

## THE LARVA OF *LEPTOGOMPHUS RISI* LAIDLAW FROM SINGAPORE WITH A COMPARISON TO *LEPTOGOMPHUS WILLIAMSONI* LAIDLAW FROM SARAWAK AND CONGENERS (ODONATA: ANISOPTERA: GOMPHIDAE)

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**ABSTRACT.** — The final instar larva of *Leptogomphus risi* Laidlaw is described and illustrated for the first time based on an exuvia collected from Singapore. A comparison of this larva with known larvae of congeners is discussed, including a first description of the larva of *Leptogomphus williamsoni* Laidlaw from Sarawak.

**KEY WORDS.** — Odonata, dragonfly, *Leptogomphus*, larva, Singapore, Sarawak, Malaysia, Borneo

### INTRODUCTION

The dragonfly genus *Leptogomphus* currently consists of 22 valid species (Schorr & Paulson, 2013). *Leptogomphus* is an Asiatic genus of small- to medium-sized species, occurring throughout most of the Indomalaya ecozone. Fully matured adults are very elusive insects, as they appear to be predominantly inhabitants of the forest canopy. It is the teneral (freshly emerged) adults and females, when they descend briefly onto streams for oviposition, which are most often encountered. They are known to occur in small- to medium-sized stream habitats in primary and old secondary forest. In Singapore, only one species, *Leptogomphus risi* is known; this species does not occur in Sarawak. At least five species occur in Sarawak, including *Leptogomphus williamsoni*, all of which are endemic to the island of Borneo.

*Leptogomphus* larvae can be found in a wide variety of small- to medium-sized forest stream habitats. Larvae of five species are now known and described, with the latest descriptions by Xu (2012). The five are: *Leptogomphus elegans* Lieftinck; *Leptogomphus hongkongensis* Asahina; *Leptogomphus lansbergei* Selys; *Leptogomphus sauteri* Ris; and *Leptogomphus yayeyamensis* Oguma (Xu, 2012). The discovery of two more species reported in this article now brings the total to seven.

### MATERIAL AND METHODS

***Leptogomphus risi*.** — During a stream survey in the secondary forest of Venus Trail in Singapore on 10 Apr.2013, a teneral female gomphid was sighted on a leaf above the stream. It was quickly collected and later identified as *Leptogomphus risi* (Fig. 1A). Immediately below the collection spot, a fresh gomphid exuvia was found by the stream bank just above the water surface. It was inferred with confidence that the caught teneral female emerged from this exuvia. The stream was swift flowing and narrow and shallow being ca. 3 m wide and ca. 30 cm deep, respectively. The substrate was fine sand with leaf litter.

***Leptogomphus williamsoni*.** — A final instar larva was collected for rearing during a Jun.2013 expedition in Kapit Division, Sarawak, Malaysia. The larva was found by hand among leaf litter and in a sandy stream bed. It was a swift-flowing, small, narrow stream ca. 50 cm wide and ca. 20 cm deep at the edge of primary forest heavily disturbed by logging activities. The adult emerged after three weeks and identified as a female *Leptogomphus williamsoni* (Fig. 1B).

The exuviae of both species were examined and dissected under a stereo microscope. Specimen drawings were made using a stereo microscope drawing tube. Abbreviations used are: HW = hind-wing; TL = total length; F-0 = final instar larva; S (numerical number) = sequence of abdominal segment. Specimens will be deposited in the Zoological Reference Collection, Raffles Museum of Biodiversity Research at the National University of Singapore.

