



**SPREP**

South Pacific Regional Environment Programme

*Invasive species  
in the Pacific:  
A technical review  
and draft  
regional strategy*

# *Invasive species in the Pacific: A technical review and draft regional strategy*

Technically edited by

**Greg Sherley**



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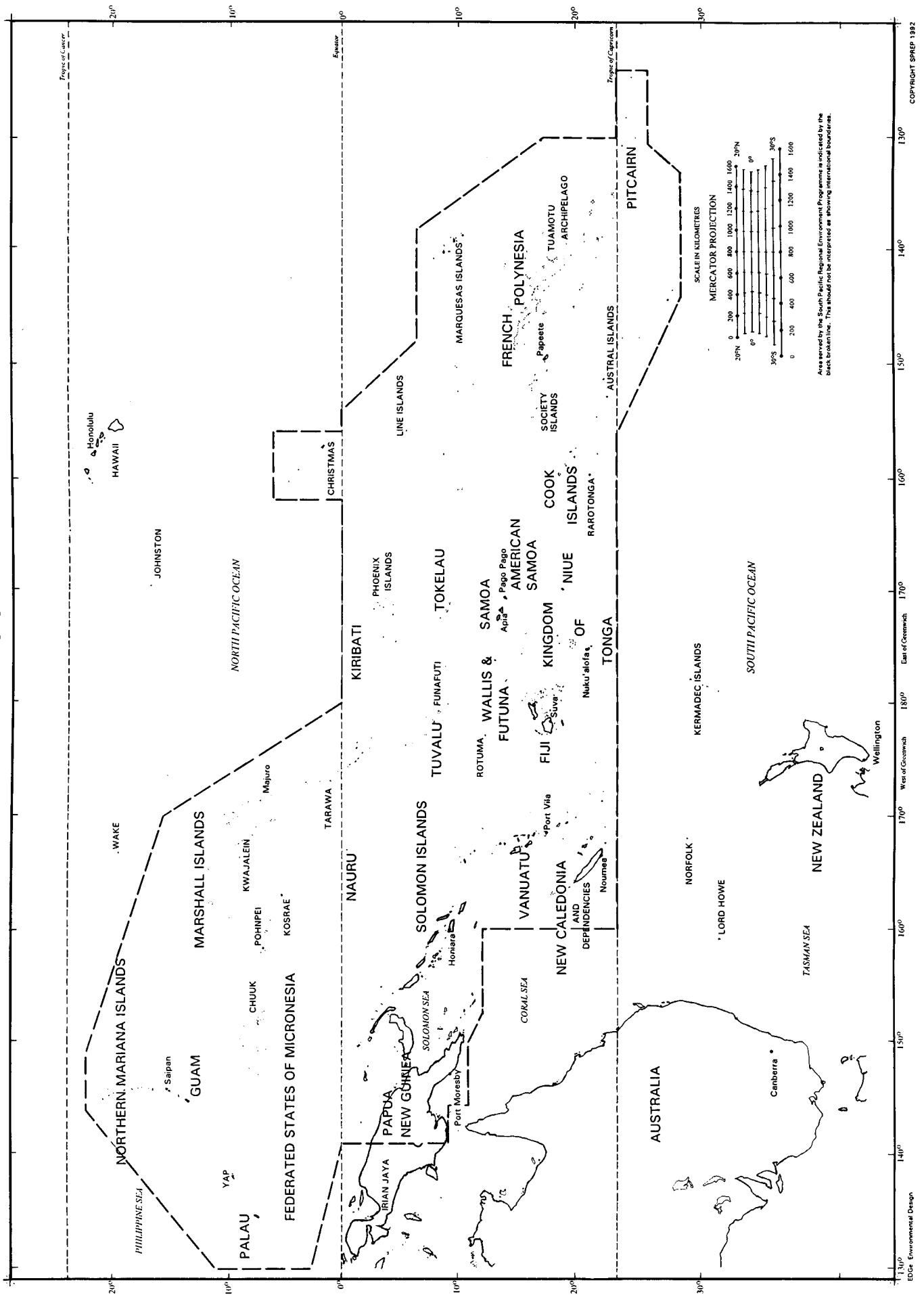
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# AREA SERVED BY THE SOUTH PACIFIC REGIONAL ENVIRONMENT PROGRAMME



# Arthropod pests of conservation significance in the Pacific: A preliminary assessment of selected groups

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## Abstract

Arthropod species are by far the most numerous invasive organisms on islands, but those of conservation significance in the Pacific, except for Hawaii and the Galapagos, are not well documented. Ants may pose the greatest arthropod threat to conservation in the Pacific, by predation, direct competition, and creating favourable conditions for other invasive biota. Information is given on some of the potentially most damaging: bigheaded ant *Pheidole megacephala*, long-legged or crazy ant *Anoplolepis longipes*, Argentine ant *Linepithema humile*, little fire ant *Wasmannia auropunctata*, and others. Vespid wasps pose another critical threat; an outline is given of the yellowjacket wasp *Vespula pensylvanica*, recorded only from Hawaii in the Pacific, but with serious potential for invading other Pacific island groups. The other significant pests discussed here are the black twig borer beetle *Xylosandrus compactus*, the coconut rhinoceros beetle *Oryctes rhinoceros*, and the avian malaria mosquito, *Culex quinquefasciatus*. A preliminary bibliography for ants in the Pacific is appended.

## 1. Overview

The invasion of oceanic islands by non-native arthropods has most likely been an ongoing phenomenon since the first human travelled from one place to settle another. The damage done to natural environments by cattle, pigs, goats and other large mammals is on a scale easily apparent to the human eye. Perhaps for this reason, the effects of their introductions are well documented. The effects of the introduction of non-native arthropods are less obvious and have generally been poorly understood and poorly documented. Nonetheless, the impacts of arthropods on the natural environment are great and deserve the same scale of investigation as exists for their larger cousins.

Given the amount of non-commercial and commercial traffic among Pacific islands, these former

oceanic havens have become easy targets for invasive pest organisms in the last half of this century. Arthropods are by far the largest group (in numbers) of organisms that invade islands each year, e.g. an estimated 20 per year in Hawaii—of which four are considered pests (Beardsley 1979). Therefore, a review of existing knowledge of arthropod pests in the Pacific is a necessary preliminary to larger, more comprehensive surveys and detailed reviews of the fauna. This study only scratches the surface of the amount of research that will be necessary to provide adequate knowledge to deal with the alien arthropod pests that threaten native ecosystems throughout the Pacific.

Arthropods of conservation significance in the Pacific, except for Hawaii and the Galapagos, are not well documented. A critical problem is the incomplete basic knowledge of the existing flora and fauna, making impacts difficult to assess. In addition, many Pacific nations lack adequate resources to recognise the problem or potential problem, identify the culprits, and mount an intervention programme if necessary. There is no single compilation of the Pacific Island arthropod fauna. Very few works deal with the arthropod fauna of the region as a whole (e.g. Curran 1945); most have dealt with arthropods on: (a) a regional basis, e.g. serial works such as *Insects of Samoa* (1927–1935); *Insects of Micronesia* (1951–present); *Insects of Hawaii* (1960–1992) or single works such as Kami and Miller (1998) or Nishida (1997), or (b) a taxonomic basis (e.g. Evenhuis 1989).

Only selected groups of terrestrial arthropods are dealt with here as a first step toward a necessary and more comprehensive study. The selected groups included the ants, the avian malaria mosquito, the yellowjacket wasp, the black twig borer, and the coconut rhinoceros beetle. Each of these groups of insects does have or has had a deleterious effect on the environment in the areas in which they have invaded, has a realised or potential impact on conservation of native biota, and for the most part, active control programmes are in progress to attempt to eradicate them from these areas. By dealing with selected groups in this way, it was felt that we could better gauge the resources needed for a more inclusive effort.

The literature concerning pest arthropods is voluminous and widely scattered and we can in no way do justice to a successful study of the entire group, or even subsets of it, such as the top 10 percent of major pest arthropods in the Pacific area, in this preliminary review. Much of the pest literature is for economic pests, and that body of literature must be consulted to glean conservation information, since detailed and definitive works on the direct effects on native ecosystems are few, although increasing recently.

### 1.1 Origins of the fauna

Zimmerman (1942) hypothesised the origins of the native insect fauna of the eastern Pacific, Gressitt (1982) discussed the biogeography of Pacific Coleoptera, and Evenhuis (1982) discussed the distribution and origin of Oceanic Bombyliidae, but none considered the origins of non-indigenous species. In fact, most studies of the Pacific island arthropod fauna have not dealt with origins of alien species.

As with the vast majority of studies of alien species in the Pacific, Hawaii has been the primary “research station”. Beardsley (1979) summarised the study of 120 accidental insect introductions into Hawaii from 1937 to 1976 and concluded that 36% originated from the west (i.e. Asia); 52% from the east; and 12% from undetermined sources. Virtually all accidentally introduced pests to Hawaii were introduced via commercial traffic. Without reference to other island studies, it is assumed that the origins of arthropods accidentally introduced into other Pacific island faunas are most likely also correlated with shipping and air traffic into these areas.

### 1.2 Types of pest arthropods

The major groups of arthropods that are considered threats to conservation efforts include chiefly the predators and parasites, and these are the groups of organisms that we deal with in this review. The term “parasite” is used here in a broad definition (for example, boring [e.g. beetles] or piercing [e.g. sap-sucking] insects can be considered parasitic on the hosts in which they feed or bore holes for the nests of their eggs and young). Their impacts on the native biota can be disastrous. There is no telling the exact number of native species of insects and other small invertebrates that have been extirpated from lowland areas of Hawaii solely because of the effects of the big-headed ant, *Pheidole megacephala*. Perkins (1907) laments the extirpation of the native fauna of Mt Tantalus just above Honolulu in just 10 years because of the introduction of this ant.

While most arthropod pests have historically been considered as such from the standpoint of their economic impact on agriculture, some are also major threats to conservation of native elements of various ecosystems. Some agriculturally important arthropod pests will not pose any direct significant problem to native biota (for example, *Bactrocera* fruit flies that attack fruit crops and cause significant economic damage to fruits would not pose a significant threat if they were to also attack native fruits since their action does not kill or reduce the reproductive effectiveness of the host). However, other agricultural pests can and do pose a serious threat to native plants, for example *Xylosandrus compactus*, the black tree borer beetle. This has had a deleterious effect on coffee trees and other Rubiaceae in Hawaii, but apparently is not specific to just coffee trees. Surveys have shown that it can attack over 100 different species of mostly woody plants in 44 different families (Hara and Beardsley 1979), some of these being rare or endangered.

### 1.3 Characteristics of invasive species

Howarth (1985) provides a concise assessment of the features that are necessary for successful colonisation of islands by introduced species. Genetic pre-adaptation to exploit resources in the new land is a basic requirement. Climatic, seasonal, and other environmental cues must be present, as must proper hosts and other natural resources. The chances of both sexes of a species being present at the time of colonisation is low in most cases, so that hermaphroditic and parthenogenetic species have a better chance of colonisation than other species. However, gravid females, or nests containing individuals of both sexes can be and have been easily introduced.

### 1.4 Greatest threats

Ants may pose the greatest arthropod threat to conservation in the Pacific. The formation of large, non-competitive, multi-queen colonies, coupled with the ability to hitchhike readily, highly aggressive predatory behaviour, protection of pests on plants, and few options for control, make ants one of the most formidable pests in the Pacific. Ants have been implicated in the elimination of lowland native invertebrates (Perkins 1913), aquatic and semiaquatic arthropods (Hardy 1979, Moore and Gagné 1982), and snails (Solem 1976), and the death or exclusion of vertebrates (Haines et al. 1994, Swaney 1994). Vespid wasps pose another critical threat. In Hawaii, yellowjacket wasps are systematically “cleansing” areas they have invaded, indiscriminately preying on many types of arthropods to feed their colonies.

Vespid and ants are critical threats, especially to native species existing in small populations occupying limited areas.

Plant-feeding species such as leafhoppers, scales, and aphids are another threat. The results of their feeding often attract ants and degrade photosynthetic capabilities of plants. Another potential threat is the indiscriminate release of parasites and predators for biocontrol purposes in commercial crops leading to unforeseen effects in native forests.

The accidental, usually unobserved, and random nature of arthropod introductions makes it difficult to predict areas of greatest threat. In general, the island groups with the greatest traffic with outside areas remain at greatest risk. Traffic in this sense includes not only commercial and military transport, but conveyances such as privately owned small planes or boats. Locations to which agricultural or horticultural plants or commodities are imported are at increased risk of introduction as are areas importing (or exporting) equipment and materials for construction. An active pet trade makes some areas more prone to introductions. Areas actively exporting agricultural products also increase the risk, as large-scale farming often is susceptible to pests and as a result more prone to use biological control agents. Most pests are associated with human disturbance, and those islands with the greatest remaining natural areas at lower elevation and adjacent to areas under cultivation are at risk.

### 1.5 Needs for the future

Loope and Medeiros (1995) provide a list of three points that are necessary for proper understanding, management, and control of invasive species and conservation of natural ecosystems. Though they are written for Hawaii, the principles are valid for most of the tropical Pacific. Continuing research is needed to:

- understand the biology and impacts of invasive species,
- provide the tools needed to manage the most destructive invasive species,
- provide tools for ecological restoration,

To this list we must add and emphasise the need for:

- foundational biosystematic research on the introduced and native arthropods,
- baseline surveys and monitoring programmes to anticipate introductions and pre-empt incipient populations.

Any systematic study is an essential first step towards any conservation programme. Without proper

identification of organisms, attempts to control, abate, or eliminate them may prove costly and fruitless.

Additionally, enhanced quarantine should be a primary consideration for all Pacific islands, and public education should be implemented on each island to augment any control work or preventative measures being done by resource managers and quarantine staff.

As each species may have a different and often unpredictable impact on an ecosystem, and considering the ease with which species are translocated today, perhaps a useful approach may be to provide an inventory of species presently known from each island group. This will allow the tracking of new introductions. A preliminary list is available for ants, but an exhaustive search has not yet been completed and the names have not been fully verified. The foundation for this is compilation of the literature, and a preliminary list is presented in Annex 1.

## 2. Beetles (Coleoptera)

### 2.1 Black twig borer

SCIENTIFIC NAME: *Xylosandrus compactus* (Eichhoff).  
Family: Scolytidae.

#### DISTRIBUTION

SPREP area: American Samoa, Fiji, Papua New Guinea, Solomon Islands.

Other areas: Hawaiian Islands, tropical Africa, southern India, Indonesia, Japan, Malaysia, Mauritius, Seychelles, Sri Lanka, southeastern USA, Vietnam.

#### DISCUSSION

The black twig borer, *Xylosandrus compactus* (Eichhoff), belongs to the tribe Xyleborini of the family Scolytidae, which contains species of beetles called ambrosia beetles. The ambrosia fungus is the primary food for the beetle's development and is the causal agent in the infection and resultant weakening or killing of the host plant that the beetle infests. Ambrosia beetles are serious pests of forest trees and, to a lesser extent, shade and fruit trees (Clausen 1978a). Most ambrosia beetles attack primarily weak or unhealthy plants; however, the black twig borer is known to attack healthy plants as well, which makes it a potentially very serious pest to native forest trees as well as other plants.

The black twig borer was first collected in 1931 on the island of O'ahu from elderberry imported from Singapore (Samuelson 1981), but not reported in the literature until it was collected again on O'ahu in 1961 (Davis 1963) where it was found attacking pink



tecoma (*Tabebuia pentaphylla* (L.) Hemsl.). It has since spread to all the other main islands (Hawaii Dept. Agric. 1975; Samuelson 1981) and the list of hosts includes 108 species of shrubs and trees in 44 families (Hara and Beardsley 1979) including some considered rare or endangered.

### ***The fungus and plant symptoms***

The fungus associated with the black twig borer in Hawaii is *Fusarium solani* (Mart.) Synd. and Hans. It is the only food for *Xylosandrus compactus* throughout its life cycle and its pathogenicity on the host plants has been confirmed (Hara and Beardsley 1979). When infected, the plant exhibits necrosis of the leaves and stems extending from the entrance hole made by the beetle distally to the terminal of the branch.

### ***Control programmes***

Davis and Krauss (1967) list the introduction into Hawaii of three parasites [*Chaetospila frater* (Girault), *Dendrosoter enervatus* Marsh, and *Ecphylyus* sp.] for control of the black twig borer; and Davis and Chong (1970) list the additional introduction of *Dendrosoter protuberans* (Nees). There have been no results on the outcomes of any of these liberations. Hill (1983) comments on the lack of success of the application of cultural methods in suppressing ambrosia beetles as a whole, but said that sprays of dieldrin, with added surfactant and sometimes with Bordeaux mixture, has given adequate levels of control in the tropics. Unsuccessful introductions for control of ambrosia beetles include the predacious clerid beetle *Thanasimus formicarius* (L.) from England into Sri Lanka in 1908 (Clausen 1978a).

## **2.2 Coconut rhinoceros beetle**

SCIENTIFIC NAME: *Oryctes rhinoceros* (Linnaeus).

Family: Scarabaeidae.

### **DISTRIBUTION**

SPREP area: American Samoa, Fiji, Palau (controlled in 1980s), Papua New Guinea, Samoa, Tokelau, Tonga, Wallis and Futuna.

Other areas: Bangladesh, Cambodia, southern China, India, Indonesia, Laos, Malaysia, Pakistan, Philippines, Taiwan, Thailand, Vietnam.

### **DISCUSSION**

The coconut rhinoceros beetle, *Oryctes rhinoceros* (Linnaeus), is one of the most serious pests of the coconut palm. Though, for the most part, coconut palms are considered agricultural crops, this beetle is included in this review because of its record of

damage, wherever it has become established in the tropics, to native palm trees and native *Pandanus*.

It is thought to be native to southern India, Sri Lanka, Myanmar, Thailand, the Malay peninsula, southernmost China including Hong Kong, the Philippines, Taiwan, the Ryukyus, and Indonesian Archipelago as far east as Ambon Island (Leefmans, 1884). It has been introduced into Samoa, Wallis and Futuna, New Britain, New Ireland, Palau, Tonga, Guam, Cook Islands, and Fiji (Gressitt 1953; Hill 1983), primarily as a result of the increased sea traffic during World War II. Swan (1974) lists its distribution among Pacific Islands (and years of introductions in parentheses) as Western Samoa (1910); Keppel Island (1921); Wallis and Futuna (1931); Palau (1942); New Guinea (1942); Tonga (1953); Fiji (1953); and Tokelau (1963). Though there are natural factors that keep the beetle under control in its native range, its introduction into insular habitats without these natural control factors allows it to reproduce quickly and spread to become a serious pest.

### ***The beetle***

The larvae of this scarab beetle develop in dead palm trunks, logs, and stumps. However, the adults cause the damage by boring into the crowns of mature palms and often killing them. Gressitt (1953) reports that in introductions of the beetle into insular situations such as Palau both the adults and larvae have been reported to survive by host-shifting on to *Pandanus* after the host palm food resource had been depleted. This is evidence of the potential danger to native palms and *Pandanus* from the ravages of this pest beetle elsewhere in the Pacific. In Gressitt's (1953) report, he lists over 45 species of monocot plants (many of which are native species) that the beetle has been reported to infest, including over 30 species of palms.

### ***Control programmes***

After World War II, the Insect Control Committee for Micronesia (ICCM) was established through the auspices of the National Academy of Science and plans were made for control efforts of the beetle (Anon. 1947). Subsequent reports follow the progress of this control programme (Anon. 1948a, 1948b, 1949, 1950, 1951, 1952, 1953). Parasites introduced from 1947 to 1950 for control of the beetle included the wasps *Scolia ruficornis* from east Africa and *Scolia patricialis* var. *plebeja* from Malaya. By 1952, surveys failed to recover any wasps, and palms continued to be attacked by the beetle.

Swan (1974) summarises the results of control of the beetle in the Pacific using predators, parasites, and various pathogens. The most promising of the ones

listed appear to be the parasite *Scolia ruficornis* (Hymenoptera: Scoliidae) and the virus *Rhabdionvirus oryctes*. Other predators or parasites in the list would have to undergo specificity trials before they could be confirmed as safe for introduction to other Pacific Islands and without the danger of damage to non-target native organisms.

