

A new species of *Baetis* from China (Ephemeroptera: Baetidae)

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Among the baetids with their life history stages collected from the creeks of Zijin Hill (Nanjing, China), *Baetis rutilocylindratus* sp. nov., is a new species described herein; its diagnostic characters include nymphs with relatively strong, pale gills with apical setae, and banded terminal filaments, legs with median bands on the femora and apical bands on the tibiae and tarsi, and adults with hind wings having two longitudinal veins, a robust costal projection, and pigmented subrectangular projections on the base segment of the forceps. The type material is deposited with the College of Life Sciences, Nanjing Normal University, Nanjing.

Keywords: Baetidae; *Baetis*; new species; Ephemeroptera; China

Introduction

The genus *Baetis* from China has been inadequately studied and only few species are known from both imaginal and nymphal stages. In many species either imaginal or nymphal stages alone are known and their exact status requires associations between these stages. More than 20 years' survey in the small streams of Zijin Hill (Nanjing City, Jiangsu Province, eastern China) led to collection of many baetids with their life history stages, and these are reared in the laboratory. Among these, *Baetis rutilocylindratus* sp. nov., is a new species, which is described herein. The type material is deposited at the College of Life Sciences, Nanjing Normal University, Nanjing.

Baetis rutilocylindratus sp. nov.
(Figures 1–4)

Description

Mature nymph (in alcohol)

Body length 6.0–6.5 mm, cerci 3.5–4.0 mm, terminal filament 3.0 mm, antennae 2.5x as long as head width; greenish brown to brown with reddish stripes and spots.

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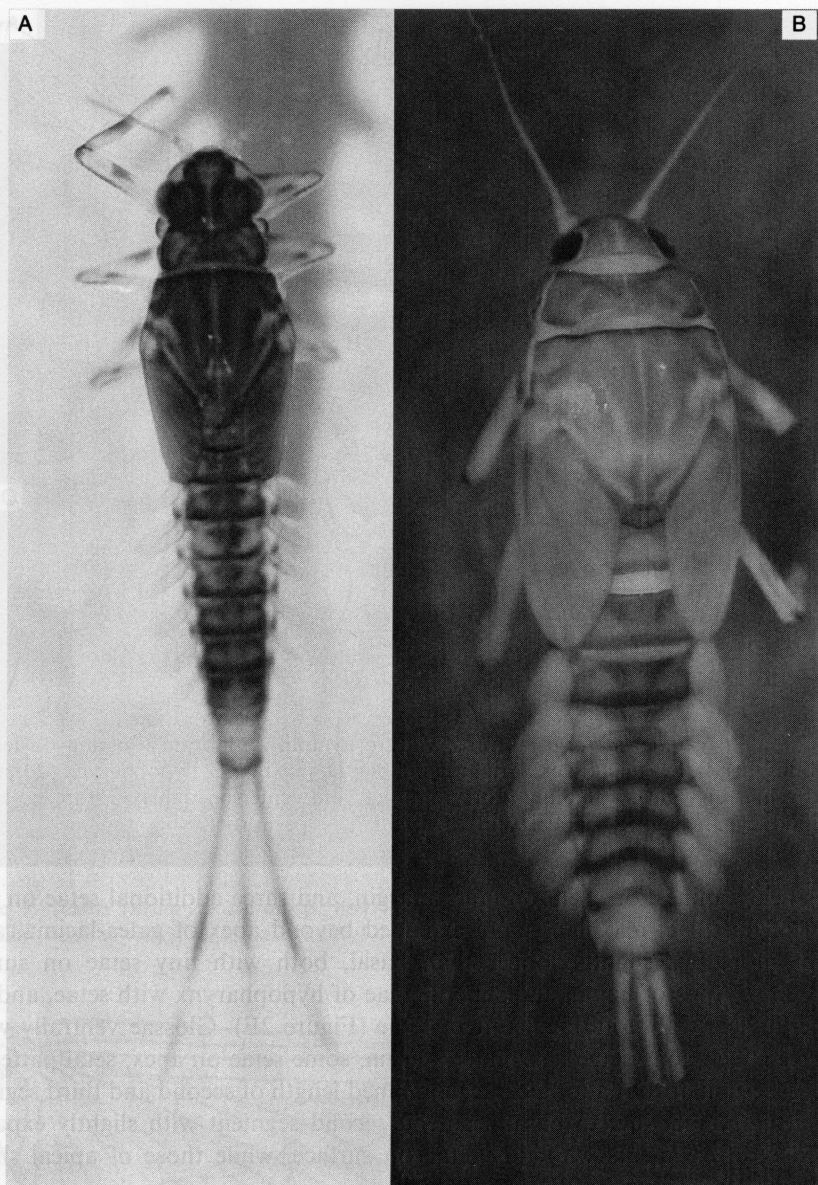


Figure 1. *Baetis rutilocylindratus* sp. nov. Nymph, habitus: A, male; B, female.

