

The larvae of *Macromia flavocolorata* and *M. septima* from Fujian, China (Odonata: Macromiidae)

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ABSTRACT

The final stadium larvae of *Macromia flavocolorata* and *M. septima* are described and illustrated for the first time. They are diagnosed against the congeners on the basis of published descriptions.

INTRODUCTION

Macromia is a large cosmopolitan genus of the family Macromiidae, with over a hundred species in the world (Silsby 2001: 151), and with 20 species in China (Zhu & Chen 2005; Xu & Liu 2008). The larval stages of most species within the genus are unknown, especially those of Chinese taxa. In China, Needham (1930) described the first *Macromia* larva from Fujian, but the species is still indeterminate. Then Lieftinck (1955) described two different *Macromia* larvae collected from Fujian, which can't be linked with any published species until now. Later, Matsuki & Lien (1982) described the larvae of *M. chui* Asahina and *M. clio* Ris in Taiwan, and provided a larval key for three Taiwanese *Macromia* species which included the former two species and *M. urania* Ris. Wilson & Theischinger (1996) last gave descriptions of the larvae of *M. berlandi* Lieftinck, *M. katae* Wilson, and *M. urania* collected from Hong Kong. In this paper, the final stadium larvae of *M. flavocolorata* Fraser and *M. septima* Martin are described and illustrated for the first time. The adult specimens emerged from these larvae were recorded and described in detail in another paper (Xu & Liu 2008).

METHODS

Larvae were collected mature or close to emergence by aquatic net and by hand respectively from Nanjing County, Fujian Province, and reared in an aquarium

with slow-running water and sand substrates. Bloodworms were supplied regularly as live food for larvae. Some sticks and a nylon net were introduced in the center of the container for larval emergence and for preventing escape of emerged adults. The final exuviae were extracted from their perches and preserved by immersing them in acetone for several hours in order to produce hard specimens for study. Diagnosis of each exuvia was based on the examination of acetone-treated specimens, with the naked eye or under a 10× magnifier and 45× stereomicroscope. Adult identities were confirmed according to the references of Asahina (1987) and Lieftinck (1929). All the specimens are deposited at Zhangzhou City University in Fujian Province, P.R.China.

LARVA OF *Macromia flavocolorata* Fraser, 1922

(Fig. 1)

Specimens studied

Altogether six exuviae – 1 ♀, Nanjing County (24°35'N, 117°22'E), leg. 07 v 2007, emerged 20 v 2007; 2 ♂, 3 ♀, same locality, leg. 21vi 2007, 1 ♀ emerged 27 vi 2007, 1 ♂ emerged 28 vi 2007, 1 ♀ emerged 30 vi 2007, 1 ♀ emerged 05 vii 2007, 1 ♂ emerged 14 vii 2007.

Description of exuvia

General appearance and colour pattern as in Figure 1a.

Head: Moderately wide, with eyes protruding dorsally. Antennae setaceous, as long as their diatance apart; segments 1-2 thickened, segment 1 almost twice as long and thick as segment 2; segments 3-7 slender, elongate and tapering. Postocular lobes (Fig. 1b) narrowly rounded, with nipple-shaped projections on postero-lateral angles. Frontal shelf (Fig. 1c) high, strongly upcurved and apically finger-shaped in frontal view. Prementum (Fig. 1d, 1e) a trifle longer than wide, with three well developed ventral longitudinal keels, one anteromedial and two lateral, the latter flaring outwards at apical 1/4. Apical border of prementum angularly projecting on middle, its free margin finely crenulate, and furnished with short and thin setae more laterally, and short spinoid setae more medially. Eight premental setae on each side, six longer ones followed inwards by two shorter ones. On each side five long palpal setae and a shorter basal one. Palpal lobes with four/five (left/right) deep irregularly V-shaped indentations and with five/six (left/right) large projections, the projections convex laterally with very finely crenulate margins, carrying a varying number of large spinoid setae.

Thorax: Prothorax about as wide as head; lateral prothoracic processes (Fig. 1f) poorly differentiated, anterior process a larger angular lobe, posterior process a

