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FINAL INSTAR CATERPILLAR AND METAMORPHOSIS OF THE HAWKMOTH, *ENPINANGA VIGENS* (BUTLER) IN SINGAPORE (LEPIDOPTERA: SPHINGIDAE: MACROGLOSSINAE)

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ABSTRACT. — The final instar caterpillar, its prepupal colour pattern, as well as the pupa of *Enpinanga vigens* (Butler) are described, accompanied with detailed photographs, which probably represent a first for this hawkmoth species. This caterpillar was feeding on the leaves of *Tetracera indica* (family Dilleniaceae) and successfully reared to metamorphosis. Morphological comparisons are also made with the final instar caterpillar of *Enpinanga borneensis* (Butler) to discern diagnostic differences.

KEY WORDS. — *Enpinanga vigens*, *Tetracera indica*, caterpillar, metamorphosis

INTRODUCTION

The hawkmoth genus, *Enpinanga* Rothschild & Jordan, is represented by three species in Asia, namely: 1) *Enpinanga assamensis* (Walker), 2) *Enpinanga borneensis* (Butler); and 3) *Enpinanga vigens* (Butler) (Inoue et al., 1997; Pittaway & Kitching, 2014). In Singapore, two species (*Enpinanga borneensis* and *Enpinanga vigens*) have been recorded, with prior efforts at rearing the caterpillars of *Enpinanga borneensis* (Leong, 2008). However, there have not been any encounters with those of *Enpinanga vigens* until recently. The geographical distribution of *Enpinanga vigens* encompasses south Thailand, Peninsular Malaysia, Sumatra, Java, Borneo, and the Philippines (Holloway, 1987; Inoue et al., 1997).

In Singapore, encounters with the adults of *Enpinanga vigens* have been few and far between. There are pictorial records from the island of Pulau Tekong, with a worn female photographed by Kelvin K. P. Lim (Fig. 1A), and a male photographed by Suay Hwee Yeo (Fig. 1B). Both moths were encountered in Dec.2005. In Borneo (Bintulu Division, Sarawak), a male specimen was encountered by the first author in Apr.2007 (Fig. 1C).

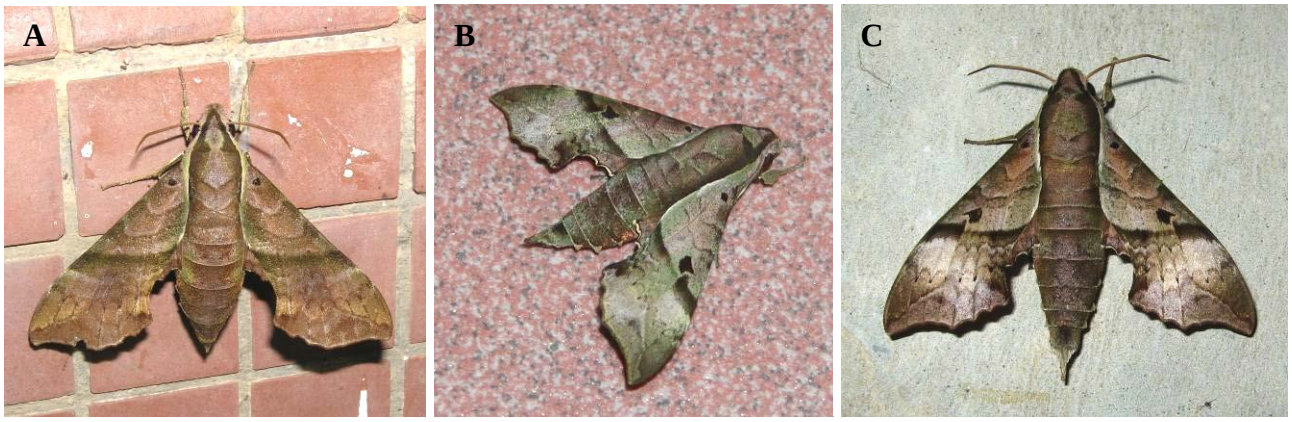

Fig. 1. A, female *Enpinanga vigens* from Pulau Tekong, Dec.2005; B, male *Enpinanga vigens* from Pulau Tekong, Dec.2005; C, male *Enpinanga vigens* from Bintulu Division, Sarawak, Borneo, Apr.2007. Body lengths of hawkmoths between 26–28 mm. (Photographs by: Kelvin K. P. Lim [A], Suay Hwee Yeo [B], Tzi Ming Leong [C]).

OBSERVATIONS

On 8 Dec.2013, a final instar sphingid caterpillar was found among the foliage of *Tetracera indica* (family Dilleniaceae) growing on a garden fence along Kew Drive, Singapore. It was well camouflaged and blended convincingly with the leaves on which it was feeding (Figs. 2, 3). Its body length was 58 mm, with a posterior tail horn length of 8 mm. Its entire body was predominantly leaf-green, with a pair of thin dorsal stripes that extended from its head to the base of its tail horn. From this pair of dorsal stripes, a series of diagonal stripes branched off towards the ventral side, just passing below the black abdominal spiracles between A2 and A7.

