

CHLOROGOMPHINAE DRAGONFLIES OF GUIZHOU PROVINCE (CHINA), WITH FIRST DESCRIPTIONS OF *CHLOROGOMPHUS TUNTI* NEEDHAM AND *WATANABEOPETALIA USIGNATA* (CHAO) LARVAE (ANISOPTERA: CORDULEGASTRIDAE)

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Five species are recorded from the province, 4 of which are new for the region. *C. tunti* and *W. usignata* larvae are described based on the specimens reared in the laboratory. The adults are illustrated and some biological information is provided.

INTRODUCTION

The chlorogomphines species are rarely encountered and distributed mostly in mountainous areas of the Oriental Realm. The Chinese chlorogomphines have a high species diversity, over half of the known species were recorded from China (CHEN, 1950; CHAO, 1999; ISHIDA, 1996; KARUBE, 1995a, 1995b, 2001, 2002; WILSON & REELS, 2001; WILSON, 2002, 2005). However, the status of the (sub)family is somewhat confused (CARLE, 1995; KARUBE, 2002). CARLE (1995) elevated the Chlorogomphinae to the family rank, with two subfamilies, Chlorogomphinae and Chloropetalinae, which altogether include three tribes, containing eight genera. But KARUBE (2002) did not agree with Carle's opinion, he suggested Chlorogomphidae should be better treated as a subfamily of Cordulegastridae based on the features of male genitalia, the analysis of mitochondrial DNA, and especially on the morphological characters of larvae. Furthermore, KARUBE (2002) downgraded CARLE's (1995) subfamily Chloropetalinae to tribus Chloropetalini within the subfam-

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ily Chlorogomphinae, and established a new genus, *Watanabeopetalia*, which includes some species previously belonging to *Orogomphus*, *Chlorogomphus* and *Chloropetalia*. KARUBE (2002) and WILSON (2002) also regarded the new genera *Aurorachlorus* and *Sinorogomphus*, established by CARLE (1995), as subgenera of the genus *Chlorogomphus*. In this sense, we agree with Karube's classificatory arrangement.

The Guizhou province, located in southwestern China, is characterized by karst limestone arranged in steep hills and intermontane basins. Guizhou has a subtropical humid climate. The weather is frequently cloudy and rainy throughout the year. The temperature is moderate, not too cold in the winter, or hot in the summer. Annual rainfall averages to almost 1000-1300 mm and annual temperature averages to 15°C approximately. Guizhou province, adjacent to Yunnan province, is usually regarded as one of the biodiversity "hotspots" in China.

Only a single Chlorogomphinae species, *Chlorogomphus papilio* Ris, was so far known to occur in this region (CAO, 2005; LI & JIN, 2006). Recently, we made several Odonata surveys in southwestern China. The results show a much higher Odonata species diversity in Guizhou than we expected. In addition to *C. papilio*, four more chlorogomphid species were collected: *C. tunti* Needham, 1930, *C. n. nasutus* Needham, 1930, *C. suzukii* (Oguma, 1926), and *Watanabeopetalia usignata* (Chao, 1999). What merits our special attention is that most Chinese chlorogomphine larvae are poorly known, so we focused on collecting their final instar larvae. These are difficult to be found, because, probably due to their long life cycle, their population density is quite low. In the field, at first sight, the Chlorogomphinae larvae are similar to those of Cordulegastrinae, but can be easily distinguished from the latter by the strongly divergent wing buds and by the frontal shelf on head.

In the present paper, we report on the adults of 5 species and describe the final instar larvae of *Chlorogomphus tunti* and *Watanabeopetalia usignata* for the first time. The association of larva and adult is confirmed by the specimens reared in the laboratory. Most of the larvae collected from Guizhou emerged successfully in two weeks' rearing in the laboratory.

All examined specimens are deposited in the Collection of Aquatic Insects and Soil Animals, Department of Entomology, South China Agricultural University, Guangzhou, China.

