

**Five new species of *Pseudocloeon* KLAPÁLEK, 1905,
(Fam. Baetidae) from the Oriental Region
(Insecta, Ephemeroptera)
with some general remarks on *Pseudocloeon***

Fünf neue Arten von *Pseudocloeon* KLAPÁLEK, 1905, (Fam. Baetidae)
vom Orient (Insecta, Ephemeroptera)
mit einigen allgemeinen Bemerkungen über *Pseudocloeon*

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With 14 figures and 1 table in the text

Abstract

The nymphs of five new species of the genus *Pseudocloeon* KLAPÁLEK (1905) are described in detail and distinguishing characteristics are illustrated. The species are: *Ps. verum* sp. n. from Malaysia, and *Ps. difficile* sp. n., *Ps. orientale* sp. n., *Ps. ambiguum* sp. n. and *Ps. klapaleki* sp. n. from Sri Lanka. A Verification Table for the newly described species includes *Pseudocloeon* sp. 1. ULMER (1939) from South Sumatra (MÜLLER-LIEBENAU 1981) and *Ps. atoki* from the Philippines (MÜLLER-LIEBENAU 1982). Hypothetical species groups are established based on mouthpart and leg morphology.

Introduction

A great uncertainty still exists in our knowledge of the taxonomic situation of the genus *Pseudocloeon* within the family Baetidae. The genus *Pseudocloeon* was established by KLAPÁLEK (1905) from a male specimen from Java, *Ps. kraepelini*. The nymph of this species is still unknown. More recent studies of this confusing genus (EDMUNDS et al. 1976; MÜLLER-LIEBENAU 1981) point out that probably many *Pseudocloeon* species from outside the Oriental Region are not congeneric with KLAPÁLEK's *Pseudocloeon*. Based on a review of ULMER's baetid material, which is stored in the Zoological Museum of the Zoological Institut, University Hamburg, an attempt was made (MÜLLER-LIEBENAU 1981) to give a new concept of KLAPÁLEK's genus *Pseudocloeon* restricting it to the Oriental Region. In their catalogue of the Ephemeroptera of the Indian Sub-region HUBBARD & PETERS (1978) do not mention any species of *Pseudocloeon* from Malaysia or Sri Lanka. In this paper detailed illustrated descriptions are given of a new species from Malaysia, *Ps. verum* sp. n., and of four new species from Sri Lanka: *Pseudocloeon difficile* sp. n., *Ps. orientale* sp. n., *Ps. ambiguum* sp. n. and *Ps. klapaleki* sp. n.

These species are compared with two previously described oriental *Pseudocloeon* species, *Ps. atoki* from the Philippines (MÜLLER-LIEBENAU 1982) and *Pseudocloeon* sp. 1 ULMER (1939) from South Sumatra (MÜLLER-LIEBENAU 1981).

The five herein described species of *Pseudocloeon* show a similar color pattern on the pronotum and dorsum of the abdomen. This color pattern, caused by muscle insertions, is typical for the nymphs of the genus *Pseudocloeon* (also in some respect for "*Pseudocloeon*" species form outside the Oriental Region and for the genus *Acentrella* BENGTTSSON). The darker figures on the pronotum and dorsum of the abdomen are somewhat different in each species. But whereas these are good characteristics for the genus complex (*Pseudocloeon* sensu KLAPÁLEK, other "*Pseudocloeon*" auct. and *Acentrella*), they are less reliable in species determination. Nevertheless they are figured in some of the following species descriptions as far as suitable material for photographs is available (Figs. 7, 9, 11).

According to definition the new species have in common a number of generic characters which are quoted here again in general and which are not mentioned in the species descriptions:

Antennae: about one and a half length of head capsule. — **Legs:** outer margin of femur and tibia of all three legs with dense row of long, finely feathered bristles, and with two such rows on tibia of third leg. Tarsus also with long, fine bristles on outer margin, but less dense than on femur and tibia; one conspicuous bristle on inner margin of tarsus near apex. In all seven species compared, the tibia of 1st and 2nd leg is about one and a half times as long as femur, tibia of 3rd leg about same length as femur. — **The hind wing pads** are minute, slender¹. — **Cerci** fringed with swimming bristles along inner margin. — **Seven pairs of abdominal gills** are developed. — **The hyaline bristles on surface of terga** are long in a longitudinal median area, in general on terga II—V/VI, and shorter on lateral parts of segments. The long median bristles are easily recognised even at lower magnification because of detritus particles collected between the bristles.

