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A Review of the Insects and Related Arthropods of Midway Atoll[1]

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Introduction

This paper presents results of a recent (1997–1999) survey of terrestrial arthropods of Midway Atoll and lists 546 species identified from 1891 to 1999. The last published compilation (Suehiro, 1960) listed 221 species, and the first complete listing from the 1923 Tanager Expedition published 38 species (Bryan *et al*., 1926). The increasing number of arthropod species reflected in these surveys is likely related to the increase in plant species present, increased contact between Midway and the outside world by means of surface and air vessels, and increased effort on the part of the U.S. Fish & Wildlife Service to inventory the arthropod fauna. The percentage of the fauna composed of native species (17%) is small and some of these species were not recollected during the present survey. Also, a large number (33%) of historically recorded alien species were not recollected. More recently introduced immigrants may have displaced some of them. The present list includes 205 new island records from Midway including 29 new records for the Hawaiian archipelago. Continued introductions resulting from frequent visits to Midway by uninspected air and surface vessels will result in serious pest problems there. Some observations are included on insects now present on Midway that may become serious pests if introduced to the main Hawaiian islands. Two species in particular, *Protaetia pryeri* (Janson) and *Scudderia paronae* Griffini should be monitored. Other concerns that should be addressed include ants, vespid wasps, and soil arthropods. A full bibliography of Midway terrestrial arthropod references is also included.

Midway is located approximately 1200 miles northwest of Honolulu and is the second oldest (28.7 ma) emergent atoll in the Hawaiian Archipelago.

In 1997, administration of Midway Atoll was transferred from the U.S. Navy to the U.S. Fish & Wildlife Service (USFWS). The USFWS, as part of an initial biological assessment of the atoll, and the Hawaii Biological Survey (HBS) at Bishop Museum supported 6 field trips to Midway to survey the terrestrial arthropod fauna. The trips were made on the following dates: 12–19 February 1997, 11–18 May 1997, 27 August–2 September 1997, 14–21 December 1997, 29 April–6 May 1998, and 20–23 October 1999. Additional material was collected with the assistance of USFWS personnel on Midway, who periodically serviced a Malaise trap in operation for an entire year. Specimens accumulated during this survey were returned to Bishop Museum in Honolulu for curatorial services and identification.

Historical Background

Relatively few entomologists have ever visited Midway and collections from that atoll are uncommon. The survey reported here has amassed the largest amount of Midway arthropod material ever accumulated. The earliest documented record of insect collecting on Midway is that of Henry Palmer in 1890, where insects were collected incidental to a bird

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survey. Several specimens from that collection were reported by Rothschild (1894). The first comprehensive survey for Midway arthropods was conducted in 1923 by the Tanager Expedition (Bryan *et al.*, 1926). The results of that survey listed 38 species of insects in 12 orders. Suehiro (1960) published a list of 221 species of arthropods in 20 orders based mainly on collections made by C.F. Clagg, E.J. Ford, Jr., and Y. Oshiro during the 1950s, but also including earlier records from the atoll. J.C. Downey *et al*., the Pacific Biological Survey, and the Smithsonian Institution engaged in exhaustive surveys of seabird parasites from 1959 to 1969. Those surveys resulted in an updated list of Pthiraptera (lice), increasing the number of Midway species from 4 (Suehiro, 1960) to 42 (Keler, 1958; Ward & Downey, 1973). We here report 546 species in 25 orders, a 147% increase in species representation as compared to the Suehiro list.

From 1936–1942, F.C. Hadden was stationed at Midway as a plant quarantine inspector for aircraft flights that used Midway as a refueling station (Hadden, 1941). Hadden concentrated on species intercepted on aircraft. For the most part, the species intercepted by Hadden did not become established on Midway, and they are not included here. Hadden's Midway quarantine collection is maintained at the Bishop Museum.

A list of the known collectors of insects and related arthropods on Midway and the dates of their collections is given in Table 1. An annotated chronology of documented insect collecting is found in Appendix 3. Additional specimens may reside elsewhere, as some unidentified U.S. Navy personnel may have also collected on Midway.

Table 1. Documented (and Probable) Insect Collectors on Midway (1890–1999).
(BPBM = Bishop Museum; HSPA = Hawaiian Sugar Planters' Association; UH = University of Hawaii; USDA = U.S. Department of Agriculture; USFWS = U.S. Fish & Wildlife Service; USN = U.S. Navy)

Year	Dates	Collector(s)
1890	July 13–17	Henry C. Palmer and George C. Munro
1902	August 21	W.A. Bryan
1905	?	G.P. Wilder
1923	?	D.T. Fullaway (Tanager Expedition).
1936–1942		F.C. Hadden (HSPA)
1938–1940	(3 short visits)	F.A. Bianchi (HSPA)
1951	March 21–27	C.B. Keck (USN)
1956–1959	(several visits)	C.F. Clagg & Y. Oshiro (USN)
1959–1961		J.C. Downey
1960	June	J.R. Einmo (USDA)
1960	November	E.J. Ford, Jr. (USDA)
1960–1962		H.I. Fisher & E.D. Klimstra
1963–1969		Pacific Ocean Biological Survey & Smithsonian Institution
1964	September 29–30	J.W. Beardsley (UH)
1964?–1966		C.F. Clagg (USN)
1970	December 13–17	J.L. Gressitt (BPBM)
1973	March	M.L. Goff & M.L. Cunningham (BPBM)
1978	April 17–18	L. Pinter (USN)
1983	July 16–19	W.C. Gagné (BPBM)
1997–1998	See text	G.M. Nishida (BPBM), A. Asquith (USFWS), G.A. Samuelson (BPBM), *et al.*
1999	October 20–23	J.W. Beardsley (BPBM)

Field Methods and Equipment

Arthropods were collected on Midway using the following methods and equipment:

Hand collecting. Plant foliage was scanned for both mobile and sessile specimens; loose bark, decomposing wood and leaf litter were searched; stones and debris of various sorts were moved for examination of the substrate beneath. This method was also employed at night assisted by a headlamp.

Aerial netting. Flying individuals were netted in the air with a fine mesh insect net, or by sweeping with the net over plants or substrate, or by stalking individuals resting on perches. Disturbed individuals that fell or were knocked to the ground were picked up manually.

Plant beating. Stout canvas beating net or a canvas collecting sheet and beating stick were used to strike plant foliage to dislodge arthropod specimens. These were then aspirated with a hand-held aspirator, or hand picked, and placed in collecting vials. This method was also employed at night.

Malaise trapping. A Malaise trap, a fine mesh trap designed to intercept flying insects and cause them to crawl upward on the trap surface into collecting chambers, was set up at favorable locations where it was serviced periodically to remove accumulated specimens and refresh the killing agent. The trap was operated at several localities on Midway over a one-year period. Excellent collections were obtained by this method; several species taken in the Malaise trap were not taken by any other method.

Trapping with attractive yellow surfaces. Yellow pan trapping was attempted. These traps are yellow-colored containers partly filled with water plus a surfactant, which serves to drown flying insects that are attracted to and attempt to land on the yellow surface. These traps were not effective on Midway when albatrosses were present. Virtually all the traps were overturned or filled with debris by the bird's activities; the technique subsequently was abandoned. The use of yellow sticky traps also was attempted. These traps are yellow cards covered with an adhesive substance and employ the same attractive principal as the pan traps. Because of concern that small birds might become stuck to these cards, this method also was abandoned. Eventually, a modified yellow window trap (a yellow cloth saturated with a pyrethroid insecticide in a partly closed container, with a collecting container beneath the cloth) was developed and proved serviceable.

Pitfall trapping. Pitfall traps consist of a baited container placed in a hole in the ground with the mouth of the container at ground level to collect crawling species. A dozen traps were set out on Midway but did not prove to be very effective. Their effectiveness was likely affected by the presence of high numbers of ants.

Tullgren funnel extraction. This device uses heat (usually provided by an incandescent light bulb) to extract small arthropods from soil, leaf-litter or similar material. As the substrate sample slowly dries downward from the top near the heat source, arthropods migrate downward into a collecting device at the bottom of the funnel. On Midway, Tullgren extractions from litter and soil yielded numerous mites, Collembola, and the like.

UV light collecting. Many nocturnally active arthropods are attracted to ultraviolet light. At suitable times, a white sheet was set up as a reflector and a landing site, and a portable UV lamp was used to attract insects, which were then hand picked from the sheet.

Laboratory Procedures

Specimens collected on Midway were taken to Bishop Museum in Honolulu where selected samples were sorted and labeled for dispersal to both intramural and extramural specialists. Some material was pin or point mounted, labeled, and presorted prior to dispersal, other material was dispersed in fluid (usually 70% ethyl alcohol). Identified specimens returned by specialists were given an identifying number and the data were added to a computerized database of Hawaiian terrestrial arthropod species maintained by the Museum. Unprocessed residues from the Malaise trap collections are maintained in fluid for long-term storage and future study. The voucher specimens for all species listed in the current survey and the unprocessed remainder are deposited with the Hawaii Biological Survey at Bishop Museum.

Results and Discussion

A full list of species identified from Midway, from 1891 to the present, is given in Appendix 1. The list, arranged alphabetically by order, family, and scientific name, provides common names if these are available, indicates the residency status, and furnishes information regarding year of collection. Following this are four columns that give the collection status of the species.

Tables 2 and 3 summarize the information detailed in Appendix 1, according to insect order, or, for other arthropods, a larger group (e.g.: acari or mites). Table 2 shows that about 7.5% of the fauna (41 species) are endemic. Several of these, known only from Midway and that have not been seen for decades, may be extinct (e.g.: *Agrotis fasciata* (Rothschild)). Only 9% (50 species, mostly migratory bird parasites) are indigenous.

Although 30 species are listed in Appendix 1 as having been purposely introduced into the Hawaiian Archipelago, there are no published records of purposeful introductions into Midway for biological control of pests, or otherwise. These species are listed in the appendix as "p/adv", although some of them may have been brought purposely to Midway by entomologists or others without the introduction being recorded in the entomological literature. In total, 455 species (83%) of the Midway arthropod fauna are considered to be adventive (accidentally introduced during historic times). This large proportion of alien species is not unexpected, as Midway has long been a center of human activity, including frequent visits by both surface vessels and aircraft, during its 142 years of recorded history. Human activity at Midway is summarized in Appendix 2.

Table 3 summarizes all known records of terrestrial arthropods reported from Midway. The first column is the total number of species reported for that particular group. The total includes literature and specimen records. The second column lists the number of species within the group collected during this survey. The third column lists the number of new island records for the group. Likewise, the fourth column lists the number of new state (or archipelago) records. The fifth column is the number of species listed previously that were recollected on this project. The sixth column lists those on the literature list that were not recollected during the course of this project. The seventh column indicates numbers of species that have yet to be verified as to presence or absence or those that were not sought for this project. For example, species parasitic on vertebrates, the lice and some of the parasitic mites, were not collected because earlier works including Keler (1958), Ward & Downey (1973), and others were considered quite thorough. Still requiring verification are the springtails (Collembola), some of the flies (Diptera), some moths (Lepidoptera), the barklice (Psocoptera), and the thrips (Thysanoptera); their listed numbers are asterisked.

Table 2. Arthropod groups listed by their residency status

	Total	Endemic	Indigenous	Purposely Introduced	Adventive
Blattaria (Cockroaches)	8	0	0	0	8
Coleoptera (Beetles)	78	4	3	13	57
Collembola (Springtails)*	19*	8*	0*	0*	11*
Dermaptera (Earwigs)	3	1	1	0	2
Diptera (Flies)*	62	7*	4*	1*	49*
Embiidina (Webspinners)	1	0	0	0	1
Heteroptera (True Bugs)	15	4	0	0	11
Homoptera (Scales et al.)	43	1	0	0	42
Hymenoptera (Bees & Wasps)	112	2	0	13	94
Isoptera (Termites)	3	0	0	0	3
Lepidoptera (Butterflies & Moths)*	36	4*	0*	1*	29*
Mantodea (Mantids)	1	0	0	0	1
Neuroptera (Lacewings etc.)	2	0	0	1	1
Odonata (Dragonflies)	1	0	1	0	0
Orthoptera (Grasshoppers etc.)	9	0	0	0	9
Phthiraptera (Lice)	42	0	38	0	4
Psocoptera (Booklice, Barklice)	1	0	0	0	1
Thysanoptera (Thrips)	6	0	0	0	6
Thysanura (Silverfish)	1	0	0	0	1
Araneae (Spiders)	26	2	0	0	24
Acari (Mites)	63	7	3	0	53
Chilopoda (Centipedes)	3	1	0	0	2
Pseudoscorpionida (Pseudoscorpions)	1	0	0	0	1
Scorpionida (Scorpions)	1	0	0	0	1
Isopoda (Pillbugs, Sowbugs)	9	0	0	0	9
Totals:	**546**	**41**	**50**	**30**	**425**

The total number of species known from Midway (546) includes both historical records and those obtained from the 1997–1999 survey. The number of these species now actually present probably is considerably less than 546. The number of species obtained from all literature sources prior to the initiation of the present survey was 332. Of those, only 121 have so far been identified from the 1997–1999 material, and 72 of the species definitely were not recollected.

The number of species so far identified from the 1997–1999 survey is 331. Another 88 species recorded from Midway are members of ectoparasitic groups considered to be well documented in relatively recent publications and were not sought in the present survey. The sum of these 2 figures (419) gives an approximation of the number of identified species presently established on the atoll. Of the 331 species from the 1997–1999 survey so far identified, 176 (53%) are new island records for Midway, and 29 (9%) are new state records based on this project, a total of 62% of the known established species. Sixty-two percent is a remarkably high number of new records, and is probably a result of a relatively high rate of arthropod immigration to Midway in combination with a relatively incomplete knowledge of the fauna.

