



## Systematics of *Potamanthodes nanchangi* Hsu, 1936 (Ephemeroptera: Potamanthidae)

WEN-JUAN LI<sup>1,2</sup>, PENG-XU MU<sup>1,3</sup> & CHANG-FA ZHOU<sup>1\*</sup><sup>1</sup>The Key Laboratory of Jiangsu Biodiversity and Biotechnology, College of Life Sciences, Nanjing Normal University, Nanjing 210023, China<sup>2</sup>✉ [1824201416@qq.com](mailto:1824201416@qq.com); <https://orcid.org/0000-0003-3922-4709><sup>3</sup>✉ [euplectmpx@163.com](mailto:euplectmpx@163.com); <https://orcid.org/0000-0003-4906-0955>\*Corresponding author. ✉ [zhouchangfa@njnu.edu.cn](mailto:zhouchangfa@njnu.edu.cn); <https://orcid.org/0000-0001-8785-5228>

### Abstract

The enigmatic mayfly *Potamanthodes nanchangi* Hsu, 1936 was briefly described based on a male. Currently, this species has an unclear taxonomic position and no supporting type specimen, consequently its recognition, differentiation and classification is vague. In this study, by using fresh specimens from type locality in Jiangxi province at central China, this species is redescribed, photographed, and a neotype is designated. This species evidently belongs to the genus *Potamanthodes* Ulmer, 1920 by its short mandibular tusks (shorter than head), presence of setae row on forefemora of nymphs, slender and deeply bifurcated V-shaped penes, common base of MP<sub>2</sub> and CuA of forewings. Significant morphological characters defining this species are relatively long penial tips, greatly bent R<sub>1</sub> of hindwings and small compound eyes of the males, large mandibular tusks and long forelegs of the nymphs. Therefore, the *P. nanchangi* is indeed a valid and apomorphic species in the genus *Potamanthodes*.

**Key words:** neotype, taxonomy, phylogeny, China, mayfly

### Introduction

The potamanthid species *Potamanthodes nanchangi* was originally described by Hsu in 1936. Although it was re-described later by Hsu (1937) and You & Gui (1995), its nymphal stages and exact characters are unknown until now.

Because of its brief original description and only an outline picture of the male genitalia, some other important structures (e.g. wing venations, eye size and hindwing shape) are missing, neither Bae & McCafferty (1991) nor Kluge (2004) could establish a classification for this species in any genus or subgenus within Potamanthidae. Thus, its *incertae sedis* status is still accepted.

The sketched drawing of male genitalia provided by Hsu (1936, 1937) shows that the species *P. nanchangi* has a longer and sharper penial tip than its congeners, clear lines or ridges on penes and concave subgenital plate, which have not been seen in any other related species in the genus *Potamanthodes* or *Potamanthus* Pictet, 1843. However, since its single type was lost during World War II (Prof. Hong Gui, personal communication), the status of this species cannot be confirmed or rejected.

During the last decade, we tried several times to collect fresh materials of this species at and around its original locations. Luckily, in 2015 and 2022, at several other places nearby, we gathered tens of imagos and nymphs. We here present detailed re-descriptions and photographs of these specimens. In this study, we not only validate this species and its morphology, but also ensure its generic status, and discuss its possible phylogenetic position in the genus.

## Materials

♂ (Neotype designed), Feng-Xin County, Yi-Chun City, Jiangxi Province, China, 28°42'02"N, 115°22'48"E, 31.VII.2015, leg. Juan-Yan Luo, Jun-Zhi Sun & Yi-Ke Han; 8 ♂♂ 10 ♀♀ 3 nymphs, same as the neotype; 20 ♂♂ 20 ♀♀ 25 nymphs, Qing-Hua Town, Wu-Yuan County, Shang-Rao City, Jiangxi Province, China, 29°24'56"N, 117°46'54"E, 2.VIII.2015, leg. Juan-Yan Luo, Jun-Zhi Sun & Yi-Ke Han; 1 ♂ 2 nymphs, Tianmen Mt., Wu-Yuan County, Shang-Rao City, Jiangxi Province, China, 29°14'53"N, 117°51'42"E, 11.VIII.2015, leg. Juan-Yan Luo; 30 nymphs, Long-Quan Prefecture, Li-Shui City, Zhejiang Province, China, 27°58'29"N, 119°02'53"E, 26.IX.2021, leg. Yang-Qi Lui; 1 ♂ 1 ♂subimago 3 nymphs, Juan-Qiao-He Wetland Park, Yi-Chang City, Hubei Province, China, 30°42'02"N, 111°16'48"E, 3.II.2022, leg. Peng-Xu Mu.

## Methods

The nymphs were collected by hand net and the adults were collected by light trap (using LED and mercury lamp). Some adults were reared from nymphs in the lab. The specimens were stored in ethanol (about 85%).