CHLOROGOMPHUS (AURORACHLORUS) PAPILIO RIS, 1927

Figure 54

Chlorogomphus papilio: RIS, 1927: 103-105, fig. 1; - NEEDHAM, 1930: 95-96, pl. 10, figs 4, 4a, 4b; - CHEN, 1950: 138, 144, 146-147, figs 1, 13; - YANG & DAVIES, 1996: 284; - WILSON, 2005: 112, 167 (b/w photo), colour photo on the journal cover.

Aurorachlorus papilio: CARLE, 1995: 391; - CHAO, 1999: 4.

Chlorogomphus (Aurorachlorus) papilio: WILSON, 2002: 66-67, figs 1-10.

Material. - 1 ♂, 20-VII-2008, Xiangzhigou reserve, Guizhou, China, 1200m, Zhang Haomiao leg.

DISTRIBUTION. – China (Guangdong, Guangxi, Fujian, Zhejiang, Sichuan and Guizhou), Laos, Vietnam and Burma.

DISCUSSION. – Both sexes possess wings coloured at the base. Although it is widely distributed in China, only few illustrations are available. The flight period in this area is from June to September. The larva is unknown. The male adult is shown in Figure 54. For the illustrations, see WILSON (2002, 2005).

CHLOROGOMPHUS (SINOROGOMPHUS) N. NASUTUS NEEDHAM,
1930

Figures 1-6, 56

Chlorogomphus nasutus NEEDHAM, 1930: 97; – KLOTS, 1947: 3-4, figs 3-4, 7-8; – CHEN, 1950: 142, 144-147, figs 6, 18; – ASAHINA, 1956: 224-225, figs 42-45.

Chlorogomphus n. nasutus: WILSON, 2005: 112.

Sinorogomphus nasutus: CARLE, 1995: 390; – CHAO, 1999: 2.

Material. – 3 ♂, 20-VII-2008, Mt Fanjing, Guizhou, China, 1100m, Zhang Haomiao leg.

DISTRIBUTION. – China (Guangdong, Guangxi, Fujian and Guizhou) and N. Vietnam.

DISCUSSION. – A rather big montane species with antefrons triangularly protruded forwards. The abdomen is slim with a big yellow ring on segment 6. *Chlorogomphus kitawakii*, described by KARUBE (1995) possess similar protruded triangular antefrons. The

two species can be easily separated from other congeners by the structure of antefrons and easily distinguished from each by the structure of caudal appendages.

During the surveys, many individuals were observed in Mt Fanjing. They fly usually very high over the mountains on forage. The males fly near the water in very sunny days for mating. They patrol over steep hill streams with high gradient in very small range, 3-4 m over the streams, and will



Figs 1-6. *Chlorogomphus n. nasutus* Needham, male, Guizhou, China: (1) head, frontal view; – (2) same, dorsal view; – (3) thorax; – (4) abdomen; – (5) caudal appendages, dorsal view; – (6) same, lateral view.

disappear in gloomy condition.

C. n. satoi is known to occur in North Vietnam (ASAHINA, 1995), and can be distinguished from the nominotypical subspecies by the yellow pattern on basal two abdominal segments.

CHLOROGOMPHUS (SINOROGOMPHUS) SUZUKII (OGUMA, 1926)

Figures 7-17, 55

Orogomphus suzukii: OGUMA, 1926: 88.

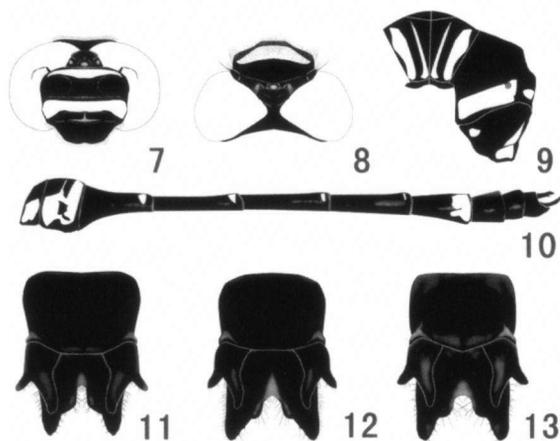
Chlorogomphus suzukii: KOBAYASHI, 1940: 326, fig. 3, pl. 1(1); – CHEN, 1950: 143-144, 146-148, figs 8, 20, 23; – ASAHINA, 1956: 222-224, figs 33-41.