The data of Appendix 1 show that the Midway fauna does not reflect normal representation of major arthropod groups found in continental assemblages. Many insect orders are not represented on Midway, particularly those associated with fresh water habitats. The Hymenoptera, especially the parasitoid groups, are more strongly represented than

Table 3. Summary of species included in Appendix 1

Group	Total Species Reported	No. Collected 1997-99	No. New Island Records	No. New State Records	No. Species Recollected	No. Not Recollected	No. Others
Blattaria	8	6	2	0	4	2	
Coleoptera	78	57	29	5	23	21	
Collembola	19	?	?	?	?	?	19
Dermaptera	3	3	0	0	3	0	
Diptera	62	26+	9	2	14	?	36
Embiidina	1	1	0	0	1	0	
Heteroptera	15	9	3	0	6	6	
Homoptera	43	38	28	0	10	5	
Hymenoptera	112	99	61	13	25	13	
Isoptera	3	3	1	0	2	0	
Lepidoptera	36	22+	8	0	13	2	12
Mantodea	1	0	0	0	0	1	
Neuroptera	2	1	0	0	1	1	
Odonata	1	1	0	0	1	0	
Orthoptera	9	5	2	0	3	4	
Phthiraptera	42	?	?	?	?	?	42
Psocoptera	1	?	?	?	?	?	?
Thysanoptera	6	?	?	?	?	?	6
Thysanura	1	0	0	0	0	1	
Araneae	26	18	11	2	5	8	
Acari	63	29+	14	6	7	7	34
Chilopoda	3	3	2	0	1	0	
Pseudoscorpionida	1	1	0	0	0	0	
Scorpionida	1	0	0	0	0	1	
Isopoda	9	9	6	1	2	0	
Totals:	**546**	**331**	**176**	**29**	**121**	**72**	**89**

expected, although this may represent more efficient collecting of these minute arthropods on Midway than is normally achieved in continental survey collections.

The identification of the collections made during the 1997-99 Midway survey is not complete, and perhaps a more accurate assessment of the faunal composition than one based simply on available identifications would be one based on those groups that are presently the most completely identified: the Coleoptera (beetles), the Homoptera (aphids, scales and relatives), the Hymenoptera (bees and wasps), and the Araneae (spiders). Of the 57 species of beetles collected in this survey, 34 (60%) are new to Midway. Of the 18 spiders collected during this survey, a remarkable 72% (13) are new island records. Of the 38 species of scales and their relatives, 28 (74%) are new island records. Of the 99 species of bees and wasps collected, 74 (75%) are new island records. These figures confirm a very high rate of introduction and establishment of terrestrial arthropods on Midway.

Forty-four of the 546 species listed from Midway do not occur in the main Hawaiian Islands. Five of the 44 are endemic and about 20 are indigenous species reported only from Midway, leaving about 19 native species not represented in those more southern islands. Add that to about 16 new archipelago records (29 are listed, but 13 of those also occur in the southern islands) and that totals about 35 species that potentially could be introduced into the southern part of the archipelago from Midway.

The recollection rate of native species was disappointing. Of the 4 endemic beetles

listed, 1 is a new record and potentially endemic, the other 3, previously recorded, were not recollected. Though not completely studied, interim results from the bugs and moths also suggest an impact on the native fauna. Of the 4 previously listed native seed bugs, only 2 were recollected. Of the 3 native moths, only 1 has been identified as recollected. These native species may still exist and their absence may be a result of exceptionally low population numbers or may just be a factor of chance in collecting. However, the consistency of non-collection among all groups suggests at the very least, the reduction of the presence of native species on Midway.

A disproportionate number of general predators and parasitic wasps occur on a relatively meager host base. For example, 13 ladybird beetles (coccinellids), were collected on the atoll, all are purposely introduced to the southern islands. Seven of the 13 are new island records for Midway. The total is 17% of the total number of beetles on Midway, and also 16% of all the coccinellids reported for all of Hawai‘i. Of 80 parasitic wasps, 11 were purposely introduced to the southern islands, but perhaps more significantly, 62 are new island records. This level of representation of predators and parasites was unexpected and suggests that a program of introduction of species for biological control of pest species took place; however, the existence of such a program is not documented.

Ants are an unfortunate major, ubiquitous component of the Midway ecosystem. In some places, particularly Eastern Island, ants dominate. They are undoubtedly a major disruptive force on what remains of the native ecosystem there, and could become an impediment to the reestablishment of native plants. Ants have been observed tending aphids, scales, and other sap-feeding species on Midway. In so doing, they probably reduce the effectiveness of parasites and predators on these pests, allowing populations of the pests to increase significantly. Ants are sometimes so numerous on Midway that nesting birds may be covered with them, apparently causing aggravation, a situation we observed several times during this survey. The effect of ants on nesting birds has not been studied on Midway, but is believed to be significantly detrimental.

Vespid wasps are another apparent problem on Midway. Many vespids are extremely efficient predators of caterpillars. The moth fauna of Midway is not only represented by relatively few species, but also appeared to be at low population levels during this survey. Night collecting using an ultraviolet light and a sheet was relatively unproductive compared to other localities in Hawai‘i. Despite diligent attention to the sheet, a disappointing low number (21) of moth species were collected on Midway and, except for a few very common alien forms, most of the species were represented by only a few individuals. Of 27 species listed prior to this survey, only 13 (48%) were recollected. Windy conditions may have limited nocturnal moth activity during periods when night survey collections were made. However, the very visible presence of hunting vespid wasps during the day suggests that these exerted a significant amount of predation pressure on larval Lepidoptera on Midway.

Of the Midway insect fauna presently known, two alien species, *Protaetia pryeri* (Janson), and *Scudderia paronae* Griffini, potentially could cause problems if introduced into the larger southeastern Hawaiian Islands. *Protaetia pryeri* (the emerald beetle) is a large, brilliantly colored scarab that was described from the Ryukyu Islands (Janson, 1888). Its habits there are unknown. On Midway, adults of the emerald beetle emerge from the soil as early as late April and a few stragglers remain through December. Peak emergence is during the late spring and early summer. The grubs live in the soil, where they feed on organic debris and possibly roots. The adults have been reported to feed on

plant foliage, fruits, and flowers in Midway gardens. Concentration of grubs seemed highest in areas of ironwood (*Casuarina*) although they were also collected under *naupaka* (*Scaevola*) and other plants. Ruddy turnstones (*Arenaria interpres*), bristle-thighed curlews (*Numenius tahitiensis*), and *kolea* or Pacific golden-plovers (*Pluvialis fulva*) were observed feeding on the grubs.

The katydid, *Scudderia paronae,* was observed feeding heavily on the growing tips of *naupaka* (*Scaevola*), especially on Eastern Island, creating distorted leaves and probably stunting growth of the plants. *Naupaka* may be an alternate host for this insect as it was most often seen in association with *Verbesina*. When the observation of *naupaka* feeding was made, *Verbesina* had mostly died back on Eastern Island and new growth had not yet appeared. *S. paronae* was first reported in the Hawaiian Islands from Kure Atoll in 1982 on *Eragrostis* (Conant 1985), suggesting that the species may be a generalized herbivore. Midway is a new island record for this species, although it might have established itself on Midway first and been overlooked before it migrated to Kure. In any case, it appears the species can disperse readily, and potentially could move to the other islands of Hawai‘i.

Twenty of the 63 mite species identified to date are new island records; 7 of these are new state records. Most of the mites were found associated with soil. Hadden (1941) estimated that 9,000 tons of soil were brought to Midway from Honolulu during the time he resided on the atoll. Though the exact origin of the soil is unknown, a significant portion of the resident mites probably were transported to Midway by this means. However, results of this survey indicate that about 1/3 of the species reported from Midway do not occur in the southern Hawaiian archipelago and could be accidentally transported there.

Numbers of Arthropod Species Relative to the Number of Plant Species

An atoll such as Midway would ordinarily have a paucity of available niches. This is reflected in the Tanager Expedition collections from 1921, which collected only 38 species of arthropods. The number of species expanded to 221 by 1960. The number of niches available was artificially expanded by the purposeful introduction of plants for windbreaks, food, and aesthetic purposes. Other plants were accidentally introduced and became established. Availability of diverse plant species, combined with ease of migration, permitted the establishment of herbivores and their associated predators and parasites and probably fostered the presence of detritivores. The number of arthropod species parallels the increase in plant species (see Figure 1). For example, W.A. Bryan reported 11 species of plants in 1902. The Tanager Expedition in 1923 reported 23 species of plants and 38 species of arthropods. Prior to 1923, the cable station already had been introducing plants to Midway. Hadden listed 54 cultivated plants in 1941, bringing the plant total to 77 species. In 1960, Suehiro reported 221 arthropod species. In 1998, Bruegmann listed 265 species of plants of which 35 were not recollected, a total of 230 resident plants. This survey reports 546 species of arthropods, of which 72 were definitely not recollected, a total of 474 species. Some of the uncollected arthropods may have been associated with the non-recollected plants. As many of the alien plant species are likely relatively recently introduced, they provide new opportunities for colonization. Howarth (1985) first described this phenomenon and used examples from the main Hawaiian Islands. Thus the number of potential new species of arthropods eventually becoming established on Midway is quite high.

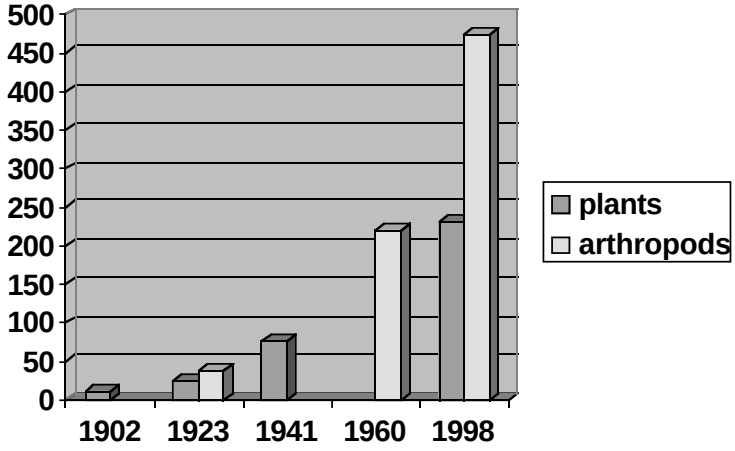

Figure 1. Relative numbers of plants and arthropods reported from Midway. Sources: 1902 = W.A. Bryan; 1923 = Tanager Expedition (E.H. Bryan et al.); 1941 = F.C. Hadden; 1960 = A. Suehiro; 1998 = M. Bruegmann, 1997-1999 Midway Survey.

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MIDWAY BIBLIOGRAPHY (including literature cited)

Adachi, M. 1952. Notes and exhibitions**:** New records and name changes in Hawaiian Ephydridae. *Proc. Hawaii. Entomol. Soc.* **14**(3): 353.

Aoki, J.-I. 1966. Oribatid mites from bird's nests on Midway Island (Acari: Cryptostigmata). *Pac. Insects* **8**(3): 770–76.

Beardsley, J.W. 1961. A review of the Hawaiian Braconidae (Hymenoptera). *Proc. Hawaii. Entomol. Soc.* **17**(3): 333–66.

———. 1967. Notes and exhibitions: *Spodoptera litura* (Fabricius) confirmed in Hawaii. *Proc. Hawaii. Entomol. Soc.* **19**(2): 130.

———. 1970. The Anagyrina of the Hawaiian Islands (Hymenoptera: Encyrtidae) with descriptions of two new species. *Proc. Hawaii. Entomol. Soc.* **20**(2): 287–310.

———. 1976. A synopsis of the Encyrtidae of the Hawaiian Islands with keys to genera and species (Hymenoptera: Chalcidoidae). *Proc. Hawaii. Entomol. Soc.* **22**(2): 181–228.

———. 1998. Hymenoptera from Midway Atoll. *Bishop Mus. Occas. Pap.* **58**: 37–50.

———. **& J.T. Huber**. 2000. Key to genera of Mymaridae in the Hawaiian Islands, with notes on some of the species (Hymenoptera: Chalcidoidea). *Proc. Hawaii. Entomol. Soc.* **34**: 1–22.

———. **& W.D. Perreira**. 2000. New distribution records for non-endemic Hymenoptera (Insecta) in Hawaii. *Bishop Mus. Occas. Pap*. **63**: 21–30.

Beatty, J.A., J.W. Berry & E.R. Berry. 2000. Additions and corrections to the spider fauna of Hawai'i. *Bishop Mus. Occas. Pap*. **64**: 32–39.

Bellinger, P.F. & K.A. Christiansen. 1989. Biogeography of the Collembola of Hawaii. *3rd Int. Seminar Apterygota. University of Seina. Siena, Italy.* **1989**: 121–26.

Berry, J.W., J.A. Beatty & J. Proszynski. 1997. Salticidae of the Pacific Islands. II. Distribution of nine genera, with descriptions of eleven new species. *J. Arachnol.* **25**(2): 109–36.

Bianchi, F.A. 1941. Thysanoptera and Aphididae new to the island of Midway. *Proc. Hawaii. Entomol. Soc.* **11**(1): 37.

———. 1945. Introduction to the Thysanoptera of New Caledonia. *Proc. Hawaii. Entomol. Soc.* **12**(2): 249–78.

Bickel, D.J. 1994 The Australian Sciapodinae (Diptera: Dolichopodidae), with a review of the Oriental and Australasian faunas, and a world conspectus of the subfamily. *Rec. Aust. Mus. Suppl*. **21**: 1–394.

———. 1994. Insects of Micronesia. Volume 13, no. 8. Diptera: Dolichopodidae Part I. Sciapodinae, Medeterinae and Sympycninae (part). *Micronesica* **27**(1/2): 73–118.

———. 1998. The Dolichopodidae (Diptera) of Midway Atoll, with a new species of *Dactylomyia* Aldrich, and taxonomic notes on the subfamily Neurigoninae. *Bishop Mus. Occas. Pap.* **55**: 45–55.

Bruegmann, M.M. 1998. Report on a botanical survey of Midway Atoll, April 1–7, 1995. U.S. Fish & Wildlife Service, Honolulu. [Unpublished report]

Bryan, E.H., Jr. 1926. Insects of Hawaii, Johnston Island and Wake Island. Introduction. *Bull. B.P. Bishop Mus.* **31**: 1–16.

———. 1926. Insects of Hawaii, Johnston Island and Wake Island. Coleoptera. *Bull. B.P. Bishop Mus.* **31**: 46–49.

———. 1926. Insects of Hawaii, Johnston Island and Wake Island. Diptera. *Bull. B.P. Bishop Mus.* **31**: 67–71.

———. 1926. Insects of Hawaii, Johnston Island and Wake Island. Orthoptera, Blattidae. *Bull. B.P. Bishop Mus.* **31**: 89.

———. 1926. Insects of Hawaii, Johnston Island and Wake Island. Other orders. *Bull. B.P. Bishop Mus.* **31**: 90-91.

———. 1926. Notes and exhibitions: Types of Tanager Expedition Coleoptera. *Proc. Hawaii. Entomol. Soc.* **6**(2): 235–36.

———. 1929. Notes and exhibitions: *Hippelates nigricornis* Thomson. *Proc. Hawaii. Entomol. Soc.* **7**(2): 235.

———. 1934. A review of the Hawaiian Diptera, with descriptions of new species. *Proc. Hawaii. Entomol. Soc.* 8(3): 399–468.

