robinson (1975) redescribed the species based on a male and female collected in Dominica. The only other congener is *Coelogluthus sinuatus* (Parent), from Central America. Based Robinson's redescription, and the original descriptions of *C. sinuatus* (Parent, 1928) and its junior synonym, *C. bicoloripes* Van Duzee (1933), *Coelogluthus* and *Dactylomyia* share similar thoracic chaetotaxy and weak vein CuA. However, the following characters distinguish the 2 *Coelogluthus* species: arista apical, pedicel with a distal lobe which intrudes into first flagellomere on median side (as in Fig. 25, Van Duzee, 1933), an elongate thorax, and a rather small hypopygium. As well, Dyte (1959) noted that female *C. concavus* has a sclerotized oviscapt, not unlike that of the dolichopodid genus *Thrypticus* (Medeterinae), which possibly is used for oviposition in plant tissue. Negrobov (1986) erected the subfamily Coelogluthinae for *Coelogluthus* and *Neotonnoiria* Robinson, which he based on the elongate, rather obliquely orientated thorax of the 2 included genera. I have not seen specimens nor adequate genitalic figures for either genus, but feel that this subfamily is premature, and pending further study, it is best to keep *Coelogluthus* associated with the Neurigoninae. As a final note, it should be noted that the female holotype of *Dactylomyia bicolor* (as *Coelinium*) and male holotype of *Coelogluthus sinuatus* have the same collection data (Costa Rica: La Caja, Schmidt, 1930), and could be conspecific.

The near cosmopolitan genus *Neurigona* comprises some 100 described species with many more awaiting description. Superficially, it shows a range of variation in thoracic chaetotaxy, venation, and habitus, and the genus needs review and redefinition. As well, its relationship to other neurigonine genera, such as the New Zealand *Halteriphorus* Parent, Australian *Arachnomyia* White, and Palaearctic *Oncopygius* Mik, requires investigation.

Following are some notes on specific aspects on neurigonine morphology:

1. In addition to *Coelogluthus* and *Dactylomyia,* some Oriental and Australasian *Neurigona* also have the anterior mesonotum largely covered by a field of setulae.

2. Males of some species in most neurigonine genera have modified fore-tarsi, including modified tarsomere length and shape, elongate setae, enlarged claws, etc. (all MSSC). These secondary sexual characters probably relate to species recognition and courtship behavior on tree trunks, where the male approaches the female from behind, and places his fore tarsi in front of her head (e.g., Gruhl, 1924).

3. Males in some neurigonine genera have postabdominal terga 5 and 6 enlarged with striking ventral modifications such as cuticular extensions and special setal arrays. These terga also partially enclose the hypopygium at rest. As well, genera in the Neurigoninae have a similar basic hypopygium, comprising an enlarged epandrial lobe which arches distad of the surstyli, and an enlarged ventral surstylar arm.

4. The female abdomen of *Dactylomyia* (Fig. 2b) has terga 9+10 short and rounded, dorsally separated, and partially covering the cercus. The cercus has a long curved ventral seta. This contrasts markedly with the female terminalia of *Neurigona* (e.g., Fig. 2c, the Palaearctic *N. pallida*) where terga 9+10 are prolonged and with a subequal digitiform cercus.

General subfamilial characters of the Neurigoninae include: dorsal postcranium flat,

not concave; arista subapical to dorsal; proepisternum with setae; posterior slope of mesonotum flattened; legs elongate, and bare of major setae; hypopygium often with complex appendages, and pedunculate; male terga 5 and 6 often with ventral modifications.

KEY TO *NEURIGONA*, *DACTYLOMYIA* AND *COELOGLUTHUS* IN THE NEW WORLD

1. Dc comprising 5–8 distinct pairs, extending anteriad of mesonotal suture; vein CuA strong, extending to wing margin; vein M ranging from subparallel with R_{4+5} to distally bent toward R_{4+5}; female abdomen telescoped, with terga 9+10 of oviscapt prolonged, and cercus digitiform ..... *Neurigona* Rondani

–. Dc comprising 3 pairs only, 2 strong setae bordering mesonotal depression, with shorter seta posteriad of mesonotal suture; anterior mesonotum with field of whitish setulae; vein CuA weak and not reaching wing margin (Fig.2a); vein M with smooth gentle curve toward R_{4+5}, and both veins closely subparallel in distally; female abdomen (where known) otherwise modified 2

2. Arista apical; pedicel intrudes into first flagellomere on median side; hypopygium rather small, partially hidden; thorax elongate; female with sclerotized blade-like oviscapt .....

..... *Coelogluthus* Aldrich

–. Arista dorsal; pedicel truncate with first flagellomere; hypopygium large, external; female abdomen blunt, with terga 9+10 short and rounded, and cercus with long curved ventral seta (Fig.2b) ..... *Dactylomyia* Aldrich

Summary of taxonomic changes

I. Subfamily NEURIGONINAE

DACTYLOMYIA Aldrich, 1894: 151. Type species, *Dactylomyia gracilipes* Aldrich, 1894 (mono.) [= *Medeterus lateralis* Say, 1829]. **N. status**

COELINIUM Parent, 1939: 148. Type species, *Coelinium bicolor* Parent, 1939 (orig. des.). **N. syn**.

bicolor Parent, 1939: 149 (*Coelinium*). Costa Rica. **N. comb**.

lateralis Say, 1829: 169 (*Medeterus*). Eastern N. America. **N. comb**.

superbiens Loew, 1861: 76 (*Saucropus*). USA (Florida).

gracilipes Aldrich, 1894: 169 (*Dactylomyia*). USA (South Dakota).

vockerothi Bickel, n. sp. Hawaiian Islands (Midway).

II. Unplaced species of DOLICHOPODIDAE

unicolor Parent, 1939: 150 (*Coelinium)*. Argentina.

Synonymic Note

Sympycnus pugil Wheeler, 1899: 51.

Neurigona kesseli Hendrickson, 1961: 278. **N. syn**.

Hendrickson described *Neurigona kesseli* based on a female holotype and male allotype from California (CAS, examined). Both specimens have a subsequent determination label, "Sympycnus pugil Wheeler /det. F.C. Harmston", which was also noted by Arnaud (1979). Harmston was correct in his determination and this note serves to make the synonymy formal, as the name *Neurigona kesseli* has appeared in recent checklists.

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Nishida, A. Asquith, L. Patrick, A. Gall, and N. Seto. K. Ribardo facilitated my studies at the California Academy of Sciences, San Francisco (CAS). S. Bullock drew the hypopygium figure of *Dactylomyia vockerothi*. J.R. Vockeroth provided stimulating conversation and ideas over the years.

