

TAXONOMIC REVIEW OF THE VIETNAMESE  
NEOPHEMERIDAE (EPHEMEROPTERA) WITH  
DESCRIPTION OF *POTAMANTHELLUS UNICUTIBIUS*,  
NEW SPECIES

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**Abstract.**—Four neophemerid mayflies, *Potamantellus amabilis* (Eaton), *P. caenoides* (Ulmer) (new record), *P. edmundsi* Bae & McCafferty (new record), and *P. uncutibus* NEW SPECIES, are reviewed based on materials collected throughout Vietnam. Description, larval habitus, and line drawings of the new species are provided; diagnoses, distributions, materials examined, habitat and biological data, taxonomic remarks, and a larval key are provided for known species and stages.

**Key Words.**—*Potamantellus uncutibus*, Neophemeridae, Ephemeroptera, taxonomy, Vietnam.

The Neophemeridae is a small group of mayflies that contains three genera and twelve species worldwide (Bae & McCafferty 1998, Zhou & Zheng 2001). The family is distributed throughout the Holarctic and Oriental regions. The larvae of Neophemeridae have unique operculate gills on the second abdominal segment that are fused medially. This character easily distinguishes them from the larvae of other mayfly families, particularly from those of Caeniidae. The adults and subimagos are characterized by the MP2 and CuA veins of forewings that are arched basally, by the A1 vein of forewings that has 1-2 veinlets, and by either slightly furcated or atrophied penes. The family was comprehensively revised by Bae & McCafferty (1998).

In Southeast Asia, members of the family have been studied by Eaton (1892), Ulmer (1932, 1939), Lestage (1930), Dang (1967), and Bae & McCafferty (1998); and three nominal species, *Potamantellus amabilis* (Eaton), *P. caenoides* (Ulmer), and *P. edmundsi* Bae & McCafferty, are known. One species, *Neophemera projecta* Zhou & Zheng (2001), was recently described from southern China. In Vietnam, only *P. amabilis* is known (Lestage 1930, Ulmer 1932, Dang 1967, Bae & McCafferty 1998).

The purpose of this study is to review and additionally describe the Vietnamese species of Neophemeridae. All larval and adult materials used in this study were collected throughout Vietnam during field trips in 2000-2002. The materials are preserved in 80% ethyl alcohol and are housed in the Aquatic Insect Collection of Seoul Women's University (SWU-AIC). In the future, the holotype material will be appropriately returned to an authorized institution or museum in Vietnam (e.g., Hanoi University of Science). Terminology, measurement, and other taxonomic methods are followed from Bae & McCafferty (1991, 1998).

*Potamantellus amabilis* (EATON)

*Rhoenanthus amabilis* Eaton, 1892: 188.

*Potamantellus horai* Lestage, 1930: 120; synonymized by Ulmer, 1932.

*Rhoenanthus amabilis* (Eaton): Lestage 1930: 136.

*Potamantellus amabilis* (Eaton): Ulmer, 1932: 211; Bae & McCafferty, 1998: 40.

*Neophemeropsis cuaraensis* Dang, 1967: 160; synonymized by Bae & McCafferty, 1998.

**Diagnosis.**—Larvae of *P. amabilis* are distinguished from other species of Neophemeridae by the combination of a rudimentary diagonal ridge on the operculate gills, rudimentary posteromedian tubercles on the abdominal terga 6-8, lacking a transverse setal row on the dorsal forefemora, small to mid-sized body (8.0-9.5 mm), and relatively long caudal filaments (0.8 × length of body) that have weakly developed lateral hairlike setae. The adults are distinguished by the combination of widely separated penes beyond the subgenital plate, heavily maculated wings, small to mid-sized body (ca. 8.0 mm), and A1 of forewings that has two veinlets (angle between A1 and veinlets 70-80°) (Bae & McCafferty 1998).

**Description.**—Larva, male, and female adults: See Bae & McCafferty (1998: 41-42).

**Distribution.**—Burma, southern China, Thailand, Vietnam.

**Materials Examined.**—See Bae & McCafferty (1998).

**Habitat and Biology.**—Larvae of *P. amabilis* occur in muddy overflow pools and mid-channels of lowland streams and rivers (Bae & McCafferty 1998).

**Remarks.**—A male subimago (holotype of *Potamantellus horai* Lestage = *P. amabilis*) of this species was recorded from Vietnam. Dang (1967) also described the larva of *Neophemeropsis cuaraensis* (= *P. amabilis*) from northern Vietnam. Bae & McCafferty (1998) provisionally placed *P. cuaraensis* as a junior subjective synonym of *P. amabilis* based on limited characters in Dang's (1967) description. However, we were unable to collect fresh materials of *P. amabilis* in our investigations in Vietnam (see Remarks under *P. edmundsi*).

