

**THE CATERPILLAR AND METAMORPHOSIS OF
EREBUS EPHESPERIS (HÜBNER, 1827) IN SINGAPORE
(LEPIDOPTERA: EREBIDAE: EREBINAE: EREBINI)**

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INTRODUCTION

Moths in the genus *Erebus* Latreille belong to the tribe Erebinini, within the subfamily Erebininae (Zahiri et al., 2010). In Singapore, the genus is represented by three species, namely *Erebus ephesperis* (Hübner, 1827), *Erebus hieroglyphica* (Drury, 1773) and *Erebus macrops* (Linnaeus, 1768), based on museum specimens and personal encounters. The first species is most frequently encountered along the forest edge and forest trails, while the latter two species have remained elusive in recent times. A table of the local voucher specimens for *Erebus ephesperis* is presented under 'Material Examined'. The geographic distribution for *Erebus ephesperis* is broad and includes the Oriental Region to Taiwan, Japan, Korea, Sundaland and the Lesser Sundas eastward to Timor and New Guinea (Holloway, 2005; Kononenko & Pinratana, 2005 – as Noctuidae: Catocalinae). Here, detailed illustrations of its cryptic caterpillar (mid-instar to final instar) and subsequent pupa are provided, accompanied by a summary of the salient larval and pupal characters. The caterpillar's defensive posture is also highlighted.



Fig. 1. Dorsal view of the moth *Erebus ephesperis* (forewing length ca. 43 mm) feeding on the ripened fruit of the sendudok shrub, *Melastoma malabathricum* (Melastomataceae) at the MacRitchie Reservoir forest on the night of 24 Mar.2009 (2330 hours).



Fig. 2. Lateral close-up of the moth (as in Fig. 1) imbibing the fruit juice with its proboscis.

OBSERVATIONS

While conducting nocturnal surveys in the forests of Singapore, adults of *Erebus ephesperis* may be frequently sighted. These moths are often attracted to ripe fruit, such as those of the sendudok, *Melastoma malabathricum* (family Melastomataceae), a widespread forest shrub (Figs. 1, 2). Occasionally, newly eclosed individuals have been sighted as they allow their wings to straighten and stiffen (Fig. 3). The sap that exudes from bruised or cracked bark of freshly fallen trees may also attract these moths (Fig. 4). However, despite the high frequency of adult sightings for this species, their caterpillars have not been readily encountered. This difficulty in detection may be due to the dense and extensive foliage of the host vine, *Smilax* species, which would certainly provide abundant hiding places for the caterpillars.

During a faunal survey within the MacRitchie Reservoir forest on the night of 26 Nov.2010, a mid-instar caterpillar (body length: 33 mm) was found at knee-level, feeding on the young leaves of the climber, *Smilax setosa* (family Smilacaceae). When it was not actively feeding, the anterior half of its body would be held away from the stem it was perched upon, its head suspended by a fine silk thread secreted from its labium (Figs. 5, 6). Comparisons with a thorough larval description of *Erebus ephesperis* helped to confirm its identity (Holloway, 2005). Holloway (2005) also listed other authors who had published prior illustrations and/or descriptions of its caterpillar. However, these historical publications are either of limited circulation or not easily accessible at present.

In the mid-instar caterpillar, a longitudinal series of brown and beige stripes was present on its venter (Fig. 7). On the morning of 28 Nov.2010, it had moulted to the penultimate instar and continued feeding soon after. By 30 Nov.2010, it had attained a body length of 46 mm. At this stage, its brown and beige colours had become more intense and the ocelli at the first abdominal segment (A1) attained a wine red colour (Fig. 8). On the afternoon of 1 Dec.2010, the caterpillar displayed pre-moult signs, with its first thoracic segment (T1) appearing elongated and swollen. The next morning (2 Dec.2010), it had moulted to the final instar. The same evening, it was provided with a fresh supply of *Smilax setosa* leaves, upon which they were readily consumed, including the larger leaves that had a stiffer lamina. In captivity, the caterpillar continued to feed and grow at a steady pace. Its body length was measured to be 60 mm on 4 Dec.2010. When measured again on 5 Dec.2010, its maximum body length was 75 mm. Its faecal pellets were dark brown, and measured to be 6–7 mm long \times 4–5 mm wide.

The final instar caterpillar was mostly dark brown along its flanks, with a well delineated beige band that began from the dorsum of A4 and continues diagonally to the base of A6 (Fig. 9). From the base of A6, a diffuse black stripe (underlined with beige) runs diagonally towards the dorsum of A7, just passing over the spiracle (A7). The series of spiracles is distinct and each spiracle is coloured deep clay. At A8, a dorsal hump is unmistakable. The abdominal prolegs at A5 and A6 were well developed and fully functional, whereas those at A4 were half the size. The prolegs at A3 have become drastically reduced and barely distinguishable.



