

## OBSERVATIONS OF PUPAL ECLOSION AND PHEROMONE RELEASE IN THE OLEANDER HAWKMOTH, *DAPHNIS NERII* (LINNAEUS, 1758) (LEPIDOPTERA: SPHINGIDAE: MACROGLOSSINAE)

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### INTRODUCTION

The caterpillars of the oleander hawkmoth, *Daphnis nerii* (Linnaeus, 1758) were previously reared to metamorphosis and briefly described by Leong & D’Rozario (2009) based on encounters in Singapore. A recent rearing of the same species provided the opportunity to document the precise moment of eclosion from the pupa, as well as to observe subsequent behaviour of pheromone release by the female hawkmoths.

### OBSERVATIONS

On 26 Sep.2011, an aggregation of oleander hawkmoth caterpillars (about 10–15 individuals) was encountered on an oleander bush (*Nerium oleander*, family Apocynaceae) growing along East Coast Terrace. The caterpillars were mostly in their final instar and feeding on the leaves, as well as the flowers of its hostplant (Figs. 1, 2). When disturbed, the caterpillars would display their characteristic defensive posture, tucking in their heads and exposing the prominent ocelli on the third thoracic segment (Fig. 3). Four caterpillars were collected to be reared in captivity. The caterpillars demonstrated a healthy appetite for the oleander leaves and by 29 Sep.2011, pre-pupal colouration and behaviour were noticed. By 1 Oct.2011, the caterpillars had already completed pupation.



Fig. 1. Final instar caterpillar of the oleander hawkmoth, *Daphnis nerii*, perched on its namesake hostplant, *Nerium oleander* (Apocynaceae) growing along East Coast Terrace on 26 Sep.2011. Its body length was ca. 75 mm, with a tail horn 4 mm long.



Fig. 2. Anterior close-up of a final instar caterpillar (as in Fig. 1) feeding on flower buds of *Nerium oleander*.



Fig. 3. Typical defensive posture of the final instar caterpillar (body length 80 mm). With its head tucked ventrally, the prominent pair of ocelli (but only one ocellus shown here) on its third thoracic segment (T3) is clearly displayed.

On the evening of 11 Oct.2011, the pupae displayed signs of imminent eclosion, as the pupal cuticle had turned translucent and was delicate to the touch. At this stage, the symmetrical arrangement of its first two pairs of limbs and wings could be readily seen inside (Fig. 4). The intersegmental membrane of its abdomen also appeared slightly swollen and distended. The first two hawkmoths emerged at ca. 2030 and 2100 hours, but the moments of eclosion were not witnessed. Close attention was then patiently focused on the third hawkmoth, which eventually eclosed at precisely 2252 hours (Figs. 5, 6).

The first splitting of the pupal cuticle was preceded by noticeable movements of its fore- and midlegs. In particular, the midlegs appear to play a pivotal role in lifting away the anterior thoracic shield piece. Within 10 seconds, the body of the hawkmoth had advanced forward, with its head entirely removed from the cephalic helmet, and its antennae, eyes and proboscis were clearly visible (Fig. 5d). Twelve seconds after the start of eclosion, its wings had become fully liberated from the pupal case (Fig. 6a). Shortly after, the hawkmoth quickly extricated itself and adopted an upright posture to scramble away in search of the nearest possible perch (Fig. 6b). In total, the entire eclosion process was completed in ca. 18 seconds. Thereafter, the hawkmoth was provided a branch on which to extend and stiffen its wings (Fig. 7).

All four of the hawkmoths successfully eclosed eventually and were found to be females. Two specimens were preserved soon after eclosion, while two others were kept alive for subsequent observation. After two days, the hawkmoths were observed to arch their abdomens while perched. Distally, a golden brown gland was extruded, and upon close examination, slow and deliberate pulsations of the dorsal membrane could be detected (Figs. 8, 9). The rhythmic contractions of this pheromone gland ranged between 15–17 pulses  $\text{min}^{-1}$ . A video clip of this process of pheromone dissemination was recorded and uploaded online (<http://www.youtube.com/watch?v=MOwb5URMMfA>).

