

FINAL INSTAR LARVA AND METAMORPHOSIS OF *BISTON PUSTULATA* IN SINGAPORE (LEPIDOPTERA: GEOMETRIDAE: ENNOMINAE)

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INTRODUCTION

The geometrid moths, *Biston pustulata* (Warren, 1896) and *Biston insularis* (Warren, 1894) were previously placed in the genus *Buzura* Walker, and both species share a typical Sundaic distribution, having been recorded from Sumatra, Peninsular Malaysia, Java, and Borneo (Barlow, 1982; Holloway, 1993). In Singapore, both species have also been recorded, represented by museum voucher specimens. Here, the final instar caterpillar of *Biston pustulata* is described and its subsequent metamorphosis documented.



Fig. 1. Dorsolateral (a), lateral (b), and ventral (c) views of the final instar larva of *Biston pustulata*, encountered at Nee Soon Swamp Forest on the night of 29 Aug.2009 (ca. 2100 hours). It was dangling by a silken thread and then proceeded to climb upwards, using its thoracic legs to catch onto the silk, alternating between left and right motions.

OBSERVATIONS

On the night of 29 Aug.2009 (ca. 2100 hours), a final instar geometrid larva was encountered near forest edge at Nee Soon Swamp Forest. It was initially dangling at knee-level, from a stem of a shrub by a silken thread (Fig. 1). The larva soon began to climb upwards systematically with the use of its thoracic legs to alternate the grip (left and right) onto the silken thread. Upon reaching the horizontal stem, the larva then positioned itself to begin feeding on the nearest leaf (Fig. 2). This plant was subsequently identified to be mempata (*Cratoxylum cochinchinense*; family Guttiferae) (A. T. Gwee, pers. comm.).



Fig. 2. Final instar larva (as in Fig. 1) feeding on the leaf of *Cratoxylum cochinchinense* (Guttiferae). Note granular texture over its entire body. The total length of this larva was 50 mm.

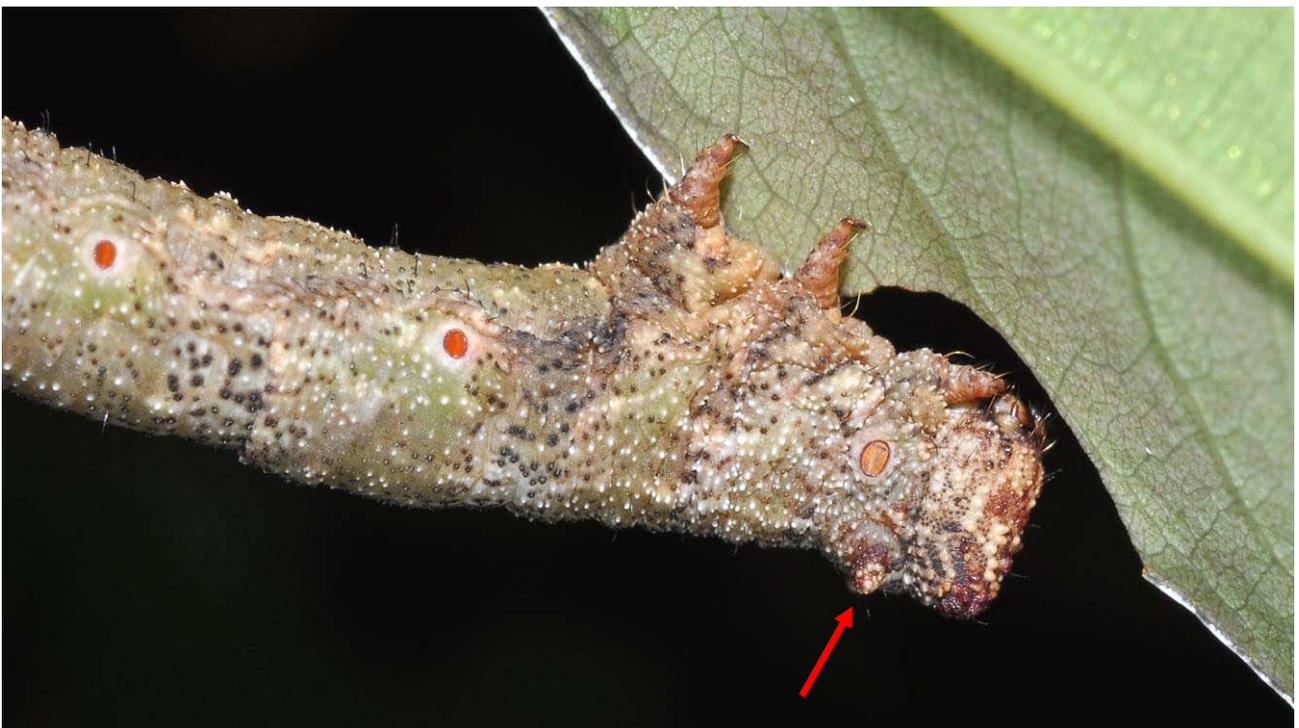


Fig. 3. Lateral close-up of head and thoracic region. Note raised, dorsolateral cone at first thoracic segment (T1), encrusted with tiny tubercles (arrowed).

