Eggs, final-instar caterpillars and metamorphosis of *Cyclosia macularia* Guérin Méneville (Lepidoptera: Zygaenidae) from its larval host plant *Baccaurea motleyana*

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Information on the immature stages of Zygaenidae moths is rather limited compared to that on the adults. An encounter with the caterpillars on the *Baccaurea motleyana* tree enabled a description of the eggs, final-instar caterpillar and characteristic cocoon of the Chalcosiine Day-flying Moth, *Cyclosia macularia* Guérin-Méneville, accompanied by illustrations. Sexual dimorphism of this species based on the adults is also described.

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Introduction

The Day-flying Moth, *Cyclosia macularia*, has been found in Sundaland and Sulawesi. Four subspecies, namely *macularia* Guérin, 1843; *metachloros* Walker, 1854; *purpurea* Jordan, 1907 and *violetta* van Eecke, 1919, have been reported in Sundaland, while one subspecies, *transita* Hering, 1922, has been found to occur in Sulawesi (Endo and Kishida 1999; as cited in Holloway 2011). This species is mainly found in the lowlands (Holloway 2011), with *Areca* and *Baccaurea* listed as its host plants (Robinson et al. 2011). Sexual dimorphism of this moth was described by Holloway with illustrations [2011, pl. 3, figs. 20 (male), 21 (female) and 22 (female)]. A note on its larvae described by Piepers and Snellen (1902) was reflected in the work of Holloway (2011), although illustrations were not provided. This description was relatively brief, somewhat lacking in details of larval morphology.

Descriptions

Pokok Rambai, *Baccaurea motleyana* (Phyllanthaceae), a species of fruit tree planted around the rural residential area at Ijok, Selangor, Malaysia, was found defoliated by brightly coloured caterpillars, causing heavy defoliation of the lower part of the trees. Ten caterpillars were collected and reared in the laboratory. The caterpillars were reared,

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Figure 1. (A) Final instar larva of *Cyclosia macularia* on *Baccaurea motleyana* leaf found in orchard (scale bar = 10 mm); (B) final instar larvae of *C. macularia* on *B. motleyana* leaf (scale bar = 10 mm); (C) turned black before it underwent pupation (scale bar = 10 mm).

observed and described according to the work done on *Cyclosia sordidus* Walker (Leong 2012). These caterpillars, with a body length of 2.8–3.0 cm, were recognised to be in the final stages of their larval form, as one caterpillar was showing pre-pupal signs, such as cessation of feeding and changing its body colour, a day after they were collected.

The caterpillars have a grey-coloured cylindrical body with sharply contrasting coloured tubercles that are bright red and yellow (Figure 1). There are six tubercles, evenly spaced, per segment. These tubercles are mostly bright yellow in colour, except those at A1, A2 and A3, with two red tubercles per segment along the dorsum. The head capsule of the caterpillars is black in colour with two dark grey tentacles protruding at the side while they feed. Most of the caterpillars had their tubercles encircled with a black-coloured ring at the base 1 day after captivity. This phenomenon might be the early stage of the pre-pupal signs. At this stage, the caterpillars still fed voraciously on the leaves. Caterpillars ceased feeding when their background body colour changed completely from grey to black (Figure 1C).

Figure 2. (A) Pinkish-brown coloured cocoon was aligned at the basal midrib of the leaf (scale bar = 50 mm); (B) the cocoon was detached from the leaf (scale bar = 10 mm).

Figure 3. The oblect pupa is golden-brown in colour, with body length ranging from 2.3 to 2.7 cm. Male pupa (♂; right) and female pupa (♀; left) (scale bar = 10 mm).

Upon pupation, the caterpillars constructed an elliptical cocoon ranging from 2.7 to 3.0 cm in length ($n = 10$) on the adaxial surface of a leaf 1 day after the caterpillars turned black. This pinkish-brown cocoon was aligned at the basal midrib of the leaf (Figure 2A). The cocoon was detached from the leaf (Figure 2B) and opened in order to examine the pupa enclosed in the cocoon. The pupae were golden-brown in colour, with body lengths ranging from 2.3 to 2.7 cm ($n = 10$). The pupae were categorised according to their sex by examining the features at the posterior end of the body segment (Figure 3). The pupae took around 7–9 days to emerge as adults.

The eclosed adults were then identified as *C. macularia* with the help of Dr. Tzi Ming Leong from the National University of Singapore, and Dr. Chey Vun Khen from the Forest Research Centre, Sabah. The female moth is overall black, with light hints of metallic blue. A broad powdery white band is found at the postdiscal area of its fore wings, variously interrupted by the wing venation, and white spots are found

Figure 4. (A) Dorsal perspective of female *Cyclosia macularia* (♀; scale bar = 5 mm); (B) female *C. macularia* found on tree bark (♀; scale bar = 10 mm); (C) ventral perspective of female *C. macularia* fore wing (♀; scale bar = 5 mm).

along the submargin (Figure 4). There are two forms (subspecies) of females, which can be differentiated by examining the hind wings. Most of the females obtained had white hind wings, black banded with white spots at the submarginal area. From the ventral perspective, the patterns of the wings are almost the same as in the dorsal view. The body of the female is metallic blue from the dorsal view and has white stripes on the ventral part. Its body length is 2.5 cm; the fore wing length is 7.0 cm

Figure 5. (A) Bipectinate antenna of female *Cyclosia macularia* (♀; scale bar = 1 mm); (B) ovipositor of female *C. macularia* (♀; scale bar = 1 mm).

