

## Parasites of Phasmida

P. E. BRAGG, 8 Cornwall Avenue, Beeston Rylands, Nottingham NG9 1NL, UK.

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### Introduction

The occurrence of parasites in stick insects has been noted by a number of authors. There are undoubtedly numerous bacteria, viruses and fungi which parasitize the Phasmida, although few of these have been recorded (Bedford, 1976; Casimer, 1956; Thomas & Poinar, 1973). Surprisingly there are also very few records of animals which are parasitic on the Phasmida. The vast majority of those recorded are insects of the orders Diptera and Hymenoptera. This paper reports parasites in several species of phasmids from Borneo; there are no previous records of phasmid parasites from this area.

### Previous Records

Bedford's (1978) review of the phasmids gives the insect parasites of Phasmida as belonging to the families: Tachinidae, Ceratopogonidae, (Diptera); Eupelmidae, Chrysididae and Cleptidae (Hymenoptera). In addition to the insects listed by Bedford, King (1867) noted the occurrence of 'Ichneumon fly larvae' in the adult females of *Anisomorpha buprestoides* (Stoll) and 'a minute species of Ichneumon fly, probably of the Chalcididae' in the ova of this species. Bedford's review also overlooked two papers which mention some of the non-insect parasites of phasmids, those by Henry (1937), and Casimer (1956).

Ticks (Arachnida: Acarina) and Microsporidia (Protozoa: Cnidospora) are listed in Carlberg's (1986) review. Carlberg's reference to ticks is based on a photograph by Workman (1978) which shows mites of the genus *Lepus* on *A. buprestoides*. The only written references to mites are from Australia and the USA. The first occurred in *Timea californica* Scudder, an immature mite on the thorax (Henry, 1937). The second is the occurrence of red mites, *Allidosoma froggatti* (Oudemans), found on *Podacanthus wilkinsoni* Macleay (Casimer, 1956). The third is a brief mention of a 'possibly parasitic mite' on the tarsus of a nymph of *Acrophylla* sp. (Daniels 1987). Some confusion could arise due to the use of the common name 'stick-ticks' which has been used for the dipteran family Ceratopogonidae (eg. Wirth, 1971).

The only parasitic worms recorded are those of the phylum Nematomorpha, which parasitize the nymphs and adults of *Podacanthus wilkinsoni* Macleay (Campbell and Hadlington, 1967), and one example of an adult female *Timea californica* Scudder which was parasitized by a nematode (Henry, 1937).

Harman (1987) states that records of parasites of Phasmida are largely of Neotropical origin. There are however quite a number of records for the Australian region, including an attempt at biological control of phasmids using parasites in Fiji (Paine, 1968). There appear to be no records of parasites of Phasmida for the Oriental region; the closest record is for Ceratopogonidae on Buru Island (Edwards, 1926).

### **New Records**

The following new records are the results of collections of phasmids made over four years in various parts of Borneo. The purpose of these collections was to try to establish the phasmids in culture, so live specimens were brought back to Britain. At the time of capture several specimens were found to have ectoparasites and subsequently several other specimens were found to be suffering from endoparasites.

The first two collections, in 1988 and 1989, were restricted to Sarawak and little notice was taken of ectoparasites, the sole concern being to remove them in order to increase their chances of survival. In 1990 collections were made on Mt. Kinabalu in Sabah and at various locations in Sarawak. In 1991 a collection of phasmids was made as part of the University of Brunei Darussalam/Royal Geographical Society Brunei Rainforest Project at Kuala Belalong in the Temburong district of Brunei; a collection was also made in Sarawak. During the 1990 and 1991 collections more notice was taken of the occurrence of parasites.

### **A) Ectoparasites**

In 1989 ectoparasites were found on specimens of *Haaniella grayi grayi* (Westwood). Although not closely examined, they were apparently reddish-brown coloured mites which were found on the antennae and leg joints of the phasmids. They occurred on at least half of the 15 specimens collected near kampong Bengoh, 30 miles south east of Kuching. Affected specimens were found on two mountains in the area and also in the farmland at the kampong. The mites were found on both males and females, from third instar nymphs up to and including the adult stage. All affected specimens had several mites and one large female had about 20 mites. In 1990 and 1991 a number of infested specimens of *H. g. grayi* were collected on Mt. Serapi, Sarawak. In 1991, of 24 examined, all but one were found to be carrying brownish-red mites, the exception was a first instar nymph. The infested individuals included all sizes of insects from first instar to adult.

At Poring Springs on Mt. Kinabalu in 1990, two out of four specimens of *Haaniella echinata* Redtenbacher were found to have several mites attached to the abdominal pits. A third infested specimen of this species was one of five found near Kapit, Sarawak, also in 1990. Not all of the specimens were closely examined in 1990 and it is likely that more than three of the specimens were infested. In 1991, at Kuala Belalong, Brunei, 21 specimens of this species were examined and all specimens, which included adults and first instar nymphs, were found to be infested.

In 1991 six specimens of *Haaniella saussurei* Kirby were collected in Sarawak, one from Simunjan and five from the outskirts of Kuching; all were found to be carrying brown mites.

Thirteen specimens of *Haaniella dehaani* (Westwood) were collected on Mt. Serapi, Sarawak in 1991 and all were found to be carrying brown mites.

