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Banana Skipper, *Erionota thrax* (L.) (Lepidoptera:Hesperiidae) in Papua New Guinea: a New Pest in the South Pacific Region

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Abstract—Banana skipper, *Erionota thrax* (L.) (Lepidoptera:Hesperiidae) a butterfly of Southeast Asian origin, was first recorded in Papua New Guinea in 1983. Since 1987, it has spread throughout the mainland from sea level to 2500 m. The larvae feed on all species of bananas reducing fruit yields and preventing the traditional use of leaves for other purposes. No hosts other than Musaceae were recorded for *E. thrax* in Papua New Guinea. A joint survey by CSIRO and the Papua New Guinea Department of Agriculture & Livestock investigated the natural enemies and abundance of *E. thrax* as a preliminary to biological control of the pest in Papua New Guinea. Of three egg parasitoids found attacking *E. thrax*, only *Ooencyrtus erionotae* Ferriere significantly influenced its abundance. Natural enemies of larvae and pupae were uncommon and an important larval parasitoid of *E. thrax* in Southeast Asia, *Apanteles erionotae* Wilkinson, was absent. *E. thrax* could spread from Papua New Guinea, posing a threat to bananas throughout the south Pacific region.

Introduction

Banana skipper, *Erionota thrax thrax* (L.), sometimes referred to as the banana leaf roller, is a minor pest in its native range of Southeast Asia but became a major pest in Guam, Mauritius, Hawaii, and Papua New Guinea, where introduced without natural enemies (Waterhouse & Norris 1989). Two other subspecies, *E. thrax mindana* Evans from southern Philippines and *E. thrax hasdrubal* Fruhstorfer from northern Moluccas, are not known to occur outside of their native range. Larvae cause damage by leaf rolling and feeding on the leaves of banana plants, reducing fruit yields when defoliation exceeds 20% (Ostmark 1974).

In Papua New Guinea, bananas are the second most important crop after sweet potato and in some provinces are the staple crop (King & Bull 1984). In August 1983, a specimen of *E. thrax* was collected at Vanimo, in northwestern

Papua New Guinea (H. Roberts pers. comm.). *E. thrax* spread to the East Sepik Province in July 1986 and by mid 1987, was found defoliating banana plants in the Madang and Morobe Provinces.

Several natural enemies of *E. thrax* have been identified in Southeast Asia (Hoffmann 1935). These include the egg parasitoid *Ooencyrtus erionotae* Ferriere (Encyrtidae) and the larval parasitoid *Apanteles erionotae* Wilkinson (Braconidae). Both have proven to be valuable agents when introduced to control *E. thrax* in countries where it has become an exotic pest (Waterhouse & Norris 1989). In Papua New Guinea, *O. erionotae* was reported attacking eggs of *E. thrax* (Arura 1987). It is not known if this parasitoid was already established on another host or if it gained entry to the country at the same time as the pest.

We discuss the distribution and hosts, damage to banana plants and studies associated with a program for biological control of *E. thrax* in Papua New Guinea. A threat to banana production elsewhere in the South Pacific region is recognised, should *E. thrax* spread further without its natural enemies.

Materials and Methods

ASSESSMENT FOR LEAF DAMAGE AND ABUNDANCE OF *E. thrax* STAGES

Sites with bananas present were selected and total number of banana plants and number with stages of *E. thrax* was recorded. Ten banana plants were selected at random from a diagonal transect to measure the number of stages of *E. thrax* per leaf, the number of leaves with damage, and to estimate percent of each leaf damaged and the position on the plant.

NATURAL ENEMIES OF *E. thrax*

Any predators were collected and retained with the host. For parasitoid emergence, *E. thrax* stages were held in plastic tubes measuring 9.5 × 1.5 cm diameter, each with a firm cotton wool plug.

For eggs the following were recorded: (i) Number of eggs/mass, (ii) Number masses with parasites, (iii) Number eggs/mass parasitized, and (iv) Identity of parasites. For larvae and pupae, the number of parasites emerging, whether hyperparasitized and the instars of larval hosts were recorded.

Results

DISTRIBUTION AND HOST RANGE OF *E. thrax*

Since its initial build up in abundance in northern Papua New Guinea (PNG) during 1987, *E. thrax* has established up to altitudes of 2,500 m in the Eastern Highlands Province, to 2,060 m in the Finisterre Ranges and all coastal areas including the Western Province, less than 3 km from the Australian Torres Strait Islands (Fig. 1).