———. 1936. Notes and exhibitions: *Milichiella lacteipennis* (Loew). *Proc. Hawaii. Entomol. Soc.* **9**(2): 145.

———. 1938. Midway Island, U.S.A. *Paradise of the Pacific* **50**(6): 7, 29–30.

———. **& O.H. Swezey**. 1926. Insects of Hawaii, Johnston Island and Wake Island. Hemiptera. *Bull. B.P. Bishop Mus.* **31**: 80–81.

Bryan, W.A. 1906. Report of a visit to Midway Island. *Occas. Pap. B.P. Bishop Mus.* **2**(4): 37–45 [291–299].

Chapin, E.A. 1965. Coccinellidae. *Ins. Micronesia* **16**(5): 189–254.

Chilson, L.M. 1961. Notes and exhibitions: *Atractomorpha sinensis* Bolivar. *Proc. Hawaii. Entomol. Soc.* **17**(3): 315–16.

———. 1962. Notes and exhibitions: *Anisolabis maritima* (Géné). *Proc. Hawaii. Entomol. Soc.* **18**(1): 5.

Christiansen, K.A. & P.F. Bellinger. 1992. Collembola. *Insects of Hawaii* **15**: 1–445.

Christophersen, E. & E.L. Caum. 1931. Vascular plants of the Leeward Islands, Hawaii. *B.P. Bishop Mus. Bull.* **81**: 1–41.

Clagg, C.F. 1957. Notes and exhibitions: *Anomala sulcatula* Burmeister. *Proc. Hawaii. Entomol. Soc.* **16**(2): 193.

———. 1957. Notes and exhibitions: *Achaea janata* (L.). *Proc. Hawaii. Entomol. Soc.* **16**(2): 197.

———. 1957. Notes and exhibitions: Coleoptera from Midway Island. *Proc. Hawaii. Entomol. Soc.* **16**(3): 338.

———. 1957. Notes and exhibitions: *Coptotermes formosanus* Shiraki. *Proc. Hawaii. Entomol. Soc.* **16**(3): 339.

———. 1965. Notes and exhibitions: Insects on MATS plane. *Proc. Hawaii. Entomol. Soc.* **19**(1): 6.

———. 1968. Notes and exhibitions: *Pantala flavescens* (Fabricius). *Proc. Haw. Ent. Soc.* **19**(3): 347.

———. 1968. Notes and exhibitions: *Aedes albopictus* (Skuse). *Proc. Haw. Ent. Soc.* **19**(3): 347.

Clarke, J.F.G. 1986. Pyralidae and microlepidoptera of the Marquesas archipelago. *Smithson. Contrib. Zool.* **416**: 1–485.

Commonwealth Institute of Entomology. 1961. *Distribution maps of pests. Series A (Agricultural).* C.A.B. International, Commonwealth Institute of Entomology, London. 569+ p.

Conant, P. 1985. Notes and exhibitions: *Scudderia paronae* Griffini. *Proc. Hawaii. Entomol. Soc.* **25**: 25.

Diaz Patxot, J. & M.L. Goff. 1985. Two new species and new records of Cheyletidae (Acari) in Hawaii with a key to the species. *Int. J. Acarol.* **11**(3): 157–62.

Dougherty, H.E. 1935. The cruise of the *Itasca*. *Paradise of the Pacific* **47**(3): 21–25.

Ehrhorn, E.M. 1911. Division of Entomology. Report of the Superintendent of Entomology for 1909. *Rep. Bd. Comm. Agric. For. Terr. Hawaii* **1910**: 103–23.

———. 1911. Board of Agriculture and Forestry. Division of Entomology [report]. *Hawaii For. Agric.* **7**(7): 207–09.

———. 1911. Board of Agriculture and Forestry. Division of Entomology [report]. *Hawaii For. Agric.* **7**(11): 330–31.

———. 1912. Division of Entomology. *Hawaii For. Agric.* **8**(5): 164–66.

———. 1912. Division of Entomology. *Hawaii For. Agric.* **8**(8): 236–37.

Einmo, J.R. 1961. Notes and exhibitions: *Spodoptera mauritia acronycotoides* (Guenée). *Proc. Hawaii. Entomol. Soc.* **17**(3): 323.

Evenhuis, N.L. 2000. New Hawaiian Diptera records, with special reference to the Diptera of Kahoʻolawe. *Bishop Mus. Occas. Pap*. **64**: 22–27.

Fefer, S.I., C.S. Harrison, M.B. Naughton & R.J. Shallenberger. 1984. Synopsis of

results of recent seabird research conducted in the northwestern Hawaiian Islands. *Proc. 2nd Symp. Res. Invest. NW Hawaii. Is.* **1**: 9–76.

Froeschner, R.C. 1977. The burrowing bugs of Hawaii, with description of a new species. *Proc. Hawaii. Entomol. Soc.* **22**(2): 229–36.

Fullaway, D.T. & N.L.H. Krauss. 1945. *Common insects of Hawaii*. Tongg Publ. Co., Honolulu. 228 p.

Gagné, W.C. & F.G. Howarth. 1985. Conservation status of endemic Hawaiian Lepidoptera. *Proc. 3rd Congr. Eur. Lepid.* 1982: 74–84.

Garrett, L.E. & F.H. Haramoto. 1967. A catalog of Hawaiian Acarina. *Proc. Hawaii. Entomol. Soc.* **19**(3): 381–414.

Goff, M.L. 1975. A new species of chigger (Acarina: Trombiculidae) from the Midway Islands. *J. Med. Entomol.* **12**(1): 52–54.

———. 1984. Three new species and new records of chiggers (Acari: Trombiculidae) from the northwestern Hawaiian Islands. *J. Med. Entomol.* **21**(3): 257–62

———. 1985. Notes and exhibitions: Some new mite records for Hawaii. *Proc. Hawaii. Entomol. Soc.* **25**: 28–29.

———. 1986. Spider mites (Acari: Tetranychidae) in the Hawaiian Islands. *Int. J. Acarol.* **12**(1): 43–49.

———. 1987. A catalog of Acari of the Hawaiian Islands. *Hawaii. Inst. Trop. Agric. Res. Ser.* **75**: 1–75.

———., **P.R. Sievert & L. Sileo**. 1989. New species of Apoloniinae (Acari: Trombiculidae) from the Laysan albatross taken in the Midway Islands and a key to the species of Apoloniinae of the world. *J. Med. Entomol.* **26**(5): 484–86.

Gressitt, J.L. 1957. Notes and exhibitions: *Xylotrechus* sp. on Midway Island. *Proc. Hawaii. Entomol. Soc.* **16**(3): 326.

———. **& C.J. Davis**. 1972. Seasonal occurrence and host-lists of Hawaiian Cerambycidae. *IBP Island Ecosyst. IRP Tech. Rep.* **5**: 1–34.

Hadden, F.C. 1939. Notes and exhibitions: *Chrysopa lanata* Banks. *Proc. Hawaii. Entomol. Soc.* **10**(1): 9–10.

———. 1941. Midway Islands. *Hawaii. Planters' Rec.* **45**(3): 179–221.

Hardwick, D.F. 1966. A description of a new subspecies of *Helicoverpa pallida* Hardwick with notes on the Heliothidinae (Lepidoptera: Noctuidae). *Can. Entomol.* **98**(8): 867–70.

Hardy, D.E. 1960. Diptera: Nematocera-Brachycera. *Insects of Hawaii* **10**: 1–368.

———. 1981. Diptera: Cyclorrhapha IV, series Schizophora, section Calyptratae. *Insects of Hawaii* **14**: 1–491.

———. **& M.A. Kohn**. 1964. Dolichopodidae. *Insects of Hawaii* **11**: 13–257.

———. **& M.D. Delfinado**. 1980. Diptera: Cyclorrhapha III, series Schizophora, section Acalypterae, exclusive of family Drosophilidae. *Insects of Hawaii* **13**: 1–451.

Hebard, M. 1926. Insects of Hawaii, Johnston Island and Wake Island. Dermaptera and Orthoptera. *Bull. B.P. Bishop Mus.* **31**: 82–88.

Henry, T.J. & R.C. Froeschner. 1988. *Catalog of the Heteroptera, or true bugs of Canada and the continental United States.* E.J. Brill, New York. 958 p.

Howarth, F.G. 1985. Impacts of alien land arthropods and mollusks on native plants and animals in Hawaii, p. 149–79. *In*: Stone, C.P. & J.M. Scott, eds., *Hawaii's terrestrial ecosystems: preservation and management: proceedings of a symposium held June 5-6, 1984, at Hawaii Volcanoes National Park.* University of Hawaii, Honolulu. 584 + xxviii p.

Howarth, F.G., G.M. Nishida & N.L. Evenhuis. 2001. Insects and other terrestrial arthropods, p. 41–62. *In*: Staples, G.W. & R.C. Cowie, eds., *Hawaii's invasive species. a guide to invasive plants and animals in the Hawaiian islands*. Mutual Publ. & Bishop Museum Press, Honolulu. [xii] + 116 p.

Hu, S.M.K. 1951. Notes and exhibitions: Midway Island insects. *Proc. Hawaii. Entomol. Soc.* **14**(3): 351.

Imada, C. 1998. Herbarium Pacificum database, Bishop Museum, Honolulu, 11 January 1998.

Jacot-Guillarmod, C.F. 1971. Catalogue of the Thysanoptera of the world (part 2). *Ann. Cape Prov. Mus.* **7**(2): 217–515.

James, M.T. 1962. Diptera: Stratiomyidae, Calliphoridae. *Insects of Micronesia* 13(4): 75–127.

Janson, O.E. 1888. On some species of Cetoniidae from the Loo Choo Islands. *Ann. Mag. Nat. Hist.* (6) **1**: 194–96.

Joyce, C.R. 1957. Notes and exhibitions: *Phaenicia* spp. *Proc. Hawaii. Entomol. Soc.* **17**(3): 326.

Keck, C.B. 1952. Notes and exhibitions: Midway Island insects. *Proc. Hawaii. Entomol. Soc.* **14**(3): 351.

Keler, S. von. 1958. Die Mallophagen von Sturmvögeln und Ruderfüssern I. *Harrisoniella* Bedford und *Perineus* Thompson (Mallophaga). *Beitr. Ent.* **8**(3/4): 378–84.

Kevan, D.K.M. 1975. The synonymy and distribution of the Crenulata- and Psittacina-groups of *Atractomorpha* Saussure 1862 (Orthoptera: Acridoidea: Pyrgomorphidae). *J. Linn. Soc. Lond. Zool.* **57**(2): 95–154

Leeper, J.R. 1975. A review of the Hawaiian Coccinellidae. *IBP Island Ecosyst. IRP Tech. Rep* **53**: 1–54.

———. 1977. A review of the Hawaiian Coccinellidae. *Proc. Hawaii. Entomol. Soc.* **22**(2): 279–306.

Mathis, W.N. 1995. Shore flies of the Galapagos Islands (Diptera: Ephydridae). *Ann. Entomol. Soc. Am.* **88**(5): 627–40.

———. 1997. Shore flies of the Belizean cays (Diptera: Ephydridae). *Smithson. Contrib. Zool.* **592**: 1–77.

———. **& T. Zatwarnicki**. 1995. World catalog of shore flies (Diptera: Ephydridae). *Mem. Entomol., Int.* **4**: 1–423.

Munroe, E.G. 1989. Changes in classification and names of Hawaiian Pyraloidea since the publication of Insects of Hawaii, Volume 8, by E.C. Zimmerman (1958) (Lepidoptera). *Bishop Mus. Occas. Pap.* **29**: 199–212.

Nishida, G.M., editor. 1992. Checklist of Hawaiian terrestrial arthropods. *Bishop Mus. Tech. Rep.* 1: viii + 262 p.

———. 1994. Checklist of Hawaiian terrestrial arthropods. Second edition. *Bishop Mus. Tech. Rep.* 4: iv + 287 p.

———. 1997. Checklist of Hawaiian terrestrial arthropods. Third edition. *Bishop Mus. Tech. Rep.* 12: iv + 263 p.

———. **& J.M. Tenorio**. 1993. *What bit me? Identifying Hawai'i's stinging and biting insects and their kin.* Univ. Hawaii Press, Honolulu. 71 p.

Palma, R.L. 1994. New synonymies in the lice (Insecta: Phthiraptera) infesting albatrosses and petrels (Procellariiformes). *N.Z. Entomol.* **17**: 64–69.

———. **& R.L.C. Pilgrim**. 1984. A revision of the genus *Harrisoniella* (Mallophaga: Philopteridae). *N.Z. J. Zool.* **11**(2): 145–66.

———. 1987. A revision of the genus *Perineus* (Phthiraptera: Philopteridae). *N.Z. J. Zool.* **14**(4): 563–86.

Pape, T. 1996. Catalogue of the Sarcophagidae of the world (Insecta: Diptera). *Mem. Entomol., Int.* **8**: 1–558.

Pemberton, C.E. 1944. Insects carried in transpacific airplanes. A review of quarantine work prior to December 7, 1941. *Hawaii Planters' Rec.* **48**(3): 183–86.

Perkins, R.C.L. 1906. Exhibitions and notes. *Proc. Hawaii. Entomol. Soc.***1**: 33–34.

———. 1913. Introduction being a review of the land-fauna of Hawaiia. *Fauna Hawaiiensis* **1**(6): xv–ccxxvii.

———. 1916. Some new Hawaiian Coleoptera. *Proc. Hawaii. Entomol. Soc.* **3**(3): 247– 51.

———. 1926. Insects of Hawaii, Johnston Island and Wake Island. Coleoptera, weevils. *Bull. B.P. Bishop Mus.* **31**: 53–66.

Pinter, L. 1980. Notes and exhibitions: widow and violin spiders in Hawaii. *Proc. Hawaii. Entomol. Soc.* **23**(2): 158.

———. 1981. Notes and exhibitions: *Dacus dorsalis* (Hendel). *Proc. Hawaii. Entomol. Soc.* **23**(3): 323.

Rainwater, H.I. 1963. Agricultural insect pest hitchhikers on aircraft. *Proc. Hawaii. Entomol. Soc.* **18**(2): 303–09.

Riotte, J.C.E. 1984. The genus *Agrius* in the Pacific region, with description of a new species (Lepidoptera: Sphingidae). *Int. J. Entomol.* **26**(4): 339–50

———. 1986. Supplement. I to E.C. Zimmerman, "Insects of Hawaii" Vol. 7(1958) Macrolepidoptera. *Insecta Mundi* **1**(4): 241–42.

Roth, V.D. & G.M. Nishida. 1997. Corrections and additions to the spider fauna of Hawaii. *Bishop Mus. Occas. Pap.* **49**: 41–48.