At the anterior segments, a prominent ventrolateral expansion was noticeable at T3 and A1. The width of this thoracic flange was measured to be 15 mm, while its body width (measured at mid-section) was 8 mm. The margins of this lateral expansion were ornamented with closely spaced tubercles. The tubercles were conical, yellow basally and tipped in white (Fig. 4). At T2, there is also a ventrolateral row of tightly spaced tubercles (yellow base with white tips), although these tubercles are smaller than those along T3 and A1. At T1, there is a single row of white granules beneath the spiracle. On its head and the anterior segments (T1 to A3), there is an even distribution of well-spaced, small, white granules. The posterior tail horn was robust and curved backwards. It was purplish brown and was uniformly adorned with low tubercles (Fig. 5). The tubercles were tipped with short, fine setae. The appearance of this final instar caterpillar agreed well with earlier published illustrations for that of *Enpinanga vigens* [Dupont & Roepke, 1941: pl. 5, figs. 25, 26 (line drawings, dorsal and lateral views); pl. 10, fig. 9 (colour painting, caterpillar depicted on leaf of *Tetracera*)].

By the morning of 10 Dec.2013, the prepupal colour changes were already noticeable in this caterpillar (Fig. 6). All traces of green had vanished from its body. Its background colour was pale yellow, with black reticulations along its flanks. A continuous, mid-dorsum yellow band was prominent. At the anterior segments, jet black patches decorated the sides of T1, T2, and T3. The margin of the ventrolateral expansion at T3/A1 was bordered with light rosy pink. By this time, the caterpillar had already ceased to feed. Its body continued to contract and by the morning of 12 Dec.2013, pupation was complete. The fully formed pupa was 33 mm long by 9 mm wide (Fig. 7). It was mostly light brown with three orange-brown inter-segmental rings encircling the abdomen. The wing discs were mostly dark brown. Its head was distinctly granular, with protruding knobs and raised ridges.

On the late afternoon of 23 Dec.2013, a female moth eventually emerged from the pupa and was confirmed to be *Enpinanga vigens* (I. J. Kitching, pers. comm.). Its body length was 27 mm, and forewing length was 26 mm. Its body and wings were chestnut brown, with darker brown markings on the head, thorax, and upperwing (Fig. 8). Lichen green scales were present on its limbs, inner margin of forewings, as well as near the tip of its abdomen. This hawkmoth was subsequently preserved as a voucher specimen and deposited at the Zoological Reference Collection of the Lee Kong Chian Natural History Museum, National University of Singapore (catalogue reference: ZRC.LEP.377).

Fig. 2. Lateral view of final instar caterpillar of *Enpinanga vigens* (body length 58 mm, tail horn length 8 mm), found on its hostplant *Tetracera indica* (family Dilleniaceae) along Kew Drive on 8 Dec.2013. (Photograph by: Tzi Ming Leong).

Fig. 3. Dorsal view of final instar caterpillar of *Enpinanga vigens* (as in Fig. 2). (Photograph by: Tzi Ming Leong).

Fig. 4. Lateral close-up of head and thoracic region of final instar caterpillar. (Photograph by: Tzi Ming Leong).

Fig. 5. Lateral close-up of posterior tail horn (8 mm). (Photograph by: Tzi Ming Leong).

Fig. 6. Dorsal view of pre-pupal caterpillar on the morning of 10 Dec.2013; compare with Fig. 3. (Photograph by: Tzi Ming Leong).

Fig. 7. A, ventral; B, lateral; and C, dorsal views of pupa (33×9 mm). (Photograph by: Tzi Ming Leong).

