
Descriptions of *Rhoenanthus sapa*, New Species, and Larval Stage of *R. magnificus* Ulmer (Ephemeroptera: Potamanthidae) from Vietnam

V.V. Nguyen and Y.J. Bae

Seoul Women's University, Seoul, Korea

Abstract

The larva and female adult of *Rhoenanthus (Potamanthindus) sapa* sp. n. and the larva of *Rhoenanthus (Potamanthindus) magnificus* Ulmer are described from Vietnam. Larval habitus, line drawings of key characters, distributions, habitat and biology data, and taxonomic remarks are provided.

Keywords: *Rhoenanthus sapa*, Potamanthidae, Ephemeroptera, description, Vietnam.

Introduction

The burrowing mayfly family Potamanthidae is widely distributed throughout the Holarctic and Oriental regions. The family contains a relatively small number of species, 23 species worldwide, and all but four Nearctic species occur in Palaearctic East Asia and Southeast Asia (Bae & McCafferty, 1991).

In Southeast Asia, members of the family have been studied by Eaton (1883–1888, 1892), Ulmer (1920, 1924, 1932, 1939), Lestage (1921, 1930), Navás (1922, 1930), Gose (1969), Uéno (1969), Bae et al. (1990), Bae and McCafferty (1991), and Soldán and Putz (2000); six nominal species in two genera and four subgenera have been reported: *Rhoenanthus (Rhoenanthus) speciosus* Eaton, *Rhoenanthus (Rhoenanthus) distafurcus* Bae and McCafferty, *Rhoenanthus (Potamanthindus) magnificus* Ulmer, *Rhoenanthus (Potamanthindus) obscurus* Navás, *Potamanthus (Potamanthodes) formosus* Eaton, and *Potamanthus (Stygifloris) sabahensis* Bae, McCafferty, and Edmunds. In Vietnam, *R. distafurcus*, *R. magnificus*, *R. obscurus*, and *P. formosus* are known.

The purpose of this study is to additionally describe the Vietnamese species of Potamanthidae. All the larval and adult material used in this study was collected from Vietnam during field trips in 2000–2002. Adults were collected by light traps and

sweeping nets. Larvae were collected by Surber nets and kick nets. The material is preserved in 80% ethyl alcohol and is housed in Seoul Women's University Aquatic Insect Collection (SWU-AIC). In the future, the type material will be appropriately returned to the places (e.g., Hanoi University of Science) where it was held originally. Terminology, measurement, and other taxonomic methods are followed from Bae and McCafferty (1991).