Rothschild, W. 1894. Some new species of Lepidoptera. *Novit. Zool.* **1**(3): 535–40.

Sakimura, K. & K. O'Neill. 1979. *Frankliniella*, redefinition of genus and revision of *minuta* group species (Thysanoptera: Thripidae*). U.S. Dep. Agric. Tech. Bull.* **1572**: 1–49.

Samuelson, G.A. 1998. New records of Hawaiian Coleoptera. *Bishop Mus. Occas. Pap.* **56**: 27–33.

Schreiner, I.H. 1991. Sources of new insects established on Guam in the post World War II period. *Micronesica Suppl.* **3**: 5–13.

Shannon, R.C. 1926. Insects of Hawaii, Johnston Island and Wake Island. A new *Lucilia* from Hawaii. *Bull. B.P. Bishop Mus.* **31**: 72.

Shelmidine, L.S. 1948. The early history of Midway Islands. *American Neptune* **1948**(July): 179–95.

Slater, J.A. & J.E. O'Donnell. 1995. *A catalogue of the Lygaeidae of the world (1960–1994).* New York Entomological Society, New York. 410 p.

Smith, M.R. 1944. Ants of the genus *Cardiocondyla* Emery in the United States. *Proc. Entomol. Soc. Wash.* **46**(2): 30–41.

St. John, H. 1935. Additions to the flora of Midway Islands. *B.P. Bishop Mus. Occas. Pap.* **11**(14): 3–4.

Stone, A. & W.W. Wirth. 1947. On the marine midges of the genus *Clunio* Haliday (Diptera: Tendipedidae). *Proc. Entomol. Soc. Wash.* **49**(8): 201–24.

Suehiro, A. 1960. Insects and other arthropods from Midway Atoll. *Proc. Hawaii. Entomol. Soc.* **17**(2): 289–98.

Suman, T.W. 1964. Spiders of the Hawaiian Islands: catalog and bibliography. *Pac. Insects* **6**(4): 665–87.

Swezey, O.H. 1920. The Tahiti coconut weevil, *Calandra taitensis* Guerin, in Hawaii. *Proc. Hawaii. Entomol. Soc.* **4**(2): 333–35.

———. 1926. Insects of Hawaii, Johnston Island and Wake Island. Lepidoptera. *Bull. B.P. Bishop Mus.* **31**: 73–79.

———. 1929. Notes on the egg-parasites of insects in Hawaii. *Proc. Hawaii. Entomol. Soc.* 7(2): 282–92

Swift, S.F. 1996. Hawaiian Raphignathoidea: family Cryptognathidae (Acariformes: Prostigmata), with descriptions of three new species of the genus *Favognathus*. *Int. J. Acarol.* **22**(2): 83–99.

———. 1997. Two new Hawaiian bird mite (Acari) records. *Bishop Mus. Occas. Pap.* **49**: 38–39.

———. **& M.L. Goff**. 1987. The family Bdellidae (Acari: Prostigmata) in the Hawaiian Islands. *Int. J. Acarol.* **13**(1): 29–49.

———. **& R.A. Norton**. 1998. Preliminary report on oribatid mite (Acari: Oribatida) diversity in the Hawaiian Islands. *Bishop Mus. Occas. Pap.* 57: 1–44.

Taiti, S. 1999. Terrestrial isopods from Midway Atoll (Crustacea: Oniscidea). *Bishop Mus. Occas. Pap*. **59**: 37–38.

———. **& F.G. Howarth**. 1996. Terrestrial isopods from the Hawaiian Islands (Isopoda: Oniscidea). *Bishop Mus. Occas. Pap.* **45**: 59–71.

Tenorio, J.A. 1969. Taxonomic and biological studies of Hawaiian Sphaeroceridae (Diptera). *Proc. Hawaii. Entomol. Soc.* **20**(1): 169–212.

———. 1979. Notes and exhibitions: *Culex pipiens quinquefasciatus* Say from Kure I., Leeward Hawaiian Islands. *Proc. Hawaii. Entomol. Soc.* **23**(1): 15.

Tenorio, J.M. 1976. Catalog of entomological types in the Bernice P. Bishop Museum. Subclass Acari. *Pac. Insects* **17**(1): 7–46.

———. 1978. Catalog of entomological types in the Bishop Museum. Mallophaga. *Pac. Insects* **20**(1): 5–17.

———. 1982. Hypoaspidinae(Acari: Gamasida: Laelapidae) of the Hawaiian Islands. *Pac. Insects* **24**(3-4): 259–74.

Tenorio, J.M. & M.L. Goff. 1980. Ectoparasites of Hawaiian rodents (Siphonaptera, Anoplura and Acari). *Spec. Publ. Dep. Entomol. Bishop Mus* [1]: 1–32.

Tenorio, J.M., H.A. Denmark & S.F. Swift. 1985. Catalog of Acari in the Hawaiian Islands. I. Mesostigmata (or Gamasida) (Acari). *Int. J. Entomol.* **27**(4): 297–309.

Thornton, I.W.B. 1981. The Psocoptera of the Hawaiian Islands. Parts I and II. Introduction and the nonendemic fauna. *Pac. Insects* **23**(1-2): 1–49.

Timberlake, P.H. 1924. Records of the introduced and immigrant chalcid-flies of the Hawaiian Islands (Hymenoptera). *Proc. Hawaii. Entomol. Soc.* **5**(3): 418–49.

———. 1926. Insects of Hawaii, Johnston Island and Wake Island. Hymenoptera. *Bull. B.P. Bishop Mus.* **31**: 17–43.

Timmermann, G. 1969. Neue Mallophagen aus dem Bernice P. Bishop Museum, Honolulu. *Bonn. Zool. Beitr.* **20**(1/3): 244–52.

Usinger, R.L. 1942. The genus *Nysius* and its allies in the Hawaiian Islands (Hemiptera, Lygaeidae, Orsillini). *Bull. B.P. Bishop Mus.* **173**: 1–167.

Van Zwaluwenburg, R.H. 1926. Notes and exhibitions: *Monocrepidius exsul* Shp. *Proc. Hawaii. Entomol. Soc.* **6**(2): 244.

———. 1932. Check list of the Elateridae of Oceania. *Occas. Pap. B.P. Bishop Mus.* **9**(23): 1–28

———. 1956. Notes and exhibitions: *Anomala sulcatula* Burmeister. *Proc. Hawaii. Entomol. Soc.* **16**(1): 2.

Walsingham, T. de Grey. 1907. Microlepidoptera. *Fauna Hawaiiensis* **1**(5): 469–759.

Ward, R.A. & J.C. Downey. 1973. Checklist of the Mallophaga of Midway Atoll, Pacific Ocean. *J. Med. Entomol.* 10(4): 391–96.

Wheeler, W.M. 1934. Revised list of Hawaiian ants. *Occas. Pap. B.P. Bishop Mus.* **10**(21): 3–21.

———. 1935. Check list of the ants of Oceania. *Occas. Pap. B.P. Bishop Mus.* **11**(11): 3– 56.

Williams, F.X. 1944. Biological studies in Hawaiian water-loving insects. Part III. Diptera or flies. D. Culicidae, Chironomidae, and Ceratopogonidae. [149–180]. Part IV. Lepidoptera or moths and butterflies [180–185]. Part V. Hemiptera or bugs [186–196]. Addenda. *Proc. Hawaii. Entomol. Soc.* **12**(1): 149–97.

Wilson, E.O. & R.W. Taylor. 1967. The ants of Polynesia (Hymenoptera: Formicidae). *Pac. Insects Monogr*. **14**: 1–109.

Wirth, W.W. 1969. The shore flies of the genus *Canaceoides* Cresson (Diptera: Canaceidae). *Proc. Calif. Acad. Sci.* (4) **36**(19): 551–69.

———. 1978. New species and records of intertidal biting midges of the genus *Dasyhelea* Kieffer from the Gulf of California (Diptera: Ceratopogonidae). *Pac. Insects* **18**(3-4): 191–98.

Yoshimoto, C.M. 1961. Notes and exhibitions: *Dolichurus stantoni* (Ashmead). *Proc. Hawaii. Entomol. Soc.* **18**(3): 342–43.

———. 1965. Synopsis of Hawaiian Eulophidae including Aphelininae (Hym.: Chalcidoidea). *Pac. Insects* **7**(4): 665–99.

Zapparoli, M. & R.M. Shelley. 2000. The centipede order Lithobiomorpha in the Hawaiian Islands (Chilopoda). I. The epigean fauna. *Bishop Mus. Occas. Pap*. **63**: 35–49.

Zimmerman, E.C. 1940 Studies of Hawaiian Neuroptera. *Proc. Hawaii. Entomol. Soc.* **10**(3): 487–510.

———. 1940. Synopsis of the genera of Hawaiian Cossoninae with notes on their origin and distribution (Coleoptera, Curculionidae). *Occas. Pap. B.P. Bishop Mus.* **15**(25): 271–93.

———. 1948. Apterygota to Thysanoptera inclusive. *Insects of Hawaii* **2**: 1–475.

———. 1948. Heteroptera. *Insects of Hawaii* **3**: 1–255.

———. 1948. Homoptera: Auchenorhyncha. *Insects of Hawaii* **4**: 1–268.

———. 1948. Homoptera: Sternorhyncha. *Insects of Hawaii* **5**: 1–464.

———. 1957. Ephemeroptera-Neuroptera-Trichoptera and supplement to volumes 1 to 5. *Insects of Hawaii* **6**: 1–209

———. 1958. Macrolepidoptera. *Insects of Hawaii* **7**: 1–542.

———. 1958. Lepidoptera: Pyraloidea. *Insects of Hawaii* **8**: 1–456.

———. 1978. Microlepidoptera. Part I. Monotrysia, Tineoidea, Tortricoidea, Gracillarioidea, Yponomeutoidea, and Alucitoidea. *Insects of Hawaii* **9**(1): 1–882.

———. 1978. Microlepidoptera. Part II. Gelechioidea. *Insects of Hawaii* **9**(2): 883–1903.

Appendix 1. Current list of arthropod species from Midway.

(Abbreviations: origin: adv = adventive, end = endemic, ind = indigenous, pur = purposely introduced, p/adv = purposely introduced to main Hawaiian islands, but adventive to Midway) (status: NIR = new island record, NSR = new archipelago or state record, pir = new island record for project, psr = new state record for project) (checklists: 23 = Tanager Expedition, 60 = Suehiro list, 98 = present project; ? = not sought or study not completed, X = not recollected) (determiners: DJB = D.J. Bickel, DJP = D.J. Preston, FGH = F.G. Howarth, GAS = G.A. Samuelson, GMN = G.M. Nishida, JB = J. Beatty, JWB = J.W. Beardsley, KA = K. Arakaki, KS = K. Sattler, MA = M. Asche, NJR = N.J. Reimer, NLE=N.L. Evenhuis, RJW: R.J. Woodrow, RRS = R.R. Snelling, RS=Rowland Shelley, SFS = S.F. Swift, S&N = S.F. Swift & R.A. Norton, ST = S. Taiti, WJK = W.J. Knight, WM=William Muchmore)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
INSECTA							
Order BLATTODEA	ROACHES						
Family Blaberidae							
Diploptera punctata (Eschscholtz, 1822)	Pacific beetle cockroach	adv	NIR			98	GMN
Pycnoscelus indicus (Fabricius, 1775)	Burrowing cockroach	adv			60	98	GMN
Family Blattellidae							
Blattella germanica (Linnaeus, 1767)	German cockroach	adv			60	X	
Blattella lituricollis (Walker, 1868)	False German cockroach	adv			60	98	GMN
Supella longipalpa (Fabricius, 1798)	Brownbanded cockroach	adv			60	X	
Symploce pallens (Stephens, 1835)		adv	NIR			98	GMN
Family Blattidae							
Periplaneta americana (Linnaeus, 1758)	American cockroach	adv		23	60	98	GMN
Periplaneta australasiae (Fabricius, 1775)	Australian cockroach	adv			60	98	GMN
Order COLEOPTERA	BEETLES						
Family Alleculidae	Comb-clawed beetles						
?Lobopoda sp.		adv?	psr			98	GAS
Family Anobiidae	Anobiid beetles						
Lasioderma serricorne (Fabricius, 1792)	Cigarette beetle	adv	NIR			98	GAS
Family Anthicidae	Antlike flower beetles						
Anthicus tobias Marseul, 1879		adv	NIR			98	GAS
Family Anthribidae	Fungus weevils						
Araecerus fasciculatus (DeGeer, 1775)	Coffee bean weevil	adv	pir			98	GAS
Araecerus levipennis Jordan, 1924	Koa haole seed weevil	adv			60	X	
Exillus lepidus Jordan, 1922		adv			60	98	GAS

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
Order Coleoptera (continued)							
Family Bostrichidae	Branch and twig borers						
Heterobostrychus aequalis (Waterhouse, 1884)		adv			60	X	
Family Bruchidae	Seed beetles						
Acanthoscelides macrophthalmus (Schaeffer, 1907)		adv	pir			98	GAS
Mimosestes nubigens (Motschulsky, 1874)		adv			60	X	
Stator pruininus (Horn, 1873)	Pruinose bean weevil	adv			60	X	
Family Cerambycidae	Longhorned beetles						
Ceresium unicolor (Fabricius, 1787)		adv			60	98	GAS
Sybra alternans (Wiedemann, 1825)		adv			60	98	GAS
Family Cerylonidae	Cerylonid beetles						
Euxestus erithacus (Chevrolat, 1864)		adv			60	X	
Murmidius sp.		adv?	psr			98	GAS
Family Chrysomelidae	Leaf beetles						
Diachus auratus (Fabricius, 1801)	Bronze leaf beetle	adv			60	X	
Family Ciidae	Minute tree-fungus beetles						
Cis sp.		end?	NIR			98	GAS
Family Cleridae	Checkered beetles						
Necrobia rufipes (DeGeer, 1775)	Redlegged ham beetle	adv			60	98	GAS
Family Coccinellidae	Ladybird beetles						
Coelophora inaequalis (Fabricius, 1775)	Common Australian lady beetle	p/adv			60	98	GAS
Cryptolaemus montrouzieri Mulsant, 1853	Mealybug destroyer	p/adv	pir			98	GAS
Curinus coeruleus (Mulsant, 1850)	Dark blue lady beetle	p/adv	pir			98	GAS
Diomus debilis (LeConte, 1852)		p/adv	pir			98	GAS
Diomus notescens (Blackburn, 1889)		p/adv			60	98	GAS
Nephus bilucernarius (Mulsant, 1850)		p/adv	pir			98	GAS
Nephus ?bipunctatus Kugelann		p/adv	pir			98	GAS
Olla v-nigrum (Mulsant, 1866)		p/adv			60	98	GAS
Rhyzobius forestieri (Mulsant, 1853)		p/adv			60	98	GAS
Rhyzobius lophanthae (Blaisdell, 1892)		p/adv	NIR			98	GAS
Rodolia cardinalis (Mulsant, 1850)	Vedalia	p/adv			60	98	GAS
Scymnodes lividigaster (Mulsant, 1853)	Yellowshouldered lady beetle	p/adv			60	98	GAS
Telsimia nitida Chapin, 1926		p/adv	NIR			98	GAS