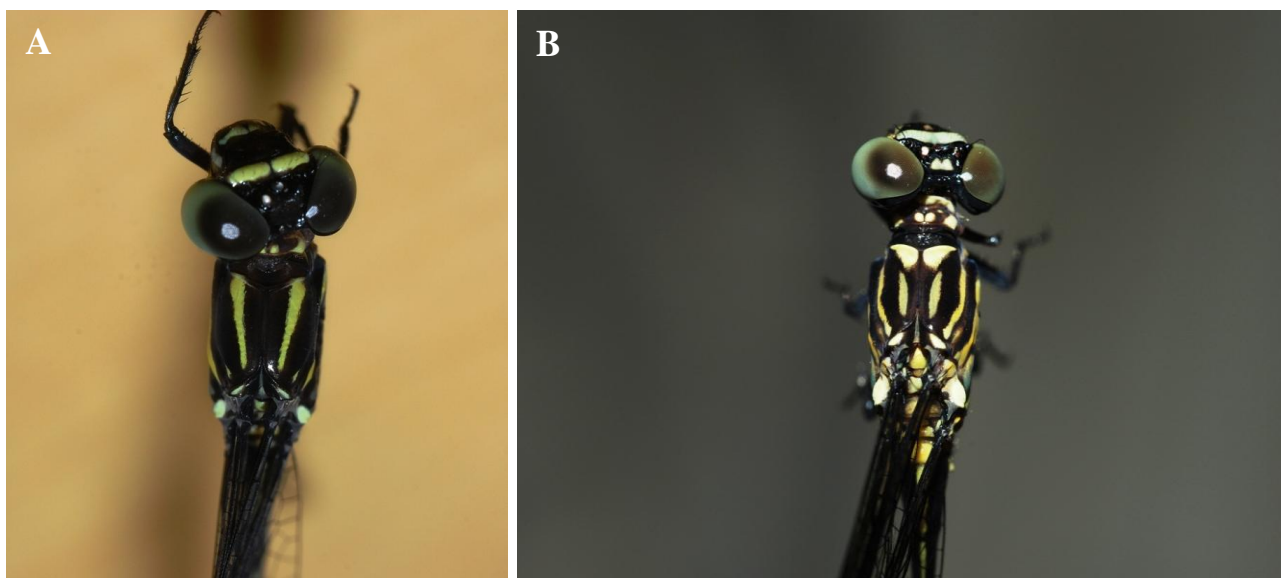


Fig. 1. Dorsal views of the head and thorax of adult *Leptogomphus risi* and *Leptogomphus williamsoni*, showing diagnostic thoracic markings. A, Adult female *Leptogomphus risi* collected from Venus Trail forest on 10 Apr.2013. Total length (TL) 50 mm; B, Adult female *Leptogomphus williamsoni* emerged from the larva collected from Sarawak on 11 Jun.2013. TL 40 mm. (Photographs by: Robin W. J. Ngiam).

## SPECIMEN DETAILS AND LARVAL DESCRIPTION

### *Leptogomphus risi* Laidlaw

**Material examined.** — One female teneral adult and one exuvia: adult HW length 33 mm, exuvia TL 21 mm, Venus Trail forest, Singapore, coll. R. W. J. Ngiam, 10 Apr.2013.

**Description of larva.** — The body is flattened, oviform, and very hairy throughout. It is uniformly brownish. The head is flattish and somewhat pentangular with the greatest width across the eyes. Three ocelli (indicated as light spots in the drawings) are obvious in a wide ocellar triangle. Antennae are four segmented. The first two segments are rectangular with rounded margins. The third segment is flat and elongated, oviform in dorsal view with the outer margin a bit more convex than the inner margin. The fourth segment is a tiny rounded tip.

The labium is flat and the prementum is longer than wide. In ventral view, setae are present on the prementum. These setae are spread across the entire distal end of the prementum (Fig. 2B). The medium lobe is slightly convex at the anterior border. About 18 small blackish serrations are present along the anterior border. Each serration bears a cluster of long setae. The labial palps are broad and robust, especially at the base where long setae are present. The inner margin of the internal lobe is concave with about 12 serrations. The movable hook is long and strongly incurved with a sharp apex.

The prothorax is slightly bulging and narrower than the head. The wing sheaths are strongly divergent. In the exuvia, the sheaths reach the base of the abdominal S4 segment. The length of the wing sheaths in the exuvia is less than that in the final instar (F-0) larva, owing to retraction related distortion during emergence. Therefore prior to emergence, the wing sheaths of the F-0 larva would have reached the middle or end of the S4 segment which is the case for *Leptogomphus williamsoni* (Fig. 3B).

