

Accidental Introductions of Insect Pests to Guam, 1945-1985

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ABSTRACT

In the period between 1945 and 1985, 30 species of insects, excluding mosquitoes and beneficials, are known to have been accidentally introduced to Guam. Of these, 11 were introduced between 1945 and 1955 (1.1 per year), 7 more between 1955 and 1970 (0.5 per year), and 17 since 1970 (1.1 per year). The number of introductions roughly corresponds to the amount of traffic to and from Guam during the period in question. Prior to 1975, most of the new introductions probably arrived from Asia or other islands in Micronesia, but since 1975, Hawaii appears to be the source of at least half of the new introductions.

The accidental movement of injurious insects by man is a matter of considerable concern to entomologists worldwide. Many countries restrict the movement of agricultural materials to reduce the rate at which new pests invade, but these quarantine procedures cannot prevent all new introductions. The continental United States receives about 9 new species of foreign insects each year (McGregor 1973, cited in Calkins 1983), despite the presence of a quarantine system. Island ecosystems appear to be particularly vulnerable to invasion because of their limited fauna, and many records of species newly introduced to the islands of the Pacific are made each year. In Hawaii, Beardsley (1979) estimates up to 2 dozen foreign insects are introduced each year. Estimates are not available for most other islands in the region.

Guam is the crossroads of Micronesia, and is served by frequent or daily commercial flights from many countries including Japan, Hawaii, the Philippines, and other islands of Micronesia. In addition to civilian flights there are two military air bases which have incoming flights from various parts of the Pacific including Northern Australia, the Philippines, and Japan. Substantial ship traffic, both commercial and pleasure, enters the commercial port from various parts of the world.

The insect pests of Guam are well known. Several insect surveys were conducted between 1911 and 1954 (Swezey 1942, 1946, Gressitt 1954), and the armed services routinely monitor mosquitoes. Ward (1984) has confirmed the establishment of at least 14 species of mosquitoes since 1945. The rest of the insect fauna of Guam has been less intensively monitored than the mosquito fauna, but various insects have been recorded as new pests on agronomic and horticultural crops since WWII. In addition, we assume that certain other insects are new introductions if they are currently abundant pests consistently present from year to year, but were not found during previous surveys.

We would like to briefly discuss several new introductions since the end of WWII. For convenience they are grouped in approximately chronological order. Species which are being reported for the first time are based on specimens in the University of Guam collection.

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1945 to 1954

***Dacus dorsalis* Hendel:** The Oriental fruit fly was found on Guam in 1947, probably introduced from one of the other islands in the Marianas. In the 1930s it had appeared on Saipan, an island about 260 km north of Guam, and then spread to neighboring islands. In the 1960s *D. dorsalis* was successfully eradicated from the Marianas. Since that time continuous trapping programs on Guam have not yielded any specimens.

***Epilachna philippinensis* Dieke:** The Philippine lady beetle, a pest of solanaceous crops native to the Philippines, was detected in 1948. Two parasites were introduced by Peterson (1955a), but only *Pediobius foveolatus* (Crawford) from the Philippines became established. *P. foveolatus* of Indian stock was reintroduced in the early 1970s. The lady beetle is under effective biological control and is normally not a problem.

***Aleurocanthus spiniferus* (Quaintance):** Peterson (1955b) reported the introduction of the citrus spiny whitefly in 1951. This insect is widespread in Asia and prior to 1950 was also present in some of the western Caroline Islands. On Guam it became a severe pest of citrus. Several parasite species which had been used to control *Aleurocanthus woglumi* Ashby in Florida, were brought to Guam. *Encarsia smithi* (Silvestri) and *Amitus hesperidum* (Silvestri) became established and have provided successful biological control. *A. spiniferus* recently appeared in the eastern Carolines on Pohnpei and Kosrae.

***Liriomyza brassicae* (Riley):** This agromyzid leafminer, which feeds principally on Cruciferae, was observed by Owen (Gressitt 1954) on Guam in 1951. Owen thought it was probably a new introduction at that time.

