

A new mayfly species of *Epeorus* Eaton 1881 (Ephemeroptera: Heptageniidae) from Peninsular India

Marimuthu Muthukatturaja** and Chellaiah Balasubramanian*

Department of Zoology, Thiagarajar College, Madurai - 625 009, Tamil Nadu, India

ABSTRACT

Both nymph and adult of *Epeorus munnarensis* sp. nov. is described and illustrated based on combination of characters with an Indian *Epeorus* species. *E. munnarensis* sp. nov. is different from *E. petersi* and *E. gilliesi* for the following combination of characters: (i) larva with straight postero-lateral spines in terga II-VII; (ii) presence of single macula on femora; (iii) claw with 11 denticles; (iv) the imago with lobed penis and 22-23 cross veins in C and Sc.

Key words : Kerala, new species, mayfly, Rhithrogeninae, Western Ghats.

INTRODUCTION

The mayfly family Heptageniidae, genus *Epeorus* Eaton (1881) is distributed in the Holarctic, Oriental and northern neotropical regions (Webb and McCafferty, 2008). Several species of *Epeorus* have been studied in Oriental region (Eaton, 1881, 1892; Traver, 1939; Ueno, 1955; Edmunds and Traver, 1954; Edmunds *et al.*, 1976; Braasch, 1980, 1981, 1990, 2006; Braasch and Soldan, 1986b; Yoon and Bae, 1984; Tomka and Zurwera, 1985; Tshernova *et al.*, 1986; Kluge, 1988, 1997; Hefli and Tomka, 1989; Braasch and Boonsoong, 2010). In India the genus *Epeorus* is found in fast flowing mountain and sub-montane streams of Western and Eastern Ghats. Only six species are known from larval and adult stages so far in Oriental (Webb and McCafferty, 2006; Stauder, 2000; Sivaramakrishnan *et al.*, 2009 and Sivaruban *et al.*, 2013). In Western Ghats of India, two species have been documented *viz.*, *E. gilliesi* from Maharashtra Braasch (1981) and Braasch and Soldan (1987) from Kerala, and *E. petersi* Sivaruben *et al.* (2013) from Tamil Nadu. On the basis of description of *Epeorus* species made by Sivaruban *et al.* (2013), the new species of *Epeorus* is described herein.

MATERIALS AND METHODS

The material used in the present description was preserved in 80 - 95% ethanol. The nymphs

were collected by Kick-net method and some are hand picked from the riffle habitat. Male and female imagoes were collected by light trap in the type locality. The collected specimens were documented with the aid of NIKON 1270i Stereo zoom binocular microscope. Holotype and paratypes were deposited in Zoological Survey of India (in alcohol), Southern Regional Centre, Chennai, Tamil Nadu.

RESULTS AND DISCUSSION

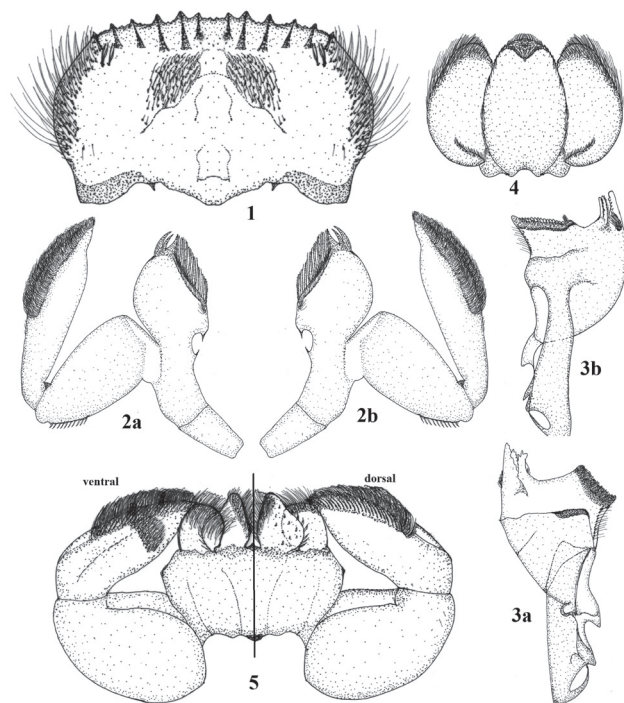
Epeorus munnarensis Balasubramanian and Muthukatturaja new species (Figs. 1-15)