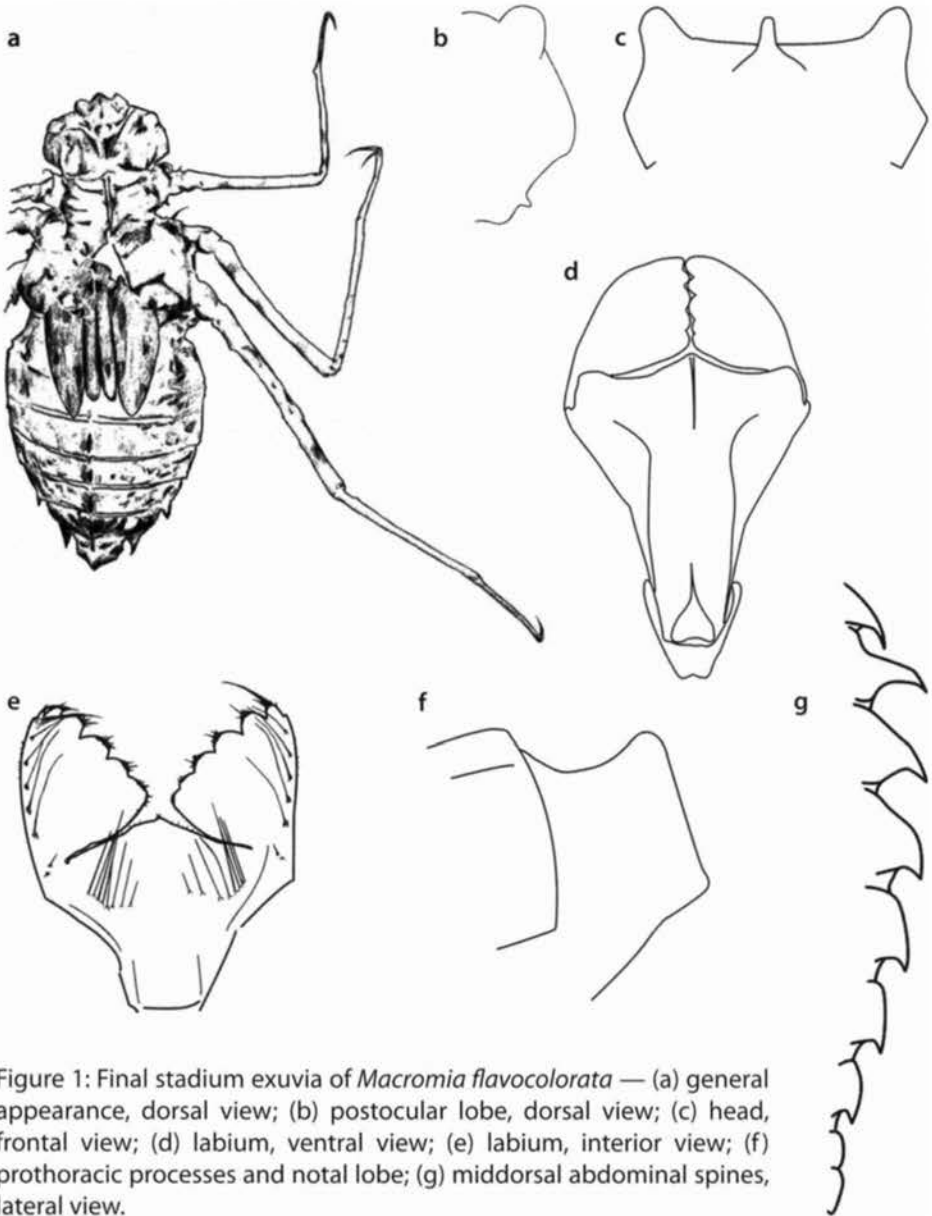


Figure 1: Final stadium exuvia of *Macromia flavicolorata* — (a) general appearance, dorsal view; (b) postocular lobe, dorsal view; (c) head, frontal view; (d) labium, ventral view; (e) labium, interior view; (f) prothoracic processes and notal lobe; (g) middorsal abdominal spines, lateral view.

smaller angular lobe; notal lobe not differentiated, almost rectangular. Synthorax wider than head. Legs very long and spidery; hind-leg longer than whole length of body; tarsal claws of fore-leg about 4/5 length of third tarsal segment; tarsal claws of middle and hind-leg nearly as long as third tarsal segment; profemur about as wide as width of head. Wing sheaths reaching approximately to end of S5.

Abdomen: Oblong, roof-shaped in cross-section, but very flat. S3-9 with dorsal hooks (Fig. 1g); dorsal hook on S3 crooked and slim, remaining dorsal hooks rather hooked and stout, all backwardly directed. S8+9 with lateral spines, those on S9 about twice as long as those on S8, spines on S9 with tip strongly upcurved. Colour brown and yellowish-brown. There are distinctive diamond-shaped eye spots located at the base of wing sheaths. Femora banded on dorsal surface.

Measurements [mm]: Total length 20.5 - 22.8, greatest width of head 5.2 - 5.8, length of metafemur 9.3 - 10.5, length of abdomen 12.2 - 13.5, greatest width 9.0 - 9.6; $n = 6$.