***Coptotermes formosanus* Shiraki:** The Formosan termite may also have been introduced around the end of the war. It is not recorded as being present before WWII (Light 1946). In the 1950s it was described as being still quite localized to military installations but was spreading rapidly (Clagg 1958).

Other Insects: According to our interpretation of Gressitt (1954) several other insects of economic importance were introduced to Guam in the 1940s and 1950s. These were the scarabeid Chinese rose beetle *Adoretus sinicus* Burmeister in 1948, the agromyzid bean fly *Ophiomyia phaseoli* (Tyron) in 1951, the chrysomelid cucumber beetle *Aulacophora similis* (Olivier) also in 1951, and *Protaetia fusca* (Herbst) (Scarabaeidae) in 1954. *Campsomeris marginella modesta* (Smith) was introduced against *Adoretus* and two species of *Opius* were released against *Ophiomyia*. *Campsomeris* and at least one of the *Opius* species became established, but only limited control of the pests was attained. *Aulacophora* remains a serious pest of cucurbit crops. *P. fusca* adults are found on corn and other crops but are not common and do not cause any economic problems.

Peterson (1957) lists some serious pests which had not appeared on earlier lists. The two most serious and abundant, and thus likely to be new introductions are the diamond back moth *Plutella xylostella* (L.) and the citrus swallowtail *Papilio polytes* L. Several parasites have been introduced to control the diamond back moth, but it is not known whether they have become established. A parasite, *Pteromalus luzonensis* Gahan was introduced in 1974 to control the citrus swallowtail but *P. polytes* remains abundant, and can damage young citrus trees. However, since the 1950s, the swallowtail *Papilio xuthus* L., which has been on Guam at least since 1925, has become extremely rare or possibly extinct on Guam.

1955 through 1969

***Erionota thrax* L.:** The banana skipper appeared in Guam in 1957 (Gressett 1958). It probably came from either the Philippines or elsewhere in Southeast Asia. This insect is currently attacked by an accidentally introduced egg parasite, *Ooencyrtus erionotae* Ferriere, and a larval parasite, *Apanteles erionotae* Wilkinson, introduced from Hawaii in 1974. Though the biological control is mostly effective, occasional outbreaks can cause fairly severe damage.

***Physomerus grossipes* (F.):** This coreid is abundant on sweet potatoes and various morning glories. It was first noted on Guam in 1964 by Maehler (Shiroma 1965). We collected specimens of this insect in Belau in 1984, where they were abundant on morning glory. This is apparently a new introduction to Belau as it is not listed in Gross (1963).

***Conotelus mexicanus* Murray:** This nititolid beetle was first found in Hawaii in 1955, and first noted in Guam in 1964 (Shiroma 1965). It is a flower feeder which has not been shown to cause any economic damage.

***Brachyplatys* sp.** A new species of pentatomid, apparently not one of the species of *Brachyplatys* previously recorded as being present on Guam, was abundant on beans and *Leucaena* in 1964 (Shiroma 1965). It has not been an economic problem in recent years.

***Phaenococcus gossypii* Townsend and Cockerell:** This mealybug was found in abundance on several hosts by Laplante in 1972 (Beardsley 1975).

***Furcaspis oceanica* Lindinger:** The coconut red scale is endemic to Micronesia, but was absent from the Marianas. It appeared in Saipan in 1943 and became a serious pest. At some time after 1954 it arrived on Guam. Although a parasite, *Anabrolepis oceanica* (Doutt), was introduced from elsewhere in Micronesia to Saipan (Gardner, 1958), there are no records of whether it established there, or whether it was introduced to Guam. *Furcaspis* is extremely abundant on coconuts in some areas of Guam.