Sinorogomphus suzukii: CARLE, 1995: 390; – CHAO, 1999: 2-3.

Material. – 1 ♂, 15-VII-2008, Mt Fanjingshan, Guizhou, China, 1100 m, Zhang Haomiao leg.

DISTRIBUTION. – China (Zhejiang, Guizhou and Taiwan)

DISCUSSION. – The single male from Mt Fanjing was compared with Taiwanese and Zhejiang *C. suzukii* specimens; its inferior caudal appendage is slightly different (Figs 11-13). This new distribution record is valuable, since *C. suzukii* was originally considered an eastern species known from Zhejiang and Taiwan. Body maculations of the specimens from the three localities is compared in Figures 14-17.



Figs 7-13. *Chlorogomphus suzukii* (Oguma), male, Guizhou, China: (7) head, frontal view; – (8) same, dorsal view; – (9) thorax; – (10) abdomen; – (11) caudal appendages, dorsal view; – (12-13) same, dorsal view: – [12: specimen from Zhejiang; – 13: specimen from Taiwan].

The flight period in Zhejiang lasts from May to September, the emergence takes place in mid May. Fully mature males usually patrol in the shady streams in uplands, flying low above the water surface. The oviposition occurs at noon, on the shallow edges of streams. An egg flock is formed first when the female is flying back and forth along the stream edge, and erect the body to put the eggs into water. When mating, the pairs fly higher and perch on the trees.



Figs 14-17. *Chlorogomphus suzukii* (Oguma):
 (14) male from Guizhou; –
 (15) male from Taiwan; –
 (16) male from Zhejiang; –
 (17) female from Zhejiang.

CHLOROGOMPHUS (SINOROGOMPHUS) TUNTI NEEDHAM, 1930

Figures 18-34, 52

Chlorogomphus tunti: NEEDHAM, 1930: 97-98; – KLOTS, 1947: 1-2, figs 1-2, 5-6, 9-10; – ASAHINA, 1956: 224-225, fig. 46.

Sinorogomphus tunti: CARLE, 1995: 390; – CHAO, 1999: 3.

Material. – 1 ♂, 1 ♀, 12-VII-2008, Xiangzhigou reserve, Guizhou, China, 1200 m, Zhang Haomiao leg; – 1 ♂, 1 ♀, 30-VII-2008, same locality and collector; – 1 ♂, 3-VIII-2008, same locality and collector.

1 final final stage larva, 10-V-2007, Xiangzhigou reserve, Guizhou, China, 1200 m, Zhang Haomiao leg; – 1 final stage larva, Mt Doupeng, 3-V-2007, Guizhou, China, 1200 m, Zhang Haomiao leg; – 2 exuviae, 10-V-2007, Xiangzhigou reserve, Guizhou, China, 1200 m, Zhang Haomiao leg. – The larvae emerged from 23-V-2007 to 26-V-2007 in the laboratory.

DESCRIPTION OF LARVA. – Medium sized larva in this family with the ground colour pale yellow (Fig. 18).

Head. – Squarish. Labrum and clypeus rectangle shaped. Postclypeus very narrow in width. Frontal shelf clearly projecting to form a trapezoid in dorsal view and triangle shaped in frontal view. Eyes rounded. Antennae short and fine, 7-segmented, its proximal two segment thick. Length ratio of 1-7 segments as follows: 0.28: 0.28: 0.34: 0.22: 0.22: 0.22: 0.22 (Fig. 22). Hind margin of head with thickset setae. Labial mask is of typical Chlorogomphinae type. The mental setae of prementum: 5+3 / 4+5. The median paired process of prementum V-shaped. The palpal lobes strongly developed, their inner margin with irregularly pointed teeth. The apex of all teeth darken in color. The outer margin of the lobes with a row of minute setae. The palpal setae: 4 / 4. Moveable hook long and pointed to the apex.