Fig. 3. A recently eclosed *Erebus ephesperis* (forewing length ca. 45 mm) perched under a leaf at the Upper Peirce Reservoir forest on the night of 20 Dec.2008 (2130 hours).



Fig. 4. A moth (forewing length ca. 42 mm) feeding on the sap that was exuding from the bruised bark of a fallen *Cinnamomum iners* (Lauraceae) tree at the MacRitchie Reservoir forest on the night of 26 Nov.2010 (2030 hours).



Fig. 5. Lateral view of the mid-instar caterpillar of *Erebus ephesperis* (body length: 33 mm) on its larval hostplant *Smilax setosa* (Smilacaceae), found at the MacRitchie Reservoir forest on the night of 26 Nov.2010 (2200 hours).

One of the most prominent patterns on this caterpillar must surely be the pair of elliptical ocelli positioned dorso-laterally at A1 (Fig. 10). They are distinctly outlined by thin, outer black and inner white rings, with a uniform clay colour internally. At its anterior, there is an orange band dorsally over the head and thoracic segments (T1–T3) of the caterpillar, with symmetrical brown and white patterns. This is well demarcated from the ventro-lateral, dark brown band immediately below. The thoracic limbs are a uniform orange brown.

When the caterpillar was disturbed, it adopted a defensive posture by curling the anterior segments inwards, thus protecting its head and thoracic limbs (Fig. 11). In the process, a prominent pair of black, round patches behind the A1 ocelli was exposed, serving to alarm any potential predator. These dark patches were otherwise concealed within the inter-segmental membrane connecting A1 and A2. Such defensive behaviour is reminiscent of the caterpillars of *Eudocima* species of the erebid subfamily Calpinae, except that the posterior segments are not elevated (Holloway, 2005).

On the evening of 7 Dec.2010, the caterpillar had stopped feeding and was perched along the stem of its hostplant, motionless. There were no significant colour changes. On the morning of 8 Dec.2010, it had already enshrouded itself within a loose cocoon that incorporated the adjacent leaf debris. This tent-like structure measured 44×20 mm (Fig. 12). On 9 Dec.2010, a narrow aperture was made to monitor the caterpillar's progress therein. Its body had become dark brown and was steadily showing signs of contraction, as the inter-segmental constrictions could be seen. Its body also appeared wet as fluids were gradually being expelled. By the morning of 10 Dec.2010, pupation was already complete.

On the 14 Dec.2010, the pupa was carefully removed from within its silk chamber for detailed observations and measurements (32×9 mm). The pupa was a uniform blackish brown, with a rounded anterior (Fig. 13). At its posterior, the cremaster consisted of four symmetrical pairs of short, reddish hooks that served to attach the pupa to the silk threads (Fig. 14). The spiracles along its side were particularly prominent, as their bright orange colour stood out against the dark pupa (Fig. 15).

On the morning of 22 Dec.2010, the adult moth finally eclosed, displaying the characteristic patterns of the species (Fig. 16). Careful examination of its underside revealed that the moth was a male, possessing both retinaculum and frenulum near the wing bases (Fig. 17). The retinaculum, however, was not immediately discernible as this structure was blanketed by long hairs at the base of the forewing. The moth was subsequently preserved as a voucher specimen and deposited at the Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity Research (RMBR) and catalogued as ZRC.LEP.337 (body length: 35 mm, forewing: 42 mm). The vacated pupal case (Fig. 18) was also cleaned, dried and preserved accordingly (ZRC.LEP.337).



Fig. 6. Anterior close-up of the mid-instar caterpillar (as in Fig. 5) secured by a fine silk thread originating from its labium. Note ocellus at its first abdominal segment (A1).



Fig. 7. Ventral view of the mid-instar caterpillar (as in Figs. 5, 6). Note the longitudinal brown and beige stripes on its underside.



Fig. 8. Lateral view of the penultimate instar caterpillar (body length: 46 mm).

