

A New Euthyplociid Burrowing Mayfly (Ephemeroptera: Euthyplociinae, Polymitarcyidae) from Vietnam

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A new euthyplociid burrowing mayfly (Polymitarcyidae, Ephemeroidea, Ephemeroptera), *Polyplocia orientalis* n. sp., from Vietnam is described with larval habitus and line drawings of mouthparts. The larva of the species is characterized by the mandibular tusks that bear numerous hairlike and stout setae on their dorsal and lateral surfaces and by the apical process of foretibiae that is nearly one-fourth the length of foretarsi. Its habitat and biological data and taxonomic remarks are provided. The burrowing mayfly subfamily Euthyplociinae is reviewed from a historical perspective.

The mayfly group "burrowing mayflies", or Ephemeroidea, is unique among insect groups because the larvae are adapted to the underground (hyporheic) environment in diverse freshwater habitats such as streams, rivers, ponds, and lakes. They possess a pair of mandibular tusks that are used mainly for excavating various substrate materials (Bae and McCafferty, 1995). The families Polymitarcyidae, Ephemeridae, and Potamanthidae belong to Ephemeroidea (McCafferty, 1991). There are about 250 species of burrowing mayflies known in the world except Australia and oceanic islands (McCafferty, 1975, 1991).

The euthyplociid mayfly group has often been classified as the family Euthyplociidae (Edmunds et al., 1976), but they are currently regarded as one of six subfamilies of the family Polymitarcyidae based on a phylogenetic classification (McCafferty, 1991). The larvae of Euthyplociinae can be easily distinguished from other burrowing mayfly larvae by their greatly elongated mandibular tusks (more than twice longer than head length) that bear numerous hairlike setae. They can also be recognized by their large (20-50 mm) and flattened body. The adults can be distinguished by their relatively broad forewings (about a half as broad as long) and wing venation (vein R1 that is forked less than one-sixth distance from base and vein MA that is forked near or beyond fork of R1) (Edmunds et al., 1976).

The Euthyplociinae is basically a tropical and subtropical group of burrowing mayflies. Eighteen species of Euthyplociinae belonging to five genera, *Euthyplocia* Eaton (1871), *Polyplocia* Lestage (1921), *Campylocia* Needham and Murphy (1924), *Mesoplocia* Demoulin

(1952), and *Probosciodoplocia* Demoulin (1966b), have been known from tropical America, India, Madagascar, and Southeast Asia, but majority of the species are distributed in tropical America and Madagascar (Eaton, 1983; Ulmer, 1919, 1920, 1932, 1939; Needham and Murphy, 1924; Demoulin, 1952, 1966a, 1966b; Frontain, 1969; Hubbard and Peters, 1978; Pereira and Silva, 1990; Hubbard 1990; Elouard and Satori, 1997; Elouard et al., 1999). *Euthyplocia* includes three species from tropical America [*E. hecuba* (Hagen), 1861 and *E. haenschi* Ulmer, 1942] and India (*E. punensis* Dubey, 1970); *Campylocia* includes three species [*C. anceps* (Eaton), 1883, *C. dochmia* Berner and Threw, 1961, and *C. bocainensis* Pereira and Silva, 1990] from tropical America; *Mesoplocia* includes one species (*M. intermedia* Demoulin, 1952) from Columbia in South America.

Polyplocia Lestage and *Probosciodoplocia* Demoulin are represented only in Southeast Asia and Madagascar, respectively. In tropical Southeast Asia, Lestage (1921) erected the monotypic genus *Polyplocia* and described the type species *P. vitalisi* based on single male adult from Laos. In addition to this species, Ulmer (1939) described *Polyplocia campylociell* (female subimage) and *P. crassinervis* (male subimage) from northern Borneo. Demoulin (1952) redescribed the male adult of *P. vitalisi* Lestage and described the male adult of *P. crassinervis* Ulmer. Demoulin (1966a) also described an undetermined larva of *Polyplocia* from western Borneo which is presumably associated with *P. crassinervis* Ulmer. On the other hand, Demoulin (1966b) elected the genus *Probosciodoplocia* based on the type species *P. sikorai* (Vayssière), 1895, from Madagascar. Elouard and Satori (1997) described six species (*P. auberti*, *P. billi*, *P. leplattemierae*, *P. magdeleinae*, *P. ruffieuxae*, and *P. vayssierei*), and Elouard et al. (1999) additionally described one species (*P. mccaffertyi*) from Madagascar.