Differential diagnosis

The larva of *M. flavocolorata* in almost all respects resembles closely the one of *M. urania*, described and illustrated by Ishida (1969), Kawai (1985), and Wilson & Theischinger (1996). According to Lieftinck's (1929) original grouping of *Macromia*, *M. flavocolorata* belongs to the *calliope*-group, to which *M. urania* also belongs. The larva of *M. flavocolorata* differs from the latter only in some minor details as follows: frontal shelf apically finger-shaped; prementum a trifle longer than wide; two lateral longitudinal keels on ventral prementum longer, flaring outwards at apical 1/4; palpal lobes with five and six large projections; profemur about as wide as width of head; and lateral spines on S9 longer, about twice as long as those on S8.

Biological notes

M. flavocolorata was recently recorded from Fujian for the first time (Xu & Liu 2008). Larvae were collected from a small fast-flowing stream which ran through a montane village surrounded by farmland. They were found at the margins of the minor polluted stream with sand and gravel substrates. When introduced to the aquarium, they buried themselves entirely in the sand by making lateral swaying movements with the body.

LARVA OF *Macromia septima* Martin, 1904

(Fig. 2)

Specimens studied

Altogether two exuviae - 1 ♂, 1 ♀, Nanjing County (24°35'N, 117°22'E), leg. 21 vi 2007, emerged 16 vii 2007 and 23 vii 2007 respectively.

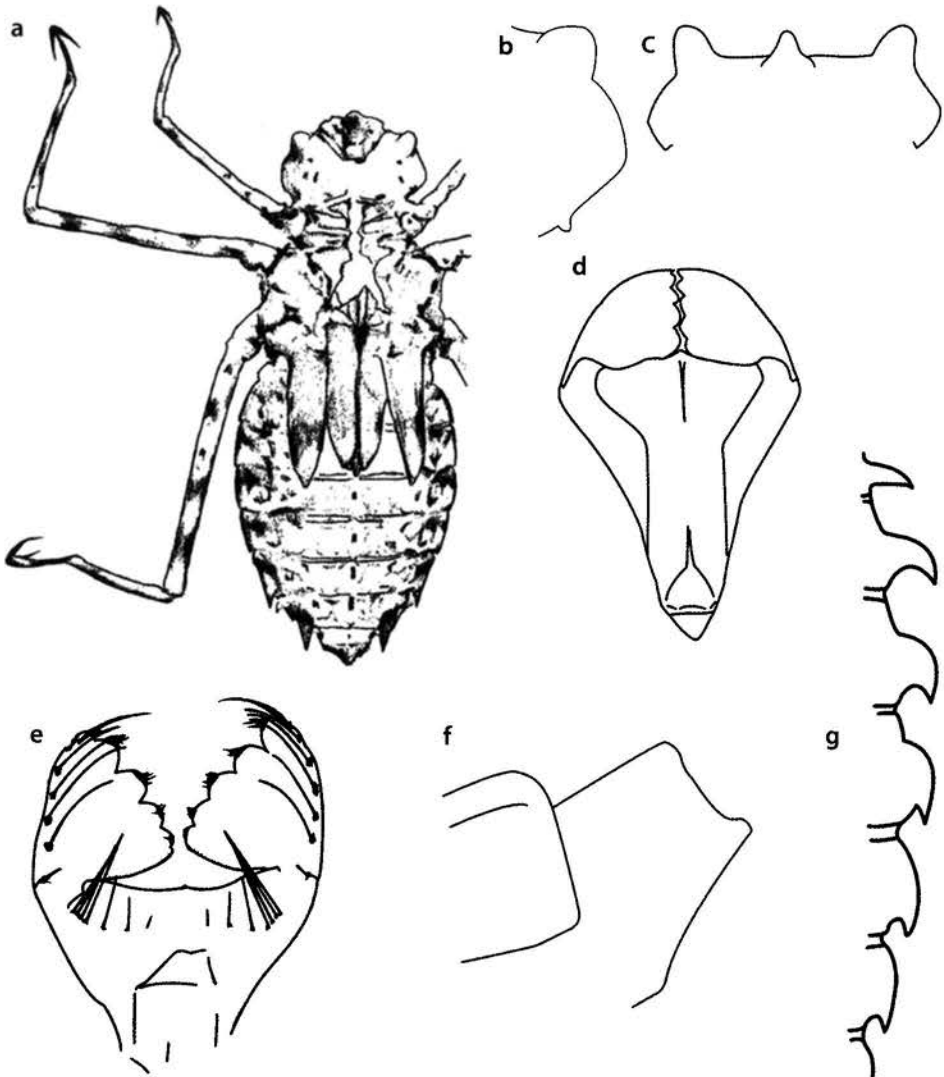


Figure 2: Final stadium exuvia of *Macromia septima* — (a) general appearance, dorsal view; (b) postocular lobe, dorsal view; (c) head, frontal view; (d) labium, ventral view; (e) labium, interior view; (f) prothoracic processes and notal lobe; (g) middorsal abdominal spines, lateral view.