Materials examined : Holotype (in ethanol): one mature nymph [ZSI/SRC-I/E 429], India, Periyavarai stream (Munnar), Idukki district, Kerala state, 29-XII-2018, 1,501m (10.109476°N, 77.057512°E), collected by Balasubramanian and Muthukatturaja. Paratypes (same data as holotype): one male and female imago, 8 mature nymphs [ZSI/SRC-I/E 430], deposited in Zoological Survey of India (Southern Regional Centre), Chennai, Tamil Nadu.

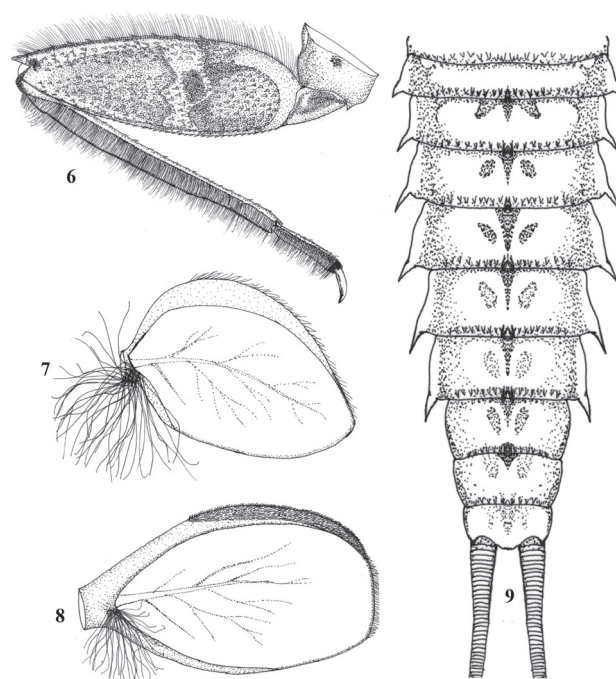
Diagnosis : *Epeorus munnarensis* sp. nov. can be distinguished from other Oriental species by the following combination of characters. **Larva**: (i) abdominal terga yellowish brown; terga III-VIII with dark brown macula on dorso-medial margin; terga III-VIII with light brown macula on either side of central macula; pair of long stout spines at mid-dorsum (Fig. 7); (ii) postero-lateral spines on abdominal segment II-VII, progressively longer (Fig. 7); (iii) gill

*Corresponding author's E-mail : ulabc62@gmail.com; Orcid Id : <https://orcid.org/0000-0001-8563-1677>

**E-mail : dmkrja83@gmail.com; Orcid Id : <https://orcid.org/0000-0001-5796-0211>



Figs. 1-5. Mature nymph *Epeorus munnarensis* sp. nov. Dorsal view : (1) Labrum, (2a,b) Maxillae, (3a,b) Mandibles, (4) Hypopharynx, (5) Labium.



Figs. 6-9. Mature nymph *Epeorus munnarensis* sp. nov. Dorsal view : (6) Foreleg, (7) Gill I, (8) Gill VII, (9) tergum.

I translucent, lacking spines on dorso-lateral margin and with hairs; 1/2 of gill plates with rows of spines at dorso-lateral margin of gill III; gill VII with dense hairs at apex and dorso-lateral margin (Fig. 8); (iv) ventral side of proximal segment with hair tufts in mesal margin (Fig. 5) and (v) legs brownish yellow with macula on femora (Fig. 6). *Imago*: (i) The penes lobed apically (Fig. 5); (ii) membrane of fore and hind wings pale yellow to translucent; longitudinal and cross veins of fore and hind wings brown; (iii) C and Sc of fore wings pale brown with about 22 and 23 cross veins respectively (Fig. 2).

Description

Mature nymph (Figs. 1-9) (Preserved in 80% alcohol) *Dimension* (mm) : body length, 14-16. Length of cerci, 17.0; antennae length, 2.5; distance between compound eyes, 2.48.