A Verification Table is given for the five newly described species in comparison with *Pseudocloeon* sp. 1 ULMER (1939) from South Sumatra (MÜLLER-LIEBENAU 1981) and *Pseudocloeon atoki* from the Philippines (MÜLLER-LIEBENAU 1982).

Ps. verum sp. n. was collected by Dr. J. E. BISHOP, Crafers, Australia, in the River Gombak near Kuala Lumpur, Malaysia. The four species from Sri Lanka were collected by Professor Dr. F. C. STARMÜHLNER and Dr. G. WENINGER, Vienna, and Dr. H. H. COSTA, Kelaniya, during the Austrian-Ceylonese Hydrobiological Mission 1970 of the 1st Zoological Institute, University of

¹ The reduced hind wing pads of nymphs in *Pseudocloeon* (and some *Baetis* species) appear to be relicts of originally larger hind wing pads of larger hind wings in the imagos. Fig. 4g shows a hind wing pad with tendency for a hind wing in subimago, but this will be — if developed in imago at all — too small to recognise.

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Descriptions

Pseudocloeon verum sp. n.

Figs. 1, 7, 8

Material: ca. 72 nymphs.

Mature nymph. — **Coloration:** Pronotum and dorsum of abdomen as in Fig. 7. The middle muscle insertion areas on pronotum triangular. Legs light brownish, tarsi distally somewhat darker, caudal filaments light. — **Body length:** ♂ 3.1 mm, cerci 2.1 mm; ♀ 3.2 mm, cerci 2.4 mm. Abdomen somewhat flattened as in *Acentrella*. — **Antennae** (Fig. 1d and e): inner margin of segments serrated. — **Labrum** (Fig. 1a) wider at base than in frontal part, twice as broad as long. — **Mandibles** (Fig. 1f): all canini well developed and of nearly same size. — **Legs** (Figs. 1g, h): a number of short, pointed, submarginal bristles, (shorter than distance between bases of long marginal bristles, Fig. 1i). — **Surface and posterior margin of terga** as shown in Fig. 8. Hyaline bristles on terga of different length. Spines on posterior margin of terga elongate, pointed.

Holotype: Mature nymph: slide preparation. Malaysia, Gombak Riv. 4½ mi. N. of Kuala Lumpur nr. Bentong road. 6. 2. 1969; leg. J. E. BISHOP.

Paratypes: ca. 65 nymphs in alcohol, 5 slide preparations.

Holotype and some **Paratypes** are deposited at Zoologische Staatssammlung, München. Some **Paratypes** are deposited at Zool. Mus. Zool. Inst., University Hamburg, and at Florida A & M University, Entomology and Structural Pest Control, Tallahassee, Florida.

Pseudocloeon verum sp. n. appears closely related to *Pseudocloeon* sp. 1 ULMER (1939). Both species have the inner margin of antennal segments serrated. The most striking morphological difference is the submarginal bristles on femora, which are short and pointed and only half the length of distance between the bases of the long marginal bristles in *Ps. verum* sp. n. (Fig. 1i), whereas they are longer and of nearly same length as distance between bases of long marginal bristles in *Pseudocloeon* sp. 1 ULMER (1939) (Fig. 6b)². Also the abdominal gills appear somewhat different in both species (Fig. 11 and 6d). The hyaline bristles on surface of terga are very long in *Ps. verum* sp. n. (Fig. 8) whereas they are only about 4–5 times as long as broad — and some of them comparatively wide — in *Pseudocloeon* sp. 1 ULMER (1939).

The ecological difference between both species is evident: *Ps. verum* sp. n. from Malaysia occurs everywhere in the River Gombak and its tributaries at altitudes ranging from about 1,200 m to 30 m (BISHOP 1973), *Pseudocloeon* sp. 1 ULMER (1939) was collected on South Sumatra in moss cascades in warm springs at 32°–34 °C.