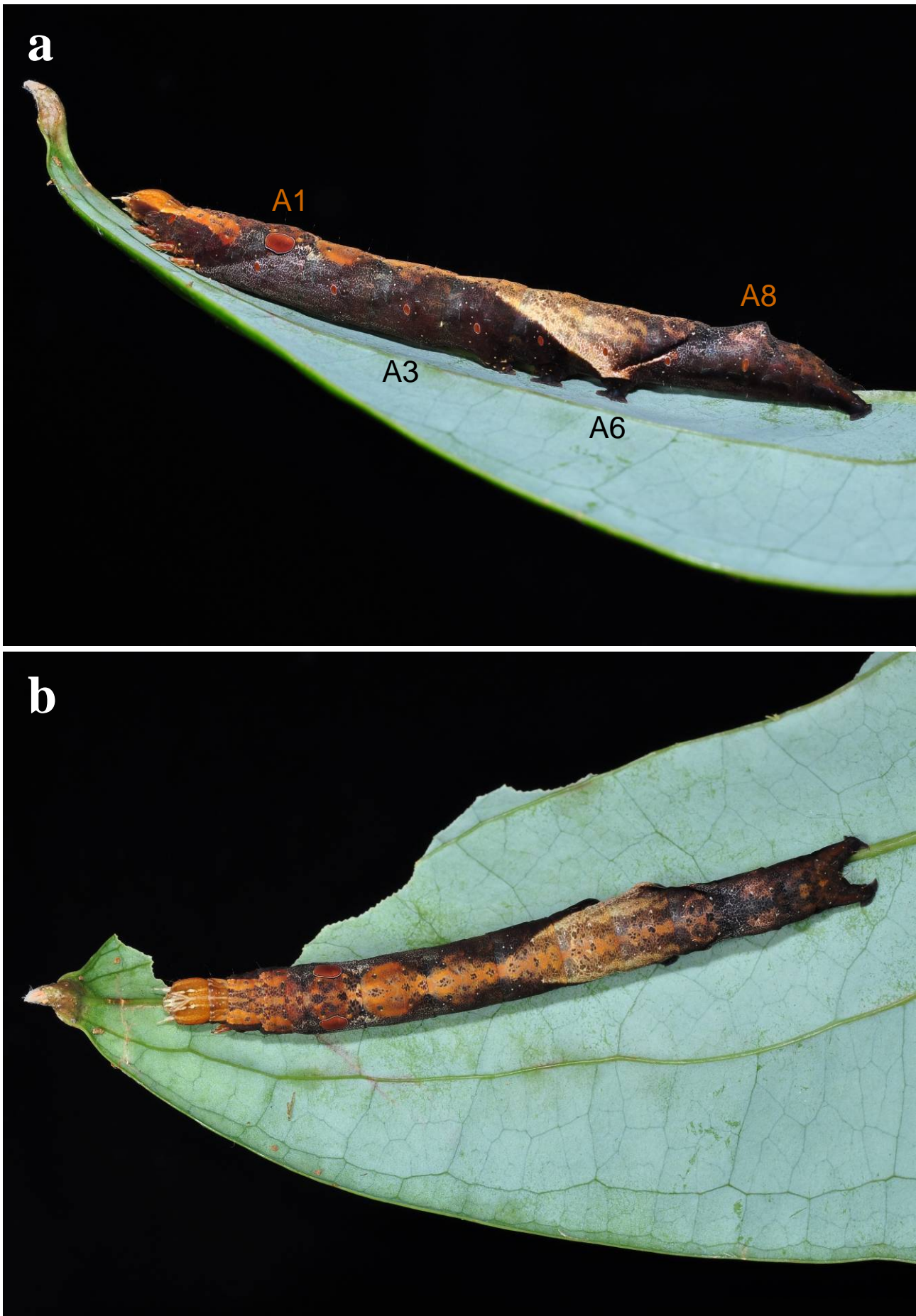


Fig. 9. Lateral (a) and dorsal (b) views of the final instar caterpillar (body length: 75 mm). Note prominent ocelli at A1 and dorsal hump at A8. The abdominal prolegs at A3 are vestigial, while those at A4 are half the regular size (at A5, A6).