Thorax. – Pronotum strongly developed. Synthorax with long setae. Wing

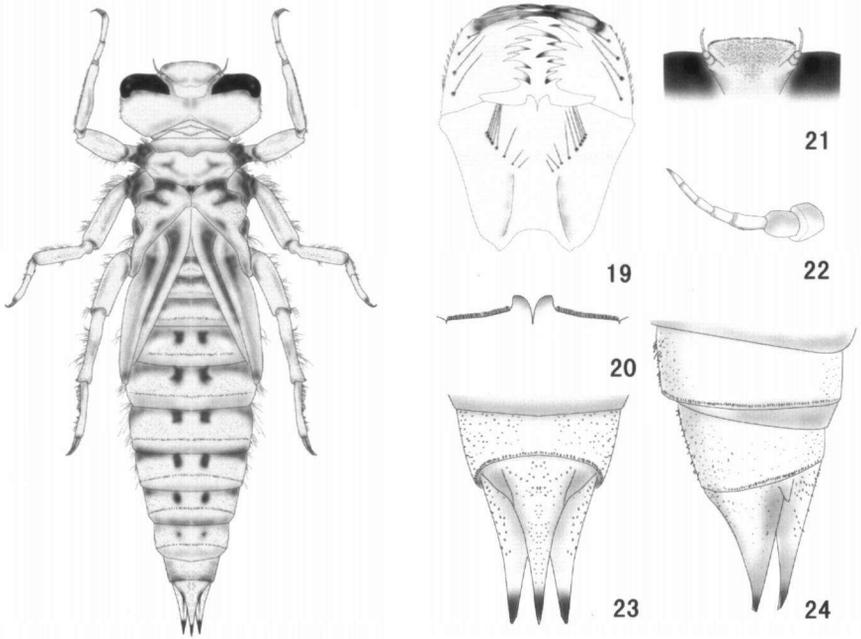


Fig. 18. *Chlorogomphus tunti* Needham, (Guizhou, China): larva, dorsal view.

Figs 19-24. *Chlorogomphus tunti* Needham, larva, Guizhou, China: (19) labial mask dorsal view; – (20) median process of prementum; – (21) frontal shelf, dorsal view; – (22) antenna; – (23) distal abdominal segments and caudal appendages, dorsal view; – (24) same, lateral view.

buds divergent, reaching the middle of 5th abdominal segment. Legs short and robust, tibiae and femur with long setae; tarsi 3-segmented with short setae.

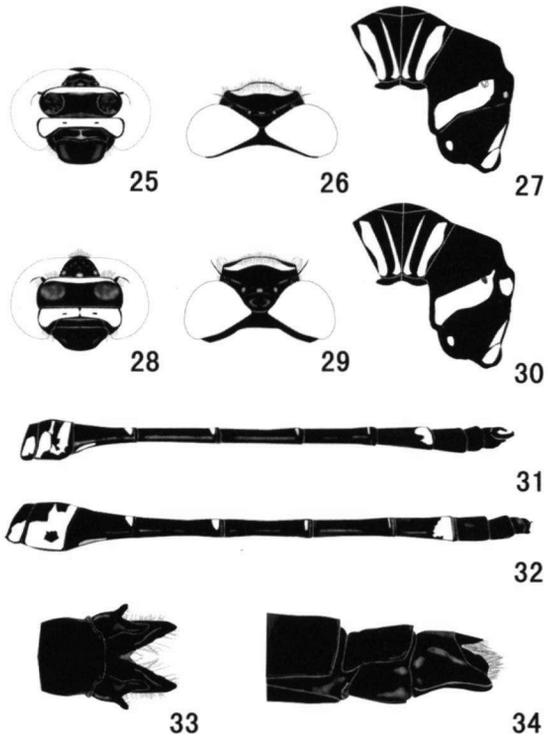
A b d o m e n. – Cylindrical, broadest at the fifth segment and tapered to the end. Segments 1-9 with a pair of black dorsal spots. The spots on segment 1-3 and segment 9 ambiguous. Caudal appendages as shown in Figures 23-24. The epiproct and paraprocts are simple and sharply pointed.