The extrusion of the pheromone gland, accompanied by regular pulsations occurring two days post-eclosion may be an indication of a necessary period for ova maturation prior to female receptiveness (I. J. Kitching, pers. comm., Oct.2011). The females continued to exhibit such pheromone-release behaviour for at least three consecutive days, between ca. 0700–1800 hours. They were subsequently preserved as voucher specimens and deposited at the Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity Research (RMBR), National University of Singapore, where they are collectively catalogued as ZRC.LEP.358 (body lengths: 41–44 mm, forewing lengths: 38–42 mm).

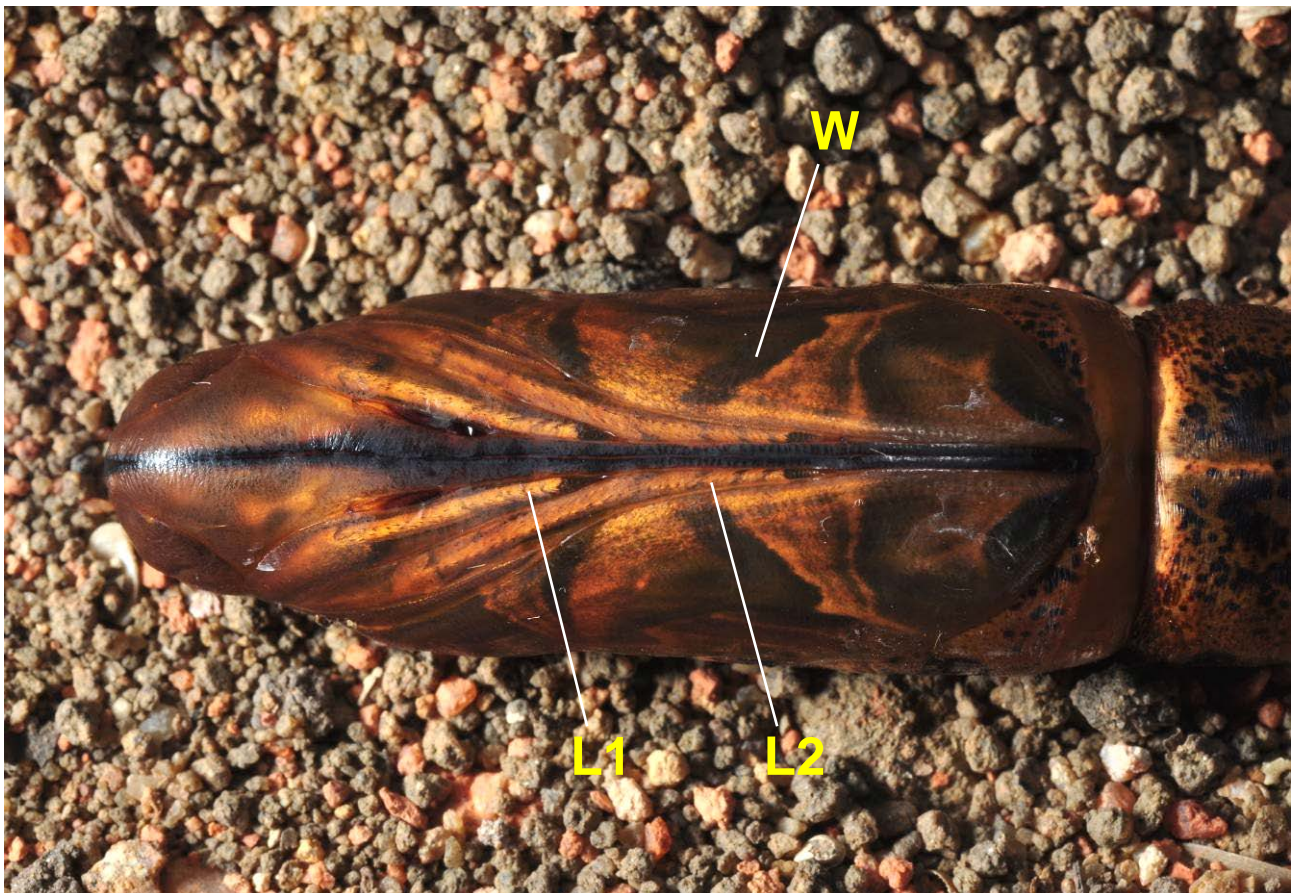


Fig. 4. Ventral close-up of the anterior segments of the pre-eclosion pupa. The pupal cuticle has become translucent, enabling clear views of the underlying wings (W) and anterior two pairs of limbs (L1, L2). Photographed on the night of 11 Oct.2011 (2230 hours).

