

**COCOON AND PUPA OF THE MOTH *CYANA PERORNATA* (WALKER, 1854)  
FROM SINGAPORE, WITH A DEDUCTION OF ITS LARVAL IDENTITY  
(LEPIDOPTERA: ARCTIIDAE: LITHOSIINAE)**

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**INTRODUCTION**

Members of the lithosiine genus *Cyana* Walker, 1854 belong to the tribe Nudariini (see Holloway, 2001). In Singapore, this genus is represented by at least five species, based on field encounters, museum specimens and published records (Holloway, 2001; Ades & Kendrick, 2004). The species include: *Cyana perornata* (Walker, 1854) [first described as *Bizone perornata*], *Cyana pudens* (Walker, 1862), *Cyana determinata* (Walker, 1862), *Cyana flavalba* (Rothschild, 1912), and *Cyana alborosea* (Walker, 1864). In Borneo, 17 species of *Cyana* have been documented (Holloway, 2001). The pupae of *Cyana* species are typically housed within a characteristic cage-like cocoon, its intricate architecture composed of carefully spaced secondary setae (e.g. Holloway, 2001: 333—Fig. 3). Within the forests of our Central Catchment Area Nature Reserves, similar cocoon structures have been regularly encountered, often with the pupa already eclosed. A recent attempt to rear a mature pupa till eventual metamorphosis has resulted in its confirmed identity as *Cyana perornata*, thereby prompting the investigation and designation of a previously encountered caterpillar candidate as its most likely larval form. Brief discussions on its larval diet, as well as sexual dimorphism in the adult moths are provided.



Fig. 1. Dorsal view of the cocoon and pupa (head towards top) of *Cyana perornata* attached to the rock face along Cave Path at the Bukit Timah Nature Reserve, encountered on the night of 9 Jul.2010 (ca. 2230 hours).



Fig. 2. Lateral view of the cocoon and pupa (as in Fig. 1). The elaborate mesh-frame of the cocoon was constructed out of secondary setae derived from its final instar larva. The cocoon was  $40 \times 28$  mm, while the pupa was  $20 \times 6$  mm. Although not immediately apparent, the cocoon design includes two subtle apertures. The bottom (posterior) aperture would facilitate expulsion of the exuvia of its final instar, while the top (anterior) aperture would allow exit by the emergent moth.

## OBSERVATIONS

While conducting a faunal survey on the night of 9 Jul.2010 (ca. 2230 hours), the cocoon and pupa of a *Cyana* species moth was encountered along Cave Path within the Bukit Timah Nature Reserve. It was situated at eye-level and attached to the rock face near the mouth of the cave. The cocoon and pupa were oriented vertically, with the head region directed upwards (Fig. 1). The cocoon measured 40 × 28 mm, while the pupa was 20 × 6 mm. Upon closer inspection, it could be discerned that the entire cocoon framework was composed of intricately arranged setae recycled from its final instar larva (Fig. 2).

The cocoon structure resembled a cage, with quadrangles formed by the intersecting setae. At both apices of the cocoon, the setae converged over two apertures: the bottom (posterior) aperture possibly facilitating disposal of its larval exuvia post-pupation, while the top (anterior) aperture allows for the emergent moth to climb out from. The colour of the pupa was a striking combination of brownish-orange with symmetrical black stripes and patches. The spiracles along its abdomen were also highlighted in black. Its ventral surface was parallel with the rock face and securely attached via a sparse network of silk. After in-situ photography, the cocoon/pupa was carefully peeled off the substrate to be reared till metamorphosis.

On the night of 11 Jul.2010 (ca. 2030 hours), a well-developed adult moth emerged from within and was determined to be a female *Cyana perornata* (Fig. 3). The attractive red-and-black patterns over its overall white background were consistent with a published illustration for the female of this species (Holloway, 2001: Pl. 1–moth 16). The female was subsequently retained as a voucher specimen and deposited at the Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity Research (RMBR), National University of Singapore, with measurements of its body length (BL) and forewing length (FW) recorded. It was catalogued as ZRC.LEP.300 (BL: 17 mm, FW: 19 mm) and preserved together with its corresponding cocoon and pupal case.

In the field, there have been prior encounters with adult moths of this species, all recorded within the Central Catchment Area Nature Reserves. For example, a male moth was sighted at Jelutong Tower, MacRitchie Reservoir forest on 20 Sep.2008 (ca. 2215 hours) as it was attracted to a light sheet. On 14 Nov.2009 (ca. 1955 hours), a male moth was encountered resting under a leaf at the Nee Soon Swamp Forest (Fig. 4). On 17 Jun.2010 (ca. 1130 hours), a female moth was sighted at Bukit Kallang, while at rest on the wall of the Central Nature Reserve (CNR) Office of the National Parks Board (NParks). The above mentioned moths were all photographed in-situ and not collected as specimens.



