

## **Sources of New Insects Established on Guam in the Post World War II Period**

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**Abstract**—The introduction of exotic species into Guam is a continuing problem, with the many serious insect pests being post World War II introductions. In the 1980s at least 25 new species were accidentally introduced. New pests include a grasshopper, a scarab beetle, several noctuid moths and a variety of small beetles, scales, thrips, whiteflies. In the last decade about one-third of the new pests on Guam apparently originated from the New World via Hawaii. Other pests arrived from the Oriental region and from other islands in the Micronesian area. Although the mode of introduction of most insects cannot be determined with precision, it can be deduced in at least three recent cases, one having arrived via an Air Force flight, and two having arrived with commercial shipments of ornamentals from Hawaii. The movement of ornamental plants and flowers is probably the most important means by which insects are currently moved around the Pacific region.

### **Introduction**

The introduction of new insect pests is a serious problem in many Pacific islands. In the South Pacific, past movement of pests has been often linked to shipping lines (Dale & Maddison 1984). Islands with political and trade links often shared pests not found in other intervening islands. Pests moved in the early part of the century were often those associated with the transportable portions of their hosts, such as roots and tubers or baskets made of vegetable material. In recent history, air travel has increased the rate at which pests move about the Pacific. Air transit has speeded up travel between the Pacific islands, and provided new opportunities for insect movement on materials such as fresh flowers and foliage or in the holds and passenger compartments of aircraft. The pace of new introductions has been shown to have accelerated recently in various locations such as Hawaii (Beardsley 1979) and Guam (Schreiner & Nafus 1986). Data from earlier in the century is no longer helpful in identifying areas of greatest quarantine threat. In this paper I will briefly examine the biology of the insects which were first found on Guam during the 1980s, speculate as to the origins and mode of entry, and then summarize the information obtained.

At least 24 species of insects and 1 mite have been recorded as new arrivals on Guam during the 1980s. The species recorded as new are either pests or large

and showy species for which it is easy to be certain that they are relatively new introductions. Other less conspicuous species have also been identified as new in the last decade, but because they are not of great economic significance, it is difficult to be certain whether they are new introductions or have been here for decades and were simply not noted. No mosquito surveys were done in the 1980s. In previous years mosquito surveys added a few species every decade to the list of insects known to occur on Guam (Ward 1984), and it seems likely the 1980s were no different.

### New Introductions

#### ORTHOPTERA

*Stenocatantops splendens* (Thunberg) is a grasshopper whose native distribution is Asia. It was first collected in 1984 at which time it was enormously abundant all over the island and did considerable damage to various vegetable crops. Since then it has been less abundant, though it is the most commonly encountered grasshopper in cultivated fields, and still sometimes damages plantings. Recently, a homeowner brought in a potted ornamental from his yard. The pot contained a large number of grasshopper eggs in the soil, most probably this species. Potted plants might have served as a mode of entry for this pest on Guam.

#### THYSANOPTERA

*Thrips palmi* Karny, the melon thrips, was first noted in Guam in 1983, though it did not reach outbreak status until 1984 (Schreiner & Nafus 1986). I cannot be certain of the origin of this pest as it is widely distributed in Asia also, but it did not become a problem in Guam until after it had been introduced to Hawaii and had become a pest there. Although it is a serious pest of the foliage of several vegetable crops, these are rarely brought to Guam. I suspect that the more likely mode of entry was in orchid flowers, which are known to be occasionally infested by this species (Nakahara et al. 1986). There is no restriction in the importation of orchids from Hawaii to Guam, and it is known that, as well as individual plants imported by homeowners, several large boxes of flowering plants are imported weekly for sale in retail outlets and the fleamarket. In contrast only limited numbers of orchids were being imported from Asia.

#### HOMOPTERA

*Aleurodicus dispersus* Russell, the spiralling whitefly, is a Neotropical species which was first noted in Hawaii in 1978. It has a wide host range and infests a wide variety of ornamental species. It arrived on Guam in 1981, most likely with a commercial shipment of ornamentals obtained from Hawaii (Schreiner & Nafus 1986). Since then the spiraling whitefly has spread to a number of other locations in Micronesia and to other islands in the Pacific.

*Aleurothrixus floccosus* (Maskell), the woolly whitefly, is a pest of citrus and guava trees. During the last 20 years it has spread from its original distribution

in the Neotropics to California, Europe and to islands in the Indian Ocean. It is a recent immigrant to Hawaii, where a species of *Eretmocerus* already present on Hawaii switched from another host to provide good control of the whitefly (Paulson 1983). An unidentified *Eretmocerus* sp. appeared in Guam concurrently with the whitefly in 1984, which makes it probable that Hawaii was the source of this whitefly.

