

**A NEW SPECIES OF SYMBIOCLOEON (EPHEMEROPTERA:
BAETIDAE) ASSOCIATED WITH
A FRESHWATER MUSSEL FROM INDIA**

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ABSTRACT. A new species of *Symbiocloeon*, residing in the gill lamella of an ancient gondwanian species of freshwater mussel, *Pseudomulleria dalyi* (Unionoida: Etheriidae) is described from nymphs collected from the Tunga river of Western Ghats, Shimoga district, Karnataka, India. The diagnostic nymphal characters of *Symbiocloeon madhyasthai*, sp. nov., are given and differentiated from *Symbiocloeon heardi* Muller-Liebenau.

Key words: *Symbiocloeon*, Ephemeroptera, Baetidae, new species, *Pseudomulleria dalyi*, Western Ghats.

Introduction

Two interesting associations of baetid mayfly nymphs with freshwater clams (mussels) were recorded previously, one in Thailand (Muller-Liebenau and Heard, 1979) and the other in Mali and Guinea in West Africa (Gillies and Elouard, 1990). The former is between the mayfly, *Symbiocloeon heardi* Muller-Liebenau, 1979 (type species for the genus) and the clam, *Hyriopsis myersiana* (Unionidae), whereas the latter is between the mayfly *Mutelocloeon bihouni* Gillies and Elouard, 1990 and large mussels of *Mutela*, *Aspartharia* and *Spathopsis* (Mutelidae). This association may be regarded as one of commensalism, beneficial to the insect, neutral for the mollusk (Muller-Liebenau and Heard, 1979), although in view of the internal lodgment of the nymph among the fimbriated lamellae of the gills, the mayfly might well be regarded as an inquiline (Gillies and Elouard, 1990).

During a field trip devoted to the survey of freshwater mollusks in January, 2003, Dr. N.A. Madhyastha collected specimens of the mussel, *Pseudomulleria dalyi* Smith, 1898 (Unionoida: Etheriidae) from Tunga River, Shimoga district, Karnataka, India. Investigation of six individuals of *P. dalyi* revealed two of the mussels containing three mayfly nymphs lodged in the gill lamella, which represent a new species of *Symbiocloeon*. This is the first report of this interesting genus from Indian subcontinent, and nymphal description of the new species given herein.

***Symbiocloeon madhyasthai*, sp. nov.** (Figs. 1A-H, 2A-F & 3A-E)

Holotype (in alcohol): Mature male nymph, 30.i.2003, Coll. N.A.Madhyastha.

Paratype (in alcohol): Immature female nymph, 30.i.2003, Coll. N.A.Madhyastha.

Holotype and paratype deposited at the National Pusa Collection (NPC), Indian Agricultural Research Institute, New Delhi 110012, India. Ref No: 1786; Type cabinet No. 136/3, Register page No. 358 dated 3/05/2006.

Type locality: INDIA: Karnataka: Shimoga district: Theerthahalli taluk: Mandagadde: Tunga River, 620m.

Description (Figs. 1A-H and 2A-F): **Male** (mature nymph in alcohol): Body long and slender, antennae partially broken (Figs. 1A, 1B). Length: Body 9.1 mm; cerci 1.7 mm; terminal filament 1.7 mm. Head maximum width 1.44mm (Fig. 1D). Colour brown. Eyes chocolate brown dorsally and blackish ventrally. Maximum inter ocular distance 0.28mm and minimum 0.58mm. Lateral ocelli semi lunar shaped and enclose a cream

coloured spot (Figs. 1D, 2A). Thorax and wing pads pale yellowish brown, thorax extends posteriorly as a short blunt process. Hind wing pads absent (Figs. 1C1, 2A). Legs milky white to pale yellowish, a moderately deep notch on the apices of femora, margins and dorsum without spines or setae. Tarsal claws sharply hooked at apex without denticles (Figs. 1F, 2E, 2F). Abdomen terga I-IX dark brown dorsally, anterior and lateral borders irregularly light brown, giving a wavy appearance. Terga I-IX pale yellow ventrally. Tergum of 10th segment has a dark brown "bird in flight" pattern. Intersegmental membranes pale yellow segments without marginal spines (Figs. 1A, 1H, 2A, 2C). Gills monolamellate and milky white, present on abdominal segments I-VII, margins smooth, anterior gills about 2x the length of anterior segments (Figs. 1G, 2D). Paraprocts smooth without bristles or pores, inner and submarginal area has chitinous thickening (Fig. 2G). Caudal filaments pale white, unbanded, caudal filaments and cerci extremely short and equal in length, inner margin of cerci and both sides of terminal filament with fine long hairs (Figs. 1H, 2C).