***Rhoenanthus (Potamanthindus) magnificus* Ulmer (Fig. 1)**

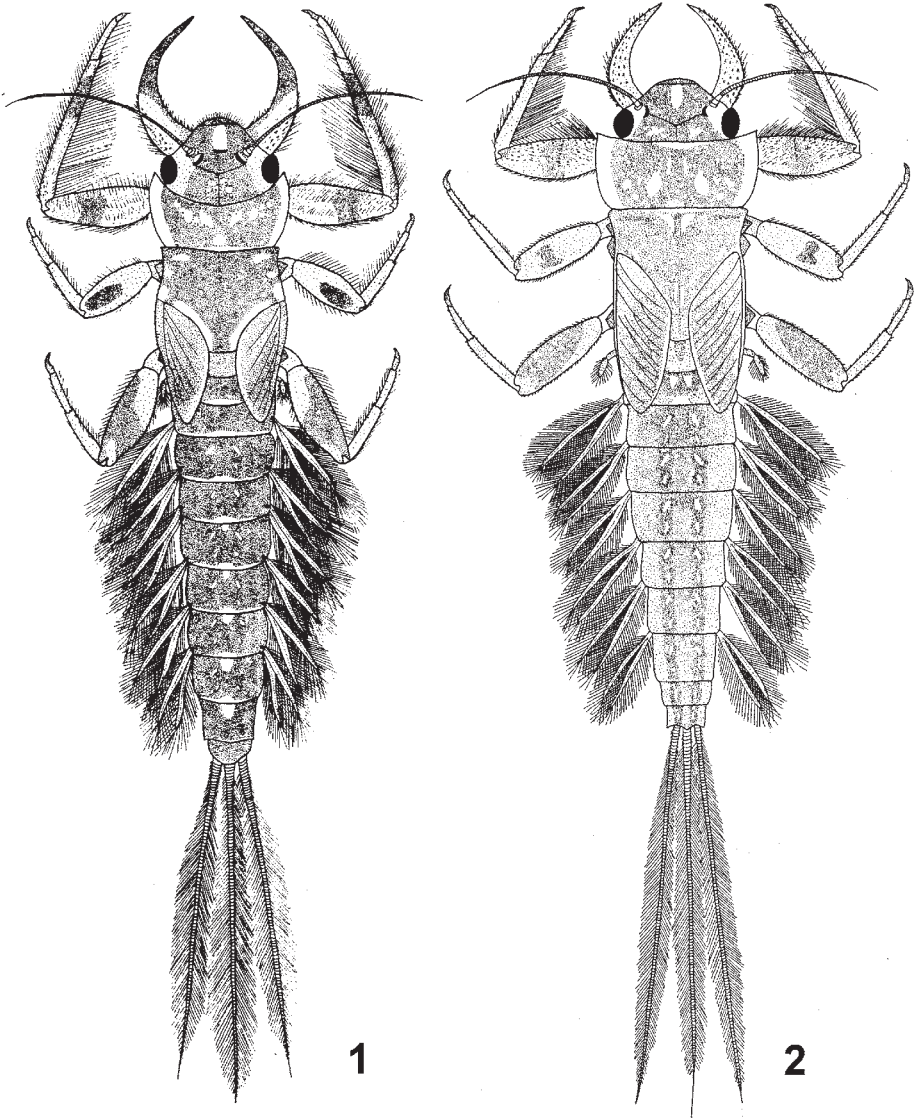
Rhoenanthus magnificus Ulmer, 1920: 11; Bae & McCafferty, 1991: 22.

Mature larva

Dimensions: Male body length 18.2 mm; caudal filaments 10.6 mm. Female body length 21.2 mm; caudal filaments 12.1 mm. Body (Fig. 1) color brown to purplish brown with light markings.

Head: Male head 2.1 mm in length, and 3.7 mm in width. Dorsal head brown with large light markings in front of anterior ocellus and around compound eyes, with irregular light markings on vertex. Compound eyes black; male compound eyes 1.1 mm in width, and 1.2 mm in distance between compound eyes ($ES = 1.09$); female compound eyes 0.80 mm in width, and 2.30 mm in distance between compound eyes ($ES = 2.87$). Antennae 5.5 mm in length, anterodorsally located. Clypeus convex anteriorly, with both simple-stout setae and hairlike setae. Labrum distal margin straight. Mandibular tusks (Fig. 1) 2.9 mm in length, strongly arched inward (33.4° in curvature); body of tusks relatively broad, light yellow in basal half and brown in apical half, with ca. 15 simple-stout setae mixed with ca. three hairlike setae basomedially, with 40–42 simple-stout setae mixed with 14–16 hairlike setae basolaterally. Maxillae galealacinal crown entirely with dense hairlike setae; maxillary palpi three-segmented; segment 1, 2, and 3 0.7 mm, 0.3 mm, and 1.2 mm, respectively; segment 3 relatively long (ca. $4.0\times$ length of segment 2), with long and dense hairlike setae on entire surface. Hypopharynx expanded laterally, with hairlike setae along margins. Labium glossae with dense hairlike setae; paraglossae expanded laterally, without ventral hairlike setae; labial palpi three-segmented; segment 1, 2, and 3 0.9 mm, 0.35 mm, and 0.9 mm, respectively; segment 3 flattened with long hairlike setae on outer and inner margins, with minute simple-stout setae on apical inner margin.