Of all species discussed in this paper, *Ps. verum* sp. n. and *Pseudocloeon* sp. 1 ULMER (1939) are most closely related to the genus *Acentrella* BENGSSON (1912) (MÜLLER-LIEBENAU 1981).

Pseudocloeon difficilum sp. n.

Figs. 2, 9, 10

Material: ca. 100 nymphs.

Mature nymph. — **Coloration** (Fig. 9): similar to *Pseudocloeon* in general. The middle muscle insertion areas on pronotum shaped like an "S". — **Body**

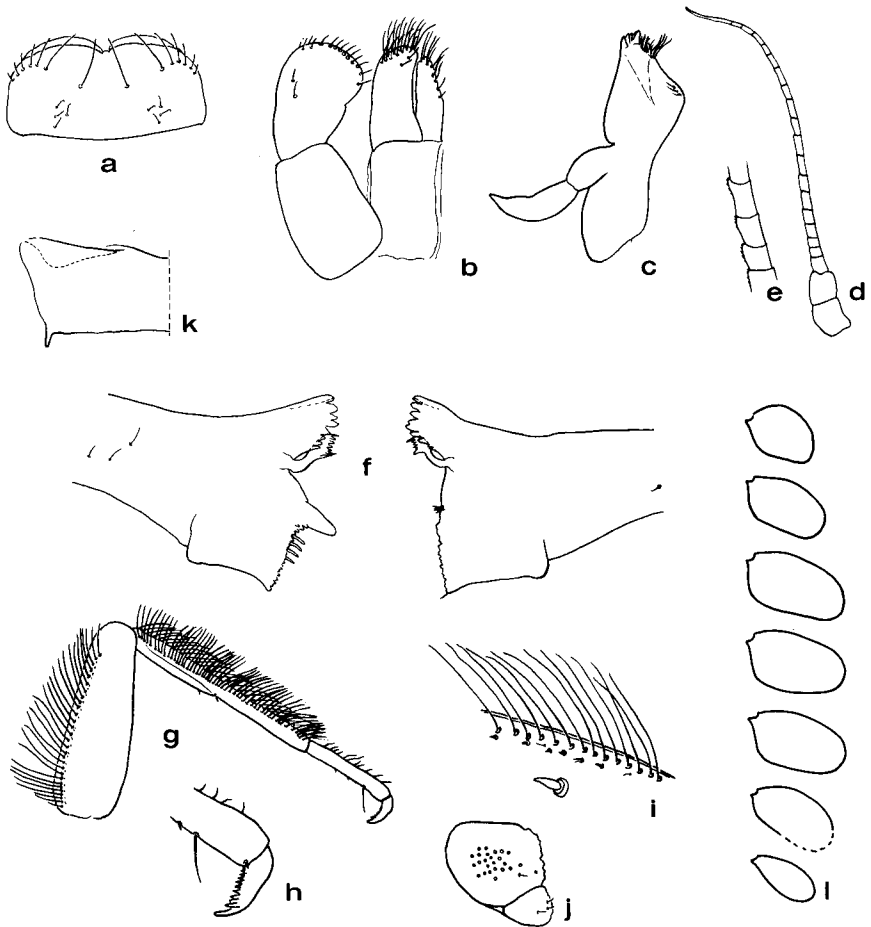


Fig. 1. *Pseudocloeon verum* sp. n., nymph: a) labrum; b) left half of labium; c) maxilla; d) antenna; e) segments of antenna with serrated inner margin; f) canini and molar area of left and right mandible; g) 3rd leg; h) claw; i) section of outer margin of femur with one submarginal bristle at higher magnification; j) paraproct; k) left half of metatergum with minute hind wing pads; l) adominal gills I—VII.

length: ♂ 3.8 mm, cerci 2.1 mm; ♀ 4.5 mm, cerci 3.0 mm. — Labrum (Fig. 2a): wider at base than in frontal part, less broad than twice the length. — Mandibles (Fig. 2d): all canini of nearly same size. — Legs (Fig. 2h) without small submarginal bristles on outer margin of femur. — Surface and posterior margin of tergas as in Fig. 10.