The femur and tibia of fore and middle legs are of approximately equal length with digging spurs present on the distal end of all four tibia. For the hind legs, the femur is longer than the tibia. When pressed against the abdomen, the hind leg femur is about the same or slightly longer than wing sheaths. Three tarsal segments are present in the hind legs. All legs are hairy.

The larva is generally devoid of dorsal markings with the abdominal S7–10 segments darker. The distal part of the S9 segment is mostly black, centralising around the dorsal spine. The S10 segment and anal appendages are black. Dorsal tubercles are present and visible from the abdominal S3–S9 segments. These are most prominent and sharp on the S8 and S9 segments, with the apex entirely black and backward pointing (Fig. 2D). The dorsal tubercle on the S9 segment is largest and longest, extending to the middle of the S10 segment. Laterally projecting sharp spines are present at the distal edges of the S7–9 segments. The cerci are slightly shorter than the epiproct while the paraprocts are longer than the epiproct.

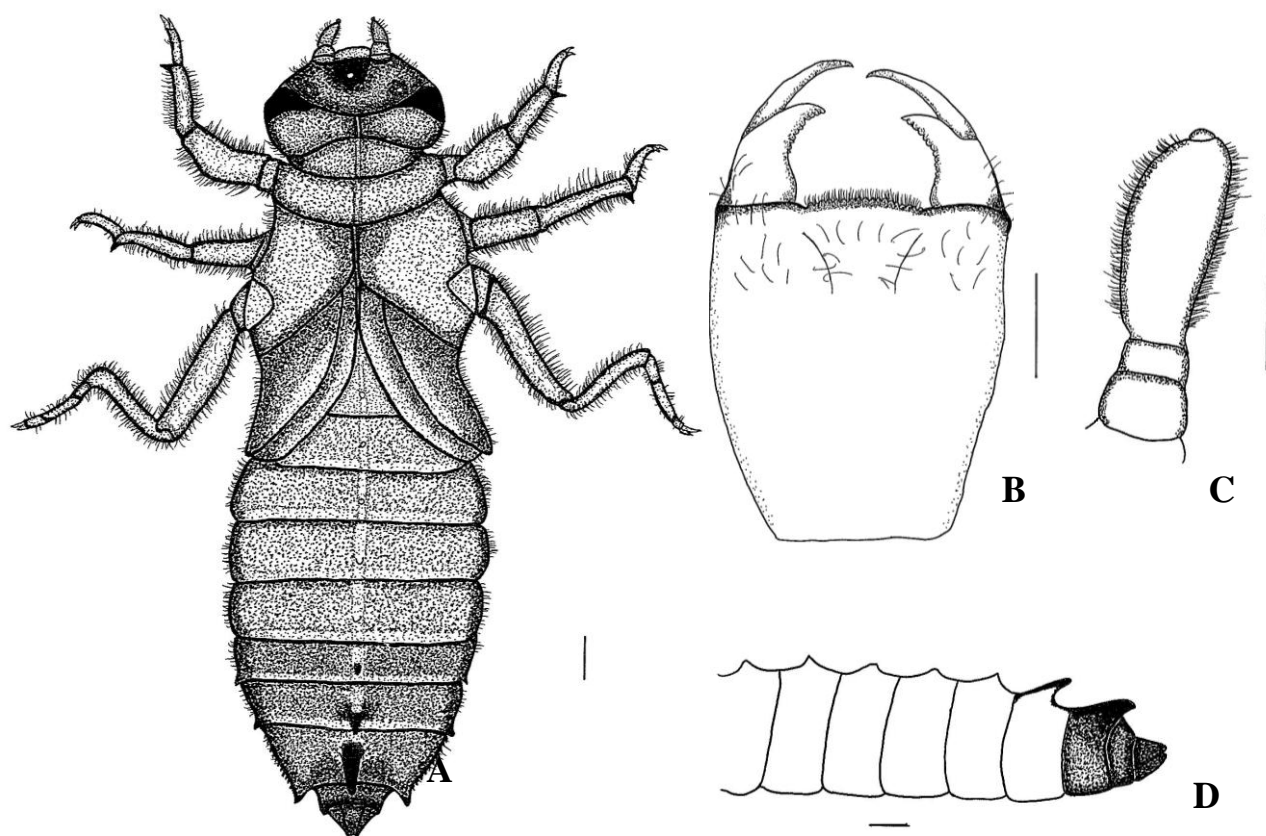


Fig. 2. A, Habitus drawing of *Leptogomphus risi* exuvia; B, Ventral view of prementum; C, Left antenna; D, Left lateral view of abdomen. Scale bars = 1mm. (Illustrations by: Robin W. J. Ngiam).

