

## A description of the larva of *Heliaeschna uninervulata* Martin (Odonata: Aeshnidae) from Singapore, with notes on its relationships

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The larva of *Heliaeschna uninervulata* is described and figured for the first time. Its characters mostly fall within the limits of variation of *Gynacantha* spp. Comparison of the larval characters of *H. filostyla*, the only other member of the genus for which the larva is known, suggests that it is not congeneric with *H. uninervulata*.

**Keywords:** Odonata; dragonfly; larva; Aeshnidae; *Heliaeschna*; *Gynacantha*; Singapore

### Introduction

The genus *Heliaeschna* Selys, 1881 presently includes some 11–16 recognised species, 10 from tropical Africa (considered by Dijkstra [2005] to represent just five species) and six from south-east Asia. The genus has generally been considered to be closely allied to *Gynacantha* Rambur, 1842, and was erected primarily on the basis of venational differences from that genus, with the median space being crossed at least once in *Heliaeschna*, whereas in *Gynacantha* it is free. It has been remarked by Laidlaw (1923) and Dijkstra (2005) that the African and Oriental species show little similarity. In particular the ventral dentigerous plate on S10 of the female bears two spines in African species, the same number as *Gynacantha*, but 3–6 spines in Oriental species.

To date the larva has been described for just one species of the genus, *H. filostyla* Martin, 1906, from Sulawesi (Kawashima & Sasamoto, 2007). This species has long been considered to be dubiously placed within the genus (Lieftinck, 1937), thus no larva of an undisputed member of the genus has hitherto been known. It is to be hoped that larval characters may help us understand the relationships within the genus, and ultimately, whether Ethiopian and Oriental species are indeed congeneric. Recently RWJN succeeded in breeding a female specimen of *H. uninervulata* Martin, 1909, from an F-4 stadium larva discovered in a leaf littered forest pool of a secondary forest within Central Catchment Nature Reserve of Singapore, and the larva is here described from the exuvia.

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The adult specimen reared represents the second record of *H. uninervulata* from Singapore and the first specimen collected, the first record being based on a photograph of an ovipositing female (Tang, Wang & Hämäläinen, 2010). The species is unusual among members of the genus in that the median space is crossed by just one vein. Also the armature of the dentigerous plate with 3–4 short spines in a single row (Lieftinck, 1953), three in the present specimen, differs from most other Oriental members of the genus which have four spines in two rows of two.

## Area and methods

A single larva (F-4) was collected using a tray net from among leaf litter in a forest pool. The location is in the secondary forest of the Chestnut streams system within Singapore's Central Catchment Nature Reserve. The larva was returned to laboratory and reared to emergence in a small plastic aquarium tank (15 × 8 × 9 cm) half-filled with water. Some leaves were provided as substrate with a wooden stick added in as a support during emergence. The larva was fed almost wholly on Tubifex worms, *Tubifex tubifex* (Müller, 1774). Only on one occasion was the larva offered small fry of the Mosquito Fish (*Gambusia holbrooki* Girard, 1859). The exuvia was examined and dissected under a stereo microscope and figures prepared with the aid of a drawing tube.

## Material examined

1 ♀ exuvia (reared), collected as F-4 larva, 14 July 2010, Singapore, forest pool at Chestnut streams within Central Catchment Nature Reserve, RWJN leg., emerged 12 September 2010.

## Description

### Diagnosis

Habitus typically aeshnid; head rather large, legs moderately long, abdomen fusiform with very long anal appendages. Coloration generally dark brownish grey with pale mottling (Figure 1). Body surface generally finely pilose, with scattering of short, moderately sparse setae.

### Head

Large, roughly pentagonal, with very prominent eyes. Postocular lobes well developed and evenly rounded. Slightly raised suboval areas immediately behind bases of eyes, oblique patch across base of postocular lobes, areas of vertex and centre of labrum glabrous. Antenna seven segmented (S6–7 missing on both sides on exuvia but clearly present on a photograph of the living larva); S1 and S2 dark, broad and short; S3 pale, *c.* twice length and half width of S2; S4 and S5 *c.* half length of S3, pale with dark bands. Prementum (Figure 2a) of moderate length and broad distally; distal one third of lateral margins with fine forward-pointing serrations interspersed with sparse setae; distal (anterior) margin very slightly convex, with dense fringe of short fine setae; median cleft very short. Labial palp terminating in long, broad flattened, securiform inner process, produced to form a short inner hook apically; entire process with finely serrate inner margin. Median part of palp bearing five very long, strong setae arising from its inner surface, the anterior two extending beyond the distal margin of the securiform process. Movable hook moderately short and stout, bearing a distinct row of very fine setae for two thirds of its length.