***Liriomyza sativae* Blanchard:** The agromyzid vegetable leafminer *L. sativae* was found on various plants in 1969–1971. *L. brassicae* was the only species of *Liriomyza* listed on Guam before that time (Spencer 1963). Presumably *L. sativae* was introduced sometime between 1963 and 1969. At that time *L. sativae* was common both in Hawaii and California, the latter a source of many vegetables imported to Guam, and most likely one of these areas served as the source of the leafminer.

1970–1979

***Pericyma cruegeri* (Butler):** The poinciana looper was detected in 1971 (Muniappan 1974). It is extremely abundant on Guam and defoliates most of the poincianas every year. *Brachymeria albotibialis* (Ashmead) was introduced from northern Australia to control it, but it only parasitizes a small percentage of the loopers. The source of this looper is not known, although it is present in Belau, northern Australia and Asia. This insect has also spread to Rota in the Commonwealth of the Northern Mariana Islands.

***Delta pyriforme* (F.):** This large eumenid potter wasp was introduced in the early 1970s. It has become a nuisance species, as it builds nests on houses and other objects.

***Delta circinalis* (F.):** This second eumenid wasp is very similar to *D. pyriforme*, and has been treated as a subspecies of the former. It may have been introduced at the same time or later.

***Protaetia* sp.:** A second *Protaetia* species was noted around 1972. The larvae of this large scarab beetle live in rotting vegetation in the soil. Adults are found in great abundance on coconut, betelnut, papaya, and mango blossoms and on ripening breadfruits, but the impact of their feeding is not known. The beetle is also found on corn, where it feeds on the tassels, silk and occasionally the kernels in the developing ear. This beetle is very similar in appearance to species found in Eastern Asia, but the genus is in need of revision so that the species cannot be identified (R.D. Gordon, pers comm.).

***Brontispa palauensis* (Esaki and Chujo):** The Palau coconut hispine beetle was found in 1973. In the 1950s in Micronesia, *B. palauensis* was present only on Belau (Gressitt, 1955), where it apparently did little damage. On Guam it caused severe damage to coconut fronds. *Tetrastichus brontispae* (Ferriere) was introduced to combat it and has provided some control (Muniappan et al. 1980), although periodic outbreaks still take place.

***Brachycyttarus* poss. *griseus* de Joannis:** This bagworm is abundant in lawns, but is not considered to be a significant pest. However, it also feeds on various ornamental plants such as canna lilies and anthuriums, where it scrapes holes in the leaves. The caterpillars pupate in exposed positions and hundreds of bags are often seen hanging on house walls. The bagworm was detected in 1976. One or more species of unidentified parasites have been reared from this bagworm on Guam, though no evaluation has been made as to their effectiveness. The most likely source of the bagworm was Vietnam (Heu et al. 1984). The insect was found in Hawaii in 1984, and the most probable source of the infestation is Guam.

***Nipaecoccus vastator* (Maskell):** This mealy bug first became a problem sometime around 1977. It had been present in Hawaii for some years, and this is a likely source of the Guam infestation. Currently it is most abundant on *Leucaena leucocephala* but can also be a problem on a number of ornamentals and vegetables. *Anagyrus indicus* Shaffee subsequently appeared and has reduced the mealybug population (Nechols and Seibert 1985). The mealybug rarely causes problems at present.

***Liriomyza trifolii* (Burgess):** This leafminer probably became established by 1978, although it was not identified until 1981. Like *L. sativae* it has a large host range and attacks a number of vegetable crops and ornamentals. Apparently it is moving around the world on chrysanthemums and other flower cuttings. Guam imports chrysanthemums from Hawaii and the U.S. mainland. Either of these locations could have been the source of this insect. Five parasites, which were probably already present on other leafminers, exert some control, but the insect regularly reaches outbreak proportions at the beginning of every dry season and is capable of defoliating beans. This insect has spread to the Northern Marianas, Yap and Pohnpei.

***Maconellicoccus hirsutus* (Green):** The Egyptian hibiscus mealybug was first identified in 1984 (Beardsley, In press), but is known to have been present on Guam for a number of years previously. It causes severe leaf curling on hibiscus plants, especially pruned ones, and is also present on other ornamentals. The source of the insect was most likely Asia. Recently this insect was also found in Truk and Hawaii.

