

A NEW SPECIES OF THE GENUS *BAETIS* FROM CHINA (EPHEMEROPTERA: BAETIDAE)¹

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ABSTRACT: The larval and imaginal stages of *Baetis maculosus* sp. nov., a new species of Baetidae from China, are described and illustrated. The spotted color pattern of the new species resembles *Baetis taiwanensis* (Müller-Liebenau), but can be readily distinguished from it and other members of the genus *Baetis* by the following diagnostic characters: inner margin of right mandibular incisors of the larvae lacks a row of fine, short setae; tibiae dorsally with minute and sharp main setae; and 6 pairs of gills on abdominal segments 2-7. The hind wing of the imago has a crossvein between the costa and the longitudinal veins proximal to its bifurcation; segments II of the genital forceps have concave interior surfaces near their base, and the apical portion is densely wrinkled.

KEY WORDS: Mayflies, Baetidae, *Baetis*, new species, larval stage, imago description

INTRODUCTION

The genus *Baetis*, established by Leach in 1815, is cosmopolitan and widely distributed throughout the Palearctic, Oriental, Ethiopian, Nearctic, Neotropical and Australian Regions (Müller-Liebenau, 1969, 1985; Waltz and McCafferty, 1997; Lugo-Ortiz and McCafferty, 1999). The baetids of China are poorly known. In particular, only 6 species in the genus *Baetis* have been described: *B. vaillanti* Navas 1931, *B. chinensis* Ulmer 1936, *B. hainanensis* She et al., 1995, *B. tatuensis* Müller-Liebenau 1985, *B. taiwanensis* Müller-Liebenau 1985, and *B. rutilocylindratus* Wang et al., 2011. Other Chinese species previously ascribed to *Baetis* have been placed in other baetid genera (Waltz et al., 1994; Kang et al., 1994; Soldán and Yang, 2003; Wang et al., 2011). In this paper, we describe a new species of *Baetis* from China based on the larval and imago stages associated by laboratory rearing.

MATERIALS AND METHODS

Larvae of the new species were collected with a D-frame net from the riffle areas of unshaded streams in Hong Kong Special Administrative Region, and in Guangzhou and Guizhou Province in southern China. Most larvae were placed directly into vials of 90% ethanol in the field, but some mature or nearly mature larvae were transported back to the laboratory in plastic bottles containing stream water and reared to emergence thereby confirming the association of imago and larva. Study specimens were examined under the stereo microscope and slide

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mounted in Hoyer's solution for closer investigation. Measurements and ratio ranges given in the paper are for mature larvae and imagoes only. Type specimens are deposited in the Collection of Aquatic Insects and Soil Animals, Department of Entomology at South China Agricultural University (SCAU), Guangzhou, China.

TAXONOMY

Baetis maculosus sp. nov.

(Figs. 1-15)

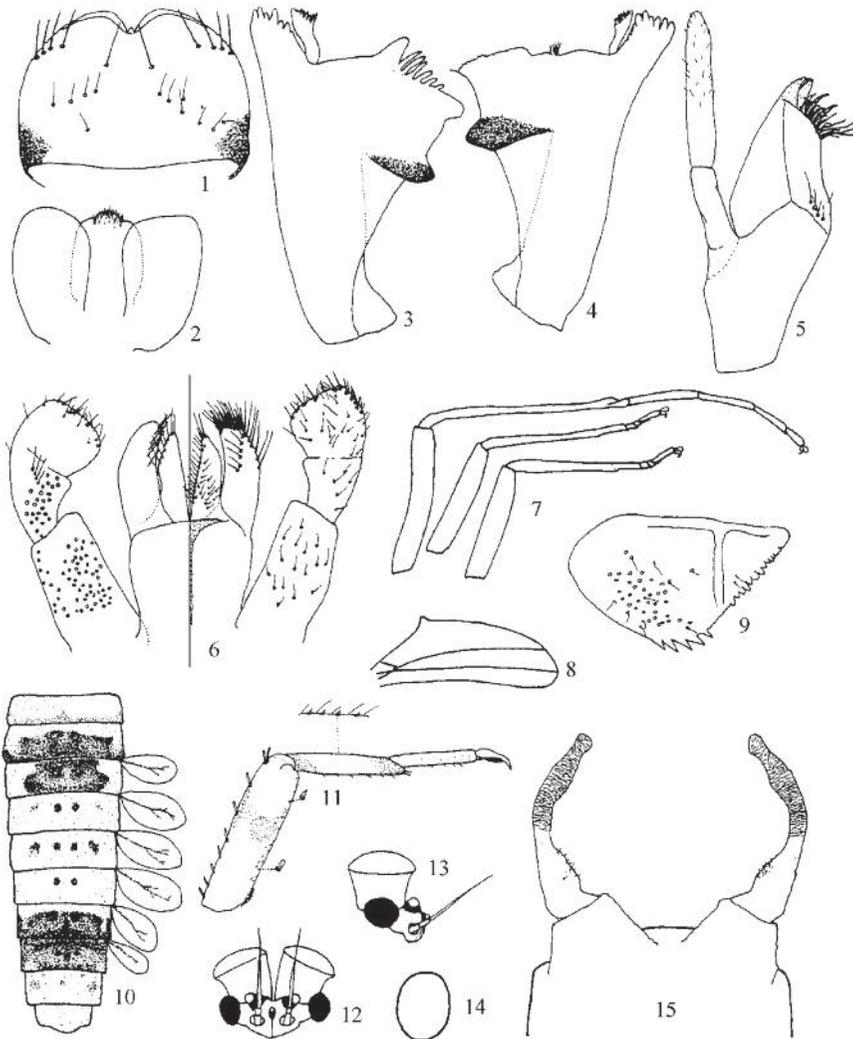
Larva: Body length 3.3-5.0 mm. Cerci 1.4-2.0 mm; medial caudal filament slightly shorter than cerci, approximately 0.85 times length of cerci.