Clausen (1978b) gives a summary of control attempts in Fiji, Samoa, Palau, New Guinea, New Britain, and Vanuatu. In almost all cases, *Scolia ruficornis* was released, but only up to 30 per cent parasitisation was achieved in Samoa, and other areas had significantly less success.

Hill (1983) summarises recommended methods of cultural control (planting methods, general area cleaning and burning of potential host substrata) and states that chemical control can be attained with sprays of various chemicals including diazinon or carbaryl.

### 3. Flies (Diptera)

#### 3.1 Avian malaria mosquito; southern house mosquito

SCIENTIFIC NAME: *Culex quinquefasciatus* Say.

Family: Culicidae.

##### DISTRIBUTION

SPREP area: American Samoa, Cook Is, Federated States of Micronesia, Fiji, French Polynesia (Austral Is, Marquesas, Society Is, Tuamotu Archipelago), Guam, Hawaiian Islands, Kiribati, Marshall Islands, Nauru, New Caledonia, Niue, Northern Marianas, Palau, Papua New Guinea, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, Wallis and Futuna.

Other areas: Widespread throughout the tropics, subtropics, and warm temperate regions of the world.

##### DISCUSSION

Avian malaria has been postulated as one of the leading causes of the reduction and even extinction of some of Hawai'i's forest birds (Warner 1968; Van Riper 1991). The disease has been found in roughly 8% of the birds tested in Hawaiian experiments (e.g. Van Riper et al. 1982). Researchers have also concluded that native birds were more susceptible to acquiring the disease than introduced birds and had a significantly poorer survival rate than introduced species (Van Riper et al. 1982; Atkinson et al. 1995). This fact has serious implications for native bird faunas elsewhere in the Pacific where the mosquito and the disease parasite may occur.

##### *The parasite*

Several species of the filarial parasite *Plasmodium* are the causal organism for avian malaria. *Plasmo-*

*dium relictum capistranoae* Russell is the parasite found in infected Hawaiian birds. Sporozoites are the infectious stage of the *Plasmodium* protozoan parasite and are transmitted to a vertebrate host through blood feeding by a mosquito. The disease to the host is caused by the parasite protozoan attacking red blood cells to continue its development. Fully developed erythrocytic schizonts cause rupturing of the red blood cells to release merozoites (to continue the blood cycle in the host) and gametocytes (capable of initiating sexual development if ingested by a mosquito). It is the merozoites with accompanying toxins that cause the chills and fever of malaria.

##### *The mosquito*

The transmitting agent of avian malaria is the mosquito. The most prevalent mosquito transmitting avian malaria in Hawaii is *Culex quinquefasciatus*, though a number of other mosquitoes have been found to harbour the parasite in experiments (summary of previous work in Hewitt 1940). *Culex quinquefasciatus*, native to North America, is found throughout the tropics and subtropics, including virtually all the island groups under SPREP as well as Hawaii.

Avian malaria itself has not yet been recorded from native birds on any island group in the Pacific except Hawaii, but this may only be a reflection of the fact that not many rigorous epidemiological surveys to find *Plasmodium relictum capistranoae* or other disease vectors for avian malaria have been conducted in the Pacific outside of Hawaii. The only research known that has surveyed other islands in the Pacific for avian malaria is by Savidge (1985) [Guam] and Steadman et al. (1990) [Cook Islands], and there were no findings of the parasite. Avian malaria is currently not an active threat to conservation on any other island group except Hawaii. However, it is included in this preliminary survey because of the high potential for the disease to spread to other Pacific islands through normal commercial traffic lanes (be it shipping or air traffic). One of the most prevalent methods by which the disease is spread is through the introduction of infected non-native birds.

In Hawaii, avian malaria has been reported from a variety of native bird species, with the 'apapane (*Himatione sanguinea*) having the highest percentage of infected individuals in surveys (e.g. Van Riper et al. 1982, 1986; Van Riper and Van Riper 1985). Other native species recorded in that study as being infected with avian malaria include i'iwi (*Vestiaria coccinea*), amakihi (*Loxops virens*), 'elepaio (*Chasiempis sandwichensis*), oma'o (*Myadestes obscurus*), Hawaiian creeper (*Loxops maculata*), and

akiapola'au (*Hemignathus munroi*) [the last is on the US Fish and Wildlife Endangered Species List]. Scott *et al.* (1986) add a few more endangered native species to the list of Hawaiian birds found to be infected with avian malaria: Townsend's (Newell's) shearwater (*Puffinus newelli*), and the Hawaiian crow (*Corvus hawaiiensis*). Massey *et al.* (1996) conducted further observations on the characteristics of the Hawaiian crow after it had become infected with *Plasmodium relictum capistranoae*. Van Riper *et al.* (1982) showed that introduced species had a substantially better survival rate after being infected than native Hawaiian birds (100% v. 42%).

In Guam, studies were conducted in the 1980s (Savidge 1985) to determine the causes of the precipitous decline of bird populations there. Neither *Plasmodium relictum capistranoae* nor any other avian malarial parasite was found in any of the birds sampled, yet the vector, *Culex quinquefasciatus* occurs on the island. Savidge concluded that the main causes of the decline in bird populations were the brown tree snake (*Boiga irregularis*) and collisions with cars, but did not rule out the possibility that *Plasmodium* might be in the mosquito populations, although at such low levels as to not have been detected.

In the Cook Islands, Steadman *et al.* (1990) surveyed nine indigenous species of birds with negative results for the presence of protozoan pathogens. Nevertheless, they point out that precautions should still be taken to prohibit the introduction of potentially infected non-indigenous birds or mosquitoes into the Cooks or any other Polynesian island because of the high potential for native birds to be fatally vulnerable to the consequences of the disease should they become infected.

### **Control programmes**

There are no active control programmes for the abatement of avian malaria. Attempts to control mosquitoes in general have been implemented in Hawaii, but have not met with success.

Mosquitoes that harbour the causal organism of avian malaria are container breeders (immatures can be found in both natural and artificial containers). The only effective procedure to reduce populations of mosquitoes is to reduce the number of potential water catchment containers in the area in which the mosquitoes are known to breed.

One way to reduce potential mosquito populations in Hawaiian forests and elsewhere is to reduce the number of pigs. In Hawaii, the introduction of pigs into forest areas has increased the number of potential breeding areas for mosquitoes. In foraging for

soft plant food items such as roots, pigs will often fell tree ferns and eat the soft cambium, leaving trough-like depressions that fill with rainwater. Pigs also create wallows in which standing water can attract mosquitoes for long enough for them to fully develop. Mosquitoes have been found in greater abundance in these pig-infested areas than elsewhere. Thus, excluding pigs from conservation areas or eradicating them from forested areas will reduce the number of potential mosquito breeding areas and thus the number of mosquitoes that could potentially spread avian malaria or other insect-borne diseases to native animals.

## **4. Wasps (Hymenoptera: Vespidae)**

### **4.1 Yellowjacket wasp**

SCIENTIFIC NAME: *Vespula pensylvanica* (Saussure).  
Family: Vespidae.

DISTRIBUTION

SPREP area: Not yet recorded.

Other areas: Hawaiian Islands, throughout North America.

DISCUSSION

Though not yet recorded from any Pacific island other than the Hawaiian Islands, we include a discussion of *Vespula pensylvanica* because of its notorious habits in Hawaii and potential for invading other Pacific island groups. We recommend that frequent and rigorous monitoring at all places of entry (ports and airports) be done on all islands so as to prevent the unwanted entry of this wasp.

Yellowjackets are predators, feeding on a wide range of arthropod taxa, with great potential for negative impact on the native fauna in insular habitats. This is especially troublesome in Hawaii, which compared to mainland areas where *Vespula* occur, has a high degree of endemism for arthropods that, for the most part, have evolved without anti-predator defence mechanisms selected for elsewhere (Gagné and Christensen 1985).

The yellowjacket wasp is native to North America. It and other members of the genus *Vespula* have natural distributions that are primarily north temperate. Climate is a major constraint on its reproductive behaviour; cold weather depletes normal food supplies, resulting in a reduction of colony individuals during cold winter months. However, in Hawaii with its warmer year-round climate, colonies appear to enlarge during warm winter months causing popula-

tion explosions in areas it has invaded (up to 300 sorties per minute have been observed at some nests [Gambino 1991]).

*Vespula pensylvanica* was first reported from Hawaii in 1919 (on Kaua'i) and subsequently on O'ahu in the 1930s where all reports were primarily about it being a nuisance to humans, with concurrent reports of stinging. However, Williams (1927), misidentifying it as *V. occidentalis*, was prescient to note that "This fierce insect will probably be of no benefit to the endemic fauna". However, it was not until an aggressive race of this species was reported from the island of Hawai'i in 1977 (Asquith 1995) that its almost simultaneous population explosion and resultant intensive predatory habits began to have repercussions on the native invertebrate populations. Gambino and Loope (1992) provide a detailed account of surveys done over a ten-year period in Hawaii Volcanoes National Park (Hawai'i Island) (1984–1990) and Haleakala National Park (Maui) (1981–1990) and identified 24 arthropod prey items at least to genus, of which 14 (58%) were endemic taxa (including some taxa that are currently considered as Species of Concern by the US Fish and Wildlife Service).

#### **Control programmes**

Almost as soon as the 1977 population was discovered, nest eradication and/or control programmes were initiated on various islands in Hawaii to attempt to control the yellowjacket. The toxicant bendiocarb, used for nest eradication, is not registered in the USA for use in agricultural situations, so its implementation had to be outside of agricultural fields. Chang (1988) discusses the use of toxic baiting in the control of yellowjackets. His results showed that the most effective combination of bait and chemical toxicant was 0.5% microencapsulated diazinon mixed with canned Figaro brand tuna cat food. Amidinohydrazone in a similar bait mix was also effective, but less so than diazinon mix. Dispenser colour for the bait also proved critical, the preferred colour of bait dispenser being translucent white.

## **5. Ants**

### **(Hymenoptera: Formicidae)**

The best-documented ant conservation problems in the Pacific are mostly from the Hawaiian Islands and the Galapagos. Most of the conservation pests listed below are exclusionary; they occupy an area, outcompete any native ants, prey on native fauna or exclude them from the area. They affect plants by harvesting seeds, pruning foliage and encouraging the increase in populations of some sap-sucking in-

sects. Most of the beneficial aspects of alien ant species appear to occur in cultivated areas. However, Compton and Robertson (1991) point out that the presence of *Pheidole megacephala* reduces seed predation and increases the number of pollinators in figs. Documentation on effects of ants in native ecosystems in the Pacific has been slow in arriving, but recent research has revealed a number of problems and potential problems. The major potential problem ant species for conservation are discussed below.

### **5.1 Bigheaded ant**

SCIENTIFIC NAME: *Pheidole megacephala* (Fabricius).  
Family: Formicidae

#### **DISTRIBUTION**

This ant is Afrotropical in origin and seems to be circumtropical in distribution (Wilson and Taylor 1967), although it is also found in heated greenhouses in temperate areas (Bernard 1968). In the Pacific, it has been reported from the Hawaiian Islands, Line Islands, Society Islands, Cook Islands, Austral Islands, Gambier Islands, Marquesas Islands, Fiji, Marshall Islands, and Guam, but is likely to be widely distributed throughout the Pacific. This species was first reported from Hawai'i in 1879 (Smith 1879), but was probably established some time before that, as Blackburn and Kirby (1880) noted that it was already quite common.

#### **DISCUSSION**

Perkins (1913) documented the loss of native species in Hawaii as a direct result of predation by the bigheaded ant. He specifically reported beetles and moths being affected, but included all arthropod groups in his assessment. Zimmerman (1948) reported the elimination of most endemic species in the bigheaded ant's range. *P. megacephala* has also been implicated in the exclusion of native spiders (Gillespie and Reimer 1993).

In Hawaii the bigheaded ant is primarily restricted to dry and mesic lowland areas although it may occasionally be found up to 1220 m altitude (Reimer 1994, Wetterer 1998, Wetterer et al. 1998). It is the dominant ant in many areas, although other aggressive ants such as *Linepithema humile*, *Anoplolepis longipes*, *Iridomyrmex glaber*, *Solenopsis geminata*, and *Pheidole fervens* have displaced it in less suitable environments (Reimer 1994).

In addition to the negative effects of general predation on the native fauna, the big-headed ant feeds on the honeydew of scale insects and other homopterans, increasing their rates of survival by protecting them from parasites and predators (Jahn and Beardsley

1994), and possibly by removing waste material (Rohrbach et al. 1988). This behaviour may foster the depredation of native host plants by increasing the parasite load and by increasing growth of sooty moulds on leaf surfaces, disrupting photosynthesis.

Large-scale programmes to control this species in non-cultivated areas appear not to have been attempted in Hawaii. Su et al. (1980) in searching for an alternative to the mirex baits withdrawn for environmental concerns, found that AC-217,300 was effective in controlling the bigheaded ant in pineapple fields. McEwen et al. (1979) and Reimer et al. (1991) reviewed chemical controls for *P. megacephala* in Hawai'i.

## 5.2 Long-legged ant, crazy ant

SCIENTIFIC NAME: *Anoplolepis longipes* (Jerdon).

Family: Formicidae.

Long-legged ant is the common name for this species in the list of common names published by the Entomological Society of America (ESA) (Bosik 1997), but crazy ant is in wide use in the Pacific. In the ESA list, *Paratrechina longicornis* is called the crazy ant.

### DISTRIBUTION

After many years of interception in quarantine, *A. longipes* was discovered established in Hawaii on O'ahu in 1952. Wilson and Taylor (1967) list Africa as the source area. This ant has been spread throughout the world by human activity. Wilson and Taylor (1967) gave its distribution as the Old World tropics, and called it the dominant ant in disturbed habitats in Melanesia and Micronesia. More specifically, in the Pacific, it has been reported from Guam, Kosrae, Marshall, Kiribati, Tuvalu, Wallis and Futuna, Samoa, Fiji, Cook, Tokelau, Ellice, Austral, Tuamotu, Gambier, Marquesas, and Solomon Islands, in addition to Hawaii, and is likely to be found on other Pacific islands.

### DISCUSSION

This ant is usually found from sea level to 800 m in the Hawaiian Islands, but has been collected as high as 1220 m altitude (Reimer 1994, Wetterer 1998). Hardy (1979) first noted the effect of the long-legged ant on formerly common native insects in riparian habitats. Beardsley (1980) confirmed the threat to endemic arthropod fauna. Moore and Gagné (1982) implicated *A. longipes* as one of the causes for the depletion of the native lowland damselfly fauna. Gillespie and Reimer (1993) demonstrated that confrontations between *A. longipes* (and *P. megacephala*) and native or alien spiders resulted in

the death of the native species and not the alien species. Gillespie and Reimer suggested the exclusion of native spiders in lowland areas occupied by *A. longipes*.

The long-legged ant is considered beneficial for agricultural purposes, often preying on agricultural pest species and reducing their numbers. At the same time, it can be a household nuisance (Haines et al. 1994). Haines et al. (1994) reported that, in addition to their predation of arthropods and similar to the big-headed ant, *A. longipes* affects plants by removing soil from roots and tending coccid populations and greatly enhancing their populations, increasing sooty mould growth.

The long-legged ant may also exclude vertebrates. In the Seychelles, Haines et al. (1994) noted that the ants killed newly hatched chickens and newly born domestic animals and forced older animals to leave the area. In Tonga, *A. longipes* has been shown to kill hatchlings of an endemic bird (*Megapodius pritchardii*) (Swaney 1994). This ant and similar aggressive species could potentially be a problem for native vertebrates throughout the Pacific, as even snakes and lizards were affected.

In the Solomon Islands, Greenslade (1971) noted that species diversity decreased wherever *A. longipes* populations flourished. Though Greenslade was referring to coconut plantations, the observation should also hold true for native forests.

An educational programme coupled with toxic baits were used in the Seychelles to control *A. longipes* and prevent its spread to islands of greater conservation significance, those with higher populations of native species (Haines et al. 1994). Partial success of the programme ensued, but full eradication failed for a variety of reasons. However, populations of *A. longipes* declined, perhaps as a result of natural factors associated with invasion by a new species (invasion, slow increase in numbers, explosive growth, high densities, decline in densities) (Simmonds and Greathead 1977). Lewis et al. (1976) reviewed earlier efforts using chemical controls in the Seychelles.

## 5.3 Argentine ant

SCIENTIFIC NAME: *Linepithema humile* (Mayr).

Family: Formicidae

### DISTRIBUTION

The Argentine ant is a tramp species that is so far reported in the Pacific only from Hawaii. This species is apparently native to Brazil and Argentina, and has a worldwide distribution, mostly in the 30°–36° latitude belts of the Northern and Southern hemi-

spheres (Fluker and Beardsley 1970, Lieberburg et al. 1975).

#### DISCUSSION

The Argentine ant was intercepted in quarantine many times before it finally became established in Hawaii in 1940 (Zimmerman 1941). At first, these ants were observed eliminating other ant species. Wilson and Taylor (1967) stated that *L. humile* excluded other larger ant species, including *Pheidole megacephala*, and Majer (1994) confirms this. However, Reimer (1994) states that *L. humile* has been displaced by other ant species, such as *P. megacephala* in Hawaii, and is now limited to the cooler higher altitudes from 900 to 2800 m. Medeiros et al. (1986) reported the Argentine ant in two slowly expanding populations at Haleakala on Maui, at altitudes of 2000–2260 m and 2740–2830 m.

Medeiros et al. (1986) suggested *L. humile* negatively affected endemic organisms, particularly ground-dwelling or ground-nesting native moths and bees. Cole et al. (1992) discussed the effects of the Argentine ant on the invertebrate fauna at higher altitudes and concluded that the ant locally reduced the abundance of many endemic species, including arthropods and snails, and could negatively affect the pollination of native plants. They also mentioned that spiders were negatively affected, although Gillespie and Reimer (1993) noted that native spiders co-existed with *L. humile* between 300 m and 1500 m altitude.

Bartlett (1961) showed that, in the absence of Argentine ants, certain parasitic species suppressed populations of scale insects, indicating that Argentine ants may also foster increases in scale insect populations to the detriment of the host plant and its surrounding environment.

Majer (1994a) suggests that the exclusivity of *L. humile* offers a potential control mechanism by giving selective advantage to competing native species. Krushelnycky and Reimer (1996) reviewed the efforts of ant control at Haleakala. Use of Maxforce baits has been effective in trials to control the Argentine ant at Haleakala (Reimer 1999).

### 5.4 Little fire ant

SCIENTIFIC NAME: *Wasmannia auropunctata* (Roger).  
Family: Formicidae

#### DISTRIBUTION

The little fire ant is a native of tropical America. It was first found in the Pacific over 35 years ago, but within the last few years has been rapidly expanding its range. *W. auropunctata* was first reported from

the Galapagos in 1972 (Silberglied 1972), New Caledonia in 1972 (Fabres and Brown 1978), Wallis and Futuna (Passera 1994); and Wetterer (1998) adds the Solomon Islands. More recently, it has been found in Fiji (personal comm. J.K. Wetterer to J. Wright and G. Sherley) and Vanuatu (Rapp 1999). In addition, this ant may have just been found in Hawaii (N. Reimer, personal comm.). The sudden increase of sightings may be attributable to the work of Wetterer and others who have done much to increase the awareness of the threat of this species. Wetterer considers this ant to be “perhaps the greatest threat in the Pacific”. Much of the work documenting the problems caused by this species is from the Galapagos. Though the Galapagos is not part of SPREP, those references are included here for background information and for use by SPREP members.

#### DISCUSSION

Smith (1965) indicated that *W. auropunctata* prefers cultivated areas and buildings, but this was in temperate and urban eastern USA. Silberglied (1972) early pointed out the potential conservation problems with *W. auropunctata* as it replaced indigenous ant fauna, attacked other terrestrial insects and invertebrates, and tended a variety of honeydew secreting insects. Lubin (1984) documented the exclusionary behaviour of *Wasmannia* and found that it reduced species diversity, reduced overall abundance of flying and arboricolous insects, and eliminated populations of arachnids. *Wasmannia* is also known for its painful stings (Spencer 1941, Silberglied 1972). Clark et al. (1982) quantified the diet of *Wasmannia* and showed that prey included eight orders of insects, chilopods, arachnids, crustaceans (mainly isopods), gastropods, annelids, and seeds and other plant parts.