Head yellowish brown; anterior margin slightly pale yellow; pale yellow stripes extending from lateral ocelli to lateral edges of head; eyes black; ocelli brownish black, paler basally; antennal scape pale yellow, pedicel light brown and flagellum translucent.

Head trapezoidal shaped; width, 2.5 mm; length, 1.5 mm. Anterior margin slightly convex, covered

with dense hair-like setae extending towards lateral margins; lateral margins rounded; posterior margin convex; sparse pale thin setae located posteriorly to eyes. Labrum (Fig. 1) length, 1.08 mm; width, 1.89 mm; widened distally; anterior margin slightly convex; dorsum with clump of setae directed antero-medially and longer bristles antero-laterally; six prominent chitinised serrations on either side of emargination; below the edge of antero-lateral margin with two bifurcated stout spines. Outer incisors of both mandibles with seven apical teeth, outer tooth of each mandible blunt (Fig. 3); base of mandibles with tuft of hairs; inner incisors with five ridges; 10 thin setae below the molar; below the inner and outer incisor with tuft of hair-like setae, posterior region of outer incisor triangular, below the molar of right mandible with clump of stout spines; prostheca represented by tuft of plumose setae. Maxillary palp (Fig. 2a, b) two segmented, proximal segment longer than distal segment; 1/2 of proximal segment broadened with tufts of monopectinate thin setae and rows of small comb like setae dorsally; apex of basal segment outer margin with 10 stout spines; trifurcated chitinised projections in galea and lacinia; apex of stapes with prominent cavity. Lingua of hypopharynx (Fig. 4) oblong shaped with two latero-apical lobes covered with dense hair-like setae;

superlingua with apical lobes on inner margin covered with hair-like setae that extend laterally; outer margin slightly extended and rounded. Glossae triangular (Fig. 5) paraglossae oblong shaped; 1/2 of posterior margin of glossa with stout spines; inner margin of glossa with few stout spines and long setae; dorsal surface of mid-glossa with tufts of brush-like thin setae; ventral surface with scattered short and longer setae on outer margins; inner margins with pale bristles extending medially near apex; apex of paraglossae covered with short spines and tufts of hairs directed anteriorly; two segmented labial palp, distal segment broader than proximal segment; proximal segment with tufts of comb-like setae below the outer margin and with tufts of long setae, mid-outer margin with long hair-like setae; ventral side of proximal segment with hair tufts in mesal margin.

Thorax yellowish brown; legs brownish yellow with macula on femora; dorsal surface of femora with scattered short spatulate setae. Hindleg larger than fore and midlegs. Foreleg (Fig. 6): length of femora/tibia/ tarsi/ claw viz., 4.0/3.5/2.0/0.54 mm. Outer margin of coxa with row of spines, trochanter with row of spines at base; femora with row of setae on outer margin and with long blunt projection distally; inner margin with row of short spines, outer margin with row of scattered blunt spines; tibia uniformly coloured, inner margin with row of long cilia and few stout spines, a thick spine in distal edge; tarsi with row of spines as same as tibia except a row of spines at outer margin; claw hooked with 11 denticles. **Midleg** : length of femora/tibia/tarsi/claw viz., 4.5/3.7/1.0/0.81 mm. Coxa with row of spines at inner margin; trochanter as same as foreleg; long, acute femoral projection distally; inner margin with sparse spines; tibia, tarsi, claw as same as foreleg. **Hindleg** : length of femora/tibia/tarsi/claw viz., 4.8/3.9/1.3/0.68 mm. Hindleg as same as foreleg except the femoral projection acute and no spine in tarsi.

Abdomen yellowish brown; postero-lateral spines on abdominal segment II-VII progressively longer; dorso-medial margin of terga III-IX (Fig. 9) with dark brown macula, terga III-VIII with light brown macula on either side of central macula, pair of long stout spines at mid-dorsum; sterna pale yellow. Gills dorsally yellow to translucent, ventrally whitish; gill plates relatively narrow, each gill plate with filaments, well developed tracheation in each gills, apex of gill plate with fine hair-like setae; gill I (Fig. 7) translucent, lacking spines on dorso-lateral margin and with hairs; 1/2 of gill plates with rows of spines at dorso-lateral margin