### *Leptogomphus williamsoni* Laidlaw

**Material examined.** — One female teneral adult emerged from larva and one exuvia: adult HW length 25 mm, exuvia TL 18 mm), Bukit Kumbong area, Ulu Baleh, Kapit Division, Sarawak, Malaysia, 1.69134N, 114.40421E, alt. 1,012 m, larva coll. R.W.J. Ngiam, 11 Jun.2013, female adult emerged 3 Jul.2013.

**Description of larva.** — The body is flattened, oviform, very hairy, and brownish. The head is flattish and somewhat pentangular with the greatest width across the eyes. Three ocelli are obvious in a wide ocellar triangle. Antennae are four segmented. The first two segments are rectangular with rounded margins. The third segment is flat and elongated, oviform in dorsal view with the outer margin a bit more convex than the inner margin. The fourth segment is a tiny rounded tip.

The labium is flat and the prementum is short and squarish. In ventral view, the setae are present on the prementum and they are concentrated in the central distal area (Fig. 4B). The medium lobe is slightly convex at the anterior border. About 18 small blackish serrations are present along the anterior border with each serration bearing a cluster of long setae. The labial palps are broad and robust. The inner margin of the internal lobe is concave with about 12 serrations. The movable hook is long and strongly incurved with a sharp apex.

The prothorax is slightly bulging and narrower than the head. Wing sheaths are strongly divergent and reach the middle of the S4 segment (Fig. 3B).

The femur and tibia of the fore and middle legs are of approximately equal length with digging spurs present on the distal end of all four tibia. The hind leg femur is longer than the tibia. When pressed against the abdomen, the hind leg femur is about the same or slightly longer than the wing sheaths. Three tarsal segments are present in the hind legs. All legs are hairy.

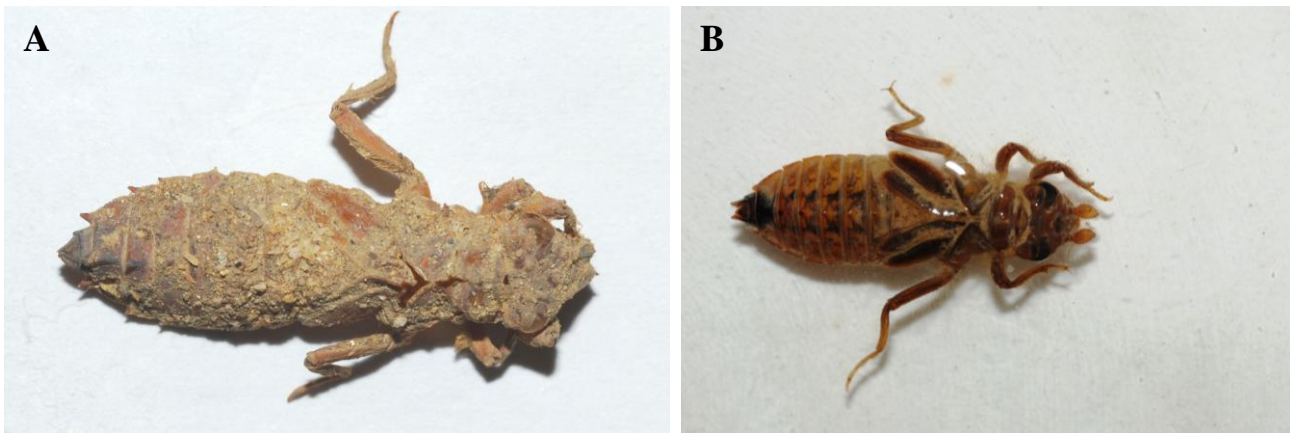


Fig. 3. A, Dorsal view of exuvia of female *Leptogomphus risi* collected from Venus Trail forest on 10 Apr.2013. TL 21 mm; B, Dorsal view of final instar larva of female *Leptogomphus williamsoni* (with missing right foreleg) collected from Sarawak on 11 Jun.2013. TL 18 mm. (Photographs by: Robin W. J. Ngiam).