In the Solomon Islands, it is considered partially beneficial because of its ability to control the coconut nutfall bug, *Amblypelta cocophaga*, in coconuts and cocoa (GPPIS 1999apr30). In New Caledonia the ant induces severe outbreaks of the coffee berry borer, *Hypothenemus hampei*, through interfering with parasitisation of the pest (GPPIS 1999apr30).

More recently, informal information suggests that *W. auropunctata* severely affects vertebrates, both domestic and native species (J.K. Wetterer to E. van Gelder in response to a query about the effects of *W. auropunctata*, April 1999). According to Wetterer, the ants attack vertebrates, including giant tortoises in the Galapagos, attacking eyes and cloacas and potentially rendering them infertile. The little fire ant also reportedly eats the hatchlings of the Galapagos tortoises (Hayashi 1999). In New Caledonia and the

Solomon Islands, local reports indicate that dogs are blinded by the ant's venom (Wetterer to van Gelder, Hayashi 1999).

Spencer (1941) reviewed control measures against *W. auropunctata* in citrus groves. Abedrabbo (1994) reviewed control efforts in the Galapagos using commercial formulations in chemical baits. Heraty (1994) offers a potential method of control, suggesting that host-specific eucharitid wasps of the genus *Orasema* might provide biological control of *Wasmannia* and *Solenopsis*.

## 5.5 Other ants

The following ant species are treated together as they were cited as conservation problems as a group, not individually.

### Fire ant

SCIENTIFIC NAME: *Solenopsis geminata* (Fabricius).  
Family: Formicidae

### [Ants without common names]

SCIENTIFIC NAME: *Monomorium floricola* (Jerdon).  
Family: Formicidae

SCIENTIFIC NAME: *Tapinoma minutum* Mayr.  
Family: Formicidae

SCIENTIFIC NAME: *Technomyrmex albipes* (F. Smith).  
Family: Formicidae

Nafus (1993) presented evidence that the ants listed above were significant factors in reducing populations of native butterflies on Guam. The most important species attacking eggs were *Monomorium floricola*, *Solenopsis geminata*, and *Tapinoma minutum*. The most commonly observed predators attacking butterfly larvae were *T. minutum*, *S. geminata*, and *Technomyrmex albipes*.

According to Wilson and Taylor (1967), *Monomorium floricola* is one of the most widespread of all pantropical ant species and probably originated from tropical Asia. It occurs virtually on all island groups in the Pacific. *Solenopsis geminata* is similarly widespread, but is native to the tropics and warmer parts of temperate New World. It prefers drier habitats. *Tapinoma minutum* is tiny, inconspicuous and often overlooked. It may be indigenous to the Southwest Pacific and has been recorded from Samoa, Micronesia, tropical Australia, New Guinea, Solomon Islands, and Fiji as well as Hawaii. *Technomyrmex albipes* is probably the most widespread member of the genus, ranging from India to eastern Australia and throughout the Pacific including Polynesia, Melanesia and Micronesia. These species are all present in Hawaii, and although recent studies on impacts of their presence (e.g. Gillespie

and Reimer 1993) did not implicate them as excluding native species of spiders, their presence may have an unobserved effect, such as predation of eggs or larvae as demonstrated by Nafus (1993).

Other ants may also be problems though not documented, especially if inserted into previously antless island ecosystems or if more aggressive species invade and disrupt the ecosystem. Some ants are potential problems, but their impact is unknown. Wetterer (1998) suggests that colonisation by more cold-tolerant ants such as *Pheidole bourbonica*, *Cardiocondyla venustula*, and *Linepithema humile* poses a general threat to the remaining native enclaves in Hawaii. The following two species are potential threats to native ecosystems, though their actual impact has not yet been confirmed.

### [Ant without a common name]

Scientific name: *Solenopsis papuana* Emery

Gillespie and Reimer (1993) found a significant inverse relationship between the abundance of *S. papuana* and native spiders in Hawaii. Although exclusion was not shown as in the case of *Pheidole megacephala* and *Anoplolepis longipes*, they suggest this species may be the most serious threat to native Hawaiian arthropods. They suggest the present co-existence of ant and spiders is due to the recent invasion of *S. papuana* (first reported as *Solenopsis* sp. "b" by Huddleston and Fluker 1969). The basis for the threat is that this ant has successfully invaded native and disturbed wet forests, areas that retain the highest level of endemism in Hawaii.

### Glaber ant

Scientific name: *Ochetellus glaber* (Mayr)

Though not included in Gillespie and Reimer's (1993) study, another ant that may bear careful observation is *Ochetellus glaber*. This ant was first reported in 1978 in Hawaii and is aggressively invading areas formerly occupied by other species of ants.

## 5.6 Tramp species of ants

Most of the ants listed above exhibit similar characteristics that categorise them as "tramp" species (Hölldobler and Wilson 1990, Passera 1994). Tramp species are attracted to perturbed environments and thus are often associated with human activities. They are unicolonial or show the absence of aggressive behaviour to individuals of the same species from different nests. They are polygynous where nests have multiple queens and the queens do not exhibit dominant behaviour. Their colonies tend to expand by budding rather than by nuptial flights and aerial dispersal. These ants are particularly aggressive to other

species of ants. Tramp species also tend to be smaller in size (<1.5 to 3.5 mm in worker length). Brandao and Paiva (1994) include opportunistic with regard to nest sites and omnivorous as additional characteristics of tramp species. Jourdan (1997) suggests the rapid spread of tramp species such as *Wasmannia auropunctata* may be partly a result of paucity of ant species and ant-filled niches in the Pacific.

Ants attracted to perturbed environments are more likely to become hitchhikers on machinery and plants associated with humans and from areas where habitat modification is commonly practised, such as farms, nurseries, greenhouses and the like. The lack of intraspecific aggression, multiple queens, and budding permit the establishment of large numbers of individuals in a single area, maximising foraging efficiency.

The traits listed for tramp species also have implications for control measures. For example, in Hawaii, Reimer (1994) states the Argentine ant occupies limited areas in Haleakala National Park and suggests it could be eliminated or contained with an appropriate bait. Colonies multiplying by budding rather than aerial dispersal could be more easily eliminated because of the restricted area of occupation. However, the budding also makes it more difficult to determine whether the entire colony has been eliminated.

### 5.7 Methods of ant control

Chemicals, particularly those used in conjunction with baits, seem to be the most effective method to control established unwanted species at this time (Lewis et al. 1976, Abedrabbo 1994, Reimer 1999).

Apart from other ant species, few biological control options exist. Predators such as antlions and ant-feeding vertebrates such as anteaters have either minimal impact on the large populations or are inappropriate to introduce. Relatively little is known about pathogenic microorganisms and fungi (Hölldobler and Wilson 1990). Parasitoids have been a major means of controlling plant pests such as scales, aphids, and caterpillars, but have not been widely used for ant control. Hölldobler and Wilson (1990) did not even include a section on ant parasitoids in their comprehensive treatment of ants. Recently, however, some effort is being made to identify and assess the impact of ant parasitoids such as eucharitid wasps (Heraty 1994) and phorid flies (Disney 1994, Morrison and Gilbert 1998).

Effective quarantine measures, continuous monitoring, and immediate response upon finding newly established ant species may be more effective than attempting to eradicate established species.

### 5.8 Summary (ants)

Many tramp species of ants are found throughout much of the Pacific. Some of these were introduced to Pacific islands very early. As many of the lowland ecosystems are quite disrupted, the damage, if any, done by these species perhaps cannot be established. For example, when first observed in Hawaii, *P. megacephala* was considered beneficial as it was found in sugar cane fields and was observed feeding on many pest species (e.g. Perkins 1907). Perkins was completing an inventory of the arthropod species of Hawaii at the time he noted the absence of native beetles, moths and other groups in areas occupied by *P. megacephala*, and began documenting the predation on native species. Other areas of the Pacific other than the Galapagos did not have the combination of baseline inventory and field observation at the time of invasion by the pest species of ants, and the effects of the invading species are probably unknown.

Perhaps one of the greatest threats to Pacific conservation is *Wasmannia auropunctata*, which is spreading rapidly. Though much of the previous evidence of their impact was anecdotal, a substantial number of reports on the negative consequences of their introduction to Pacific islands are beginning to emerge. The damage to native ecosystems from this species is likely to be considerable.

In Hawaii, except for *Linepithima humile*, which is found as high as 3000 m, most of the environmental depredations caused by ants have been at lower elevations. This would suggest that intact lowland ecosystems with high diversity of native species would be most at risk. However, Wetterer (1998) states that ants continue to spread in the Hawaiian Islands, and cites unpublished data indicating that *P. megacephala* is found as high as the saddle area between Mauna Kea and Mauna Loa, up to 2020 m in altitude. Though populations of most ant species have not deeply penetrated native forest at higher altitudes, the situations posed by *Linepithima humile* and possibly *Solenopsis papuana* should serve as warnings about the potential threats posed by ants to native flora and fauna at even the higher elevations and in wet forests. Others have pointed out that ants can exclude vertebrates. For example, Wetterer et al. (1998) suggest that ants rather than avian malaria at upper elevations on the island of Hawai'i may be responsible for the exclusion of the endangered palila (*Loxioides bailleui*). Ants are also predators of other invertebrates including snails, and invertebrate biodiversity must be considered also when assessing ant invasions.

Particular care should be taken in introducing ants as biological control agents, and Majer (1994b) cautions



against such an approach. Zenner-Polania (1994) documents the effects on the native ant fauna of introducing *Paratrechina fulva* (Mayr) into Colombia, and many authors discuss the exclusion of native species of ants by aggressive invaders.

A review of the information cited above indicates that much more information must be gathered to understand the true impact of ants on native ecosystems, especially considering the uniqueness of Pacific floras and faunas. Their actual impact may not have been observed nor fully understood, as monitoring of Pacific island ecosystems has not usually been done. Only recently have some of the negative aspects of their presence been documented and these present increasing and extremely disturbing evidence of environmental modification. Based on the information presented above, it appears that many if not most ants may have an effect on any environment they invade. Except for a few species, the size of the impact, whether positive or negative, and the extent of the impact are usually poorly known.

Current methods of eradicating ant invasions in native forests are for the most part, inadequate, ineffective, or inappropriate. Control is often obtained by the use of baits with pesticides. More research is needed in this area.

## 6. References

- Abedrabbo, S. 1994. Control of the little fire ant, *Wasmannia auropunctata*, on Santa Fe Island in the Galapagos Islands. Pp. 219–227 in: D.F. Williams (ed.) *Exotic ants: biology, impact, and control of introduced species*. Westview Press, Boulder. 332 pp.
- Anonymous. 1947. Insect Control Committee for Micronesia (ICCM). *Annual Report of the Pacific Science Board*, 1: 17–21.
- Anonymous. 1948. Insect Control Committee for Micronesia (ICCM). *Annual Report of the Pacific Science Board*, 2: 16–20.
- Anonymous. 1948. Insect Control Committee for Micronesia (ICCM). *Annual Report of the Pacific Science Board* (suppl. to 1947 report): 9–13.
- Anonymous. 1949. Insect Control Committee for Micronesia (ICCM). *Annual Report of the Pacific Science Board*, 3: 74–79.
- Anonymous. 1950. Insect Consultants Committee for Micronesia (ICCM). *Annual Report of the Pacific Science Board*, 4: 25–31.
- Anonymous. 1951. Insect Consultants Committee for Micronesia (ICCM). *Annual Report of the Pacific Science Board*, 5: 30–37.
- Anonymous. 1952. Insect Consultants Committee for Micronesia (ICCM). *Annual Report of the Pacific Science Board*, 6: 28–36.
- Anonymous. 1953. Insect Consultants Committee for Micronesia (ICCM). *Annual Report of the Pacific Science Board*, 7: 21–28.
- Asquith, A. 1995. Alien species and the extinction crisis of Hawaii's invertebrates. *Endangered Species Update* 12(6): 6–11.
- Atkinson, C.T., K.L. Woods, R.J. Dusek, L.S. Sileo K.W. Iko. 1995. Wildlife disease and conservation in Hawaii: pathogenicity of avian malaria (*Plasmodium relictum*) in experimentally infected I'iwi (*Vestiaria coccinea*). *Parasitology*, 111, Suppl.: S59–S69.
- Bartlett, B.R. 1961. The influence of ants upon parasites, predators, and scale insects. *Annals of the Entomological Society of America*, 54: 543–551.
- Beardsley Jr, J.W. 1979. New immigrant insects in Hawaii: 1962 through 1976. *Proceedings of the Hawaiian Entomological Society*, 23: 35–44.
- Beardsley, J.W. 1980. Haleakala National Park Crater District Resources Basic Inventory: Insects. *Cooperative National Park Research Study Unit Technical Report*, 31: 1–49.
- Bernard, F. 1968. Les Fourmis (Hymenoptera: Formicidae) d'Europe occidentale et septentrionale. *Faune de l'Europe et du Bassin méditerranéen*. Masson et Cie, Paris. 411 pp.
- Blackburn, T.; Kirby, W.F. 1880. Notes on species of aculeate Hymenoptera occurring in the Hawaiian Islands. *Entomologists Monthly Magazine*, 17: 85–89.
- Bosik, J.J. (Chair). 1997. *Common names of insects and related organisms 1997*. Entomological Society of America, (Annapolis, MD). 232 pp.
- Brandao, C.R.F.; Paiva, R.V.S. 1994. The Galapagos ant fauna and the attributes of colonizing ant species. Pp. 1–10 in: Williams, D.F. (ed.) *Exotic ants: biology, impact, and control of introduced species*. Westview Press, Boulder. 332 p.
- Chang, V. 1988. Toxic baiting of the western yellowjacket (Hymenoptera: Vespidae) in Hawaii. *Journal of Economic Entomology*, 81: 228–35.
- Clark, D.B.; Guayasamín, C.; Pazamiño, O.; Donoso, C.; Páez de Villacís, Y. 1982. The tramp ant *Wasmannia auropunctata*: autecology and effects on ant diversity and distribution on Santa Cruz Island, Galapagos. *Biotropica*, 14: 196–207.
- Clausen, C.P. 1978a. Scarabaeidae. Pp. 277–92 in: Clausen, C.P. (ed.) *Introduced parasites and predators of arthropod pests and weeds: a world review*. US Department of Agriculture, Agriculture Handbook no. 480: vi + 545.
- Clausen, C.P. 1978b. Scolytidae. Pp. 292–94 in: Clausen, C.P. (ed.) *Introduced parasites and predators of arthropod pests and weeds: a world review*. U.S. Department of Agriculture, Agriculture Handbook no. 480: vi + 545.
- Cole, F.R.; Medeiros, A.C.; Loope, L.L.; Zuehlke, W.W.. 1992. Effects of the Argentine ant on arthropod fauna of Hawaiian high-elevation shrubland. *Ecology*, 73(4): 1313–1322.
- Compton, S.G.; H.G. Robertson. 1991. Effects of ant-homopteran systems on fig-figwasp interactions. Pp. 120–130 in: Huxley C.R.; Cutler, D.E. (eds) *Ant-Plant Interactions*. Oxford University Press, Oxford. 601 pp.

- Curran, C.H. 1945. *Insects of the Pacific world*. New York. 317 pp.
- Davis, C.J. 1963. Notes and exhibitions. *Xyleborus morstatti* Hagedorn. *Proceedings of the Hawaiian Entomological Society*, 18: 201–207.
- Davis, C.J.; Chong, M. 1970. Recent introductions for biological control in Hawaii. XIV. *Proceedings of the Hawaiian Entomological Society*, 20[1969]: 317–322.
- Davis, C.J.; Krauss, N.L.H. 1967. Recent introductions for biological control in Hawaii. XI. *Proceedings of the Hawaiian Entomological Society*, 19[1966]: 201–207.
- Disney, R.H.L. 1994. *Scuttle flies: the Phoridae*. Chapman and Hall, London.
- Evenhuis, N.L. 1982. Preliminary considerations on the zoogeography of Oceanic Bombyliidae (Diptera: Brachycera). *Entomologia Generalis*, 8: 79–86.
- Evenhuis, N.L. (ed.) 1989. *Catalog of the Diptera of the Australasian and Oceanian Regions*. Bishop Museum, Honolulu.; E.J. Brill, Leiden. 1155 pp.
- Fabres, G.; Brown, W.L. Jr. 1978. The recent introduction of the pest ant *Wasmannia auropunctata* into New Caledonia. *Journal of the Australian Entomological Society*, 17: 139–142.
- Fluker, S.S.; J.W. Beardsley. 1970. Sympatric associations of three ants: *Iridomyrmex humilis*, *Pheidole megacephala*, and *Anoplolepis longipes* in Hawaii. *Annals of the Entomological Society of America*, 63 (5): 1290–1296.
- Gagné, W.C.; Christensen, C.C. 1985. Conservation status of native terrestrial invertebrates in Hawaii. Pp. 105–41 in: Stone, C.P.; Scott, J.M. (eds), *Hawai'i's terrestrial ecosystems: preservation and management. Proceedings of a symposium held June 5–6, 1984 at Hawaii Volcanoes National Park*. Cooperative National Park Resources Studies Unit, University of Hawaii, Honolulu. xxviii + 584 pp.
- Gambino, P. 1991. Reproductive plasticity of *Vespula pensylvanica* (Hymenoptera: Vespidae) on Maui and Hawaii Islands, USA. *New Zealand Journal of Zoology*, 18: 139–49.
- Gambino, P.; Loope, L.L. 1992. Yellowjacket *Vespula pensylvanica* biology and abatement in the National Parks of Hawaii. *Cooperative National Park Research Study Unit Technical Report*, 86: 1–41.
- Gillespie, R.G.; N. Reimer. 1993. The effect of alien predatory ants (Hymenoptera: Formicidae) on Hawaiian endemic spiders (Araneae: Tetragnathidae). *Pacific Science*, 47: 21–33.
- GPPIS (Global Plant.; Pest Information System). [www.pppis.fao.org/](http://www.pppis.fao.org/) Version: 1999 April 30.
- Greenslade, P.J.M. 1971. Interspecific competition and frequency changes among ants in Solomon Islands coconut plantations. *Journal of Applied Ecology*, 8: 323–352.
- Gressitt, J.L. 1953. The coconut rhinoceros beetle (*Oryctes rhinoceros*) with particular reference to the Palau Islands. *Bishop Museum Bulletin no. 212*: 1–157.
- Gressitt, J.L. 1982. Pacific-Asian biogeography with examples from the Coleoptera. *Entomologia Generalis*, 8: 1–11.
- Haines, I.H.; Haines, J.B.; Cherrett, J.M.. 1994. The impact and control of the Crazy ant, *Anoplolepis longipes* (Jerd.), in the Seychelles. Pp. 206–218 in: Williams, D.F. (ed.), *Exotic ants. Biology, impact, and control of introduced species*. Westview Press, Boulder, San Francisco, Oxford. 332 pp.
- Hara, A.H.; J.W. Beardsley Jr. 1979. The biology of the black twig borer, *Xylosandrus compactus* (Eichhoff), in Hawaii. *Proceedings of the Hawaiian Entomological Society*, 23: 55–70.
- Hardy, D.E. 1979. An ecological survey of Puaaluu Stream. Part III. Report of a preliminary entomological survey of Puaaluu Stream, Maui. *Cooperative National Park Research Study Unit Technical Report*, 27 (3): 34–37.
- Hawaii Department of Agriculture, Division of Plant Industry, Entomology Branch. 1975. Distribution of some agricultural pests in Hawaii. Memo. 28 pp.
- Hayashi, A.M. 1999. Attack of the fire ants. *Scientific American*, 280 (2): 26, 28.
- Heraty, J.M. 1994. Biology and importance of two eucharitid parasites of *Wasmannia* and *Solenopsis*. Pp. 104–120 in: Williams, D.F. (ed.) *Exotic ants. Biology, impact, and control of introduced species*. Westview Press, Boulder, San Francisco, Oxford. 332 pp.
- Hewitt, R.I. 1940. Bird malaria. *American Journal of Hygiene, Monograph Series, no. 15*: xvii + 228 pp.
- Hill, D.S. 1983. *Agricultural insect pests of the tropics and their control. Second edition*. Cambridge University Press, Cambridge, UK. xii + 746 pp.
- Hölldobler, B.; Wilson, E.O. 1990. *The Ants*. Springer-Verlag, Berlin. 732 pp.
- Howarth, F.G. 1985. Impacts of alien land arthropods and mollusks on native plants and animals in Hawaii. Pp. 149–79 in: Stone, C.P.; Scott, J.M. (eds) *Hawai'i's terrestrial ecosystems: preservation and management. Proceedings of a symposium held June 5–6, 1984 at Hawaii Volcanoes National Park*. Cooperative National Park Resources Studies Unit, University of Hawaii, Honolulu. xxviii + 584 pp.
- Huddleston, E.W.; Fluker, S.S. 1968. Distribution of ant species in Hawaii. *Proceedings of the Hawaiian Entomological Society*, 20: 45–69.
- Jahn, G.C.; Beardsley, J.W. 1994. Big-headed ants, *Pheidole megacephala*: interference with the biological control of Gray pineapple mealybugs. Pp. 199–205 in: Williams, D.F. (ed.) *Exotic ants. Biology, impact, and control of introduced species*. Westview Press, Boulder, San Francisco, Oxford. 332 pp.
- Jourdan, H. 1997. Threats on Pacific islands: the spread of the tramp ant *Wasmannia auropunctata* (Hymenoptera: Formicidae). *Pacific Conservation Biology*, 3: 61–64.
- Kami, K.; Miller, S.E. 1998. Samoan insects and related arthropods: checklist and bibliography. *Bishop Museum Technical Report, no. 13*: v + 121.
- Krushelnicky, P.D.; Reimer, N.J. 1996. Efforts at control of the Argentine ant in Haleakala National Park, Maui, Hawaii. *Cooperative National Park Resources Study Unit Technical Report, no. 109*: 1–33.