Head. Coloration pale brown. Labrum (Fig. 1) with a dorsal submedial pair of long setae and an anterior submarginal row of 4 long setae on each side of midline. Hypopharynx as Figure 2. Incisors of left and right mandibles (Figs. 3 and 4) with 6 and 7 denticles respectively. Maxillae (Fig. 5) palp segment I shorter than segment II; palpi extending beyond galealaciniae. At the base of the galealacinia, a row of 3-4 basal setae and a single median hump seta. Labium (Fig. 6) with glossae slightly shorter than paraglossae; glossae with numerous long ventral setae, and with long, relatively robust medial and apical setae; paraglossae with 2 close rows of long, robust apical setae; palp segment I subequal in length to segments II and III combined; palp segment II moderately apicomediaally produced and with sublateral row of 3-4 long dorsal setae; terminal segment subrectangular, with mixture of both fine and robust long setae scattered over the surface.

Thorax. Thoracic nota light yellow-brown with complex pale markings. Hind wing pads present. Legs (Fig. 11) off-white to light yellow-brown; femora off-white with dark brown markings anteriorly and submedially, bearing the villopore and a row of long, robust, clavate setae dorsally and numerous elliptic and conical setae ventrally (Fig. 11); tibiae cream with pale brown marks basally and apically, dorsal and ventral main setae are both acute, but dorsal setae much shorter and smaller than ventral setae; tarsi light yellow-brown, dorsal and ventral main setae similar to those of tibiae; tarsal claws with a row of 13 denticles.

Abdomen. Cream coloration with dark brown blotches and spots (Fig. 10). Tergal surfaces with numerous scale bases and scattered, short, fine setae; posterior margins with somewhat irregular weak spination. Six pairs of gills (Fig. 10) on segments 2-7, relatively poorly tracheated, bearing serrations and short setae marginally. Paraprocts (Fig. 9) with marginal spines. Caudal filaments cream with dark brown bands distally; median terminal filament slightly shorter than the cerci.

Male imago: Body length 3.0 mm; forewing 3.0 mm; cerci 5.6 mm. Turbinate eyes (Figs. 12-14) orange and well developed. Ocelli off-white with red-brown basal rings. Antennae light brown, longer than head capsule. Thorax yellow-brown. Forewings hyaline, longitudinal veins and paired marginal intercalaries



Figures 1-15. Larva and imago of *Baetis maculosus* sp. nov. Fig. 1. Labrum; 2. Hypopharynx; 3. Left mandible; 4. Right mandible; 5. Maxilla; 6. Labium (left: dorsal view; right: ventral view); 7. Legs of male imago; 8. Hind wing; 9. Paraproct; 10. Abdominal tergites and gills of larva; 11. Foreleg of larva; 12. Head of male imago (anterior view); 13. Head of male imago (lateral view); 14. Head of male imago, faceted surface of turbinate eye; 15. Genital forceps of male imago.

pale. Hind wing (Fig. 8) hyaline with acute costal spur and a crossvein between costa and the longitudinal veins proximal to its bifurcation. Legs (Fig. 7) pale or cream. Length of foreleg segments (mm): femora 0.6; tibiae 0.83; tarsal segments 0.04, 0.30, 0.24, 0.16 and 0.10. Abdominal segments II-VI off-white and

translucent; tergum I brown medially, terga II-VI with single light grey transverse streak posteriorly, terga VII-X yellow-brown. Segment I of genital forceps (Fig. 15) broad and trapezoid without any projection; segment II long, with concave interior surfaces near the base, and dense wrinkles apically; terminal segment oval and covered with wrinkles. Cerci off-white.