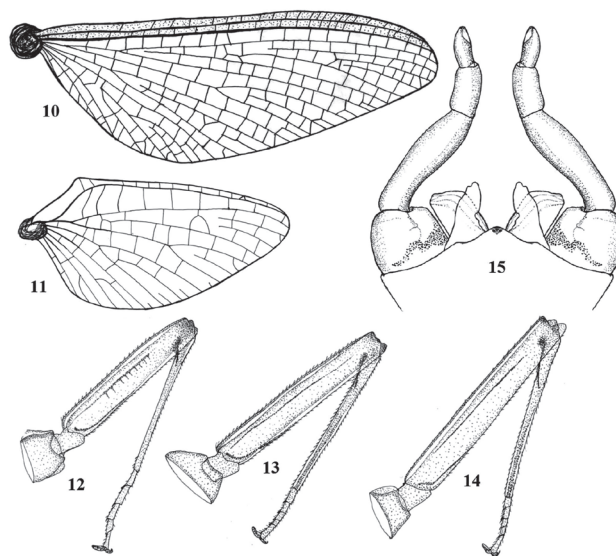
of gill III, gill VII (Fig. 8) with dense hairs at apex and dorso-lateral margin. Cerci yellowish brown, 1/3 of segments brown with blunt setae.

Male Imago (Figs. 10-15) (preserved in 95% ethanol) **dimensions** (mm): **Length** : body, 8.0-8.5; forewings, 9.0-9.3; hindwing, 3.2-3.5. **Width** : forewings (Fig. 10), 3.4-3.7; hindwing (Fig. 11), 1.7-2.0; Cerci, 42.0.

Head yellowish brown; area between lateral ocelli and covers of head brown (Fig. 1); scape and pedicel of antennae light brown, flagellum translucent; eyes black; basal half of ocelli black, apical half white; dorsal diameter of eye, 0.65 mm; distance between compound eyes 0.13 mm.

Thorax washed yellow, edges brownish yellow; venter pale yellow to translucent. **Legs** (Figs. 12-14) pale yellow; femora brownish yellow with brown band at distal margin; tarsi brownish yellow except at base, claws yellowish brown. **Wings** : membrane of fore and hind wings pale yellow to translucent; longitudinal and cross veins of fore and hind wings brown; C and Sc of fore wings pale brown with about 22 & 23 cross veins respectively; Rs forked at 1/5 from the base to margin; MA forked near 2/3 from the base; MP forked at 1/3 from the base; 2 forks between CuA and CuP.

Abdomen : terga I-IX yellowish brown, posterior margin of terga II-IX with dark brown band; sterna pale yellow to transparent; **Genitalia** (Fig. 15): pale brown; base of forceps pale yellow without macula,



Figs. 10-15. Adult *Epeorus munnarensis* sp. nov. Dorsal view : (10) Forewing, (11) Hindwing, (12) Foreleg, (13) Midleg, (14) Hindleg, (15) Genitalia.

apex yellowish brown; penis washed yellow; penis short, lobed apically without spines (Fig. 5); caudal filaments brownish yellow, annulations at articulations dark brown.

Female imago (preserved in 95% ethanol) *dimensions* (mm) : *Length* : Body, 9.0-9.5; forewings, 13.2-13.5; hindwing, 4.5-4.8. *Width*: forewings, 3.4-3.7; hindwing, 1.5-1.8; Cerci 37.0.

Head brownish yellow, area between lateral ocelli and covers of head pale brown (Fig. 1); scape and pedicel of antennae pale brown, flagellum washed yellow; eyes brownish black; basal half of ocelli brown, apical half pale yellow; dorsal diameter of eye, 0.32 mm; distance between compound eyes 0.8 mm.

Thorax yellowish brown; pronotum brownish yellow; meso and metathorax washed yellow; venter pale as in male imago. *Legs* : coloration as in male imago. *Wings*: structure and colouration as in male imago.

Abdomen yellowish brown; posterior margin of terga II-IV and IX with narrow brown band; sterna washed yellow, sterna IX pale; caudal filaments yellowish brown, annulations at articulations blackish brown.

Etymology : The species name *munnaensis* refers to the locality, where the new species was collected.