Thorax: Pronotum brown, with irregular light markings, greatly expanded laterally; anterolateral processes small and acute; lateral margins white. Mesonotum and metanotum light brown to brown, with light markings. Wingpads dark brown, with 3–4 small black spots on veins. Forefemora, foretibiae, foretarsi, and foreclaws 3.8 mm, 5.6 mm, 1.9 mm, and 0.4 mm, respectively. Forefemora pale yellow, with brown stripe at $2/3$ apically, with brown spot subbasally, with strongly developed hairlike setae (with few simple-stout setae) on dorsal surface; foretibiae relatively long ($1.5\times$ length of forefemora, $2.9\times$ length of foretarsi), light yellow, with broad brown stripe subapically, with strongly developed hairlike setal fields (filtering setae) rowed along both inner and outer margins (dorsal surface with weakly developed filtering



Figures 1, 2. *Rhoenanthus* spp., larval habitus: (1) *Rh. magnificus*; (2) *Rh. sapa* sp. n.

setae; ventral surface bare); foretarsi brown, with simple-stout setae and long harlike setae dorsally and laterally (ventrally bare); foreclaws basally brown and apically dark brown. Mid femora, mid tibiae, mid tarsi, and mid claws 3.2 mm, 2.2 mm, 1.2 mm, and 0.4 mm, respectively; mid femora pale yellow, with large brown markings centrally, with simple-stout setae and hairlike setae dorsally and marginally; mid tibiae and mid tarsi without markings, with long hairlike setae dorsally and marginally; mid

claws apically dark brown. Hind femora, hind tibiae, hind tarsi, and hind claws 3.6 mm, 2.6 mm, 1.2 mm, and 0.5 mm, respectively; hind femora pale yellow, with broad brown marking covering more than apical half; hind tibiae and hind tarsi pale yellow, without markings; setation of hind legs similar to mid legs.

Abdomen: Ground color generally light brown to brown, with two pairs of light submedian teardrop-shaped spots on each tergum (Fig. 1). Gills 1 single, rudimentary, two-segmented, curved upward, flattened, with hairlike setae on margins of terminal segment; gills 2–7 lateral in position, double, white with darker tracheae, with long marginal fringes (fringes somewhat twisted); gills 3 with 52–54 and 38–40 marginal fringes in each lateral margin of dorsal and ventral lamellae, respectively. Caudal filaments 0.6× length of body, with long lateral hairlike setae.

Diagnosis

Larvae of *R. magnificus* are distinguished from those of other *Rhoenanthus* by the relatively large body size (18.2–21.2 mm) and relatively long and strongly arched (33.4°) mandibular tusks (Fig. 1). Their foretibiae are relatively long (about 1.5× length of forefemora and about 2.9× length of foretarsi) and the filtering setae are strongly developed.

Material examined

47 L: Nghe An Prov., Con Cuong, Khe Choang Cr., 12-I-2001, V.V. Nguyen; 3 M, 1 F and 3 mature L: Nghe An Prov., Con Cuong, Khe Choang Cr., 6-IV-2002, V.V. Nguyen & D.H. Hoang; 36 L: Cao Bang Prov., Pac Po, Lenin Cr., 15-VI-2000, 16-XII-2000, V.V. Nguyen; 1 L: Ha Giang Prov., Vi Xuyen, Bac Phat Cr., 11-XII-2000, V.V. Nguyen; 4 L: Da Nang Prov., Ba Na, Nui Chua, Tuy Loan, Mo Cr. (alt. 250 m), 31-III-2002, D.H. Hoang & V.V. Nguyen.

Distribution, habitat, and biology

The male and female adults of *Rhoenanthus magnificus* were originally known from northern Vietnam and southern China (Bae & McCafferty, 1991). From our investigations, this species is known common in northern and mid-Vietnam. The larvae are found in the lower reaches of mountain streams (altitude 500–650 m) in limestone areas where the streams are 50–80 m wide, 10–50 cm deep, and contain a large number of rapids and backwaters. The water temperature range is 22–28°C; and the pH range is 7.2–7.6. The substrates are mostly stony and sandy. The larvae are often found at the interface of a stone and finer substrate such as sand and gravel in the slow current areas. Mature and last instar larvae are dominant in late January, but the adults occur throughout the year (collected in January, March, April, May, August, and September).