M e a s u r e m e n t s (mm). – Body length 35.5-36.0, length of abdomen 23.5-24.0 (including caudal appendages), maximum width of head 8.0; length of hind femur 7.0-7.5; length of hind wing bud 8.0-9.5.

DISTRIBUTION. – China (Shaanxi, Henan, Sichuan and Guizhou)

DISCUSSION. – *C. tunti* was described by NEEDHAM (1930) from a single female collected from Sichuan. KLOTS (1947) described the male in the American Museum from Mt Omei, Sichuan province. The types were compared with *C. nasutus* Needham, 1930 from which they can be separated by the big yellow ring on segment 7.

C. tunti is a Chinese endemic species and distributed in western China. ZHANG & ZHANG (2006) recorded it from Shaanxi, and WANG (2007) from Henan. During the surveys conducted in 2007 and 2008, *C. tunti* was collected from the reserve in central Guizhou at an altitude of above 1000 m. The larvae emerged mid May, fully mature adults appear early in June. The males usually patrol along small mountain streams in open areas, in a steady and slow flight, staying less than 1 m above the water, sometimes closely approaching the surface. The females settle at the edge of the stream, searching for a suitable, shallow oviposition site. The flight period lasts in this area from May to September. The adults structural features are shown in Figures 25-34.



Figs 25-34. *Chlorogomphus tunti* Needham, Guizhou, China: (25) male, head, frontal view; – (26) same, dorsal view; – (27) male, thorax; – (28) female, head, frontal view; – (29) same, dorsal view; – (30) female, thorax; – (31) male, abdomen; – (32) female, abdomen; – (33) caudal appendages, male, dorsal view; – (34) same, female, lateral view.

WATANABEOPETALIA USIGNATA (CHAO, 1999)

Figures 35-51, 53, 57

Chloropetalia usignata: CHAO, 1999: 8-11, figs 11-19.

Watanabeopetalia usignata: KARUBE, 2002: 84.

Material. – 2 ♂, 1 ♀, 13-VII-2008, Xiangzhigou reserve, Guizhou, China, 1200 m, Zhang Haomiao leg; – 1 ♀, 30-VII-2008, same locality and collector.

2 final stage larvae, 10-V-2007, Xiangzhigou reserve, Guizhou, China, 1200 m, Zhang Haomiao leg; – 1 exuvia, 2-V-2007, same locality and collector. – The larva emerged on 11-V-2007 in the laboratory.

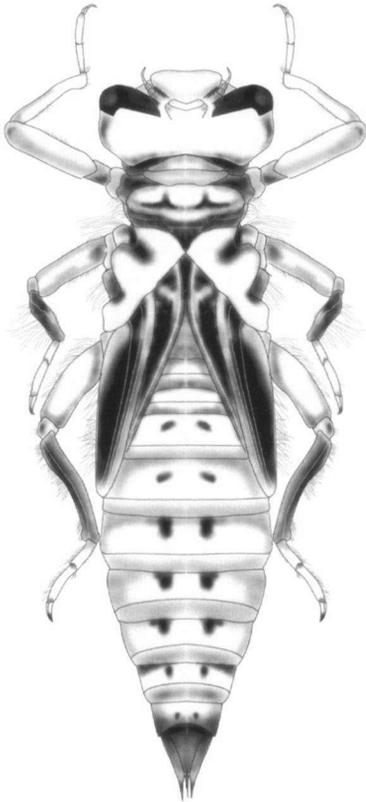


Fig. 35. *Watanabeopetalia usignata* (Chao) (Guizhou, China): larva, dorsal view.

tarsi 3-segmented with short setae.

A b d o m e n. — Cylindrical, broadest at the fifth segment and tapered to the end. Segments 1-10 with a pair of black dorsal spots. Caudal appendages as shown in Figure 40. The epiproct and paraprocts are simple and sharply pointed.