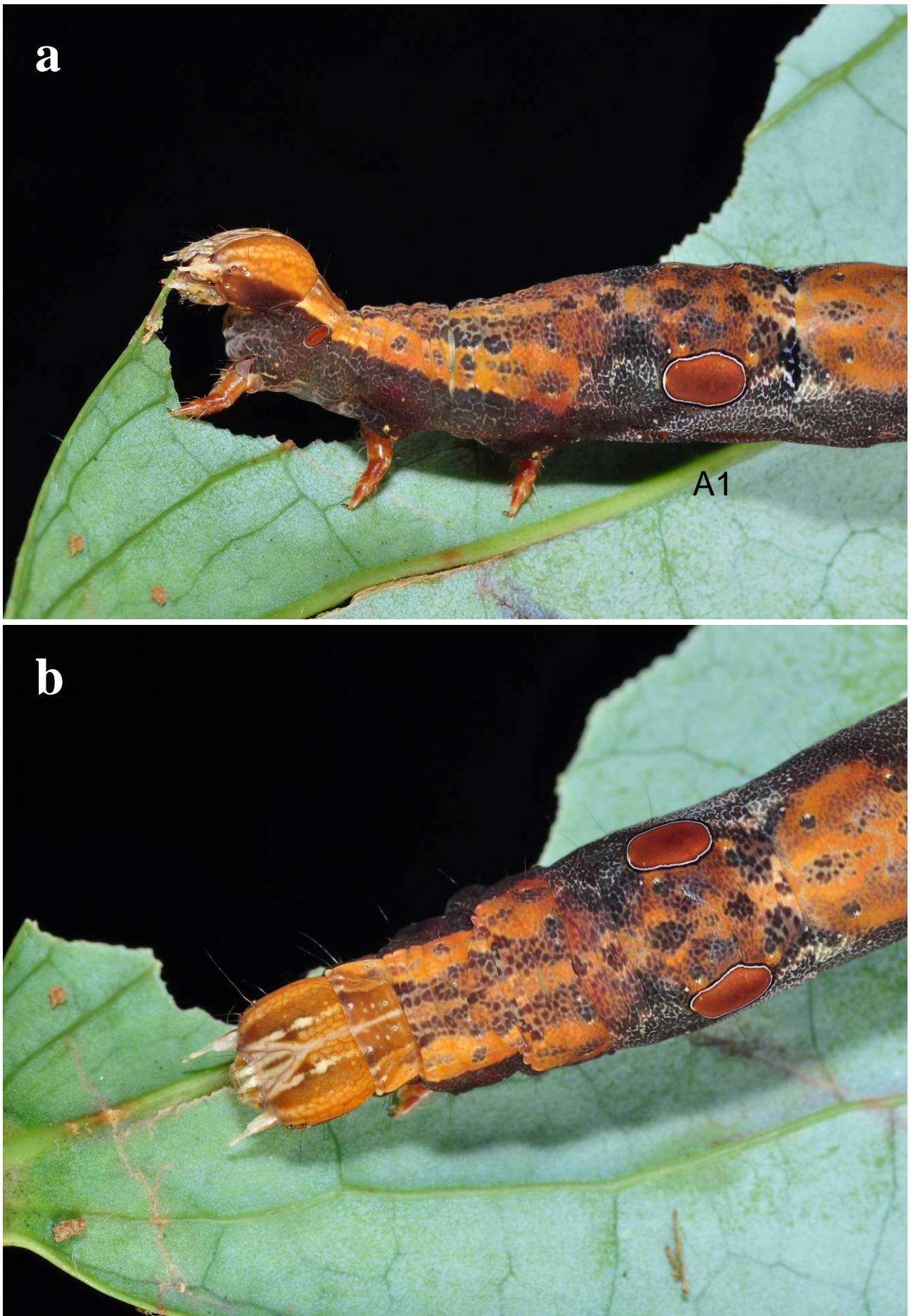


Fig. 10. Lateral (a) and dorsal (b) close-ups of the final instar caterpillar (body length: 75 mm) to view details of head and ocelli at A1.