Dorsal patterns on the abdomen are very distinct. From the abdominal S4–8 segments, markings resembling the letter ‘M’ are visible along the central dorsum (Fig. 4A). On both sides of this central pattern are fainter black blotches. The central dorsum of the S9 segment is entirely black, extending broadly from the proximal to distal end of the abdomen, forming a lamp shade-like mark. The S10 segment is entirely black. The anal appendages are mostly black proximally. The dorsal tubercles are minute and hardly visible except on the S4–6 segments (Fig. 4D). Laterally projecting spines are present at the distal edge of S7–9 but they are not protrusive. The cerci are slightly shorter than epiproct while the paraprocts are longer than the epiproct.

#### DISCUSSION

Based on the descriptions above, the two species can be tentatively differentiated by size (*Leptogomphus risi* is clearly larger and more robust), dorsal abdominal patterns, shape of prementum (*Leptogomphus williamsoni* is short and squarish whereas it is longer than wide in *Leptogomphus risi*), and the presence or absence of dorsal abdominal tubercles. However we emphasise that this is based on only two individual specimens and some of the characters may be phenotypical, for example, *Leucorrhinia* species have a loss or reduction in larval spines when in fishless lakes

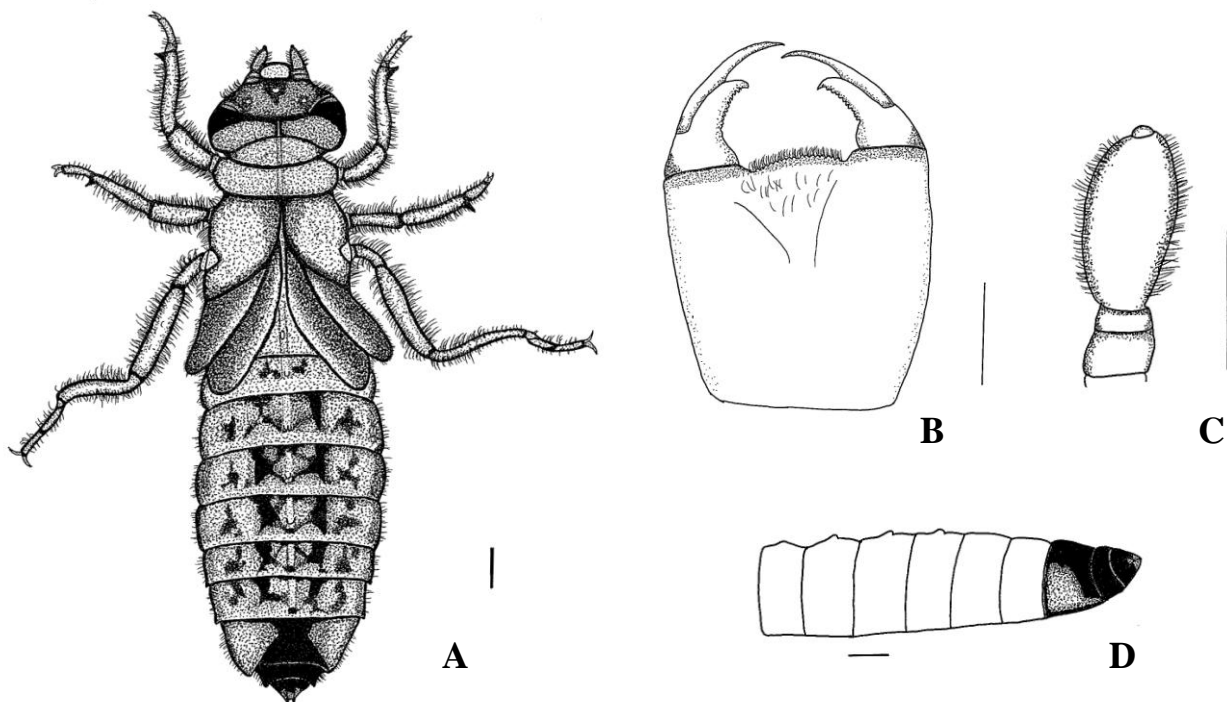


Fig. 4. A, Habitus drawing of *Leptogomphus williamsoni* exuvia with missing right foreleg visualised; B, Ventral view of prementum; C, Left antenna; D, Left lateral view of abdomen. Scale bars = 1 mm. (Illustrations by: Robin W. J. Ngiam).

compared to larvae in lakes with fish as top predators (Mikolajewski et al., 2010). Xu (2012) provided a comparative analysis of all known larvae in the genus. These two new discoveries contribute further to his analysis, as discussed below.

Prior to this article, the only other known *Leptogomphus* larva of Malaysian or Malesian origin (van Tol, 1990) was *Leptogomphus lansbergei* (Lieftinck, 1948). The other four known larvae are species from southern China, Hong Kong, Taiwan, and Japan. Consequently, Xu (2012) accentuated several morphological differences between *Leptogomphus lansbergei* and the other four species, giving the unintended impression that Malesian larvae have distinctive characteristics. Now, the known larva of *Leptogomphus risi* and *Leptogomphus williamsoni* proves otherwise.