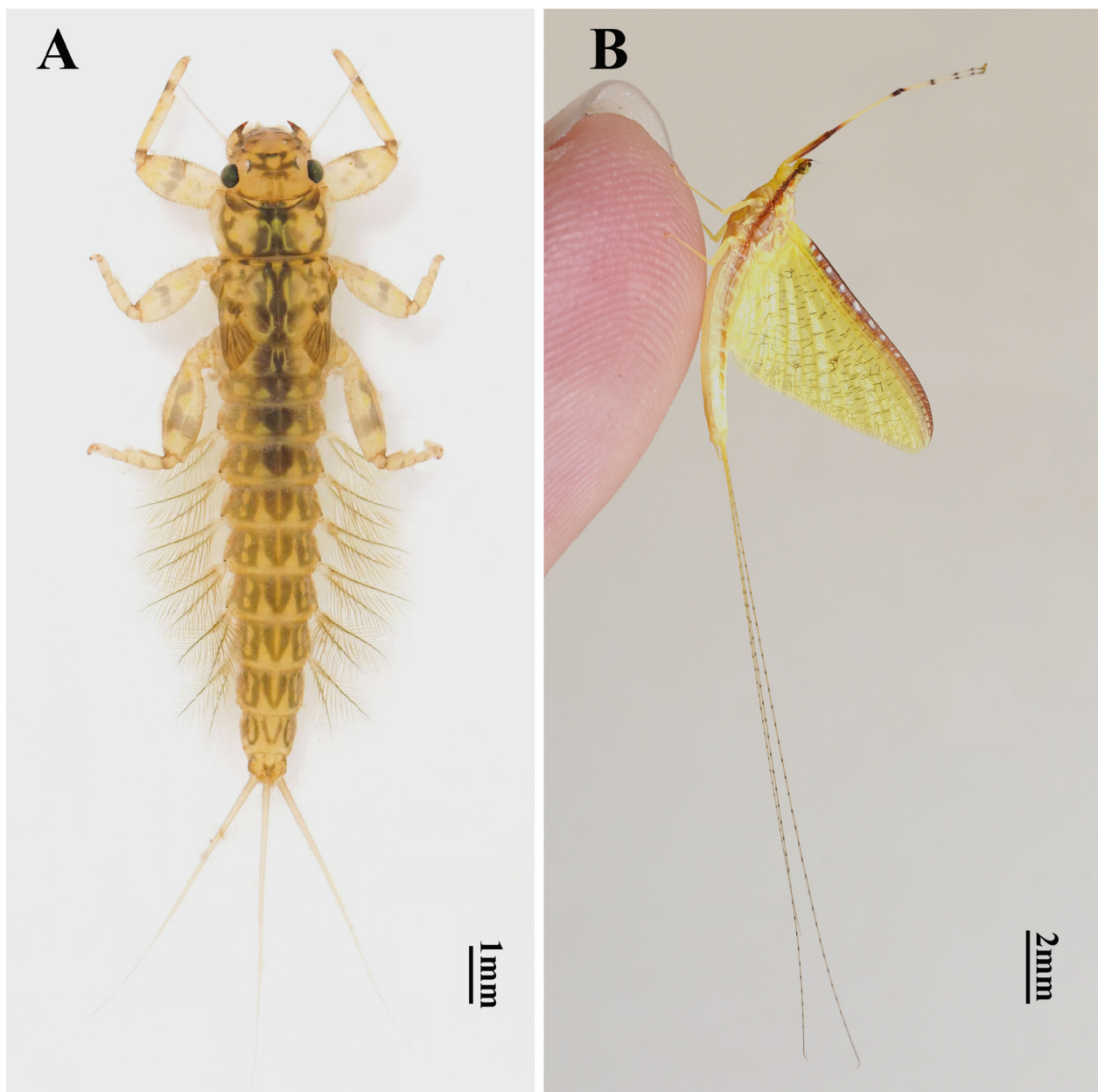


FIGURE 1. Habitus of *Potamanthodes nanchangi* Hsu, 1936: A, Nymph; B, Male imago.

All specimens were examined under a stereomicroscope (MshOt MZ81) and photographed with a digital camera coupled to the microscope (Nikon eclipse 50i). Some small structures, such as gills, mouthparts, terga and legs, were observed and photographed with a microscope camera prepared in the temporary slides. After that, the structures are deposited in ethanol again. All specimens used in this study are deposited in the mayfly collection, College of Life Sciences, Nanjing Normal University, China.

Eggs were dissected from female imagos. The scanning electronic microscope samples were prepared with a standard protocol: fixed in 4% glutaraldehyde for 5–8 h, rinsed with PBS (phosphate buffered saline) 2–3 times (10–15 min each), dehydrated in concentration gradient acetone (30%, 50%, 70%, 80%, 90%, 100%, 10–15 min each), and coated with gold film in a vacuum.

## Results

### Description

#### *Potamanthodes nanchangi* Hsu, 1936

*Potamanthodes nanchangi* Hsu, 1936: 322. Types: male, Fig. 5, from Jiangxi province, China.

*Neopotamanthodes nanchangi*: Hsu 1937: 223, Fig. 46; Gui 1985: 91; You & Gui 1995: 127, Fig. 136.

*Potamanthus nanchangi*: Bae & McCafferty 1991: 70 (subgenus *incertae sedis*); Zhou 2013: 203; Zhou *et al.* 2015: 253.

*Potamanthodes nanchangi*: Kluge 2004: 223.