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In a series of systematic study of Vietnamese mayflies, we herein describe a new species of the Euthyplociinae. Materials used in this study were collected throughout Vietnam during the field trips in 2000-2002. Larvae were collected by Surber nets and kick nets. All materials were preserved in 80% ethyl alcohol and deposited in the Aquatic Insect Collection of Seoul Women's University (SWU-AIC). In the future, the type materials will be appropriately returned to the places (e.g. Hanoi University of Science) where they originated. Terminology, descriptions, measurement, abbreviations, and other taxonomic methods are followed by Bae and McCafferty (1991).

Description

Polyplocia orientalis n. sp.
(Figs. 1, 2)

Types: Holotype. Mature male larva (SWU-EPH-3571), Vietnam, Dak Lak Prov., Dak Mil, Dak Mol, Dak Pri' stream, riffle at 740 m (alt.), 5-III-2001, D.H. Hoang. Paratypes. 1 female larva (SWU-EPH-3579), Vietnam, Lam Dong Prov., Bao Loc, Da Mre stream, 450 m (alt.), 22-III-2002, V.V. Nguyen & D.H. Hoang; 1 female larva (SWU-EPH-3577), Vietnam, Thua Thien Hue Prov., Aluoi, Hong Thuy, 9-I-2002, T.K.T. Cao.

Additional materials examined: 2 larvae, same locality and data as paratype of SWU-EPH-3579; 1 larva, same locality and data as paratype of SWU-EPH-3577; 2 larvae, Da Nang Prov., Son Tra, 250 m (alt.), 4-IV-2002, V.V. Nguyen & D.H. Hoang; 2 larvae, Ha Tay Prov., Ba Vi N.P., Huong stream, 22-XII-2000, V.V. Nguyen; 6 larvae, Quang Binh Prov., Phong Nha, 11-VIII-2001, N.X. Nam.

Description: Larva. Male body length 22.5 mm; cerci length 19.5 mm; median filament length 21.5 mm. Body color generally brown with lighter markings.

Head (Fig. 1) 2.35 mm in length and 3.85 mm in width, dorsoventrally flattened, narrower than pronotum, and brown with light markings around ocelli. Compound eyes black; ocelli white; male compound eyes 0.95 mm in width, and 2.00 mm in distance between compound eyes. Antennae 8.5 mm in length; pedicel brown; flagellum light brown. Clypeus anteriorly convex, with numerous hairlike and stout setae dorsally. Labrum (Fig. 2A) anteriorly concave, with hairlike setae on dorsal surface and along anterior and lateral margins. Mandibular tusks (Figs. 2B, C) 4.6 mm in length, ca. 2.0 x length of head, cylindrical, strongly arched inward (21.3° in curvature) and pointed apically, dorsally brown and laterally dark brown, with numerous long hairlike setae dorsally and laterally (ventrally bare), with 5-7 spines 1/3 apicolaterally (Fig. 1). Maxillae (Fig. 2D) with hairlike setae on galealacinal crown and on medial and lateral margins; maxillary palpi distinctly 3-segmented; segment 1, 2, and 3 0.76 mm, 0.64 mm, and 1.35 mm in length, respectively; segment 2 and 3 with long and dense hairlike setae on medial and lateral margins. Hypopharynx (Fig. 2E) extended laterally, with hairlike setae along margins. Labium (Fig. 2F) with dense hairlike setae; labial palpi 3-segmented; segment 1, 2, and 3 0.72 mm, 0.22 mm, and 0.60 mm in length, respectively; segment 2 with long hairlike setae laterally; segment 3 relatively broad, with numerous stout setae apically, and with hairlike setae dorsally and laterally.