Immature stages of *E. thrax* were collected from *Musa sapientum* Linn. and *M. textilis* Née, *Musa* spp. (including sections *Australimusa* and *Eumusa*) and several varieties. No immature stages of *E. thrax* were found on *Heliconia bihai*

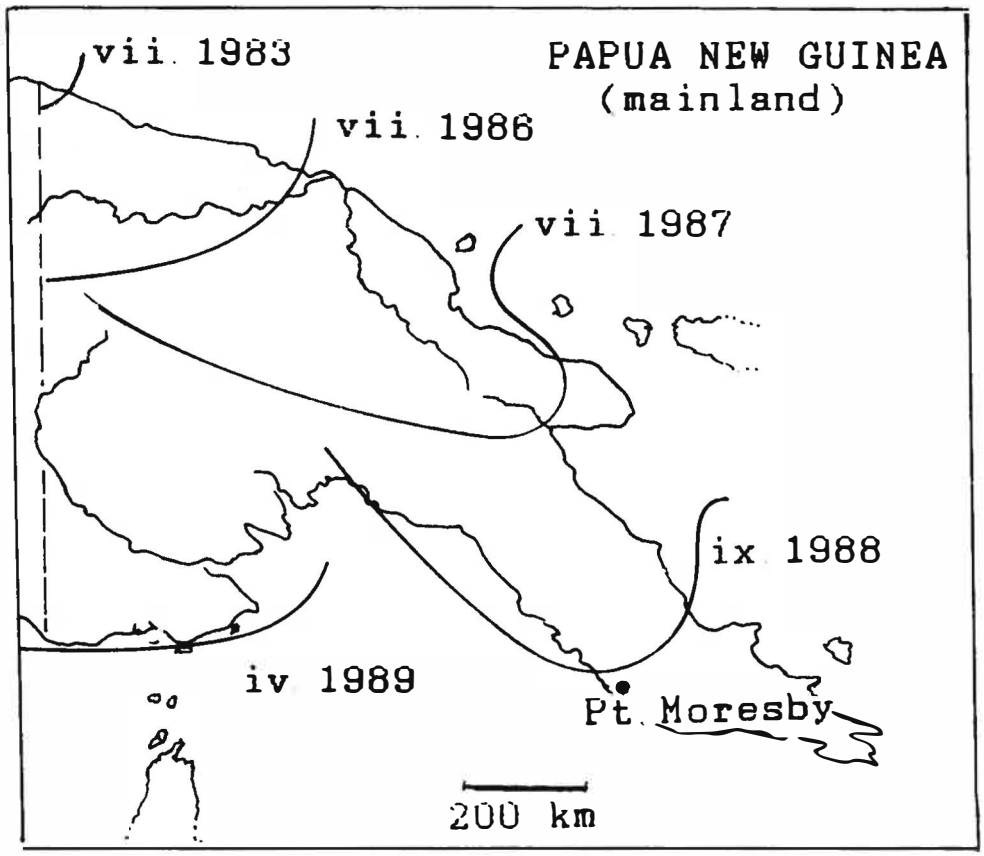

Figure 1. Establishment and spread of *Erionota thrax* in Papua New Guinea.

Linn, *Ensete glaucum* (Roxb.) Cheesman, *Nypa fruticans* Wirmb., *Metroxylon* sp., *Calmus* spp., *Ravenala madagascariensis* J. Gmelin, *Cocus nucifera* Linn., *Areca catechu* Linn. or *Elaeis guineensis* Jacq., even when infested *Musa* spp. plants were growing close by.

In the laboratory, groups of 10 newly-hatched of *E. thrax* died without feeding when placed on fresh foliage of *H. bahai, C. nucifera* and *E. guineensis*, whereas all larvae placed on *M. sapientum* as controls, began feeding.

ABUNDANCE OF IMMATURE STAGES OF *E. thrax* AND DAMAGE TO BANANA PLANTS

Summaries from surveys carried out in three Provinces of PNG, in May–June 1988 and the Western Province, in March–April 1989 are shown in Table 1. *E. thrax* was present at all localities surveyed in the Morobe, Eastern Highlands and Madang Provinces in 1988 and Western Provinces in 1989.

The maximum number of leaves infested with *E. thrax* stages was 94% at Bulolo, Morobe Province. The highest level of defoliation per site was 70% near

Table 1. Leaf damage to banana plants and abundance of *Erionota thrax* stages.

Province	Number of Localities	Dates	Total Plants	$\bar{x}$% Defoliation	$\bar{x}$% Leaves with Stages (±SE)	$\bar{x}$ No. Stages per Leaf		
						No. Eggs	Larvae	Pupae
Morobe	32	v.-	217	37.0	40.7 ± 4.0	6.8	3.9	3.1
Madang	7	vi.	41	29.3	27.1 ± 3.2	3.8	1.3	1.4
E. Highlands	2	1988	20	29.2	56.3	10.8	3.3	1.5
Western	14	iii–vi. 1989	83	23.9	31.7 ± 6.1	2.7	4.7	0.7

Table 2. Parasitization of Immature Stages of *E. thrax* (May–June 1988).