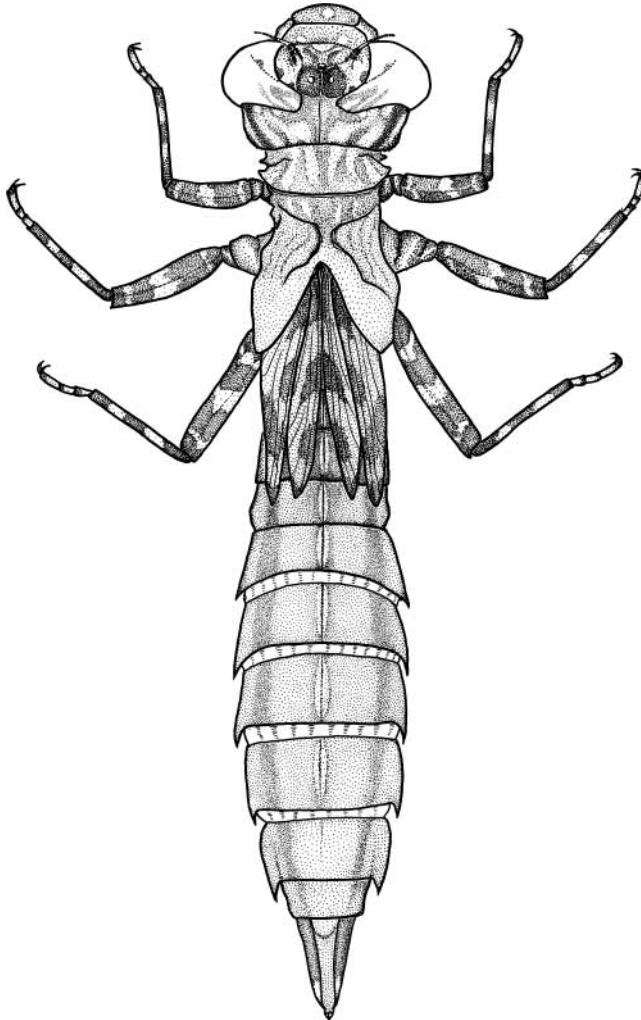


Figure 1. *Heliaeschna uninervulata* ♀ exuvia, habitus, dorsal view.

### ***Thorax***

Relatively short and narrower than head. Pronotum shield-shaped, terminating in two lateral, forward directed processes dorsally, visible as the posterior prothoracic process in Figure 1; ventrolaterally prothorax with two subequal finger-like processes above coxa bearing moderately long pale setae and several small spines (Figure 2b); (in Figure 1 only the anterior pair is visible, the posterior pair lying under the dorsal shield); space between two forming a ‘U’ shape. Legs moderately long, as shown in Figure 1, distinctly banded. Wing sheaths reaching anterior margin of S4 or a little beyond; distinctly banded.

### ***Abdomen***

Moderately high in profile, in section a somewhat flattened inverted catenary shape. Dorsal spines absent. In dorsal view strongly fusiform. S5–9 with short ventrolateral spines (Figures 1, 2d).