Pronotum subquadrate, brown with light brown markings dorsally; lateral margins strongly expanded and light yellow; anterolateral corners acute. Mesonotum and metanotum light brown. Wingpads brown. Forelegs (Fig. 1) relatively long and stout, with strongly developed setae, and with distinct tibial spine; forefemora, foretibiae, foretarsi, and foreclaws 3.4 mm, 4.3 mm, 2.6 mm, and 0.4 mm in length, respectively; forefemora light yellow, with well-developed hairlike setae mixed with scattered

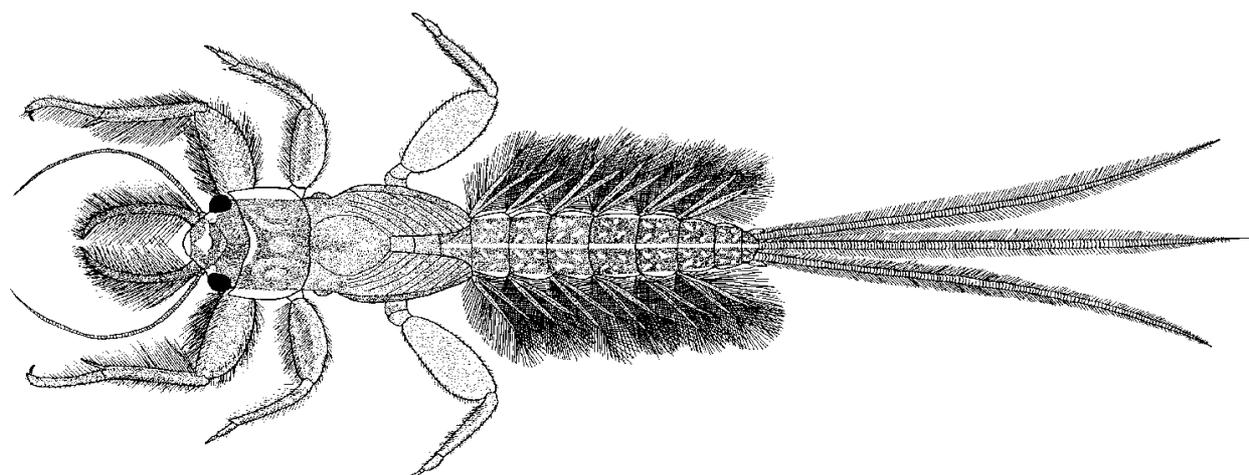


Fig. 1. *Polyplocia orientalis* n. sp., larval habitus.

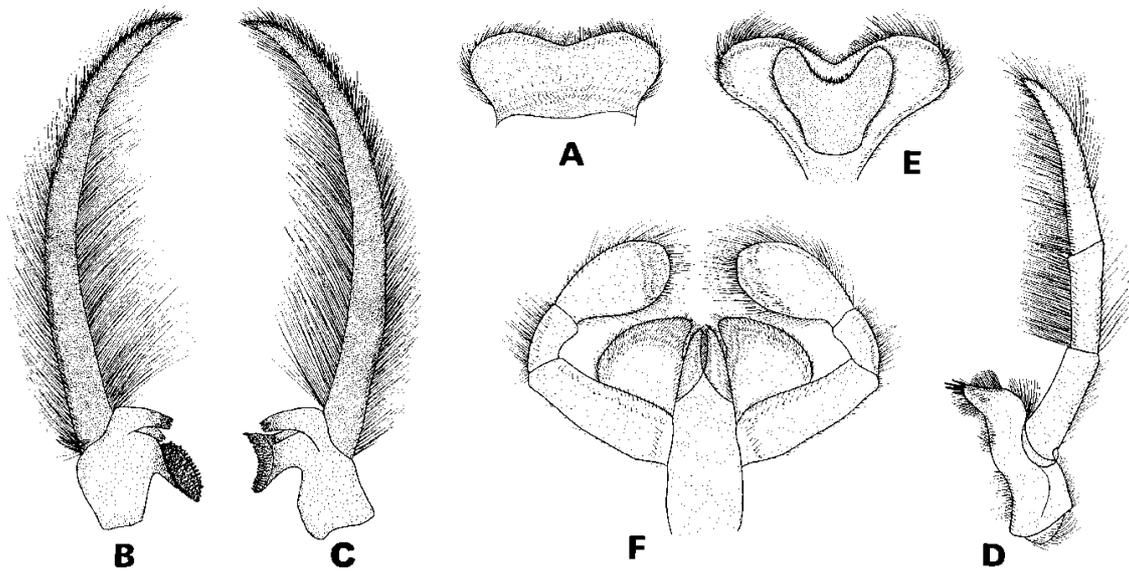


Fig. 2. Mouthparts of *Polyploccia orientalis* n. sp. A, Labrum. B, Right mandible. C, Left mandible. D, Maxilla. E, Hypopharynx. F, Labium.