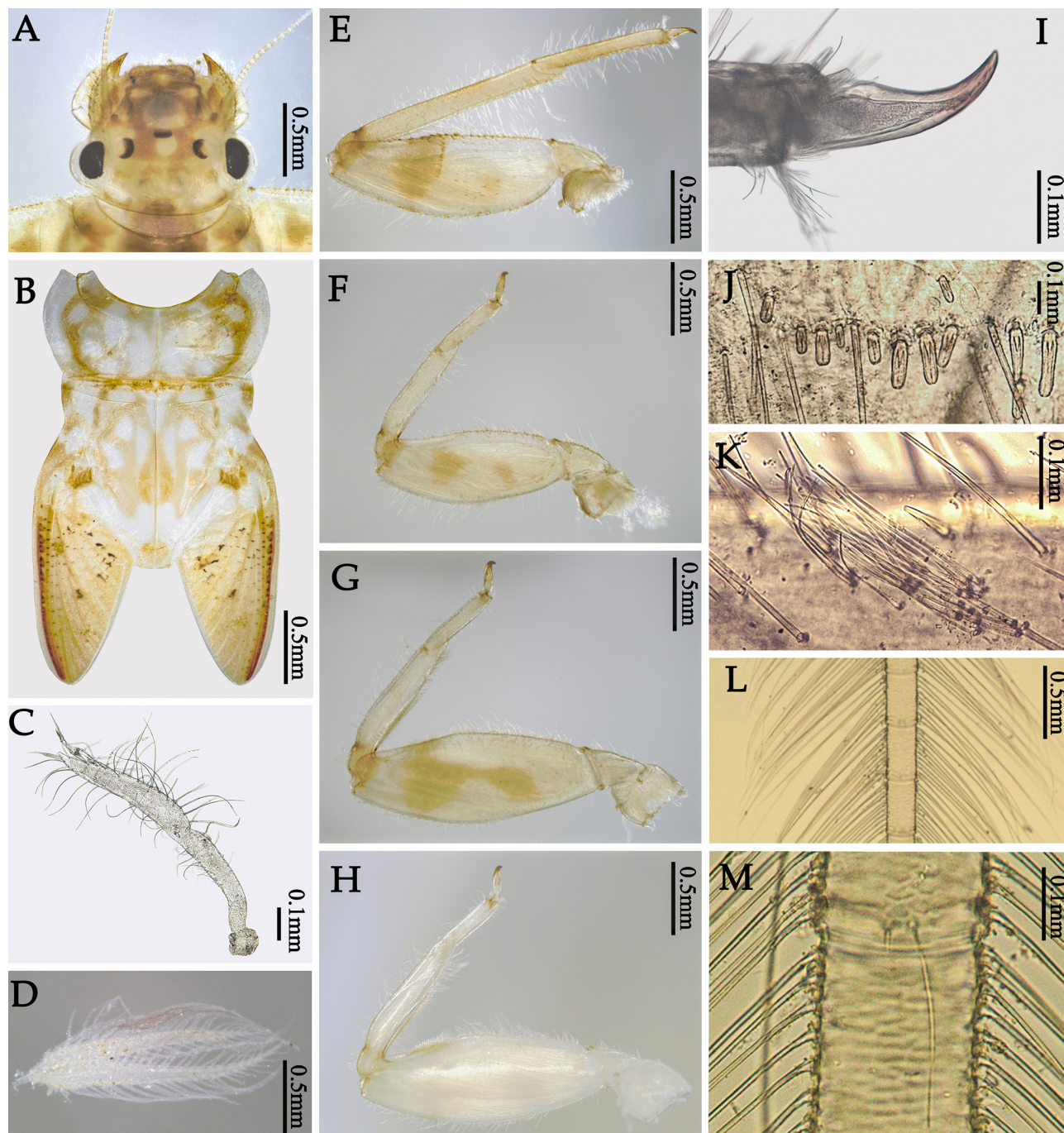
**Mature nymph** (in alcohol): body length 9.8–11.5mm, caudal filaments 6.0–7.5mm. body pale to yellowish but with reddish brown to dark brown stripes and dots (Fig. 1A).

Head: Pale, a rough pair of brown stripes on clypeus to occiput, 3–5 transverse stripes linking them together; four additional brown dots on occiput, shortest distance between two eyes: diameter of one eye = 3.0–4.0 (Figs 1A, 2A, five nymphs measured). Mouthparts: labrum nearly oval but with a shallow median groove on anterior margin; both dorsal and ventral surfaces with hair-like setae, those on dorsal surface and free margins relatively longer but sparser, ventral setae denser but shorter than dorsal ones; an additional setae row along anterior groove (Fig. 3A). Superlinguae of hypopharynx with hair-like setae on free margins; lingua with a V-shaped median groove which further with very fine hair-like setae along margins (Fig. 3B). Both mandibles with distinct tusks which visible in dorsal view (Figs 1A, 2A); spines and hair-like setae on outer margin; apexes of outer and inner incisors of left mandible divided into three teeth, prostheca with a denticle and a tuft of tine spines (Fig. 3C). Apexes of outer incisor of right mandible with three teeth but inner one with two only; prostheca represents as a serrated denticle; first denticle of molar near prostheca expanded and clear, a tuft of hair-like setae on inner corner under molar (Fig. 3D). Inner and outer margins of maxillae with hair-like setae, distal dentisetae and proximal dentisetae longer and broader than others (Fig. 3E); a tuft of spines on apex; outer margin of basal segment of maxillary palpi with hair-like setae too, surfaces of second and third segments of maxillary palpi with relatively longer hair-like setae. Length ratio of three segment = 1.0: 0.7: 1.2; cardo also with hair-like setae (Fig. 3F). Labium: glossae and paraglossae with dense hair-like setae on both ventral and dorsal surface; glossae near oval, paraglossae rough heart-shaped; the latter width ca. 4 times of glossae; basal segment of labial palpi broader than second one, the latter slightly broader than apical one; length ratio of them from base to apex = 1.0: 0.7: 0.7. Hair-like setae on outer margins of basal and second segments of labial palpi but whole surface of apical segment with hair-like setae and spines, especially on apex and inner margins; mentum and submentum with sparse hair-like setae on ventral surface (Fig. 3G).