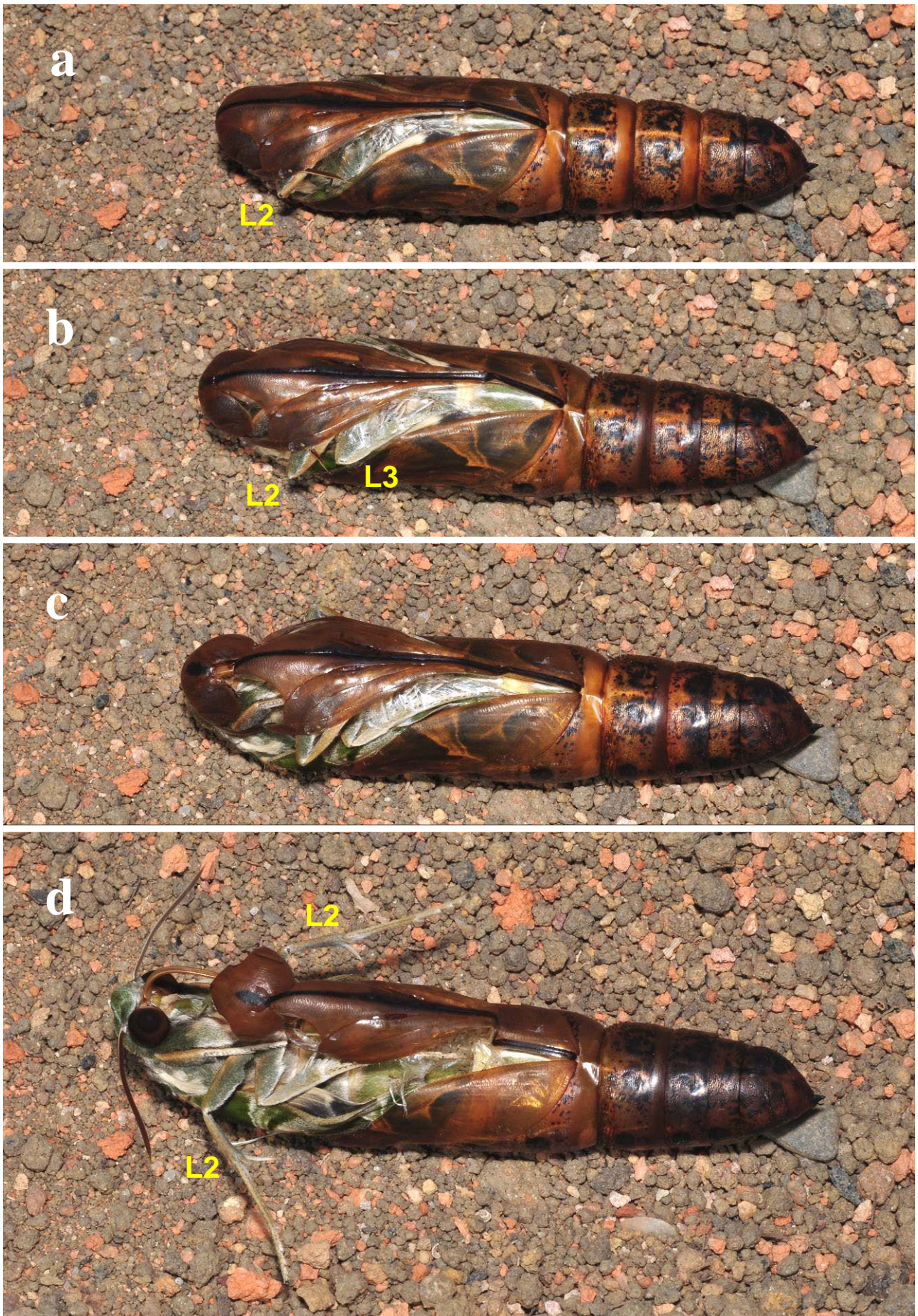


Fig. 5. Pupal eclosion sequence witnessed on the night of 11 Oct.2011, at 2252 hours: a-c, at 4-second intervals; and d, after 2 seconds. L2 and L3 refer to the second and third pairs of legs respectively.