- Leefmans, S. 1884. *De klappertor* (*Oryctes rhinoceros* L.). Ruygrok & Co., Batavia. viii + 156 pp.
- Lewis, T.; Cherrett, J.M.; Haines, I.; Haines, J.B.; Mathias, P.L. 1976. The crazy ant (*Anoplolepis longipes* (Jerd.) (Hymenoptera, Formicidae)) in Seychelles, and its chemical control. *Bulletin of Entomological Research*, 66: 97–111.
- Lieberburg, I.; Kranz, P.M.; Seip, A. 1975. Bermudian ants revisited: the status and interaction of *Pheidole megacephala* and *Iridomyrmex humilis*. *Ecology*, 56: 473–478.
- Loope, L.L.; Medeiros, A.C. 1995. Strategies for long-term protection of biological diversity in rainforests of Haleakala National Park and East Maui, Hawaii. *Endangered Species Update*, 12 (6): 1–5.
- Lubin, Y.D. 1984. Changes in the native fauna of the Galapagos islands following invasion by the little red fire ant, *Wasmannia auropunctata*. *Biological Journal of the Linnean Society*, 21 (1&2): 229–242.
- Majer, J.D. 1994a. Spread of Argentine ants (*Linepithema humile*), with special reference to Western Australia. Pp. 163–173 in: Williams, D.F. (ed.) *Exotic ants. Biology, impact, and control of introduced species*. Westview Press, Boulder, San Francisco, Oxford. 332 pp.
- Majer, J.D. 1994b. Introduction of ants as potential biological control agents, with particular reference to cocoa. *Harvest*, 16 (1&2): 1–4.
- Massey, J.G.; Graczyk, T.K.; Cranfield, M.R. 1996. Characteristics of naturally acquired *Plasmodium relictum capistranoae* infections in naive Hawaiian crows (*Corvus hawaiiensis*) in Hawaii. *Journal of Parasitology*, 82: 182–85.
- McEwen, F.L.; Beardsley, J.W. Jr.; Hapai, M.; Su, T.H. 1979. Laboratory tests with candidate insecticides for control of the big-headed ant, *Pheidole megacephala* (Fabricius). *Proceedings of the Hawaiian Entomological Society*, 23: 119–123.
- Medeiros, A.C.; Loope, L.L.; Cole, F.R. 1986. Distribution of ants and their effects on endemic biota of Haleakala and Hawaii Volcanoes National Parks: a preliminary assessment. Pp. 39–52 in: Smith, C.W. *Proceedings Sixth Conference in Natural Sciences Hawaii Volcanoes National Park*. Cooperative National Park Resources Study Unit, University of Hawaii at Manoa. 98 pp.
- Moore, N.; W.C. Gagné. 1982. *Megalagrion pacificum* (McLachlan) – a preliminary study of the conservation requirements of an endangered species. *Report of the Odonata Specialist Group, IUCN*, no. 3: 1–5.
- Morrison, L.W.; Gilbert, L.E. 1998. Parasitoid-host relationships when host size varies: the case of *Pseudacteon* flies and *Solenopsis* fire ants. *Ecological Entomology* 23(4): 409–416.
- Nafus, D.M. 1993. Movement of introduced biological control agents onto nontarget butterflies, *Hypolimnys* spp. (Lepidoptera: Nymphalidae). *Environmental Entomology*, 22 (2): 265–272.
- Nishida, G.M. 1997. Hawaiian terrestrial arthropod checklist. Third edition. *Bishop Museum Technical Report*, no. 12: iv + 263.
- Passera, L. 1994. Characteristics of tramp species. Pp. 23–43 in: Williams, D.F. (ed.) *Exotic ants. Biology, impact, and control of introduced species*. Westview Press, Boulder, San Francisco, Oxford. 332 pp.
- Perkins, R.C.L. 1907. Insects of Tantalus. *Proceedings of the Hawaiian Entomological Society* (1906), 1: 38–51.
- Perkins, R.C.L. 1913. Introduction. *Fauna Hawaiiensis*, 1, pt. 6: xv–ccxxvii.
- Rapp, G. 1999. Introduction of the fire ant *Wasmannia auropunctata* into Vanuatu. *Ag Alert* 18: 1 p.
- Reimer, N.J. 1994. Distribution and impact of alien ants in vulnerable Hawaiian ecosystems. Pp. 11–22 in: Williams, D.F. (ed.) *Exotic ants. Biology, impact, and control of introduced species*. Westview Press, Boulder, San Francisco, Oxford. 332 pp.
- Reimer, N. 1999. A pictorial key to the most pestiferous ant species threatening Hawaii's native fauna and flora. [www.pppis.fao.org/](http://www.pppis.fao.org/) Version: 1999 May 4.
- Reimer, N.J.; Glancey, B.M.; Beardsley, J.W. 1991. Development of *Pheidole megacephala* (Hymenoptera: Formicidae) colonies following ingestion of fenoxycarb and pyriproxyfen. *Journal of Economic Entomology*, 84: 56–60.
- Rohrbach, K.G.; Beardsley, J.W.; German, T.L.; Reimer, N.; Sanford, W.G. 1988. Mealybug wilt, mealybugs and ants on pineapple. *Plant Disease*, 72: 558–565.
- Samuelson, G.A. 1981. A synopsis of Hawaiian Xyleborini (Coleoptera: Scolytidae). *Pacific Insects*, 23: 50–92.
- Savidge, J.A. 1985. The role of disease and predation in the decline of Guam's avifauna. PhD dissertation, University of Illinois, Urbana. 79 pp.
- Scott, J.M.; Mountainspring, S.; Ramsey, F.L.; Kepler, C.B. 1986. Forest bird communities of the Hawaiian Islands: their dynamics, ecology, and conservation. *Studies in Avian Biology*, 9, xiii + 341 p.
- Silberglie, R. 1972. The 'little fire ant,' *Wasmannia auropunctata*, a serious pest in the Galapagos Islands. *Noticias Galapagos*, 19/20: 13–15.
- Simmonds, F.J.; Greathead, D.J. 1977. Introductions and pest and weed problems. Pp. 109–124 in: Cherrett, J.M.; Sagar, G.R. (eds) *Origins of pest, parasite, disease and weed problems*. Symposium of the British Ecological Society, 18. Blackwell Scientific Publications Oxford. 413 pp.
- Smith, F. 1879. Descriptions of new species of aculeate Hymenoptera collected by the Rev. T. Blackburn in the Sandwich Islands. *Journal of the Linnean Society of London, Zoology*, 14, no. 79: 674–685.
- Smith, M.R. 1965. House infesting ants of the eastern United States, their recognition, biology and economic importance. *US Department of Agriculture Technical Bulletin*, no. 1326: 1–105.
- Solem, [G.] A. 1976. *Endodontoid land snails from Pacific Islands (Mollusca: Pulmonata: Sigmurethra). Part I. Family Endodontidae*. Field Museum of Natural History, Chicago. xii + 508 pp.
- Spencer, H. 1941. The small fire ant *Wasmannia* in citrus groves – a preliminary report. *Florida Entomologist*, 24: 6–14.

- Steadman, D.W.; Geiner, E.C.; Wood, C.S. 1990. Absence of blood parasites in indigenous and introduced birds from the Cook Islands, South Pacific. *Conservation Biology*, 4: 398–404.
- Su, T.H.; Beardsley, J.W.; McEwen, F.L. 1980. AC-217,300, a promising new insecticide for use in baits for control of the bigheaded ant in pineapple. *Journal of Economic Entomology*, 73 (6): 755–756.
- Swan, D.I. 1974. A review of the work on predators, parasites and pathogens for the control of *Oryctes rhinoceros* (L.) (Coleoptera: Scarabaeidae) in the Pacific area. *Commonwealth Agriculture Bureaux Miscellaneous Publication*, no. 7, 64 p.
- Swaney, D. 1994. *Tonga. A Lonely Planet travel survival kit*. 2<sup>nd</sup> Edition. Lonely Planet Publications, Hawthorn, Australia. 198 pp.
- Van Riper III, C.S. 1991. The impact of introduced vectors and avian malaria on insular passeriform bird populations in Hawaii. *Bulletin of the Society of Vector Ecologists*, 16: 59–83.
- Van Riper III, C.S.; Van Riper, S.G.; Goff, M.L.; Laird, M. 1982. The impact of malaria on birds in Hawaii Volcanoes National Park. *Cooperative National Park Resources Studies Unit Technical Report*, no. 47: iii + 74.
- Van Riper III, C.S.; Van Riper, S.G.; Goff, M.L.; Laird, M. 1986. The epizootiology and ecological significance of malaria in the Hawaiian land birds. *Ecological Monographs*, 56: 327–44.
- Van Riper, S.G.; Van Riper III, C.S. 1985. A summary of the known parasites and diseases recorded from the avifauna of the Hawaiian Islands. Pp. 298–371 in: Stone, C.P.; Scott, J.M. (eds) *Hawai'i's terrestrial ecosystems: preservation and management. Proceedings of a symposium held June 5–6, 1984 at Hawaii Volcanoes National Park*. Cooperative National Park Resources Studies Unit, University of Hawaii, Honolulu. xxviii + 584 pp.
- Warner, R.E. 1968. The role of introduced diseases in the extinction of the endemic Hawaiian avifauna. *Condor*, 70: 101–20.
- Wetterer, J.K. 1997. Ants on *Cecropia* in Hawaii. *Biotropica*, 29: 128–132.
- Wetterer, J.K. 1998. Nonindigenous ants associated with geothermal and human disturbance in Hawai'i Volcanoes National Park. *Pacific Science*, 52 (1): 40–50.
- Wetterer, J.K.; Banko, P.C.; Laniawe, L.P.; Slotterback, J.W.; Brenner, G.J. 1998. Nonindigenous ants at high elevations on Mauna Kea, Hawaii. *Pacific Science*, 52 (3): 228–236.
- Williams, F.X. 1927. Notes on the habits of bees and wasps of the Hawaiian Islands. *Proceedings of the Hawaiian Entomological Society*, 6: 425–64.
- Wilson, E.O.; R.W. Taylor. 1967. The ants of Polynesia (Hymenoptera: Formicidae). *Pacific Insects Monographs*, no. 14: 1–109.
- Zenner-Polania, I. 1994. Impact of *Paratrechina fulva* on other ant species. Pp. 121–132 in: Williams, D.F. (ed.) *Exotic ants. Biology, impact, and control of introduced species*. Westview Press, Boulder, San Francisco, Oxford. 332 pp.
- Zimmerman, E.C. 1941. Argentine ant in Hawaii. *Proceedings of the Hawaiian Entomological Society*, 11 (1): 108.
- Zimmerman, E.C. 1942. Distribution and origin of some eastern oceanic insects. *American Naturalist*, 76: 280–307.
- Zimmerman, E.C. 1948. *Insects of Hawaii. Volume 1. Introduction*. University of Hawaii Press, Honolulu. 206 pp.

## Annex 1.

### Pacific ant references

A large body of literature exists pertaining to the ants of the Pacific. The following is not complete, and is biased towards the Hawaiian Islands, but it is a beginning towards building the reference base for the Pacific.

- Abedrabbo, S. 1994. Control of the little fire ant, *Wasmannia auropunctata*, on Santa Fe Island in the Galapagos Islands. Pp. 219–227 in: Williams, D.F. (ed.) *Exotic ants: biology, impact, and control of introduced species*. Westview Press, Boulder. 332 pp.
- Alfken, J.D. 1904. Beitrag zur Insectenfauna der hawaiischen und neu-seeländischen Inseln. (Ergebnisse einer Reise nach dem Pacific.) Schauinsland 1896–97. *Zoologische Jahrbuecher, Abteilung fuer Systematik Oekologie und Geographie der Thiere*, 19: 561–628.
- Alicata, J.E. 1964. Parasitic infections of man and animals in Hawaii. *Hawaii Agricultural Experiment Station Technical Bulletin*, no. 61: 1–13.
- Alicata, J.E. 1969. *Parasites of man and animals in Hawaii*. Karger, Basel, New York. 190 pp.
- Allison, A.; Miller, S.E.; Nishida, G.M. 1995. Hawaii Biological Survey. P. 362 in: LaRoe, E.T.; Farris, G.S.; Puckett, C.E.; Doran, P.D.; Mac, M.J. (eds) *Our living resources. A report to the nation on the distribution, abundance, and health of US plants, animals, and ecosystems*. US Department of Interior, National Biological Service, Washington, DC. 530 pp.
- Asquith, A. 1995. Distribution, abundance and phenology of *Scaptomyza (Bunostoma) anomala* Hardy (Diptera: Drosophilidae): a proposed representative species for monitoring protein bait sprays in Hawaii. *Proceedings of the Hawaiian Entomological Society*, 32: 69–81.
- Asquith, A.; Messing, R.H. 1993. Contemporary Hawaiian insect fauna of a lowland agricultural area on Kaua'i: implications for local and island-wide fruit fly eradication programs. *Pacific Science*, 47: 1–16.
- Bach, C.E. 1991. Direct and indirect interactions between ants (*Pheidole megacephala*), scales (*Coccus viridis*) and plants (*Pluchea indica*). *Oecologia*, 87: 233–239.
- Back, E.A.; Pemberton, C.E. 1917. The melon fly in Hawaii. *USDA Entomology Bulletin*, no. 491: 1–64.
- Back, E.A.; C.E. Pemberton. 1918. The Mediterranean fruit fly in Hawaii. *USDA Technical Bulletin*, no. 536: 1–119.
- Baker, G.L. 1976. The seasonal life cycle of *Anoplolepis longipes* (Jerdon) (Hymenoptera: Formicidae) in a cacao plantation and under brushed rain forest in the northern district of Papua New Guinea. *Insectes Sociaux*, 23: 253–261.
- Banko, W.E. 1978. Some limiting factors and research needs of endangered Hawaiian forest birds. Pp. 17–25 in: Smith, C.W. (ed.) *Proceedings Second Conference in Natural Sciences Hawaii Volcanoes National Park*. University of Hawaii at Manoa, Honolulu. 354 pp.
- Banko, W.E.; Banko, P.C. 1976. Role of food depletion by foreign organisms in historical decline of Hawaiian forest birds. Pp. 29–34 in: Smith, C.W. (ed.) *Proceedings First Conference in Natural Sciences Hawaii Volcanoes National Park*. University of Hawaii at Manoa, Honolulu. 243 pp.
- Baroni Urbani, C. 1974. Competition et association dans les biocenoses de fourmis insulaires. *Revue Suisse de Zoologie*, 81: 103–135.
- Bartlett, B.R. 1961. The influence of ants upon parasites, predators, and scale insects. *Annals of the Entomological Society of America*, 54: 543–551.
- Basset, Y. 1996. Local communities of arboreal herbivores in Papua New Guinea: predictors of insect variables. *Ecology*, 77: 1906–1919.
- Beardsley, J.W. (ed.). 1979. New immigrant records for the year 1976. *Proceedings of the Hawaiian Entomological Society*, 23: 27.
- Beardsley, J.W. 1980. Haleakala National Park Crater District Resources Basic Inventory: Insects. *Cooperative National Park Research Study Unit Technical Report*, 31: 1–49.
- Beardsley, J.W. 1980. Impact of introduced arthropods on endemic terrestrial organisms in Hawai'i. Pp. 17–18 in: Smith, C.W. (ed.) *Proceedings Third Conference in Natural Sciences Hawaii Volcanoes National Park*. University of Hawaii at Manoa, Honolulu. 396 pp.
- Beardsley, J.W. 1991. Introduction of arthropod pests into the Hawaiian Islands. *Micronesica* Suppl. 3: 1–4.
- Beardsley, J.W.; Tuthill, L.D. 1959. Additions to the known insect fauna of Niihau. *Proceedings of the Hawaiian Entomological Society*, 17: 56–61.
- Beardsley, J.W., Jr.; Su, T.H.; McEwen, F.L.; Gerling, D. 1982. Field investigations on the interrelationships of the big-headed ant, the graypineapple mealybug, and pineapple mealybug wilt disease in Hawaii. *Proceedings of the Hawaiian Entomological Society*, 24: 51–67.
- Bernard, F. 1968. Les Fourmis (Hymenoptera: Formicidae) d'Europe occidentale et septentrionale. *Faune de l'Europe et du Bassin méditerranéen*. Masson, Paris. 411 pp.
- Bianchi, F.A. 1940. Notes on the role of the self-introduced insects in the economic entomology of Hawaii. *Proceedings of the Hawaiian Entomological Society*, 10: 377–388.
- Blackburn, T. 1881. Hawaiian entomology. *Thrum's Hawaiian Almanac Annual 1882*: 58–61.
- Blackburn, T.; Cameron, P. 1886. On the Hymenoptera of the Hawaiian Islands. *Proceedings of the Literary and Philosophical Society of Manchester*, 25: 134–183. [this paper also published in *Memoirs of the Manchester Literary and Philosophical Society*, ser. 3, 10: 194–245, 1886].
- Blackburn, T.; Cameron, P. 1887. On the Hymenoptera of the Hawaiian Islands. *Memoirs of the Manchester Literary and Philosophical Society*, ser. 3, 10: 194–245.
- Blackburn, T.; Kirby, W.F. 1880. Notes on species of aculeate Hymenoptera occurring in the Hawaiian Islands. *Entomologist's Monthly Magazine*, 17: 85–89.