simple-stout setae dorsally on anterior and posterior areas; foretibiae brown, with long and dense hairlike setal field rowed along medial and lateral areas; apical spine of foretibiae 0.70 mm, ca. 1/4 x length of foretarsi; foretarsi brown, with long hairlike setae on dorsal surface and on medial and lateral areas; foreclaws dark brown and hooked. Midlegs pale yellow, with moderately developed setae; midfemora, midtibiae, midtarsi, and midclaws 2.9 mm, 2.9 mm, 0.9 mm, and 0.5 mm in length, respectively. Hindlegs pale yellow, with weakly developed setae; hindfemora, hindtibiae, hindtarsi, and hindclaws 4.6 mm, 2.5 mm, 1.1 mm, and 0.6 mm in length, respectively.

Abdominal terga (Fig. 1) brown (each tergum posteriorly darker in color); terga 1-10 with median stripe; tergum 1-9 each with 4 pairs of light yellow spots; sterna light brown. Gills lateral in position; gills 1 small and forked, with weakly developed hairlike setae dorsally and laterally; gills 2-7 paired, white with darker tracheae, with long marginal fringes; gills 3 with 46-50 and 38-40 marginal fibrillae on each lateral margin of dorsal and ventral lamellae, respectively. Caudal filaments ca. 0.9 x length of body, with rows of hairlike setae laterally.

Adult. Unknown.

Diagnosis: The larva of *Polyploccia orientalis* n. sp. can be distinguished from other known larvae of Euthyplociinae by the combination of the following characters: the mandibular tusks are ca. 2.0 times length of the head with numerous long hairlike setae on the dorsal and lateral surfaces, and possess 5-7 spines that are arranged apicolaterally on 1/3 length of the tusks; the apical spine of the foretibiae is nearly 1/4 length of the foretarsi.

Etymology: The specific name, *orientalis*, refers to the oriental distribution of this species.

Distribution, habitat, and biology: *Polyploccia orientalis* n. sp. is distributed throughout Vietnam. The larvae occur in mountain streams ranging 250-740 m in altitude. The streams are about 3-5 m wide and 20-30 cm deep, and are partially canopied by the riparian forest. The water temperature is 26-28°C, and pH is 7.2-7.8. The substrates are composed of mainly large rocks and boulders on a sandy bottom. The larvae are attached on the stones under the substrates in relatively shallow (10-15 cm in depth) rapids.

Remarks: Only one species of the three known Southeast Asian *Polyploccia* species is associated with the larval and adult stages as noted above. Considering the geographic distributions of the known species of *Polyploccia*, *Polyploccia orientalis* n. sp. is most presumably associated with *P. vitalisi* Lestage (1921) that is reported in Tonkin (northern Vietnam and vicinity areas) and is known in the adult stage only.

The generic concept of *Polyploccia* needs a revision together with tropical American genera *Euthyplocia*, *Campylocia*, and *Mesoplocia*. Current concepts of all the genera are virtually based on adult characters. From a biogeographic point of view, the distribution of *Euthyplocia* (*E. punensis* Dubey) in India is questionable because the genus is limited to tropical America.