Figure 6. (A) Dorsal perspective of male *Cyclosia macularia* (♂; scale bar = 5 mm); (B) ventral perspective of male *C. macularia* (♂; scale bar = 5 mm).

($n = 6$). Its antennae are metallic blue and bipectinate (Figure 5A). A very distinct tubular ovipositor can be easily seen at the end of its abdomen (Figure 5B).

There is significant sexual dimorphism in *C. macularia*, with males being noticeably smaller and with different wing colour from the females. Males have black forewings with light hints of metallic red. The hind wing is metallic blue with a black band along the costa, distal margin and tornus (Figure 6A). The patterns of the wings from the ventral perspective are different from those of the dorsal. The forewings are black in colour with two to three long white bands at the postdiscal area, while the black-coloured hind wings have more white stripes extending from the basal to the tornus and subapical area (Figure 6B). The body of the male is also metallic blue in dorsal view and a golden brown colour from the ventral view. Its body length is 2.0 cm; the fore wing length is 5.0 cm ($n = 2$). Its antennae are also metallic blue and bipectinate.

Most of the males that emerged were deformed; two died 1 day after emerging as adults and the other two were not active; thus, copulation did not occur throughout

Figure 7. (A) Eggs that were laid in mass (scale bar = 1.5 mm); (B) eggs that were laid scattered singly (scale bar = 1.5 mm).

the periods when the adults were mixed and reared in the cage. The reason for the deformity of the males is not known as the females were handled in the same way. However, pale-yellowish eggs, oblong in shape and with size ranging from 1.40 to 1.85 mm (length) and 0.78 to 0.84 mm (width; $n = 20$), were found deposited on the wall of the cage although females were presumed unfertilised. The eggs were either laid in mass (Figure 7A) or scattered around singly (Figure 7B). The pre-oviposition period for the virgin females is about 2 days.

Cyclosia macularia occur only occasionally on the *B. motleyana* at that specific area, and no record can be traced to predict their further occurrence. The morphology of larval stages can be informative, especially in clarifying phylogenetic relationships in the Zygaenoidea (Fänger and Naumann 2001), yet for the caterpillars of *Cyclosia*, there are relatively fewer records on their larval stages. In this case, the overall morphology of *C. macularia* is very similar to that of *C. papilionaris*, and these two species can be easily mixed up by only looking at their larval stages where both have a grey background body colour with striking yellow and red tubercles.

Figure 8. Final instar larva of *Cyclosia macularia*: (A) lateral perspective (scale bar = 10 mm); (B) ventral perspective (scale bar = 10 mm). AP – abdominal prolegs, AnP – anal prolegs, AS – anal shield, H – head, LB – labrum, MD – mandible, T – tentacle, TL – thoracic legs, PS – prothoracic shield.

Figure 9. Final instar larvae of *Cyclosia macularia*: (A) frontal view (scale bar = 1 mm); (B) stemmata region (scale bar = 1 mm). A – antenna, CL – clypeus, LB – labrum, MD – mandibles, S – spinneret, ST – stemmata, T – tentacles.

Figure 10. Final instar larvae of *Cyclosia macularia*: (A) thoracic leg (scale bar = 1 mm); (B) A3 proleg (scale bar = 1 mm). C – distal claw, CX – coxa, F – femur, TA – tarsus, TI – tibia, TR – trochanter.

Further illustration of the external morphology of the *C. macularia* larval stage was conducted with close-up pictures taken with a digital camera (Nikon Digital Sight DSFi1) attached to the stereomicroscope (Leica® MZ6), and software NIS-Elements BR 3.0. These included the ventral and lateral view of the caterpillar (Figure 8); ventral view of the head (Figure 9A); and close-ups of the stemmata (Figure 9B), thoracic leg (Figure 10A) and proleg (Figure 10B). Hopefully, more records on the larval stage of these stunning, delicate Day-flying Moths will be published to enable comparisons of larval morphology, and for early identification.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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References

- Endo T, Kishida Y. 1999. Day-flying Moths: Chalcosiinae & Epicopeia. In: Endless collection series, Vol. 8. Tokyo: Endless Science Information; pp. 119.
- Fänger H, Naumann CM. 2001. The morphology of the last instar larva of *Aglaope infausta* (Lepidoptera: zygaenidae: chalcosiinae). Eur J Entomol. 98:201–218.
- Holloway JD. 2011. The Moths of Borneo (Part 2): families Phaudidae, Himantopteridae and Zygaenidae; Revised and Annotated Checklist. Malay Nat J. 63:1–548.
- Leong TM. 2012. Final Instar Caterpillars and Metamorphosis of *Cyclosia sordidus* (Walker) in Singapore (Lepidoptera: zygaenidae: chalcosiinae). Nat Singapore. 5:151–158.
- Piepers MM, Snellen MC. 1902. Énumération des Lépidoptères Hétérocères de Java. III. Famille VI. Zygaenidae, m. (Zygaenoidea H. S.). Tijdschrift voor Entomologie. 45:151–242, pls. 13–15.
- Robinson GS, Ackery PR, Kitching IJ, Beccaloni GW, Hernández LM. 2011. HOSTS—A Database of the World's Lepidopteran Hostplants [Internet]. London: Natural History Museum; [cited 2014 May 15]. Available from: <http://www.nhm.ac.uk/research-curation/research/projects/hostplants/>