NATURAL ENEMIES OF *AXIAGASTUS CAMBELLI* DISTANT (HEMIPTERA: PENTATOMIDAE) ON THE GAZELLE PENINSULA, NEW BRITAIN

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ABSTRACT

The coconut spathe bug, Axiagastus cambelli *Dist., has been recorded from the Bismarck Archipelago, Bougainville, British Solomon Islands, Aignan (Misima) Island and the New Hebrides. Although it is widely distributed throughout the Bismarck Archipelago and Bougainville, high populations occur only on the Lihir group of islands.*

A parasite survey carried out on the Gazelle Peninsula revealed the presence of five A. cambelli *parasites. These include three egg-parasites*—Anastatus *sp. (Eupelminae),* Trissolcus painei *Ferr. (Scelionidae) and* Acroclisoides *?* megacephalus *Gir. (Pteromalidae); one nymphal parasite,* Aridelus *sp. (Braconidae); and one adult parasite,* Pentatomophaga bicincta *de Meij. (Tachinidae).* Aridelus *sp. and* A. ? megacephalus *are new* A. cambelli *parasite records.*

Whilst P. bicincta *is known to have oviposited on* A. cambelli *adults in the British Solomon Islands Protectorate, it apparently failed to develop in them. However, in Papua New Guinea it has been definitely proved to be an adult parasite.*

Of all the parasites the egg-parasites were by far the most important group of natural enemies of A. cambelli. *Among these,* T. painei *was the most common followed by* Anastatus *sp., while* A. ? megacephalus *became numerous only at irregular intervals.*

On the Lihir group of islands, only the two egg-parasites Anastatus *sp. and* T. painei *were recorded.*

The predacious ant Oecophylla smaragdina *F. appears to deter* A. cambelli *and the encouragement of this ant would undoubtedly be of great help in protecting palms from the ravages of* A. cambelli.

INTRODUCTION

Axiagastus cambelli Dist., the coconut spathe bug, has been recorded from Bismarck Archipelago, Bougainville, British Solomon Islands, Aignan (Misima) Island and the New Hebrides. (Lepesme 1947). Whilst the coconut palm (*Cocos nucifera*) is its principal host plant *A. cambelli* has also been recorded from betel-nut palm (*Areca sp.*) (Lever 1933b).

Whilst *A. cambelli* is distributed throughout the Bismarck Archipelago and Bougainville heavy populations only occur on the Lihir group of islands. The low populations observed on the Gazelle Peninsula, East New Britain, and elsewhere suggested that some natural control agents might be responsible for the low populations in these areas. In view of this, and because of the lack of knowledge as to what species of *A. cambelli* parasites occur in Papua New Guinea, investigations on the natural enemies of *A. cambelli* were commenced in 1969. Most of this work was carried out on the Gazelle Peninsula in 1969-1970.

Brief notes on the biology of *A. cambelli* have been given by Tothill (1929) and Lever (1933b). According to Tothill coconut leaflets are the preferred oviposition sites but Lever reported that the fibrous stipule was the preferred site, although eggs were also found on needle-like leaves of *Casuarina* sp. However on the Gazelle Peninsula, eggs have been found, usually in rows of 14, on coconut leaves, the undersides of spadix stipules, the fibrous material on frond edges and around the trunks, on spiderwebs between fronds and even on

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plants growing under the coconuts. Under laboratory conditions at Keravat the eggs hatched in six to eight days as against seven days as recorded by Lever (1933b).

The five nymphal instars occupy approximately 45 days (Lever 1933b).

Under laboratory conditions at Keravat field-collected adults lived for 14 to 21 days when fed on either coconut inflorescence or ripe fruits of a cluster palm (? *Ptychosperma* sp.). The pre-oviposition period is not known. However, no mating or oviposition was observed in freshly moulted adults which lived for about a fortnight in captivity.

Most of the previous investigations on the parasites and predators of *A. cambelli* have been carried out in the British Solomon Islands Protectorate. Tothill (1929) recorded 60 per cent parasitism of *A. cambelli* eggs by a chalcidoid and another unidentified hymenopterous parasite. These were later identified as a eupelmine, *Anastatus* sp., and a scelionid, *Microphanurus* sp., respectively, and although apparently distributed throughout the Islands, appeared to be of local importance only (Lever 1933a). Ferriere (1933) later described the two parasites as *A. axiagasti* Ferr. and *M. painei* Ferr.

Lever (1933c, 1934) studied the ovipositional behaviour and morphology of *M. painei* and *A. axiagasti* adults. In the field *M. painei* was nine times as numerous as *A. axiagasti* and the two were responsible for the destruction of about 64 per cent of the host eggs on one island.