Holotype: Mature nymph; slide preparation. Ceylon, FC 30/a, We Ganga near Balangoda, 10. 12. 1970, leg. Starmühlner.

Paratypes: ca. 95 nymphs in alcohol, 3 slide preparations.

² Fig. 1i, 3l, 4h, 5h, 6b, 6c are of same magnification.

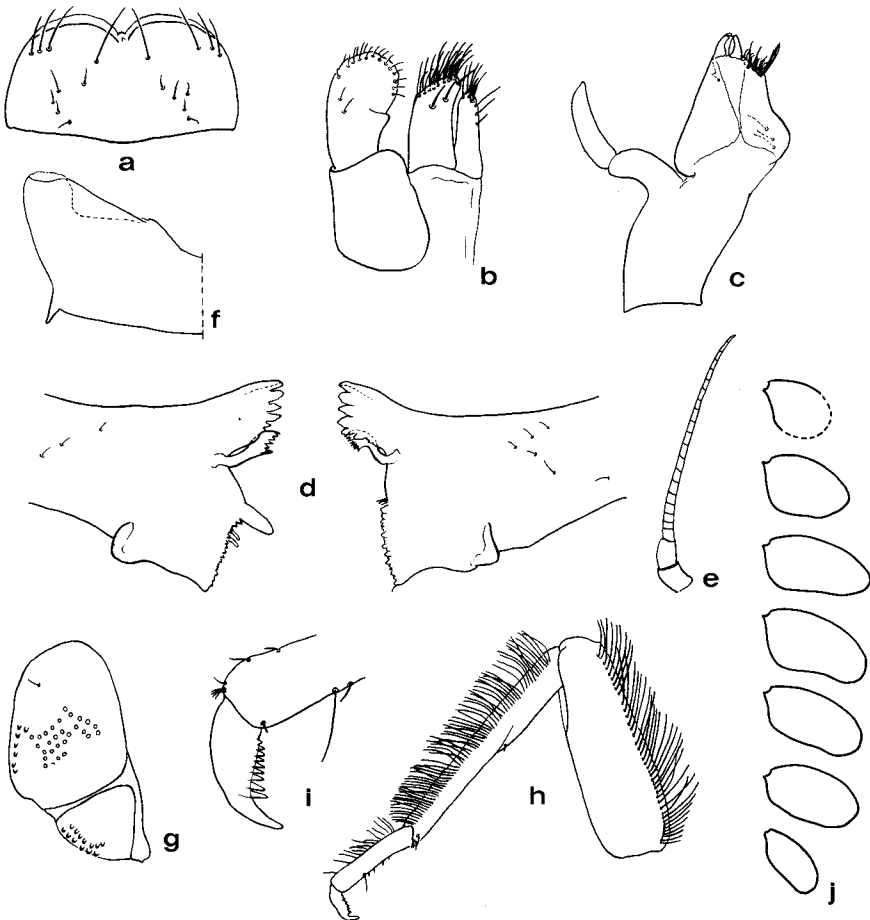


Fig. 2. *Pseudocloeon difficilum* sp. n., nymph: a) labrum; b) left half of labium; c) maxilla; d) canini and molar area of left and right mandible; e) antenna; f) left half of metatergum with minute hind wing pad; g) paraproct; h) 1st leg; i) claw; j) abdominal gills I–VII.

Holotype and some Paratypes are deposited at Zool. Staatssammlung, München. Some Paratypes are deposited at the Zool. Mus. Zool. Inst., University Hamburg, and at Florida A & M University, Entomology and Structural Pest Control, Tallahassee, Florida.

The morphological details of *Ps. difficilum* sp. n. show close relationship to *Ps. verum* sp. n. — *Ps. difficilum* sp. n. differs from *Ps. verum* sp. n. in having smooth inner margins of antennal segments, which is serrated in *Ps. verum* sp. n. Submarginal bristles near the bases of the long, marginal bristles on the outer margins of the femora are not developed. The spines on the posterior margins of the terga are elongate and pointed in *Ps. verum* sp. n. (Fig. 8) but shorter and rather blunt in *Ps. difficilum* sp. n. (Fig. 10).