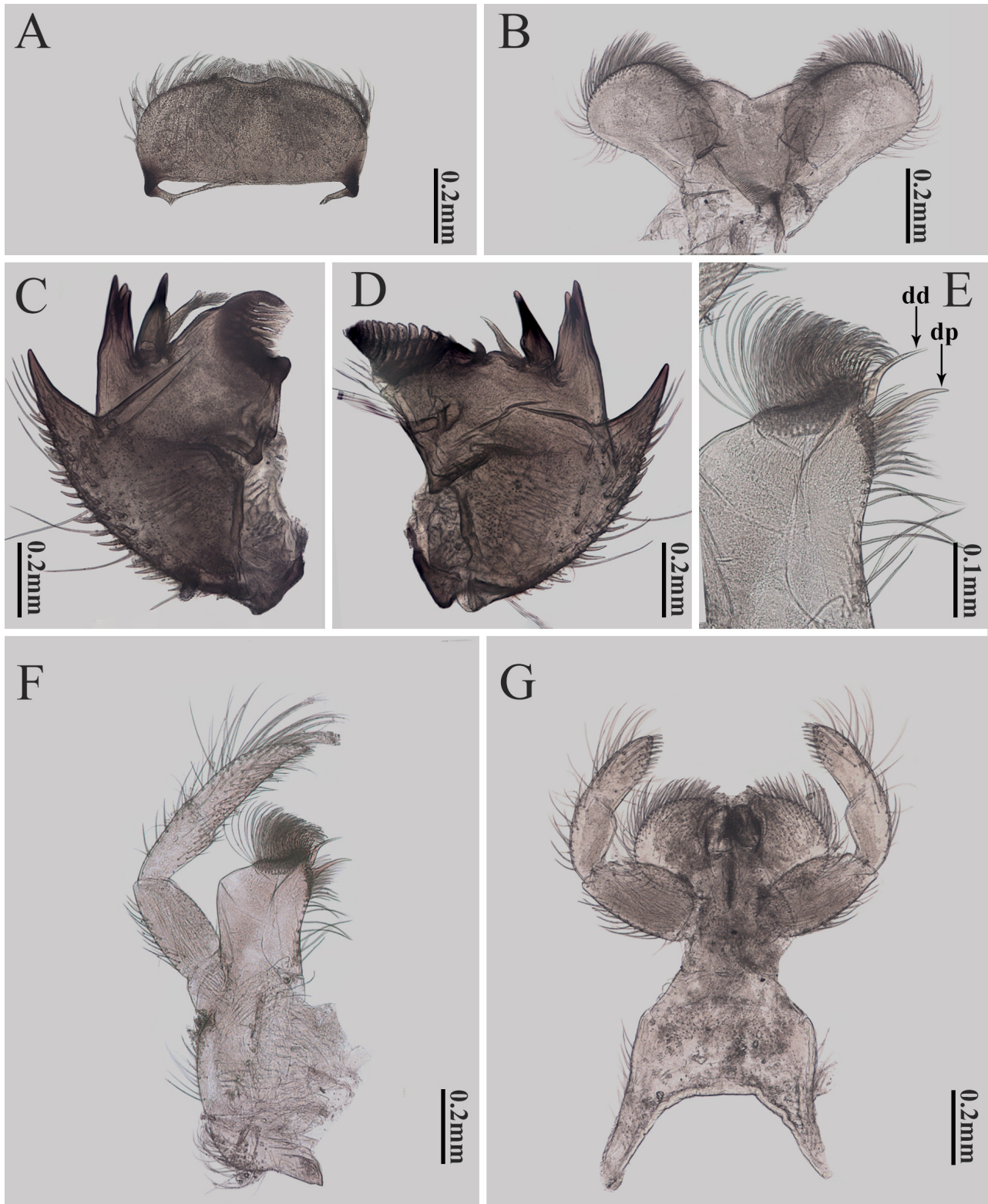
Thorax: Color pattern as in figure 2B, a pair of dark dots near wingpad bases; pronotum expanded laterally into clear lobes; anterior portion connecting head thickened into a half-ring like structure (Figs 1A, 2A–B). Femora of all legs with three brown bands dorsally, median one larger than others and extend to ventral surface. Tibiae of all legs with wide brown band in middle and a narrow one at base, tarsi with broad median band too (Figs 1A, 2E–G). Claws of all legs similar, with smoothly curved dark apex (Fig. 2I). Femora of forelegs with clear setae row in middle (Fig. 2E, 2J), additional sparse hair-like setae and spatulate setae on dorsal surface, both margins also with hair-like setae (Fig. 2E). Whole surface of tibiae with hair-like setae but ventral ones sparser and shorter than dorsal ones; some spines and setae tuft near apex (Fig. 2K). Tarsi similar to tibiae in setaceous pattern but with more setae tufts near apex (Fig. 2E). Length ratio of femora: tibiae: tarsi of foreleg = 1.0: 0.9: 0.6 (Fig. 2E). Midlegs and hindlegs

similar to forelegs except hindlegs with fine setae tuft on ventral surface near apex (Fig. 2E–H). Length ratio of femora: tibiae: tarsi of midlegs = 1.0: 0.6: 0.4 (Fig. 2F), that ratio of hindlegs=1.0: 0.5: 0.4 (Fig. 2G–H).

Abdomen: Lateral margins of terga I–X gray to brown; terga I–IX each with 3 pairs of brown longitudinal stripes, median pair of them sometimes widened and with transverse line attaching two neighbor stripes; terga X with one big brown dot and a transverse line in the middle (Fig. 1A). Gill I with sharp apex, hair-like setae on surface; length ratio of basal segment: apical segment = 1.0: 1.2 (Fig. 2C). Gills II–VII similar in structure, Gill II and VII slightly shorter than others (Figs 1A, 2D). Caudal filaments with fine hair-like setae on articulations, basal half of all filaments with long hair-like setae on both margins (swimming setae) (Figs 1A, 2L–M).