Description of exuvia

General appearance and colour pattern as in Figure 2a.

Head: Moderately wide, with eyes strongly protruding dorsally. Antennae setaceous, as long as their distance apart; segments 1-2 thickened, segment 1 almost

twice as long and thick as segment 2; segments 3-7 slender, elongate and tapering. Postocular lobes (Fig. 2b) rounded, with nipple-shaped tubercles on postero-lateral angles. Frontal shelf (Fig. 2c) high, strongly upcurved and apically rounded in frontal view. Prementum (Fig. 2d, 2e) hardly wider than long, with three well developed ventral longitudinal keels, one anteromedial and two lateral, the latter flaring and arc-shaped at apical half. Apical border of prementum angulated, projecting on middle, its free margin finely crenulate, and furnished with short and thin setae more laterally, and short spinoid setae more medially. Seven premental setae on each side, four longer ones followed inwards by three shorter ones. On each side five long palpal setae and a shorter basal one. Palpal lobes with four deep irregularly V-shaped indentations and with five large projections, the latter convex laterally with very finely crenulate margins, carrying a varying number of large spinoid setae.

Thorax: Prothorax about as wide as head; lateral prothoracic processes (Fig. 2f) poorly differentiated, anterior process not discernible, posterior process a small lobe; notal lobe not differentiated, almost rectangular. Synthorax wider than head. Legs very long and spidery; hind-leg longer than whole length of body; tarsal claws of fore-leg about 4/5 length of third tarsal segment; tarsal claws of middle and hind-leg nearly as long as third tarsal segment; profemur a trifle longer than width of head. Wing sheaths reaching beyond end of S5.

Abdomen: Oblong, roof-shaped in cross-section, but very flat. S3-9 with dorsal hooks (Fig. 2g); dorsal hook on S3 erect and slim, remaining dorsal hooks rather hooked and stout, all backwardly directed. S8-9 with lateral spines, those on S9 less than twice as long as those on S8, spines on S9 with tip strongly upcurved. Colour brown and yellowish-brown. There are distinctive diamond-shaped eye spots located at the base of wing sheaths. Femora banded on dorsal surface.

Measurements [mm]: Total length 21.6 - 21.8, greatest width of head 5.5 - 5.7, length of metafemur 9.0 - 9.2, length of abdomen 14.3 - 14.5, greatest width 8.9 - 9.0; $n = 2$.

Differential diagnosis

M. septima also belongs to the *calliope*-group, as do *M. flavocolorata* and *M. urania*. The larva of *M. septima* is undoubtedly very similar to the larvae of the latter two species, from which the former is distinguished by three major characters: two lateral longitudinal keels on the ventral prementum reaching the apical border of prementum, flaring outwards and arc-shaped at apical half; on each side four long premental setae, followed inwards by three shorter ones; wing sheaths reaching beyond end of S5.

Biological notes

Same as the larvae of *M. flavocolorata*. The two species were found living together, i.e. sympatrically, within the same habitat.

DISCUSSION

From the descriptions of the exuviae of *Macromia flavocolorata* and *M. septima*, we can see that the two species are sand-dwellers par excellence. Their bodily structures adapt them well for living buried in the sand underlying the current of small streams, e.g. body broad and very flattened; legs exceptionally long and spidery, tarsal claws remarkably long and slender, etc. Besides, their pale sandy colouring harmonizes well with the environment of sand and gravel substrates. Undoubtedly, they belong to the *gerstaeckeri*-group that Lieftinck (1950) determined according to the adaptive modifications of Malaysian *Macromia* larvae to their environment. As a matter of fact, although the larva of *M. septima* was still unknown at that time, Lieftinck (1950: 692) pointed out, based on the locality (Djampang, West-Java) where adults were regularly recorded, that "its frequent occurrence at higher elevations suggests that the principal breeding places of this species are streams with a swifter current."

Based on larval morphology, the relationships of some *Macromia* species can be established. Among the seven known Chinese *Macromia* larvae, *M. chui* and *M. urania* also belong to the *gerstaeckeri*-group (Ishida 1996: 314). Among the four Chinese species of the *gerstaeckeri*-group, the larvae of *M. flavocolorata*, *M. septima*, and *M. urania* are highly similar in general appearance, they differ obviously by smaller bodies, larger heads, longer prementums, and distinctive diamond-shaped eye spots located at the base of wing sheaths from *M. chui*, which is thought to be related to *M. daimoji* Okumura, an endemic to Japan (Matsuki & Lien 1982). The larva of *M. flavocolorata* could only be distinguished from that of *M. urania* by some minor details, so it is allied to the latter. And the larva of *M. septima* bears a strong resemblance to that of *M. flavocolorata* and *M. urania*, so it is highly related to both species.

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