Head. Capsule brown to dark, area between compound eyes and base of antennae pale; dorsal eyes of male reddish brown; antennae and ocelli pale, except basal portion dark (Figure 1A,B). Labrum with triangular median emargination, its posterolateral angles dark pigmented; dorsal surface with sparse and irregular bristles, ventral surface with dense median setae and longer dense setae on apical margin (Figure 2A). Mandibles (Figure 2B, C): incisors and prostheca strong, apex of prostheca divided into many bristles and spines, and other setae absent. Apex of maxillae terminating in triad of stout canines, galea-lacinia with a tuft of spines and

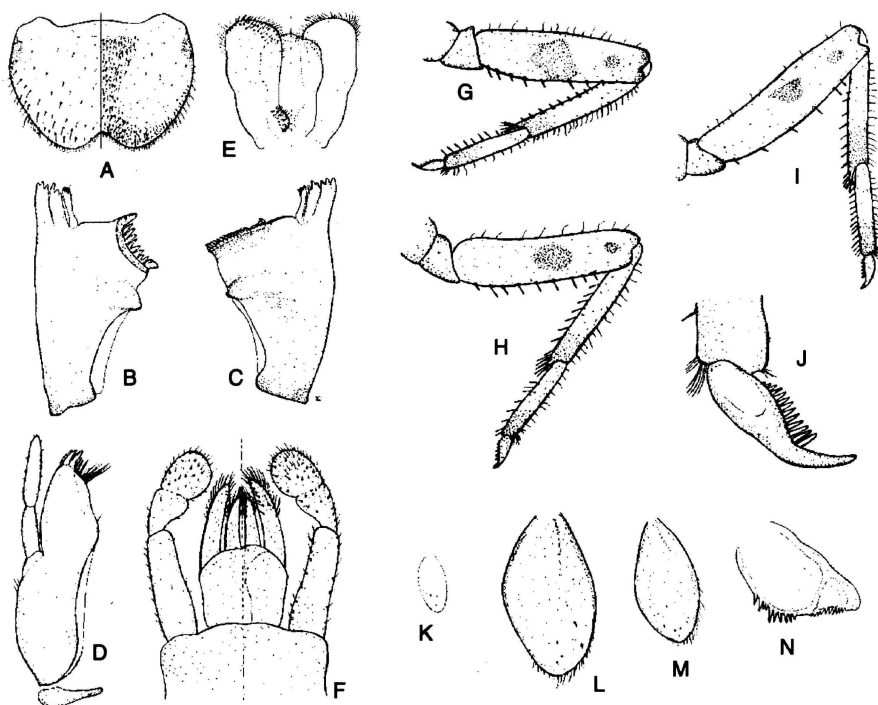


Figure 2. *Baetis rutilocylindratus* sp. nov. Mature nymph. A, labrum (dorsum on left and venter on right); B, left mandible; C, right mandible; D, maxilla; E, hypopharynx (dorsum on left and venter on right); F, labium (dorsum on left and venter on right); G, foreleg; H, mid leg; I, hind leg; J, claw; K, gill 1; L, gill 2; M, gill 7; N, paraproct.

bristles near canines; one seta on inner margin, and three additional setae on outer margin of maxillae; maxillary palpi extended beyond apex of galea-lacinia, apical segment of palpus slightly longer than basal, both with tiny setae on surfaces (Figure 2D). Apex of lingua and superlinguae of hypopharynx with setae, and base of superlinguae with additional tuft of setae (Figure 2E). Glossae ventrally with a row of relatively long setae near inner margin, some setae on apex; setal pattern on paraglossae similar to that of glossae; combined length of second and third segments of labial palpi subequal to basal segment; second segment with slightly expanded inner lobe; all segments with tiny setae on surface, while those of apical slightly longer and denser (Figure 2F).