Female (immature nymph in alcohol): Body long and slender, abdomen partially broken. Head maximum width 1.0 mm (Fig. 1E). Colour brown. Eyes divided in the meson of head (Fig. 1E), upper eyes black and the lower ones purplish, maximum interocular distance 0.5x of head width. Antennae partially broken, scape and pedicel without any setae. Thorax and wing pads pale yellowish brown, thorax does not extend posteriorly as a short blunt process. Hind wing pads absent (Figs. 1C2, 2B). Legs similar to male. Abdomen terga light brown dorsally, markings indistinct. Intersegmental and ventral sides pale white, tergum of 10th segment has a faint brown "bird in flight" pattern. Gills and caudal filaments similar to male. *Mouthparts* (Figs. 3A-E): Labrum slightly shallowly notched with sparse setae near front margin on both sides (Fig. 3A). Mandible stout and slightly curved in middle of the outer margin, vaulted mid-dorsally and devoid of setae, molar region has two rows of stout setae (Fig. 3C). Hypopharynx with three large lotus shaped lobes of uniform size and shape, beset with uniform fine setae (Fig. 3B). Maxillary palpi one-segmented, without setae and equal in length to galealacinia. About 6 setae in the outer apical angle and 3-4 sub apical setae on the ventral surface of galea (Fig. 3D). Labium with second and third segments fused towards the base, give an appearance of a large segment, segments without setae, glossae and prapaglossae of almost same length, densely covered with inwardly directed long setae towards the apical end (Fig. 3E).

Etymology: Species named after Prof. N.A. Madhyastha, Department of Zoology, Poornaprajna College, Udupi, India who collected the host mussels with nymphs.

Comments: *S. madhyasthai* differs from *S. heardi* in the nymphal stage in the margins and dorsum of legs without spines or setae; tarsal claws sharply hooked at apex without denticles; thorax of male nymph extends posteriorly as a short blunt process; tergum of 10th abdominal segment has a dark brown "bird in flight" pattern; abdominal segments without marginal spines; caudal filaments and cerci extremely short and equal in length; mandible without setae in the middle part; maxillary palp equal in length to galealacinia; second and third segments of labium fused towards the base; glossae and prapaglossae covered densely with inwardly directed long setae towards the apical end and smooth paraproct without bristles or pores.

Ecological notes: *S. madhyasthai* is disjunctly distributed from its conspecific *S. heardi*. It was found in between the gill folds of the host *Pseudomulleria dalyi*. This bivalve is typically found in the rocky areas of the river, generally inaccessible during

monsoon months. *P. dalyi* is included in the red data book as an endangered species (IUCN, 2008). It is the only cemented bivalve in the freshwater rivers, particularly at higher elevations (>300m) in India. At present *P. dalyi* is found only in Tunga and Bhadra rivers of Krishna basin. Although it was previously recorded from Koyna and Ghataprabha rivers, it was not found in recent surveys (Dr. N.A. Madhyastha, personal communications). The current status of *P. dalyi* indicates that the newly described mayfly *S. madhyasthai*, sp.nov., may also be threatened along with its host.