The 1980s

***Ceroplastes ceriferus* (F.):** The Indian wax scale was identified in 1984 (Beardsley, in press) but was observed in large numbers on *Ficus* in 1982. It is now heavily parasitized and not particularly abundant. The scale has a wide host range

and feeds on many ornamental plants. On Guam the scale has only been observed on various species of figs and it currently is not a problem. This scale has nearly cosmopolitan distribution.

***Steatococcus samaraius* Morrison:** This magarodid was first identified in 1985 (Beardsley, in press). It was found in large numbers on monkeypod. The insect was previously known from Belau and Yap (Beardsley 1966).

***Aleurodicus dispersus* Russell:** The spiraling whitefly was first found in 1981 around the house and nursery of a person who was importing ornamentals from Hawaii. As in Hawaii, the whitefly population increased rapidly and attacked many different species of fruit trees and ornamentals. Two natural enemies were imported from Hawaii, and good control was achieved on Guam within a year after introduction. The spiralling whitefly spread to Saipan soon after it appeared in Guam, and has recently spread to Belau and Pohnpei.

***Thrips palmi* Karny:** This insect has long been present in South Asia, but in recent years it has begun to expand its range at a rapid rate. It arrived in Japan in the last decade, and has also appeared in Hawaii, New Caledonia, Wallis and Futuna and American Samoa since 1980. On Guam, it was first observed at low densities in 1983 (Beardsley, in press), and it seriously damaged watermelon plantings in 1984. Although the source could be the Philippines, we suspect that it came from Hawaii as the insect appeared on Guam about a year after it had become abundant on Oahu.

***Aleurothrixus floccosus* (Maskell):** The wooly whitefly was first noted in 1984 on citrus and guava. The likely source of this insect was Hawaii, where it was first found in 1981.

***Heteropsylla* sp. poss. *incisa*:** This psyllid was first observed in Hawaii in 1984, where it became enormously abundant on *L. leucocephala*. It was noticed in Guam in 1985 and was already abundant at that time. Shortly thereafter it was found on Saipan and other islands of the Northern Marianas, and in Belau. In 1985 it was also found on numerous other islands in the South Pacific including Tonga and Fiji. It is possible that this insect has spread throughout the Pacific on the wind rather than by human agency.

***Rhyarida* sp.:** This small brown chrysomelid was first collected in 1985. It is found commonly in areas with lawns. This beetle is frequently intercepted from aircraft originating in Asia (R.E. White, personal communication).

***Popillia lewisi* Arrow:** This scarab beetle is closely related to the Japanese beetle, but was described from the Ryukyu Islands. It was found in Guam in mid-1985. An eradication effort was immediately begun, but a few adult beetles were still being captured in Feb. 1986. To date, beetles have only been found in the vicinity of the docking bay at Anderson Air Force Base. It presumably arrived in Guam via an Air Force flight from Okinawa.

DISCUSSION AND CONCLUSIONS

Excluding mosquitoes, the known number of accidental introductions of insect pests to Guam is 35 species over the last 40 years. Other insects are also known to have been introduced. Ward (1984) documented the establishment of fourteen species of mosquitoes on Guam since 1945, and several beneficial insects are known to have established. Probably many other species of insects have become established without being noticed.

In the Hawaiian Islands Beardsley (1979) estimates that in recent years between 20 and 25 new species of insects become established every year. Of these immigrants

perhaps 3 per year are pests or are otherwise particularly noticeable. On Guam, during the last fifteen years, 7 mosquito species (Ward 1984) and 17 other species of insects, excluding deliberately or accidentally introduced beneficials, are known to have become established. This is a rate of over 1.5 new immigrants every year, which is about half the number of noticeable immigrants to Hawaii. If we assume that Guam and Hawaii receive a similar proportion of noticeable and inconspicuous immigrant insects, we estimate that about 10 to 12 species of insect become established on Guam each year. In the continental United States about 9 new species of insects become established every year (McGregor 1973, cited in Calkins, 1983).