- Bolton, B. 1979. The ant tribe Tetramoriini (Hymenoptera: Formicidae). The genus *Tetramorium* Mayr in the Malagasy region and in the New World. *Bulletin of the British Museum of Natural History, Entomology*, no. 38: 129–181.
- Bolton, B. 1982. Afrotropical species of the myrmicine ant genera *Cardiocondyla*, *Leptothorax*, *Melissotarsus*, *Messor* and *Cataulacus* (Formicidae). *Bulletin of the British Museum of Natural History, Entomology*, no. 45: 307–370.
- Bolton, B. 1983. The Afrotropical dacetine ants (Formicidae). *Bulletin of the British Museum of Natural History, Entomology*, no. 46: 267–416.
- Bolton, B. 1987. A review of the Solenopsis genus-group and revision of afrotropical *Monomorium* Mayr (Hymenoptera: Formicidae). *Bulletin of the British Museum of Natural History, Entomology*, no. 54: 263–452.
- Bonnet, D.D. 1948. Certain aspects of medical entomology in Hawaii. *Proceedings of the Hawaiian Entomological Society*, 13: 225–233.
- Braekman, J.C.; Daloze, D.; Pasteels, J.M.; Van Hecke, J.P. 1987. Tetraponerine-8, an alkaloidal contact poison in a Neoguinean pseudomyrmecine ant, *Tetraponera* sp. *Zeitschrift für Naturforschung Section C Journal of Biosciences*, 42: 627–630.
- Brandao, C.R.F.; Paiva, R.V.S. 1994. The Galapagos ant fauna and the attributes of colonizing ant species. Pp. 1–10 in: Williams, D.F. (ed.) *Exotic ants: biology, impact, and control of introduced species*. Westview Press, Boulder. 332 pp.
- Brennan, B.M.; Mitchell, W.C.; Springer, D. 1981. Arthropods on reproductive organs of 'Ohi'a-lehua trees. US-IBP (Int Biol Prog) Syn Ser 15: Pp.127–133 in: Mueller-Dombois, D.; Bridges, K.W.; Carson, H.L. (eds) *Island ecosystems. Biological organization in selected Hawaiian communities*. Hutchinson Ross Publishing Company, Stroudsburg, PA; Woods Hole, MA. 583 pp.
- Bridwell, J.C. 1918. Entomological program. *Proceedings of the Hawaiian Entomological Society*, 3: 383–384.
- Bridwell, J.C. 1918. Certain aspects of medical and sanitary entomology in Hawaii. *Transactions of the Medical Society of Hawaii*, 1916-17: 27–32.
- Bridwell, J.C. 1920. Some notes on Hawaiian and other Bethyridae (Hymenoptera) with the description of a new genus and species. 2nd paper. *Proceedings of the Hawaiian Entomological Society*, 4: 291–314.
- Brown, W.L. 1949. Revision of the ant tribe Dacetini. I. Fauna of Japan, China and Taiwan. *Mushi*, 20: 1–25.
- Brown, W.L. 1949. Revision of the ant tribe Dacetini. III. *Epitritus* Emery and *Quadristuma* new genus (Hymenoptera: Formicidae). *Transactions of the American Entomological Society (Philadelphia)*, 75: 43–51.
- Brown, W.L. 1954. The ant genus *Strumigenys* Fred. Smith in the Ethiopian and Malagasy regions. *Bulletin of the Museum of Comparative Zoology*, 112: 1–34.
- Brown, W.L. 1960. Contributions toward a reclassification of the Formicidae. III. Tribe Amblyoponini (Hymenoptera). *Bulletin of the Museum of Comparative Zoology*, 122: 145–230.
- Brown, W.L. 1962. The neotropical species of the ant genus *Strumigenys* Fr. Smith: synopsis and keys to the species. *Psyche* 69: 238–267.
- Brown, W.L. 1975. Contributions toward a reclassification of the Formicidae, V. Ponerinae, tribes Platythyreini, Cerapachyini, Cyldromyrmecini, Acanthostichini, and Aenictogitini. *Search: Agriculture* (Geneva N Y) 5: 1–115.
- Browne, A.C. 1942. Insects taken at light at Kalawahine Place, Honolulu. *Proceedings of the Hawaiian Entomological Society*, 11: 151–152.
- Bryan, E.H., Jr. 1926. Introduction. Pp. 1-16 in: E.H. Bryan, E.H., Jr.; Collaborators. Insects of Hawaii, Johnston Island and Wake Island. *Bulletin of the Bernice P. Bishop Museum* 31: 94 pp.
- Bryan, E.H., Jr. 1933. Insects from Kaula Island. *Proceedings of the Hawaiian Entomological Society*, 8: 245–246.
- Bryan, E.H., Jr. 1934. A review of the Hawaiian Diptera, with descriptions of new species. *Proceedings of the Hawaiian Entomological Society*, 8: 399–468.
- Bryan, E.H., Jr. 1935. *Hawaiian nature notes*. 2nd edition. Honolulu Star-Bulletin, Honolulu. 285 pp.
- Bryan, E.H., Jr. 1935. Insects from Rabbit Island. *Proceedings of the Hawaiian Entomological Society*, 9: 39–43.
- Buckley, S.B. 1867. Descriptions of new species of North American Formicidae. *Proceedings of the Entomological Society of Philadelphia*, 6: 335–350.
- Buckley, R.; Gullan, P. 1991. More aggressive ant species (Hymenoptera: Formicidae) provide better protection for soft scales and mealybugs (Homoptera: Coccidae, Pseudococcidae). *Biotropica*, 23: 282–286.
- Butler, G.D. 1961. Insects and other arthropods from Laysan Island. *Proceedings of the Hawaiian Entomological Society*, 17: 379–387.
- Butler, G.D.; Usinger, R.L. 1963. Insects and other invertebrates from Laysan Island. *Atoll Research Bulletin*, 98: 1–30.
- Butler, G.D.; Usinger, R.L. 1963. Insects and other arthropods from Kure Island. *Proceedings of the Hawaiian Entomological Society*, 18: 237–244.
- Cameron, P. 1886. On a new species of *Strumigenys* (*S. lewisi*) from Japan. *Proceedings of the Literary and Philosophical Society of Manchester*, 25: 229–232.
- Carter, W. 1932. Studies of populations of *Pseudococcus brevipes* (Ckl.) occurring on pineapple plants. *Ecology*, 13: 296–304.
- Caspers, H. 1966. Verbreitung und Farbanpassung der Strandfauna im Gebiet des schwarzen Lavasandes auf Hawaii. *Internationale Revue der Gesamten Hydrobiologie*, 51: 3–13.
- Chang, V.C.S. 1985. Colony revival and notes on rearing and life history of the big-headed ant. *Proceedings of the Hawaiian Entomological Society*, 25: 53–58.
- Chang, V.C.S.; Ota A.K.; Sanders, D. 1980. Parallel ridge barrier to control ant damage to orifices of drip irrigation tubes. *Journal of Economic Entomology*, 73: 403–406.
- Clark, D.B.; Guayasamin, C.; Pazmino, O.; Donoso, C.; de Villacis, Y.P. 1982. The tramp ant *Wasmannia*

- auropunctata*: autecology and effects on ant diversity and distribution on Santa Cruz Island, Galapagos. *Biotropica*, 14: 196–207.
- Cole, F.R.; Medeiros, A.C.; Loope, L.L.; Zuehlke, W.W. 1992. Effects of the argentine ant on arthropod fauna of Hawaiian high-elevation shrubland. *Ecology*, 73: 1313–1322.
- Compton, S.G.; Robertson, H.G. 1991. Effects of ant-homopteran systems on fig-figwasp interactions. In: Huxley, C.R.; Cutler, D.E. (eds) *Ant-Plant Interactions*. Oxford University Press, Oxford. 601 pp.
- Coppo, G.; Wells, S. 1987. Threatened Galapagos snails. *Oryx*, 21: 236–241.
- Cornelius, M.L.; Grace, J.K. 1994. Behavioral responses of the Formosan subterranean termite (Isoptera: Rhinotermitidae) to semiochemicals of seven ant species. *Environmental Entomology*, 23: 1524–1528.
- Cornelius, M.L.; Grace, J.K. 1995. Laboratory evaluations of interactions of three ant species with the Formosan subterranean termite (Isoptera: Rhinotermitidae). *Sociobiology*, 26: 291–298.
- Cornelius, M.L.; Grace, J.K. 1996. Effect of two ant species (Hymenoptera: Formicidae) on the foraging and survival of the Formosan subterranean termite (Isoptera: Rhinotermitidae). *Environmental Entomology*, 25: 85–89.
- Cornelius, M.L.; Grace, J.K. 1997. Effect of termite soldiers on the foraging behavior of *Coptotermes formosanus* (Isoptera: Rhinotermitidae) in the presence of predatory ants. *Sociobiology*, 29: 247–253.
- Cornelius, M.L.; Grace, J.K.; Ford, P.W.; Davidson, B.S. 1995. Toxicity and repellency of semiochemicals extracted from a dolichoderine ant (Hymenoptera: Formicidae) to the Formosan subterranean termite (Isoptera: Rhinotermitidae). *Environmental Entomology*, 24: 1263–1269.
- Cornelius, M.L.; Grace, J.K.; Yates, J.R., III. 1996. Acceptability of different sugars and oils to three tropical ant species (Hymen., Formicidae). *Anzeiger für Schädlingskunde Pflanzenschutz*, 69: 41–43.
- Cuddihy, L.W.; Stone, C.P. 1990. *Alteration of native Hawaiian vegetation. Effects of humans, their activities and introductions*. University of Hawaii Cooperative National Park Resources Studies Unit, Honolulu. 138 pp.
- Dalla Torre, C.G. de. 1893. *Formicidae (Heterogyna). Catalogus Hymenopterorum hucusque descriptorum systematicus et synonymicus*. Sumptibus Guilelmi Engelmann, Lipsiae. 289 pp.
- Delabie, J.H.C.; da Encarnação, A.M.V.; Cazorla, I.M. 1994. Relations between the little fire ant, *Wasmannia auropunctata*, and its associated mealybug, *Planococcus citri*, in Brazilian cocoa farms. Pp. 91–103 in: Williams, D.F. (ed.) *Exotic ants: biology, impact, and control of introduced species*. Westview Press, Boulder. 332 pp.
- de la Vega, I. 1983. Behavior in the search for food by *Wasmannia auropunctata* and by native ants and competition between them. *Informe a Estacion Cientias Charles Darwin*, 1982: 99–108.
- de la Vega, I. 1994. Food searching behavior and competition between *Wasmannia auropunctata* and native ants on Santa Cruz and Isabela, Galapagos Islands. Pp. 73–79 in: Williams, D.F. (ed.) *Exotic ants: biology, impact, and control of introduced species*. Westview Press, Boulder. 332 pp.
- Desutter-Grandcolas, L. 1997. First record of ant-loving crickets (Orthoptera: Myrmecophilidae: Myrmecophilinae) in New Caledonia. *Australian Journal of Entomology*, 36: 159–163.
- Disney, R.H.L. 1994. *Scuttle flies: the Phoridae*. Chapman and Hall, London. xii + 467 pp.
- Dlusskiy, G.M. 1993. Ants (Hymenoptera: Formicidae) of Fiji, Tonga and Samoa and the problem of island faunas formation. 1. The problem. *Zoologicheskii Zhurnal*, 72: 66–76.
- Dlusskiy, G.M. 1993. Ants (Hymenoptera, Formicidae) of Fiji, Tonga, and Samoa and the problem of island faunas formation. 2. Tribe Dacetini. *Zoologicheskii Zhurnal*, 72: 52–65.
- Donisthorpe, H. 1916. *Epitritus wheeleri*, n.sp., an ant new to science; with notes on the genus *Epitritus*, Emery. *Entomologist's Record and Journal of Variation*, 28: 121–122.
- Early, M.; Goff, M.L. 1986. Arthropod succession patterns in exposed carrion on the island of Oahu, Hawaiian Islands, USA. *Journal of Medical Entomology*, 23: 520–531.
- Ehrhorn, E.M. 1911. Board of Agriculture and Forestry. Division of Entomology [report]. *Hawaiian Forester and Agriculturalist*, 7: 330–331.
- Ehrhorn, E.M. 1911. Division of Entomology. Report of the Superintendent of Entomology for 1909. *Report of the Board of Commissioners of Agriculture and Forestry of the Territory of Hawaii*, 1910: 103–123.
- Ehrhorn, E.M. 1912. Division of Entomology. *Hawaiian Forester and Agriculturalist*, 8: 164–166.
- Ehrhorn, E.M. 1913. Division of Entomology. *Hawaiian Forester and Agriculturalist*, 9: 290–291.
- Ehrhorn, E.M. 1913. Report of the Superintendent of Entomology. *Report of the Board of Commissioners of Agriculture and Forestry of the Territory of Hawaii*, 1912: 101–151.
- Ehrhorn, E.M. 1914. Division of Entomology. *Hawaiian Forester and Agriculturalist*, 10: 21–25.
- Ehrhorn, E.M. 1915. Division of Entomology. *Hawaiian Forester and Agriculturalist*, 11: 36–38.
- Ehrhorn, E.M. 1915. Division of Entomology. Report of the Superintendent of Entomology. *Report of the Board of Commissioners of Agriculture and Forestry of the Territory of Hawaii*, 1914: 103–142.
- Ehrhorn, E.M. 1916. Division of Entomology. *Hawaiian Forester and Agriculturalist*, 12: 46–48.
- Ehrhorn, E.M. 1917. Division of Entomology. *Hawaiian Forester and Agriculturalist*, 13: 43–45.
- Ehrhorn, E.M. 1918. Division of Plant Inspection. *Hawaiian Forester and Agriculturalist*, 14: 8–10.
- Ehrhorn, E.M. 1920. Division of Plant Inspection. *Hawaiian Forester and Agriculturalist*, 16: 13–14.
- Ehrhorn, E.M. 1921. Division of Plant Inspection. Report

- of the Chief Plant Inspector, June, 1921. *Hawaiian Forester and Agriculturalist*, 18: 179–181.
- Ehrhorn, E.M. 1922. Division of Plant Inspection. Report of the Chief Plant Inspector, September, 1922. *Hawaiian Forester and Agriculturalist*, 19: 261–262.
- Ehrhorn, E.M. 1923. Division of Plant Inspection. Report of Chief Plant Inspector, February, 1923. *Hawaiian Forester and Agriculturalist*, 20: 63–65.
- Ehrhorn, E.M. 1923. Division of Plant Inspection. Report of the Chief Plant Inspector. *Report of the Board of Commissioners of Agriculture and Forestry of the Territory of Hawaii*, 1922: 69–80.
- Ehrhorn, E.M. 1924. Division of Plant Inspection. Report of Chief Plant Inspector, February, 1924. *Hawaiian Forester and Agriculturalist*, 21: 71–74.
- Ehrhorn, E.M. 1925. Division of Plant Inspection. Report of Chief Plant Inspector, December, 1924. *Hawaiian Forester and Agriculturalist*, 22: 18–20.
- Ehrhorn, E.M. 1925. Division of Plant Inspection. Report of the Chief Plant Inspector. *Report of the Board of Commissioners of Agriculture and Forestry of the Territory of Hawaii*, 1924: 36–44.
- Ehrhorn, E.M. 1926. Division of Plant Inspection. Report of Chief Plant Inspector, February, 1926. *Hawaiian Forester and Agriculturalist*, 23: 20.
- Ehrhorn, E.M.; Fullaway, D.T.; Swezey, O.H. 1913. Report of committee on common names of economic insects in Hawaii. *Proceedings of the Hawaiian Entomological Society*, 2: 295–300.
- Emery, C. 1869. Enumerazione dei formicidi che ringengonsi nei contorni di Napoli con descrizioni di specie nuove o meno conosciute. *Annali Accademia degli Aspirante Naturalisti Napoli*, 2: 1–26.
- Emery, C. 1890. Studii sulle formiche della fauna neotropica. *Bolletino della Societa Entomologica Italiana*, 22: 38–80.
- Emery, C. 1894. Viaggio di Leonardo Fea in Birmania e regioni vicine. LXIII. Formiche di Birmania del Tenasserim e dei Monti Carin raccolte da L. Fea e descritte da Carlo Emery. (Parte II). *Annali del Museo Civico di Storia Naturale Genova*, ser. 2, 14: 450–483.
- Emery, C. 1894. Mission scientifique de M. Ch. Alluaud aux Îles Sechelles. 2e mémoire. Formicides. *Annales de la Societe Entomologique de France*, 63: 67–72.
- Emery, C. 1895. Beiträge zur Kenntniss der nord-amerikanischen Ameisenfauna. *Zoologische Jahrbuecher, Abteilung fuer Systematik Oekologie und Geographie der Thiere*, 8: 257–360.
- Emery, C. 1899. Ergebnisse einer Reise nach dem Pacific (Schauinsland 1896–97), Formiciden. *Zoologische Jahrbuecher, Abteilung fuer Systematik Oekologie und Geographie der Thiere*, 12: 438–440.
- Emery, C. 1900. Formicidarum species novae vel minus cognitae in collectione Musaei Nationalis Hungarici, quas in Nova-Guinea, colonia Germanica, collegit L. Biro. Publicatio secunda. *Termeszetráji Füzetek*, 23: 310–338.
- Evenhuis, N.L.; Polhemus, D.; Swift, S.; Arakaki, K.; Preston, D. 1995. A study of the biology of the orangeblack Hawaiian damselfly (*Megalagrion xanthomelas*), with special reference to conservation of the population at Tripler Army Medical Center, Oahu. Final Report. *Bishop Museum Technical Report*, no. 8: 1–81.
- Fabres, G.; Brown, W.L., Jr. 1978. The recent introduction of the pest ant *Wasmannia auropunctata* into New Caledonia. *Journal of the Australian Entomological Society*, 17: 139–142.
- Fabricius, J.C. 1793. *Entomologia systematica emendata et aucta. Secundum classes, ordines, genera, species, adjectis synonymis, locis, observationibus, descriptionibus*. Tom. II. C.G. Proft, Fil. et Soc. Hafniae. 519 pp.
- Fabricius, J.C. 1804. *Systema Piezatorum secundum ordines, genera, species adiectis synonymis, locis, observationibus descriptionibus*. Carolum Reichard, Brunsvigae. 439 pp.
- Fellers, J.H.; Fellers, G.M. 1982. Status and distribution of ants in the crater district of Haleakala National Park. *Pacific Science*, 36: 427–437.
- Fluker, S.S.; Beardsley, J.W. 1970. Sympatric associations of three ants: *Iridomyrmex humilis*, *Pheidole megacephala*, and *Anoplolepis longipes* in Hawaii. *Annals of the Entomological Society of America*, 63: 1290–1296.
- Folsom, J.W. 1932. Hawaiian Collembola. *Proceedings of the Hawaiian Entomological Society*, 8: 51–92.
- Forel, A.H. 1881. Die Ameisen der Antille St. Thomas. *Mitteilungen der Muenchner Entomologischen Verein*, 5: 1–16.
- Forel, A.H. 1886. Études myrmecologiques en 1886. *Annales de la Societe Entomologique de Belgique*, 30: 131–215.
- Forel, A.H. 1887. Indian ants of the Indian Museum, Calcutta No. 2. *Journal of the Asiatic Society of Bengal*, 55: 239–249.
- Forel, A.H. 1890. *Aenictus-Typhlatta* découverte de M. Wroughton nouveaux genres de formicides. *Annales de la Societe Entomologique de Belgique*, 34: cii–cxiv.
- Forel, A.H. 1894. Les Formicides de l'Empire des Indes et de Ceylan. Part IV. Adjonction aux genres *Camponotus*, Mayr., et *Polyrhachis*, Shuck. *Journal of the Bombay Natural History Society*, 8: 396–420.
- Forel, A.H. 1899. Heterogyna (Formicidae). *Fauna Hawaiiensis or the zoology of the Sandwich (Hawaiian) Isles...* Cambridge University Press, Cambridge. 759 pp.
- Forel, A.H. 1901. Formiciden aus dem Bismarck-Archipel, auf Grundlage des von Prof. Dr. F. Dahl gesammelten Materials bearbeitet. *Mitteilungen aus dem Zoologischen Museum in Berlin*, 2: 1–37.
- Forel, A.H. 1907. Formicides du Musée National Hongrois. *Annales Historico-Naturales Musei Nationalis Hungarici*, 5: 1–42.
- Forel, A.H. 1912. Quelques fourmis de Tokio. *Annales de la Société Entomologique de Belgique*, 56: 339–342.
- Fullaway, D.T. 1914. Report of the Entomologist. *Hawaii Agricultural Experiment Station Report*, 1913: 18–21.
- Fullaway, D.T. 1914. A list of Laysan Island insects. *Proceedings of the Hawaiian Entomological Society*, 3: 20–22.