Remarks

Our description of the larva of this species is based on fresh material collected from a place near the type locality of *R. magnificus* in northern Vietnam. Although rearing

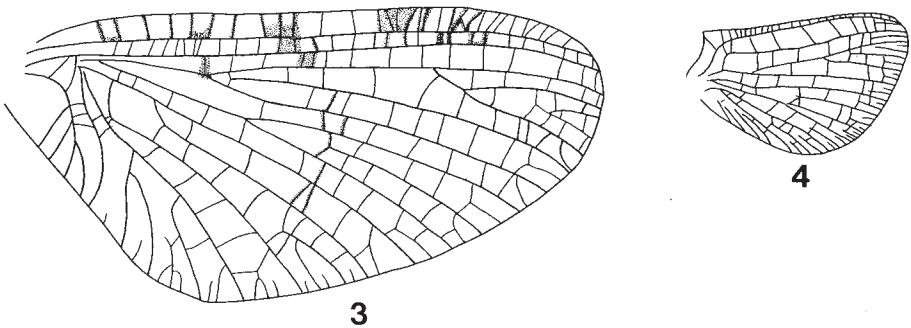
at that time was not successful, male and female adults of *R. magnificus* were collected together with the larvae; large body size and characteristic abdominal markings in both larval and adult stages helped to easily associate the larvae with the adults of *R. magnificus*. No other potamanthids were found from the area. Male and female adults of *R. magnificus* were redescribed by Bae and McCafferty (1991).

Rhoenanthus (Potamanthindus) sapa sp. n. (Figs. 2–4)

Mature larva

Dimensions: Female body length 12.9 mm; cerci 8.5 mm; terminal median filament 9.1 mm. Body (Fig. 2) color brown to purplish brown with light markings.

Head: Female head 1.60 mm in length, 2.50 mm in width; dorsal head brown, with light round markings in front of anterior ocellus and around compound eyes, and with irregular light markings on vertex. Compound eyes black; female compound eyes 0.60 mm in width, 1.40 mm in distance between compound eyes ($ES = 2.30$). Antennae 2.6 mm in length, anterodorsally located. Clypeus convex anteriorly, with hairlike and simple-stout setae dorsally. Labrum distal margin straight. Mandibular tusks (Fig. 2) 1.90 mm in length, moderately arched inward (27.7°), light brown, with 30–32 dark purplish brown simple-stout setae mixed with 13–15 hairlike setae throughout dorsally, and with 28–30 dark purplish brown simple-stout setae mixed with 13–15 hairlike setae throughout laterally. Maxillae galealacinal crown entirely with dense hairlike setae; maxillary palpi three-segmented; segment 1, 2, and 3 0.37 mm, 0.27 mm, and 0.52 mm, respectively; segment 3 moderately long ($1.9\times$ length of segment 2), with moderately developed hairlike setae on entire surface. Hypopharynx expanded laterally, with row of hairlike setae along margins. Labium glossae with dense hairlike setae; paraglossae expanded laterally; labial palpi three-segmented; segment 1, 2, and 3 0.40 mm, 0.28 mm, and 0.41 mm, respectively; segment 3 flattened, with long hairlike setae on outer and inner margins, with minute simple-stout setae on apical inner margin.



Figures 3, 4. *Rhoenanthus sapa* sp. n., adult female: (3) forewing; (4) hind wing.

Thorax: Pronotum brown, with irregular light markings, greatly expanded laterally; anterolateral processes moderately angled; lateral margins white. Mesonotum and metanotum brown, with small light markings. Forefemora, foretibiae, foretarsi, and foreclaws 2.20 mm, 2.40 mm, 1.30 mm, and 0.30 mm, respectively. Forefemora pale yellow, with brown stripe at midlength, with scattered simple-stout setae mixed with weakly developed long hairlike setae dorsally and marginally, and with 5–7 simple-stout setae mixed with 6–8 hairlike setae transversely rowed at midlength; foretibiae pale yellow, relatively short (ca. $1.1\times$ length of forefemora, $1.9\times$ length of foretarsi), with field of weakly developed hairlike setae (filtering setae) rowed along inner margin (outer margin with few setae); foretarsi subbasally dark brown, with row of 8–10 simple-stout setae on inner margin, and with hairlike setae dorsally and laterally (ventral surface with a few setae); foreclaws basally brown and apically dark brown. Mid femora, mid tibiae, mid tarsi, and mid claws 1.80 mm, 1.20 mm, 0.70 mm, and 0.30 mm, respectively; mid femora pale yellow, with dark brown marking at $2/3$ apically, with weakly developed hairlike setae and simple-stout setae dorsally and laterally; mid tibiae and mid tarsi with scattered hairlike setae dorsally; mid claws dark brown apically. Hind femora, hind tibiae, hind tarsi, and hind claws 2.40 mm, 1.40 mm, 0.80 mm, and 0.30 mm, respectively; hind femora pale yellow, with large brown area dorsally; setation similar to mid legs.

