

**FINAL INSTAR CATERPILLAR AND METAMORPHOSIS OF
LEBEDA COGNATA GRÜNBERG, 1913 IN SINGAPORE
(LEPIDOPTERA: LASIOCAMPIDAE)**

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ABSTRACT. — The final instar caterpillar of *Lebeda cognata* Grünberg is described and illustrated from a successful attempt at rearing to metamorphosis. Details of the morphology of the larva, cocoon, and pupa are provided. Sexual dimorphism in this species is highlighted, with comparative male examples from Singapore and Borneo.

KEY WORDS. — caterpillar, pupa, Lasiocampidae, *Lebeda cognata*

INTRODUCTION

The lasiocampid moth *Lebeda cognata* was first described by Grünberg (1913) based on a male type specimen from Kinabalu, Borneo. The geographic range of this species includes Borneo, Sumatra, Peninsular Malaysia, Singapore, and northern and southern Thailand (Holloway, 1976; Zolotuhin & Pinratana, 2005). It is primarily an inhabitant of lowland forests, and in Peninsular Malaysia and Sumatra, replaced in the highlands by the montane species, *Lebeda nobilis* Walker (Holloway, 1987, Zolotuhin & Pinratana, 2005). A brief description of its larvae, accompanied by an illustration of a mature caterpillar, was previously provided by Barlow (1982: 50, pl. 50, Fig. 1). However, there appears to be no prior illustrations of its pupa.



Fig. 1. A mature caterpillar (head towards right, total length ca. 110 mm, possibly penultimate instar) of *Lebeda cognata* adopting its defensive posture when encountered at MacRitchie Reservoir forest on the night of 19 Aug. 2008 (ca. 2230 hours).

OBSERVATIONS

Within the Central Catchment Nature Reserve of Singapore, the mature caterpillars of *Lebeda cognata* have been occasionally encountered, often as single individuals resting vertically on tree trunks. Despite their large size (100–130 mm long), they can be very well camouflaged against the bark, especially with their shades of grey-brown, and their overall outline disrupted by a dense arrangement of fine setae. Usually resting motionless by day, the caterpillars are nocturnal and active at night. On the night of 19 Aug.2008 (ca. 2230 hours), a mature caterpillar (total length ca. 110 mm) was actively crawling along a branch at eye-level, within the MacRitchie Reservoir forest (Fig. 1).

When approached for closer examination, it immediately elevated its anterior segments and tucked in its head as a defensive posture. This exposed the dense rows of protective spines along the anterior margins of its thoracic segments. The sheer size of this caterpillar, as well as its formidable armour of sharp spines, was sufficient deterrence to warn the observers (and potential predators) to keep a safe distance. Hence, the caterpillar was not collected.



Fig. 2. Lateral (a) and dorsal (b) views of final instar caterpillar (head towards top, total length: 135 mm, width: 18 mm) of *Lebeda cognata* observed at the Bukit Timah Nature Reserve on 25 Nov.2011.

At the Bukit Timah Nature Reserve (BTNR), a final instar caterpillar was encountered while it was crawling along the ground beside a forest trail on the evening of 25 Nov.2011. With some courage, it was carefully collected to be reared in captivity. At rest, it plastered itself against a branch and remained absolutely still by day. Its total length was 135 mm, and body width at mid-section was 18 mm. It was an overall pale grey, with symmetrical, dark brown bands and streaks along its dorsum and flanks (Fig. 2). At the front end, its head was not readily distinguishable, as it was mostly obscured by dense, fine setae originating from T1 and T2 (Fig. 3). Along the dorsal margin of T1, a row of fine, spatulate setae projected above its head. The pair of pinkish brown spiracles, outlined with black, was visible at T1.

Along its dorsum, there was a dense row of rearward-pointing, dark red spines along the anterior margin of each segment (Fig. 4). In the middle of the segment was a row of small, spatulate, light-yellow setae. Along its flanks, there was a pair of prominent ventrolateral protuberances per segment, situated below each spiracle (Fig. 5). Originating from these bulbous structures were two types of setae: (i) long and fine, and (ii) short and spatulate. Its posterior-most segments (including anal segment and anal prolegs) were mostly chalky white, with symmetrical brown patterns and speckles (Fig. 6).