*Ceroplastes ceriferus* (F.), the Indian wax scale, was first noted on Guam by Dr. J. Beardsley in 1984 during a brief visit (Beardsley 1986). The source of this insect is not known. It is widely distributed in the tropics and was previously known from Palau (Beardsley 1966).

*Steatococcus samaraius* Morrison is a magarodid species found previously in New Guinea, Palau and Yap (Beardsley 1966). This insect was briefly abundant on monkeypod trees on Guam around 1985, but the ladybeetle *Rodolia pumila*, introduced to control other magarodid species, feeds on this species, and *S. samaraius* has not become a pest on Guam. *S. samaraius* has a wide host range and could have been introduced on a number of ornamental plants or young trees. A Palauan population of several thousand people residing permanently on Guam is known to import ornamental plants from their home island for their gardens on Guam.

*Heteropsylla cubana* Crawford, the leucaena psyllid, is native to Central America. It spread to Florida in 1983 and to Hawaii in 1984 (Nakahara & Lai 1984) where it became enormously abundant. It appeared almost simultaneously in a number of islands in the western edge of the Pacific in 1985 and then spread westward in the following year, making it possible that this insect was spread in the wind (Waterhouse & Norris 1987). As it is attracted to lights, it might have also spread in the holds of airplanes. This is the most likely method by which the insect reached Hawaii.

A palm aphid *Cerataphis* sp. was found on Guam in 1988 but has not yet been identified. *C. lataniae* (Boisduval) has been present on other islands in the Marianas and Micronesia for many years (Essig 1956). *Cerataphis* species are also found in Hawaii and the Orient. On Guam, the palm aphids are not particularly common, and may have here for years prior to being detected. It was found on coconuts and betelnuts.

*Flaccia dione* Fennah is a species of derbid first found on Guam in 1985. Adults occasionally become very numerous on bananas, although they do little damage. This insect was previously known from the Marshall Islands, several Caroline atolls and Kosrae (Fennah 1956), where it also periodically becomes extremely abundant.

*Melormenis basalis* (Walker) is a flatid bug first noted in Guam in 1985. It is a probable import from Hawaii where it was first noted in 1967 (Shiroma 1968). The species originated in the Neotropics. The flatid attacks a number of host plants but is often found on guava. The adults move readily, but the eggs are placed in the stems of plants and the insect could easily have been introduced by this route. *M. basalis* is quite rare on Guam and may have been present for a number of years prior to being noted.

Several armored scales were first noted during the 1980s. Two of these, *Furcaspis biformis* (Cockerell) (McConnell & Muniappan 1988a) and *Genaparlatoria pseudaspidotus* (Lindinger) (McConnell & Muniappan 1988b) are species most commonly found on orchid plants. The former is found primarily in South America but is also known from Hawaii and several other islands of the south Pacific. The latter is tropicopolitan (Williams & Watson 1988). I do not know the origin of the Guam immigrants of these species, but it is almost certain they were imported on orchid plants.

Two other species of armored scale were also noted as arrivals in the second half of the decade. *Lindingaspis tingi* McKenzie was first noted in 1988. Its previous known distribution was the Philippine islands and the islands eastward (Williams 1963, D. Miller pers. comm.). It attacks a variety of plants including orchids, hoyas, ferns and cycads. It is not very common on Guam, where it is heavily parasitized. *Pseudaonidia trilobitiformis* (Green) is another recent arrival. The species originated in southern Asia, but now occurs in some areas of Melanesia as well as in Africa and South America (Williams & Watson 1988). It is not yet known from Hawaii. It attacks a variety of trees, but on Guam it is most damaging to citrus. The citrus types vary in their susceptibility with pummello being most affected on Guam. The scale causes leaf distortion and also attacks the fruit. It is not parasitized on Guam, although *Chilocorus nigritus* feeds on it.

#### COLEOPTERA

*Rhyparida* sp. is a small brown chrysomelid which appears identical to a species frequently intercepted in the U.S.A. on aircraft and military cargo originating in East and South-East Asia (R. E. White pers. comm.) This beetle was first collected on Guam in 1985. Its hosts are not known, but adults are found commonly in lawns, and it seems likely the larvae may be root feeders on lawn plants.