*Potamantellus caenoides* (ULMER)

*Neophemeropsis caenoides* Ulmer, 1939: 485.

*Potamantellus caenoides* (Ulmer): Bae & McCafferty, 1998: 42.

**Diagnosis.**—Larvae of *P. caenoides* are distinguished from other species of Neophemeridae by the combination of a distinct diagonal ridge on the operculate gills, distinct posteromedian tubercles on the abdominal terga 6-8, having a transverse setal row on the dorsal forefemora, relatively small body size (6.5-8.0 mm), and relatively short caudal filaments (0.5 × length of body) that have strongly developed lateral hairlike setae. The adults are distinguished by the combination of greatly furcated penes, weakly maculated wings, relatively small body size (6.1-8.0 mm), and A1 of forewings that has a single veinlet (angle between A1 and veinlet almost 90°) (Bae & McCafferty 1998).

**Description.**—Larva, male, and female adults: See Bae & McCafferty (1998: 42).

**Distribution.**—Indonesia (Sumatra, Java, Bali, Lombok, Flores), Malaysia (Malay Peninsula, Sabah, Sarawak), Philippines (Mindanao), Thailand, Vietnam.

**Materials Examined.**—23 L: VIETNAM, Dak Lak Prov., Dak Pli' Cr., 450, 740, 770 & 800 m (alt.), 4, 5, 8 & 13 Mar 2001, D. H. Hoang.

**Habitat and Biology.**—The larvae of *P. caenoides* occur in slow current areas in mountain streams ranging 450-800 m in altitude where the streams are about 15-20 m wide and 15-60 cm deep during the dry season (November-April). The substrates consist of relatively coarse particles (large rock-boulder 30%, cobble 20%, pebble 20%, and gravel and sand 30%), abundant detritus, fallen leaves, root masses, and mosses. The streams are well protected and largely canopied (60-90%) by predominant riparian trees such as bamboo, large fern, and timber. The water temperature in March ranges 19-23°C; and pH ranges 8.0-8.1. Larvae were obtained in both Surber and kick samples.

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In a Malaysian river, the larvae were also taken from the *Saraca* root balls in muddy pool areas by G. F. Edmunds, Jr. (Bae & McCafferty 1998).

*Remarks.*—The lectotype (male imago) of this species was designated by Bae & McCafferty (1998) from Indonesia (Sumatra). We report this species from Vietnam for the first time. This species is known to be widespread in insular and peninsular Southeast Asia.

*Potamanthellus edmundsi* Bae and McCafferty

*Potamanthellus edmundsi* Bae and McCafferty, 1998: 48.

*Diagnosis.*—Larvae of *P. edmundsi* can be distinguished from other species of Neophemeridae by the combination of lacking a diagonal ridge on the operculate gills, having rudimentary posteromedian tubercles on the abdominal terga 6–8, having a transverse setal row on the dorsal forefemora, mid-sized body (10–11 mm), and relatively short caudal filaments ( $0.5 \times$  length of body) that have moderately developed lateral hairlike setae.

*Description.*—*Larva:* See Bae & McCafferty (1998: 48). *Male and female adults:* Unknown.

*Distribution.*—Malaysia (Malay Peninsula), Thailand, Vietnam.

*Materials Examined.*—12 L: VIETNAM, Cao Bang Prov., Ha Quang, Phu Ngoc 17 Dec 2000, V. V. Nguyen; 4 L: Nghe An Prov., Con Cuong, Khe Choang Cr., 12 Jan 2001, V. V. Nguyen; 1 L: Dak Lak Prov., Yok Dol National Park, Dak Klau Cr., 13 Feb 2001, D. H. Hoang; 1 L: Dak Lak Prov., Yok Dol National Park, Ea N'dneik Cr. 16 Feb 2000, D. H. Hoang; 2 L: Thua Thien Hue Prov., Aluoi, Hong Thuy, 9 Jan 2002, T. K. T. Cao.

*Habitat and Biology.*—Larvae of *P. edmundsi* occur in the lower reaches of mountain streams (alt. 500–650 m) in limestone areas where the streams are 20–80 m wide, 10–50 cm deep, contain a large number of rapids and backwaters. In these streams, water temperature ranges 18–25°C; pH ranges 7.6–8.1; and the substrates are mostly stony on a sandy bottom. The larvae often occur together with other mayfly larvae such as *Rhoenanthus magnificus* and *Ephemer* spp.