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References

- Bae YJ and McCafferty WP (1991) Phylogenetic systematics of the Potamanthidae (Ephemeroptera). *Trans Am Entomol Soc* 117: 1-143.
- Bae YJ and McCafferty WP (1995) Ephemeroptera tusks and their evolution. In: Corkum L and Ciborowski J (eds), *Current Directions in Research on Ephemeroptera*. Canadian Scholar's Publishing, Toronto, pp 377-405.
- Berner L and Threw TB (1961) Comments on the mayfly genus *Campylocia* with description of a new species (Euthyplociidae: Euthyplociinae). *Am Midl Natur* 66: 329-336.
- Demoulin G (1952) Contribution à l'étude des Eporonidae Euthyplociinae (Insectes Éphéméroptères). *Bull Inst Roy Sci Nat Belg* 28: 1-22.
- Demoulin G (1966a) Contribution à l'étude des Euthyplociidae. III. Insectes Éphéméroptères. *Zool Meded* 41: 137-141.
- Demoulin G (1966b) Contribution à l'étude des Euthyplociidae (Ephemeroptera). IV. Un nouveau genre de Madagascar (1). *Ann Soc Entomol Fr* 2: 941-949.
- Dubey OP (1970) Description of a new ephemerid from India. *Agra Univ J Res Sci* 19: 67-68.
- Eaton AE (1871) A monograph on the Ephemeridae. *Trans Entomol Soc Lond* 1-164.
- Eaton AE (1883) A revisional monograph of recent Ephemeridae or mayflies. *Trans Linn Soc Lond, 2nd Ser Zool* 3: 1-77.
- Edmunds GF Jr, Jensen SL, and L Berner (1976) *The Mayflies of North and Central America*. University Minnesota Press, Minneapolis. pp 278-281.
- Elouard JM and Sartori M (1997) *Probosciodoplocia* (Ephemeroptera: Polymitarcyidae: Euthyplociinae). In: Landiolt P and Sartori M (eds), *Ephemeroptera and Plecoptera: Biology, Ecology and Systematic*, MTL, Fribourg, pp 439-448.
- Elouard JM, Michel S., Gattolliat JL, and Oliarinony R (1999) *Probosciodoplocia* (Ephemeroptera, Polymitarcyidae) from the Réserve Naturelle Intégrale d'Andohahela and surrounding areas, with a description of a new species. *Fieldiana Zool* 94: 111-114.
- Frontaine J (1968) Contribution à l'étude des Ephéméroptères malgaches: la superfamille des Epemeroidea. *Bull Mém Soc Linn Lyon* 6: 228-242.
- Hagen (1861) Synopsis of the Neuroptera of North America with a list of the South American species. *Smithoni Misc Collect* pp 38-55.
- Hubbard MD and Peters WL (1978) A catalogue of the Ephemeroptera of the Indian Subregion. *Orient Insects Suppl* 9: 1-42.
- Hubbard MD (1990) *Mayflies of the World. A Catalog of the Family and Genus Group Taxa* (Insecta: Ephemeroptera). Sandhill Crane Press, Gainesville, pp 1-119.
- Lestage JA (1921) Les Éphémères Indo-Chinoises. *Ann Soc Entomol Belg* 61: 211-222.
- Lestage JA (1924) Les Ephemerides de L'Indochine Francaise. *Faune Entomologique de L'Indochina Francaise*, pp 80-93.
- McCafferty WP (1975) The burrowing mayflies of the United States. *Trans Am Entomol Soc* 101: 447-504.
- McCafferty WP (1991) Toward a phylogenetic classification of the Ephemeroptera (Insecta): a commentary on systematics. *Ann Entomol Soc Am* 4: 343-360.
- Needham JG and Murphy HE (1924) Neotropical mayflies. *Bull Lloyd Library* 24: 1-79.
- Pereira SM and Silva ER (1990) Nova espécie de *Campylocia* Needham & Murphy, 1924 com notas biológicas (Ephemeroptera, Euthyplociidae). *Bol Mus Nac* 336: 1-12.
- Ulmer G (1919) Neue Ephemeropteren. *Arch Naturg* 85: 1-80.
- Ulmer G (1920) Übersicht über die Gattungen der Ephemeropteren, nebst Bemerkungen über einzelne Arten. *Stett Entomol Z* 81: 97-144.
- Ulmer G (1932) Bemerkungen über die seit 1920 neu aufgestellten Gattungen der Ephemeropteren. *Stett Entomol Z* 93: 204-219.
- Ulmer G (1939) Eintagsfliegen (Ephemeroptera) von den Sunda-Inseln. *Arch Hydrobiol Suppl* 16: 443-692.
- Ulmer G (1942) Alte und neue Eintagsfliegen (Ephemeropteren) aus Süd- und Mittelamerika. *Stett Entomol Z* 103: 98-128.
- Vayssièrè A (1895) Description zoologique de l'Euthyplocia Sikorai, nouvelle espèce d'Ephéméridè Madagascar. *Ann Soc Entomol Fr* 64: 297.

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