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
Order Coleoptera (continued)							
Family Corylophidae	Minute fungus beetles						
Sericoderus sp.		adv?	NIR			98	GAS
Family Curculionidae	Weevils						
Asynonychus godmani Crotch, 1867	Fuller rose beetle	adv			60	98	GAS
Dryophthorus distinguendus Perkins, 1900		end			60	X	
Dryophthorus squalidus Sharp, 1878		end	1958			X	
Dryotribus mimeticus Horn, 1873		adv	1906			X	
Dryotribus wilderi Perkins, 1916		ind		23	60	98	GAS
Oodemas laysanensis Fullaway, 1914	Laysan oodemas weevil	end		23	60	X	
?Orchidophilus ?not aterrima (Waterhouse)		adv?	NIR			98	GAS
Oxydema fusiforme Wollaston, 1873		adv			60	98	GAS
Oxydema longulum (Boheman, 1859)		adv			60	X	
Pentarthrum halodorum Perkins, 1926		adv		23	60	X	
Pentarthrum obscurum Sharp, 1878	Obscure pentarthrum weevil	adv?	1906			X	
Sphenophorus venatus vestitus Chittenden, 1904	Hunting billbug	adv	NIR			98	GAS
Family Dermestidae	Dermestid or skin beetles						
Attagenus fasciatus (Thunberg, 1795)	Wardrobe beetle	adv			60	X	
Dermestes ater DeGeer, 1774	Black larder beetle	ind?		23	60	98	GAS
Dermestes maculatus DeGeer, 1774	Hide beetle	ind			60	98	GAS
Trogoderma anthrenoides (Sharp, 1902)		adv			60	X	
Family Elateridae	Click beetles						
?Cardiophorus sp.		adv?	psr			98	GAS
Conoderus amplicollis (Gyllenhal, 1817)	Gulf wireworm	adv	pir			98	GAS
Conoderus exsul (Sharp, 1877)		adv		23	60	98	GAS
Conoderus pallipes (Eschscholtz, 1830)		adv			60	98	GAS
Prodrasterius collaris (Candeze, 1859)		adv	NIR			98	GAS
Family Histeridae	Hister beetles						
Saprinus lugens Erichson, 1834		adv			60	98	GAS
Family Lyctidae	Powderpost beetles						
Lyctus brunneus (Stephens, 1830)	Powderpost beetle	adv			60	X	
Family Mycetophagidae	Hairy fungus beetles						
Typhaea stercorea (Linnaeus, 1758)	Hairy fungus beetle	adv			60	X	

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
Order Coleoptera (continued)							
Family Nitidulidae	Sap beetles						
Carpophilus dimidiatus (Fabricius, 1792)	Corn sap beetle	adv			60	X	
Carpophilus maculatus Murray, 1864		adv	NIR			98	GAS
Conotelus mexicanus Murray, 1864		adv	pir			98	GAS
Family Oedemeridae	False blister beetles						
Ananca bicolor (Fairmaire, 1849)		adv			60	X	
Family Ptiliidae	Feather-winged Beetles						
Genus? species?		adv?	NIR			98	GAS
Family Scarabaeidae	Scarab beetles						
Adoretus sinicus Burmeister 1855	Chinese rose beetle	adv			60	X	
Anomala sulcatula Burmeister, 1844		adv			60	98	GAS
Pleurophorus parvulus (Chevrolat, 1864)		adv	pir			98	GAS
Protaetia fusca (Herbst, 1790)	Mango flower beetle	adv	pir			98	GAS
Protaetia pryeri (Janson, 1888)	Emerald beetle	adv	psr			98	GAS
Family Scolytidae	Bark beetles						
Hypothenemus sp.		adv?	NIR			98	GAS
Xyleborus perforans (Wollaston, 1857)		adv	NIR			98	GAS
Family Silvanidae	Flat grain beetles						
Oryzaephilus surinamensis (Linnaeus, 1758)	Sawtoothed grain beetle	adv	NIR			98	GAS
Family Staphylinidae	Rove beetles						
Atheta coraria (Kraatz, 1856)		adv	pir			98	GAS
Carpelimus fulvipes (Erichson, 1840)		adv	pir			98	GAS
?Platystethus sp.		adv	NIR			98	GAS
Scopaeus sp.		adv?	psr			98	GAS
Family Tenebrionidae	Darkling beetles						
Alphitobius diaperinus (Panzer, 1796)	Lesser mealworm	adv	NIR			98	GAS
Alphitobius laevigatus (Fabricius, 1781)	Black fungus beetle	adv	1958			98	GAS
Blapstinus dilatatus LeConte, 1851		adv			60	98	GAS
Gonocephalum adpressiforme Kaszab, 1951		adv			60	98	GAS
Platydema subfascia (Walker, 1858)		adv			60	X	
Tribolium castaneum (Herbst, 1797)	Red flour beetle	adv			60	98	GAS

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
Order Collembola	Springtails						
Family Entomobryidae							
Entomobrya unostrigata Stach 1930		adv	1992			?	
Lepidocyrtus hakea Christiansen & Bellinger, 1992		end	1992			?	
Lepidocyrtus heterophthalmus Carpenter 1904		adv	1992			?	
Lepidocyrtus hukulii Christiansen & Bellinger, 1992		end	1992			?	
Lepidocyrtus immaculatus Folsom, 1932		end	1992			?	
Lepidocyrtus kuakea Christiansen & Bellinger, 1992		end	1992			?	
Lepidocyrtus mele Christiansen & Bellinger, 1992		end	1992			?	
Lepidocyrtus olena Christiansen & Bellinger, 1992		end	1992			?	
Lepidocyrtus pallidus Reuter, 1890		adv	1992			?	
Seira pihulu Christiansen & Bellinger, 1992		end?	1992			?	
Seira terrestris (Folsom, 1932)		adv	1992			?	
Family Hypogastruridae							
Brachystomella contorta Denis 1931		adv?	1992			?	
Family Isotomidae							
Cryptopygus thermophilus (Axelson, 1902)		adv	1992			?	
Folsomides parvulus Stach 1922		adv	1992			?	
Proisotoma centralis Denis 1931		adv	1992			?	
Proisotoma nigromaculosa Folsom, 1932		adv	1992			?	
Family Onychiuridae							
Onychiurus folsomi (Schaeffer, 1900)		adv	1992			?	
Tullbergia yosiii (Rusek, 1967)		adv	1992			?	
Family Sminthuridae							
Sminthurides lolelua Christiansen & Bellinger, 1992		end	1992			?	
Order Dermaptera	Earwigs						
Family Carcinophoridae							
Anisolabis maritima (Bonelli, 1832)		ind			60	98	FGH
Euborellia annulipes (Lucas, 1847)	Ringlegged earwig	adv		23	60	98	GMN
Family Labiduridae							
Labidura riparia (Pallas, 1773)	Striped earwig	adv			60	98	GMN

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
Order Diptera	Flies	(partly studied)					
Family Agromyzidae	Leafminers						
Amauromyza maculosa (Malloch, 1913)	Blotch leafminer	adv			60	98	KA
Calycomyza humeralis (Roser, 1840)	Aster leafminer	adv	1980			98	KA
Liriomyza sativae		adv	NIR			98	NLE
Melanagromyza splendida Frick, 1953		adv	NIR			98	KA
Phytoliriomyza sp.		adv			60	?	
Pseudonapomyza spicata (Malloch, 1914)		adv	NIR			98	KA
Family Anthomyiidae	Anthomyiid flies						
Fucellia boninensis Snyder, 1965		adv	1960			?	
Family Asteiidae	Asteiid flies						
Loewimyia ?bifurcata Sabrosky		adv	NSR?			98	KA
Family Calliphoridae	Blowflies						
Chrysomya megacephala (Fabricius, 1794)	Oriental blow fly	adv			60	?	
Lucilia graphita Shannon 1926		end		23	60	?	
Lucilia sericata (Meigen, 1826)	Greenbottle fly	adv			60	?	
Rhinia apicalis (Wiedemann, 1830)		adv			60	98	KA
Family Canacidae	Beach flies						
Canaceoides angulatus Wirth, 1969		adv	1969			?	
Nocticanace sp.		?			60	?	
Family Cecidomyiidae	Gall midges						
Giardomyia pallidithorax Hardy 1960		end			60	?	
Parallelodiplosis bimaculata Hardy 1960		end			60	?	
Family Ceratopogonidae	Biting midges						
Dasyhelea calvescens Macfie, 1938		ind			60	?	
Family Chironomidae	Midges						
Clunio littoralis Stone & Wirth, 1947*		end				98	NLE
Polypedilum nubiferum (Skuse, 1889)		adv	NIR			98	KA
Family Chloropidae	Chloropid flies						
Cadrema pallida (Loew, 1865)		adv		23	60	98	KA
Siphunculina striolata (Wiedemann, 1830)		adv			60	?	

* Confirmed island record; previously listed with question mark by Hardy (1960)

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
Order Diptera (continued)	Flies	(partly studied)					
Family Chyromyidae	Chyromyid flies						
Chiromyia sp.		adv?			60	?	
Family Culicidae	Mosquitoes						
Aedes albopictus (Skuse, 1894)	Asian tiger mosquito	adv			60	98	GMN
Culex quinquefasciatus Say, 1823	Southern house mosquito	adv			60	98	GMN
Family Dolichopodidae	Long-legged flies						
Chrysosoma globiferum (Wiedemann, 1830)		adv		23	60	98	DJB
Chrysotus longipalpis Aldrich, 1896		adv?			60	98	DJB
Dactylomyia vockerothi (Bickel, 1998)		adv	psr			98	DJB
Krakatauia micronesiana Bickel, 1994		ind?	pir			98	DJB
Medetera grisescens Meijere, 1916		end			60	98	DJB
Syntormon flexibile Becker, 1922		adv	pir			98	DJB
Family Drosophilidae	Pomace flies						
Drosophila simulans Sturtevant 1919		adv			60	?	
Family Ephydridae	Shore flies						
Clasiopella uncinata Hendel, 1914		adv	1952			?	
Hecamede granifera (Thomson, 1869)		adv			60	?	
Placopsidella grandis (Cresson, 1925)		adv	1980			?	
Scatella stagnalis (Fallen, 1813)		adv	NIR			98	KA
Family Fanniidae	Faniid flies						
Fannia pusio (Wiedemann, 1830)	Chicken dung fly	adv			60	?	
Family Lauxaniidae	Lauxaniid flies						
Homoneura unguiculata (Kertesz, 1913)		adv			60	98	KA
Family Milichiidae	Milichiid flies						
Desmometopa tarsalis Loew 1865		adv			60	?	
Desmometopa sp.		adv			60	?	
Milichiella lacteipennis (Loew, 1865)		adv		23	60	98	KA
Family Muscidae	Muscid flies						
Hydrotaea aenescens (Wiedemann, 1830)		adv			60	?	
Hydrotaea chalcogaster (Wiedemann, 1824)		adv		23	60	?	
Musca domestica Linnaeus 1758	House fly	adv		23	60	?	
Muscina levida (Harris, 1776)		adv			60	?	

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
Order Diptera (continued)	Flies	(partly studied)					
Family Psychodidae	Sand Flies						
Psychoda williamsi Quate 1954		end			60	?	
Family Sarcophagidae	Flesh Flies						
Goniophyto bryani Lopes 1938		ind			60	?	
Helicobia morionella (Aldrich, 1930)		adv			60	?	
Sarcophaga argyrostoma (Robineau-Desvoidy, 1830)		adv			60	?	
Sarcophaga dux Thomson 1869		adv			60	?	
Family Sciaridae	Darkwinged Fungus Gnats						
Bradysia molokaiensis (Grimshaw, 1901)		end		23	60	?	
Bradysia tritici (Coquillett, 1895)		adv			60	?	
Family Sphaeroceridae	Small Dung Flies						
Coproica ferruginata (Stenhammar, 1855)		adv		23	60	?	
Coproica hirtula (Rondani, 1880)		adv	1967			?	
Leptocera fuscipennis (Haliday, 1833)		adv	1969			?	
Thoracochaeta brachystoma ((Stenhammar, 1855)		adv	1969			?	
Trachyopella nuda Rohacek & Marshall 1986		adv	1969			?	
Family Syrphidae	Flower flies						
Simosyrphus grandicornis (Macquart, 1842)		adv			60	98	KA
Family Tephritidae	Fruit flies						
Acinia picturata (Snow, 1894)		p/adv	NIR			98	KA
Bactrocera dorsalis (Hendel, 1912)	Oriental fruit fly	adv	1981			?	
Dioxyna sororcula (Wiedemann, 1830)		adv	NIR			98	KA
Family Tethinidae	Tethinid flies						
Dasyrhicnoessa insularis (Aldrich, 1931)		ind?			60	98	KA
Tethina variseta (Melander, 1951)		adv			60	98	KA
Order Embiidina	Webspinners						
Family Oligotomidae							
Oligotoma saundersii (Westwood, 1837)	Saunders embiid	adv			60	98	GMN