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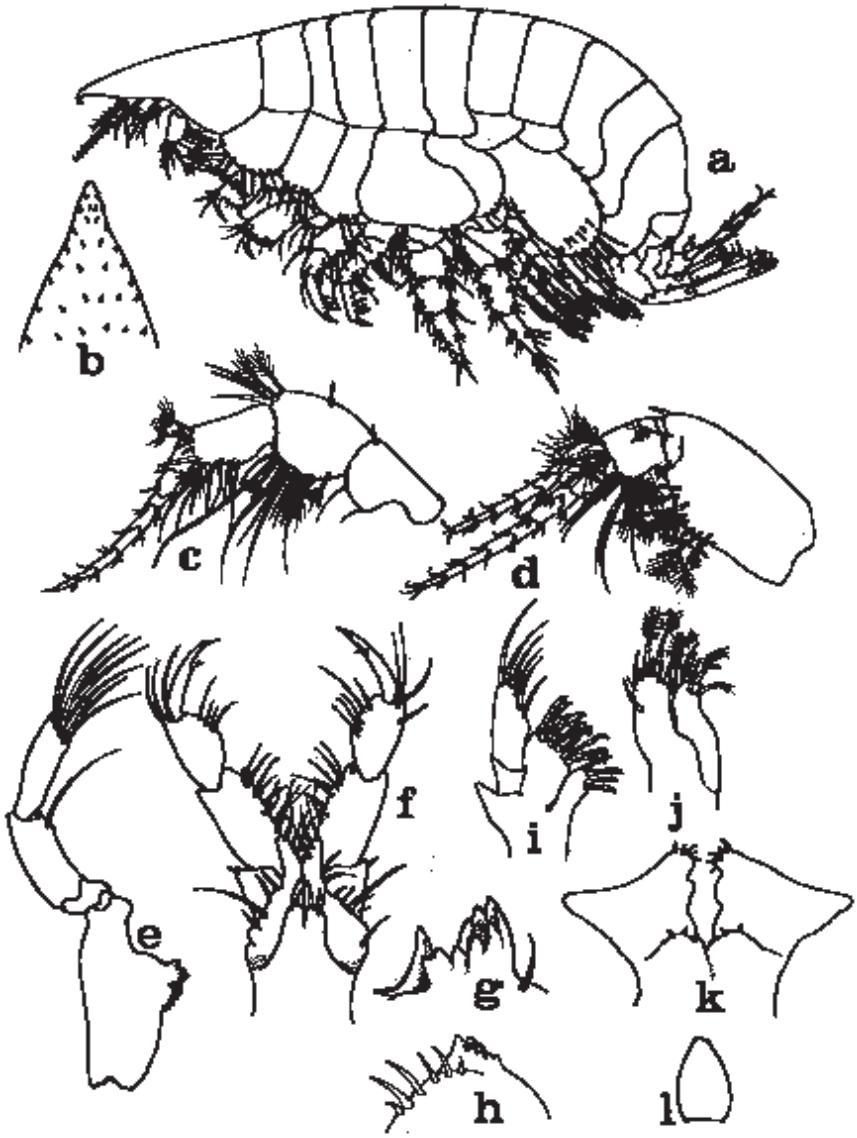

Fig. 1. *Mandibulophoxus hawaiiloa* Muir & DeFelice n. sp. **a**, whole animal; **b**, rostrum, dorsal view; **c**, antenna 2; **d**, antenna 1; **e**, left mandible; **f**, maxilliped; **g**, cutting edge, right mandible; **h**, cutting edge, left mandible; **i**, left maxilla 1; **j**, left maxilla 2; **k**, lower lip; **l**, upper lip.

Fig. 2. *Mandibulophoxus hawaiiloa* Muir & DeFelice, n. sp. **a**, ganthopod 1 (pereopod 1); **b**, gnathopod 2 palm; **c**, gnathopod 2; **d**, gnathopod 2 palm; **e**, pereopod 2; **f**, pereopod 2, detail, article 6, 7; **g**, pereopod 2; **h**, pereopod 3; **i**, pereopod 3; **j**, pereopod 5; **k**, telson; **l**, pleopod 2 (inner setae omitted for clarity);**m**, uropod 1; **n**, uropod 2; **o**, uropod 3.

A New Species of Phoxocephalid (Crustacea: Amphipoda: Gammaride: Phoxocephalidae) from Hawai'i[1]

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In the course of a survey of infaunal benthic invertebrates in Hanalei Bay, Kaua'i, Hawai'i in 1994, an unidentified amphipod was recovered in large numbers from a depth of 8–21 m in carbonaceous sand of coralline origin. Densities of 355/m^2 of this amphipod were found in coarse grain sands ($f = 1.20$), and densities up to 1357/ m^2 were found in fine sediments ($f = 2.93$) (DeFelice, 1997). The amphipod seemed to bear a close resemblance to organisms described by Pillai (1957) and Barnard (1957, 1960, 1991) and was assigned to the genus *Mandibulophoxus* (Muir, 1997) where it was reported as a new record for the genus in Hawai'i. Congeners have previously been found in Africa (Barnard, 1957), India (Barnard, 1957; Pillai, 1957), Australia (Barnard & Drummond, 1978), and California (Barnard, 1957; Gray & McCain, 1979). Previous to this discovery, the only phoxocephalid recorded from Hawai'i was *Paraphoxus centralis* (Schellenberg) (Barnard, 1971).

Some confusion has surrounded the systematics of *Mandibulophoxus*. Barnard (1957) erected the genus to accommodate a species recovered from deep waters off the California coast. The type species, *M. gilesi* Barnard, was based on a single individual. A similar species from Indian waters was identified by Pillai (1957), which he named *Pontharpinia uncirostratus*, conforming to an earlier description by Giles (1890). On the basis of Pillai's (1957) description, Barnard (1960) synonymized *P. uncirostratus* under *M. gilesi*.

Gray & McCain (1969) reexamined Barnard's identification when additional specimens of *Mandibulophoxus* sp. were recovered from Tomales Bay, California. On the basis of a variety of characters from their specimens and from descriptions in Pillai (1957) and Giles (1890), they determined that the Californian specimens, including those of Barnard (1957, 1960), should be assigned to *M. gilesi*, but that the specimen described by Pillai (1957) differed sufficiently to maintain separate species status and be transferred to *Mandibulophoxus*.

Table 1 provides a comparison of the differences noted by Gray & McCain (1969) between *M. gilesi* and *M. uncirostratus*, and also provides the same character comparisons for the specimens from Hanalei Bay, described below as *Mandibulophoxus hawaiiloa*.

The Hawaiian specimens are clearly most closely allied to *M. uncirostratus* (Giles). In particular, the short inner ramus of uropod 3 is distinctive, whereas *M. gilesi* has inner and outer rami equal in length. While the Hawaiian population does share some characters with both *M. uncirostratus* (Giles) and *M. gilesi* Barnard, we believe that there are sufficient differences and distinctive characters to warrant the new species described below.