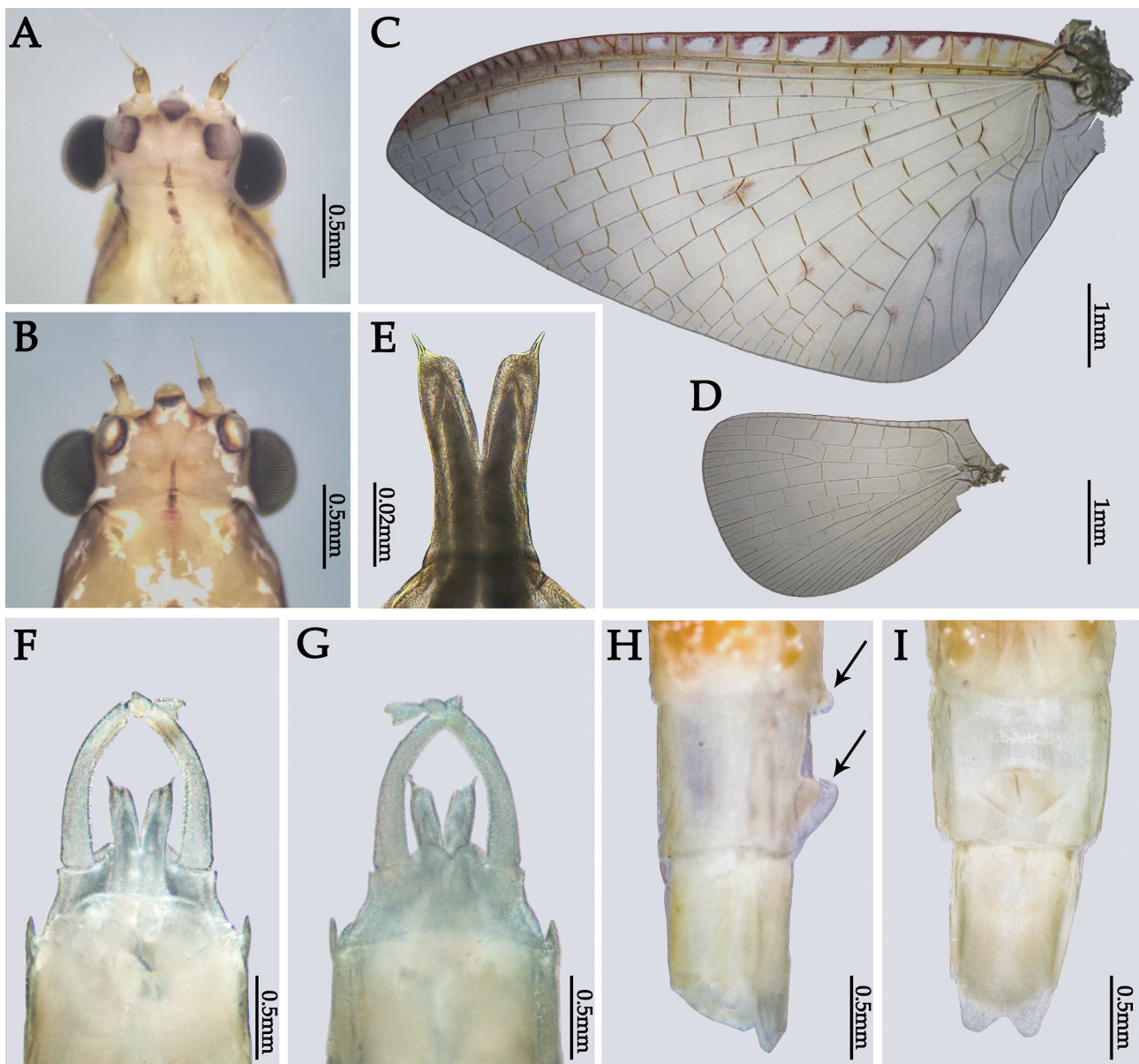
**FIGURE 2.** Nymph of *Potamanthodes nanchangi* Hsu, 1936: A, Head; B, Thorax; C, Gill I; D, Gill VII; E, Foreleg; F, Midleg; G, Hindleg (dorsal view); H, Hindleg (ventral view); I, Claw of foreleg; J, Setae row of forefemora; K, Setae tuft of subapical foretibia; L–M, Cerci.



**FIGURE 3.** Mouthparts of *Potamanthodes nanchangi* Hsu, 1936 nymph: A, Labrum; B, Hypopharynx; C, Left mandible; D, Right mandible; E–F, Maxilla (dd: distal dentisetae; dp: proximal dentisetae); G, Labium.

**Male imago** (in alcohol): Body length 9.5–12.5 mm, caudal filaments 20.5–27.0 mm; body pale with reddish brown stripes and dots (Fig. 1B). Head: antennae with brown scape and basal flagella, basal half of ocelli dark, a pair of dark dots between ocelli, a median reddish-brown line on occiput (Fig. 4A). Compound eyes with dark basal half and gray upper half, shortest distance between them: one eye diameter = 1.6 (Fig. 4A, five males measured).

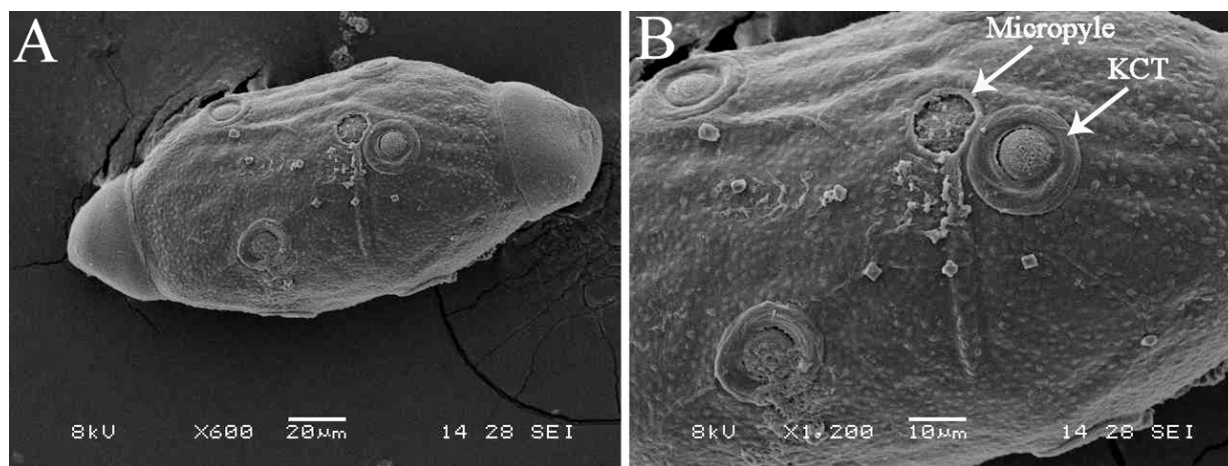
Thorax: Median longitudinal line of thorax reddish brown. Length ratio of forefemora: tibiae: tarsi = 1.0: 1.2: 0.9, ratio of foretarsal segments I: II: III: IV: V = 0.1: 0.5: 0.3: 0.2: 0.2; length ratio of midfemora: tibiae: tarsi = 1.0: 1.2: 0.5, ratio of midtarsal segments I: II: III: IV = 0.3: 0.2: 0.1: 0.2; length ratio of hindfemora: tibiae: tarsi = 1.0: 0.9: 0.4, ratio of hindtarsal segments I: II: III: IV = 0.2: 0.1: 0.1: 0.3 (Fig. 1B). Forewings yellowish but with remarkable reddish paints and dots, especially near anterior margins; crossveins also pigmented;  $MP_2$  fused with  $CuA$  at base (Fig. 4C). Hindwings pale with acute costal projection and convex curved  $Sc$  towards  $C$ ; base of  $R_1$  greatly curved towards  $Sc$  and connecting it with two crossveins;  $MA$  single,  $MP$  orienting towards  $CuA$  at base and forked asymmetrically (Fig. 4D). Abdomen pale. Genitalia: length of basal segment of forceps ca. 3X combined length of second and third segment, the latter with concave apex, its length ca. 1.7X second one; inner margins of forceps with tiny projections (Fig. 4E–G). Penes half-length of forceps; apical 2/3 divided, basal 1/3 fused together; ca. half penes extend out of subgenital plate (Fig. 4F–G); apex of penes tapered into thin and acute tips, like needle or spine; spermatic duct in penis clear (usually darker than other place, Fig. 4E–G). Terminal filament shorter than cerci, all of them pale but with pigmented articulations, especially apical half (Fig. 1B).