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
Order Heteroptera	True bugs	(partly studied)					
Family Anthocoridae	Minute pirate bugs						
Orius persequens (White, 1877)		adv		23	60	98	GMN
Family Cydnidae	Negro bugs						
Geotomus pygmaeus (Dallas, 1851)	Oceanic burrower bug	adv			60	X	
Rhytidoporus indentatus Uhler, 1877		adv	NIR			98	JWB
Family Lygaeidae	Seed bugs						
Geocoris pallens Stål, 1854	Western bigeyed bug	adv	NIR			98	DJP
Nysius fullawayi fullawayi Usinger, 1942	Fullaway's seed bug	end		23	60	98	GMN
Nysius kinbergi Usinger 1959		end			60	X	
Nysius palor Ashlock 1963		end?			60	98	JWB
Nysius terrestris Usinger 1942		end			60	X	
Family Nabidae	Damsel bugs						
Nabis capsiformis Germar, 1837	Pale damsel bug	adv		23	60	98	DJP
Family Pentatomidae	Stink bugs						
Brochymena quadripustulata (Fabricius, 1775)	Rough stink bug	adv	NIR			98	GMN
Family Reduviidae	Assassin bugs						
Empicoris rubromaculatus (Blackburn, 1889)	Thread bug	adv			60	98	DJP
Empicoris whitei (Blackburn, 1881)		adv			60	X	
Zelus renardii Kolenati 1856	Leafhopper assassin bug	adv			60	98	JWB
Family Rhopalidae	Scentless plant bugs						
Liorhyssus hyalinus (Fabricius, 1794)	Hyaline grass bug	adv			60	X	
Family Tingidae	Lace bugs						
Corythucha morrilli Osborn & Drake 1917	Morrill lacebug	adv	1988			X	
Order Homoptera	Aphids, scales, and relatives						
Family Aleyrodidae	Whiteflies						
Trialeurodes vaporariorum (Westwood, 1856)	Greenhouse whitefly	adv	NIR			98	
Family Aphididae	Aphids						
Aphis craccivora C.L. Koch 1854	Cowpea aphid	adv			60	X	
Aphis gossypii Glover, 1877	Cotton aphid, melon aphid	adv			60	98	JWB
Hyperomyzus lactucae (Linnaeus, 1758)	Sow thistle aphid	adv	NIR			98	JWB
Hysteroneura setariae (Thomas, 1878)	Rusty plum aphid	adv	NIR			98	JWB
Lipaphis erysimi (Kaltenbach, 1843)	Turnip aphid	adv	NIR			98	JWB
Rhopalosiphum maidis (Fitch, 1855)	Corn leaf aphid	adv	NIR			98	JWB
Schizaphis rotundiventris (Signoret, 1860)		adv	NIR			98	JWB

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
Order Homoptera (continued)							
Family Cicadellidae	Leafhoppers						
Balclutha timberlakei (Osborn, 1935)		end			60	X	
Deltocephalus sonorus Ball, 1900		adv	NIR			98	WJK
Empoasca solana DeLong, 1931	Southern garden leafhopper	adv	NIR			98	WJK
Family Coccidae	Soft Scales						
Coccus viridis (Green, 1889)	Green scale	adv			60	98	JWB
Kilifia acuminata (Signoret, 1873)	Acuminate scale	adv			60	X	
Parasaissetia nigra (Nietner, 1861)	Nigra scale	adv			60	98	JWB
Saissetia miranda (Cockerell, 1899)	Mexican black scale	adv	NIR			98	JWB
Family Delphacidae	Delphacid planthoppers						
Opiconsiva paludum (Kirkaldy, 1910)		adv			60	X	
Toya dryope (Kirkaldy, 1907)		adv	NIR			98	MA
Family Diaspididae	Armored scales						
Aonidiella inornata McKenzie, 1938	Inornate scale	adv	NIR			98	JWB
Chrysomphalus aonidum (Linnaeus, 1758)	Florida red scale	adv			60	98	JWB
Chrysomphalus dictyospermi (Morgan, 1889)	Dictyospermum scale	adv	NIR			98	JWB
Clavaspis herculeana (Doane & Hadden, 1909)		adv	NIR			98	JWB
Duplaspidiotus claviger (Cockerell, 1901)		adv	NIR			98	JWB
Hemiberlesia lataniae (Signoret, 1869)	Latania scale	adv	NIR			98	JWB
Lepidosaphes ?laterochitinosa Green, 1925		adv?	NIR			98	JWB
Lepidosaphes tokionis (Kuwana, 1902)	Croton mussel scale	adv	NIR			98	JWB
Odonaspis ruthae Kotinsky, 1915	Ruth grass scale	adv	NIR			98	JWB
Pinnaspis strachani (Cooley, 1899)	Hibiscus snow scale	adv			60	98	JWB
Pseudaulacaspis cockerelli (Cooley, 1897)	Cockerell scale	adv	NIR			98	JWB
Family Eriococcidae							
Acanthococcus araucariae (Maskell, 1878)	Araucaria mealybug	adv	NIR			98	JWB
Family Flatidae	Flatid planthoppers						
Melormenis basalis (Walker, 1851)	West Indian flatid	adv	NIR			98	DJP
Family Margarodidae	Giant coccids						
Icerya purchasi Maskell, 1878	Cottony cushion scale	adv			60	98	DJP
Family Membracidae	Treehoppers						
Spissistilus festinus (Say, 1830)	Threecornered alfalfa hopper	adv			60	98	JWB
Vanduzeea segmentata (Fowler, 1895)	Van Duzee treehopper	adv			60	98	GMN

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
Order Homoptera (continued)							
Family Pseudococcidae	Mealybugs						
Antonina graminis (Maskell, 1897)	Rhodesgrass mealybug	adv	NIR			98	JWB
Chorizococcus rostellum (Lobdell, 1930)		adv	NIR			98	JWB
Dysmicoccus neobrevipes Beardsley, 1959		adv	NIR			98	JWB
Ferrisia consobrina Williams & Watson, 1988		adv	NIR			98	JWB
Laminicoccus pandani (Cockerell, 1895)		adv	NIR			98	JWB
Palmicultor palmarum (Ehrhorn, 1916)	Palm mealybug	adv			60	X	
Phenacoccus madeirensis Green 1923	Madeira mealybug	adv			60	98	JWB
Phenacoccus solani Ferris, 1918		adv	NIR			98	JWB
Planococcus citri (Risso, 1813)	Citrus mealybug	adv			60	98	JWB
Family Psyllidae	Jumping plantlice						
Heteropsylla sp.		adv	NIR			98	GMN
Order Hymenoptera	Bees, wasps, ants						
Family Agaonidae	Fig wasps						
Pleistodontes froggatti Mayr, 1906		p/adv	NIR			98	JWB
Family Anthophoridae	Cuckoo bees, carpenter bees						
Ceratina arizonensis Cockerell, 1898		adv	NIR			98	RRS
Xylocopa sonorina F. Smith, 1874	Sonoran carpenter bee	adv			60	98	GMN
Family Aphelinidae	Aphelinids						
Aphytis sp., ?hispanicus Mercet		adv	psr			98	JWB
Aspidiotiphagus lounsburyi (Berlese & Paoli, 1916)		adv	pir			98	JWB
Azotus sp.		adv	pir			98	JWB
Centrodora xiphidii (Perkins, 1906)		adv	pir			98	JWB
Coccophagus ceroplastae (Howard, 1895)		adv	pir			98	JWB
Encarsia pergandiella Howard, 1907		p/adv	pir			98	JWB
Encarsia sp.		adv	psr			98	JWB
Eretmocerus sp.		adv	psr			98	JWB
Family Bethylidae	Bethylids						
Epyris sp.		adv?			60	X	
Sierola sp.		adv?	pir			98	JWB

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
Order Hymenoptera (continued)	Bees, wasps, ants						
Family Braconidae	Braconids						
Apanteles carpatus (Say, 1836)		adv			60	98	JWB
Apanteles sp.		adv	pir			98	JWB
Chelonus blackburni Cameron, 1887		adv		23	60	98	JWB
Cotesia plutellae (Kurdjumov, 1912)		p/adv	pir			98	JWB
Cotesia marginiventris (Cresson, 1865)		p/adv			64	98	JWB
Lysiphlebus testaceipes (Cresson, 1880)		p/adv	1941			98	JWB
Parallorhogas pallidiceps (Perkins, 1910)		adv	pir			98	JWB
Phanerotoma hawaiiensis Ashmead, 1901		adv			60	98	JWB
Rhaconotus vagrans (Bridwell, 1920)		adv	pir			98	JWB
Urosigalphus bruchi Crawford 1907		p/adv			60	X	
Family Ceraphronidae	Ceraphronids						
Aphanogmus sp.		adv	NIR			98	JWB
Ceraphron plebeius Perkins, 1910		adv	pir			98	JWB
Ceraphron sp.		adv	psr			98	JWB
Family Chalcididae	Chalcidids						
Antrocephalus apicalis (Walker, 1874)		adv	pir			98	JWB
Antrocephalus pertorvus (Girault, 1917)		adv			60	98	JWB
Proconura n.sp.		adv	psr			98	JWB
Family Diapriidae	Diapriids						
Trichopria sp.		adv	psr			98	JWB
Family Encyrtidae	Encyrtids						
Adelencyrtus odonaspidis Fullaway, 1913		adv	pir			98	JWB
Aeptencyrtus bruchi DeSantis, 1957		adv	psr			98	JWB
Anagyrus swezeyi Timberlake, 1919		adv		23	60	98	JWB
Blepyrus insularis (Cameron, 1886)		adv	pir			98	JWB
Cheiloneurus sp.		adv	pir			98	JWB
Coccidoxenoides peregrina (Timberlake, 1919)	Oriental mealybug parasite	adv		23	60	98	JWB
Dicarnosis ripariensis Kerrich, 1978		adv	psr			98	JWB
Diversinervus elegans Silvestri 1914		adv	1977			98	JWB
Encyrtus infelix (Embleton, 1902)		adv	pir			98	JWB
Gyranusoidea phenacocci (Beardsley, 1970)		adv	pir			98	JWB

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
Order Hymenoptera (continued)	Bees, wasps, ants						
Family Encyrtidae (continued)	Encyrtids						
Leptomastidea abnormis (Girault, 1915)		p/adv	pir			98	JWB
Metaphycus flavus (Howard, 1881)		adv	pir			98	JWB
Neodusmetia sangwani (Subba Rao, 1957)		adv	pir			98	JWB
Plagiomerus sp.		adv	pir			98	JWB
Family Eucoilidae	Eucoilids						
Gronotoma micromorpha (Perkins, 1910)		adv	pir			98	JWB
Family Eulophidae	Eulophids						
Aprostocetus hagenowii (Ratzeburg, 1852)		adv	pir			98	JWB
Aprostocetus sp.		adv?	pir			98	JWB
Elachertus advena Timberlake, 1926		adv		23	60	98	JWB
Hemiptarsenus semialbiclavus (Girault, 1916)		adv	pir			98	JWB
Neochrysocharis formosa (Westwood, 1833)		adv	pir			98	JWB
Neotrichoporoides viridimaculata (Fullaway, 1955)		adv	pir			98	JWB
Tetrastichus beardsleyi Fullaway, 1956		adv	pir			98	JWB
Family Eupelmidae	Eupelmids						
Anastatus koebelei Ashmead, 1901		adv?	pir			98	JWB
Family Eurytomidae	Seed chalcids						
Tetramesa sp.		adv	pir			98	JWB
Family Evaniidae	Ensign wasps						
Evania appendigaster (Linnaeus, 1758)	larger ensign wasp	adv			60	98	JWB
Family Formicidae	Ants						
Camponotus variegatus (F. Smith, 1858)	Hawaiian carpenter ant	adv			60	X	
Cardiocondyla emeryi Forel, 1881		adv	NIR			98	RRS
Cardiocondyla nuda (Mayr, 1866)		adv		23	60	98	NJR
Monomorium floricola (Jerdon, 1851)		adv	1967			X	
Monomorium monomorium Bolton, 1987		adv		23	60	X	
Monomorium pharaonis (Linnaeus, 1758)	Pharaoh ant	adv	NIR			98	NJR
Paratrechina bourbonica (Forel, 1886)		adv		23	60	X	
Paratrechina longicornis (Latreille, 1802)	Crazy ant	adv			60	98	RRS
Pheidole megacephala (Fabricius, 1793)	Bigheaded ant	adv		23	60	98	RRS

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
Order Hymenoptera (continued)	Bees, wasps, ants						
Family Formicidae	Ants						
Plagiolepis alluaudi Emery, 1894	Little yellow ant	adv			60	98	RRS
Solenopsis geminata (Fabricius, 1804)	Fire ant	adv			60	98	NJR
Tapinoma melanocephalum (Fabricius, 1793)	Tiny yellow house ant	adv		23	60	X	
Tetramorium bicarinatum (Nylander, 1847)	Guinea ant	adv		23	60	98	NJR
Tetramorium simillimum (F. Smith, 1851)		adv	NIR			98	RRS
Family Ichneumonidae	Ichneumons						
Anomalon californicum (Cresson, 1879)		adv	pir			98	JWB
Casinaria infesta (Cresson, 1872)		adv	pir			98	JWB
Diplazon laetatorius (Fabricius, 1781)		adv			60	98	JWB
Venturia sp.		adv			60	98	JWB
Family Megachilidae	Leafcutting Bees						
Chalicodoma umbripennis (F. Smith, 1853)		adv			60	98	RRS
Megachile fullawayi Cockerell, 1914		adv	NIR			98	RRS
Megachile timberlakei Cockerell, 1920		adv	NIR			98	RRS
Family Mymaridae	Fairyflies						
Anagrus frequens Perkins, 1905		p/adv	pir			98	JWB
Anagrus nigriventris Girault, 1911		adv	pir			98	JWB
Anaphes calendrae (Gahan, 1927)		p/adv	pir			98	JWB
Camptoptera sp.		adv	psr			98	JWB
Gonatocerus sp. litoralis group		adv	psr			98	JWB
Gonatocerus sp. membraciphagus group		adv	psr			98	JWB
Gonatocerus ornatus Gahan, 1918		adv	pir			98	JWB
Stephanodes reduvioli (Perkins, 1905)		end?		23	60	98	JWB
Family Platygasteridae	Platygasterids						
Fidiobia sp.		adv	pir			98	JWB
Family Pteromalidae	Pteromalids						
Chlorocytus longiscapus Graham, 1965		adv	pir			98	JWB
Halticoptera circulus (Walker, 1833)		adv	pir			98	JWB
Heteroschema sp.		adv	pir			98	JWB
Lariophagus texanus Crawford 1910		p/adv			60		
Spalangia cameroni Perkins, 1910		p/adv	pir			98	JWB