Thorax. Pro- and mesonota greenish brown to brown; pronotum with blackish bands surrounding lateral margins, mesonotum with submedian dark brown, dorsal longitudinal stripes and irregular pale areas near bases of wing pads (Figure 1A,B). All legs pale grey to cream; femora with distinct dark brown median markings and yellowish subapical spot, their apex slightly darker and tibiae and tarsi with brown band apically (Figures 1A,B, 2G–I). Forefemora slightly longer than foretibiae, with a row of setae on outer margin, inner margin with sparse bristles; tibiae slightly longer than tarsi, both with a row of setae on outer margin and bristles on inner margin, setae on tarsi sparser than those of tibiae, and tibiae and tarsi with dense

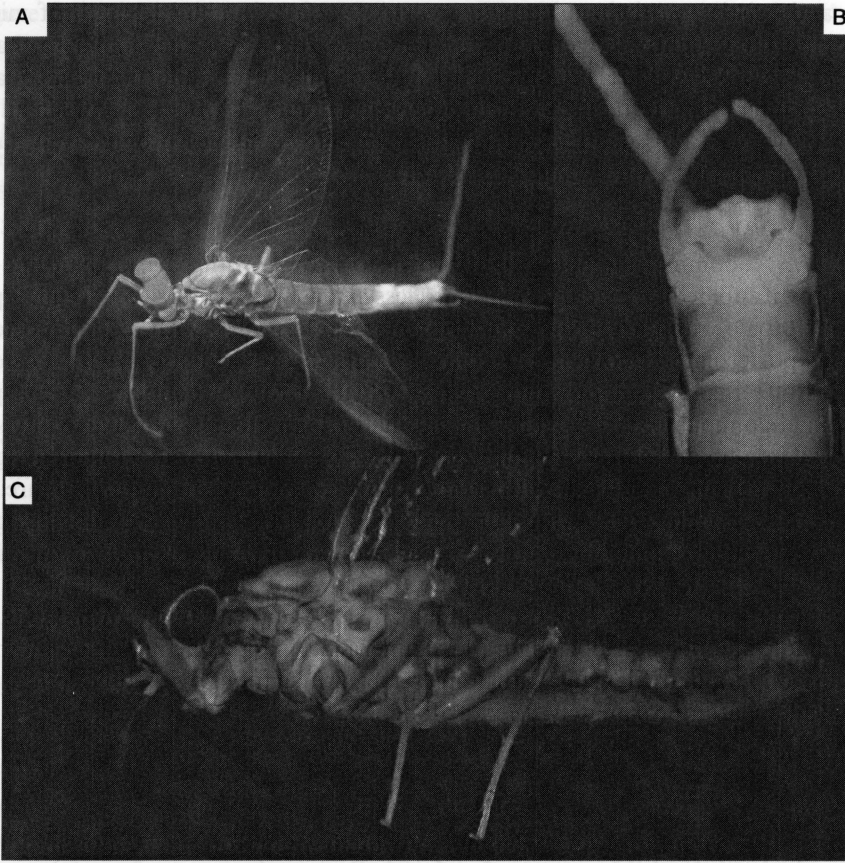


Figure 3. *Baetis rutilocylindratus* sp. nov. Imago: A, male (lateral view); B, male external genitalia (ventral view); C, female (lateral view).

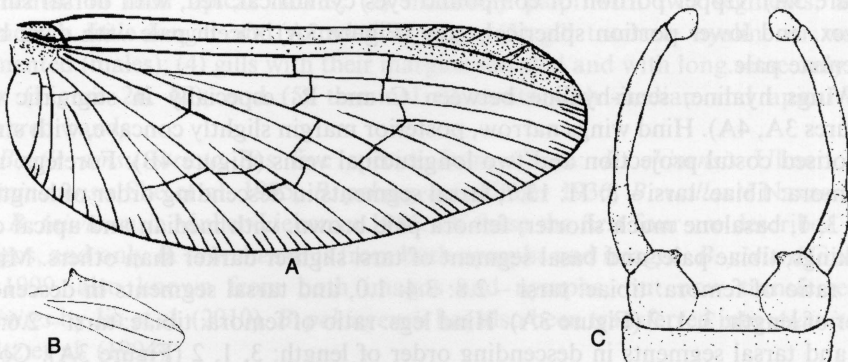


Figure 4. *Baetis rutilocylindratus* sp. nov. Imago, male: A, forewing; B, hind wing; C, external genitalia (ventral view).

hairs and bristles on their apices (Figures 1A,B, 2G). Combined length of middle tibiae and tarsi slightly longer than mid femora, pattern of setae similar to that of foreleg (Figures 1A,B, 2H). Combined length of hind tibiae and tarsi subequal to hind femora; and pattern of setae as in other legs (Figures 1A,B, 2I). Claws in all legs with a row of strong denticles along inner margin, denticles progressively larger apically (Figure 2J). Hind wing pads present.