**FIGURE 4.** Male and female structures of *Potamanthodes nanchangi* Hsu, 1936: A, Head of male; B, Head of female; C, Forewing; D, Hindwing; E–F, Genitalia (dorsal view); G, Genitalia (ventral view); H, Abdominal segments VII–X of female imago (lateral view); I, Abdominal segments VII–X of female imago (ventral view).

**Female imago** (in alcohol): Body length 10.0–13.5 mm, caudal filaments 10.5–14.0 mm, color pattern similar to male. Head: shape and color are very similar to the male, size of compound eyes approximately equal to male, shortest distance between two eyes: diameter of one eye = 1.7 (Fig. 4B, five females measured). Thorax: length ratio of forefemora: tibiae: tarsi = 1.0: 1.1: 0.6, ratio of foretarsal segments I: II: III: IV: V = 0.1: 0.5: 0.3: 0.2: 0.4; length ratio of midfemora: tibiae: tarsi = 1.0: 1.1: 0.4, ratio of midtarsal segments I: II: III: IV = 0.2: 0.1: 0.1: 0.3; length ratio of hindfemora: tibiae: tarsi = 1.0: 0.9: 0.4, ratio of hindtarsal segments I: II: III: IV = 0.2: 0.2: 0.1: 0.3. Posterior margin of sternum VII slightly extended backward and thickened, produced to half-length of sternum VIII (Fig. 4H–I). Posterior margin of subanal plate with semi-oval median cleft (Fig. 4I).

**Egg:** Olive, with two polar caps, length ca. 190  $\mu\text{m}$  (including polar cap), width at equator ca. 80  $\mu\text{m}$  (Fig. 5A); chorionic surface with some knob-terminated coiled threads (KCTs) and a distinct micropyle at equator with a diameter of about 10  $\mu\text{m}$  (Fig. 5B).



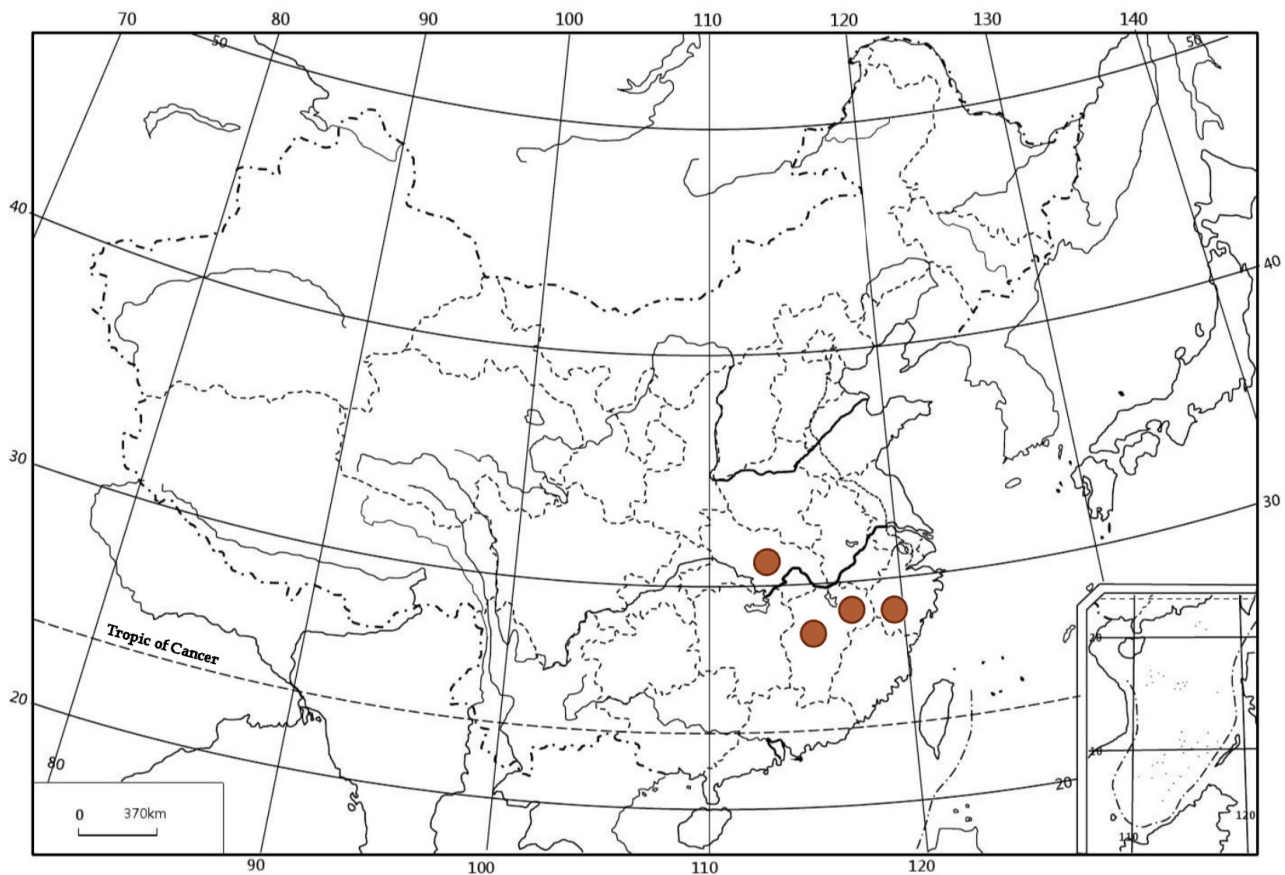
**FIGURE 5.** Egg of *Potamanthodes nanchangi* Hsu, 1936: A, Whole picture; B, KCT and micropyle.