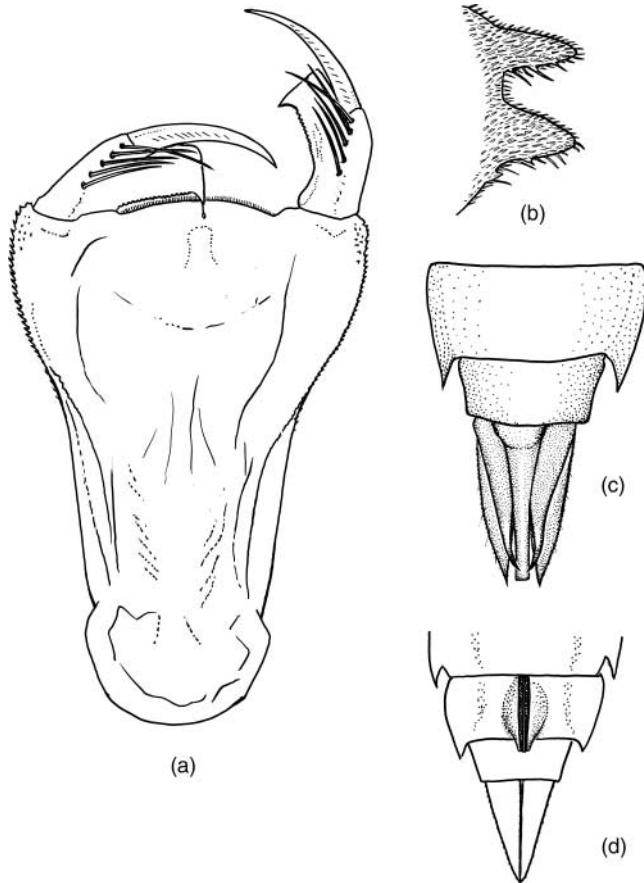


Figure 2. *Heliaeschna uninervulata* ♀ exuvia: (a) dorsal view of mask with prementum and labial palps; (b) right propleural processes immediately above prothoracic coxa; (c) S9–10 + anal appendages, dorsal view; (d) S8–10 + anal appendages, ventral view.

Appendages (Figure 2c) very long; epiproct 2.2 times length of S10, terminating bluntly. Paraprocts slightly longer, terminating in a sharp point; inner and outer margins weakly serrate with a few long fine setae and a sparse covering of fine short setae. Cerci very long, almost reaching end of paraproct, slightly hooked inward toward the tip and terminating in a sharp point. Gonapophyses (Figure 2d) extend for full length of sternum of S9 and overlap first quarter of S10; outer gonapophyses extending almost to tips of inner gonapophyses.

**Measurements (mm)**

Total length 30; head width 7.3; pronotum dorsal width 4.9; length of paraprocts 3.6.

**Habitat and behavioural observations**

The female larva was found in a pool near a forest stream. The pool was about 1 m deep and filled with dense leaf litter, fallen twigs and branches. The underlying substrate was muddy. The surrounding forest was mainly secondary with a small sandy stream flowing by.

In captivity, the F-4 larva spent much of the time grasping onto a wooden perch facing upwards near the water surface with its body held close to the wood. It remained completely submerged and motionless in this ambush stance. Occasionally, it would turn around to adopt the same stance but facing downwards. Prey in the form of *Tubifex* worms were seized with a quick labium strike. If prey was out of labium reach, the larva would move actively towards it. On the only occasion when small fry of Mosquito Fish (*Gambusia holbrooki*) were offered, the larva moved several times to adopt different ambush positions along the perch until it successfully captured this prey. All prey was consumed underwater; the larva never displayed semi-terrestrial behaviour such as displayed by *Tetracanthagyna plagiata* larvae (Orr, Ngiam & Leong, 2010). Faeces were projected out of water onto the tank surface. When approached by a foreign object such as a pair of forceps, the larva showed anti-predator behaviour by swivelling to the other side of the perch thus concealing itself from view.

The larva was fed almost daily resulting in rapid growth. From F-4 larva, it moulted to F-3 on 18 July 2010, F-2 on 25 July 2010, F-1 on 2 August 2010 and finally to F stadium on 18 August 2010. The moulting process to F stadium was witnessed at around 08:00 h. The larva moulted while facing downwards perched onto the wood. At the end of the moulting, the last piece of the exuvia hanging by the abdomen tip was discarded with a forceful flick. This action threw the old moult some distance away from the final instar larva.

Transformation occurred in the early hours of 12 September 2010. When observed at around 08:30 hrs, the adult was fully emerged with wings opened.