No natural enemies have actually been introduced into the British Solomon Islands Protectorate for the control of *A. cambelli*. However, parasites introduced against more injurious pentatomids and coreids also took to *A. cambelli*. Thus *Trissolcus* (*Microphanurus*) *basalis* Wool., a scelionid egg-parasite of pentatomids, introduced from Sydney in 1941 for the control of the coreid *Amblypelta cocophaga* China, preferred *A. cambelli* eggs (Lever 1941) and soon established as a parasite of *A. cambelli* (Johns 1941).

Five egg-parasites of the Javanese coreids *Homoeocerus lucidus* Walk. and *Dasynus manihotis* Blote were introduced into the British Solomon Islands for the control of *A. cocophaga* (Phillips 1941). Two of these, *Ooencyrtus malayensis* Ferr. (Encyrtidae) and *Anastatus* sp. (Eupelminae), were also found to parasitize the eggs of *A. cambelli*.

The Australian (Queensland) tachinid, *Pentatomophaga bicincta* de Meij, introduced into the British Solomons in 1938-1939 to control *A. cocophaga*, apparently preferred to oviposit on *A. cambelli*. Whilst the eggs hatched, the larvae failed to develop in *A. cambelli* (Phillips 1956). Another tachinid, *Trichopoda pennipes* F., introduced from Florida in 1949 to control *A. cocophaga* and *Nezara viridula* L. in Fiji and the British Solomon Islands Protectorate, was also found to oviposit on *A. cambelli* (O'Connor 1950).

The ants *Anoplolepis longipes* Jerd. and *Oecophylla smaragdina* F. were recorded by Lever (1933b) as efficient predators of *A. cambelli*. However he has also stated that the ants *Iridomyrmex myrmecodiae* Emery and *Pheidole oceanica* Mayr. were antagonistic to these two beneficial species. In the Western Solomons there was almost complete absence of *A. cambelli* on coconut palms where *O. smaragdina* occurred and where *I. myrmecodiae* was absent (Lever 1933c).

GAZELLE PENINSULA OBSERVATIONS

Collections of *A. cambelli* adults, nymphs and egg-clusters were made at various times from localities throughout the Gazelle Peninsula. Field-collected nymphs and adults were placed in breeding cages and provided with either coconut inflorescence or ripe fruits of a cluster palm (? *Ptychosperma* sp.) as food. Moist soil or sawdust was placed at the bottom of the cages for parasite pupation. Egg-clusters were kept in 4 x 1 inch glass specimen tubes. *Ixora* sp. leaves were put into the tubes to provide moisture.

Parasites bred from the different stages of *A. cambelli* are listed below:—

Eggs

1. *Trissolcus painei* Ferriere (Scelionidae).
2. *Acroclisoides* ? *megacephalus* Girault (Pteromalidae).
3. *Anastatus* sp. (Eupelminae).

Nymphs

Aridelus sp. (Braconidae)

Adults

Pentatomophaga bicincta de Meij. (Tachinidae).

Whilst a parasitized egg-cluster of *A. cambelli* will usually yield one species of an egg-parasite it is not uncommon to find two species of any of the three parasites emerging from the one egg-cluster.

Notes on the bionomics, behaviour and possible importance of the various parasites are given below.

***Trissolcus painei* Ferr.**

This is the most numerous and widely distributed egg-parasite of *A. cambelli* and is easily bred in the laboratory.

Under laboratory conditions a female can oviposit in more than 10 host eggs, each oviposition taking from three to five minutes. Although many instances of multi-oviposition were observed in the laboratory, only one individual of *T. painei* hatched from each egg following multi-oviposition.

Successful parasitism and development by *T. painei* was observed in host eggs one to seven days old at the time of oviposition. However, whilst the parasite larvae consumed the entire contents of the eggs when oviposition occurred in one to four day-old eggs only three-quarters of the contents were enough for complete development of larvae in eggs five or more days old.

A. cambelli eggs parasitized by *T. painei* developed a dark meridional band some four to five days (average 4.2 days) after being parasitized and this was constant in all eggs parasitized between one and seven days. The remainder of the parasitized egg remained white until a day or so before the emergence of the adult parasite, whereupon it turned black. The dark meridional band persisted on the egg shell even after the parasite had emerged.

The parasites emerge from the host eggs through an irregular hole in the operculum, usually between 7 and 11 a.m.

The development period of *T. painei* in 427 host eggs ranged from 12 to 15 days (average 13.5) with approximately 91 per cent of the parasites developing successfully.

The longevity of *T. painei* adults in captivity varied from one to five days depending on whether they were fed and whether they oviposited or not. When fed on honey solution and allowed to oviposit, they lived for one to two days; when given no food and not allowed to oviposit, two to four days; and when given food but no host eggs to oviposit in, they lived for three to five days.

It is thought that the abundance of *T. painei* over other egg-parasites of *A. cambelli* may result from its persistent ovipositional behaviour, as it continues to oviposit even when being walked over or pushed by other competing individuals.

The ovipositional behaviour of *T. painei* has also been discussed by Lever (1933c).