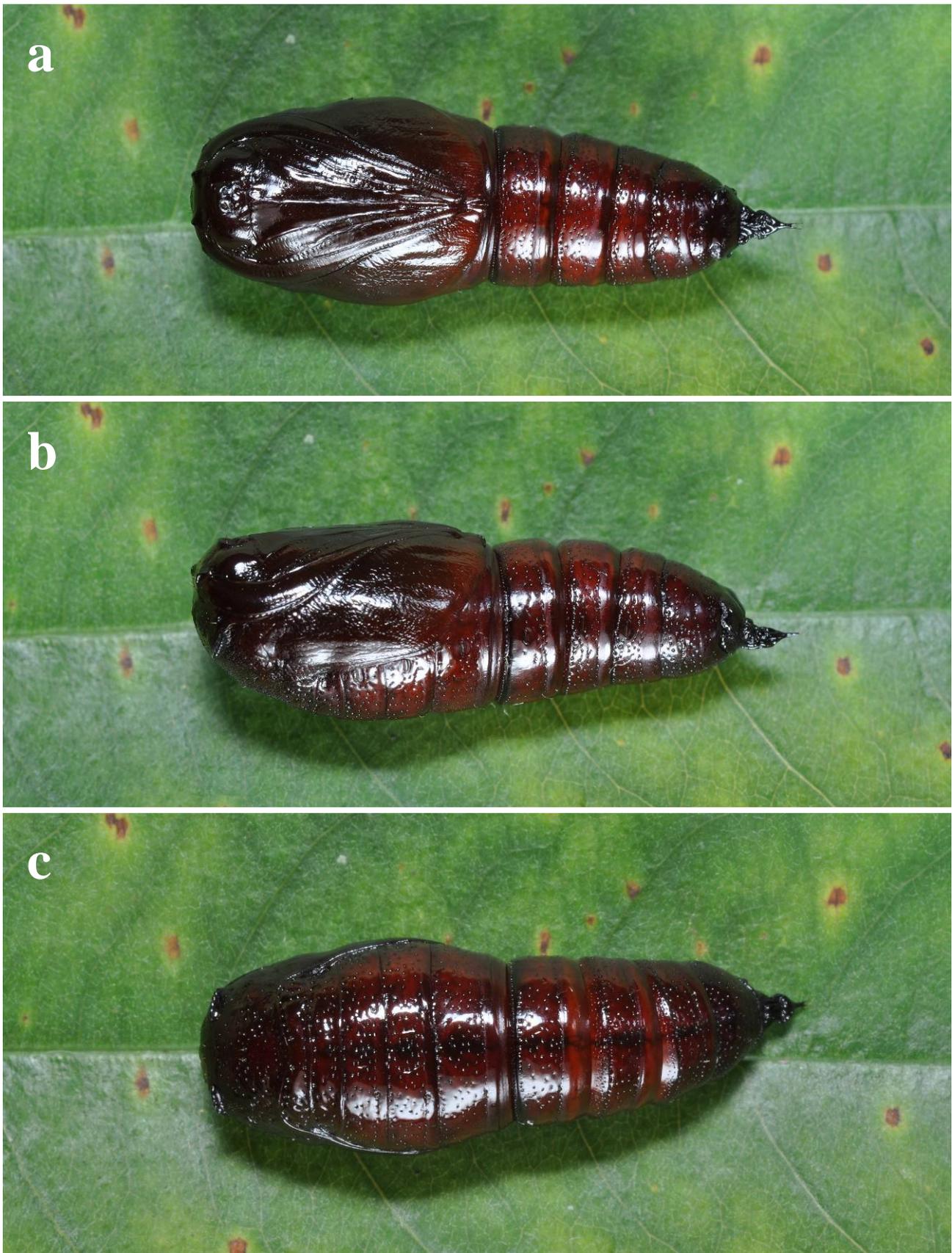


Fig. 4. Ventral (a), lateral (b), and dorsal (c) views of pupa. The pupa was 21 mm by 7 mm.