Mandibulophoxus hawaiiloa Muir & DeFelice **new species** Figs. 1–2

Diagnosis. The species can be distinguished from its congeners by the characters given in Table 1.

Description. A small phoxocephalid: 11 specimens (type and paratypes deposited in the Bishop Museum), with mean length (rostrum to base of 3rd uropod) 2.3 mm (range 1.8–2.85 mm); beige in color and extremely laterally compressed; only females have been found so far.

Head and rostrum: (Fig. 1a, b) The head and rostrum together equal in length to first 4 pereion

segments. Rostrum straight, somewhat broad at base, lower edge slightly convexly curved. Rostrum terminates with distinct apical hook. Series of small spines set in rows decorate dorsal surface of rostrum and line its edge. No eyes present.

Body: (Fig. 1a) Body convexly curved in profile. Thoracic segment 2 narrower than 1 or 3, other thoracic segments subequal in width. Pleonal segments 2 and 3 with convexly expanded lower posterior corners. 1st epimeral segment large, with distinctly convexly curved dorsal edge; other epimeral segments small.

Antenna 1: (Fig. 1d) 1st article long, hidden below rostrum, with long setae and hairs on ventral surface. 2nd article shorter (< 0.5 · article 1) with brush of long setae on ventral surface. Jointing of article 2 and article 1 allows antenna to protrude upwards from beneath rostrum and on either side of it. Article 3 very short (< 0.25 · article 1) with no setae, except a few marking flagellar joint. Flagellum with 8 articles, accessory flagellum with 5. Each joint marked by a few distal, stout spines.

*Antenna 2: (*Fig. 1c) Equal in length to antenna 1. Articles 1, 2 and 3 of peduncle equal in length. Article 1 with a few long ventral setae, article 2 ventrally expanded with numerous very long setae, forming distinct brush. An apical clump of 3–4 long setae also present on distal dorsal corner at joint with article 3. Article 3 with clump of long setae on ventral surface, pair of stout, bladelike spines at distal edge on either side of first flagellar segment. Flagellum with 6 articles, each joint marked by set of small, stout distal spines.

Maxilliped: (Fig. 1f) Inner plates free, small, with 3–4 long apical setae. Outer plates slightly longer than palp article 1, with numerous, long setae on inner edge, a few on outer edge. Article 1 of palp with sharp, pointed upper and outer corner, bearing short, stout spine. Article 2 long (3 · article 1), with line of 6–7 setae on inner edge, small brush of setae on outer distal corner at joint with Article 4. Article 4 curved, sharp with distinct terminal spin; small spine on inner edge at 2/3 of its length.

Maxilla 1: (Fig. 1i) Inner plate equal in length to outer plate, somewhat distally expanded, bearing 4 complex apical setae. Inner plate large, with ca. 11 apical setae similar to those on inner plate. Palp 2 jointed, borne on winglike lateral expansion of outer plate. Palp with 6 or more apical spines, simple in structure, long, gently curved. Plates and palp of maxilla 1 completely folded with one another and maxilla 2 [it was impossible to render this realistically as the microscope preparations for *camera lucida* drawing distort the 3–dimensional structure of these mouthparts].

Maxilla 2: (Fig. 1j) Lobes equal in size, slightly smaller than inner lobes of maxilla 1. Each with apical bunches of 7 or more setae, simple in structure.

Mandible: (Fig. 1e) Mandibles asymmetrical; left with blunt incisor process in curved row of 5 accessory teeth forming double row (Fig. 1g),with row of 6–7curved spines (Fig. 1h). Right mandible with larger incisor with only 2–3 accessory teeth in single row, spine row of 8 or more teeth. No molar process.

Lips: (Fig. 1k,l) Upper lip pointed; lower bilobed, with small sharp spines on apices of both inner and outer lobes

Gnathopod 1, 2: (Fig. 2a–d) Gnathopods undifferentiated; gnathopod 1 slightly smaller, with elongate 5th article, article 5 is short in gnathopod 2. In both, palm defined by sharp cusp with sharp spine. Palm slightly rounded, with sparse setae and hairs. Dactyl curved, sharp, point folding against defining cusp. Insertion of dactyl marked by tuft of long setae.

Pereopod 1 & 2: (Fig. 2e–g) Pereopods 1 and 2 similar, 2 slightly larger, with triangular coxa, coxa of 1 rectangular. Posterior edges with long, curved setae. Dactyl 0.5 · length of article 6. Article 6 with double row of long, blade-like spines on posterior edge, 2–3 similar spines at distal posterior corner of article 5. Pereopod 2 coxa largest, posterior edge produced backwards as far as pereopod 7 (Fig. 1a, 2 g).

Pereopod 3 & 4: (Fig. 2h,i) Both with markedly flattened articles 2, 4, and 5 with small coxae. Numerous long, curved setae and shorter stout spines on each. Pereopod 3 also with numerous long, plumose setae on anterior and posterior edges of articles 4–6. Pereopod 4 with only 2 short plumose setae on anterior edge of articles 4 and 5.

Pereopod 5: (Fig. 2j) Short, with small coxa and extremely enlarged, flat article 2 reaching to end of article 6, extended back to lie below pleon segments 1 and 2. All articles bear curved setae. Dactyl long (= article 6). Posterior edge of article 2 has 4 or 5 teeth with small spines; lower edge of article has 5–6 long setae, some short hairs on outer surface.

Pleopods 1–3: (Fig. 2l) Similar in structure to one another, pleopod 1 largest. Each with basal

peduncle with 2 rami. Pleopods bear numerous long, curved, plumose setae.

Uropod 1: (Fig. 2m) Long, with outer ramus bearing 3 large spines in marked groove on dorsal surface. Inner ramus bears 2 similar spines. Large, curved tooth on dorsal surface of peduncle at insertion of rami, 2 slightly smaller spines below this. [In some individuals, other small spines also occurred on the peduncle.]

Uropod 2: (Fig. 2n) Small, equal in size to peduncle of uropod 1, otherwise similar, with 3 large spines on outer ramus; 2 on inner, 1 large and 1 smaller curved tooth on peduncle.

Uropod 3: (Fig. 2o) Longest of uropods: Peduncle relatively short, outer ramus very long, 2-jointed, with number of sharp, curved setae of varying lengths; 3 long, straight setae define end of 2nd article. Inner ramus very short (< 1/3 2nd article of outer ramus), with long, sharp, apical seta.

Telson: (Fig. 2k) Small, fleshy, completely divided. Each lobe terminated by sharp, stout spines. Most commonly, each lobe bears 2 such spines, together with very minute spine. Some individuals with 3 larger spines; some with 2 on 1 lobe, 3 on the other. Also, each lobe usually with single, long, plumose seta on outer and dorsal surface. Rarely, 2 plumose setae occur, 1 long, 1 very short.

Holotype: Female, 2.2 mm, BPBM S11298.