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
Order Hymenoptera (continued)	Bees, wasps, ants						
Family Scelionidae	Scelionids						
Anteromorpha dubiosa (Perkins, 1910)		adv	pir			98	JWB
Encyrtoscelio sp.		adv	pir			98	JWB
Idris peregrinus (Perkins, 1910)?		adv	pir			98	JWB
Telenomus nawai Ashmead, 1904	Armyworm egg parasite	adv	1960			98	JWB
Telenomus vulcanus Perkins, 1910		end?	pir			98	JWB
Telenomus sp.		adv	psr			98	JWB
Family Signiphoridae	Signophorids						
Signiphora sp.		adv	pir			98	JWB
Family Sphecidae	Sphecid wasps						
Ampulex compressa (Fabricius, 1781)	Emerald cockroach wasp	p/adv			60	X	
Chalybion bengalense (Dahlbom, 1845)		adv	NIR			98	RRS
Dolichurus stantoni (Ashmead, 1904)	Black cockroach wasp	p/adv			60	X	
Isodontia apicalis (F. Smith, 1856)		adv			60	X	
Isodontia mexicana (Saussure, 1867)		adv	NIR			98	JWB
Sceliphron caementarium (Drury, 1770)	Mud dauber	adv			60	X	
Family Trichogrammatidae	Trichogrammatids						
Oligosita sp.		adv	pir			98	JWB
Trichogramma sp.		adv	pir			98	JWB
Uscana sp.		p/adv	pir			98	JWB
Family Vespidae	Paper wasps, etc.						
Pachodynerus nasidens (Latreille, 1832)	Keyhole wasp	adv			60	98	RRS
Parancistrocerus fulvipes (Saussure)		adv	NSR			98	RRS
Polistes aurifer Saussure, 1853	Golden paper wasp	adv			60	98	RRS
Polistes exclamans Viereck, 1906	Common paper wasp	adv	NIR			98	RRS
Polistes jadwigae Dalla Torre, 1904		adv	NIR			98	RRS
Ropalidia marginata (Le Peletier, 1836)		adv			60	X	
Order Isoptera	Termites						
Family Kalotermitidae	Drywood termites						
Cryptotermes brevis (Walker, 1853)	West Indian drywood termite	adv			60	98	RJW
Incisitermes immigrans (Snyder, 1922)	Lowland tree termite	adv	NIR			98	RJW

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
Order Isoptera (continued)	Termites						
Family Rhinotermitidae	Dampwood termites						
Coptotermes formosanus Shiraki, 1909	Formosan subterranean termite	adv			60	98	RJW
Order Lepidoptera	Butterflies and moths	(partially studied)					
Family Arctiidae	Tiger moths						
Utetheisa pulchelloides Hampson, 1907		adv?	1991			X	
Family Cosmopterigidae	Cosmopterigid moths						
Asymphorodes dimorpha (Busck, 1914)		adv		23	60	98	DJP
Asymphorodes sp.		adv?				98	KS
Hyposmocoma neckerensis (Swezey, 1926)	Necker petrochroan leaf miner	end	1926			98	KS
Hyposmocoma rubescens Walsingham, 1907		end	1907			98	KS
Pyroderces rileyi (Walsingham, 1882)	Pink scavenger caterpillar	adv			60	98	DJP
Family Crambidae	Crambid moths						
Hellula undalis (Fabricius, 1781)	Imported cabbageworm	adv			60	98	DJP
Herpetogramma licarsisalis (Walker, 1859)	Grass webworm	adv	NIR			98	DJP
Spoladea recurvalis (Fabricius, 1775)	Hawaiian beet webworm	adv			60	98	DJP
Family Geometridae	Measuringworms						
Cyclophora nanaria (Walker, 1861)		adv	NIR			98	DJP
Macaria abydata Guenee, 1857		adv	NIR			98	DJP
Family Gracilariidae	Gracilariid moths						
Stoeberhinus testaceus Butler, 1881		adv		23	60	98	DJP
Family Noctuidae	Noctuid moths, cutworms, armyworms						
Achaea janata (Linnaeus, 1758)	Croton caterpillar	adv			60	?	
Agrotis fasciata (Rothschild, 1894)	Midway agrotis noctuid moth	end		23	60	?	
Agrotis ipsilon (Hufnagel, 1767)	Black cutworm	adv	NIR			98	DJP
Chrysodeixis eriosoma (Doubleday, 1843)	Green garden looper	adv		23	60	98	DJP
Helicoverpa zea (Boddie, 1850)	Corn earworm	adv	1963			?	
Hypena laceratalis Walker, 1858		p/adv	NIR			98	DJP
Leucania loreyimima Rungs, 1953		adv	1991			98	DJP
Pseudaletia unipuncta (Haworth, 1809)	Armyworm	adv			60	?	
Spodoptera exempta (Walker, 1856)	Nutgrass armyworm	adv			60	?	
Spodoptera litura (Fabricius, 1775)		adv		23		?	
Spodoptera mauritia (Boisduval, 1833)	Lawn armyworm	adv	1973			?	

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
Order Lepidoptera (continued)	Butterflies and moths	(partially studied)					
Family Nymphalidae	Brushfooted butterflies						
Vanessa cardui (Linnaeus, 1758)	Painted lady	adv	NIR			98	GMN
Family Plutellidae	Diamondback moths						
Plutella xylostella (Linnaeus, 1758)	Diamondback moth	adv		23	60	98	DJP
Family Pterophoridae	Plume moths						
Lioptilodes parvus (Walsingham, 1880)		adv			60	?	
Megalorhipida leucodactylus (Fabricius, 1793)		adv	1913		60	98	DJP
Family Pyralidae							
Pyralis manihotalis Guenee, 1854		adv			60	?	
Family Sphingidae	Hawk moths, hornworms						
Agrius cingulata (Fabricius, 1775)	Sweetpotato hornworm	adv	1984			98	DJP
Deilephila nerii (Linnaeus, 1758)	Oleander hawk moth	adv	1986			X	
Family Tineidae	Clothes moths & others						
Erechthias simulans (Butler, 1882)		adv			60	98	DJP
Monopis meliorella		adv	NIR			98	KS
Opogona aurisquamosa (Butler, 1881)		adv			60	?	
Family Tortricidae	Tortricid moths						
Amorbia emigratella Busck, 1910	Mexican leafroller	adv			60	?	
Bactra sp. nr. straminea (Butler, 1881)		adv?	NIR			98	DJP
Crocidosema blackburni (Butler, 1881)		end?		23		?	
Order Mantodea	Mantids						
Family Mantidae							
Tenodera angustipennis Saussure, 1869	Narrowwinged mantid	adv			60	X	
Order Neuroptera	Lacewings						
Family Chrysopidae	Common lacewings						
Chrysoperla comanche (Banks, 1938)	Comanche lacewing	adv		23	60	98	JWB
Family Hemerobiidae	Brown lacewings						
Sympherobius barberi (Banks, 1903)	Barber brown lacewing	p/adv			60	X	

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
Order Odonata	Dragonflies, damselflies						
Family Libellulidae	Common skimmers						
Pantala flavescens (Fabricius, 1798)	Globe skimmer	ind	1968			98	GMN
Order Orthoptera	Grasshoppers, katydid, crickets, and relatives						
Family Acrididae	Shorthorned grasshoppers						
Oxya japonica (Thunberg, 1824)	Japanese grasshopper	adv			60	X	
Family Gryllidae	Crickets						
Gryllodes sigillatus (Walker, 1869)	Flightless field cricket	adv			60	98	GMN
Modicogryllus conspersus (Schaum, 1862)	Small field cricket	adv	NIR			98	GMN
Myrmecophila quadrispina Perkins, 1899		adv			60	X	
Family Pyrgomorphidae	Coneheaded grasshoppers						
Atractomorpha sinensis Bolivar, 1905	Pinkwinged grasshopper	adv			60	X	
Family Tettigoniidae	Katydids, longhorned grasshoppers						
Conocephalus saltator (Saussure, 1859)	Longhorned grasshopper	adv		23	60	98	GMN
Elimaea punctifera (Walker, 1869)	Narrowinged katydid	adv			60	98	GMN
Scudderia paronae Griffini, 1896		adv	NIR			98	GMN
Xiphidiopsis lita Hebard, 1922		adv			60	X	
Order PHTHIRAPTERA	Lice	(not sought)					
Family Hoplopleuridae							
Polyplax spinulosa (Burmeister, 1839)	Spined rat louse	adv	1980			?	
Family Menoponidae							
Actornithophilus bicolor (Piaget, 1880)		ind	1973			?	
Actornithophilus ceruleus (Timmermann, 1954)		ind	1973			?	
Actornithophilus incisus (Piaget, 1880)		ind	1973			?	
Actornithophilus umbrinus (Burmeister, 1838)		ind	1973			?	
Austromenopon becki (Kellogg, 1906)		ind	1973			?	
Austromenopon paululum (Kellogg & Chapman, 1899)		ind	1973			?	
Austromenopon pinguis (Kellogg, 1896)		ind	1973			?	
Colpocephalum angulaticeps Piaget, 1880		ind	1973			?	
Trinoton querquedulae (Linnaeus, 1758)	Large duck louse	adv	1973			?	

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
Order Phthiraptera (continued)							
Family Philopteridae							
Anaticola anseris (Linnaeus, 1758)	Slender goose louse	ind	1973			?	
Anatoecus sp.		ind	1973			?	
Carduiceps zonarius (Nitzsch, 1866)		ind	1973			?	
Columbicola columbae (Linnaeus, 1758)	Slender pigeon louse	adv	1973			?	
Docophoroides ferrisi Harrison, 1937		ind	1973			?	
Docophoroides niethammeri Timmermann, 1969		ind	1973			?	
Episbates pederiformis (Dufour, 1835)		adv?	1973			?	
Halipeurus leucophryna Timmermann, 1960		ind	1973			?	
Halipeurus mirabilis Thompson, 1940		ind	1973			?	
Halipeurus spadix Timmermann, 1961		ind	1973			?	
Harrisoniella copei Timmermann, 1969		ind	1969			?	
Harrisoniella densa (Kellogg, 1896)		ind	1958			?	
Lunaceps hopkinsi Timmermann, 1954		ind	1973			?	
Naubates harrisoni Bedford, 1930		ind	1973			?	
Paraclisis confidens (Kellogg, 1899)		ind	1958			?	
Paraclisis giganticola (Kellogg, 1896)		ind	1958			?	
Pectinopygus annulatus (Piaget, 1880)		ind	1973			?	
Pectinopygus gracilicornis (Piaget, 1880)		ind	1973			?	
Pectinopygus sulae (Rudow, 1869)		ind	1973			?	
Perineus concinnus (Kellogg & Chapman, 1899)		ind	1958			?	
Quadraceps birostris (Giebel, 1874)		ind	1973			?	
Quadraceps hopkinsi Timmermann, 1952)		ind	1973			?	
Quadraceps obscurus (Burmeister, 1838		ind	1973			?	
Quadraceps ornatus striolatus (Nitzsch, 1866		ind	1973			?	
Quadraceps separatus (Kellogg & Kuwana, 1902)		ind	1973			?	
Saemundssonia albemarlensis (Kellogg & Kuwana, 1902)		ind	1973			?	
Saemundssonia hexagona (Giebel, 1874)		ind	1973			?	
Saemundssonia lari lari (O. Fabricius, 1780)		ind	1973			?	
Saemundssonia remota Timmermann, 1951		ind	1973			?	
Saemundssonia scolopacisphaeopodis (Schrank, 1803)		ind	1973			?	
Saemundssonia snyderi (Kellogg & Paine, 1910)		ind	1973			?	
Trabeculus hexakon (Waterston, 1914)		ind			60	?	

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
Order Psocoptera	Booklice, barklice	(not studied)					
Family Ectopsocidae							
Ectopsocus perkinsi Banks, 1931		adv			60	?	
Order Thysanoptera	Thrips		Not Studied				
Family Phlaeothripidae							
Haplothrips gowdeyi (Franklin, 1908)	Black flower thrips	adv			60	?	
Family Thripidae	Common thrips						
Chirothrips mexicanus Crawford, 1909		adv			60	?	
Frankliniella minuta (Moulton, 1907)		adv			60	?	
Heliothrips haemorrhoidalis (Bouche, 1833)	Greenhouse thrips	adv			60	?	
Thrips hawaiiensis (Morgan, 1913)	Hawaiian flower thrips	adv			60	?	
Thrips tabaci Lindeman, 1889	Onion thrips	adv			60	?	
Order Thysanura	Silverfish, bristletails						
Family Lepismatidae	Silverfish						
Ctenolepisma longicaudatum Escherich, 1905		adv			60	X	
ARACHNIDS							
Order Araneae	Spiders						
Family Araneidae	Orbweavers						
Neoscona oaxacensis (Keyserling, 1864)		adv			60	98	JB
Family Clubionidae	Twoclawed hunting spiders						
Chiracanthium mordax L. Koch, 1866	Pale leaf spider	adv			60	98	JB
Clubiona alveolata L. Koch, 1873		adv	psr			98	JB
Family Corinnidae							
Corinna cetrata (Simon, 1888)		adv	pir			98	JB
Family Gnaphosidae	Hunting spiders						
Camillina elegans (Bryant, 1940)		adv	1997			X	
Family Heteropodidae	Giant crab spiders						
Heteropoda venatoria (Linnaeus, 1767)	Large brown spider	adv			60	98	JB
Family Linyphiidae	Sheetweb spiders						
Coloncus sp.		adv?			60	X	
Family Ochyceratidae							
Theotima radiata (Simon, 1891)		adv	pir			98	JB

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
Order Araneae (continued)	Spiders						
Family Oonopidae	Minute jumping spiders						
Ischnothyreus omus Suman, 1965		end	NIR			98	JB
Oonops sp.		adv?			60	X	
Opopaea lena Suman, 1965		end	NIR			98	JB
Family Pholcidae	Longlegged spiders						
Artema atlanta Walckenaer, 1837		adv	NIR			98	JB
Smeringopus pallidus (Blackwall, 1858)		adv	NIR			98	JB
Family Salticidae	Jumping spiders						
Hasarius adansoni (Audouin, 1826)		adv			60	98	JB
Menemerus bivittatus (Dufour, 1831)		adv			60	98	JB
Messua cf. felix (Peckham & Peckham, 1901)		adv	pir			98	JB
Phintella versicolor (C.L. Koch, 1846)		adv	pir			98	JB
Plexippus paykulli (Audouin, 1826)		adv	pir			98	JB
Family Scytodidae	Spitting spiders						
Scytodes fusca Walckenaer, 1837		adv			60	X	
Scytodes longipes Lucas, 1845		adv			60	X	
Family Tetragnathidae							
Tetragnatha nitens (Audoin, 1826)		adv	pir			98	JB
Family Theridiidae	Combfooted spiders						
Achaearanea tepidariorum (C.L. Koch, 1841)		adv			60	X	
Coleosoma adamsoni (Berland, 1934)		adv	psr			98	JB
Latrodectus hesperus Chamberlin & Ivie, 1935	Western black widow spider	adv	1980			X	
Latrodectus mactans (Fabricius, 1775)	Black widow spider	adv	1980			X	
Theridion melanostictum Cambridge, 1876		adv	pir			98	JB
Order Acari	Mites	(partly studied)					
Family Acaridae							
Tyrophagus putrescentiae (Schrank, 1781)	Mold mite	adv	1975			98	SFS
Family Alloptidae							
Laminalloptes phaetontis (Fabricius, 1775)		ind?	1997			?	
Family Argasidae	Soft ticks						
Ornithodoros capensis Neumann, 1901		adv	1967			?	
Family Atopomelidae							
Listrophoroides cucullatus (Trouessart, 1893)		adv	1975			?	