Fig. 6. Continuation of pupal ecdysis sequence (from Fig. 5) on 11 Oct.2011, at 2252 hours after a 6-second interval, when the hawkmoth righted itself and crawled away hurriedly in search of the nearest perch.

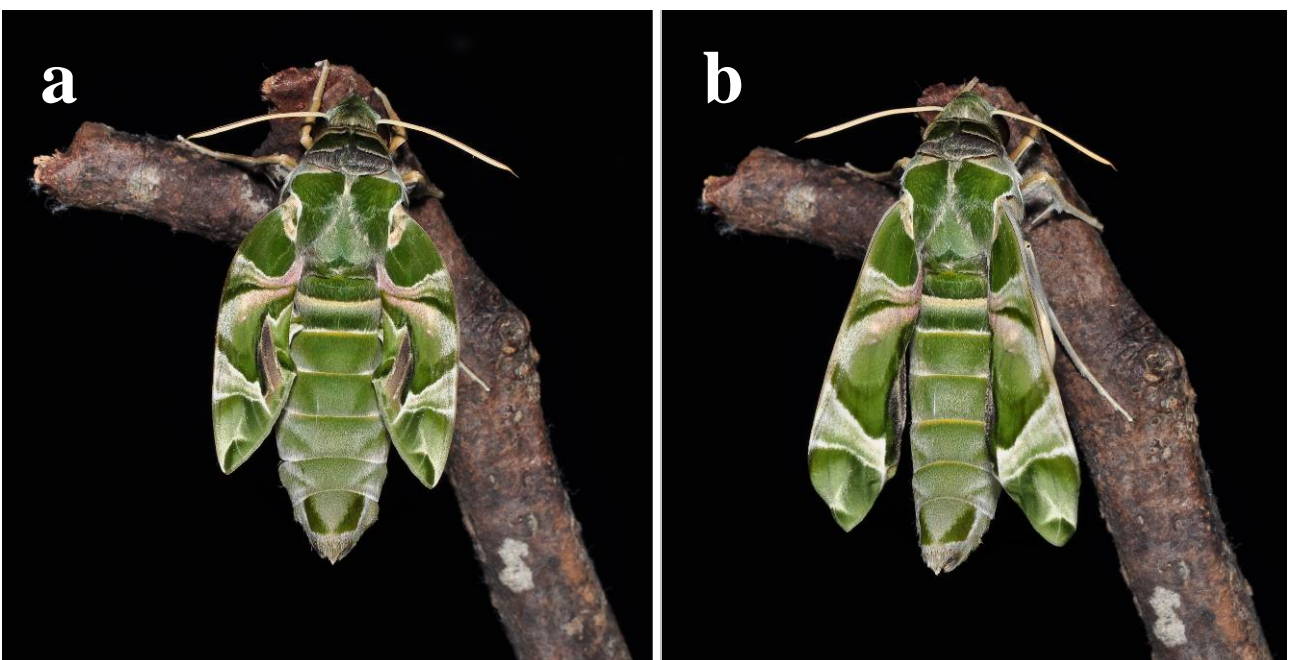


Fig. 7. Freshly eclosed hawkmoth (as in Figs. 4–6) extending its wings: a, at 2255 hours; and b, at 2300 hours.