In captivity, the caterpillar did not feed, as it rested by day and paced about restlessly at night, displaying possible signs of pre-pupal behaviour. On the morning of 27 Nov.2011, the caterpillar was found to have crawled into a curled, dried leaf. Upon closer inspection, the narrow gaps of the dried leaf had begun to be sealed by strong strands of silk. Pupation was complete within the following days and careful examination of the dried leaf revealed that it was blanketed with short, sharp spines over its entire surface (Fig. 7). These spines were all directed outwards and clearly re-employed by the caterpillar to ensure continued protection over the course of its pupal phase.

On 8 Dec.2011, the cocoon was carefully dissected in order to examine the pupa within. Attached to the inner surface of the dried leaf was a dense meshwork of long, fine setae (as in Fig. 5), intertwined with strong, silk strands. At one corner of the cocoon, the shriveled larval skin of the final instar was found and removed for preservation (Fig. 8). The head capsule was clearly visible now and exhibited deep brown bands and blotches.



Fig. 3. Dorsal close-up of the caterpillar head, largely obscured by forward-directed setae, originating from T1 and T2.



Fig. 4. Dorsal close-up of mid-section of caterpillar (head towards right). The anterior margin of each segment is armed with a dense row of short, stiff spines pointing backwards. Posterior to this is a row of short, spatulate, yellowish setae.



Fig. 5. Lateral close-up of caterpillar (head towards right). Note prominent, ventrolateral protuberance at each segment, from which radiated long, fine setae, as well as shorter, spatulate setae.



Fig. 6. Close-up of posterior segments.

The pupa was temporarily extracted for detailed measurements and examination (Fig. 9). Its total length was 63 mm; width, 21 mm; and depth, 21 mm. It had a robust form and was well rounded at both ends. Its overall colour was a deep, reddish brown. The abdominal segments were flexible and rotated about when disturbed. Dense arrangements of short, golden setae were present on the apical region of its head, as well as along the posterior margins of its abdominal segments. At its posterior, silk strands were securely fastened to the cremaster. After documentation of this pupa, it was then replaced into the cocoon to continue with its development.

On the morning of 22 Dec.2011, a female moth was found to have eclosed. Its wings had achieved full extension and the anterior margins of the hindwings were positioned well in front of the forewings, in typical lasiocampid fashion (Fig. 10). Its wings were a uniform chocolate-brown, with faint grey, transverse bands and a white, semilunar discal spot on the forewing. At its anterior, its blunt head was an ashy grey (Fig. 11). Its antennae were pectinate, but with significantly reduced pectinations. The specimen was later preserved as a voucher at the Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity Research (RMBR), National University of Singapore. It was catalogued as ZRC.LEP.372 (body length: 62 mm, body width: 21 mm, forewing length: 69 mm, antenna length: 16 mm). Prior to preservation, the female moth had extruded seven eggs. They were elliptical (2.7×2.3 mm), light brown, with a white apical ring encircling a brown spot (Fig. 12).