Paratypes: 10 females, BPBM S11299.

Type Locality: Hanalei Bay, Kaua‘i, Hawai‘i.

The specific name continues the tradition established by Barnard (1955, 1970, 1971) of assigning names derived from the Hawaiian language. Hawai‘i Loa was the mythical navigator of the first Polynesian canoe to reach the Hawaiian Islands and is a reflection of the long journey that settlers of these islands, such as the ancestor of this small amphipod, had to travel to reach here. It is also a tribute to Hawaii Loa College, the institution that first brought the senior author to the Hawaiian Islands.

Discussion. In addition to those detailed in Table 1, we note the following differences between our specimens and *M. uncirostratus*, as described by Pillai (1957): a) *M. uncirostratus* is larger (6.0 mm) where *M. hawaiiloa* is small (ca. 2.0 mm); b) the rostrum in *M. uncirostratus* is narrow and the lower edge is concave and shallowly excavate, where that of *M. hawaiiloa* is broad and has a convex lower edge; c) article 2 and 3 of antenna 1 in *M. uncirostratus* are the same length, and in *M. hawaiiloa* article 3 is less than half the length of article 2; d) from the figures in Pillai (1957), the structure of the incisor process and cutting edge of *M. uncirostratus* appears to be quite different to that of *M. hawaiiloa*. In addition, the 2nd palp article of *M. uncirostratus* has 2 well separated setae, where that of *M. hawaiiloa* usually has only 1 (though rarely, 2 may occur together). The 3rd article of the mandibular palp in *M. uncirostratus* has 6 setae, where there are 8 in *M. hawaiiloa;* e) the coxa of pereopod 2 in *M. uncirostratus* is smaller than that of *M. hawaiiloa*, which extends to the 4th pereopod; f) the coxa of pereopod 3 in *M. uncirostratus* is very much smaller than that of *M. hawaiiloa*; g) coxa 7 of *M. uncirostratus* is larger than that of *M. hawaiiloa*; in *M. uncirostratus* it extends as far as the end of the dactyl; in *M. hawaiiloa* it extends as far as the end of the 6th article.

Barnard (1971), in a review of the amphipods of the Hawaiian Islands, noted the occurrence of only 1 phoxocephalid, *Paraphoxus centralis* (Schellenberg), whose location was given as Fern and Whale Islands. Congeners of this species are tropical American species (Barnard, 1970). Barnard (1971) expressed the hope that adequate sampling of soft bottomed substrates in Hawai‘i would yield various phoxocephalid species, but apart from a report by Hobson & Chess (1979) of an unidentified phoxocephalid from Midway and Kure Atolls, no record apart from ours has been published.

While thus far only recorded from Hanalei Bay, Kaua‘i, *Mandibulophoxus hawaiiloa* is locally abundant, and ecologically important: of 77 invertebrate taxa recorded in the

Table 1. Comparison of characters of *Mandibulophoxus uncirostratus, M. gilesi and M. hawaiiloa* n.sp.

Character	***M. uncirostratus* Giles**	***M. gilesi* Barnard**	***M. hawaiiloa* Muir & DeFelice, n. sp.**
Spines on U1 rami	4 (i) 4 (o)	5 (i) 6 (o)	2 (i) 3 (o)
Spines on U2 rami	3 (i) 4 (o)	5 (i) 7 (o)	3 (i) 3 (o)
U3 inner ramus	< 0.5 · outer	equal to outer	< 0.3 · outer
Teeth, Art 2, Per 5	3 or 4	> 6	4 or 5
Ratio , Art4:5, Per 5	4>>5	4=5	4=5
Pereiopod 4	numerous plumose setae	numerous plumose setae	few plumose setae
Rostrum	shallowly hooked along length	straight	straight, with terminal hook
Mandibular process	indistinct, rounded	distinct, narrow	distinct, narrow
Ratio arts 4:5, Per 5	4<5	4=5	4=5
Mand. palp setae	6	8	8
Mand. palp art 2	2 separated spines	2 spines together	single spine or none
Antenna 1 flagellum articles	9	14 - 16	8

Hanalei Bay sediments, it proved to be the most commonly encountered, occurring in 88% of all benthic samples taken. It was also found to be an important prey item of fishes in the area, and was recovered from stomach contents of bonefish (*Albula* sp.), bluelined snapper (*Lutjanus kasmira* Forsskal), razor wrasse (*Xyrichthys pavo* Valenciennes) and sharphead wrasse (*Cymolutes lecluse* Matsuda *et al*.) (DeFelice, 1997).

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New Records, Taxonomic Notes, and a Checklist of Hawaiian Starfish[1]

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Starfishes (Echinodermata: Asteroidea) make up among the most prominent and familiar of the Indo-Pacific invertebrate fauna. Diversity of asteroids in the Indo-Pacific of both shallow-water and deep-sea faunas is thought to constitute one of—if not *the*—richest in the world. The Hawaiian Islands host a small but relatively well-known shallow-water asteroid fauna (summarized in Fisher, 1925). However, just the opposite can be said for this region's deep-sea starfishes, which by and large, have not been revisited since Fisher (1906, 1925) and may be far more diverse than those sea stars that inhabit shallower water.

This paper summarizes the status of asteroid biodiversity in the Hawaiian Islands. By way of accomplishing this goal, this paper:

1. Summarizes all currently valid taxonomic designations of all recorded Hawaiian Asteroidea and establish a checklist of all species of asteroids which have been reliably recorded from Hawaiian waters.
2. Presents preliminary notes on potentially new species, new records of asteroids previously unknown to Hawaiian waters, and directs attention towards problems in Hawaiian asteroid taxonomy/systematics.
3. Comments on endemism and species richness.

Standards for intermediate taxonomic groupings follow the phylogeny and revisions by Blake (1987), Clark & Downey (1992), and Mah (1998). Changes from the original descriptions from Fisher (1906) are taken from and summarized in Clark (1989, 1993, 1996). Species are listed by order, in historical "phylogenetic" order (paxillosids first, forcipulates last), then by family, genus, and species in alphabetical order. Ordinal level arrangement does not constitute an endorsement of any phylogenetic hypothesis but is used here for convenience. For the sake of brevity, only the citation of the original description is included.

Data for this paper were collected during a 3-week visit to the Bishop Museum (BPBM) in July–August 1997 and from specimens at the Department of Invertebrate Zoology, California Academy of Sciences (CASIZ).

CHECKLIST OF HAWAIIAN ASTEROIDEA (DEEP AND SHALLOW WATER)

[* Indicates deep-water species; # Indicates subtidal to deep-water species; all others are intertidal to subtidal (0–43 m)]

PAXILLOSIDA

Astropectinidae

Astropecten hawaiiensis Döderlein, 1917
Döderlein, 1917: 121; Range: Hawaiian Is., 50–133 m.