The body length of the larva was 50 mm. Its overall colour was olive brown, speckled with black and white. The spiracles were a prominent brick-orange. The texture of its entire body was uniformly granular, with well distributed, minute tubercles. At its first thoracic segment (T1), there is a dorsolateral pair of low cones, each clustered with tubercles (Fig. 3). The head also exhibits two low 'horns', corresponding to the position of the cones at T1.

On the 30 Aug.2009, the larva was found to have ceased feeding and was lying motionless. The following day (31 Aug.2009), it proceeded to contract its body, accompanied by the simultaneous release of internal fluids. By the night of 1 Sep.2009 (ca. 2230 hours), pupation had been complete. While the abdominal segments had started to turn golden brown, the head and thoracic region were still a translucent, jade green. In the following days, the pupa attained a rich, reddish brown colour and was measured to be 21 mm by 7 mm (Fig. 4). Its abdominal segments were distinctly pitted uniformly. At its posterior end, the glossy black cremaster comprised a swollen base (that appeared to be engraved) which tapered elegantly to a sharp, bifid apex (Fig. 5).

On the night of 15 Sep.2009, a male moth eclosed and its identity was subsequently verified to be *Biston pustulata* (J. D. Holloway, pers. comm.). This specimen was comparable with earlier illustrations of the males of this species (Barlow, 1982: Pl. 45—moth 4; Holloway, 1993: Pl. 12—moth 9). The inherent colour patterns of this moth enabled it to blend effectively against a substrate of lichen-covered bark (Fig. 6). This camouflage capability brought to mind the classic example of the temperate geometrid species, *Biston betularia* (Linnaeus, 1758), commonly referred to as the peppered moth, which has been the focus of much research attention, textbook illustration, as well as evolutionary debate (Majerus, 2009).

At its head region, the bipectinate antennae of the male *Biston pustulata* were discernible (Fig. 7). The moth was subsequently preserved and catalogued as a voucher specimen at the Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity Research, with measurements of its body length (BL) and forewing length (FW) obtained: ZRC.LEP.205 (BL: 18 mm, FW: 22 mm). As previously noted by Barlow (1982), the undersides of both fore- and hindwings have prominent, black cell-end spots. The eclosed pupal case was also cleaned and preserved as well.

Additional specimens of *Biston pustulata* from Singapore were also examined, including: ZRC.LEP.234 (male, BL: 21 mm, FW: 25 mm, Kent Ridge, coll. J. W. H. Yong, May 1992), ZRC.LEP.235 (male, BL: 22 mm, FW: 27 mm, Clementi Avenue 2, coll. Sammie Ang, 21 Jan.2005). Examples of *Biston insularis* from Singapore were also compared, and found to be slightly larger than the former species. Voucher specimens examined include: ZRC.LEP.231 (male, BL: 24 mm, FW: 29 mm, 'Singapore', coll. R. Morrell, 8 Apr.1955), ZRC.LEP.232 (female, BL: 23 mm, FW: 28 mm, Nee Soon Swamp Forest, light trap, coll. not stated, 28 May 1992), ZRC.LEP.233 (male, BL: 24 mm, FW: 29 mm, Nee Soon Swamp Forest, coll. not stated, 28–29 May 1992), ZRC.LEP.236 (male, BL: 23 mm, FW: 30 mm, Bukit Kallang, CNR office, coll. Aidi Abdul Ghani & Genevie Chua, 14 Oct.2004).



Fig. 5. Ventral close-up of cremaster.



Fig. 6. The male *Biston pustulata* (ZRC.LEP.205, body length: 18 mm, forewing length: 22 mm) eclosed on the night of 15 Sep.2009. Its wing colouration and patterns allowed it to blend effectively against a lichen encrusted bark.



Fig. 7. Anterior close-up of male *Biston pustulata* (ZRC.LEP.205). Note bipectinate antennae.

The previously documented larval hostplants for *Biston pustulata* include *Acacia mangium* and *Gliricidia* (both Fabaceae), *Camellia sinensis* (Theaceae) and *Elaeis guineensis* (Arecaceae) (Holloway, 1993; Robinson et al., 2009). The current record of *Cratoxylum* (Guttiferae) may thus be added to this list. Nevertheless, most members of the genus *Biston* are generally regarded as highly polyphagous defoliators (Holloway, 1993). Hopefully, an encounter with the diagnostic caterpillar of *Biston insularis* in future survey efforts will provide us with an opportunity for detailed comparisons of larval morphology and foodplant preference.

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