- Fullaway, D.T. 1919. Division of Entomology. Report of the Entomologist. *Report of the Board of Commissioners of Agriculture and Forestry of the Territory of Hawaii, 1918*: 54–60.
- Fullaway, D.T. 1931. Division of Entomology. Report of the Entomologist. January 1, 1929–December 31, 1930. *Report of the Board of Commissioners of Agriculture and Forestry of the Territory of Hawaii, 1930*: 74–97.
- Fullaway, D.T. 1947. Niihau insects. *Proceedings of the Hawaiian Entomological Society*, 13: 51–53.
- Fullaway, D.T.; Krauss, N.L.H. 1945. *Common insects of Hawaii*. Tongg Publishing Co., Honolulu. 228 pp.
- Funasaki, G.Y.; Lai, P.-Y.; Nakahara, L.M.; Beardsley, J.W.; Ota, O.K. 1988. A review of biological control introductions in Hawaii: 1890 to 1985. *Proceedings of the Hawaiian Entomological Society*, 28: 105–160.
- Gagné, W.C. 1979. Canopy-associated arthropods in *Acacia koa* and *Metrosideros* tree communities along an altitudinal transect on Hawaii Island. *Pacific Insects*, 21: 56–82.
- Gagné, W.C. 1980. Altitudinal distribution and composition of arthropods in 'Ohī'a (*Metrosideros collina* subsp. *polymorpha*) canopies in Hawaii Volcanoes National Park with ecological implications for some native biota. Pp. 115–123 in: Smith, C.W. (ed.) *Proceedings Third Conference in Natural Sciences Hawaii Volcanoes National Park*. University of Hawaii at Manoa, Honolulu. 396 pp.
- Gagné, W.C. 1981. Canopy-associated arthropods. Pp. 118–127 in: Mueller-Dombois, D.; Bridges, K.W.; Carson, H.L. (eds) *Island ecosystems. Biological organization in selected Hawaiian communities*. Hutchinson Ross Publishing Company, Stroudsburg, PA; Woods Hole, MA. 583 pp.
- Gagné, W.C.; Christensen, C.C. 1985. Conservation status of native terrestrial invertebrates in Hawai'i. Pp. 105–126 in: Stone, C.P.; Scott, J.M. (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 pp.
- Giffard, W.M. 1922. Observations on *Xylocopa* and *Lithurgus* (Hymenoptera). *Proceedings of the Hawaiian Entomological Society*, 5: 53–54.
- Gillespie, R.G. 1997. Range contraction and extinction vulnerability: what is natural? *Memoirs of the Museum of Victoria*, 56: 401–409.
- Gillespie, R.G.; Reimer, N. 1993. The effect of alien predatory ants (Hymenoptera: Formicidae) on Hawaiian endemic spiders (Araneae: Tetragnathidae). *Pacific Science*, 47: 21–33.
- Goff, M.L.; Early, M.; Odom, C.B.; Tullis, K. 1986. A preliminary checklist of arthropods associated with exposed carrion in the Hawaiian Islands. *Proceedings of the Hawaiian Entomological Society*, 26: 53–57.
- GPPIS (Global Plant; Pest Information System). Web database at [pppis.fao.org/](http://pppis.fao.org/). Version: 1999 April 30.
- Greenslade, P.J.M. 1971. Interspecific competition and frequency changes among ants in Solomon Islands coconut plantations. *Journal of Applied Ecology*, 8: 323–352.
- Grace, J.K.; Yates, J.R.; Tome, C.H.M. 1995. Modification of a commercial bait station to collect large numbers of subterranean termites (Isoptera: Rhinotermitidae). *Sociobiology*, 26: 259–268.
- Greenslade, P.J.M. 1972. Comparative ecology of four tropical ant species. *Insectes Sociaux*, 19: 195–212.
- Greenslade, P.J.M.; Greenslade, P. 1978. Some effects of vegetation cover and disturbance on a tropical ant fauna. *Insectes Sociaux*, 24: 163–182.
- Gulick, L. 1913. Synoptic list of ants reported from the Hawaiian Islands. *Proceedings of the Hawaiian Entomological Society*, 2: 306–311.
- Gullan, P.J.; Buckley, R.C. 1990. Coccids in ants nests inside live plants in Australia and Papua New Guinea (Homoptera: Coccoidea: Coccidae). *Proceedings of the 6th International Symposium on Scale Insect Studies*, p. 82.
- Hadden, F.C. 1941. Midway Islands. *Hawaiian Planters' Record*, 45: 179–221.
- Haines, I.H.; Haines, J.B.; Cherrett, J.M. 1994. The impact and control of the crazy ant, *Anoplolepis longipes* (Jerd.), in the Seychelles. Pp. 206–218 in: Williams, D.F. (ed.) *Exotic ants: biology, impact, and control of introduced species*. Westview Press, Boulder. 332 pp.
- Hansen, J.D.; Hara, A.H.; Chan, H.T., Jr.; Tenbrink, V.L. 1991. Efficacy of hydrogen cyanide fumigation as a treatment for pests of Hawaiian cutflowers and foliage after harvest. *Journal of Economic Entomology*, 84: 532–536.
- Hardy, D.E. 1960. Diptera: Nematocera-Brachycera. Vol. 10. *Insects of Hawaii. A manual of the insects of the Hawaiian Islands...* University of Hawaii Press, Honolulu. 368 pp.
- Hardy, D.E. 1979. An ecological survey of Pua'alu'u Stream. Part III. Report of preliminary entomological survey of Pua'alu'u Stream, Maui. *Cooperative National Park Resources Study Unit Technical Report*, 27: 34–37.
- Hardy, D.E. 1981. Diptera: Cyclorrhapha IV, series Schizophora, section Calyptratae. Vol. 14. In: *Insects of Hawaii. A manual of the insects of the Hawaiian Islands...* University of Hawaii Press, Honolulu. 491 pp.
- Hardy, D.E. 1992. Diptera new to the Hawaiian Islands. *Hawaiian Entomological Society Newsletter*, 2: 2.
- Hardy, D.E.; Delfinado, M.D. 1974. Flightless Dolichopodidae (Diptera) in Hawaii. *Proceedings of the Hawaiian Entomological Society*, 21: 365–371.
- Hardy, D.E.; Delfinado, M.D. 1980. Diptera: Cyclorrhapha III, series Schizophora, section Acalyptratae, exclusive of family Drosophilidae. Vol. 13. In: *Insects of Hawaii. A manual of the insects of the Hawaiian Islands...* University of Hawaii Press, Honolulu. 451 pp.
- Hata, T.Y.; Hara, A.H.; Jang, E.B.; Imaino, L.S.; Hu, B.K.S.; Tenbrink, V.L. 1992. Pest management before harvest and insecticidal dip after harvest as a systems approach to quarantine security for red ginger. *Journal of Economic Entomology*, 85: 2310–2316.

- Hebard, M. 1926. Records of Hawaiian Dermaptera and Orthoptera of the family Gryllidae. *Proceedings of the Hawaiian Entomological Society*, 6: 299–303.
- Heraty, J.M. 1994. Biology and importance of two eucharitid parasites of *Wasmannia* and *Solenopsis*. Pp. 104–120 in: Williams, D.F. (ed.) *Exotic ants: biology, impact, and control of introduced species*. Westview Press, Boulder. 332 pp.
- Hewadikaram, K.A.; Goff, M.L. 1991. Effect of carcass size on rate of decomposition and arthropod succession patterns. *American Journal of Forensic Medicine and Pathology*, 12: 235–240.
- Hinckley, A.D. 1960. The klu beetle, *Mimosestes sallaei* (Sharp), in Hawaii (Coleoptera: Bruchidae). *Proceedings of the Hawaiian Entomological Society*, 17: 260–269.
- Holdaway, F.G. 1944. Insects of vegetable crops in Hawaii today. *Proceedings of the Hawaiian Entomological Society*, 12: 59–80.
- Holdaway, F.G.; Look, W.C. 1942. Insects of the garden bean in Hawaii. *Proceedings of the Hawaiian Entomological Society*, 11: 249–260.
- Hölldobler, B.; Wilson, E.O. 1990. *The Ants*. Springer-Verlag, Berlin. 732 pp.
- Howarth, F.G. 1981. Community structure and niche differentiation in Hawaiian lava tubes. Pp. 318–336 in: Mueller-Dombois, D.; Bridges, K.W.; Carson, H.L. (eds) *Island ecosystems. Biological organization in selected Hawaiian communities*. Hutchinson Ross Publishing Company, Stroudsburg, PA; Woods Hole, MA. 583 pp.
- Howarth, F.G. 1985. Impacts of alien land arthropods and mollusks on native plants and animals in Hawai'i. Pp. 149–179 in: Stone, C.P.; Scott, J.M. (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 pp.
- Howarth, F.G.; Medeiros, A.C. 1989. Non-native invertebrates. Pp. 82–87 in: Stone, C.P.; Stone, D.B. (eds) *Conservation biology in Hawai'i*. University of Hawaii Cooperative National Park Resources Studies Unit, Honolulu. 251 pp.
- Howarth, F.G.; Nishida, G.; Asquith, A. 1995. Insects of Hawaii. Pp. 365–368 in: LaRoe, E.T.; Farris, G.S.; Puckett, C.E.; Doran, P.D.; Mac, M.J. (eds) *Our living resources. A report to the nation on the distribution, abundance, and health of US plants, animals, and ecosystems*. US Department of Interior, National Biological Service, Washington, D.C. 530 pp.
- Huddleston, E.W.; S.S. Fluker, S.S. 1968. Distribution of ant species in Hawaii. *Proceedings of the Hawaiian Entomological Society*, 20: 45–69.
- Huddleston, E.W.; LaPlante, A.A.; S.S. Fluker, S.S. 1968. Pictorial key of the ants of Hawaii based on the worker forms. *Proceedings of the Hawaiian Entomological Society*, 20: 71–79.
- Huxley, C.R. 1978. The ant-plants *Mymecodia* and *Hydnophytum* (Rubiaceae), and the relationships between their morphology, ant occupants, physiology and ecology. *New Phytologist*, 80: 231–268.
- Illingworth, J.F. 1914. Little brown ant doing good work in Hawaii. *Hawaiian Forester and Agriculturalist*, 10: 370–371.
- Illingworth, J.F. 1916. Hen Fleas. *Xestopsylla gallinacea*. *Hawaiian Forester and Agriculturalist*, 12: 130–132.
- Illingworth, J.F. 1917. Economic aspects of our predaceous ant (*Pheidole megacephala*). *Proceedings of the Hawaiian Entomological Society*, 3: 349–368.
- Illingworth, J.F. 1923. Insect fauna of hen manure. *Proceedings of the Hawaiian Entomological Society*, 5: 270–273.
- Illingworth, J.F. 1926. A study of ants in their relation to the growing of pineapples in Hawaii. *Association of Hawaiian Pineapple Cannery, Experiment Station Bulletin*, 7: 1–16.
- Illingworth, J.F. 1926. Pineapple insects and some related pests. *Association of Hawaiian Pineapple Cannery, Experiment Station Bulletin*, 9: 1–64.
- Illingworth, J.F. 1927. A report on insects and other animal organisms collected in the pineapple growing section at Mauna Loa, Molokai, June, 1926. *Proceedings of the Hawaiian Entomological Society*, 6: 390–397.
- Illingworth, J.F. 1928. Insects collected in the pineapple growing section on the island of Lanai, August, 1927. *Proceedings of the Hawaiian Entomological Society*, 7: 42–46.
- Illingworth, J.F. 1929. Preliminary notes on pests of agricultural crops of Kona, March 15, 1928. *Proceedings of the Hawaiian Entomological Society*, 7: 248–254.
- Illingworth, J.F. 1941. Feeding habits of *Bufo marinus*. *Proceedings of the Hawaiian Entomological Society*, 11: 51.
- Illingworth, J.F. 1942. An outbreak of cockroaches, *Nauphoeta cinerea* (Olivier), in Honolulu. *Proceedings of the Hawaiian Entomological Society*, 11: 169–170.
- Ito, K. 1940. Ants caught on wind traps in pineapple fields on Oahu. *Proceedings of the Hawaiian Entomological Society*, 10: 429–435.
- Ito, K. 1942. Seasonal trend in the development of the sex forms of the fire ant, *Solenopsis geminata* (Fabr.) var. *rufa* (Jerdon), in the pineapple fields of Oahu. *Proceedings of the Hawaiian Entomological Society*, 11: 171–175.
- Ito, K.; Carter, W. 1932. Notes on insects found on pineapple planting material. *Proceedings of the Hawaiian Entomological Society*, 8: 41–44.
- Jahn, G.C.; Beardsley, J.W. 1994. Big-headed ants, *Pheidole megacephala*: interference with the biological control of gray pineapple mealybugs. Pp. 199–205 in: Williams, D.F. (ed.) *Exotic ants: biology, impact, and control of introduced species*. Westview Press, Boulder. 332 pp.
- Jahn, G.C.; Beardsley, J.W. 1996. Effects of *Pheidole megacephala* (Hymenoptera: Formicidae) on survival and dispersal of *Dysmicoccus neobrevipes* (Homoptera: Pseudococcidae). *Journal of Economic Entomology*, 89: 1124–1129.
- Jebb, M. 1991. Cavity structure and function in the tuberous Rubiaceae. Pp. 374–389 in: Huxley, C.R.; D.F.

- Cutler, D.F. (eds) *Ant-Plant Interactions*. Oxford University Press, Oxford, New York; Tokyo. 601 pp.
- Jerdon, T.C. 1851. A catalogue of the species of ants found in southern India. *Madras Journal of Literature and Science*, 17: 103–127
- Jourdan, H. 1997. Threats on Pacific islands: the spread of the tramp ant *Wasmannia auropunctata* (Hymenoptera: Formicidae). *Pacific Conservation Biology*, 3: 61–64.
- Joyce, C.R. (ed.) 1980. New immigrant records for the year 1977. *Proceedings of the Hawaiian Entomological Society*, 23: 189–190.
- Kido, M.H.; Ha, P.; Kinzie, R.A., III. 1993. Insect introductions and diet changes in an endemic Hawaiian amphidromous goby, *Awaous stamineus* (Pisces: Gobiidae). *Pacific Science*, 47: 43–50.
- Kirkaldy, G.W. 1904. A preliminary list of the insects of economic importance recorded from the Hawaiian Islands. Part III. Lepidoptera (Butterflies and Moths). *Hawaiian Forester and Agriculturalist*, 1: 205–210.
- Kirkaldy, G.W. 1907. On some peregrine Aphidae in Oahu (Hem.). *Proceedings of the Hawaiian Entomological Society*, 1: 99–102.
- Kirkaldy, G.W. 1909. Entomological notes. *Hawaiian Planters' Record*, 1: 146.
- Kirkaldy, G.W. 1909. A bibliography of sugar-cane entomology. *Hawaiian Sugar Planters Association Entomology Bulletin*, 8: 1–37.
- Kohout, R.J. 1988. A new species of *Polyrhachis* (*Polyrhachis*) from Papua New Guinea with a review of the New Guinean and Australian species (Hymenoptera: Formicidae: Formicinae). *Memoirs of the Queensland Museum*, no. 25: 417–427.
- Kohout, R.J. 1990. A review of the *Polyrhachis viehmeyeri* species-group (Hymenoptera: Formicidae: Formicinae). *Memoirs of the Queensland Museum*, 28: 499–508.
- Kotinsky, J. 1909. Report of Superintendent of Entomology for September, 1908. *Hawaiian Forester and Agriculturalist*, 5: 233–235.
- Kotinsky, J. 1909. Division of Entomology. Fifth Report of Superintendent of Entomology. *Report of the Board of Commissioners of Agriculture and Forestry of the Territory of Hawaii*: 97–114.
- Krauss, N.L.H. 1944. Notes on insects and other arthropods from the islands of Molokai and Maui, Hawaii. *Proceedings of the Hawaiian Entomological Society*, 12: 81–94.
- Krauss, N.L.H. 1945. Notes on some Hawaiian insects. *Proceedings of the Hawaiian Entomological Society*, 12: 309–317.
- Krombein, K.V.; Hurd, P.D., Jr.; Smith, D.R.; Burks, B.D. 1979. *Catalog of Hymenoptera in America north of Mexico. Volume 2. Apocrita (Aculeata)*. Pp. 1199–2209. Smithsonian Institution Press, Washington, DC.
- Krushelnicky, P.D.; Reimer, N.J. 1996. Efforts at control of the Argentine ant in Haleakala National Park, Maui, Hawaii. *Cooperative National Park Resources Study Unit Technical Report*, 109: 1–33.
- Kugler, J. 1983. The males of *Cardiocondyla* Emery (Hymenoptera: Formicidae) with the description of the winged male of *Cardiocondyla wroughtoni* (Forel). *Israel Journal of Entomology*, 17: 1–21.
- Kuhns, D.B. 1910. Notes on Maui insects. *Proceedings of the Hawaiian Entomological Society*, 2: 93.
- Lambdin, P.; Kosztarab, M. 1988. *Psoraleococcus browni*: a new species of pit scale from Papua New Guinea (Homoptera:Coccoidea: Lecanodiaspididae). *Annals of the Entomological Society of America*, 81: 724–727.
- Latreille, P.A. 1802. *Histoire naturelle des Fourmis, et recueil de mémoires et d'observations sur les Abeilles, les Araignées, les Faucheurs, et autres Insectes*. Chez Theophile Barrois Père, Paris. 445 pp.
- Latreille, P.A. 1805. *Histoire naturelle generale et particuliere des Crustacés et des Insectes*. Tome treizième. F. Dufart, Paris. 432 pp.
- Leclercq, S.; Braekman, J.C.; Kaisin, M.; Daloze, D.; Detrain, J.C. 1997. Venom constituents of three species of *Crematogaster* ants from Papua New Guinea. *Journal of Natural Products (Lloydia)* 60: 1143–1147.
- Lewis, L.V. 1912. A few notes on *Solenopsis geminata*. *Proceedings of the Hawaiian Entomological Society*, 2: 175–178.
- Lieberburg, I.; Kranz, P.M.; Seip, A. 1975. Bermudan ants revisited: the status and interaction of *Pheidole megacephala* and *Iridomyrmex humilis*. *Ecology*, 56: 473–478.
- Linnaeus, C. 1758. *Systema Naturae per regna tria naturae, secundum classes, ordines, genera, species cum characteribus, differentiis, synonymis, locis. Tomus I. Editio Decima, reformata*. Laurentii Salvii, Holmiae. 824 pp.
- Loope, L. 1995. Hawaii's invasive invertebrates. *Aliens*, Mar 1995: 4.
- Loope, L.L.; Medeiros, A.C. 1995. Haleakala silversword. Pp. 363–364 in: LaRoe, E.T.; Farris, G.S.; Puckett, C.E.; Doran, P.D.; Mac, M.J. (eds) *Our living resources. A report to the nation on the distribution, abundance, and health of US plants, animals, and ecosystems*. US Department of Interior, National Biological Service, Washington, D.C. 530 pp.
- Loschiavo, S.R.; Okumura, G.T. 1979. A survey of stored product insects in Hawaii. *Proceedings of the Hawaiian Entomological Society*, 23: 95–118.
- Lubin, Y.D. 1982. Programa de entomologia. *Informe Anuario Estacion Cientias Charles Darwin*, 1981: 29–33.
- Lubin, Y.D. 1983. Some changes in the invertebrate fauna of the Galapagos Islands following the invasion of the little fire ant *Wasmannia auropunctata*. *Informe Anuario Estacion Cientias Charles Darwin*, 1982: 56–74.
- Lubin, Y.D. 1984. Changes in the native fauna of the Galapagos Islands following invasion by the little red fire ant, *Wasmannia auropunctata*. *Biological Journal of the Linnaean Society*, 21: 229–242.
- Lubin, Y.D. 1986S. Studies of the little fire ant, *Wasmannia auropunctata*, in a Niño year. *Estacion Cientias Charles Darwin Informe Anuario*, 1983: 22–24.
- Mackay, W.P. 1995. New distributional records for the ant genus *Cardiocondyla* in the new world (Hymenoptera: Formicidae). *Pan-Pacific Entomologist*, 71: 169–172.