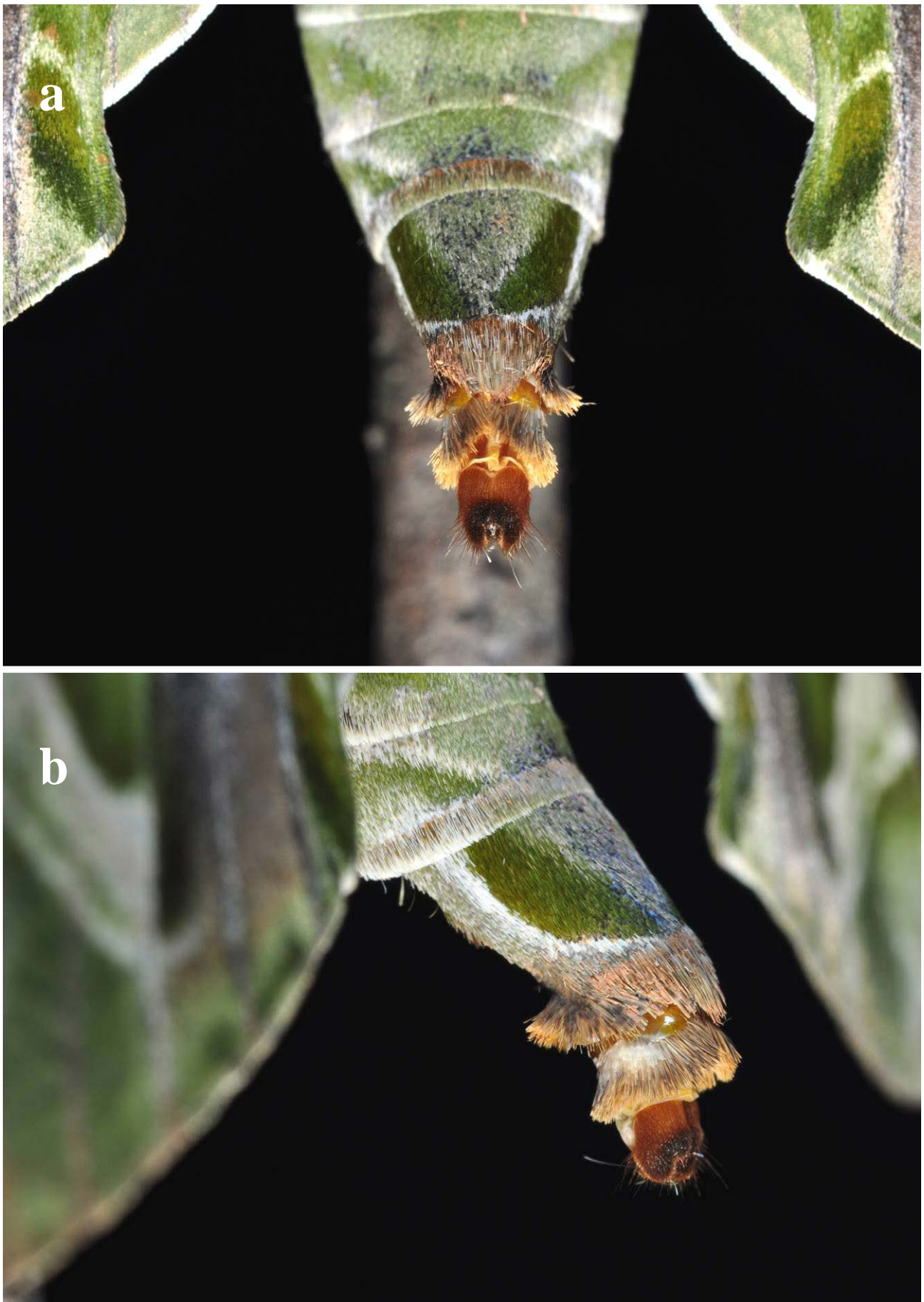


Fig. 8. Dorsal (a) and lateral (b) close-ups of the extruded pheromone gland of a female hawkmoth (ZRC.LEP.358, body length: 44 mm, forewing: 42 mm), first observed on the morning of 14 Oct.2011. Slow and deliberate pulsations of its dorsal membrane were observed (15–17 pulses  $\text{min}^{-1}$ ).



Fig. 9. Ventral close-up of the extruded pheromone gland of a female hawkmoth (as in Fig. 8).

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#### LITERATURE CITED

Leong, T. M. & V. D'Rozario, 2009. Final instar larvae and metamorphosis of the oleander hawkmoth, *Daphnis nerii* (Linnaeus) in Singapore (Lepidoptera: Sphingidae: Macroglossinae). *Nature in Singapore*, **2**: 297–306.