T. painei has also been bred from eggs collected from the Lihir group of islands.

***Anastatus* sp.**

Since adults of *Anastatus* sp. are easily disturbed by the approach of other individuals when ovipositing, it was not possible to make detailed studies of the behaviour of this species. However Lever (1933c) has given a good account of the ovipositional behaviour of a related species *A. axiagasti*.

Anastatus sp. does not seek out the host eggs as avidly as *T. painei*, and mating does not occur readily. *A. cambelli* eggs parasitized by *Anastatus* sp. do not develop the meridional band, but gradually assume a brownish colour. The adult parasite emerges through the operculum of the host egg through a more or less circular hole. The total development period within the host eggs is about 16 days.

An *Anastatus* sp. has also been bred from *A. cambelli* eggs collected from the Lihir group of islands but it is not known if this is the same species which occurs on the Gazelle Peninsula.

The species of *Anastatus* recorded from *A. cambelli* eggs in the British Solomon Islands Protectorate is *A. axiagasti*. *A. axiagasti* is also known to attack the eggs of *Amblypelta cocophaga* in that area (Phillips 1956).

***Acroclisoides* ? *megacephalus* Gir.**

This is the first record of *A.* ? *megacephalus* from *A. cambelli* eggs. *A.* ? *megacephalus* is comparatively less common than either of the other two egg-parasites present on the Gazelle Peninsula. Although it occurred at all the sites, it was only bred in any numbers from the Napapars. Most of the individuals bred from field-collected parasitised host eggs were males.

A. cambelli eggs parasitized by *A. ? megacephalus* also develop a meridional band. However, the band is much darker than that developed by *T. painei* parasitized eggs, but unless *A. ? megacephalus* parasitized eggs are compared with those parasitized by *T. painei*, they are very difficult to separate using this factor.

This species has not been recorded from the Lihir group of islands.

***Pentatomophaga bicincta* de Meij**

P. bicincta has been bred from *A. cambelli* adults collected from all localities under investigation on the Gazelle Peninsula, but in very small numbers. By far the greater number have been bred from adults collected from Tavilo Plantation. It is an internal parasite of *A. cambelli* adults. To pupate, the fully grown larvae emerge from the parasitized host through the anal part of the abdomen. The pupal period in a few individuals observed varied from 17 to 19 days.

P. bicincta does not appear to be of great significance as an *A. cambelli* biocontrol agent.

It has not been recorded from the Lihir group of islands.

***Aridelus* sp.**

This unidentified braconid would appear to be the first record of a nymphal parasite of *A. cambelli*. It first showed up when a sluggish-looking nymph which had been isolated from the bulk rearing cage was found dead on the following day with the dorso-posterior portion of its abdomen ruptured. The white pupal cocoon of the parasite was found attached to the side of the tube containing the host nymph.

The braconid has so far only been recovered from nymphs collected from the Napapars, but its parasitism rate has always been low.

It has not been recorded from the Lihir group of islands.

Predators—Ants

Among the species of ants predaceous on various stages of *A. cambelli*, kurukum ants (*Oecophylla smaragdina* F.) when nesting or foraging on coconut palms, appear to give very good protection from *A. cambelli*. The encouragement of *O. smaragdina* to establish on coconuts would undoubtedly be of great help in protecting palms from the ravages of *A. cambelli*.

CONCLUSIONS

A survey of the natural enemies of *A. cambelli* occurring on the Gazelle Peninsula revealed the presence of three egg-parasites, one nymphal parasite and one adult parasite. Among the egg-parasites, *T. painei* was the most common and important, followed by *Anastatus* sp. Appreciable numbers of *A. ? megacephalus* appeared only at irregular intervals. The populations of both the braconid *Aridelus* sp. and the tachinid *P. bicincta* always remained low. The recording of *A. ? megacephalus* and *Aridelus* sp. from *A. cambelli* are new parasite records. The first recorded breeding of the tachinid from *A. cambelli* was obtained during this survey.

Whilst the very low populations of *Aridelus* sp. and *P. bicincta* on the Gazelle suggest that these may not be of appreciable importance as biocontrol agents on their own, it is possible that their effect on the control of *A. cambelli* may be important when the effect of all the parasites is summed.

From the Lihir group of islands, the only parasites recorded were the egg-parasites *Anastatus* sp. and *T. painei*.

In view of the abundance of *A. cambelli* parasites in the Gazelle Peninsula, it seems that this insect is possibly indigenous to Papua New Guinea.

It is well known that insects which become established in new areas often reach harmful proportions when their natural parasites and predators are not present. Introduction of parasites or predators of these insects can be of benefit in controlling outbreaks. Parasites and predators of insects indigenous to Papua New Guinea may also be of value in controlling related insects in other countries. Thus a general survey of natural enemies of Papua New Guinea insects may be worthwhile and might prove of benefit to other countries.

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