Astropecten polyacanthus Müller & Troschel, 1842
Müller & Troschel, 1842: 69; Range: Indo-West Pacific; 0–185 m.

Astropecten triseriatus myobrachius Fisher, 1926
Fisher, 1926: 69; Range: Hawaiian Is. no depth listed.

Astropecten productus Fisher, 1906*
Fisher, 1906: 1010; Range: Hawaiian Is., 22 2–260 m.

Astropecten pusillulus Fisher, 1906*
Fisher, 1906: 1008; Range: Hawaiian Is., Maldive Is., 256–683 m.
Astropectinides callistus (Fisher, 1906)*
Fisher, 1906: 1012 (as *Astropecten*); Range: Hawaiian Is., 96–426 m.
Astropectinides ctenophora (Fisher, 1906)*
Fisher, 1906: 1006 (as *Astropecten*); Range: Hawaiian Is., 238–271 m.
Ctenophoraster hawaiiensis Fisher, 1906*
Fisher, 1906: 1015; Range: Hawaiian Is., 104 m.
Dipsacaster nesiotes Fisher, 1906*
Fisher, 1906: 1026; Range: Hawaiian Is. and Moluccas, 517–564 m.
Patagiaster nuttingi Fisher, 1906*
Fisher, 1906: 1029; Range: Hawaiian Is., 402–540 m.
Persephonaster cingulatus cingulatus Fisher, 1906*
Fisher, 1906: 1023 (as *Psilasteropsis*); Range: Hawaiian Is., western Indian Ocean, 765–2000 m.
Psilaster attenuatus Fisher, 1906*
Fisher, 1906: 1019; Range: Hawaiian Is., 517–610 m.
Tritonaster craspedotus Fisher, 1906*
Fisher, 1906: 1017; Range: Hawaiian Is., 403–572 m.

Luidiidae

Luidia aspera Sladen, 1889
Sladen, 1889: 248; Range: Hawaiian Is, (possibly Philippines if syn. with *Luidia hystrix* Fisher, 1906), 18 m.
Luidia magnifica Fisher, 1906#
Fisher, 1906: 1033; Range: Hawaiian Is, Philippines, 18–133 m.
Luidia prionata Fisher, 1913* **New state record**
Fisher, 1913: 202; Range: Philippines, NW Australia, Arabian Gulf, 8–99 m.
Range Extension: Hawai‘i: BPBM 1362, off Waikiki in 120–180 fms (ca. 240–360 m).

NOTOMYOTIDA

Benthopectinidae

Cheiraster (Cheiraster) inops Fisher, 1906*
Fisher, 1906: 1043; Range: Hawaiian Is., Philippines to Sri Lanka, 430–1250 m.
Cheiraster (Cheiraster) snyderi Fisher, 1906*
Fisher, 1906: 1040; Range: Hawaiian Is., Nicobar Is, 420–1670 m.
Cheiraster (Christopheraster) horridus Fisher, 1906* (ex. *Luidiaster horridus*)
Fisher, 1906: 1042; Range: Hawaiian Is., 260–330 m.

VALVATIDA

Acanthasteridae

Acanthaster planci (Linnaeus, 1758)
Linnaeus, 1758: 823 (as *Asterias*); Range: East Pacific, Gulf of California to Galapagos throughout entire Indo-Pacific region (Australia, southern Japan, Indonesia, Papua New Guinea, Philippines, etc.) to Goa, W. India, 5–65 m.

Asterodiscididae

Asterodiscides tuberculosus Fisher, 1906#
Fisher, 1906: 1075 (as *Asterodiscus*); Range: Hawaiian Is., 59–396 m.

Asterinidae

Anseropoda insignis Fisher, 1906*
Fisher, 1906: 1088; Range: Hawaiian Is., 22 2–332 m.
Asterina anomala H.L. Clark, 1921
H.L. Clark, 1921: 95; Range: Lord Howe Is., E. Australia, N and E to Caroline Is., Hawaiian Is., and Polynesia, 0–18 m.

Asteropseidae

Asteropsis carinifera (Lamarck, 1816) (ex. *Gymnasteria carinifera*)

Lamarck, 1816: 556 (as *Asterias*); Range: Hawaiian Is., throughout Indo-Pacific region and East Pacific, 0–15 m.

Valvaster striatus (Lamarck, 1816)

Lamarck, 1816: 564 (as *Asterias*); Range: Hawaiian Is., Mascarenes, Indian Ocean, Australia, Philippines, South Pacific Is., 0–20 m.

Ganeriidae

Hyalinothrix millespina Fisher, 1911*

Fisher, 1911: 659; Range: Hawaiian Is., 232–281 m.

Goniasteridae

Anthenoides epixanthus (Fisher, 1906)*

Fisher, 1906: 1067 (as *Antheniaster*); Range: Hawaiian Is., W. Japan, 100–488 m.

Astroceramus callimorphus Fisher, 1906*

Fisher, 1906: 1056; Range: Hawaiian Is., 233 m.

Calliaster pedicellaris Fisher, 1906*

Fisher, 1906: 1061; Range: Hawaiian Is., 238–276 m.

Calliderma spectablis fisher, 1906*

Fisher, 1906: 1058; Range: Hawaiian Is., 143–390 m.

Ceramaster bowersi (Fisher, 1906)*

Fisher, 1906: 1049 (as *Nereidaster*); Range: Hawaiian Is., 411–593 m.

Evoplosoma forcipifera Fisher, 1906*

Fisher, 1906: 1065; Range: Hawaiian Is., 930–1250 m.

Gilbertaster anacanthus Fisher, 1906*

Fisher, 1906: 1063; Range: Hawaiian Is., 462–700 m.

Hippasteria imperialis Goto, 1914* **New state record**

Goto, 1914: 338; Range: Sagami Bay, S. Japan, 400–640 m.

Range Extension to Hawai‘i: CASIZ # 102006: O‘ahu: 6 mi offshore from Makapu‘u Point; 43.3 m (1300 ft); BPBM# W3022. Makapu‘u coral beds. 1200 ft.; BPBM: no # SE O‘ahu off Makupu‘u, Pt. Kaiwi Channel, 200 fms (365 m).

Mediaster ornatus Fisher, 1906*

Fisher, 1906: 1046; Range: Hawaiian Is., Philippines, East Indies, Maldives and Arabian Sea, 523–1630 m.

Peltaster micropeltus (Fisher, 1906)*

Fisher, 1906: 1054 (as *Tosia (Ceramaster)*); Range: Hawaiian Is., 570–1460 m.

Plinthaster ceramoidea (Fisher, 1906)*

Fisher, 1906: 1052 (as *Tosia (Plinthaster)*); Range: Hawaiian Is., 420–510 m.

Pseudarchaster jordani Fisher, 1906*

Fisher, 1906: 1038; Range: Hawaiian Is., to Moluccas, Borneo and S. of India, 590–1980 m.