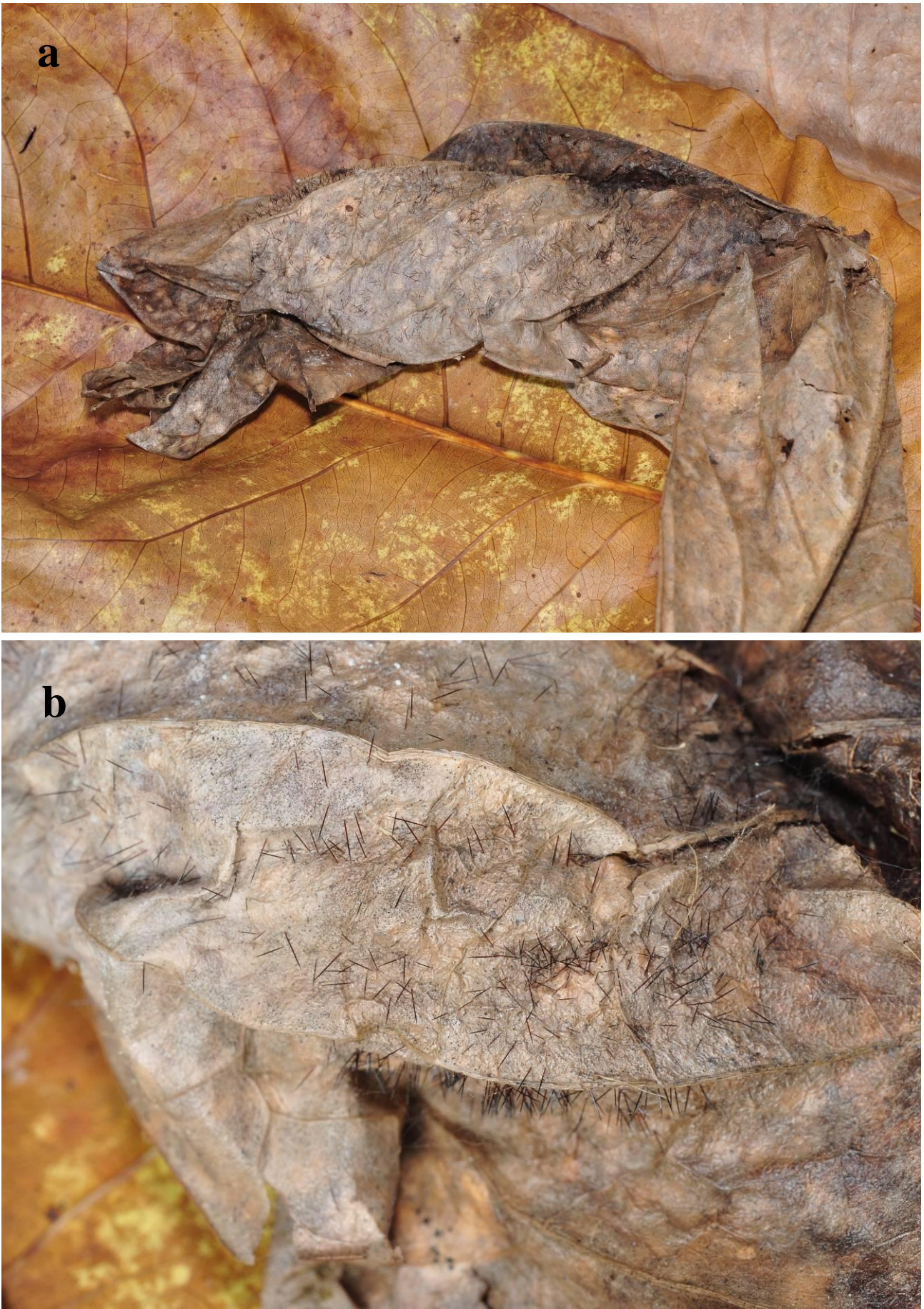


Fig. 7. The caterpillar had crawled into a dried, curled leaf on 27 Nov.2011 and constructed its cocoon within over the next few days (a). Upon completion of its cocoon, it could be seen that multiple sharp spines (as in Figs. 4, 5) were incorporated into its exterior, forming a formidable, deterrent barrier (b).



Fig. 8. Shriveled larval skin of the final instar, removed from within the cocoon upon dissection.

Pronounced sexual dimorphism is witnessed in *Lebeda cognata*, with males being smaller, but possessing distinctly bipectinate antennae. The forewing patterns of males also demonstrate greater contrast (Fig. 13). A single male specimen from Singapore was examined (ZRC.LEP.374, body length: 43 mm, body width: 9 mm, forewing length: 35 mm, antenna length: 11 mm). It was collected during a National Parks Board survey of Nee Soon Swamp Forest on 17 Jun.1992. Males have also been previously encountered at the BTNR on at least two occasions: 12 Dec.2007 and 20 Jun.2010 (Fig. 14). They were probably attracted by the night lights of the BTNR Visitor Centre. At rest, their wings were folded over their bodies, with the abdomen protruding just beyond the wing tips. A Bornean male example was examined at the Bukit Kana Research Station (Bintulu Division, Sarawak, East Malaysia) on 31 Mar.2007 at ca. 0010 hours (Fig. 15). It was in the warm-up process of fluttering its wings, in preparation to take flight. During the upstroke, the contrasting underwing patterns of dark versus light brown could be observed.

