

DESCRIPTION AND DEVELOPMENT OF THE EGGS OF TWO STICK INSECTS (PHASMATODEA: PHASMATIDAE) FROM NEW BRITAIN

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Abstract

The eggs of the New Guinea phasmatids *Eurycantha calcarata* Lucas and *Anchiale maculata* Olivier are described, and their incubation periods studied at room temperature with a diurnal range of 21 to 35 °C. *E. calcarata* eggs hatched after an average of 101 days incubation, and *A. maculata* eggs after an average of 114 days. Fifty per cent of the *E. calcarata* eggs, and 77% of the *A. maculata* eggs, hatched. The fungus *Aspergillus flavus* infested 0 to 19% of the *E. calcarata* eggs in different batches, and 15% of the *A. maculata* eggs.

Introduction

As comparatively little information is available on the biology of tropical Phasmatodea, an opportunity was taken to observe the duration of development of the eggs of two phasmatid species found in New Britain, *Eurycantha calcarata* Lucas of the subfamily Eurycanthinae, and *Anchiale maculata* Olivier of the Phasmatinae.

Materials and methods

Adult males and females were kept in cages, with leafy branches of food-plant provided in jars of water: Japanese cherry (*Muntingia calabura* L.) for *A. maculata* (though this species sometimes also feeds on cacao (*Theobroma cacao* L.) leaves), and croton (*Codiaeum variegatum* (L.) Blume var. *pictum*) for *E. calcarata* (though this species could also be fed Japanese cherry). Eggs were collected daily from the floor of the cages, and each day's collection was placed on the surface of sterilised sand in a small, circular, plastic pillbox 5 cm in diameter and 2.5 cm high, with lid. The eggs were lightly moistened with water once a week, using an atomizer, and checked daily for hatching. Throughout their development, the eggs were kept in an insectary in which the diurnal temperature ranged from 21 to 35 °C.

Measurements of the eggs were made using a micrometer eyepiece in a stereomicroscope. The terminology of egg structures and method of measurement are those used by Clark (1976).

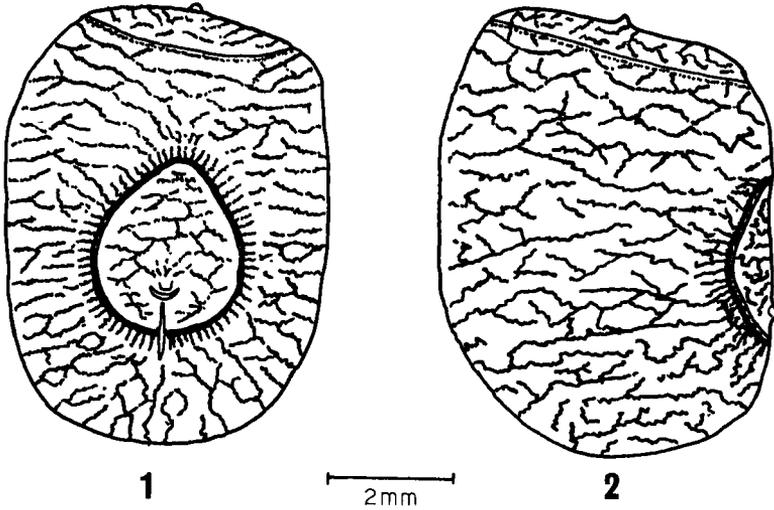
Results

Description of eggs

Eurycantha calcarata (Figs. 1, 2)

Similar to those of *E. horrida* Boisduval as described by Sharp (1898). Operculum a flat circular plate capping anterior end of egg; surface rugose, with tiny central point; mottled light and deeper brown. Opercular angle ca +10° (operculum tilted downwards towards dorsal, i.e. micropylar, side). Capsule roughly spherical. Capsule surface rugose, covered with numerous interconnecting low ridges. Micropylar plate ovate, light brown, lightly rugose, and demarcated from rest of capsule by slightly raised dark margin. Median line a ridge running posteriorly from micropylar cup to terminate just beyond edge of plate. Capsule light brown, with deeper brown mottling.