Pseudarchaster myobrachius Fisher, 1906*

Fisher, 1906: 1037; Range: Hawaiian Is., 780–1240 m.

Fisher’s (1906) differentiation between *Pseudarchaster myobrachius* and *Pseudarchaster jordani* is based upon shorter rays and the absence of enlarged spinules on the actinal intermediate plates in the former and longer rays and the presence of enlarged spinules in the latter. Given the nature of the characters, and the very small size of the type material I suspect that the 2 species are synonyms.

Sphaeriodiscus ammophilus Fisher, 1906*

Fisher, 1906: 1051 (as *Pentagonaster*); Range: Hawaiian Is., 403–470 m.

Mithrodiidae

Mithrodia fisheri Holly, 1932

Holly, 1932: 6; Range: Hawaiian Islands and possibly Philippines and New Ireland, 20–86 m.

Thromidia catalai Pope & Rowe, 1977

Pope & Rowe, 1977: 203; Range: New Caledonia, Hawaiian Is., Bonin Is., E. of Japan and Philippines, 10–45 m.

Ophidiasteridae

Dactylosaster cylindricus pacificus Fisher, 1925
Fisher, 1925: ; Range: Hawaiian Is., 0–5 m.

Leiaster glaber (Peters, 1852)
Peters, 1852: 177 (as *Ophidiaster*); Range: Mozambique and Hawaiian Is., ~10 m.

Leiaster leachi (Gray, 1840)
Gray, 1840: 284; Fisher, 1925: 77 (as subspecies of *hawaiiensis*); Range: Throughout the Indo-Pacific, 10–30 m.

Linckia guildingi Gray, 1840 (including. *Linckia diplax*)
Gray, 1840: 285 (as *Ophidiaster*); Range: "Tropicopolitan" throughout tropical Pacific, Atlantic and Indian Oceans, 0–29 m.

Linckia multifora (Lamarck, 1816)
Lamarck, 1816: 565 (as *Asterias*); Range: From Hawai'i to S. Japan and throughout tropical Indo-West Pacific, 0–46 m.

Ophidiaster hemprichi Müller & Troschel, 1842
Müller & Troschel, 1842: 29; Range: Red Sea, S to East Africa and Mauritius, E. to Maldives and tropical W. Pacific including Hawai'i (as *Ophidiaster squameus* Fisher, 1906: 1079), 0–276 m.

Ophidiaster lorioli Fisher, 1906
Fisher, 1906: 1077; Range: Hawaiian Is., Samoa, SE Polynesia, Japan, 17 m.

Ophidiaster rhabdotus Fisher, 1906*
Fisher, 1906: 1082; Range: Hawaiian Is., c. 426 m.

Tamaria scleroderma (Fisher, 1906)*
Fisher, 1906: 1081 (as *Ophidiaster*); Range: Hawaiian Is., 180–194 m.

Tamaria tenella (Fisher, 1906)*
Fisher, 1906: 1082 (as *Ophidiaster*); Range: Hawaiian Is., 240–285 m.

Tamaria triserata (Fisher, 1906)*
Fisher, 1906: 1080 (as *Ophidiaster*); Range: Hawaiian Is., 125–165 m.

Oreasteridae

Culcita novaeguinae Müller & Troschel, 1842
Müller & Troschel, 1842: 38; Range: Hawaiian Is., throughout West Pacific, New Guinea, Andaman Is., 0–30 m.

Pentaceraster cumingi (Gray, 1840)
Gray, 1840: 276 (as *Pentaceros*); Range: Hawaiian Is., possibly East Pacific, Gulf of California, Peru, and Galapagos, 55–73 m.

VELATIDA

Myxasteridae

Asthenactis papyraceus Fisher, 1906*
Fisher, 1906: 1907; Range: Hawaiian Is., 1390–1830 m.

Pterasteridae

Benthaster eritimus Fisher, 1906*
Fisher, 1906: 1101; Range: Hawaiian Is., 405–910 m.

Hymenaster pentagonalis Fisher, 1906* **Depth extension**
Fisher, 1906: 1099; Range: Hawaiian Is., 530–620 m.
BPBM: Townsend Cromwell, 21°5.4'N, 156°34.4'W to 211°05'N, 156°32.6'W, 314–380 m.

Pteraster obesus myonotus Fisher, 1916* **New state record**
Fisher, 1916: 28l; Range: Philippines and N. Tasman Sea, 135–840 m.
Range Extension to Hawai'i: Bishop Museum, TC Sta. 40, #42: 21°01'N, 156°43.8'W to 20°57.5'N to 156°42.6'W, 120 fms (240 m); Bishop Museum TC Sta. 40, #48: 21°01.3'N, 156°43.8'W to 20°57.3'N, 156°47.5'W, 119 fms (238 m).

Pteraster reticulatus Fisher, 1906*
Fisher, 1906: 1098; Range: Hawaiian Is., 520–550 m.

SPINULOSIDA

Echinasteridae

?***Echinaster*** sp.

Fisher (1906: 1092) described 2 specimens of *Echinaster* he was unable to assign to a species but noted they had affinities to *Echinaster sladeni* (now *Cistina columbiae* [Ophidiasteridae]).

Range: Hawaiian Is., 142–294 m.

Henricia pauperrima Fisher, 1906*

Fisher, 1906: 1091; Range: Hawaiian Is., 362–1460 m.

Henricia robusta Fisher, 1906*

Fisher, 1906: 1090; Range: Hawaiian Is., 357–441 m.

Henricia sp.* **New state record**

A 3rd morphological form of *Henricia* was found in the Bishop Museum collections. This specimen differed from both *Henricia pauperrima* and *Henricia robusta* in terms of its overall size, arm and body morphology, and adambulacral spination. It could not be immediately reconciled with any *Henricia* spp. from Fisher (1906, 1919).

Material examined: BPBM W1773; Hawaiian Is., Moloka'i Channel, 200–250 fms, October 10, 1996, collected in tanglenet.

FORCIPULATIDA

Asteriidae

Coscinasterias acutispina (Stimpson, 1862)

Stimpson, 1862: 262 (as *Asterias*); Range: Hawaiian Is., Japan 0–6 m.

Sclerasterias euplecta (Fisher, 1906)*

Fisher, 1906: 1105 (as *Coscinasterias (Distolasterias)*); Range: Hawaiian Is., 98–396 m.

Tarsastrocles verrilli (Fisher, 1906)*

Fisher, 1906: 1106 (as *Hydrasterias*); Range: Hawaiian Is., 568–580 m.

Labidiasteridae

Coronaster eclipes Fisher, 1925*

Fisher, 1925: 86; Range: Hawaiian Is., 54 m (27 fms).