*Remarks.*—*Potamanthellus edmundsi* Bae & McCafferty (1998) was described based on larval materials from Malaysia (Malay Peninsula) and Thailand. From our studies of *P. edmundsi* from Vietnam, this species seems to be widespread in peninsular Southeast Asia. Although *Potamanthellus cuaraensis* (Dang 1967) was previously synonymized with *P. amabilis* (Eaton 1892) (see Remarks under *P. amabilis*, above), it has been also assumed that *P. cuaraensis* is closely related to *P. edmundsi* because the larvae of *P. edmundsi* were collected at a place (Con Cuong) near the type locality (Cua Rao) of *P. cuaraensis* (Con Cuong is located in ca. 60 km NW from Cua Rao). It is, however, noted that types and all reference materials of *P. cuaraensis* were lost (N. T. Dang, personal communication); and diagnostic characters in Dang's (1967) description are not enough to taxonomically associate *P. edmundsi* with *P. cuaraensis*. Adults of this species are required to verify the relations of the Vietnamese populations of *P. edmundsi* with other species of *P. amabilis*-group, *Potamanthellus amabilis*-group (*P. amabilis*, *P. cuaraensis*, *P. ganges*, *P. edmundsi*, and *P. chinensis*) is characterized by the reduced or absent diagonal ridge on the operculate gills and presumably by the atrophied genitalia (widely separated penes beyond the subgenital plate) (Bae & McCafferty 1998).

*Potamanthellus unicutibus* Nguyen and Bae, NEW SPECIES

(Figs. 1–9)

*Types.*—Holotype: mature female larva (SWU-EPH-3546), VIETNAM, Lao Cai Prov., Sa Pa, Trung Trai, alt. 1200 m, 29 Dec 2000, V. V. Nguyen & T. K. T. Cao, deposited at

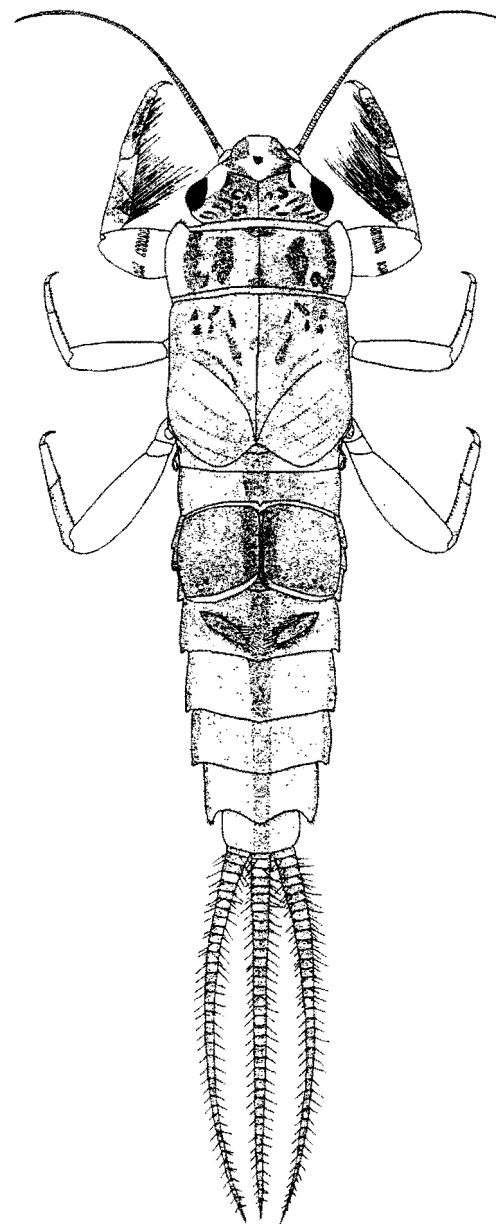
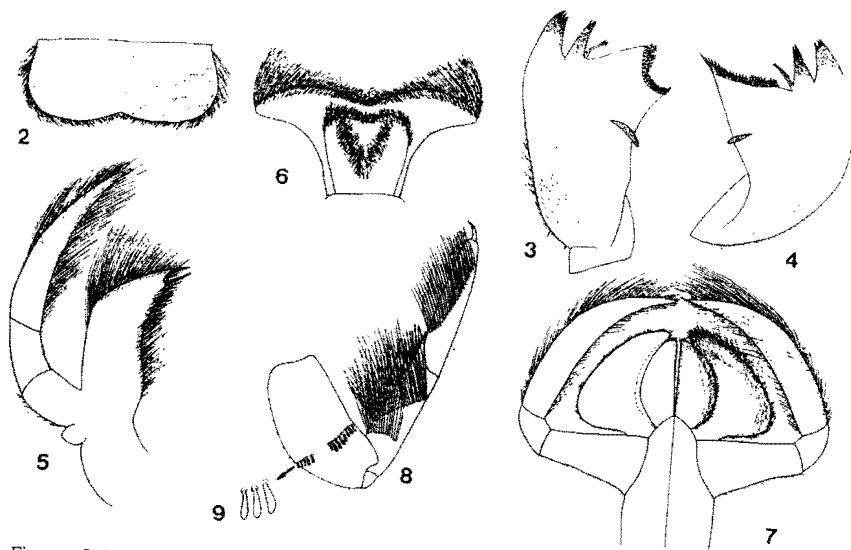