Abdomen. Abdominal terga 1–8 light brown to brown, with pale median line and dark brown submedian maculae, markings less extensive on terga 4–5; tergum 9 pale; tergum 10 pale with dark brown posterior margin; terga 1–8 with reddish posterior margin; posterolateral corners of terga 1–7 dark brown (Figure 1A,B). Posterior margins of terga 1–2 smooth and terga 3–10 with a row of denticles. Sterna pale. Gills on abdominal terga 1–7; gills 1 much smaller than others, with sparse tiny setae on apical margin and surface (Figure 2K); gills 2–6 similar, their inner margin lightly expanded, margin sclerotised, with setae on surface and apical margin (Figure 2L); gills 7 smaller, symmetrical, with more setae (Figure 2M). Tracheae of all gills lightly tinted to hyaline, sometimes grey at base, those of male clearer than female (Figures 1A,B, 2K–M). Paraprocts with two rows of denticles along mesal and posterior margins (Figure 2N). Caudal filaments pale but with two brown bands, one near middle and one apically (Figure 1A); inner margin of cerci and, inner and outer margins of terminal filament with long setae; articulations with tiny spines; and caudal filament approximately 0.75x as long as cerci.

Male imago (in alcohol)

Body length 4.5 mm, forewing 4.3 mm, hindwing 0.7 mm, foreleg 3.2 mm, middle leg 2.9 mm, hind leg 1.7 mm, cerci 10.5 mm.

Head and thorax. Orange to reddish, with sclerites brown and sutures pale (Figure 3A). Upper portion of compound eyes cylindrical, red, with dorsal surface convex, and lower portion spherical, grey (Figure 3A). Ocelli pale with dark base. Antennae pale.

Wings hyaline, semi-hyaline between C and R₁ especially in stigmatic area (Figures 3A, 4A). Hind wings narrow, posterior margin slightly concave, with strong sclerotised costal projection and two longitudinal veins (Figure 4B). Forelegs: ratio of femora: tibiae: tarsi – 8: 11: 13.7, tarsal segments in descending order of length: 4, 5, 2, 3, 1, basalone much shorter; femora pale brown, with median and apical dark markings; tibiae pale; and basal segment of tarsi slighter darker than others. Middle legs: ratio of femora: tibiae: tarsi – 2.8: 3.4: 1.0, and tarsal segments in descending order of length: 3, 1, 2 (Figure 3A). Hind legs: ratio of femora: tibiae: tarsi – 2.6: 2.9: 1.0, and tarsal segments in descending order of length: 3, 1, 2 (Figure 3A). Colour pattern of middle and hind legs similar to forelegs but much paler. Claws of all legs dissimilar, one blunt, pad-like; and the other hooked apically.

Abdomen. Terga with pair of submedian reddish stripes, a pair of pale maculae beside them, lateral areas reddish, posterior margin red with small posterior denticles

(Figure 3A); sterna 1–9 each with a pair of pale reddish, median maculae although sometimes faded. Cerci pale, with reddish rings at articulation.

Genitalia (Figures 3B, 4C). Styliiger plate with convex posterior margin. Forceps segment 1 broad, with short medially-directed projections; segment two long, constricted approximately one-third distance from base; apical segment short, inner margin slightly expanded.

Female imago (in alcohol)

Body length 3.5 mm, forewings 3.8 mm, hind wings 0.6 mm, cerci 5.1 mm. Ratio of length of femora, tibiae and tarsi of middle legs – 5.1, 5.0 and 3.0, and ratio of hind legs – 5.1, 5.0 and 3.0. Body colour similar to that of male but much paler and uniformly pale brown (Figure 3C). Posterior margin of sternum 7 slightly expanded and extended. Apex of sternum 9 slightly extended and shallowly concave.

Male subimago (in alcohol)

Body length 3.2 mm, forewings 3.5 mm, hind wings 0.7 mm, cerci 6.5 mm; ratio of length of femora, tibiae and tarsi of forelegs – 2.2, 3.0 and 3.1, length ratio of middle legs – 2.0, 2.1 and 1.0, and that of hind legs – 3.2, 3.4 and 2.3. Body colour pattern as in male imago but much paler.

Comments

Baetis rutilocylindratus sp. nov. can be distinguished from its Far Eastern congeners of *Baetis sensu stricto* in the following combination of characters: males with (1) upper portion of compound eyes cylindrical and orange-reddish; (2) hind wings with strong costal projection and two longitudinal veins; (3) base segment of forceps with a pigmented, subrectangular projection on inner margin; and (4) apical segment of forceps broad. In nymphs, (1) femora with a median brown patch, tibiae and tarsi pigmented in their apical halves; (2) maxillary palpi with two segments, apical segment a little longer and rounded at apex; (3) gill tracheae hyaline or weakly pigmented (males); (4) gills with their margins serrated and with long setae only near apex (Figure 2K–M); and (5) terminal filaments with median and apical dark coloured bands.