Province	Eggs			Larvae		Pupae	
	No. Masses	Total Eggs	% Parasitized[1]	No.	% Parasitized	No.	% Parasitized[2]
Morobe	34	511	32.7	191	0	172	5.8
Madang	0			17	0	7	0
E. Highlands	32	338	25.7	24	0	11	0

[1] by *Ooencyrtus erionotae*
[2] by *Brachymoria* sp. and unidentified tachinid

Busu Village in the Markham Valley and the maximum number of leaf rolls was 6 per leaf, at Goroka, Eastern Highlands Province. At several localities individual plants were completely defoliated, leaving only the leaf stalks, by as few as 2–3 larvae per leaf. *O. erionotae* was present at all of the defoliated sites.

When sites in the Morobe and Madang Provinces were revisited in March–April 1990, levels of infestation were much lower than in 1987 and 1988, except at Boana, Morobe Province.

NATURAL ENEMIES OF *E. thrax*

Three egg parasitoids were reared: *Ooencyrtus erionotae*, an unidentified *Ooencyrtus* sp. and an unidentified *Anastatus* sp. Of these, only *O. erionotae* contributed to significant mortality of *E. thrax* (Table 2). Egg parasitization by *O. erionotae* averaged 30% (total 849 eggs) from all localities for the period May–June 1988 but reached 82% on one occasion in the Morobe Province.

Eggs on *Cephrenes mosleyi* (Butler) were never attacked in the field by *O. erionotae* even when present (on different host plants) with *E. thrax* in the same localities. Eggs of *C. mosleyi* were attacked by a different, unidentified *Ooencyrtus* sp. However, in recent studies in the laboratory, *O. erionotae* completed development in eggs of *Cephrenes augiades* (Felder), showing that *O. erionotae* will attack other hosts when confined in an artificial environment.

Larvae of *E. thrax* were occasionally attacked by predatory Hemiptera but not by any Hymenoptera. Only 10 of 190 pupae collected from the field were parasitized (ca. 5%), two by a *Brachymeria* sp. and the remaining eight, by tachinid Diptera. The same *Brachymeria* sp. was reared from *C. mosleyi*. Diseased pupae (possibly by a microsporidian) frequently supported the development of sarcophagid Diptera.

Discussion

After an initial build up in abundance, with accompanying serious defoliation of banana plants in Papua New Guinea during 1987–88, *E. thrax* numbers appeared to decrease by March 1990. However, some outbreaks particularly in the Markham Valley continued to cause problems. The decrease in abundance of *E. thrax* can in part, be attributed to egg parasitization by *O. erionotae* but the level of biological control is not considered effective.

Since the arrival of *E. thrax* in PNG, defoliation of banana plants has lowered fruit yields as well as disrupted the traditional use of banana leaves for: (i) wrapping ripening fruit, to prevent attack by birds and bats, (ii) as table cloths, (iii) sheltering firewood from rain, (iv) covering food to prevent settling by flies and (v) making baskets (Waterhouse & Norris 1989).

Adults of *E. thrax* are active from sunset until about two hours after dusk (unpubl. obs.) and specimens are frequently attracted to lights. Lights in boats and loading aircraft may attract adults of *E. thrax*, enabling movement between Pacific countries. However, their powerful flight may be sufficient for international dispersal, especially movement from mainland Papua New Guinea to the Bismarck Archipelago, the Torres Strait Island and eventually, mainland Australia and the Solomon Islands. Should *E. thrax* establish in countries elsewhere in the southwestern Pacific without natural enemies, banana plants will be adversely affected as previously seen in Mauritius, Guam and Hawaii.

A collaborative project between Australia CSIRO and the PNG Department of Agriculture & Livestock is assessing the potential for biological control of *E. thrax* in PNG. Since the egg parasitoid, *Ooencyrtus erionotae* is already present, the larval parasitoid *Apanteles erionotae* would appear to be the most promising agent to achieve control.

Following an assessment of the abundance of *E. thrax* and its natural enemies in PNG, a decision was made to conduct further tests on the larval parasitoid, *A. erionotae*. These tests, carried out on a population from Guam, are being carried out in a quarantine facility in Papua New Guinea.