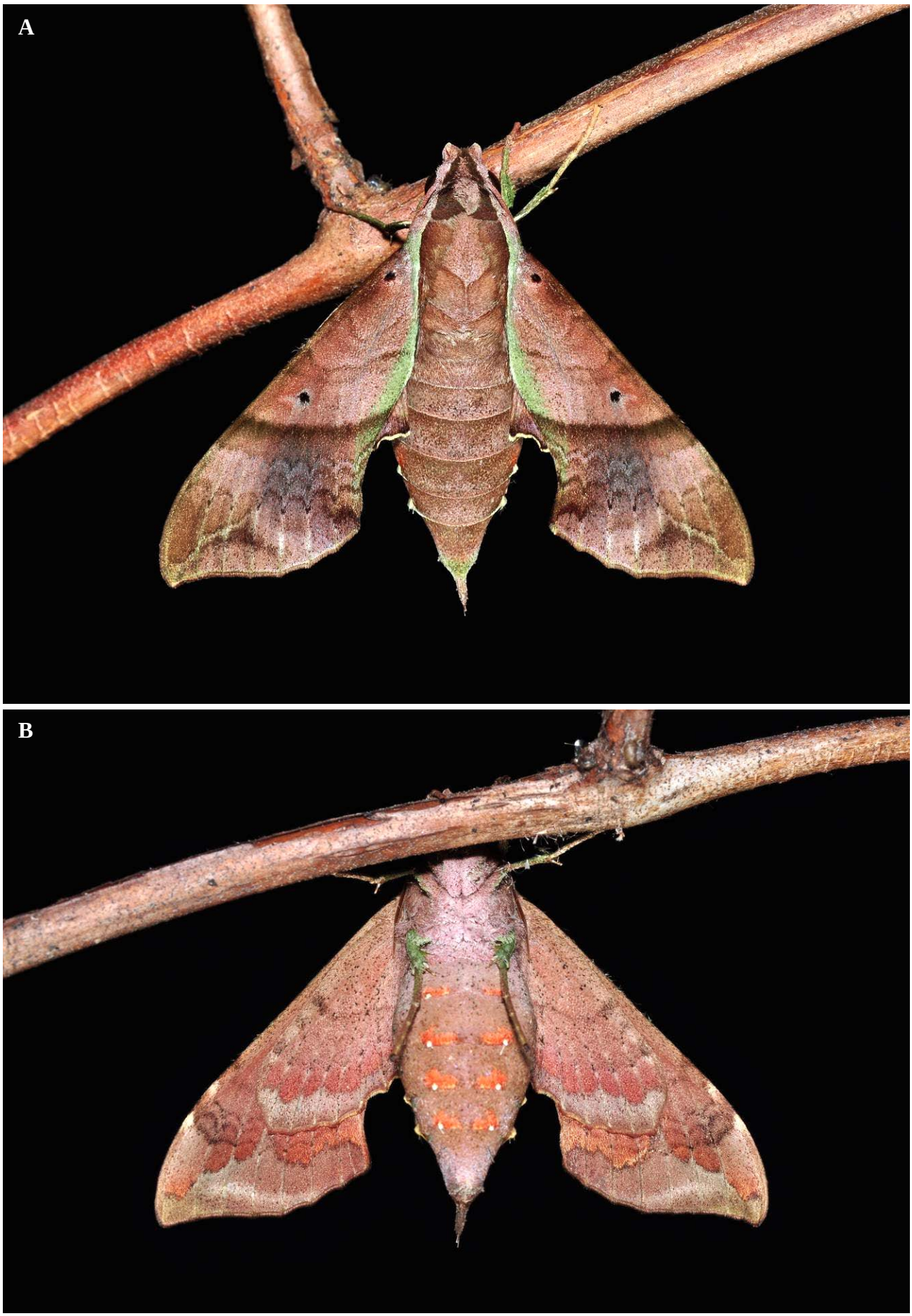

Fig. 8. A, upperside; and B, underside of freshly eclosed *Enpinanga vigens* female (ZRC.LEP.377, body length 27 mm, forewing 26 mm). (Photograph by: Tzi Ming Leong).

COMPARISONS WITH THE CATERPILLAR OF *ENPINANGA BORNEENSIS*

The final instar caterpillar of *Enpinanga borneensis* is similar to that of *Enpinanga vigens*, as both share an overall green body colour (Fig. 9; Leong, 2008). However, the pair of dorsal stripes in *Enpinanga borneensis* is less distinct and rather faint. For *Enpinanga borneensis*, there is also a ventrolateral expansion at the T3/A1 segments, but this is less pronounced than in *Enpinanga vigens*. This anterior flange has an orange margin, with a 'burnt' black spot anterior to the spiracle at A1 for *Enpinanga borneensis* (Fig. 10), but not so for *Enpinanga vigens* (Fig. 4). Along the rim of this ventrolateral expansion in *Enpinanga borneensis*, there is a row of small, white granules between T2 and the anterior half of A1 (Fig. 10), but these are not as closely arranged or as large as in *Enpinanga vigens* (Fig. 4).

Fig. 9. Final instar caterpillar of *Enpinanga borneensis* (body length ca. 70 mm) feeding on *Dillenia suffruticosa* (family Dilleniaceae) at Admiralty Park on 19 Oct.2011. (Photograph by: Tzi Ming Leong).

Fig. 10. Anterior close-up of final instar caterpillar of *Enpinanga borneensis* (as in Fig. 9). Compare with anterior details of *Enpinanga vigens* (Fig. 4). (Photograph by: Tzi Ming Leong).

There are also significant differences in the prepupal colour patterns between the two species. For *Enpinanga borneensis*, the prepupa retains much of its original green colouration (with some intensification), and displays deep green blotches between T2 and A1 (Leong, 2008: fig. 4). For *Enpinanga vigens*, virtually all traces of green are lost in the prepupa, as it acquires a contrasting yellow and black pattern (Fig. 6).

For the time being, the caterpillar and foodplant of the third species, *Enpinanga assamensis* remain largely unknown (Inoue et al., 1997; Pittaway & Kitching, 2014). It would be enlightening to see how its larval form compares with those of *Enpinanga borneensis* and *Enpinanga vigens*.

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