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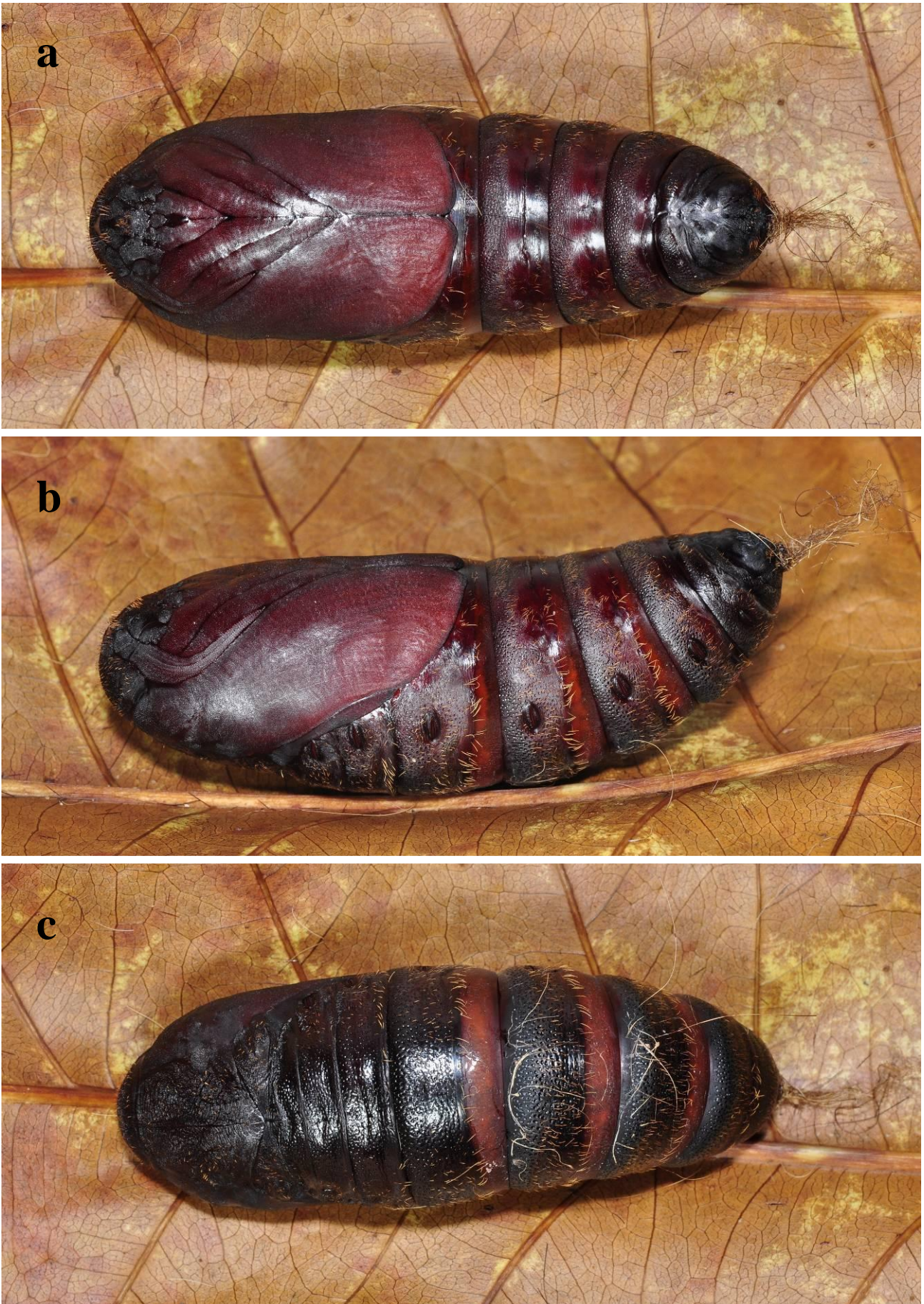


Fig. 9. Ventral (a), lateral (b), and dorsal (c) views of pupa (length: 63 mm, width: 21 mm, depth: 21 mm). Note arrangement of short, golden setae at its head region, and along the posterior margins of abdominal segments. Remnant strands of cocoon silk were still attached to its cremaster.



Fig. 10. Recently eclosed female moth (ZRC.LEP.372, body length: 62 mm, forewing length: 69 mm) with outstretched wings on 22 Dec.2011.