Figure 1. *Potamanthellus unicutibus*, NEW SPECIES, larval habitus.



Figures 2–9. Mouthparts and foreleg of *Potamanthellus unicutibius*, NEW SPECIES. Figure 2. Labrum, dorsal. Figure 3. Left mandible, dorsal. Figure 4. Right mandible, dorsal. Figure 5. Left maxilla, dorsal. Figure 6. Hypopharynx, ventral. Figure 7. Labium, dorsal (left) and ventral (right). Figure 8. Right foreleg, dorsal. Figure 9. Setae on forefemur, enlarged.

SWU-AIC. Paratypes: 3 half-grown larvae (SWU-EPH-3548), locality and other data same as holotype, deposited at SWU-AIC.

**Description.**—*Larva.* Female body length 9.8 mm; cerci 4.6 mm; terminal median filament 4.6 mm. Body (Fig. 1) color brown with dark brown markings. **Head:** Head length 1.4 mm; width 2.0 mm; dorsal head brown, with light round areas in front of anterior ocellus and between lateral ocelli and compound eyes, and with light branch-shaped markings on vertex. Compound eyes black. Antennae 3.5 mm in length, anterolaterally located. Clypeus slightly convex anteriorly, with few setae. Labrum (Fig. 2) dorsally and marginally with dense hairlike setae; anterior margin moderately emarginate. Mandibles with simple stout setae on dorsolateral area; outer and inner incisors of left mandible (Fig. 3) both trifurcate; outer and inner incisors of right mandible (Fig. 4) trifurcate and bifurcate, respectively. Maxillae (Fig. 5) with dense hairlike setae on crown; palpi 3-segmented; segment 1, 2, and 3 0.24 mm, 0.22 mm, and 0.55 mm, respectively; segment 3 very long ( $2.5 \times$  length of segment 2), with strongly developed hairlike setae on outer and inner margins. Hypopharynx (Fig. 6) moderately divergent laterally, with well developed hairlike setae along margins. Labial palpi (Fig. 7) 3-segmented; segment 1, 2, and 3 0.35 mm, 0.12 mm, and 0.60 mm, respectively; segment 3 greatly elongated ( $5.6 \times$  length segment 2), apically pointed, with long hairlike setae on outer and inner margins. **Thorax:** Pronotum brown, with irregular dark brown markings, weakly expanded anterolaterally and laterally; anterolateral corners round, with simple-stout setal field; lateral margins light brown. Mesonotum and metanotum brown, with dark brown markings, without lateral expansions. Forefemora, foretibiae, foretarsi, and foreclaws 1.10 mm, 1.10 mm, 1.20 mm, and 0.25 mm, respectively. Forefemora (Figs. 1 and 8) light yellow, with stout and flattened setae transversely rowed at midlength (Figs. 8 and 9); foretibiae (Fig. 8) brown, with light yellow areas basally and apically, with two rows of greatly developed hairlike setae (filtering setae) diagonally arranged on dorsal surface, and with greatly developed hairlike setal field along inner margin; foretarsi (Fig. 8) brown, with light yellow areas basally and apically, with single row of greatly developed hairlike setae diagonally arranged on dorsal surface, and with greatly developed hairlike setal field along inner margin; foreclaws basally brown and apically dark brown, without denticles. Midfemora, midtibiae, midtarsi, and midclaws 1.10 mm, 0.80 mm,