Abdomen: Tergum 1 light brown; tergum 2 brown with light triangular submedian markings; tergum 2–9 brown, with dark brown midlongitudinal stripe containing two pairs of light teardrop-shaped markings (paired markings longitudinally fused and forming triangular markings as in adult abdomen) (Fig. 2). Gills 1 single, rudimentary, two-segmented, curved upward, flattened, with hairlike setae on margins of terminal segment; gills 2–7 lateral in position, double, white with slightly darker tracheae, with long marginal fringes; gills 3 with 36–38, and 42–46 fringes in each lateral margin of dorsal and ventral lamellae, respectively. Caudal filaments $0.7\times$ length of body, with long lateral hairlike setae.

Male adult

Unknown.

Female adult

Dimensions: Body length 14.5 mm; antennae length 1.5 mm; forewings length 14.2 mm; forewings width 5.9 mm; hind wings length 4.4 mm; hind wings width 2.6 mm; cerci 24.5 mm, median terminal filament 23.5 mm. Body color white to light yellow with brown to dark brown markings.

Head: Dorsal head brown; compound eyes black in alcohol, small and widely separated; dorsal diameter of compound eyes 0.55 mm; distance between compound eyes 0.95 mm (ES = 1.72).

Thorax: Pronotum white with brown markings laterally; mesonotum and metanotum white, with dark brown longitudinal stripes. Forewings (Fig. 3) lightly stained

brown in costal and central areas; cross veins dark brown, slightly infuscated in costal and central areas, with 32, 30, and 15 cross veins between C and Sc, Sc and R1, and R1 and R2, respectively; MAs $0.6\times$ length MA1; MP2 originating at base of MP1 and basally greatly arched to CuA; cubital area with three intercalaries (2–3 irregularly forked); A1 single forked, with distal branch somewhat more divergent than basal branch. Hind wings (Fig. 4) transparent, longitudinal veins colorless; cross veins dark brown in central and distal areas, slightly infuscated in central area; costal projection acute; R1 basally strongly arched to costal area; MP-cell present. Mid legs and hind legs white (forelegs missing).

Abdomen: Abdominal tergum 1–10 light yellow, with dark brown mid-longitudinal stripe, containing paired triangular markings; sterna white, without markings. Cerci ca. $1.7\times$ length of body, pale yellow with dark brown band at each suture; terminal filament as long as cerci, with dark brown band at each suture.

Diagnosis

Larvae of *Rhoenanthus sapa* sp. n. are distinguished from other species of *Rhoenanthus* by the gradually attenuated and moderately arched (27.7°) mandibular tusks that possess mixed simple-stout and hairlike setae throughout dorsal and lateral surfaces (Fig. 2). Their foretibiae are relatively short (ca. $1.1\times$ length of forefemora, $1.9\times$ length of foretarsi) and their filtering setae are relatively short and weakly developed. Forewings of female (Fig. 3) are lightly stained brown in costal and central areas. Basal R1 of hind wings is strongly bent to costal area; and costal projection of hindwings is acute (Fig. 4).

Etymology

The specific epithet, *sapa* (noun), refers to the type locality.

Material examined

Holotype: Female mature larva (SWU-EPH-3403), VIETNAM, Lao Cai Prov., Sa Pa, Cat Cat, alt. 1400 m, 21-IV-2002, Y.J. Bae, V.V. Nguyen & D.H. Hoang, [SWU-AIC]. Paratypes: 4 female adults (SWU-EPH-3410, 3415, 3417, 3418), 3 mature and 2 half-grown larvae (SWU-EPH-3404), same data as holotype, [SWU-AIC]. Other material: 5 half-grown L: Lao Cai Prov., Sa Pa, Cat Cat, 28-XII-2000, T.K.T. Cao; 15 half-grown L: Lao Cai Prov., Sa Pa, Ta Van, 28-XII-2000, T.K.T. Cao; 36 half-grown L: Lao Cai Prov., Sa Pa, Cau May, 28-XII-2000, T.K.T. Cao.