Pedicellasteridae

cf. ***Tarsaster*** n. sp? **New state record**

BPBM houses approximately 3 lots (~60 specimens) of a small 6 to 7-rayed pedicellasterid forcipulatacean. No pedicellasterids are known from the Hawaiian region (Fisher, 1906) and no similar species could be located in the literature for that immediate area (e.g., Fisher, 1919). Although tentatively identified as a new species, comparisons with type material and a more thorough search of the literature may reveal it to be otherwise.

Material examined: BPBM: TC 40, sta. 56: 21°2.3'N, 156°44.4'W to 20°58.9'N, 156°49.3'W. Depth: 130 fms (~260 m).

Zoroasteridae

Zoroaster spinulosus Fisher, 1906*

Fisher, 1906: 1102; Range: Hawaiian Is., 656–1114 m.

BRISINGIDA

Brisingidae

Brisinga alberti Fisher, 1906*

Fisher, 1906: 1111; Range: Hawaiian Is., 638–1000 m.

Brisinga evermanni Fisher, 1906*

Fisher, 1906: 1113; Range: Hawaiian Is., 800–1000 m.

Brisinga panopla Fisher, 1906*

Fisher, 1906: 1109; Range: Hawaiian Islands to Arabian Sea vicinity of Sri Lanka, 600–1136 m.

Hymenodiscidae

Hymenodiscus fragilis Fisher, 1906*

Fisher, 1906: 1115 (as *Brisinga*); Range: Hawaiian Islands, 256–414 m.

Novodiniidae

Novodinia pacifica Fisher, 1906*

Fisher, 1906: 1108 (as *Odinia*); Range: Hawaiian Is., to Japan, 600–1056 m.

Questionable Records in Hawai'i

The following species have been recorded as present in the Hawaiian fauna. No specimens or records of these species being present in Hawai'i have been confirmed in this century. The presence of any of the following in the Hawaiian Islands seems unlikely and the original records are suspect:

Archaster typicus Müller & Troschel, 1840 (Archasteridae)
Asterina miniata (Brandt, 1835) (as *Asterina granulosa*) (Asterinidae)
Fromia pacifica H.L. Clark, 1921 (Ophidiasteridae)
Gomophia egyptiaca Gray, 1840 (ex. *Nardoa egyptiaca*) (Ophidiasteridae)
Heliaster multiradiata Gray, 1840(Heliasteridae)
Linckia laevigata (Linnaeus, 1758) (Ophidiasteridae)
Luidia columbiae Gray, 1840 (including. *Luidia brevispina* Luetken, 1871) (Luidiidae)
Nepanthia (Asterinidae)
*Nidorellia armata(*Gray, 1840) (Oreasteridae)

Potential Endemism and Biodiversity

As currently understood, most deep-sea Hawaiian asteroids are endemic. Currently, at least 34 deep-sea asteroid species are known to occur only in Hawai'i. Fifteen species have distributions throughout the Pacific. However, in practically every case of endemic asteroid species, no investigations into morphological variation or geographic distribution has been done beyond the original description. In biodiversity studies of opisthobranch gastropods, Gosliner & Draheim (1996) stated that the perceived level of endemism for Hawaiian opisthobranchs was decreasing with increasing taxonomic refinement and discovery of additional species. Thus, the possibility exists that the perceived potentially high levels of endemism may be artifactual. However, no data exists to support or disprove a theory of high endemism in Hawaiian deep-sea starfishes.

A large disparity in diversity exists between shallow water and deep-sea Hawaiian asteroids species with the latter far exceeding the former. A total of 53 deep-sea asteroid species are known to occur in the Hawaiian islands region versus approximately 17 shallow-water species. Given the broad distributions of some deep-sea asteroids (e.g., *Mediaster ornatus*) and further taxonomic refinement it is possible the number of nominal species will decrease. However, until data from phylogenetic and vicariance studies are collected, evidence suggests an area of high deep-sea diversity versus a relatively depauperate shallow/inshore asteroid fauna

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The Hawaiian Species of *Trapezia* (Crustacea, Brachyura, Trapeziidae), Symbionts of *Pocillopora* (Scleractinia)

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Confusion has existed concerning the number of species of *Trapezia* that occur in the Hawaiian Islands. Discrepancies in the names used to refer to these species has added to the confusion.

Collections of live material and the study of collections deposited at the Bernice P. Bishop Museum, Honolulu (BPBM), Muséum National d'Histoire Naturelle, Paris (MNHN), National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM), The Natural History Museum, London (BMNH) and the Natural History Museum of Los Angeles County (LACM) show that 6 species of *Trapezia* inhabit the Hawaiian Islands. The list of species that follows includes all known published records from the islands. Registration numbers are given only for specimens from the Northwestern Hawaiian Islands.

List of Species

Trapezia digitalis Latreille, 1828
Grapsillus digitalis - Rathbun, 1906: 866.
Trapezia digitalis - Edmondson, 1933: 245; 1946: 301; 1962: 302, fig. 31e. - Preston, 1973: 470, fig. 1(4). - Huber & Coles, 1986: 23.

Remarks. *Trapezia digitalis* is widely distributed throughout the Indo-west Pacific and eastern Pacific regions.

Trapezia ferruginea Latreille, 1828
Grapsillus ferrugineus - Rathbun, 1906: 865.
Trapezia ferruginea maculata - Lenz, 1910: 466.
Trapezia cymodoce ferruginea - Edmondson, 1933: 245; 1946: 301; 1962: 298.
Trapezia ferruginea - Preston, 1973: 470, fig. 1(3). - Huber & Coles, 1986: 23.

Remarks. *Trapezia ferruginea* is known from across the Indo-west Pacific and eastern Pacific regions.

Trapezia flavopunctata Eydoux & Souleyet, 1842
Trapezia latifrons - Milne Edwards, 1867: 281. - Lenz, 1910: 467.
Grapsillus rufopunctatus flavopunctatus - Rathbun, 1906: 866.
Trapezia rufopunctata - Edmondson, 1933: 245; 1946: 301.
Trapezia flavopunctata - Edmondson, 1962: 300, figs. 31d, 32a (part). - Huber & Coles, 1986: 23.
Trapezia flavomaculata - Preston, 1973: 470, fig. 1(5).

Remarks. *Trapezia flavopunctata* is found throughout the Indo-west Pacific region from the Red Sea to French Polynesia. One specimen from the Hawaiian Islands (MNHN-B 2955) is part of the type material of *T. latifrons* Milne Edwards, 1867, a junior synonym of *T. flavopunctata*. Edmondson (1933, 1946) confused *T. flavopunctata* with *T. rufopunctata*. Although his description and illustrations of the species (Edmondson, 1962) are correct, most of the specimens he examined were incorrectly identified as *T. rufopunctata*. From the Northwestern Hawaiian Islands, it is known from Pearl and Hermes Atoll (BPBM S2716, USNM 64206) and Kure (BPBM S1127).