M e a s u r e m e n t s (mm). — Body length 34.0, length of abdomen 22.5 (including caudal appendages), maximum width of head 8.0; length of hind femur 7.0; length of hind wing bud 9.5.

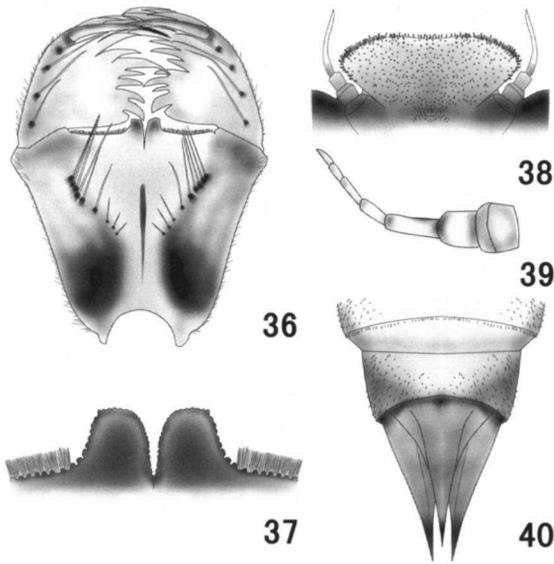
D I S T R I B U T I O N. — China (Shaanxi, Sichuan and Guizhou).

D I S C U S S I O N. — *Watanabeopetalia usignata* is named after the unique U mark on the labrum, though the mark can also be missing in both sexes. The genus *Watanabeopetalia* was established by KARUBE (2002) for *Orogomphus atkinsoni* based on the male genitalia and the female valvula vulvae. *Chloropetalia usignata* was also assigned to this genus, based on the figures in CHAO (1999). The larvae emerge from mid May, and emergence can last to July. Fully mature adults are abundant from June to August. Males usually patrol along small mountain

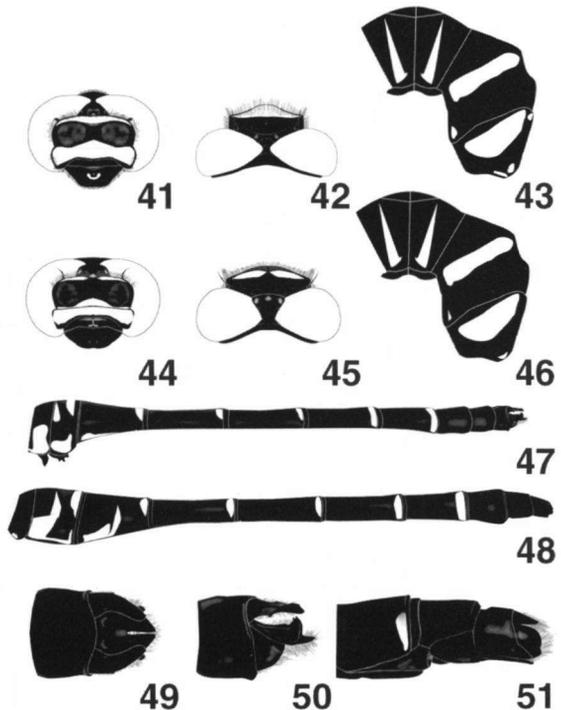
DESCRIPTION OF LARVA. — Medium sized larva in this family with the ground colour ivory-white (Fig. 35).

H e a d. — Squarish. Labrum and clypeus rectangular. Frontal shelf clearly projecting to form a trapezoid in dorsal view with the anterior margin appreciably bent inwards in the middle. Eyes rounded and darkening in colour. Antennae short and fine, 7-segmented, proximal two segments thick. Length ratio of 1-7 segments as follows: 0.31: 0.31: 0.41: 0.23: 0.23: 0.22: 0.22. (Fig. 39). Hind margin of head with thickset setae. Labial mask is of typical Chlorogomphinae type. Mental setae of prementum: 5+4 / 4+5. The median paired process of prementum V-shaped with a dentate margin. Palpal lobes strongly developed, their inner margin with irregularly pointed teeth. Apex in all teeth dark. The outer margin of the lobes with a row of minute setae. Palpal setae: 4 / 4. Moveable hook long and pointed to the apex.