Distribution, habitat, and biology

Rhoenanthus sapa sp. n. is distributed in the high mountain areas (ranging 1200–1500 m in altitude) in northern Vietnam. Larvae of *R. sapa* inhabit streams about 12–15 m wide and 10–70 cm deep during the dry season. The substrates consist of mixed sand, gravel, and various sized stones with rich organic matter. The water temperature range is 17–22°C, and the pH range is 7.6–8.0 in the streams of Sa Pa in

April. The larvae are more abundant in relatively slow current areas in the main stream course (10–30 cm deep), but they are scarce in the rapids with very fast current. General kick sampling may yield the larvae, but they are also found attached to the surface under large stones embedded in sandy and gravel substrates. Half-grown larvae are predominant in late December, while mature larvae reach up to 80% of the total larvae collected in the latter part of April in the Sa Pa area. Some adults occur around this time. One female adult contains about 500–700 eggs.

Remarks

The female adults and larvae of this species were collected at the same time and no other potamanthids were found in the area; they were associated by the characteristic abdominal markings in both larval and adult stages. The phylogenetic characters of *Rhoenanthus sapa* sp. n. such as unspecialized (unarranged) setation in the mandibular tusks and weakly developed filtering setae on the forelegs may indicate that this species belongs to a proximal (plesiotypic) clade in the *Rhoenanthus* lineage (see cladogram in Bae & McCafferty, 1991: 88).

Acknowledgments

We thank Dr. X.Q. Nguyen (Hanoi University of Science, Hanoi) for his help in checking mayfly material at Hanoi University of Science, and Mr. D.H. Hoang (SWU) and Ms. T.K.T. Cao (SWU) for their assistance on the field trips. This work was supported by the Korea Science & Engineering Foundation Grant (R01-000-00086-1).

References

- Bae YJ, McCafferty WP (1991): Phylogenetic systematics of the Potamanthidae (Ephemeroptera). *Trans Am Entomol Soc* 117: 1–143.
- Bae YJ, McCafferty WP, Edmunds GF, Jr (1990): *Stygifloris*, a new genus of mayflies (Ephemeroptera: Potamanthidae) from Southeast Asia. *Ann Entomol Soc Am* 83: 887–891.
- Eaton AE (1883–1888): A revisional monograph of recent Ephemeridae or mayflies. *Trans Linn Soc London, 2nd Ser Zool* 3: 1–352.
- Eaton AE (1892): New species of Ephemeridae from the Tenasserim Valley. *Trans Ent Soc London* 1892: 185–190.
- Gose K (1969): Mayflies (Ephemeroptera) from Thailand. *Nat Life SW Asia, Japan* 6: 125–138.
- Lestage JA (1921): Les éphémères Indo-Chinoises. *Ann Soc Entomol Belg* 61: 211–222.
- Lestage JA (1930): Contribution à l'étude des larves des Éphéméroptères. VI. Le groupe Potamanthidien. *Mém Soc Entomol Belg* 23: 73–146.
- Navás L (1922): Efemerópteros nuevos o pocco conocidos. *Bolet Soc Entomol Esp* 1922: 54–63.

- Navás L (1930): Insectos del Museo de Paris. *Broteria Ser Zool* 24: 15–24.
- Soldán T, Putz M (2000): The larva of *Rhoenanthus distafurcus* Bae et McCafferty (Ephemeroptera: Potamantidae) with notes on distribution and biology. *Aquat Insect* 22: 9–17.
- Uéno M (1969): Mayflies (Ephemeroptera) from various regions of Southeast Asia. *Orient Insects* 3: 221–238.
- Ulmer G (1920): Neue Ephemeropteren. *Arch Naturg* 85: 1–80.
- Ulmer G (1924): Ephemeropteren von den Sunda-Inseln und den Philippinen. *Trebia* 6: 28–91.
- Ulmer G (1932): Bemerkungen über die seit 1920 neu aufgestellten Gattungen der Ephemeropteren. *Stett Entomol Zeit* 93: 204–219.
- Ulmer G (1939): Eintagsfliegen (Ephemeropteren) von den Sunda-Inseln. *Arch Hydrobiol (Suppl)* 16: 443–692.

Copyright of Aquatic Insects is the property of Taylor & Francis Ltd and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.