Trapezia intermedia Miers, 1886
Trapezia rufopunctata var. *intermedia* Miers, 1886: 168, pl. 12, fig. 2.
Grapsillus ferrugineus intermedius - Rathbun, 1906: 865.
Trapezia cymodoce intermedia - Edmondson, 1933: 245, fig. 151c; 1946: 301, fig. 180e; 1962: 298, fig. 31a.
Trapezia intermedia - Preston, 1973: 470, fig. 1(1). - Huber & Coles, 1986: 23.

Remarks. *Trapezia intermedia* was described from material collected by the *Challenger* Expedition in Honolulu (BMNH S84.31). It is known only from the main Hawaiian Islands, the Northwestern Hawaiian Islands, Wake (BPBM S1438), the northern Marshall Islands (USNM), and Palmyra Atoll (BPBM S11361). It has been collected from most of the Northwestern Hawaiian Islands: French Frigate Shoals (BPBM S1298), Laysan (BPBM S1242, USNM 29474), Lisianski (BPBM S1160), Pearl and Hermes Atoll (BPBM S1190, S2815; USNM 64198, 64199, 64203), Midway (BPBM S4588, LACM), and Kure Atoll (BPBM S1130).

Trapezia rufopunctata (Herbst, 1799)
Grapsillus rufopunctatus - Rathbun, 1906: 866, pl. 11, fig. 5.
Trapezia rufopunctata - Edmondson, 1962: 300, fig. 31c (part).
Trapezia flavopunctata - Edmondson, 1933: 247; 1946: 301.
?*Trapezia rufopunctata* - Cano, 1889: 211.

Remarks. *Trapezia rufopunctata* is widely distributed across the Indo-west Pacific region from the Red Sea to French Polynesia. There are only very few records from the Hawaiian Islands. The identification of the specimen recorded by Cano (1889) from Honolulu has not been verified. Only 1 specimen from O‘ahu (BPBM S5089) exists at the Bishop Museum. The Hawaiian specimens at BPBM identified by Edmondson as *T. rufopunctata* (see Edmondson, 1962) actually represent *T. flavopunctata*. Edmondson (1933, 1946) was also confused when he described *T. rufopunctata* but referred to is as *T. flavopunctata*. *T. flavopunctata* is also known from Midway (LACM).

Trapezia tigrina Eydoux & Souleyet, 1842
Trapezia tigrina Eydoux & Souleyet, 1842: 232, pl. 2, fig. 4.
Grapsillus maculatus - Rathbun, 1906: 865.
Trapezia maculata - Stimpson, 1858: 37; 1907: 73. Edmondson, 1933: 245, fig. 151e; 1946: 301, fig. 180f.
Trapezia cymodoce maculata - Edmondson, 1962: 300, fig. 31b.
Trapezia wardi - Preston, 1973: 470, fig. 1(2). - Huber & Coles, 1986: 23.

Remarks. *T. tigrina* was described from material collected in the Hawaiian Islands (MNHN-B 2950). In the Northwestern Hawaiian Islands, it is known from French Frigate Shoals (USNM 29484), Laysan (USNM 2959, 29483), Pearl and Hermes Atoll (BPBM S2816) and Midway Atoll (BPBM S11360). It is distributed across the Indo-west Pacific region from the Red Sea to French Polynesia.

Discussion

While 14 species of *Trapezia* have been recorded from French Polynesia and other islands of southeastern Polynesia (Castro, 1997), only 6 are found in the Hawaiian Islands. The geographic isolation of the Hawaiian Islands with respect of the rest of the Indo-west Pacific region accounts for the relatively small number of species. The low species richness of its *Pocillopora* hosts, also a consequence of geographic isolation, is perhaps another factor. The eastern Pacific, another geographically isolated region, has

only 4 species of *Trapezia* (Castro, 1996). Five species are so far known from Johnston Atoll, while 12 are known from the Line Islands.

Except for a record from Honolulu by Cano (1889), another (location given only as "Hawaiian Islands") by Rathbun (1906) and its inclusion as part of the Hawaiian fauna by Edmondson (1933, 1946), the presence of *T. cymodoce* (Herbst, 1801) in the Hawaiian Islands has never been confirmed. Although common throughout the Indian and western Pacific Oceans, it is known only as far east as southwestern Micronesia and Fiji, with questionable records from Samoa and French Polynesia. Specimens from Palmyra Atoll identified as *T. cymodoce* by Edmondson (1923) actually represent *T. lutea* Castro, 1997. Furthermore, Rathbun and others often confused specimens of *T. ferruginea* with *T. cymodoce*. As a result, several authors (including Edmondson, 1923) mistakenly included the Hawaiian Islands as part of the geographic distribution of *T. cymodoce*. Its inclusion in a key to the Hawaiian Xanthidae by Edmondson (1962) added to the confusion.

Key to the Hawaiian species of *Trapezia*

1. Dorsal surface of carapace without color spots, dots or irregular markings other than a white band in juveniles 2
— Dorsal surface of carapace with color spots, dots or irregular markings 3
2. Carapace dark brown (broad white band in juveniles). Anterolateral borders of carapace of adults straight and almost parallel to each other ..... *T. digitalis*
— Carapace brown orange. Anterolateral borders of carapace of adults curved .... *T. ferruginea*
3. Inner margin of cheliped propodus armed with teeth-like tubercles 4
— Inner margin of cheliped propodus smooth or with microscopic tubercles 5
4. Teeth along frontal border of carapace rounded. Carapace red with large orange to yellow spots ..... *T. flavopunctata*
— Teeth along frontal border of carapace pointed. Carapace cream with red spots .... *T. rufopunctata*
5. Carapace with irregular, light brown spots. Short setae along outer margin of cheliped propodus ..... *T. intermedia*
— Carapace cream with small red dots. No setae along outer margin of cheliped propodus ..... *T. tigrina*

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Taxonomic Changes Published in This Volume

ANGIOSPERMAE
Poaceae:

Agrostis semiverticillata (Forssk.) C. Chr. = *Polypogon viridis* (Gouan) Breistr., **new synonymy.**

Eragrostis molokaiensis St. John = *Eragrostis brownii* (Kunth) Nees ex Steud., **new synonymy.**

INSECTA
Diptera: Dolichopodidae:
Dactylomyia Aldrich, **new status**
Dactylomyia vockerothi Bickel, **new species**
Dactylomyia bicolor Parent, **new combination**; transferred from *Coelinium*.
Dactylomyia lateralis Say, **new combination**; transferred from *Medeterus*.
Neurigona kesseli Hendrickson = *Sympycnus pugil* Wheeler, **new synonymy.**

AMPHIPODA
Phoxocephalidae:
Mandibulophoxus hawaiiloa Muir & DeFelice, **new species**

(Records of the Hawaii Biological Survey for 1997: Part 2: Notes, are in *Bishop Museum Occasional Papers* 56)