*Popillia lewisii* Arrow is a close relative of the Japanese beetle but was found previously only in the Ryukyu islands. It was first observed in 1985 at Anderson Air Force base in an area close to the flight line. A trapping program run for the last five years has not shown it to be spreading and it has been quite rare except in the first year when a spray program with carbaryl was being undertaken to keep the numbers down. That situation may have changed in 1990, however, as trapping which has just resumed after a hiatus of some months shows it to be quite abundant this year.

*Epitrix hirtipennis* (Melsheimer), the tobacco flea beetle, is a North American species which has been present in Hawaii for at least a century (Samuelson 1973). On Guam, it was first identified from specimens collected in 1983. It is a minor pest of eggplants and occasionally young tomato plants may be damaged.

*Chaetocnema confinis* Crotch, the sweet potato flea beetle, was first noticed in 1986 when it was seriously damaging sweet potatoes in a farmer's field, although since that time little damage has been observed. This is also a North American species which had immigrated to Hawaii in 1983 (Lai 1985). The adults make characteristic long narrow feeding tracks on the leaves, and the larvae feed on

the roots and surface of the tubers. In the U. S. A. they are considered to be pest of sweet potatoes and are one of a number of species for which resistance is being bred (Chalfant et al. 1990). There appears to be variation in resistance even in local varieties. This flea beetle has since been found in Saipan and in Majuro.

#### LEPIDOPTERA

The noctuid moths of the Micronesian region have not been well studied, but lists of pests and some other species are available for Guam. Several species which appear to be new to the island have been noted recently. These include *Helicoverpa assulta* (Guenee), one of the moths of the corn earworm complex. It was first collected in 1987 both at a blacklight set up in the forest of Northwest Field and in a sweet corn field. It is widely distributed in the Old World tropics. The moth is a minor pest compared to *H. armigera* (Hübner) which has been present on Guam for many years.

*Platyja umminia* (Cramer) was first noted in 1988 (Denton et al. 1989). In 1989 it had become sufficiently abundant to show up in a student collection. This fruit piercing moth is a South-East Asian species. Another new moth, which is attracted to fruit but which is not a primary piercer, is *Parallelia palumba* (Guenee), first noted in 1989 both in fruit-baited traps and in a student collection.

*Hulodes caranea* Cramer is a large moth which was first collected in 1986. At that time it was quite numerous at lights. Later in the year it was also found for the first time in a student collection. It is not a pest but, being one of the largest noctuid moths we have on Guam, it is quite conspicuous at the times of the year when it is common. It is known to have been present on Palau for a number of years.

#### DIPTERA

*Melanagromyza splendida* Frick was only recently identified, though specimens had been collected in 1986. This agromyzid fly is an internal borer in the stem or midribs of large leaves (Spencer 1973). Previously, it was known to attack Compositae and Umbelliferae, but on Guam it has been reared from tomato leaves and from midribs of mizuna, an Asian *Brassica* variety. The native distribution of this species is the tropical and subtropical Americas, but it has been present in Hawaii for many years.

#### HYMENOPTERA

Another relatively recent import is the big headed ant, *Pheidole megacephala* (F). According to pest control operators it has been present in at least one housing subdivision in northern Guam for a number of years, but it appears to be spreading, having reached the University only in the last year. The big headed ant has a widespread distribution in the tropics.

#### ACARI

*Eotetranychus cendanai* Rimando is a spider mite known previously from South East Asia. I first noted the species in 1983, but it had probably been on

Guam for some years previously. In S. E. Asia it is said to only damage citrus when DDT is used, but on Guam certain varieties of lemons are very susceptible and die back due to the continuing damage to the new leaves and shoots.

#### MOST RECENT INTRODUCTIONS

Halfway through 1990, we already have one possible new introduction for the coming decade. One specimen of *Pyropotasia pryeria* (Jason), a scarab beetle, has been found on Guam. The beetle arrived on Midway some years ago where it has become enormously abundant on palm blossoms (L. Pinter pers. comm). It is also a horticultural pest. I am not certain this species has been really introduced to Guam, however, because to date the only specimen found was lying dead in a building.

#### Discussion

Information from previous papers (Schreiner & Nafus 1986, Ward 1984) was updated and used to determine the origin of pest species arriving on Guam at various times in the Post World War II period (Table 1). Immediately post war there was considerable movement of men and materials around the Pacific region. Fifteen new insect pests were noted between 1945 and 1954, most of them originating in Asia. Thirteen more were introduced in the next 19 years between 1955 and 1970. Most of this time Guam was under U.S. Naval administration, and a very limited amount of travel was taking place between Guam and other parts of the world. Most of the species introduced during this period have tropicopolitan distributions. Two species each clearly originated from Asia and from Hawaii. Six of the species were mosquitos introduced possibly via military flights, and several insects may have been introduced on fresh produce.