## Discussion

In its general form the larva of *H. uninervulata* exhibits a range of characters entirely consistent with those known for various species of *Gynacantha* and related genera. Typical features include the large head, prominent eyes, large rounded postocular lobes, sculpturing of the prothorax, elongate anal appendages and small posterolateral spines on abdominal segments 5–9, (sometimes 6–9 in *Gynacantha*—e.g. Matsuki, 1986b). Moreover, a close affinity with *Gynacantha* is indicated by the five large setae on the labial palp. As far as is known this character occurs in all *Gynacantha* species although the actual number of setae may be fewer as in *G. hyalina* Selys 1882 (Matsuki, 1986b), *G. basiguttata* Selys, 1882 (C.Y. Choong pers. comm.) and various Australian species as described and figured by Theischinger (2002) and Theischinger & Endersby (2009). Indeed the setae on the labial palps are probably as long and at least as stout as in any hitherto known aeshnid larva, and are exceeded in number by only a few species, such as *Austrogynacantha heterogena* Tillyard, 1908, *Triacanthagyna* species as presented by Heckman (2006), *G. dobsoni* Fraser, 1951 and *G. rosenbergi* Kaup, 1857 (Theischinger and Endersby, 2009). *G. japonica* Barteneff, 1909 also bears five large setae but these are shorter and finer (Matsuki, 1986a). The slightly convex anterior margin to the prementum is typical of Oriental and Australian *Gynacantha* as is the securiform shape of the inner process of the labial palp. Certain *Gynacantha* species bear a small tooth on the anterior margin of the prementum on either side of the median cleft. However this is lacking or vestigial in many species, such as *G. japonica*, in which the form of the mask is almost identical to that of *H. uninervulata*. The prothoracic processes are distinctly thinner than in *H. filostyla* or *G. rosenbergi* (Theischinger, 2007), the space between their adjacent margins being ‘U’-shaped as opposed to a ‘V’-shaped in those species. Nevertheless if the exuvia of *H. uninervulata* had been discovered without an associated adult, it would have been logical to assign it to *Gynacantha*.

The form of *Heliaeschna* larva described here is consistent with the close relationship between this genus and *Gynacantha* identified by von Ellenrieder (2002). However it shows fewer similarities with the larva of *H. filostyla*, described by Kawashina & Sasamoto (2007). In particular,

the form of the mask of *H. filostyla* is unlike that of *H. uninervulata* or any known *Gynacantha* or of *Austrogynacantha heterogena* Tillyard, 1908. Firstly, at the base of the labial palp and near the outer anterior margin of the prementum are small articulating spurs, also present in *Periaeschna laidlawi* (Förster, 1908) (Kawashima & Sasamoto, 2006) and *Tetracanthagyna* Selys, 1881 spp. (Orr et al., 2010), but absent from *H. uninervulata* or *Gynacantha* spp. Secondly, the inner process of the labial palp is rather hook-shaped, tending more to the form found in *P. laidlawi*, or at its most extreme in *Tetracanthagyna*, than in *H. uninervulata* or *Gynacantha* spp. Thirdly, the anterior margin of the prementum is deeply incised around the median cleft to form a rounded V leading into the cleft and on either side are two short rounded processes well removed from the cleft; marginal setae are dense and moderately long. These characters, especially the mid-lateral processes, occur variously and probably by convergence in *Periaeschna* Martin, 1909 (Kawashima & Sasamoto, 2006; Matsuki & Lien, 1984) and *Planaeschna* McLachlan, 1892 (Matsuki, 1989), but not in *H. uninervulata* or *Gynacantha* spp. Finally, in *H. filostyla* all setae on the labial palp are short and fine, although their position possibly suggests they may be homologous with the large setae of *H. uninervulata*. In their discussion, Kawashima & Sasamoto (2007) suggest a possible relationship between *H. filostyla* and the New Guinea genus, *Plattycantha* Lieftinck, 1937, the larvae of which remain unknown. This was based mainly on a comment by Lieftinck (1937) but the idea has broader acceptance (G. Theischinger pers. comm. 6/12/2010). The taxonomy of the genus *Plattycantha* Förster, 1908 is probably not yet resolved, and the relationships between the species of this genus and *H. filostyla* are worth investigating. Furthermore, it will be of considerable interest to examine the larvae of other Oriental and also African *Heliaeschna* species once they are discovered. At present most Oriental members of the genus, including *H. bartelsi* Lieftinck, 1940, *H. crassa* Krüger, 1899, *H. idae* (Brauer, 1865), *H. simplicia* (Karsch, 1891), but excluding *H. filostyla*, can be maintained as a separate genus (although possibly not *Heliaeschna* as the nominotypic species; *H. fuliginosa* Selys, 1883 may in fact belong to *Gynacantha* – Dijkstra [2005]) on adult characters, especially the armature of the dentigerous plate of female S10, but the larval characters of *H. uninervulata* are clearly not sufficient for separating the genera. It should however be noted that in other Oriental species presently included in the genus the dentigerous plate has two rows of spines rather than one row, suggesting a relatively distant relationship to *H. uninervulata*. Thus there is a possibility that Oriental *Heliaeschna* as currently recognised represents at least three different genera.

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