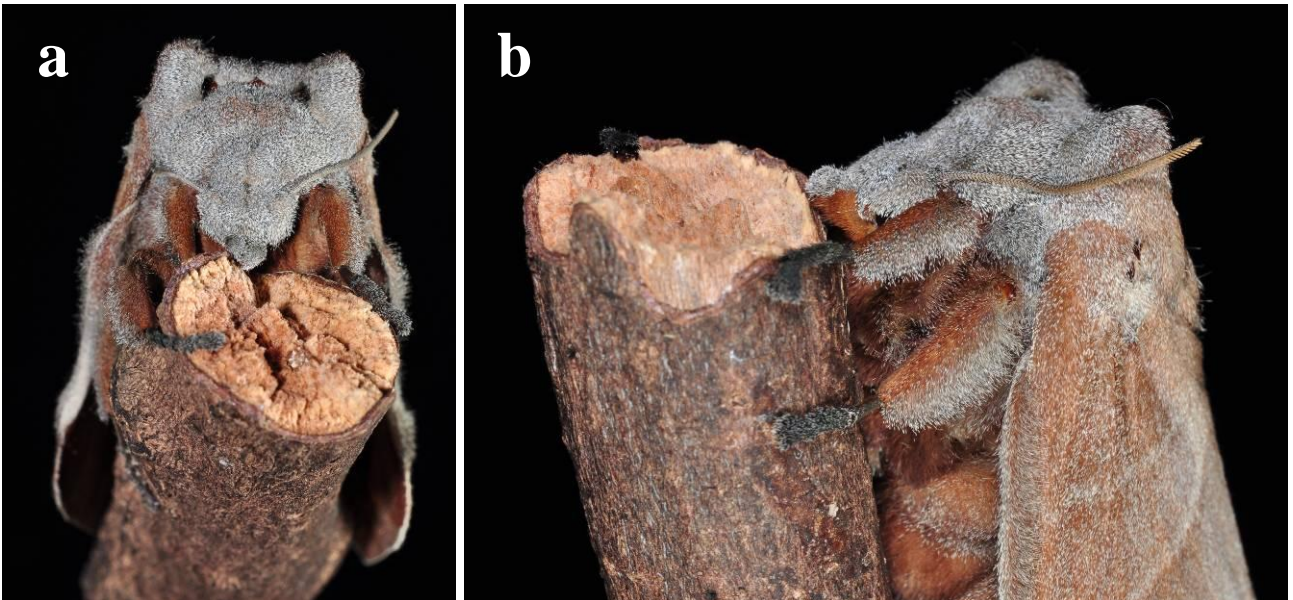


Fig. 11. Frontal (a) and lateral (b) close-ups of female moth (as in Fig. 10).



Fig. 12. Extruded eggs (2.7×2.3 mm) of the female moth (ZRC.LEP.372).

