

LARVAL DEVELOPMENT AND METAMORPHOSIS OF THE HAWKMOTH, *THERETRA SUFFUSA* (WALKER) (LEPIDOPTERA: SPHINGIDAE: MACROGLOSSINAE)

T. M. Leong^{1*} and V. D’Rozario²

¹Central Nature Reserve, National Parks Board,

601 Island Club Road, Singapore 578775, Republic of Singapore

²National Institute of Education, Nanyang Technological University,

1 Nanyang Walk, Singapore 637616, Republic of Singapore

(*Corresponding author: leong_tzi_ming@nparks.gov.sg, baniarana@gmail.com)

INTRODUCTION

The hawkmoth, *Theretra suffusa* (Walker, 1856), has a broad South Asian to Sundaic distribution, having been recorded from Nepal, northeast India, southern China, Taiwan, Ryukyu Archipelago, Vietnam, Laos, Cambodia, Thailand, the Andaman Islands, Sumatra, Java, Peninsular Malaysia, Borneo and Palawan (the Philippines) (Pittaway & Kitching, 2008). A brief account of its larval development and metamorphosis in Singapore is reported here.

OBSERVATIONS

On the 18 Oct.2006, the second author noticed the droppings of a young caterpillar on the leaves of the native shrub, *Melastoma malabathricum* (family Melastomataceae) near the Western Catchment Area forest of Singapore. Upon closer inspection, she found the source to be a small sphingid caterpillar (Fig. 1) and subsequently brought it to the attention of the first author, who identified it and reared it to eventual metamorphosis. This particular individual was a brown-form caterpillar of *Theretra suffusa*, which is known also to have a green-form. The first author had previously attempted to rear a green form of this species from Bukit Kallang (MacRitchie Reservoir forest), but it proved to be parasitised by the larvae of a tachinid fly, and died before completing its metamorphosis.



Fig. 1. Early instar of *Theretra suffusa*, first found on 18 Oct.2006 by Vilma D’Rozario on its hostplant, *Melastoma malabathricum* (family Melastomataceae). Note the distinct row of lateral ocelli along the first seven abdominal segments. At this stage, its body length was 21 mm and the tail horn was 8 mm long.



Fig. 2. Close-up of the tail horn of the early instar. Note the uniform distribution of short, sharp thorns along its entire length.



Fig. 3. On 28 Oct.2006, the caterpillar moulted to its next instar. Note the empty shell of its head and the pale, deflated exuvia from which it emerged.

This early instar, brown-form caterpillar displayed a conspicuous row of seven distinct ocellar markings on the first seven abdominal segments of its body. Each ocellus was outlined by a continuous black ring and had a coloured, semicircular pattern in its upper half. In the first pair of ocelli, this semicircle was blue and clearly outlined in black. The caterpillar was 21 mm long, with a tail horn 8 mm long. The tail horn was almost straight, tapering towards a sharply pointed apex and the entire surface was adorned with small thorns (Fig. 2).



Fig. 4. On 1 Nov.2006, the penultimate instar exhibited pre-moult behaviour (non-feeding, remaining still) and colouration (head turning translucent green, skin of body becoming cloudy). At this stage, its body length was 55 mm and the tail horn was 10 mm long.



Fig. 5. On 2 Nov.2006, the caterpillar moulted into its final instar. Note the contracted, empty exuvia of its penultimate instar.

The caterpillar was noticed to have freshly moulted on 28 Oct.2006, when it was found perched beside its exuvia and empty shell of its head (Fig. 3). The tail horn appeared to be thicker and more robust, and was curved towards its apex. The caterpillar continued to feed and grow steadily until it was ready to moult yet again, displaying indications on 1 Nov.2006. It abruptly stopped feeding and remained motionless in a resting posture for at least 24 hours. This was accompanied by a noticeable change in colour: its head had become translucent green and its body appeared to have a cloudy sheen (Fig. 4). This penultimate instar was 55 mm long and had a tail horn 10 mm long.



Fig. 6. Full grown final instar (brown form) with a body length of 90 mm and tail horn length of 11 mm. At this stage, its tail horn has attained a bluish colour. Photographed on 4 Nov.2006.



Fig. 7. Dorsal close-up of the posterior of the final instar. The last pair of abdominal ocelli may serve as deterrent false eye-spots, startling any potential predators that approach the caterpillar from the rear.