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
Order Acari (continued)	Mites						
Family Bdellidae							
Bdella sp.		adv?	NIR			98	SFS
Bdellodes longirostris Hermann, 1804		adv	NIR			98	SFS
Spinibdella cronini (Baker & Balock, 1944)		adv	1987			?	
Family Carabodidae							
Austrocarabodes imperfectus (Sellnick, 1959)		ind	1966			98	SFS
Family Cheyletidae							
Cheletomimus berlesei (Oudemans, 1904)		adv	1985			?	
Cheletomimus duosetosus Muma, 1964		adv	1985			?	
Hemicheyletia wellsi (Baker, 1949)		adv	1987			?	
Hemicheyletia sp.		end?				98	SFS
Family Cosmochthoniidae							
Cosmochthonius sp.		adv	NIR			98	SFS
Phyllozetes sp.		adv	psr			98	S&N
Family Cryptognathidae							
Favognathus goffi Swift, 1996		adv?	1968			98	SFS
?Favognathus variabilis Swift, 1996		adv?	NIR			98	SFS
Family Ctenacaridae							
Ctenacarus araneolus (Grandjean, 1932)		adv	pir			98	S&N
Family Cunaxidae							
Dactyloscirus nr. glebulentus Den Heyer, 1908 ?		adv	NSR			98	SFS
Neocunaxoides sp.		adv?	NIR			98	SFS
Pulaeus sp. 1		adv?	NSR			98	SFS
Pulaeus sp. 2		adv?	NSR			98	SFS
Family Cymbaeremaeidae							
Scapheremaeus fisheri Aoki, 1966		end?	1966			98	SFS
Family Epilohmanniidae							
Epilohmannia sp.		adv	pir			98	S&N
Family Ereynetidae							
?Ereynetes sp.		adv?	?NIR			98	SFS
Family Euphthiracaridae							
Rhysotritia ardua (C.L. Koch, 1841)		adv	1966			?	

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
Order Acari (continued)	Mites						
Family Eupodidae							
Eupodes sp.		adv?	NIR			98	SFS
Family Galumnatidae							
Galumna australis pembertoni (Jacot, 1934)		end?	1966			98	SFS
Galumna climata (C.L. Koch, 1841)		adv	1966			98	SFS
Family Laelapidae							
Androlaelaps hermaphrodita (Berlese, 1887)		adv	1980			?	
Hypoaspis queenslandicus (Womersley, 1956)		adv	1982			?	
Hypoaspis scimita (Womersley, 1956)		adv	1982			?	
Laelaps echidnina Berlese, 1887		adv	1958			?	
Family Listrophoridae	Fur mites						
Afrolistrophorus musculus (Wilson & Lawrence, 1967)		end?	1975			?	
Family Macrochelidae							
Holostaspella n.sp.		adv?	1985			?	
Macrocheles similis Krantz & Filipponi, 1964)		adv	1985			?	
Family Macronyssidae							
Ornithonyssus bacoti (Hirst, 1913)	Tropical rat mite	adv	1975			?	
Family Myobiidae							
Myobia musculi (Schrank, 1781)		adv	1975			?	
Radfordia affinis (Poppe, 1896)		adv	1980			?	
Radfordia ensifera (Poppe, 1896)		adv	1987			?	
Family Myocoptidae							
Myocoptes musculinus (C.L. Koch, 1838)		adv	1975			?	
Family Lohmanniidae							
Annectacarus sp.		adv	psr			98	S&N
Family Ologamasidae							
Gamasiphis sp.		adv?	pir			98	SFS
Family Oribatulidae							
Oribatula sp.		adv	psr			98	S&N
Family Paratydeidae							
Neotydeius sp.		adv?	1987			?	
Family Raphignathidae							
Raphignathus sp.		adv?	pir			98	SFS

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
Order Acari (continued)	Mites						
Family Scheloribatidae							
Scheloribates muiri Jacot, 1934		ind	1966			98	SFS
Family Sejidae							
Sejus armatus (Fox, 1947)		adv	1987			?	
Sejus sp.		adv?				98	SFS
Family Sphaerochthoniidae							
Sphaerochthonius suzukii Aoki, 1977		adv	pir			98	S&N
Family Stigmaeidae							
Stigmaeus sp.		adv?	NIR			98	SFS
Family Tarsonemidae							
?Tarsonemus sp.		adv?	NIR			98	SFS
Family Tectocepheidae							
Tectocepheus velatus (Michael, 1880)		adv	1966			?	
Family Tetranychidae	Spider mites						
Bryobia praetiosa C.L. Koch, 1835	Clover mite	adv	1986			?	
Tetranychus cinnabarinus (Boisduval, 1867)	Carmine spider mite	adv	1986			?	
Tetranychus ludeni Zacher, 1913		adv			60	?	
Family Trombiculidae	Chiggers						
Guntheria domrowi (Brennan, 1965)		adv	1984			?	
Neoschoengastia gettmani Goff, 1984		end?	1984			?	
Neoschoengastia n.sp.		end?	1985			?	
Neotrombicula megensi Goff, 1975		end?	1975			?	
Womersia midwayensis Goff, Sievert & Sileo, 1989		end?	1989			?	
Family Tydeidae							
Tydeus tuttlei Baker, 1965		adv	1987			?	
Family Uropodidae							
Uropoda sp.		adv?	1987			?	
Family Xolalgidae							
n.gen. n.sp.		adv?	1987			?	

Appendix 1. Current list of arthropod species from Midway (continued)

Taxon	common name	origin	status	checklists			determiners
				23	60	98	
CHILOPODA	Centipedes						
Family Henicopidae							
Lamyctes africana (Porat, 1871)		adv	pir			98	RS
Family Lithobiidae							
Lithobius moanana (Chamberlin, 1926)		end	pir			98	RS
Family Scolopendridae							
Scolopendra subspinipes Leach, 1815	Large centipede	adv			60	98	GMN
PSEUDOSCORPIONIDA	Pseudoscorpions						
Lechytia sakagamii Morikawa, 1952		adv				98	WM
SCORPIONES	Scorpions						
Family Buthidae							
Isometrus maculatus (DeGeer, 1778)	Lesser brown scorpion	adv			60	X	
CRUSTACEA							
ISOPODA	Pillbugs and sowbugs						
Family Armadillidae							
Venezillo parvus (Budde-Lund, 1885)		adv	pir			98	ST
Family Halophilosciidae							
Halophiloscia couchii (Kinahan, 1858)		adv	psr			98	ST
Family Philosciidae							
Littorophiloscia culebrae (Moore, 1901)		adv	pir			98	ST
Family Porcellionidae							
Agabiformius lentus (Budde-Lund, 1885)		adv	pir			98	ST
Porcellio laevis Latreille, 1804		adv	1996			98	ST
Porcellio lamellatus lamellatus Budde-Lund, 1885		adv	pir			98	ST
Porcellionides pruinosus (Brandt, 1833)		adv	1996			98	ST
Family Scyphacidae							
Armadilloniscus ellipticus (Harger, 1878)		adv	pir			98	ST
Family Trachelipodidae							
Nagurus nanus (Budde-Lund, 1908)		adv?	pir			98	ST

Appendix 2. Chronology Of Documented Human Activity At Midway (except period of U.S. Navy Control)

1859	July 8. Middlebrook Islands (Midway) discovered by Captain N.C. Brooks on the *Gambia*.
1867	September 30. Captain William Reynolds on the *Lackawanna*, took possession of the atoll for the U.S. The crew seined fish, then went ashore to cook them and picnic. The survey was for the purpose of ascertaining whether a coal depot could be established for the convenience of Pacific mail ships.
	Sometime later. A coal shed was erected on Sand Island, a cargo of coal landed and one man left in charge, but he left at first opportunity with a schooner seeking freshwater.
1870	March 24. U.S.S. *Saginaw* sent to Midway to dredge channels in preparation for a naval station. The *Kate Piper* was chartered to carry supplies back and forth from Honolulu, and assist in the dredging.
1886	November 16. The *General Siegel*, on a shark-fishing expedition from Honolulu, stopped to provision with bird eggs and was wrecked on a reef. Seven or eight men were marooned and made use of buildings abandoned by the dredging party. Survivors eventually sailed for the Marshall islands, leaving one crewmember on Midway.
1888	February 8. The *Wandering Minstrel* was wrecked in Welles Harbor with about 30 survivors.
	March 15. Six survivors leave with a boat and are presumed lost.
	October 13. Three of the stranded visitors including the one remaining from the previous wreck left on a small boat, eventually reaching the Marshall Islands.
1889	March 26. Remaining castaways rescued.
1890	July 11. Rothschild Expedition lands two scientists (ornithologists Henry Palmer and George C. Munro), who collect birds and a few insects.
1891	July 12. The Charles G. Wilson arriving from the Marshalls, lands to secure water.
1900	A survey party from the U.S.S. *Iroquois*, sent to make soundings for a trans-pacific cable, observed Japanese poachers killing birds for their feathers. Complaints about Japanese squatters on the islands caused the Islands to be placed under the Navy Department.
1903	April 29. First contingent of the Pacific Commercial Cable Company arrived on the *Hanalei* and put up temporary structures and tents. The contingent found the *Yeiju Maru* anchored in the lagoon and its crew killing birds ashore.
	June 3. The U.S.S. *Iroquois* arrived and its commander ordered the Japanese to leave the islands. The *Iroquois* assisted in landing the shore ends of the cable.
	July 4. The trans-Pacific cable completed.
	October 23. Chartered at Honolulu to carry supplies, the *Julia E. Whalen* is wrecked.

1903–1930	Naval vessels visit Midway intermittently. A regular supply ship visited Midway from Honolulu once a month.
1904	May. A garrison of marines sent out. A lighthouse and dock are constructed. The Midway colony consisted of approximately 100 people.
1905	The cable station's permanent buildings completed. Two donkeys imported from Honolulu in 1905 and released on Eastern Islands; in a few years there was a herd of twenty or more.
	July 4. The trans-Pacific cable completed.
1906	September 16. The Pacific Mail S.S. *Mongolia* went aground on the western side.
	December 28. The *Carrollton*, with a load of coal from Newcastle to Honolulu is lost on Midway.
1908	Marines leave Midway. The remaining cable personnel reduced to about thirty.
1909	Two canaries brought to Sand Island and bred in a cage. After a dozen or more birds were reared they were liberated.
1920	October. First arrival of a naval plane.
1935	April 12. The ship *North Haven* arrived to bring equipment and supplies for developing an air station between San Francisco and the Philippines. Soon regular weekly trips were bringing visitors through Midway.
1935	May. Navy held fleet maneuvers around Midway.
1940	Construction began on a Naval Air Station and a garrison of 850 marines established.
1941–1998	U.S. Navy operates atoll as a Naval Base.
1997	April. U.S. Fish & Wildlife Service takes over atoll as a wildlife refuge.

Appendix 3. Chronology Of Insect Collecting And Biological Introductions On Midway

1890	July 13–16. Moths observed and collected by the ornithologists, Henry Palmer and George C. Munro. Laysan rails are released on Eastern I.
	July 17. Spiders noted to be "in good variety". Two moths were captured. The "skineating beetle is scarce but small blue blow flies are very numerous and very tame."
1894	First insect from Midway, *Peridroma fasciata* described by W. Rothschild.
1900	August 21. W.A. Bryan arrived for a few hours and made some observations and collected some plants. He noted that Sand Island is barren, covered with dunes with but a few hardy shrubs and grasses on the top of most of the dunes. Eastern was "clothed in green down to the beach." "The most important plants determined for Midway are: *Cenchrus calyculatus* Cav., *Boerhaavia tetrandra* Forst., a variety near *Lepidium oahuensis* Chan. I. Schl., *Capparis sandwichiana* DC., *Ipomoea insularis* Stend., *Scaevola koenigii* Vahl., *Tribulus cistoides* Linn., and *Eragrostis cynosuroides* (Retz). In addition to the above are three widely distributed beach plants, two of which are grasses that are as yet undetermined." This is followed by a list of birds collected.
1905	G.P. Wilder took a few insects.
1905–1921	D. Morrison of the Cable Station imported the grass, *Ammophila arenaria* from beaches near San Francisco, set out ironwood trees, *Casuarina equisetifolia*, as windbreaks, and numerous other kinds of ornamental and useful trees, shrubs, and herbs. Shiploads of soil were brought from Honolulu and used for gardens and other plant growth. He also imported canary birds and Laysan finches in 1906 and fostered the flightless rails that had been introduced from Laysan.
1923	The Tanager expedition [with D.T. Fullaway] obtained a few specimens from Midway. Dr. D.R. Chisholm, the resident physician at the Cable Station and others added notes and plant specimens.
1923	Fullaway visited Eastern Island and noted a fringe of *Scaevola* with central open space. A grove of ironwood occupied the eastern end, and a herd of donkeys lived on the island. In contrast, Sand Island was reclaimed with soil from Honolulu and planted to trees and gardens.
1931	December. Dr. Chisholm collected additional plants, including ornamental trees and weeds that were excluded in the earlier plant collections.
1935	F.C. Hadden stationed on Midway on November 24, 1936. His duty was to inspect and fumigate the clipper planes going in both directions. About 200 insect species were intercepted on planes arriving on Midway. Most planes came from Honolulu, Wake, Guam, Manila or Hong Kong.
1938–1940	F.A. Bianchi took 3 short successive yearly visits to Midway, concentrating on aphids and thrips.
1942	Jan. 12: F.C. Hadden left Midway.
1956–1958	C.F. Clagg with U.S. Naval District Public Works & Yoshio Oshiro, a construction worker with Hawaiian Dredging Company, brought numerous specimens from Midway.

1959	November. E.J. Ford, Jr. made an intensive survey of the atoll.
1959–1961	J.C. Downey surveyed seabird ectoparasites.
1960–1962	H.I. Fisher & E.D. Klimstra
1970	J.L. Gressitt collected for one week.
1971	March. M.L. Goff & M.L. Cunningham, collected on Midway, concentrating on mites.
1983	W.C. Gagne spent a few days on Midway.
1997–1998	G.M. Nishida collected on Midway Atoll on 5 separate trips accompanied by A. Asquith on 1 trip, and G.A. Samuelson on another. A number of Midway refuge personnel assisted with the servicing of a Malaise trap that remained up for over a year.
1999	October 20–23: J.W. Beardsley collected, concentrating on scales, aphids, and parasitic wasps.