Ps. difficilum sp. n. was collected in running waters in Sri Lanka at altitudes ranging between 650 m—30 m above sea level, where the nymphs live on and under stones and

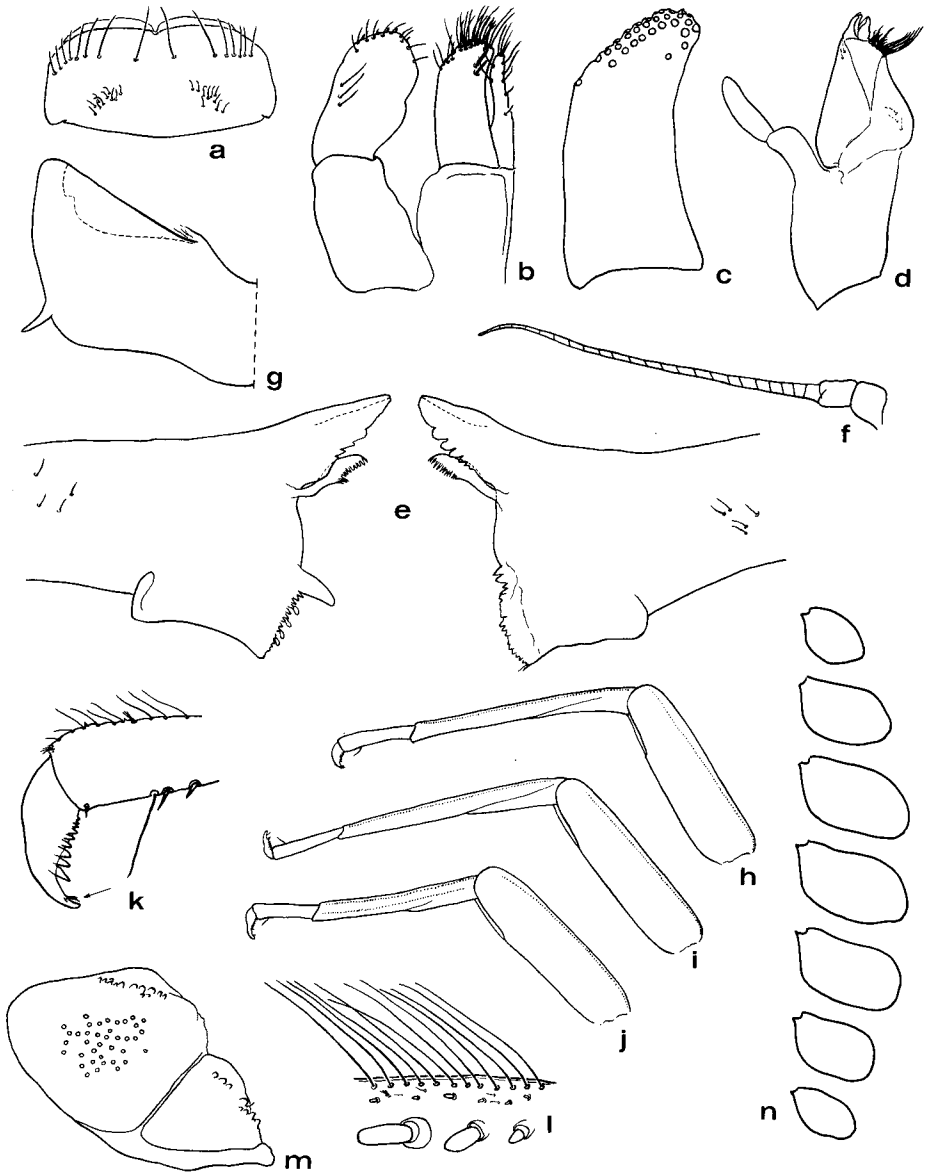


Fig. 3. *Pseudocloeon orientale* sp. n., nymph: a) labrum; b) left half of labium; c) paraglossa, ventral; d) maxilla; e) canini and molar area of left and right mandible; f) antenna; g) left half of metatergum with minute hind wing pad; h) 1st leg; i) 2nd leg; j) 3rd leg (black dots along outer margin of femora and tarsi indicate bases of long, fine submarginal bristles; k) claw; l) segment of outer margin of femur with small submarginal bristles at higher magnification; m) paraproct; n) abdominal gills I—VII.

banks in stronger current and in the cascades. The water temperature in collecting sites was between 18.3 and 27.3 °C.