Fig. 3. Newly emerged adult female *Cyana perornata* (ZRC.LEP.300, body length: 17 mm, forewing length: 19 mm) eclosed on the night of 11 Jul.2010 (ca. 2030 hours).



Fig. 4. A male *Cyana perornata* encountered at the Nee Soon Swamp Forest on the night of 14 Nov.2009 at ca. 1955 hours (specimen not collected). The black discal spot on each forewing is more elliptical, in comparison with that of the female. The red markings at the apex of its forewing are also more extensive (compare with Fig. 3).

Upon careful comparison between males and females of *Cyana perornata*, the inherent sexual dimorphism soon becomes apparent. A majority of these morphological differences reside in the forewing design/pattern. In males, the black discal spot is more elliptical (round in females), the red markings on the apex are more extensive (less so in females), the tornus is more angular (broadly rounded in females) (see Fig. 5a: male, dorsal). Examination of the underside of the male's forewings reveals the presence of prominent pinkish androconial patches at the anterior margin (absent in females) (see Fig. 5b: male, ventral). An example of a previously published male *Cyana perornata* appears in Holloway (2001: Pl. 1—moth 6).

In Asia, the caterpillars and/or cocoon, pupae of a handful of *Cyana* species have been described, based on Javanese and Japanese species (Holloway, 2001). The known larvae are generally dark-bodied and heavily armed with long, black setae originating from prominent verrucae. Additional markings of whitish, ochreous or red may be distributed over the thoracic and abdominal segments, including the verrucae. Their documented foodplants include either mosses or lichens growing on rocks, walls or tree trunks (Holloway, 2001). In the central forests of Singapore, caterpillars that were consistent with the characteristic morphology and feeding preference of *Cyana* species have been regularly sighted, usually at night. However, these caterpillars occurred in a range of sizes, as well as slight modifications of colour patterns, most certainly representing various larval instars of different species. Nevertheless, *Cyana perornata* is regarded as the largest species for its genus in Borneo (Holloway, 2001), as well as in Singapore. Hence, it would be a reasonable deduction to allocate the larger *Cyana* caterpillars as belonging to this species.

An example of such a caterpillar candidate was encountered at Bukit Timah Nature Reserve on the night of 23 Oct.2009 (ca. 2020 hours). This final instar caterpillar had a total length of ca. 40 mm and was an overall velvety black (Fig. 6). Throughout its body, there were dorsal, lateral and ventro-lateral rows of reddish verrucae, from which multiple setae originated. On the dorsum of its first abdominal segment (A1), there was a pair of cream coloured dots. Posterior to this, pairs of finer dots were present on the dorsum. This caterpillar was observed to be quietly feeding on the film of lichen growing at the base of a large tree, at knee-level. Based on available evidence, it was thus deduced with reasonable confidence that this caterpillar was highly likely to belong to *Cyana perornata*. Although this caterpillar was not reared ex-situ (owing to the challenges of providing suitable lichen/moss food), subsequent attempts may serve to confirm the present deduction if successful metamorphosis is achieved.