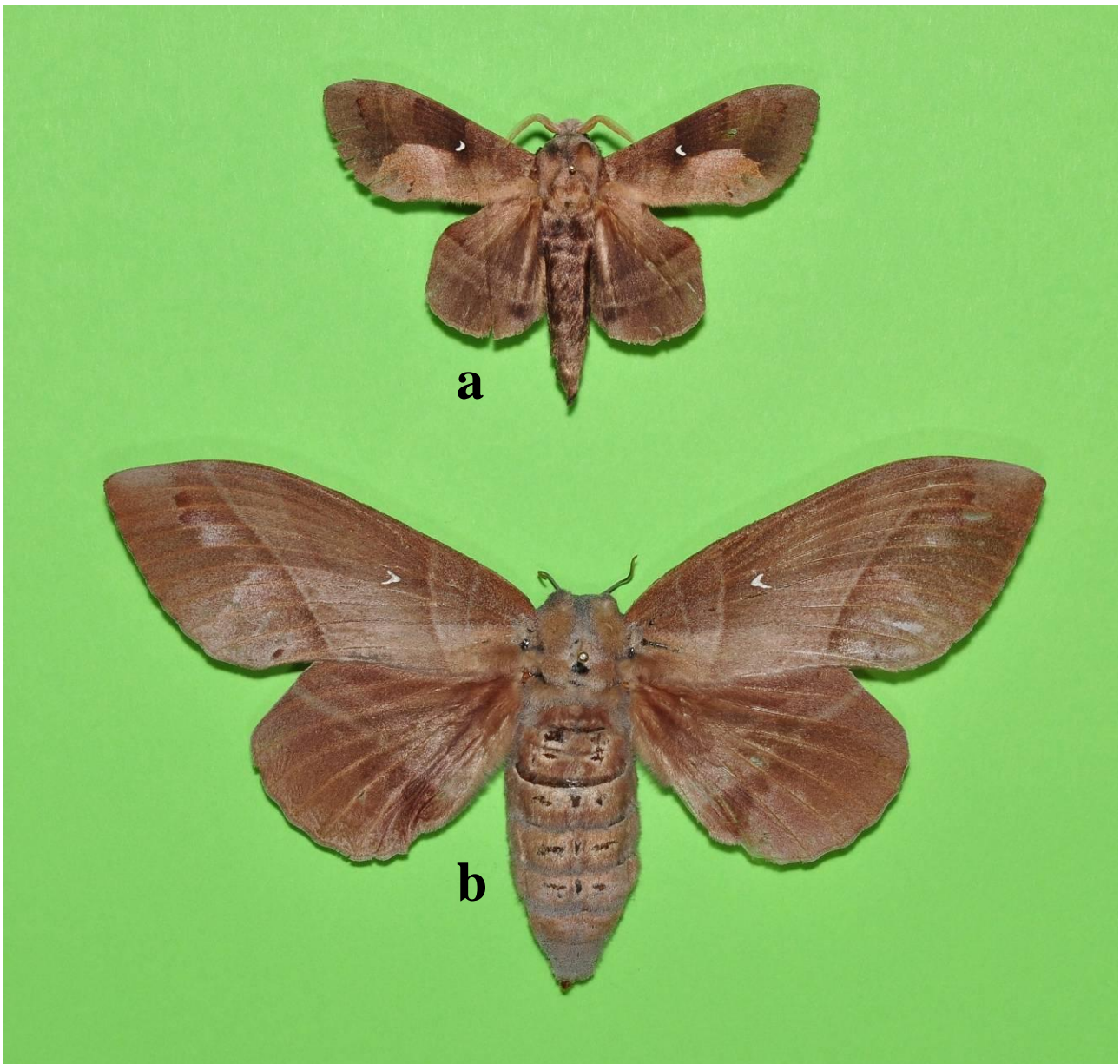


Fig. 13. Male (a) and female (b) specimens of *Lebeda cognata* from Singapore. The male specimen (ZRC.LEP.374, body length: 43 mm, body width: 9 mm, forewing length: 35 mm, antenna length: 11 mm) was collected from Nee Soon Swamp Forest in Jun.1992. The female specimen (ZRC.LEP.372, body length: 62 mm, body width: 21 mm, forewing length: 69 mm, antenna length: 16 mm) is the same individual featured in Fig. 10.

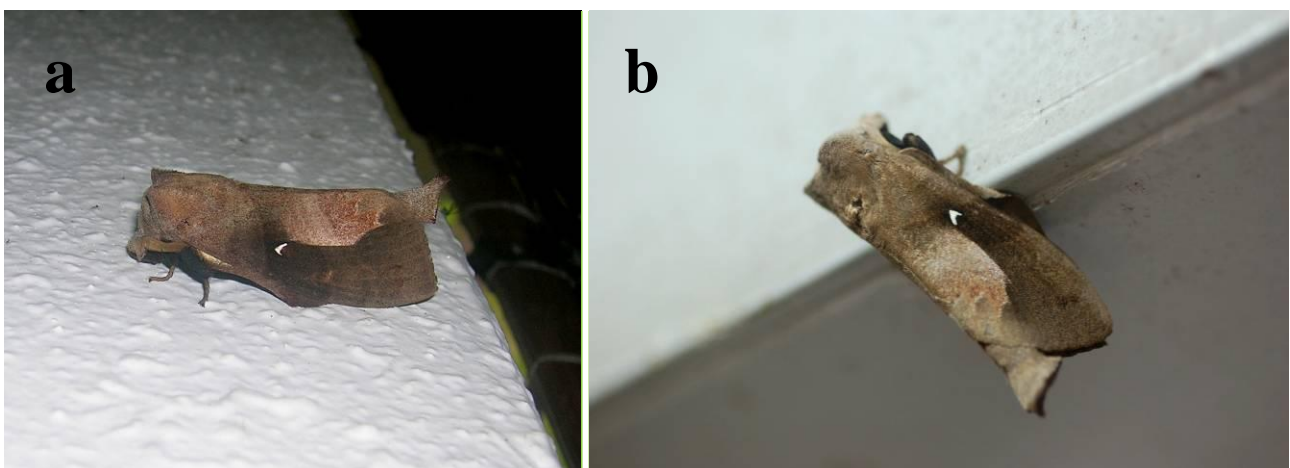


Fig. 14. Examples of males (body lengths: ca. 45 mm) encountered at the Visitor Centre of the Bukit Timah Nature Reserve on 12 Dec.2007 (a), and 20 Jun.2010 (b).



Fig. 15. Dorsal (a) and lateral (b) views of a male *Lebeda cognata* (body length: ca. 45 mm) encountered in Sarawak, Borneo on 31 Mar.2007 (ca. 0010 hours).