**Habitat:** The nymphs of this study were collected from median to large rivers (10–30 m width). The collecting sites usually have stony bottoms with sandy sediments. The size of stone there ranges from 10 cm to 1 m (Fig. 6).



**FIGURE 6.** Habitat of *Potamanthodes nanchangi* Hsu, 1936 (Zhejiang Province, China, September 2021).

**Distribution:** China (Jiangxi, Zhejiang and Hubei Province) (Fig. 7).



**FIGURE 7.** Localities of Chinese *Potamanthodes nanchangi* Hsu, 1936.

**Diagnosis:** Li & Zhou (2022) regarded the taxa *Potamanthus*, *Potamanthodes* and *Stygifloris* Bae *et al.*, 1990 as genera of the family Potamanthidae, along with the two other genera (*Rhoenanthus* Eaton, 1881 and *Anthopotamus* McCafferty & Bae, 1990). The males of *P. nanchangi* have slender and deeply divided penes (Fig. 4E–G, in contrast to the genera *Potamanthus* and *Stygifloris*), MP fused to CuA at base (Fig. 4C, in contrast to *Stygifloris* and *Rhoenanthus*), heavily pigmented forewings (Fig. 4C, in contrast to *Potamanthus* and *Stygifloris*), hindwings with single MA but forked MP and greatly bent  $R_1$  (Fig. 4D, in contrast to the genera *Potamanthus*, *Stygifloris* and *Rhoenanthus*), smaller compound eyes (Fig. 4A, in contrast to all other genera). In nymphs, this species has shorter mandibular tusks (Figs 1A, 2A, in contrast to *Rhoenanthus* or *Anthopotamus*) and setae row on forefemora (Figs 1A, 2E, 2J, in contrast to *Potamanthus*), labial palpi without expanded apical segments (Fig. 3G, in contrast to *Stygifloris*). Those aggregate characters show this species is a *Potamanthodes* member.

At the species level, the *P. nanchangi* has several unique characters. In male, its bent  $R_1$  of hindwing almost attaching Sc (Fig. 4D), its penial tips are longest in the genus, its subgenital plate with a median V-shaped cleft (Fig. 4G), the male eyes are subequal to female eyes (Fig. 4A–B). In nymph, its mandibular tusks can be seen clearly in dorsal view (Figs 1A, 2A), foretibiae are longer than forefemora (Fig. 2E), and the setae in forefemora row are somewhat uniform in length (Fig. 2J).

Its subgenital plate is similar to that of *P. yunnanensis* You *et al.*, 1982 (imago known only) but their penes are totally different, the latter has no clear penial tips. The penial length of *P. nanchangi* is shorter than that of *P. macrophthalmus* You, 1984 and *P. formosus* Eaton, 1892 but is longer than *P. yunnanensis* and *P. kwangsiensis* Hus, 1937. Additionally, all other known males of *Potamanthodes* have shallow concave subgenital plate instead of median cleft.

The eggs of *P. nanchangi* are similar to other species in general shape and structure (with two polar caps and two rows of KCTs). Its micropyle locates nearby a row of KCTs. In contrast, *P. yooni* Bae & McCafferty, 1991 and *P. macrophthalmus* has a near equatorial micropyle (see Bae & McCafferty 1991 and Li & Zhou 2022) while the KCTs of *P. formosus* eggs are somewhat randomly distributed (see Koss & Edmunds 1974). The eggs of this species are drum-shaped, much shorter than that of *P. idiocerus* Bae & McCafferty, 1991 (see Kang & Yang 1994).



**Phylogeny:** In our view, generally in the genus *Potamanthodes*, the evolutionary trends include smaller eyes, less pigmented spots on wings, bent Sc and R<sub>1</sub>, shorter penes and longer penial tips in males, larger mandibular tusks, longer forelegs, longer foretibiae and its hair-like setae along inner margins, longer setae row on forefemora in nymphs (see Li & Zhou 2022). According to this standpoint, the *P. nanchangi* might be more apomorphic than *P. yooni*, *P. macrophthalmus* and *P. formosus* but more plesiomorphic than *P. yunnanensis* and *P. sangangensis* You, 1984.

## Discussion

Although the original drawing of Hsu (1936, 1937) is ambiguous on regarding the genitalia shape and subgenital plate, he did show the longer penial tips and longitudinal lines on penes. Upon our fresh specimens, we believe the latter comes from the dark spermatic ducts which seemly makes a penis divide into three parts (Fig. 4E–G).

The eyes of mayflies usually present sexual size dimorphism. In Potamanthidae, Baetidae and Leptophlebiidae, usually the eyes of males are much bigger than females (Mayorga & Bae 2021). Only in Caenidae of China, as far as we know, this phenomenon is not obvious. Here the *P. nanchangi* shows another example, which is an apomorphy among the other *Potamanthodes* species (Fig. 4A–B).

Comparing the length of mandibular tusks and foretibiae in the genus *Potamanthodes*, we can see they usually are enlarged simultaneously in the same species, and seems to be a correlation. Previous study on allometry of mandibular tusks in *Rhoenanthus coreanus* (Yoon & Bae, 1985) showed that there is a positive correlation with the size of tusks and forelegs of this species. This may occur because the nymphs of this family usually use both structures to dig in the rocky sediments, or for feeding (Bae *et al.* 1990; Bae & McCafferty 1994; Mayorga & Bae 2021).

The Chinese *Potamanthodes* is under review. A more comprehensive comparison of imagos, nymphs and eggs of all species will be provided soon. The exact relations of *P. nanchangi* to some similar species, like *P. kwangsiensis* (nymph unknown), *P. longitibius* Bae & McCafferty, 1991 (imago unknown) is hoped to be clarified.

## Acknowledgements

We are sincerely grateful to associate professor Boonsatien Boonsoong (Department of Zoology, Kasetsart University, Thailand) for providing some pictures to compare for this study. We also thank Mr. Alfredo Mayorga Villalobos (Lab of Biodiversity and Ecology, Korea University, Korea) for taking some Korean species pictures for us and giving valuable comments on our draft. Two reviewers also improved our submission linguistically and academically.