The larvae of *E. munnaensis* sp. nov. can be differentiated from *E. petersi* and *E. gilliesi* by the following combination of characters: (i) femora with single macula; (ii) straight postero-lateral spines in terga II-VII (Figs. 9); (iii) dorso-medial margin of terga III-VIII (Fig. 9) with dark brown macula; (iv) claw hooked with 11 denticle. The imago of *E. munnaensis* n. sp. can be differentiated from that of *E. petersi* by the shape of penis lobed and absence of sub circular reddish brown macula on forceps base and number of cross veins in C and Sc. *E. lahaulensis* penes with spines ventrally just below the apex, whereas in *E. munnaensis* n. sp. spines on penes lobe are absent. Imagoes of *E. psi* was inadequately described and the larval characters are remains unknown.

Distribution : Southern Western Ghats, India.

ACKNOWLEDGEMENTS

Senior author (CB) thanks Ministry of Environment Forest and Climate Change - AICOPTAX (F.No.: 22018/05/2015) for financial assistance. Authors are grateful to the Management of Thiagarajar College, for their constant support and encouragement to carry out the research.

REFERENCES

- Braasch, D. and Soldán, T. 1979. Neue Heptageniidae aus Asien (Ephemeroptera). *Reichenbachia*, **17**: 261-72.
- Braasch, D. 1981. Eintagsfliegen (Gattungen *Epeorus* and *Iron*) aus Nepal (II) (Ephemeroptera, Heptageniidae). *Reichenbachia*, **19**: 105-10.
- Chang-Fa Zhou, Shi-Lei Wang and Hui Xie. 2007. The nymph and additional imaginal description of *Epeorus melli* new combination from China (Ephemeroptera: Heptageniidae). *Zootaxa*, **1652**: 49-55. DOI: 10.11646/zootaxa.1652.1.4
- Eaton, A.E. 1881. An announcement of new genera of the Ephemeridae. *Entomologist's Monthly Mag.*, **17**: 21-27.
- Matsumura, S. 1931. 6000 illustrated insects of Japan empire. Toko-shoin, Tokyo, 1688 pp. (in Japanese).
- Sivaramakrishnan, K.G., Subramanian, K.A. and Ramamoorthy, V.V. 2009. A revised and annotated checklist of Ephemeroptera of Indian subregion. *Oriental Insects*, **43**: 315-39. <http://dx.doi.org/10.1080/000305316.2009.10417592>
- Sivaruban, T., Barathy, S., Arunachalam, M., Venkataraman, K. and Sivaramakrishnan, K.G. 2013. *Epeorus petersi*, a new species of Heptageniidae (Ephemeroptera) from the Western Ghats of southern India. *Zootaxa*, **3731**: 391-94. <http://dx.doi.org/10.11646/zootaxa.3731.3.9>
- Stauder, A. 2000. Bestand und Ökologie der Heptageniidae (Ephemeroptera) in Fließgewässern des indischen Himalaya (Nord-West Indien). Dissertation, Albert-Ludwigs-Universität Freiburg, 165 pp.
- Tong, X.L. and Dudgeon, D. 2003. Two new species of Heptageniidae from China (Insecta, Ephemeroptera). *Acta Zootaxonomica Sinica*, **28**: 469-73.
- Uéno, M. 1928. Some Japanese mayfly nymphs. Memoirs of the College of Science, Kyoto Imperial University (B), **4**: 19-63.
- Webb, J.M. and McCafferty, W.P. 2006. First description of the adult male of *Epeorus aculeatus* Braasch (Ephemeroptera: Heptageniidae). *Zootaxa*, **1277**: 65-68.
- Webb, J.M. and McCafferty, W.P. 2008. Heptageniidae of the world (Part II). Key to the genera. *Canadian J. Arthropod Identific.*, **7**: 1-55.
- You, D. and Gui, H. 1995. Economic insect fauna of China [48: Ephemeroptera]. Science Press, Beijing, China, 152 pp.
- You, D.S. 1987. A preliminary study of Tibet (Xizang province) Ephemeroptera. *Agric. insects, spiders, plant diseases and weeds of Tibet* (Xizang province) **1**: 29-36.

(Received : March 8, 2021; Accepted : August 28, 2021)