As expected, the caterpillar moulted the following day, revealing slight changes in its colour pattern and tail horn morphology (Fig. 5). First, the first abdominal ocelli no longer had the earlier blue colour and the last abdominal ocelli now displayed the darkest semicircular pattern. Second, its tail horn was blunter at its apex and was purplish-brown. The colour of the tail horn subsequently turned blue over the next few days, which also marked a period of growth spurt as it eventually attained a length of 90 mm, with a tail horn 11 mm long (Fig. 6). When viewed from above, the posterior-most pair of ocelli was convincing as false eye-spots (Fig. 7). Despite having attained the upper limit of its larval size-range, the last instar continued to feed relentlessly prior to entering its prepupal stage (Fig. 8).



Fig. 8. Prior to its prepupal stage, the final instar continued to feed on the leaves of its hostplant at a steady rate, displaying a hearty appetite.



Fig. 9. Lateral (a) and dorsal (b) perspectives of the caterpillar exhibiting its characteristic prepupal colour patterns on 8 Nov.2006. Its body turned dark brown, with faint green dots on its dorsum, and the upper halves of its abdominal ocelli have turned entirely jet black.



Fig. 10. Ventral (a), lateral (b) and dorsal (c) perspectives of the pupa, with a length of 72 mm. The pupation process was complete by 12 Nov.2006. Its developing proboscis was housed in a protruding, semi-circular sheath projecting anteriorly. When disturbed, the pupa was able to swing its abdominal segments to the left and right repeatedly.

On 8 Nov.2006, the caterpillar displayed the attractive patterns of its transient, prepupal phase, whereby all the semicircular patterns within the abdominal ocelli became completely jet black. This drastic change of colour patterns was most visually striking, especially when viewed from above (Fig. 9). By the same afternoon, the prepupa had begun to spin silken threads between adjacent leaves around it. On 10 Nov.2006, there was a noticeable shrinkage of the prepupa, accompanied by the gradual discharge of fluids from the entire body. By 12 Nov.2006, the fully formed pupa was complete and the shed last instar skin was removed for preservation.

The chestnut brown pupa was 72 mm long and actively wriggled its abdominal segments when occasionally inspected to monitor its development (Fig. 10). Its proboscis sheath was drawn out anteriorly for about 10 mm, with a smooth, rounded anterior margin. After spending three weeks within its pupal case, the adult female hawkmoth finally emerged on 3 Dec.2006 (Fig. 11).



Fig. 11. On 3 Dec.2006, an adult female *Theretra suffusa* (ZRC.LEP.54, forewing length: 46 mm, body length: 50 mm) emerged from its pupa. Note the characteristic bright red of its hindwings.



Fig. 12. Vacated pupa after successful emergence of adult hawkmoth (ZRC.LEP.54).

The top of its head and thorax was dark brown, with a pinkish, mid-dorsal band that continued onto the abdomen, fading posteriorly. On the thorax, this was flanked by a pair of parallel, thin, golden-red stripes. The forewings had a combination of cream and dark brown oblique markings, but most noticeable was the red of the hindwings, visible when the forewings were parted to reveal this striking colour. The hindwings were bordered with a dark brown band along the posterior margin.

The adult female was preserved as a voucher specimen in the Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity Research, National University of Singapore (ZRC.LEP.54, forewing length: 46 mm, body length: 50 mm), together with its empty pupal case (Fig. 12). Two more adult specimens (both males) from Singapore were previously deposited in the ZRC. The earliest (ZRC.LEP.52, forewing length: 40 mm, body length: 45 mm) was obtained from Raffles College on 10 Aug.1947. The second (ZRC.LEP.53, forewing length: 40 mm, body length: 47 mm) was found by Doris Sam at a Seletar household on 27 Sep.2000. The red of the hindwings was faded in the older specimen. Based on available specimens, the males of this species are about 87% the size of the female.

Outside Singapore, the first author has encountered the adult of this species in a field research facility in Borneo (Bintulu Division, Sarawak, East Malaysia) on the night of 23 Apr.2007.

The earliest descriptions of the larva and pupa of *Theretra suffusa* were based on material from south China, where it was found feeding on *Melastoma sanguineum* (Mell, 1922). Subsequent descriptions of Javanese material were published by Dupont & Roepke (1941), where, like the Singapore population, it was also recorded feeding on *Melastoma malabathricum*.

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