Female imago: Body length 4.0 mm; Forewing 4.0 mm; cerci 6.6 mm. Head light yellow-brown. Compound eyes black; ocelli off-white with red-brown basal rings. Antennae longer than length of head capsule. Vertex pale yellow-brown, with notch in posterior margin. Pronotum pale yellow-brown; meso- and meta-nota yellow-brown. Wings hyaline, with brown veins. Femora pale; tibiae light yellow-brown; tarsi pale with light brown terminal segment. Abdominal terga I-VII light brown, terga VIII-X pale. Cerci pale brown.

Etymology. The epithet *maculosus* from Latin, meaning having many spots, referring to the color pattern of the abdominal terga of mature larvae.

Distribution. China (Hong Kong, Guangdong, Guizhou).

Material examined. *Holotype:* Mature male larva, Tan Shan River (22°28' 55"N, 114°09'36"E, 50m a.s.l.), Hong Kong, CHINA, 18-III-1998, Tong Xiaoli. *Paratypes:* CHINA, **Hong Kong:** 6 larvae, 2 male adults, locality and date as holotype; 12 larvae, Lantau Is., Wang Lung Hang, 17-XII-1996, Tong Xiaoli; 8 larvae, Sai Kung, Sha Kok Mei, 23-V-1997, David Gallacher; 7 larvae, Lantau Is., Sam Tsuen (near Tai O Road), 18-VI-1997, Tong Xiaoli; 1 larva, Tai Po, Ha Wan Yiu, 4-XI-1997, Tong Xiaoli; 3 male adults, 1 female adult, Lam Tsuen Valley, Shek Shan Tsuen, 12-XI-1997, Tong Xiaoli; 4 larvae, Tan Shan River (near Tan Chuk Hang), 18-III-1998, Tong Xiaoli; 6 larvae, 6 female adults, Ho Chung, 31-III-1998, Tong Xiaoli; 1 larva, 1 male adult, and 1 female adult, Pak Tam Chung, 5-V-1998, Tong Xiaoli; 7 larvae, Lantau Is., Pui O, near the Pumping Station, 22-IV-1999, Tong Xiaoli; 17 larvae, Tan Shan River (near Sze Tei Shan), 6-V-1999, Tong Xiaoli; 2 larvae, Sai Kung, Ho Chung, 31-III-1998, Tong Xiaoli; 1 larva, Sai Kung, Tai Mong Tsai, 9-XII-1998, Tong Xiaoli; CHINA, **Guangdong Province:** 9 larvae, Yadong River (23°41'53"N, 113°43'35"E, 65m a.s.l.), Liangkou Town, Conghua, Guangzhou, 15-XI-2010, Li Xianfu; CHINA, **Guizhou Province:** 3 larvae, Daheba Protection Station (28°39'N, 108°15'E, 470 m a.s.l.), National Mayang River Nature Reserve, Yanhe County, 21-III-2012, Shi Weifang.

Ecological notes. The new species' larvae are widely distributed in streams in the mainland New Territories of Hong Kong. It is usually found in moderately rapid to swift riffles at unshaded low-altitude (<500 m a.s.l.) sites with cobble and gravel substrates where algae are abundant. The new species seems to have some tolerance for organic pollution, and has been recorded from streams adjacent to villages in which mean ammonia, nitrate and phosphate levels were 0.04, 0.1 and 0.25 mg/L respectively.

DISCUSSION

The larva of *Baetis maculosus* sp. nov. resembles *Baetis taiwanensis* Müller-Liebenau (Müller-Liebenau, 1985; Fujitani et al., 2004) in the color pattern of the abdominal terga in mature or nearly mature larvae, but it can be distinguished from the latter by the following diagnostic characters: inner margin of right mandibular incisors of larvae lacks a row of short setae (cf. Müller-Liebenau, 1985: Fig. 1e); tibiae dorsally with tiny and acute main setae (not long and clavate dorsal setae as in *B. taiwanensis*); 6 pairs of gills on abdominal segments 2-7. In addition; the hind wing of the imago with a crossvein (Fig. 8) between costa and two longitudinal veins proximal to its bifurcation, and the second segment of the forceps is concave interiorly near the base and is densely wrinkled on the apical portion (Fig. 15). By contrast, the imago of *B. taiwanensis* lacks the crossvein between costa and longitudinal veins of the hind wing, and the first segment of the forceps bears a weak projection on the inner margin (Fujitani et al., 2004). The numbers of veins and the shape of costal spur in the hind wing can be used for differentiating *Baetis* imagoes, which are sometimes only distinguishable with certainty through the use of hind-wing characteristics (Gillies, 1949). The hind wing of *B. maculosus* sp. nov., like some other Asian species such as *B. dipsicus*, *B. thurbonis* and *B. tigroides* from India (Gillies, 1949), as well as *B. acuminatus* from Japan (Gose, 1980), possesses a crossvein proximal to the bifurcation of two longitudinal veins. This allows these species to be readily distinguished from other *Baetis* imagoes, but this character cannot be used to characterize baetid genera because of variability in the hind-wing venation within (as in *Baetis*) and among genera.

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