Dimensions (based on 22 specimens): capsule length 6.4-7.5 (mean 7.0) mm; capsule width 3.5-4.1 (mean 3.8) mm; capsule height 3.6-4.2 (mean 3.9) mm; micropylar plate length 2.3-3.0 (mean 2.6) mm; micropylar plate width 1.7-2.3 (mean 2.0) mm; ratio height:length 53-62 (mean 56)%; width:length 52-58 (mean 54)%; width/height 92-100 (mean 96)%.

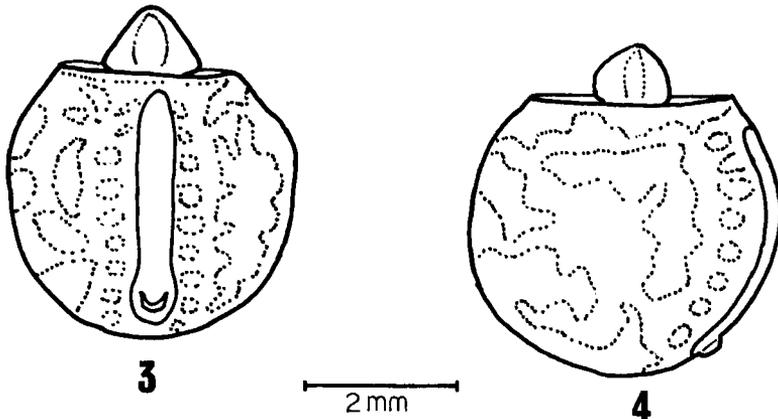


FIGS. 1, 2. Egg of *Eurycantha calcarata*: (1) view of micropylar side; (2) lateral view.

Anchiale maculata (Figs. 3, 4)

Similar to those of *A. stollii* Sharp as described by Sharp (1898); the names may be synonymous. Operculum flat, ovate, dark brown; surmounted by central yellow capitulum which bears three to four symmetrical indentations. Opercular angle *ca* -5 to 10° (operculum tilted downwards towards ventral surface). Capsule somewhat flattened laterally. Capsule surface shiny, polished, dark brown to black, with some uneven rounded areas light grey. Micropylar plate an elongated raised band with smooth shiny surface, extending almost full length of dorsal surface and widening at posterior end. Micropylar cup close to posterior pole; no well defined median line. As egg ages, its surface loses its shine and becomes duller, while capitulum shrinks and may lose its indentations.

Dimensions (based on 18 specimens): capsule length 3.3-3.9 (mean 3.7) mm; capsule width 2.4-2.7 (mean 2.7) mm; capsule height 3.1-3.4 (mean 3.4) mm; micropylar plate width (maximum) 0.8-0.9 (mean 0.8) mm; micropylar plate width (at middle) 0.4-0.7 (mean 0.5) mm; ratio height/length 86-100 (mean 91)%; width/length 68-80 (mean 71)%; width/height 73-83 (mean 78)%.



FIGS. 3, 4.—Egg of *Anchiale maculata*: (1) view of micropylar side; (2) lateral view.

Duration of development

For 255 *E. calcarata* eggs, the mean incubation period was 101 ± 3 days (95% c.l.), with a range of 77 to 185 days. The pattern of hatching (Fig. 5) shows a definite peak at about 90 days, and a long tail extending beyond 180 days.