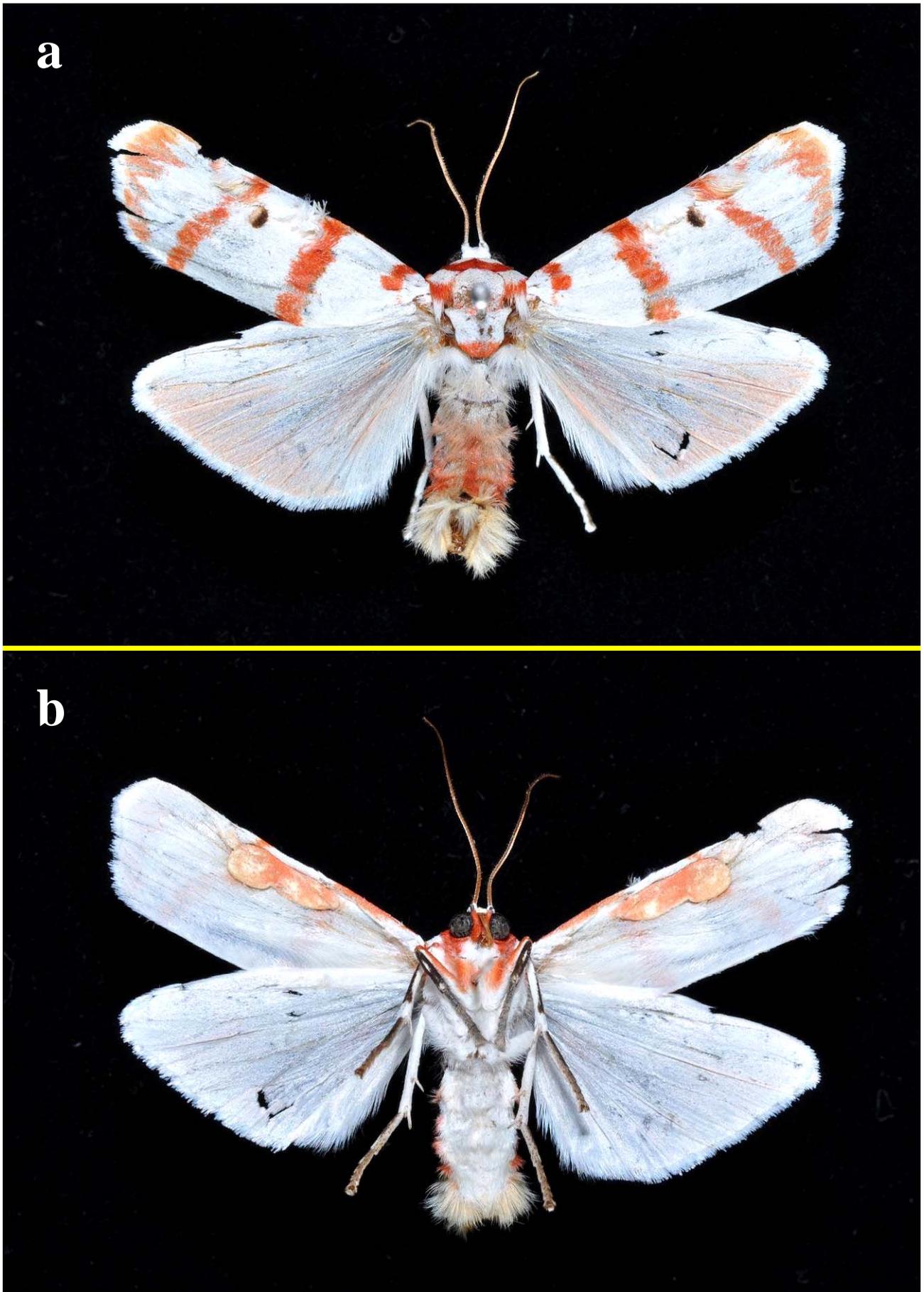


Fig. 5. Dorsal (a) and ventral (b) views of a male individual (ZRC.LEP.299, body length: 17 mm, forewing: 17 mm), collected from the Lower Peirce forest on the night of 4 Jun.1992. Note prominent pinkish androconial patches along the anterior margin of the forewing underside (b).



Fig. 6. Dorsal (a) and lateral (b) views of a final instar larva (total length ca. 40 mm) that is deduced to be that of *Cyana perornata*. Note the dense arrangement of long setae (black with white tips), radiating from uniform rows of reddish verrucae. These setae would subsequently be employed in the cocoon construction prior to pupation. This particular larva was feeding on the lichen growth at the base of a tree within the Bukit Timah Nature Reserve on the night of 23 Oct.2009 (ca. 2020 hours).

**COMPARATIVE MATERIAL EXAMINED**

***Cyana perornata* (Walker, 1854)**

ZRC.LEP.297 (female, BL: 15 mm, FW: 18 mm), coll. Nature Reserves Survey, 28 May 1992, Nee Soon Swamp Forest, light trap; ZRC.LEP.298 (female, BL: 17 mm, FW: 19 mm), ZRC.LEP.299 (male, BL: 17 mm, FW: 17 mm), both specimens coll. Nature Reserves Survey, 4 Jun.1992, Lower Peirce forest, light trap.

***Cyana determinata* (Walker, 1862)**

ZRC.LEP.316 (female, BL: 11 mm, FW: 14 mm), coll. L. L. Koh, 17–18 Jan.2006, Nee Soon Swamp Forest.

***Cyana pudens* (Walker, 1862)**

ZRC.LEP.317 (female, BL: 7 mm, FW: 9 mm), coll. Nature Reserves Survey, 28 May 1992, Nee Soon Swamp Forest; ZRC.LEP.318 (male, BL: 7 mm, FW: 8 mm), coll. Nature Reserves Survey, 4 Jun.1992, Lower Peirce forest.

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**LITERATURE CITED**

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