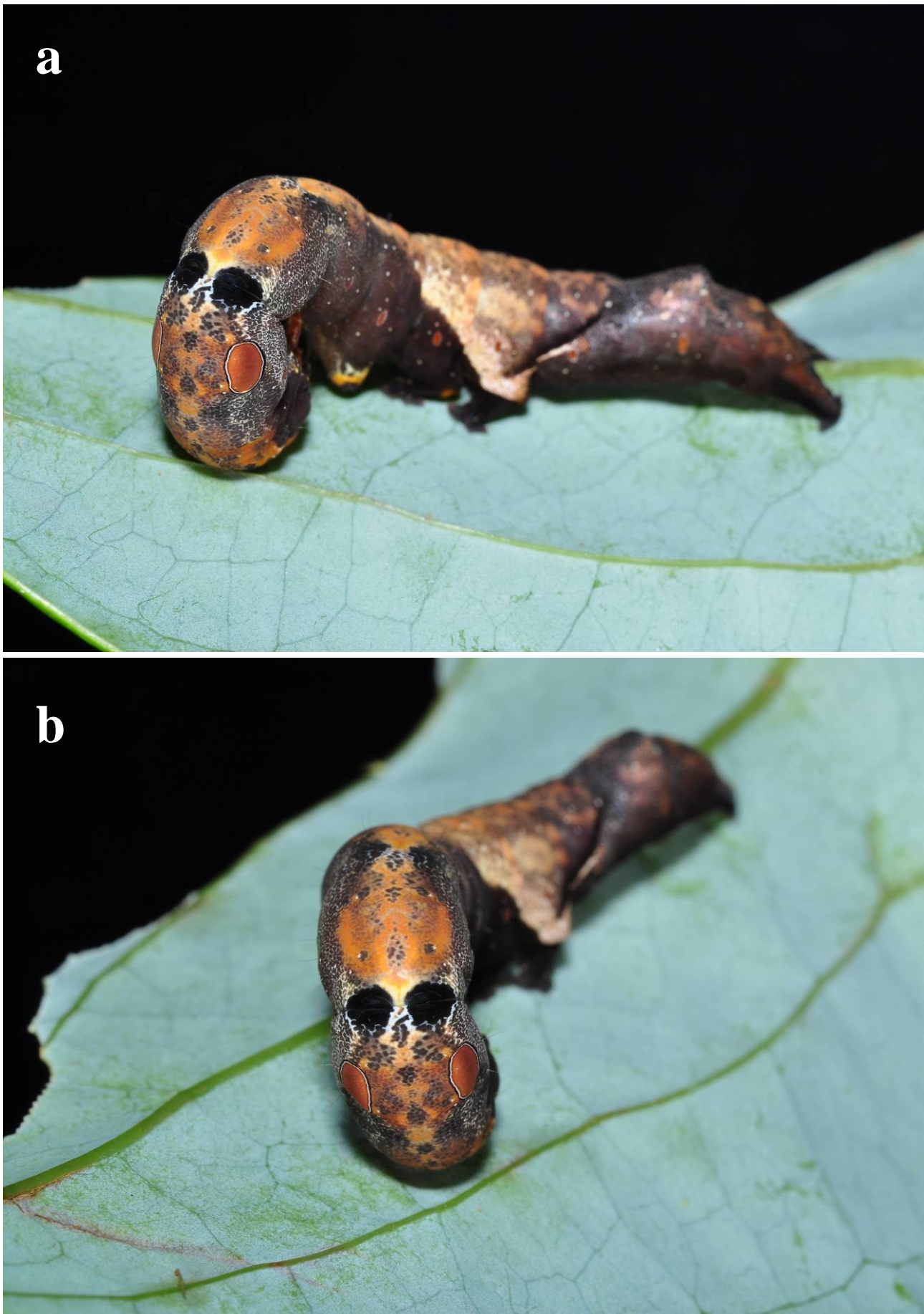


Fig. 11. Lateral (a) and frontal (b) views of the final instar caterpillar (body length: 75 mm) in defensive posture. Its head and thoracic segments are tucked under, thus exposing a striking pair of round, black patches — otherwise concealed within the inter-segmental membrane between A1 and A2.



Fig. 12. Leaf debris was incorporated into the loose silken cocoon that the caterpillar had enshrouded itself in. The cocoon measured 44×20 mm.

Besides *Erebus ephesperis*, at least two other species of *Erebus* have been recorded to utilise *Smilax* vines as their larval hostplant. These include *Erebus caprimulgus* (Fabricius, 1781) feeding on *Smilax macrophylla* in Peninsular Malaysia (Barlow, 1982), and *Erebus crepuscularis* (Linnaeus, 1758) feeding on *Smilax ovalifolia* in India (Robinson et al., 2011).

MATERIAL EXAMINED

Table 1. Specimens of adult *Erebus ephesperis* from Singapore, deposited at ZRC, RMBR. [M = male, F = female, BL = body length (mm), FW = forewing length (mm)].

ZRC.LEP.	sex	BL	FW	Locality	Collected by	Date
340	M	31	44	'Singapore'	R. Morrell	10 May 1953
341	M	28	41	Nee Soon swamp forest, NS 99 – light trap	NUS	26 May 1993
342	M	30	42	Lornie forest	L. L. Koh	7–8 Jan.2007
343	F	31	45	Bukit Timah; Hindhede Drive	H. K. Lua	24 Oct.1989
344	M	31	44	Kent Ridge	C. M. Yang	3 Nov.1989
345a	M	32	44	Bukit Timah; Hindhede Drive	H. K. Lua	5 Nov.1989
345b	F	30	45	Bukit Timah; Hindhede Drive	H. K. Lua	5 Nov.1989
346	F	30	44	Bukit Timah; Hindhede Drive	H. K. Lua	19 Nov.1989
347	M	34	47	Western Catchment forest; feeding on fruits of <i>Melastoma malabathricum</i>	T. M. Leong et al.	21 Apr.2004