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Biological Control of Some Introduced Pests in the Federated States of Micronesia

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Abstract—An active biological control program is being pursued to suppress the populations of introduced pests into the Federated States of Micronesia. Natural enemies of orange spiny whitefly, southern green stink bug, leaf footed bug, Egyptian fluted scale and Siam weed have been introduced. Introduction of natural enemies of giant sensitive weed, spider mites, and coconut termite are being planned.

Introduction

A number of insect pests have been accidentally introduced to the Federated States of Micronesia (FSM) over the past few years. Leaving behind their natural enemies, with ample food and environment favorable for their development and survival, these pests have threatened the production of existing crops and new crops on the island nation. In most cases, indigenous natural enemies have had no impact on them. As a result, a number of them have become serious insect pests and are now the target of bio control programs.

Current Control Programs

Orange spiny whitefly—*Aleurocanthus spiniferus* Quiantance

The orange spiny whitefly has been a major pest of citrus on Yap, Pohnpei, Truk and Kosrae. In 1988, control of the orange spiny whitefly on citrus on Pohnpei was achieved by using the parasite, *Encarsia smithi* (Silvestri) introduced from Guam. On Kosrae, satisfactory control of the whitefly was achieved in the early 80's using the same parasite. Through Agricultural Development in the American Pacific (ADAP) projects on Biocontrol Agent Exchange, the same parasite was released on whitefly infested citrus trees in Chuuk on November 1, 1989 and in Yap State in 1990.

Southern Green Stink Bug—*Nezara viridula* (Linn.)

The stink bug is a perennial pest of many crops on Pohnpei. On November 22, 1989, the College of Micronesia Land Grant Programs received parasitized eggs of *N. virudula* from the Hawaii Department of Agriculture. These eggs were

incubated and adults of the parasite *Trissolcus basalis* (Wollaston), that emerged were released on cucumber plantings infested with the stinkbugs. The collection of stinkbug eggs is being continued to confirm the establishment of the parasite.

Leaf Footed Bug—*Leptoglossus australis* (Fabr.)

Although present on Guam and Belau, the leaf footed bug occurs only on Pohnpei but not in other states of the FSM. Both nymph and adult bug suck the sap from developing fruits, flowers, leaves, and stems of the host plants such as bittermelon, cucumber, watermelon, pumpkin, waxgourd, guava, citrus, beans, tomato, eggplant, and zuccini. As a result of their feeding the flowers fall off, the fruits fail to form, or fruits become deformed at maturity. It is suspected that the parasite, *T. basalis* also attacks eggs of the leaf footed bug.

Egyptian fluted scale—*Icerya aegyptiaca* (Douglas)

This mealybug is a serious pest of breadfruit on Mokilloa atoll. It has been observed to be present on the main island of Pohnpei, Kosrae, Yap and Chuuk but the population has never reached a level where control measures need to be initiated. The predatory coccinellid beetle, *Rodolia pumila* Weise is an effective biocontrol agent of this mealybug. Adults were collected from the main island of Pohnpei and released on breadfruit trees infested with the mealybug in Mokilloa atoll.

Siam Weed—*Chromolaena odorata* (L.) King and Robinson

C. odorata is an important weed of pastures, vacant areas, roadsides and also farm lands. The weed is present in Kosrae, Yap, Pohnpei and Belau. On Pohnpei, the weed is particularly abundant in Kitti and Madolenihmw. An arctiid moth, *Pareuchaetes pseudoinsulata* Rego Barros was received from Guam, mass multiplied and field released. It has been established in the field at Palikir in October, 1990.

Planned Biological Control Projects

Giant Sensitive Plant—*Mimosa invisa* Martius ex Colla.

The giant sensitive plant is a major weed on the island of Yap. It occurs on roadsides, vacant areas, pastures and even cultivated lands. It is an aggressive weed and can take over main crops planted in the area. Since it is thorny, the weed interferes with the farming activities. A request was made to the South Pacific Commission in February 1989 for the psyllid, a natural enemy of *M. invisa.* The Biological Control Officer of South Pacific Commission has agreed to supply the psyllid to Yap State.

Spider mites—*Tetranychus* spp.

Spider mites caused serious damage to cassava, papaya, sweet potato and other crops throughout the FSM in 1989. Affected leaves showed brownish spots and fell off in severe cases of infestation. Some susceptible varieties of cassava

were rendered leafless even during the early stages of plant growth. We plan to introduce the predaceous mites, *Phytocelus persimilus* from California for control of spider mites in the FSM.

Coconut termite

This termite is becoming an important pest in the FSM. It attacks coconuts on Pohnpei, Chuuk and Yap. Specimens of this termite have been sent to Australia for identification. We plan to initiate a biological control program utilizing an entomophagous nematode.