## Funding

This work was supported by the National Natural Science Foundation of China [Grant Nos. 31750002 and 32070475], funded by the Priority Academic Program Development of Jiangsu Higher Education Institutions (PAPD), and supported by key projects of science-technology basic condition platform from The Ministry of Science and Technology of the People's Republic of China [Grant No. 2005DKA21402]. It is also a part of the Project of Biological Resources Survey in Wuyishan National Park.

## References

- Bae, Y.J., McCafferty, W.P. & Edmunds, G.F. Jr (1990) *Stygifloris*, a new genus of mayflies (Ephemeroptera: Potamanthidae) from southeast Asia. *Annals of the Entomological Society of America*, 83 (5), 887–891.  
<https://doi.org/10.1093/aesa/83.5.887>
- Bae, Y.J. & McCafferty, W.P. (1991) Phylogenetic Systematics of the Potamanthidae (Ephemeroptera). *Transactions of the American Entomological Society*, 117 (3–4), 1–143.
- Bae, Y.J. & McCafferty, W.P. (1994) Microhabitat of *Anthopotamus verticis* (Ephemeroptera: Potamanthidae). *Hydrobiologia*, 288, 65–78.  
<https://doi.org/10.1007/BF00007127>

- Eaton, A.E. (1881) An announcement of new genera of the Ephemeridae. *Entomologist's Monthly Magazine*, 17, 191–197.
- Eaton, A.E. (1892) IX. New species of Ephemeridae from the Tenasserim Valley. *Transactions of the Entomological Society of London*, 2, 185–190.  
<https://doi.org/10.1111/j.1365-2311.1892.tb02045.x>
- Gui, H. (1985) A catalog of the Ephemeroptera of China. *Journal of Nanjing Normal University*, 4, 79–97. [in Chinese]
- Hsu, Y.C. (1936) New Chinese mayflies from Kiangsi Province (Ephemeroptera). *Peking Natural History Bulletin*, 10 (4), 319–326.
- Hsu, Y.C. (1937) The mayflies of China. *Peking Natural History Bulletin*, 12 (2 & 3), 123–126 & 221–224.  
<https://doi.org/10.1104/pp.12.1.221>
- Kang, S.C. & Yang, C.T. (1994) Ephemeroidea of Taiwan (Ephemeroptera). *Chinese Journal of Entomology*, 14, 391–399.
- Kluge, N.J. (2004) *The phylogenetic system of Ephemeroptera*. Kluwer Academic Publishers, Dordrecht, 442 pp.  
<https://doi.org/10.1007/978-94-007-0872-3>
- Koss, R.W. & Edmunds, G.F. Jr. (1974) Ephemeroptera eggs and their contribution to phylogenetic studies of the order. *Zoological Journal of the Linnean Society*, 55 (4), 267–349, pls. 1–24.  
<https://doi.org/10.1111/j.1096-3642.1974.tb01648.x>
- Li, W.J. & Zhou, C.F. (2022) The first description of the nymph of *Potamanthodes* macrophthalmus You, 1984 and reinstatements of the genera *Potamanthodes* Ulmer, 1920 and *Stygifloris* Bae, McCafferty and Edmunds, 1990 (Ephemeroptera: Potamanthidae). *Aquatic Insects*. [published online]  
<https://doi.org/10.1080/01650424.2022.2074043>
- Mayorga, A. & Bae, Y.J. (2021) Allometry of exaggerated mandibular tusks in the burrowing mayfly *Rhoenanthus coreanus* (Ephemeroptera: Potamanthidae). *Entomological Research*, 51, 263–269.  
<https://doi.org/10.1111/1748-5967.12509>
- McCafferty, W.P. & Bae, Y.J. (1990) *Anthopotamus*, a new genus for North American species previously known as *Potamanthus* (Ephemeroptera: Potamanthidae). *Entomological News*, 101 (4), 200–202.
- Pictet, F.J. (1843) *Histoire naturelle générale et particulière des Insectes Névroptères—Famille des Ephemerines*. Baillière édit., Paris: Kessmann et Cherbuliez édit, aussi à Genève, 319 pp.  
<https://doi.org/10.5962/bhl.title.48625>
- Ulmer, G.H. (1920) Übersicht über die Gattungen der Ephemeropteren, nebst Bemerkungen über einzelne Arten. *Stettiner Entomologische Zeitung*, 81, 97–144. [<https://biostor.org/reference/197268>]
- Yoon, I.B. & Bae, Y.J. (1985) The classification of Ephemeroidea (Ephemeroptera) in Korea. *Entomological Research Bulletin, Korean Entomological Institute, Korea University*, 11, 93–109.
- You, D.S., Wu, T., Gui, H. & Hsu, Y.C. (1980) A new species of genus *Potamanthodes* (Ephemeroptera: Potamanthidae). *Journal of Nanjing Normal University*, 2, 1–4. [in Chinese]
- You, D.S., Wu, T., Gui, H. & Hsu, Y.C. (1982) Genus *Potamanthodes* and two new species (Ephemeroptera: Potamanthidae). *Acta Zootaxonomica Sinica*, 7 (4), 410–415. [in Chinese]
- You, D.S. (1984) A revision of genus *Potamanthodes* with a description of two new species (Ephemeroptera, Potamanthidae). In: Landa V. & Soldán T. & Tonner M. (Eds.), *Proceedings of the 4<sup>th</sup> International Conference of Ephemeroptera*. Czechoslovak Academy of Sciences, České Budejovice, pp. 101–107.
- You, D.S. & Gui, H. (1995) *Ephemeroptera*. Science Press, Beijing, 152 pp. [in Chinese]
- Zhou, C.F. (2013) A species list of Chinese mayflies (Insecta: Ephemeroptera). *Inland Waters Biology, Proceedings of the 1<sup>st</sup> Symposium of Benthological Society of Asia (BSA)*, 6, 167–225.
- Zhou, C.F., Su, C.R. & Gui, H. (2015) *Outline of Chinese Mayflies*. Science Press, Beijing, 310 pp. [in Chinese]