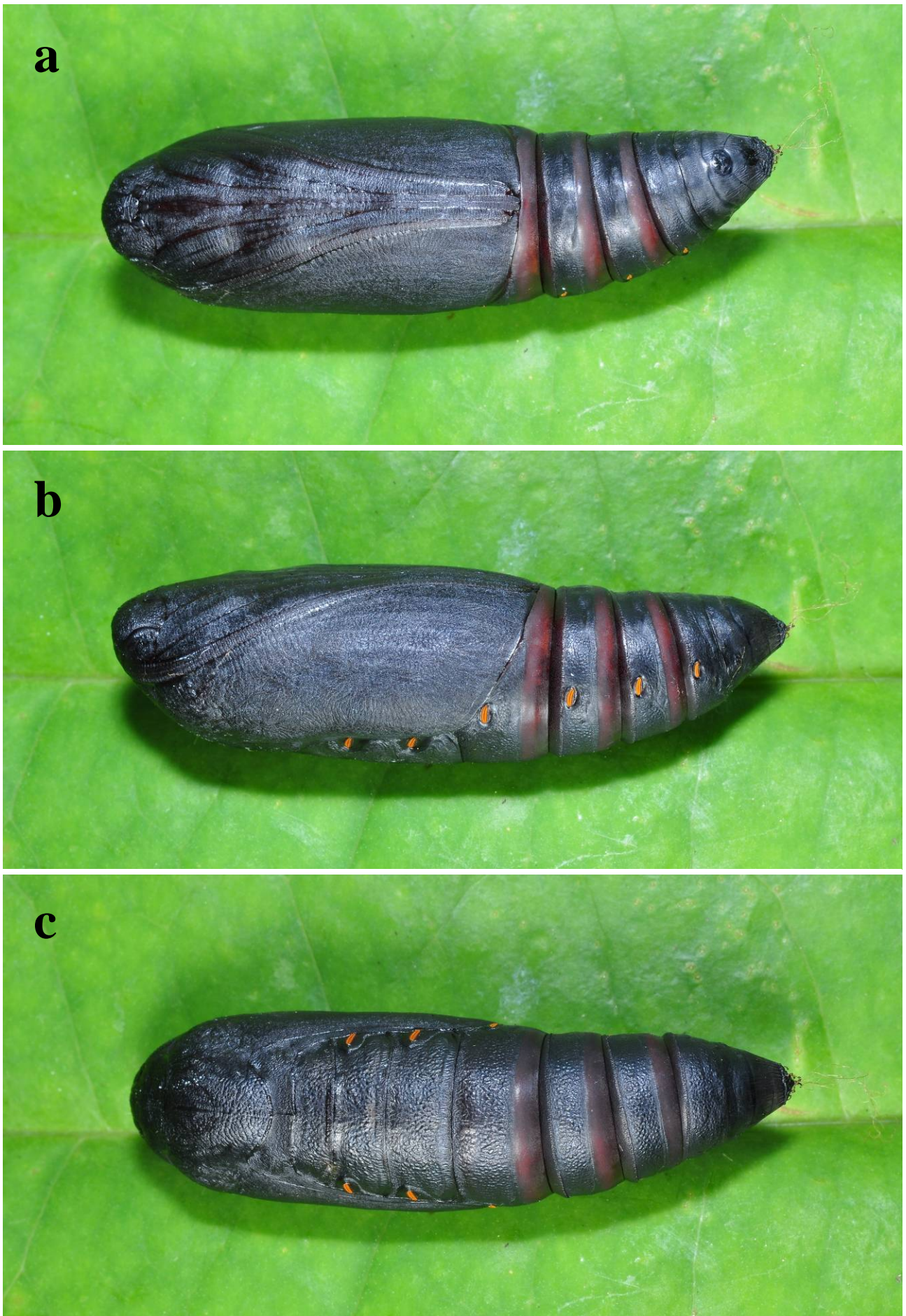


Fig. 13. Ventral (a), lateral (b), and dorsal (c) views of the pupa. It was measured to be 32×9 mm.