The number of insect immigrants is associated with the volume of traffic in and out of Guam during the period in question. Immediately post war there was considerable movement of men and materials around the Pacific region. Excluding mosquitoes, which are discussed by Ward (1984), eleven new insect pests were collected between 1948 and 1954, most of them apparently from other parts of Micronesia and the Philippines. Seven more were introduced in the next 15 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, apart from military flights and shipping. Around 1970, after the administration of Guam was transferred to local civilian control, tourists began coming to Guam and immigration, emigration, and general travel by the local population to and from Guam increased sharply. Since 1970 at least 17 insect pest species, apart from mosquitoes, established on Guam; eight of these since 1980. The new insects found during the early 1970s were largely of Asian origin, and it is highly probable that they were introduced in connection with military operations in Vietnam. Since the mid-70s, 6 of the 12 new insects which established during this period probably arrived from Hawaii. These insects are largely small, polyphagous species. We are fairly certain that one species was introduced through the movement of ornamentals, and it is probable that many others were also. Of the remaining 6 insects, 4 probably came from Asia, and the other 2 possibly from Belau or from Asia.

Currently, agricultural quarantine inspections of flights from the Philippines and other parts of Asia are very strict, and large quantities of contraband plant material, especially mangoes, are routinely seized. Inspection of flights from Hawaii is more lenient than it is for flights from Asia. Because Guam is a territory of the United States, local political pressure has made it difficult for Guam quarantine inspectors to be more strict with passengers from Hawaii. Also, there are legal and political problems with inspecting first class mail from the United States. Of the recent introductions, at least three, *L. trifolii*, *A. dispersus* and *Heteropsylla* sp. almost certainly came from the U.S., and *T. palmi*, *N. vastator* and *A. floccosus* may have. Hawaii, in particular, because of its tropical climate, and its direct flight connection with Guam, is an important source of imported insects. New introductions to Hawaii that become abundant there, frequently are found on Guam 1 to 2 years later.

The limited data available suggests that once insects arrive in Guam, they then spread from Guam to Hawaii and to other parts of Micronesia, especially the other Mariana Islands, which are connected to Guam by several flights daily. Some insects, such as the poinciana looper, may have reached the closest island, Rota, by flight.

The rate of successful immigration of pests to Guam is unacceptably high, particularly given the small size of Guam. Quarantine procedures have prevented the introduction or reintroduction of certain species, particularly fruit flies, but

additional steps need to be made to slow the rate of acquisition of other species. Mail inspection, and stricter measures on the importation of small quantities of plants need to be implemented. Currently up to 12 plants accompanied by a phytosanitary permit can be imported by an individual. These plants are released to the owner immediately after inspection by local authorities and are not held in post-quarantine. Mail inspection is not routinely performed and is a major weakness in the system.

Aircraft inspection and dissection needs careful consideration, as we suspect many insects are being transmitted this way. We personally observed mosquitoes flying around the cabin of an aircraft travelling from Manila to Guam. These mosquitoes were actively moving around the cabin at the time of disembarkment in Guam despite aerosol insecticide treatments in a stop in Hong Kong and about 5 minutes before landing in Guam. Without more stringent quarantine procedures, the rate of new introduction of agricultural and medical pests will continue to be high.

ACKNOWLEDGMENTS

We thank R. Muniappan who witnessed many of these new introductions, and has provided us with details. Ivan DeSoto also provided information on the mud daubers. We also wish to thank the many taxonomists who have provided identification of new introductions to Guam over the years. These include K.A. Spencer, J. Beardsley of the University of Hawaii, S. Nakahara, R.D. Gordon, A.S. Menke and R.E. White of the U.S.D.A. Biosystematics Laboratory, and many others whom we are not aware of. This is publication number 40 of the Guam Agricultural Experiment Station.

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