On Mt. Serapi, Sarawak, in 1990, seven female and four males of *Dares ulula* (Westwood) were collected. One female was found with one red coloured mite on the upper surface of the abdomen.

In August 1990 I accompanied Mr C.L. Chan of Kota Kinabalu, Sabah to Mt. Kinabalu Park Headquarters. Four nights were spent collecting phasmids in the area around the Headquarters. During this time about twenty specimens of a wingless form of *Asceles margaritatus* Redtenbacher were found to be infested with small brown mites. I removed and preserved a number of these mites which affected about 50% of this species. The mites occurred on the thorax, abdomen, legs and antennae of the Phasmids. Most infested specimens had several mites and several specimens had more than ten mites on them. The mites affected adults and nymphs of both sexes. The mites on adult males were concentrated around the base of the rudimentary wings.

Two other affected species of the sub-family Necrosiinae were also found near Kinabalu Park H.Q. One male *Asceles dorsalis* Redtenbacher had a single red coloured mite attached to the base of the fore wing, two females of the same species showed no signs of parasitism. A total of 11 *Acacus sarawacus* (Westwood) were collected near the Park H.Q.; one adult female was found to have a red mite on the upper surface of the abdomen.

## B) Endoparasites

One adult female specimen of *Lonchodes jejunos* (Brunner), collected at Damai, Sarawak in December 1987, became listless within a day of arrival in Britain. The following day a mermithid larva was found in the cage. During the next few days the insect became more torpid and more mermithid larvae were found. The insect was found to be dead, having produced six worms over a period of seven days. These worms were all off-white in colour, 1mm diameter and in excess of 25cm long, the largest being 36cm. The insect has a body length of 15cm. The only other phasmid brought back alive from Damai was another adult female *L. jejunos*. This laid 59 eggs during the following three weeks and was then discovered dead with a single 30cm worm in the cage. Several eggs were hatched successfully and gave rise to a sexual culture. None of the second generation were affected by parasites.

A single adult female *Carausius abbreviatus* (Brunner) was captured at Bengoh, Sarawak in July 1989, a few days later it was found almost dead on the bottom of its cage. Lying nearby was a living Mermithid larva approximately 20cm in length and 1mm diameter. The insect and worm have been deposited in the Sarawak Museum, Kuching.

In August 1990 at Mt. Kinabalu Park a female *Carausius sanguineoligatus* (Brunner), one of four collected, was found dead two days after capture; in the cage a single living

mermithid larva was found.

In August 1991, at Kuala Belalong Brunei, one male, of the 21 specimens of *H. echinata* which were collected, died and produced a 54cm long mermithid larva a few days after being caught.

In January 1988 a pair of *Hoploclonia gecko* (Westwood) were collected in at Bako National Park, Sarawak. In early March, twelve weeks after capture the female became listless, and approximately eight worms were found around the ovipositor and anus. These worms were between 1mm and 2mm in length but they were not closely examined. They may have been nematodes or insect larvae but their size and general proportions suggests that they were probably insect larvae. The phasmids were being reared in a room which was unheated, apart from sufficient to keep the temperature from falling below 5°C. The low temperature and the fact that other cultures have never shown signs of similar infestations, suggests that these parasitic worms may have been of Sarawak origin.

## Discussion

The endoparasites of *L. jejunus*, *C. sanguineoligatus*, *C. abbreviatus* and *H. echinata* appeared to be identical. The specimen from *C. sanguineoligatus* has been identified by Dr D.I. Gibson of the NHM, as a mermithid larva (Nematoda: Mermithidae).

The emergence of the largest endoparasites so soon after capture suggests that the stress of travel, change in climate or change of the host's diet, may have caused the parasites to emerge early. If this were not the case I would have expected some further evidence of infestations in specimens which lived much longer. Specimens of *L. jejunus* lived for up to six months after capture and other species lived for up to one year, but all the worms were found within two weeks of capture and usually within a few days. As might have been expected, endoparasites occurred in the older phasmids, these having had longer to encounter a parasite.

The rate of parasitism seems high; 19% of the 200 specimens from Mt. Serapi were found to be affected in 1991. During 1990 more attention was paid to the possibility of ectoparasites and the number of affected species which were noticed implies that some may have been overlooked at Bengoh in 1989 where at least 5% of the 180 specimens were affected. However it should be noted that collections were made at ground level and therefore a disproportional number of Heteropteryginae were found. The Heteropteryginae are generally slow moving, ground dwelling insects and the frequency of parasitism in the more mobile subfamilies appears to be much lower. Many of the fully winged phasmids seem to live mainly in the canopy and are not frequently encountered; although I have collected over one hundred specimens only one has been parasitized, the male *Asceles dorsalis* from Sabah.

In 1991 special attention was paid to specimens of *Haaniella* spp., the results strongly suggest that parasitism by mites is normal for this genus. This genus is essentially ground dwelling and therefore likely to be in frequent contact with mites in the leaf litter.

## Summary

Parasitism of phasmids by mites and nematodes appears to be more widespread than is suggested by existing records. Parasites have been found in twelve species from Borneo which have not previously been recorded as hosts. Members of the genus *Haaniella* are usually infested by parasitic mites.

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