Baetis sensu stricto has five species from China: *B. chinensis* Ulmer 1936; *B. hainanensis* She et al. 1995; *B. pekingensis* Ulmer 1936; *B. vaillanti* Navas 1931; and *B. taiwanensis* Muller-Liebenau 1985. Of these the first four are described from imagos, and only *B. taiwanensis* is from both nymphs and imagos. *B. yixiani* Gui and Lu 1999, also known from both imagos and nymphs, but now transferred to *Alainites* by Jia et al. (2010). *B. pekingensis* has also been transferred into *Alainites* by Waltz et al. (1994).

The concept of *Baetis* is mostly based on nymphs, and hence those species known only from imagos need to be associated with nymphs for further interpretations. The original description of *B. vaillanti* by Navas is very brief, but he illustrates a broad hind wing with three longitudinal veins and a few cross veins; hind wing of *B. chinensis* oval and lacks a costal projection although it does have two longitudinal veins; however, imagos of *B. hainanensis* She et al. 1995 have very small hind wings

with a large costal projections but only one longitudinal vein; imagos of *B. rutilocylindratus* sp. nov. can be distinguished from all these Chinese species by the presence of hind wing with a costal projection and with two longitudinal veins.

The nymph of *Baetis taiwanensis* was first described by Muller-Liebenau (1985); unfortunately, Figures 1 and 2 in the original publication were reversed which misled Kang et al. (1994); and its imaginal characters were given by Fujitani et al. (2004). *Baetis rutilocylindratus* sp. nov. can be distinguished from this by the presence of a darker colour pattern on the middle abdominal terga (Figure 1A,B) as well as softer and smoother gills; gills 2–7 of the new species have many setae on the apical margins (Figure 2L,M) which are absent in *B. taiwanensis*; in male adults, the new species has cylindrical compound eyes and the width of the dorsal portion is equal to that of the stalk, while in *B. taiwanensis* the dorsal portion is broader than the stalk; and although both have two longitudinal veins in hind wings, the hind wings of *B. rutilocylindratus* sp. nov. are narrower and costal projections are stronger.

Fujitani et al. (2003) retained 12 Japanese nominal species in *Baetis sensu stricto*, and all these are illustrated by Gose (1980). Among these, only two species (*B. acuminatus* Gose 1980; *B. hyugensis* Gose 1980) have two longitudinal veins in the hind wings, but neither of these have subrectangular projections on the base segment of the forceps; the apical segment of the forceps of *B. acuminatus* is relatively narrow compared to the new species; the forceps of *B. hyugensis* is much broader; and the nymphs of these Japanese species lack median and apical bands on the terminal filaments.

Novikova and Kluge (1987) placed 16 species from Russia in *Baetis s. s.* and half of these are found in the Russian Far East, and four of these also reported from Korea (Bae and Park 1998); imagos are figured by Tshernova et al. (1986). The male imago of *B. rutilocylindratus* sp. nov. can be easily distinguished from these Palaearctic species, all of which either have three longitudinal veins, or lack a costal projection on the hind wings, or have no pigmented, subrectangular projections on the inner margin of the base segment of the forceps.

Types

Holotype m; *paratypes* 2m, 3f, 3L, 10L, Zijin Hill (118°49'35" E, 32°05'36" N, 66m), Coll. 27.ix.2008, Ping Chen, Yanyan Jia, Min Ju; 10L, 15.iii.2010, Ping Chen, Yuyu Wang, Jiazhang Qin; material is deposited at the College of Life Sciences, Nanjing Normal University, Nanjing.

Etymology

The epithet *rutilocylindratus* is from the Latin prefix *rutilo* (meaning red, reddish) and *cylindratus* (adjective, meaning cylindrical), in reference to male compound eyes.

Biology

The streams in which collections was made at Zijin Hill was about 1 m wide with less than 40 cm deep water flow (in some places only 10 cm); often small lentic pools with water flow under the stream bed in some sections; except after rain, these flow slowly, less than 20 cm/s and most parts shaded under a heavy tree canopy. Most nymphs of *B. rutilocylindratus* sp. nov. are collected from small pools in streams with

hand nets, often found under the surface of stones in water, and are collected in most seasons except cold winter (usually from end of November to February).

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