0.50 mm, and 0.25 mm, respectively; midfemora light yellow, without markings; midtibiae and midtarsi brown with row of hairlike setae on inner margin; midclaws basally brown and apically dark brown. Hindfemora, hindtibiae, hindtarsi, and hindclaws 1.90 mm, 1.00 mm, 0.80 mm, and 0.30 mm, respectively; color and setation similar to midlegs. **Abdomen:** Terga 1–10 (Fig. 1) brown, with longitudinal dark brown median stripe; posteromedian tubercle on abdominal tergum 1 small, on tergum 2 distinct, on tergum 6 rudimentary, and on tergum 7–10 absent; posterolateral projections on tergum 6–9 moderately developed, with weakly developed simple stout setal fields. Gills (Fig. 1) on abdominal segments 1–6; gills 1 vestigial, 2-segmented, anterolaterally oriented, and with dense hairlike setae marginally; gills 2 operculate, subquadrate, brown (lacking tiny light spots), with minute setae on dorsal surface, with row of hairlike setae along medial margin, with marginal membrane posteriorly, and without diagonal ridge; gills 3–5 double, fringed, concealed under operculate gills; gills 6 single, exposed (in all specimens examined herein, gills 6 are exposed as in Fig. 1), with row of marginal fringes. Cerci and median terminal filament brown, robust, ca.  $0.5 \times$  length of body, with whorls of dark brown stout setae, without lateral setae.

**Male and Female Adults:** Unknown.

**Diagnosis.**—Larvae of *P. unicutibius* are distinguished from other species of Neophemeridae by the combination of lacking diagonal ridge on the operculate gills, lacking posteromedian tubercles on the abdominal terga 6–8 (tubercle on tergum 6 sometimes rudimentary), greatly elongated labial palp segment 3 ( $5.6 \times$  length of segment 2), transverse row of stout setae on the dorsal forefemora, two rows of greatly developed hairlike setae diagonally arranged on the dorsal surface of foretibiae, and single row of greatly developed hairlike setae diagonally arranged on the dorsal surface of foretarsi (Figs. 1 and 8).

**Distribution.**—Northern Vietnam.

**Eymology.**—The specific name *unicutibius* is Latin, from *unicus* (unique) and *tibia* (tibia), an allusion of the unique foretibiae that have two rows of long filtering setae.

**Other Materials Examined.**—1 L: VIETNAM Lao Cai Prov., Sa Pa, Coc Xan, 29 Dec 2000, V. V. Nguyen & T. K. T. Cao; 2 L: Lao Cai Prov., Sa Pa, Ta Phin, 29 Dec 2000, V. V. Nguyen & T. K. T. Cao.

**Habitat and Biology.**—Larvae of *P. unicutibius* occur in the high mountain areas of northern Vietnam ranging 1100–1300 m in altitude where the streams are 15–18 m wide and 10–50 cm deep during the dry season. The stream banks are covered by tropical evergreen trees. The stream substrates consist of mixed sand, gravel, and larger stones with rich organic matter. In streams of Sa Pa in December, water temperature is  $17^{\circ}\text{C}$  and pH is 7.6–8.0. The larvae occur in slow current areas and pools. General kick sampling yields the larvae. Well-developed hairlike setal rows on the forelegs as well as highly setaceous mouthparts indicate that the larvae are probably active filterers or deposit filterers. Some mayfly larvae, e.g., larvae of Potamanthidae (Bae & McCafferty 1991, 1995; McCafferty & Bae 1992), having similar filtering setae on the forelegs show such filtering behavior.

**Remarks.**—When considering phylogenetic characters, the combination of the characters of the absence of lateral setae in caudal filaments, setaceous mouthparts, and the absence of notal expansions in the larvae of *P. unicutibius* does not agree with the current generic concepts of neophemerid genera, i.e., *Potamanthellus*, *Ochernova*, and *Neophemera* (see character table and cladogram in Bae & McCafferty 1998). We, therefore, provisionally classify this species in *Potamanthellus* based on general phenetic similarity of the larval body, although those larval characters are considered plesiomorphic. The unique setal rows on the foretibiae and foretarsi and extremely setaceous mouthparts could be the autapomorphies of this taxon. When the adults of this species are known, its phylogeny and phylogenetic classification have to be re-worked.

## KEY TO VIETNAMESE SPECIES OF NEOEPHEMERIDAE

*Known larvae*

- 1a. Foretibiae with two diagonal rows of long hairlike setae dorsally (Fig. 1)  
 ..... *Potamanthellus unicutibius*
- 1b. Foretibiae without diagonal rows of long hairlike setae dorsally ..... 2
- 2a (1b). Abdominal terga 6–8 with distinct posteromedian tubercles .....  
 ..... *Potamanthellus caenoides*
- 2b. Abdominal terga 6–8 with rudimentary posteromedian tubercles or lacking them ..... 3
- 3a (2b). Operculate gills with rudimentary diagonal ridge .....  
 ..... *Potamanthellus amabilis*
- 3b. Operculate gills without diagonal ridge ..... *Potamanthellus edmundsi*

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