- Maehler, K.L. 1962. The impact of jet transportation on plant quarantine. *Proceedings of the Hawaiian Entomological Society*, 18: 43–46.
- Maeyama, T.; Terayama, M.; Matsumoto, T. 1997. Comparative studies of various symbiotic relationships between rubiacerous epiphytic mymecophytes and their inhabitant ant species (Hymenoptera: Formicidae). *Sociobiology*, 30: 169–174.
- Majer, J.D. 1993. Comparison of the arboreal ant mosaic in Ghana, Brazil, Papua New Guinea and Australia - its structure and influence on arthropod diversity. Pp. 115–141 in: LaSalle, J.; Gauld, I.D. (eds) *Hymenoptera and biodiversity*. CAB International, Wallingford, Oxon, UK. 348 pp.
- Majer, J.D. 1994. Spread of Argentine ants (*Linepithema humile*), with special reference to Western Australia. Pp. 163–173. in: Williams, D.F. (ed.) *Exotic ants. Biology, impact, and control of introduced species*. Westview Press, Boulder. 332 pp.
- Majer, J.D. 1994. Introduction of ants as potential biological control agents, with particular reference to cocoa. *Harvest*, 16 (1&2): 1–4.
- Mann, W.M. 1921. Ants of the Fiji Islands. *Bulletin of the Museum of Comparative Zoology*, 64: 403–499.
- Mayr, G.L. 1855. Formicina Austriaca. Beschreibung der bisher im Österreichischen Kaiserstaate aufgefundenen Ameisen nebst Hinzufügung jener in Deutschland, in der Schweiz und in Italien vorkommenden Arten. *Verhandlungen der Zoologisch-Botanischen Gesellschaft in Wien*, 5: 273–478.
- Mayr, G.L. 1862. Myrmecologische Studien. *Verhandlungen der Zoologisch-Botanischen Gesellschaft in Wien*, 12: 649–776.
- Mayr, G.L. 1865. Formicidae. Pp. 1–119 in: *Reise der Österreichischen Fregatte Novara um die Erde in den Jahren 1857, 1858, 1859 unter den Befehlen des Commodore B. von Wüllerstor-Ubair. Zoologischer theil, Zweiter Band. I. Abtheilung A. 3. Der kaiserlich-königlichen Hof- und Staatsdruckerei, Wien*. 119 pp.
- Mayr, G.L. 1866. Myrmecologische Beiträge. *Sitzungsberichte der Akademie der Wissenschaften in Wien*, 53: 484–517.
- Mayr, G.L. 1867. Adnotationes in monographiam formicidarum Indo-neerlandicarum. *Tijdschrift voor Entomologie*, ser. 2, 2: 33–117.
- Mayr, G.L. 1868. Formicidae novae americanae collectae a Prof. P. de Strobel. *Annuario della Societa dei Naturalisti in Modena*, 3: 161–178.
- Mayr, G.L. 1870. Neue Formiciden. *Verhandlungen der Zoologisch-Botanischen Gesellschaft in Wien*, 20: 939–996.
- Mayr, G.L. 1872. Formicidae borneenses collectae a J. Doria et O. Beccari in territorio Sarawakannis 1865–1867. *Annali del Museo Civico di Storia Naturale Genova*, 2: 133–155.
- Mayr, G.L. 1878. Beiträge zur Ameisen-fauna Asiens. *Verhandlungen der Zoologisch-Botanischen Gesellschaft in Wien*, 28: 645–686.
- Mayr, G.L. 1887. Südamerikanische Formiciden. *Verhandlungen der Zoologisch-Botanischen Gesellschaft in Wien*, 37: 511–632.
- McAlpine, D.K. 1988. Studies in upside-down flies (Diptera: Neurochaetidae) Part 2. Biology, adaptations and specific mating mechanisms. *Proceedings of the Linnaean Society of New South Wales*, 110: 59–82.
- McEwen, F.L.; Beardsley, J.W., Jr.; Hapai, M.; Su, T.H. 1979. Laboratory tests with candidate insecticides for control of the big-headed ant, *Pheidole megacephala* (Fabricius). *Proceedings of the Hawaiian Entomological Society*, 23: 119–123.
- Medeiros, A.C.; Loope, L.L.; Cole, F.R. 1986. Distribution of ants and their effects on endemic biota of Haleakala and Hawaii Volcanoes National Parks: a preliminary assessment. Pp. 39–52 in: Smith, C.W. (ed.) *Proceedings Sixth Conference in Natural Sciences Hawaii Volcanoes National Park*. University of Hawaii at Manoa, Honolulu. 98 pp.
- Meier, R.E. 1982. Ecology and behaviour of ants on giant cacti at the Darwin Station and at Tortuga Bay (Island of Santa Cruz, Galapagos). *Informe Anuario Estacion Cientias Charles Darwin*, 1981: 90–92.
- Meier, R.E. 1986. Coexisting patterns and foraging behavior of ants within the arid zone of the three Galapagos Islands. *Estacion Cientias Charles Darwin Informe Anuario*, 1983: 25–27.
- Meier, R.E. 1994. Coexisting patterns and foraging behavior of introduced and native ants (Hymenoptera Formicidae) in the Galapagos Islands (Ecuador). Pp. 44–62 in: Williams, D.F. (ed.) *Exotic ants: biology, impact, and control of introduced species*. Westview Press, Boulder. 332 pp.
- Miyagi, I. 1981. *Malaya leei* (Wharton) feeding on ants in Papua New Guinea (Diptera: Culicidae). *Japanese Journal of Sanitary Zoology*, 32: 332–333.
- Montgomery, S.L. 1975. Comparative breeding site ecology and the adaptive radiation of picture-winged *Drosophila* (Diptera: Drosophilidae) in Hawaii. *Proceedings of the Hawaiian Entomological Society*, 22: 65–103.
- Moore, N.W.; Gagné, W.C. 1982. *Megalagrion pacificum* (McLachlan) - a preliminary study of the conservation requirements of an endangered species. *Reports of the Odonata Specialist Group, IUCN*, 3: 1–5.
- Morrison, L.W. 1996. The ants (Hymenoptera: Formicidae) of Polynesia revisited: species numbers and the importance of sampling intensity. *Ecography* 19: 73–84.
- Morrison, L.W. 1996. Community organization in a recently assembled fauna: the case of Polynesian ants. *Oecologia*, 107: 243–256.
- Morrison, L.W.; Gilbert, L.E. 1998. Parasitoid-host relationships when host size varies: the case of *Pseudacteon* flies and *Solenopsis* fire ants. *Ecological Entomology* 23(4): 409–416.
- Mueller-Dombois, D. 1981. Spatial integration of the organisms studied along the transect. Pp. 181–210 in: Mueller-Dombois, D.; Bridges, K.W.; Carson, H.L. (eds) *Island ecosystems. Biological organization in selected Hawaiian communities*. Hutchinson Ross Publishing Company, Stroudsburg, PA; Woods Hole, MA. 583 pp.

- Muir, F. 1916. Review of the autochthonous genera of Hawaiian Delphacidae. [2 parts: 168-197, 197-221] *Proceedings of the Hawaiian Entomological Society*, 3: 168-221.
- Muir, F. 1921. The sugar cane leafhopper and its parasites in Hawaii. *Hawaiian Planters' Record*, 25: 108-123.
- Muir, F.; Swezey, O.H. 1926. Entomologists' report on termite problems. *Hawaiian Planters' Record*, 30: 331-335.
- Nafus, D.M. 1993. Movement of introduced biological control agents onto nontarget butterflies, *Hypolimnys* spp. (Lepidoptera: Nymphalidae). *Environmental Entomology*, 22 (2): 265-272.
- Nafus, D.M.; Schreiner, I.H. 1988. Parental care in a tropical nymphalid butterfly *Hypolimnys anomala*. *Animal Behavior*, 36: 1425-1431.
- Nakahara, L.M.; Burkhart, R.M.; Funasaki, G.Y. 1992. Review and status of biological control of *Clidemia* in Hawai'i. Pp. 452-465 in: Stone, C.P.; Smith, C.W.; Tunison, J.T. (eds) *Alien plant invasions in native ecosystems of Hawai'i: management and research*. Co-operative National Park Resources Studies Unit, Honolulu. 887 pp.
- Namba, R. 1957. *Cryptophlebia illepidia* (Butler) (Lepidoptera: Eucosmidae) and other insect pests of the macadamia nut in Hawaii. *Proceedings of the Hawaiian Entomological Society*, 16: 284-297.
- Nichols, J.R.; Seibert, T.F. 1985. Biological control of the spherical mealybug, *Nipaecoccus vastator* (Homoptera: Pseudococcidae): assessment by ant exclusion. *Environmental Entomology*, 14: 32-37.
- Nishida, G.M.; Tenorio, J.M. 1993. *What Bit Me? Identifying Hawai'i's Stinging and Biting Insects and their Kin*. University of Hawaii Press, Honolulu. 71 pp.
- Nishida, T. 1957. Food plants, distribution, and variation in abundance of *Conotelus mexicanus* Murray, a recently discovered immigrant insect in Hawaii (Coleoptera: Nitidulidae). *Proceedings of the Hawaiian Entomological Society*, 16: 307-312.
- Nishida, T. 1958. Extrafloral glandular secretions, a food source for certain insects. *Proceedings of the Hawaiian Entomological Society*, 16: 379-386.
- Nishida, T. 1963. Ecology of the pollinators of passion fruit. *Hawaii Agricultural Experiment Station Technical Bulletin*, no. 55: 1-38.
- Nishida, T. 1966. Behavior and mortality of the southern stink bug *Nezara viridula* in Hawaii. *Researches on Population Ecology*, 8: 78-88.
- Nylander, W. 1847. Additamentum adnotationum in monographiam Formicarum borealium Europae. *Acta Societatis Scientiarum Fennicae*, 2: 1041-1062.
- Passera, L. 1994. Characteristics of tramp species. Pp. 23-43 in: Williams, D.F. (ed.) *Exotic ants. Biology, impact, and control of introduced species*. Westview Press, Boulder. 332 pp.
- Pemberton, C.E. 1934. Some future work for the entomologist in Hawaii. *Proceedings of the Hawaiian Entomological Society*, 8: 505-514.
- Pemberton, C.E. 1943. Insects and other arthropods of medical interest in Hawaii. *Hawaii Medical Journal*, 2: 191-194.
- Pemberton, C.E. 1947. Some insect pests of the mainland of the United States occurring also in Hawaii. *Hawaiian Planters' Record*, 51: 85-87.
- Pemberton, C.E. 1964. Highlights in the history of entomology in Hawaii 1778-1963. *Pacific Insects*, 6: 689-729.
- Pemberton, C.E.; Willard, H.F. 1918. Work and parasitism of the Mediterranean fruitfly in Hawaii during 1917. *Journal of Agricultural Research*, 14: 605-610.
- Pemberton, C.E.; Willard, H.F. 1918. A contribution to the biology of fruit-fly parasites in Hawaii. *Journal of Agricultural Research*, 15: 419-465.
- Perkins, R.C.L. 1903. The leaf-hopper of the sugar cane. *Bulletin Division of Entomology of the Board of Commissioner of Agriculture and Forestry of Hawaii*, 1: 1-66.
- Perkins, R.C.L. 1907. The insects of Tantalus. *Proceedings of the Hawaiian Entomological Society*, 1: 38-51.
- Perkins, R.C.L. 1913. Introduction being a review of the land-fauna of Hawaiia. *Fauna Hawaiensis or the zoology of the Sandwich (Hawaiian) Islands...* Cambridge University Press, Cambridge. 1(6): xv-ccxxvii pp.
- Perrault, G.H. 1988. Les fourmis de Tahiti. *Bulletin de la Societe Zoologique de France*, 112: 429-446.
- Perrault, G.H. 1993. Peuplement en fourmis de l'atoll de Fangataufa. *Bulletin de la Societe Entomologique de France*, 98: 323-338.
- Phillips, J.S. 1934. The biology and distribution of ants in Hawaiian pineapple fields. *Bulletin of the Experiment Station Pineapple Producers Association*, 15: 1-57.
- Phillips, J.S. 1934. Fire ants in dry areas. *Proceedings of the Hawaiian Entomological Society*, 8: 515.
- Phillips, J.S. 1934. The relations of ants with insects attacking certain poisonous plants in Hawaii. *Transactions of the Entomological Society of London*, 82: 1-3.
- Plowman, K.P. 1981. Resource utilization by two New Guinea rainforest ants. *Journal of Animal Ecology*, 50: 903-916.
- Rainwater, H.I. 1963. Agricultural insect pest hitchhikers on aircraft. *Proceedings of the Hawaiian Entomological Society*, 18: 303-309.
- Reimer, N.J. 1988. Predation on *Liothrips urichi* Karny (Thysanoptera: Phlaeothripidae): a case of biotic interference. *Environmental Entomology*, 17: 132-134.
- Reimer, N.J. 1994. Distribution and impact of alien ants in vulnerable Hawaiian ecosystems. Pp. 11-22 in: Williams, D.F. (ed.) *Exotic ants: biology, impact, and control of introduced species*. Westview Press, Boulder. 332 pp.
- Reimer, N. 1999. A pictorial key to the most pestiferous ant species threatening Hawaii's native fauna and flora. Web publication at [www.hear.org/AlienSpeciesInHawaii/ants/#PictorialAntKey](http://www.hear.org/AlienSpeciesInHawaii/ants/#PictorialAntKey)
- Reimer, N.J.; Beardsley, J.W. 1990. Effectiveness of hydramethylnon and fenoxycarb for control of big-headed ant (Hymenoptera: Formicidae), an ant associated with mealybug wilt of pineapple in Hawaii. *Journal of Economic Entomology*, 83: 74-80.

- Reimer, N.J.; Glancey, B.M.; Beardsley, J.W. 1991. Development of *Pheidole megacephala* (Hymenoptera: Formicidae) colonies following ingestion of fenoxycarb and pyriproxyfen. *Journal of Economic Entomology*, 84: 56–60.
- Reimer, N.J.; Cope, M.-L.; Yasuda, G. 1993. Interference of *Pheidole megacephala* (Hymenoptera: Formicidae) with biological control of *Coccus viridis* (Homoptera: Coccidae) in coffee. *Environmental Entomology*, 22: 483–488.
- Richards, E.N.; Goff, M.L. 1997. Arthropod succession on exposed carrion in three contrasting tropical habitats on Hawaii Island, Hawaii. *Journal of Medical Entomology*, 34: 328–339.
- Roger, J. 1859. Beiträge zur Kenntniss der Ameisenfauna der Mittelmeerländer. *Berliner Entomologische Zeitschrift*, 3: 225–259.
- Roger, J. Die Ponera-artigen Ameisen. *Berliner Entomologische Zeitschrift*, 5: 1–54.
- Roger, J. 1863. Die neu aufgeführten Gattungen und Arten meines Formiciden-Verzeichnisses. *Berliner Entomologische Zeitschrift*, 7: 131–214.
- Rohrbach, K.G.; Beardsley, J.W.; German, T.L.; Reimer, N.; Sanford, W.G. 1988. Mealybug wilt, mealybugs and ants on pineapple. *Plant Disease* 72: 558–565.
- Rutkowski, F. 1996. A new larval foodplant for *Tmolus echion* (Lepidoptera: Lycaenidae). *Bishop Museum Occasional Papers*, 46: 32.
- Sanburn, C. 1996. Island ants. *Honolulu Weekly* 6: 5–7.
- Sanders, D.A.; Chang, V.C.S.; Ota, A.K.; Nomura, N. 1992. Food acceptability and distribution in the colony of the bigheaded ant, *Pheidole megacephala* (Fabr.) (Hymenoptera: Formicidae). *Proceedings of the Hawaiian Entomological Society*, 31: 65–72.
- Say, T. 1836. Descriptions of new species of North American Hymenoptera, and observations on some already described. *Boston Journal of Natural History*, 1: 209–305.
- Schwartz, C.W.; Schwartz, E.R. 1949. *A reconnaissance of the game birds in Hawaii*. [cover page differs from titlepage and reads: The game birds in Hawaii.] Board of Commissioners of Agriculture and Forestry, Territory of Hawaii, [Honolulu]. 168 pp.
- Scott, J.M.; Mountainspring, S.; Ramsey, F.L.; Kepler, C.B. 1986. *Forest bird communities of the Hawaiian Islands: their dynamics, ecology, and conservation*. Cooper Ornithological Society, [Lawrence, KS]. 431 pp.
- Sherman, M.; Marsden, D.A. 1979. Farm and home insect pests. Cockroaches, what to do about them! *University of Hawaii Cooperative Extension Service Entomology Note*, 3: 1–3.
- Silberglied, R. 1972. The little fire ant', *Wasmannia auropunctata*, a serious pest in the Galapagos Islands. *Noticias Galapagos*, 19–20: 13–15.
- Simmonds, F.J.; Greathead, D.J. 1977. Introductions and pest and weed problems. Pp. 109–124 in: Cherrett, J.M.; Sagar, G.R. (eds) *Origins of pest, parasite, disease and weed problems*. Symposium of the British Ecological Society, 18. Blackwell Scientific Publications Oxford. 413 pp.
- Simmons, J.S.; Whayne, T.F.; Anderson, G.W.; Horack, H.M. 1944. *Global epidemiology. A geography of disease and sanitation. Volume One. Part One: India and the Far East. Part Two: The Pacific Area*. J.B. Lippincott Company, Philadelphia; London; Montreal. 504 pp.
- Smith, C.W. 1980. Haleakala Crater: its resources and management problems. Pp. 311–317 in: Smith, C.W. (ed.) *Proceedings Third Conference in Natural Sciences Hawaii Volcanoes National Park*. University of Hawaii at Manoa, Honolulu. 396 pp.
- Smith, E.S.C. 1981. An integrated control scheme for cocoa pests and diseases in Papua New Guinea. *Tropical Pest Management*, 27: 351–359.
- Smith, F. 1851. *List of the British animals in the collection of the British Museum. Part VI. Hymenoptera Aculeata*. British Museum, London. 134 pp.
- Smith, F. 1857. Catalogue of the hymenopterous insects collected at Sarawak, Borneo; Mount Ophir, Malacca; and at Singapore by A.R. Wallace. *Journal and Proceedings of the Linnaean Society of London Zoology*, 2: 42–130.
- Smith, F. 1858. Part VI. Formicidae. *Catalogue of hymenopterous insects in the collection of the British Museum*. Printed by order of the Trustees [British Museum]. London.
- Smith, F. 1860. Catalogue of hymenopterous insects collected by Mr. A.R. Wallace in the islands of Bachian, Kaisaa, Amboyna, Gilolo, and at Dory in New Guinea. *Journal of the Linnaean Society of London Zoology*, 4 suppl.: 93–143.
- Smith, F. 1861. Catalogue of the hymenopterous insects collected by Mr. A.R. Wallace in the islands of Ceram, Celebes, Ternate, and Gilolo. *Journal and Proceedings of the Linnaean Society of London Zoology*, 6: 36–66.
- Smith, F. 1862. Descriptions of some new species of ants from the Holy Land, with a synonymic list of others previously described. *Journal and Proceedings of the Linnaean Society of London Zoology*, 6: 31–35.
- Smith, F. 1874. Descriptions of new species of Tenthredinidae, Ichneumonidae, Chrysidae, Formicidae, &c. of Japan. *Transactions of the Entomological Society of London*, 1874: 373–409.
- Smith, F. 1879. Descriptions of new species of aculeate Hymenoptera collected by the Rev. T. Blackburn in the Sandwich Islands. *Journal of the Linnaean Society of London Zoology*, 14: 674–685.
- Smith, M.R. 1944. Ants of the genus *Cardiocondyla* Emery in the United States. *Proceedings of the Entomological Society of Washington*, 46: 30–41.
- Smith, M.R. 1957. A contribution to the taxonomy, distribution and biology of the vagrant ant, *Plagiolepis alluaudi* Emery (Hymenoptera, Formicidae). *Journal of the New York Entomological Society*, 65: 195–198.
- Smith, M.R. 1965. House infesting ants of the eastern United States, their recognition, biology and economic importance. *US Department of Agriculture Technical Bulletin*, 1326: 1–105.
- Solem, [G.] A. 1976. *Endodontoid land snails from Pacific Islands (Mollusca: Pulmonata: Sigmurethra)*.