Around 1970, tourists began coming to Guam and immigration, emigration, and general travel by the local population to and from Guam increased sharply. Of the 21 new species which were first noted in the 1970s, 15 were found between 1970 and 1975. These insects were mostly of Asian origin, and it is highly probable that they were introduced in connection with military operations in Vietnam. Two North American species were also introduced during the decade, one possibly via Hawaii and the other possibly directly from the mainland U.S.A. in produce or ornamentals.

Table 1. Number of insects established on Guam by area of origin.

Source	1945-54	1955-69	1970-79	1980-89
Asia	7	2	9	8
Micronesia	1	1	4	2
Hawaii	0	2	2	8
Unknown	7	8	6	7
Total	15	13	21	25



In the 1980s at least 25 new pests or conspicuous species were noted. The available evidence suggests that one-third of them came to Guam from Hawaii. Many were species that had immigrated to Hawaii only one or a few years prior to their introduction to Guam. A number of these species have also been recently found on islands in the South Pacific region (Waterhouse & Norris 1987), and a few have reached South-East Asia. Whereas Hawaii used to be the most isolated island chain in the world, it now appears to be a major transshipment point for introducing the Neotropical fauna to the Old World biota. Hawaii has already been noted as a staging area for the introduction of Old World species into California (Dowell & Gill, 1989).

The years immediately following a new introduction, when the insect populations are at a very high level, seem to pose the greatest risk in terms of further emigration of the pest population. Quarantine advisories are only rarely made available to the islands of the Pacific, but it appears these would need to be updated with great frequency to be most useful in helping to prevent the further movement of pests. The Hawaii Pest Report published by the Hawaii Department of Agriculture Plant Pest Control Branch was a very useful early warning beacon for the islands which have flight connections with Hawaii, but unfortunately is no longer published.

In addition to Hawaii, Asia and the other islands of Micronesia continue to be important sources of new insects arriving on Guam. Although Guam has obtained direct flight connections to Australia and New Guinea within the last two years, these areas have not yet become obvious as sources of new insects.

Guam is not only a recipient of new pest insects, but also an exporter. Guam serves a major role in redistributing insects in Micronesia, as many pests which are first noted on Guam are observed on various islands in the Micronesian region within a few years. On at least one or two occasions Guam has served as a jumping point to transport Asian fauna to Hawaii, as in the case of a bagworm, *Brachycyttarus* sp., which was first found around the household of a family which had recently moved from Guam to Hawaii.

Many of the introductions to Guam in the last decade appear to be associated with the movement of ornamental plants. Half of the introductions were Homoptera, and all but two of these almost certainly immigrated to Guam on host material. Species in other orders may have also traveled by this route. Other species of pests may have traveled in flowers or in potting mixture. Unfortunately there is not a big local industry to produce material for the commercial plant nurseries on Guam, so these import large volumes of living material on a frequent basis, primarily from Hawaii. Many local residents also buy small quantities of ornamentals while traveling.

In 1990 we had a case where the origin of a plant-infesting insect could be pinpointed with some accuracy. A nursery owner noted serious problems with hibiscus imported from Hawaii. The Guam quarantine service failed to inspect the particular box of hibiscus plants in which the whiteflies traveled, and the whitefly adults were noted by the nursery owner when the box was opened. The insects spread to other hibiscus plants in the nursery, and numerous hibiscus

plants had already been sold before the owner realized that the whiteflies were damaging the plants. Fortunately this whitefly proved to be *Bemisia tabaci* (Genn.), a species which was already present on Guam. It arrived only recently in Hawaii and is currently at very high levels there.

Although Guam quarantine personnel in recent years have become better at detecting insects on plant material from the USA, it is clear that they are still missing some. Only in the last year have they started inspecting material which arrives via first class mail, and many of the ornamentals are shipped that way. They do not check all the material that arrives, even that which is clearly marked as being plant material, but in any case, the best inspections could not expect to discover all scale insects or insect eggs in large boxes of potted plants. Because there is not a large agriculture industry on Guam, the farm lobby is not a sufficiently potent force to insist that post-entry quarantine be performed on all living plant material, even though many of the pests introduced on ornamentals have wide host ranges and become crop pests after their arrival. If the number of new pest introductions is to be reduced, post-entry quarantine of all plants, in a compartmentalized facility where insect movement is limited, would appear to be necessary.