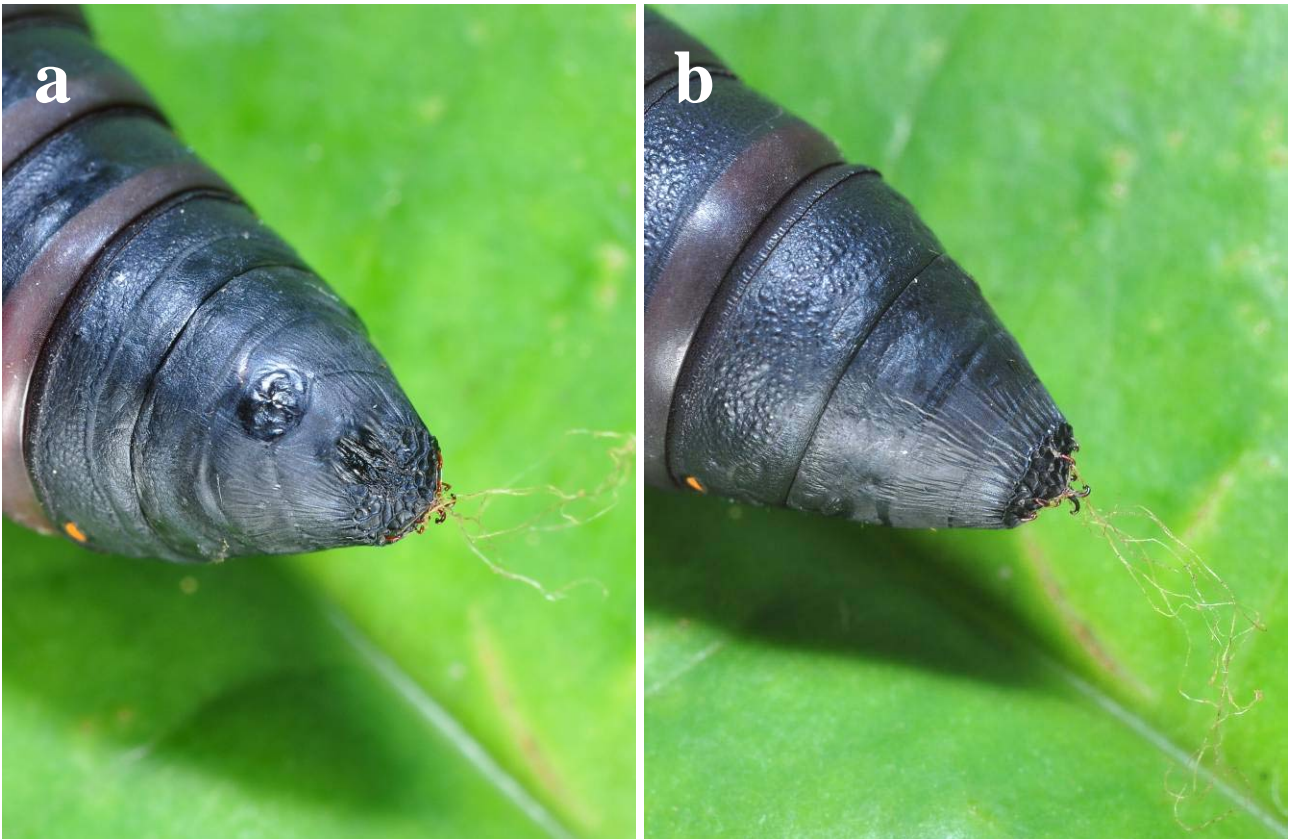


Fig. 14. Ventral (a) and dorsal (b) close-ups of the cremaster. Note symmetrical arrangement of short hooks used to fasten the pupa onto the silken threads of the cocoon.



Fig. 15. Lateral close-up of pupa (as in Fig. 13b) to view details of the prominent orange spiracles.

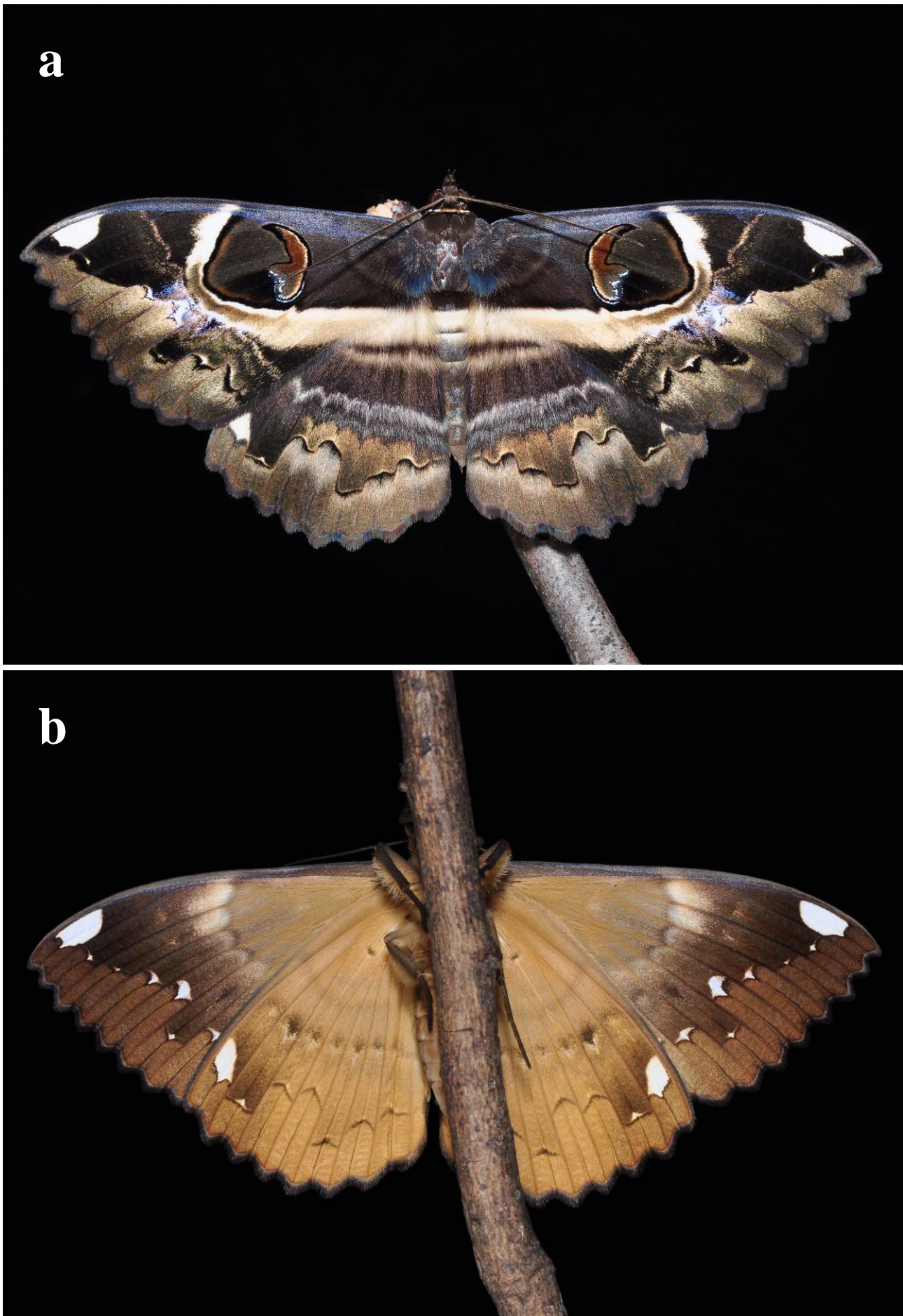


Fig. 16. Dorsal (a) and ventral (b) views of the adult moth (ZRC.LEP.337, male, body length: 35 mm, forewing: 42 mm), freshly eclosed on 22 Dec.2010.