Firstly, when describing the two subspecies of *Leptogomphus lansbergei*, Lieftinck (1948) did not remark any serrations along the anterior border of the prementum. This was highlighted by Chao (1990) and further mentioned by Xu (2012). All other known larvae in congeners have these serrations. The presence of these serrations in both species reported here shows that its absence is not a distinguishing feature for larvae of Malesian *Leptogomphus* species, but apparently an unfortunate oversight by Lieftinck.

Secondly, the wing sheaths of *Leptogomphus lansbergei* reach the end of the abdominal S4 segment while those in the other four species are shorter (Xu, 2012). The wing sheaths of the final instar of *Leptogomphus williamsoni* reach only to the middle of the S4 segment (Fig. 3B), thus demonstrating that shorter wing sheaths do occur in Malesian *Leptogomphus* species.

Thirdly, unlike the other four species, the two subspecies of *Leptogomphus lansbergei* do not have a dorsal tubercle on the abdominal S9 segment (Lieftinck, 1948). The presence of a large S9 segment tubercle on *Leptogomphus risi* shows that lack of this tubercle is not a distinguishing character of Malesian *Leptogomphus*. Moreover, evidence suggests the presence or absence and size of dorsal tubercles are phenotypic characters (Mikolajewski et al., 2010).

Lastly, the prementum of *Leptogomphus risi* is longer than wide, not squarish as inferred for Malesian *Leptogomphus* by Xu (2012).

Taking into account all the known larvae of *Leptogomphus*, Xu (2012) redefined the five major larval taxonomic characteristics of the genus. The characteristics of the larva of *Leptogomphus risi* and *Leptogomphus williamsoni* concur with the five characteristics which are summarised here: 1) body flattish, narrowly oblong; 2) antenna 4-segmented, third segment flattened, narrowly ovoid, fourth segment vestigial; 3) anterior border of prementum comparatively straight with row of squarish serrations; 4) wing sheaths strongly divergent; and 5) dorsal tubercles present on most abdominal segments, and for *Leptogomphus risi* in Singapore, the S9 segment tubercle is large and extends into middle of the S10 segment. Lateral spines are present on the S7–9 segments.

In Singapore, Tang et al. (2010) reported *Leptogomphus risi* as being very rare with only two known records. RWJN now has at least five more confirmed records in a working checklist since 2010. These records are from various localities in the Bukit Timah Nature Reserve and Central Catchment Nature Reserve. Hence the species is widely distributed in Singapore's forests but records remain sparse owing to its elusiveness.

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