The moths which arrived during the last decade, several of the beetle species, and perhaps a couple of the Homoptera species most likely traveled to Guam in the hold or passenger compartments of airplanes and were probably not associated with plant material in flight. The scheduling of flights to Guam is such that many travel during the night, leaving and arriving at times when lights are needed. This provides a good opportunity for attracting many species of insects to the holds. Residual insecticide sprays in the holds could do much to decrease this problem, without resulting in any of the liability problems that spraying the passenger compartment might cause.

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#### References

- Beardsley, J. W., Jr. 1966. Homoptera: Coccoidea. *Insects of Micronesia*. 6(7): 376-562.
- Beardsley, J. W., Jr. 1986. Notes and Exhibitions. *Proc. Hawaii. Entomol. Soc.* 26: 9.
- Beardsley, J. W., Jr. 1979. New immigrant insects to Hawaii: 1962 through 1976. *Proc. Hawaii. Entomol. Soc.* 23: 35-44.
- Chalfant, R. B., R. K. Jansson, D. R. Seal & J. M. Schalk. 1990. Ecology and management of sweet potato insects. *Annu. Rev. Entomol.* 35: 157-180.



- Denton, G. R. W., R. Muniappan, M. Marutani, J. McConnell & T. S. Lali. 1989. Biology and natural enemies of the fruit piercing moth, *Othreis fullonia* (Lepidoptera: Noctuidae) from Guam. Proc. ADAP Plant Protection Conf., Univ. of Hawaii. In press.
- Dowell, R. V. & R. Gill. 1989. Exotic invertebrates and their effect on California. PanPacific Entomol. 65: 132-145.
- Essig, E. O. 1956. Homoptera: Aphididae. Insects of Micronesia. 6(2): 15-37.
- Gressitt, J. L. 1954. Introduction. Insects of Micronesia. Vol. 1. 257 pp.
- Lai, P. Y. 1985. Notes and Exhibitions. Proc. Hawaii. Entomol. Soc. 25: 17.
- McConnell, J. & R. Muniappan. 1988a. Red orchid scale, *Furcaspis bifformis* (Cockerell), Diaspididae. Guam Pest Series. Cooperative Extension Service, Univ. of Guam. 1 p.
- McConnell, J. & R. Muniappan. 1988b. Vanda orchid scale, *Genaparlatoria pseudaspidotus* (Lindinger), Diaspididae. Guam Pest Series. Cooperative Extension, Univ. of Guam. 1 p.
- Nakahara, L. M. & P. Y. Lai. 1984. Hawaii Department of Agriculture Plant Pest Control Branch. Hawaii Pest Report 4(2): 2-8.
- Nakahara, L. M., K. Sakimura & R. A. Heu. 1986. Notes and Exhibitions. Proc. Hawaii. Entomol. Soc. 26:10.
- Paulson, G. S. 1983. The biology and natural enemies of the woolly whitefly, *Aleurothrixus floccosus* (Maskell) in Hawaii. M.S. Thesis. University of Hawaii, 71 pp.
- Samuelson, G. A. 1973. Alticinae of Oceania (Coleoptera: Chrysomelidae). Pacific Insect Monograph 30.
- Shiroma, E. 1968. Notes and Exhibitions. Proc. Hawaii. Entomol. Soc. 20: 264.
- Schreiner, I. & D. Nafus. Accidental introductions of insect pests to Guam, 1945-1985. Proc. Hawaii. Entomol. Soc. 27: 45-52.
- Spencer, K. A. 1973. Agromyzidae (Diptera) of economic importance. W. Junk. The Hague. 418 pp.
- Ward, R. A. 1984. Mosquito fauna of Guam: Case history of an introduced fauna. In M. Laird (ed.), Commerce and the spread of pests and disease vectors, pp. 143-161. Praeger, New York.
- Waterhouse, D. F. & K. R. Norris. 1987. Biological control: Pacific prospects. Inkata Press Pty Ltd. Melbourne. 454 pp.
- Williams, D. J. 1963. Synoptic revisions of I. *Lindingaspis* and II. *Andaspis* with two new allied genera (Hemiptera: Coccoidea). The Bulletin of the British Museum. Entomological Series 15(1).
- Williams, D. J. & G. W. Watson. 1988. The scale insects of the tropical South Pacific region. Part 1. The armoured scales (Diaspididae). C.A.B. International Institute of Entomology.