Acknowledgments

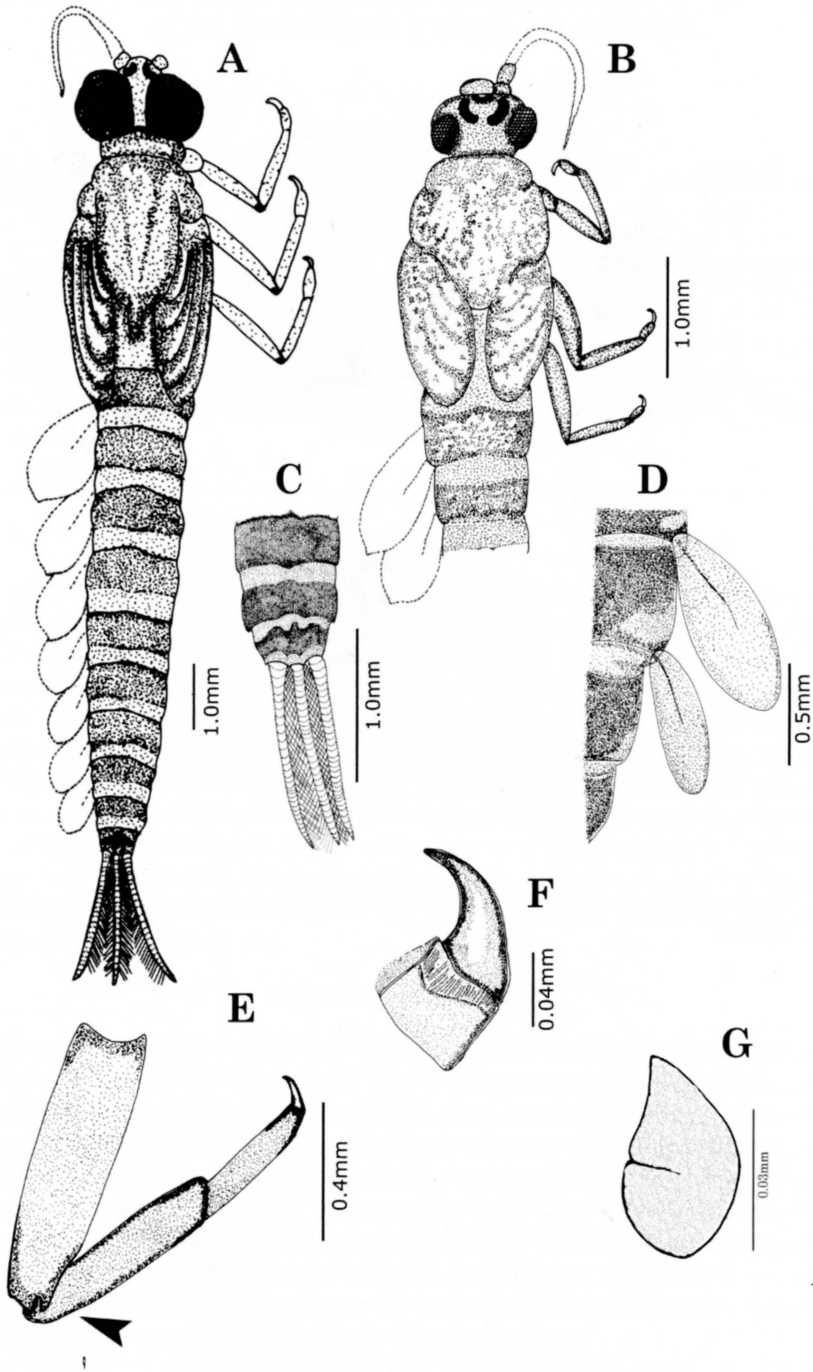
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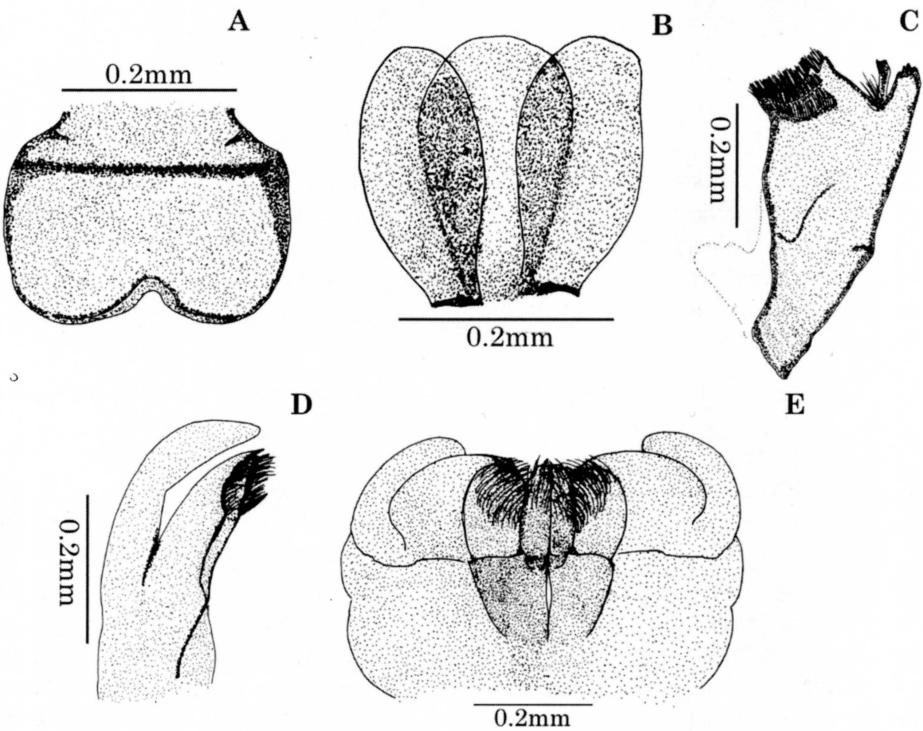
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Figs.1A-H. *Symbiocloeon madhaysthai*, sp.nov.: A, holotype, male nymph, dorsal view; B, holotype, male nymph, lateral view; C1, holotype, male head and thorax, arrow pointing the extended blunt process of thorax; C2, paratype, female head and thorax; D, holotype, male head; E, paratype, female head; F, paratype, female legs; G, holotype, male gills; H, holotype, male abdominal segments, caudal filaments, cerci, arrow points to "bird in flight" pattern of 10th abdominal segment. Note: 1A, 1B and 1C composite images.



Figs.2A-G. *Symbiocloeon madhaysthai*, sp.nov. A, holotype, male nymph, dorsal view; B, paratype, female nymph, dorsal view; C, holotype, male abdominal segments, caudal filaments, cerci, arrow points to “bird in flight” pattern of 10th abdominal segment; D, holotype, male gills; E, leg, arrow points to the notch at the apices of femora; F, tarsal claw; G, paraproct.



Figs.3A-E. *Symbiocloeon madhaysthai*, sp.nov. A, labrum; B, hypopharynx; C, mandible; D, maxilla; E, labium