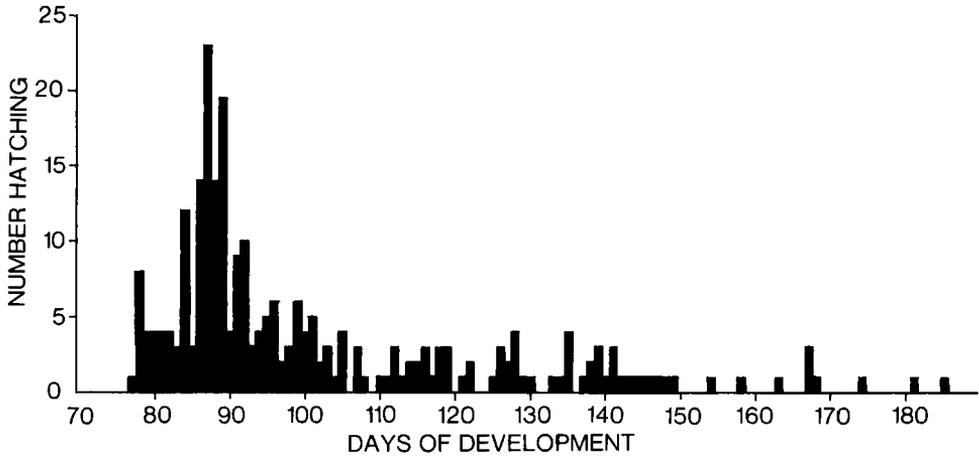


FIG. 5.—Pattern of hatching of *E. calcarata* eggs.

The mean duration of development of 1,707 *A. maculata* eggs was 114 ± 1 days (95% c.l.), with a range of 86 to 218 days. The pattern of hatching (Fig. 6), in comparison with that of *E. calcarata*, shows a more pronounced peak at about 110 days, with proportionately fewer eggs hatching after an extended period of time.

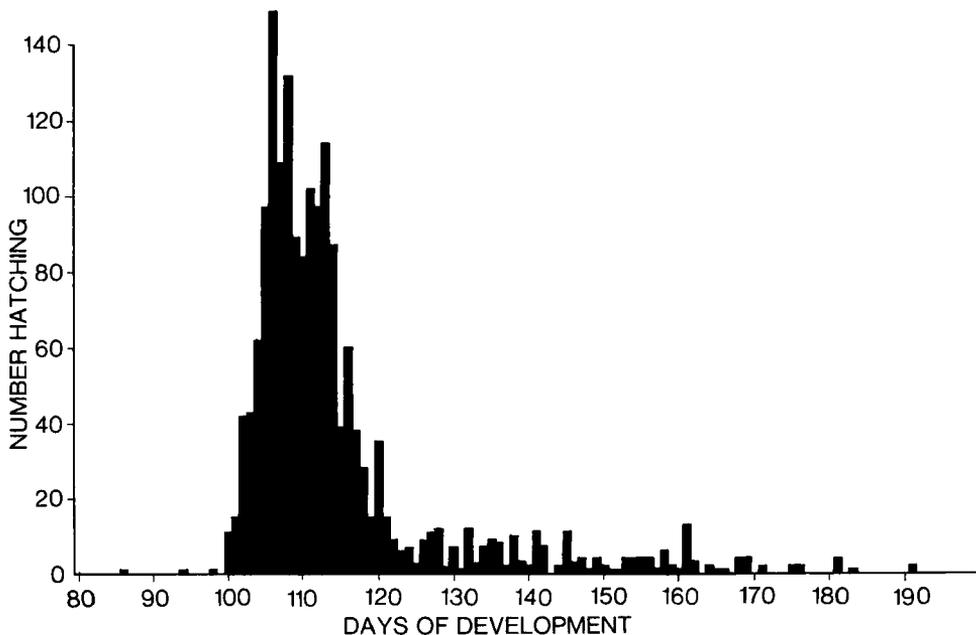


FIG. 6.—Pattern of hatching of *A. maculata* eggs.

Percentage hatch and occurrence of diseased eggs

Fifty per cent of the *E. calcarata* eggs hatched, as did 77% of the *A. maculata* eggs. Eggs which had not hatched after about a year were dissected, with results shown in Table 1. In some eggs, the yolk had a healthy yellow appearance, and, in other cases, it could be classified as soft, dark coloured and rotten, or an orange, rubbery jelly (particularly in *E. calcarata*), or hard and desiccated. Some eggs contained green or brown embryos still moist, but, in other eggs, the embryos were dead and dried. A number of eggs was found to be filled with a compact brown mass of fungal hyphae, with white fruiting bodies on the outside of the shell. The primary pathogen in *A. maculata* eggs was diagnosed as *Aspergillus flavus* Link by the Laboratory for the