- Part I. Family Endodontidae. Field Museum of Natural History, Chicago. xii + 508 pp.
- Spencer, H. 1941. The small fire ant *Wasmannia* in citrus groves – a preliminary report. *Florida Entomologist*, 24: 6–14.
- Stechmann, D.-H.; Volkl, W.; Stary, P. 1996. Ant-attendance as a critical factor in the biological control of the banana aphid *Pentalonia nigronervosa* Coq. (Hom. Aphididae) in Oceania. *Journal of Applied Entomology*, 120: 123.
- Stone, C.P.; Pratt, L.W. 1994. *Hawai'i's plants and animals. Biological sketches of Hawaii Volcanoes National Park*. Hawaii Natural History Association, [Honolulu]. 399 pp.
- Su, T.H.; Beardsley, J.W.; McEwen, F.L. 1980. AC-217,300 a promising new insecticide for use in baits for control of the bigheaded ant in pineapple. *Journal of Economic Entomology*, 73: 755–756.
- Suehiro, A. 1959. Insects of Moku Manu Islet. *Proceedings of the Hawaiian Entomological Society*, 17: 90–91.
- Suehiro, A. 1960. Insects and other arthropods from Midway Atoll. *Proceedings of the Hawaiian Entomological Society*, 17: 289–298.
- Suehiro, A. 1986. Report 4. Insects of Honaunau. In: Bryan, E.H., Jr.; Emory, K.P. *The natural and cultural history of Honaunau, Kona, Hawaii. Part I. The natural history of Honaunau*. Bernice Pauahi Bishop Museum, Honolulu. 263 pp. [*Bishop Museum Anthropology Department Report*, 86-2: 31–61.]
- Sugarman, B.B. 1979. Additions to the list of insects and other arthropods from Kwajalein Atoll (Marshall Islands). *Proceedings of the Hawaiian Entomological Society*, 23: 147–151.
- Swaney, D. 1994. *Tonga. A Lonely Planet travel survival kit*. 2nd Edition. Lonely Planet Publications, Hawthorn, Australia. 198 pp.
- Swezey, O.H. 1909. Notes on the bud moth of sugar cane and its lepidopterous associates. *Hawaiian Planters' Record*, 1: 119–143.
- Swezey, O.H. 1909. The Hawaiian sugar cane bud moth (*Ereunetia flavistriata*) with an account of some allied species and natural enemies. *Hawaiian Sugar Planters Association Entomology Bulletin*, 6: 1–41.
- Swezey, O.H. 1913. Sugar cane mealy bugs in the Hawaiian Islands. *Hawaiian Planters' Record*, 8: 200–208.
- Swezey, O.H. 1915. Insects from French Frigate Shoals. *Proceedings of the Hawaiian Entomological Society*, 3: 98–99.
- Swezey, O.H. 1921. Some aspects of Hawaiian entomology. Proceedings of the First Pan-Pacific Scientific Conference. *Special Publication of the Bernice P. Bishop Museum*, 7: 167–176.
- Swezey, O.H. (ed.) 1925. Records of immigrant insects for 1924. *Proceedings of the Hawaiian Entomological Society*, 6: 217.
- Swezey, O.H. 1925. Maui insect notes and records. *Proceedings of the Hawaiian Entomological Society*, 6: 47–48.
- Swezey, O.H. (ed.) 1927. Records of immigrant insects for 1926. *Proceedings of the Hawaiian Entomological Society*, 6: 558.
- Swezey, O.H. (ed.) 1931. Records of immigrant insects for 1929 and 1930. *Proceedings of the Hawaiian Entomological Society*, 7: 516.
- Swezey, O.H. 1934. Insects from Bermuda grass, Kawela Bay, Oahu, April 23, 1933. *Proceedings of the Hawaiian Entomological Society*, 8: 533–534.
- Swezey, O.H. 1935. The winter revival of insect life in the arid region at Koko Head, Oahu. *Proceedings of the Hawaiian Entomological Society*, 9: 93–96.
- Swezey, O.H. 1936. Biological control of the sugar cane leafhopper in Hawaii. *Hawaiian Planters' Record*, 40: 57–101.
- Swezey, O.H. (ed.) 1941. Records of immigrant insects for the year 1940. *Proceedings of the Hawaiian Entomological Society*, 11: 130.
- Swezey, O.H. 1942. Hymenoptera. Formicidae of Guam. *Bulletin of the B.P. Bishop Museum*, no. 172: 175–183.
- Swezey, O.H. 1945. Insects associated with orchids. *Proceedings of the Hawaiian Entomological Society*, 12: 343–403.
- Swezey, O.H. 1952. Insect fauna of a coconut tree. *Proceedings of the Hawaiian Entomological Society*, 14: 377–378.
- Swezey, O.H. 1954. Forest entomology in Hawaii. An annotated check-list of the insect faunas of the various components of the Hawaiian forests. *Special Publications of the Bernice P. Bishop Museum*, 44: 1–266.
- Swezey, O.H.; Bryan, E.H., Jr. 1927. Notes on some forest insects of Molokai. *Proceedings of the Hawaiian Entomological Society*, 6: 411–422.
- Swezey, O.H.; Bryan, E.H., Jr. 1929. Further notes on the forest insects of Molokai. *Proceedings of the Hawaiian Entomological Society*, 7: 293–314.
- Tanada, Y.; Beardsley, J.W. 1958. A biological study of the lawn armyworm, *Spodoptera mauritia* (Boisduval), in Hawaii (Lepidoptera: Phalaenidae). *Proceedings of the Hawaiian Entomological Society*, 16: 411–436.
- Taylor, R.W. 1967. A monographic revision of the ant genus *Ponera* Latreille (Hymenoptera: Formicidae). *Pacific Insects Monographs* 13: 1–112.
- Taylor, R.W. 1976. The ants of Rennell and Bellona islands. *Natural History of Rennell Island*, 7: 73–90.
- Taylor, R.W. 1977. New ants of the Australasian genus *Orectognathus*, with a key to the known species (Hymenoptera: Formicidae). *Australian Journal of Zoology*, 25: 581–612.
- Taylor, R.W. 1978. Melanesian ants of the genus *Amblyopone* (Hymenoptera: Formicidae). *Australian Journal of Zoology*, 26: 823–839.
- Taylor, R.W. 1980. Australian and Melanesian ants of the genus *Eurhopalothrix* Brown and Kemp - notes and new species (Hymenoptera: Formicidae). *Journal of the Australian Entomological Society*, 19: 229–239.
- Taylor, R.W. 1980. The rare Fijian ant *Myrmecina* (= *Archaeomyrmex*) *cacabau* (Mann) rediscovered (Hymenoptera: Formicidae). *New Zealand Entomologist*, 7: 122–123.
- Taylor, R.W. 1985. The ants of the Papuan genus *Dacatinops* (Hymenoptera: Formicidae: Myrmicinae). *Series Entomologica*, 33:41–67.



- Taylor, R.W. 1987. A checklist of the ants of Australia, New Caledonia and New Zealand (Hymenoptera: Formicidae). *CSIRO Division of Entomology Report*, 41: 1–92.
- Taylor, R.W. 1988. The nomenclature and distribution of some Australian and New Caledonian ants of the genus *Leptogenys* Roger (= *Prionogenys* Emery, n. syn.) (Hymenoptera: Formicidae: Ponerinae). *General and Applied Entomology* 20: 33–37.
- Taylor, R.W. 1992. Nomenclature and distribution of some Australian and New Guinean ants of the subfamily Formicinae (Hymenoptera: Formicidae). *Journal of the Australian Entomological Society*, 31: 57–69.
- Tennant, L.E. 1994. The ecology of *Wasmannia auropunctata* in primary tropical rainforest in Costa Rica and Panama. Pp. 80–90 in: Williams, D.F. (ed.) *Exotic ants: biology, impact, and control of introduced species*. Westview Press, Boulder. 332 pp.
- Tenorio, J.M.; Nishida, G.M. 1995. *What's bugging me? Identifying and controlling household pests in Hawai'i*. University of Hawaii Press, Honolulu. 184 pp.
- Terayama, M. 1996. Taxonomic studies on the Japanese Formicidae, part 2. Seven genera of Ponerinae, Cerapachyinae and Myrmicinae. *Nature and Human Activities* 1: 9–32.
- Terayama, M.; Miyano, S.; Kurozumi, T. 1994. Ant fauna (Insecta: Hymenoptera: Formicidae) of the northern Mariana Islands, Micronesia. *Natural History Research Special Issue* 1: 231–236.
- Timberlake, P.H. 1926. Hymenoptera. In: Bryan, E.H., Jr. and collaborators. *Insects of Hawaii, Johnston Island and Wake Island*. *Bulletin of the B.P. Bishop Museum*, 31: 17–43.
- Timberlake, P.H. 1927. Biological control of insect pests in the Hawaiian Islands. *Proceedings of the Hawaiian Entomological Society*, 6: 529–556.
- Timberlake, P.H.; Ehrhorn, E.M.; Swezey, O.H. 1921. Report of committee on common names of economic insects in Hawaii. *Proceedings of the Hawaiian Entomological Society*, 4: 607–609.
- Toyama, G.M.; Ikeda, J.K. 1976. An evaluation of fly predators at animal farms on leeward and central Oahu. *Proceedings of the Hawaiian Entomological Society*, 22: 369–379.
- Tullis, K.; Goff, M.L. 1987. Arthropod succession in exposed carrion in a tropical rainforest on Oahu Island, Hawaii. *Journal of Medical Entomology*, 24: 332–339.
- Ulloa-Chacon, P.; Cherix, D. 1994. Perspectives on control of the little fire ant (*Wasmannia auropunctata*) on the Galapagos Islands. Pp. 63–72 in: Williams, D.F. (ed.) *Exotic ants: biology, impact, and control of introduced species*. Westview Press, Boulder. 332 pp.
- Van Riper, S.G.; Van Riper, C., III. 1985. A summary of known parasites and diseases recorded from the avifauna of the Hawaiian Islands. Pp. 298–371 in: Stone, C.P.; Scott, J.M. (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 pp.
- Van Zwaluwenburg, R.H. 1931. The soil fauna of sugar cane fields. Pp. 339–352 in: Williams, F.X. *Handbook of the insects and other invertebrates of Hawaiian sugar cane fields*. Hawaiian Sugar Planters' Association, Honolulu. 400 pp.
- Van Zwaluwenburg, R.H. 1943. The insects of Canton Island. *Proceedings of the Hawaiian Entomological Society*, 11: 300–312.
- Van Zwaluwenburg, R.H. (ed.) 1944. New insect records for the year 1943. *Proceedings of the Hawaiian Entomological Society*, 12: 212.
- Van Zwaluwenburg, R.H.; Rust, E.W.; J.S. Rosa, J.S. 1928. Notes on the rice-borer, *Chilo simplex*. *Hawaiian Forester and Agriculturalist*, 25: 79–82.
- Van Zwaluwenburg, R.H.; Rust, E.W.; J.S. Rosa, J.S. 1928. Notes on the rice-borer, *Chilo simplex*. *Hawaiian Planters' Record*, 32: 401–405.
- Ward, P.S. 1984. A revision of the ant genus *Rhytidoponera* (Hymenoptera: Formicidae) in New Caledonia. *Australian Journal of Zoology*, 32: 131–175.
- Ward, P.S. 1985. Taxonomic congruence and disparity in an insular ant fauna: *Rhytidoponera* in New Caledonia. *Systematic Zoology*, 34: 140–151.
- Warren, A. 1915. A study of the food habits of the Hawaiian dragonflies. *College of Hawaii Bulletin*, 3: 1–45.
- Warren, A. 1915. Dragonflies and their food. *Proceedings of the Hawaiian Entomological Society*, 3: 72–82.
- Wetterer, J.K. 1997. Ants on *Cecropia* in Hawaii. *Biotropica*, 29: 128–132.
- Wetterer, J.K. 1998. Nonindigenous ants associated with geothermal and human disturbance in Hawai'i Volcanoes National Park. *Pacific Science*, 52, no. 1: 40–50.
- Wetterer, J.K.; Banko, P.C.; Laniawe, L.P.; Slotterback; J.W. 1998. Nonindigenous ants at high elevations on Mauna Kea, Hawai'i. *Pacific Science*, 52: 228–236.
- Whalen, M.A.; Mackay, D.A. 1988. Patterns of ant and herbivore activity on five understory euphorbiaceous saplings in submontane Papua New Guinea. *Biotropica*, 20: 294–300.
- Wheeler, W.M. 1908. The ants of Porto Rico and the Virgin Islands. *Bulletin of the American Museum of Natural History*, 24: 117–158.
- Wheeler, W.M. 1909. Ants collected by Prof. F. Silvestri in the Hawaiian Islands. *Bollettino del Laboratorio di Entomologia Agraria Portici*, 3: 269–272.
- Wheeler, W.M. 1928. Ants collected by Professor F. Silvestri in China. *Bollettino del Laboratorio di Entomologia Agraria Portici*, 22: 3–38.
- Wheeler, W.M. 1931. Concerning some ant gynandromorphs. *Psyche*, 38: 80–85.
- Wheeler, W.M. 1933. Three obscure genera of ponerine ants. *American Museum Novitates*, 672: 1–23.
- Wheeler, W.M. 1933. An ant new to the fauna of the Hawaiian Islands. *Proceedings of the Hawaiian Entomological Society*, 8: 275–278.
- Wheeler, W.M. 1934. Revised list of Hawaiian ants. *Occasional Papers of the B.P. Bishop Museum*, 10: 3–21.



- Wheeler, W.M. 1935. Ants from the Society Islands. *Bulletin of the B.P. Bishop Museum*, 113: 13–19.
- Wheeler, W.M. 1935. Check list of the ants of Oceania. *Occasional Papers of the B.P. Bishop Museum*, 11: 3–56.
- Whitney, L.A. 1923. Division of Plant Inspection. Report of Acting Chief Plant Inspector, September, 1923. *Hawaiian Forester and Agriculturalist*, 20: 159–161.
- Whitney, L.A. 1926. Division of Plant Inspection. Report of Associate Plant Inspector, September, 1926. *Hawaiian Forester and Agriculturalist*, 23: 153–154.
- Whitney, L.A. 1927. Division of Entomology. Report of Associate Plant Inspector, June, 1927. *Hawaiian Forester and Agriculturalist*, 24: 87–88.
- Willard, H.F. 1927. Presidential address. Some observations in Hawaii on the ecology of the Mediterranean fruit fly *Ceratitis capitata* Wiedemann and its parasites. *Proceedings of the Hawaiian Entomological Society*, 6: 505–515.
- Willard, H.F.; Bissell, T.L. 1926. Work and parasitism of the Mediterranean fruit fly in Hawaii in 1912. *Journal of Agricultural Research*, 33: 9–15.
- Willard, H.F.; Mason, A.C. 1937. Parasitization of the Mediterranean fruitfly in Hawaii, 1914–33. *US Department of Agriculture Circular*, no. 439: 1–17.
- Williams, F.X. 1927. Notes on the habits of the bees and wasps of the Hawaiian Islands. *Proceedings of the Hawaiian Entomological Society*, 6: 425–464.
- Williams, F.X. 1931. *Handbook of the insects and other invertebrates of Hawaiian sugar cane fields*. Hawaiian Sugar Planters' Association, Honolulu. 400 pp.
- Williams, F.X. 1936. Biological studies in Hawaiian water-loving insects. Part I. Coleoptera or beetles. Part II. Odonata or dragonflies. *Proceedings of the Hawaiian Entomological Society*, 9: 235–349.
- Williams, F.X. 1944. Biological studies in Hawaiian water-loving insects. Part III. Diptera or flies. Culicidae, Chironomidae, and Ceratopogonidae. [149–180]. Part IV. Lepidoptera or moths and butterflies [180–185]. Part V. Hemiptera or bugs [186–196]. Addenda. *Proceedings of the Hawaiian Entomological Society*, 12: 149–197.
- Williams, F.X. 1946. *Stigmatomma (Fulakora) zwaluwenburgi*, a new species of ponerine ant from Hawaii. *Proceedings of the Hawaiian Entomological Society*, 12: 639–640.
- Wilson, E.O. 1957. The Tenuis and Selenophora groups of the ant genus *Ponera* (Hymenoptera: Formicidae). *Bulletin of the Museum of Comparative Zoology*, 116: 355–386.
- Wilson, E.O. 1958. Studies on the ant fauna of Melanesia III. Rhytidoponera in western Melanesia and the Moluccas. IV. The tribe Ponerini. *Bulletin of the Museum of Comparative Zoology*, 119: 303–371.
- Wilson, E.O. 1973. The ants of Easter Island and Juan Fernandez. *Pacific Insects*, 15: 285–287.
- Wilson, E.O. 1976. Which are the most prevalent ant genera? *Studia Entomologica* 19: 187–200.
- Wilson, E.O.; Taylor, R.W. 1967. The ants of Polynesia (Hymenoptera: Formicidae). *Pacific Insects Monograph*, 14: 1–109.
- Wirth, W.W. 1947. A review of the genus *Telmatogeton* Schiner, with descriptions of three new Hawaiian species (Diptera: Tephritidae). *Proceedings of the Hawaiian Entomological Society*, 13: 143–191.
- Wong, M.A.; Wong, T.T.Y. 1988. Predation of the Mediterranean fruit fly and the Oriental fruit fly (Diptera: Tephritidae) by the fire ant (Hymenoptera: Formicidae) in Hawaii. *Proceedings of the Hawaiian Entomological Society*, 28: 169–177.
- Wong, T.T.Y.; McInnis, D.O.; Nishimoto, J.I.; Ota, A.K.; Chang, V.C.S. 1984. Predation of the Mediterranean fruit fly (Diptera: Tephritidae) by the argentine ant (Hymenoptera: Formicidae) in Hawaii. *Journal of Economic Entomology*, 77: 1454–1458.
- Young, G.R. 1996. The crazy ant, *Anoplolepis longipes* (Jerdon) (Hymenoptera: Formicidae) on coconut palms in New Guinea. *Papua New Guinea Agriculture Journal*, 39: 10–13.
- Zakharov, A.A. 1994. Ant population structure on the islands of Tonga and Western Samoa. Pp. 1–253 in: Sokolov, V.E. [ed.] *Animal population of the islands of Southwestern Oceania*. Oecogeographic, Moscow. 253 pp.
- Zimmerman, E.C. 1941. The Bostrichidae found in Hawaii (Coleoptera). *Proceedings of the Hawaiian Entomological Society*, 11: 103–108.
- Zimmerman, E.C. 1941. Argentine ant in Hawaii. *Proceedings of the Hawaiian Entomological Society*, 11(1), p. 108.
- Zimmerman, E.C. 1948. Introduction. In: *Insects of Hawaii. A manual of the insects of the Hawaiian Islands...* University of Hawaii Press, Honolulu. 206 pp.
- Zimmerman, E.C. 1948. Apterygota to Thysanoptera inclusive. In: *Insects of Hawaii. A manual of the insects of the Hawaiian Islands...* University of Hawaii Press, Honolulu. 475 pp.
- Zimmerman, E.C. 1948. Homoptera: Auchenorrhyncha. In: *Insects of Hawaii. A manual of the insects of the Hawaiian Islands...* University of Hawaii Press, Honolulu. 268 pp.
- Zimmerman, E.C. 1948. Homoptera: Sternorrhyncha. In: *Insects of Hawaii. A manual of the insects of the Hawaiian Islands...* University of Hawaii Press, Honolulu. 464 pp.
- Zimmerman, E.C. 1958. Macrolepidoptera. In: *Insects of Hawaii. A manual of the insects of the Hawaiian Islands...* University of Hawaii Press, Honolulu. 542 pp.
- Zimmerman, E.C. 1958. Lepidoptera: Pyraloidea. In: *Insects of Hawaii. A manual of the insects of the Hawaiian Islands...* University of Hawaii Press, Honolulu. 456 pp.
- Zimmerman, E.C. 1970. Adaptive radiation in Hawaii with special reference to insects. *Biotropica*, 2: 32–38.
- Zimmerman, E.C. 1978. Microlepidoptera. Part I. Monotrysis, Tineoidea, Tortricoidea, Gracillarioidea, Yponomeutoidea, and Alucitoidea. In: *Insects of Hawaii. A manual of the insects of the Hawaiian Islands...* University of Hawaii Press, Honolulu. 882 pp.