T h o r a x. — Pronotum strongly developed. Synthorax with long setae. Wing buds divergent, reaching the middle of the 5th abdominal segment. Legs short and robust, tibiae and femur with long setae;

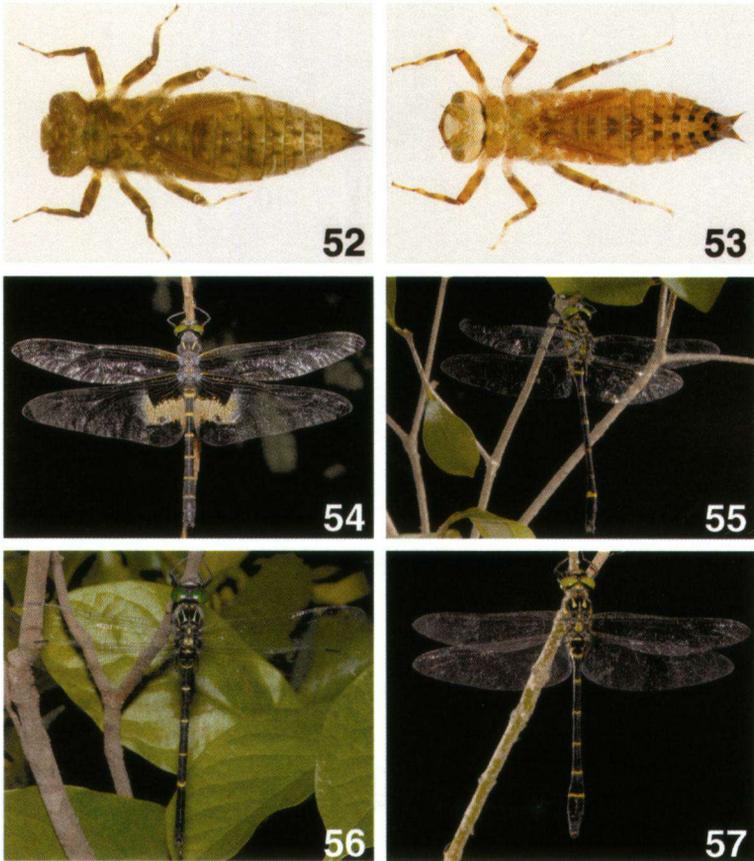


Figs 36-40. *Watanabeopetalia usignata* (Chao), larva, Guizhou, China: (36) labial mask, dorsal view; - (37) median process of prementum; - (38) frontal shelf, dorsal view; - (39) antenna; - (40) distal abdominal segments and caudal appendages, dorsal view.



Figs 41-51. *Watanabeopetalia usignata* (Chao), Guizhou, China: (41) male, head, frontal view; - (42) same, dorsal view; - (43) male, thorax; - (44) female, head, frontal view; - (45) same, dorsal view; - (46) female, thorax; - (47) male, abdomen; - (48) female, abdomen; - (49) male, caudal appendages, dorsal view; - (50) same, lateral view; - (51) female, caudal appendages, lateral view.

streams in open areas in a steady and slow flight, staying very closely above the water surface. The species co-occurs with *Chlorogomphus tunti*. Males of the two species fight for the territories. Females settle at the edge of the streams to choose a suitable place for oviposition in very shallow sections of the stream. Mating pairs fly higher and perch on the trees. The flight period in this area lasts from May to September. The adult structural features are presented in Figures 41-51.



Figs 52-57. (Figs 52-53) Final instar larva: (52) *Chlorogomphus tunti* Needham; – (53) *Watanabeopetalia usignata* (Chao); – (Figs 54-57) Adult male: (54) *Chlorogomphus papilio* Ris; – (55) *C. suzukii* Oguma; – (56) *C. n. nasutus* Needham; – (57) *Watanabeopetalia usignata* (Chao). – [Photos: Mo Shanlian]

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