Diagnosis of Insect Diseases, University of California, Berkeley (Thomas and Poinar 1973), with possible secondary invasion by other fungi. (When the egg sample was submitted, Thomas and Poinar were mistakenly informed that the species of *Anchiale* Stål was *majalis*.*)

TABLE 1
RESULTS OF EXAMINATION OF *EURYCANTHA CALCARATA* AND *ANCHIALE MACULATA*
EGGS

	PERCENTAGE OF EGGS			<i>Anchiale</i> Laid Jan. - May 1969
	Lot 1 laid May-Aug. 1968	<i>Eurycantha</i> Lot 2 laid Feb.-June 1969	Lot 3 laid Nov. 69- March 70	
Hatched	59.2	50.4	41.0	77.3
Dead dry embryos	5.8	14.2	5.5	4.2
Moist embryos	2.5	1.4	6.9	0.2
Hard desiccated yolk	10.5	14.2	7.1	0.2
Soft rotten yolk	0	0	0	0.6
Jelly yolk	3.3	19.9	23.3	2.0
Yellow yolk	0	0	9.0	0.4
Fungus	18.8	0	7.1	15.1
Total eggs	277	141	434	2,319

Discussion

The incubation period (101 days for *E. calcarata* and 114 days for *A. maculata*) is of an order similar to that of other tropical Phasmatodea (Table 2). At Keravat (latitude approximately 4°S), the tropical climate shows little change in either the diurnal temperature range throughout the year (mean minimum daily temperature for 1974 21.5°C, and mean maximum 31.3°C), or in the rainfall (average monthly rainfall ranges from 183 to 280 mm, but November to April are the wettest months), while the host-plants bear foliage continuously. Under these conditions, there is no evidence for the occurrence of obligatory diapause in the eggs. This is in contrast to species such as *Didymuria violescens* Leach, which occurs on eucalypts in the temperate climate of southern New South Wales and Victoria. Here the eggs enter one or two obligatory diapauses, enabling them to overwinter once or twice before hatching, the diapauses being eliminated by exposure to cold winter temperatures (Readshaw and Bedford 1971).

On some occasions, numbers of late-instar nymphs and adults of *A. maculata* occurred on certain *Muntingia calabura* trees at Keravat, while they were not seen at other times. These occurrences could be caused by the bulk of the eggs tending to hatch over a narrow time-span. Synchronization of development among the members of a phasmatid population (of either a temperate or tropical species) is advantageous for mating, and the time so provided while the next generation is in the egg stage may permit the production of new foliage by the host-plant.

The fungus *Aspergillus flavus* caused a mycosis in 0 to 19% of different batches of *E. calcarata* eggs, and 15% of the *A. maculata* eggs. Thomas and Poinar (1973) also reported a mycosis caused by *Paecilomyces farinosus* Brown and Smith in eggs of the Australian phasmatid *Didymuria violescens*.

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* *Lapsus* for *maculata*.

TABLE 2
EGG DEVELOPMENT TIMES FOR TROPICAL PHASMATODEA

Species	Duration of development (days)	Temperature at which eggs kept (°C)	Author
<i>Carausius morosus</i> Brunner	104 days at 100% RH 120 days at 7% RH	15-21	Leclercq (1946)
<i>Phyllium crurifolium</i> Serville	120-210	21	Leigh (1909)
<i>Graeffea crouani</i> Le Guillou	90-100	Room temperature (Fiji)	Swaine (1969)
<i>Orxines macklotti</i> de Haan	Fertilised 126 Unfertilised 168	?	Kuyten (1962)
<i>Eurycnema goliath</i> Gray	182 (range 128-485)	28	Bedford (1968)
<i>Eurycnema herculeana</i> Charpentier	195-212 (most hatched 205)	Room temperature (Singapore)	Hanitsch (1902)
<i>Clitumnus extradentatus</i> Brunner	Fertilised 44 Unfertilised 56	27	Bergerard (1958)
<i>Necrosia sparaxes</i> Westwood	3 types of eggs: Type A 33- 58 Type B 263-316 Type C 116-165	Room temperature (India)	Gangrade (1963)

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