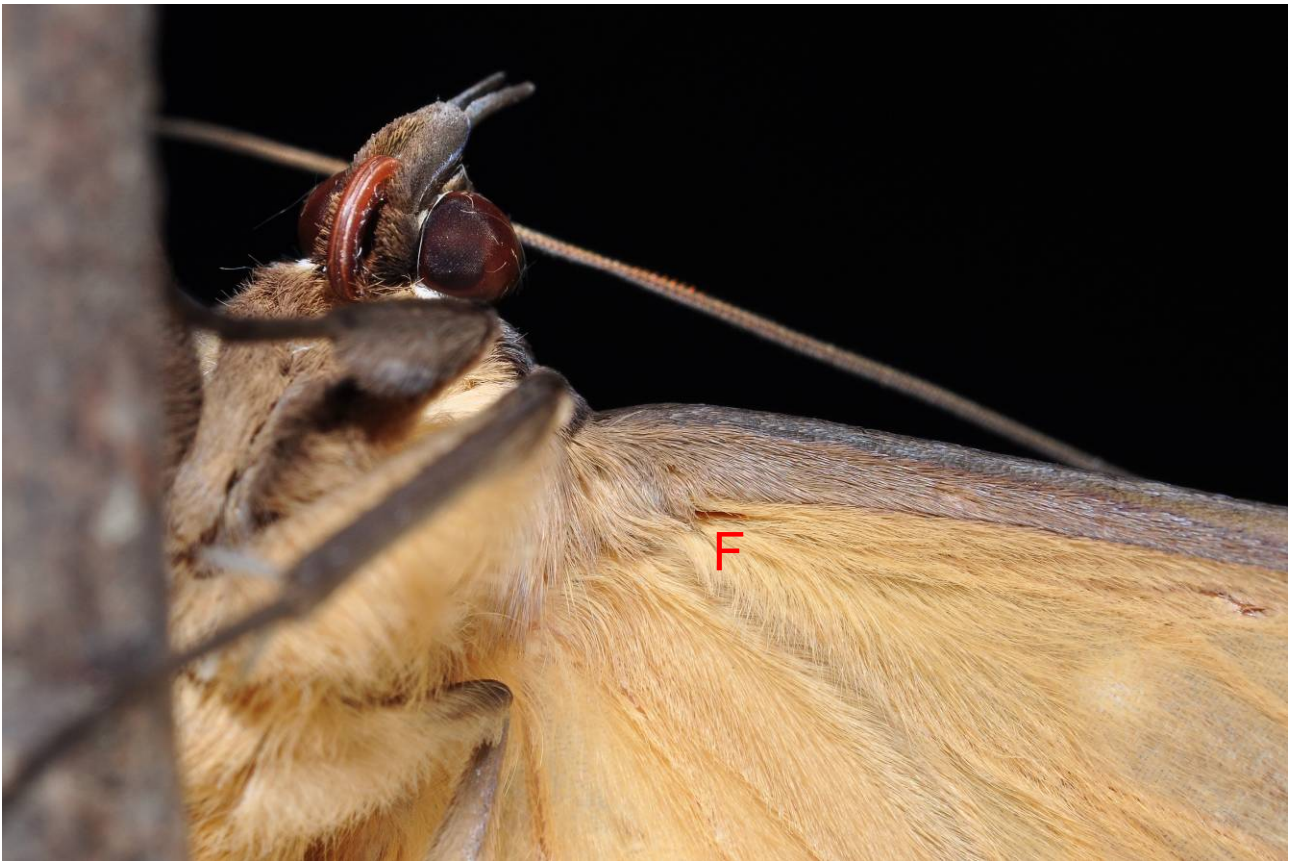


Fig. 17. Ventral close-up of the wing base (ZRC.LEP.337) to view the frenulum (F) that was coupled to the hook-like retinaculum, not readily discernible here as it was obscured by long hairs.



Fig. 18. The freshly vacated pupal case, still lying in a pool of meconium that was secreted by the moth upon eclosion. It was subsequently cleaned and preserved (ZRC.LEP.337).

ACKNOWLEDGEMENTS

I am grateful to Gwee Aik Teck (Herbarium, Singapore Botanic Gardens) for kindly identifying the larval hostplant to species level. Jeremy D. Holloway (Natural History Museum, London) provided an update on the higher classification of this moth. I thank Kelvin K. P. Lim and Lua Hui Kheng for granting permission to examine the moth specimens at the ZRC Lepidoptera collection. An anonymous lepidopterist reviewer provided valuable comments which improved the original manuscript.

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