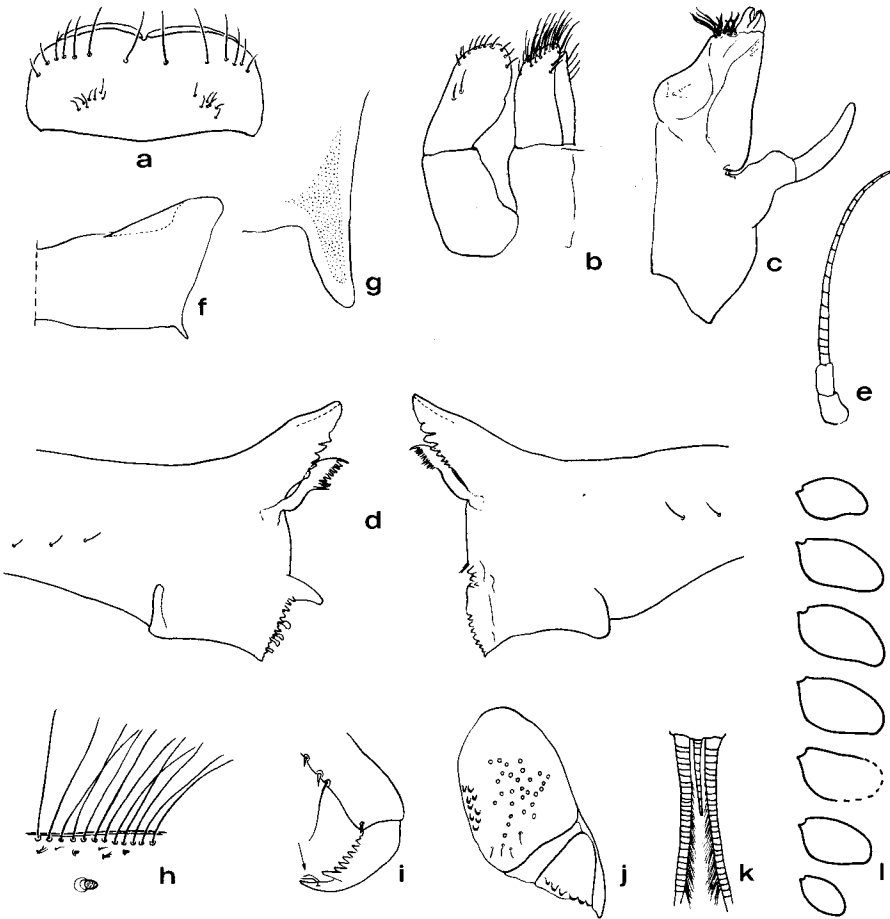


Fig. 4. *Pseudocloeon ambiguum* sp. n., nymph: a) labrum; b) left half of labium; c) maxilla; d) canini and molar area of left and right mandibles; e) antenna; f) right half of metatergum with minute hind wing pad; g) hind wing pad at higher magnification; h) segment of outer margin of femur with long, fine bristles and with very small submarginal bristles at higher magnification; i) claw; j) paraproct; k) base of caudal filaments with terminal filament reduced; l) abdominal gills I–VII.

Collecting sites in Sri Lanka (COSTA & STARMÜHLNER 1972): 7/b, 7/c, 8/2, 12/c, 13/d, 15/c, 24/2, 30/b, 34/b, 37/c.

Pseudocloeon orientale sp. n.

Figs. 3, 11, 12

Material: ca. 200 nymphs.

Mature nymph. — **C o l o r a t i o n** (Fig. 11): The middle muscle insertion areas on pronotum similar to *Ps. verum* sp. n. but with an indentation near middle of triangular. Legs brownish, a longitudinal light line on basal half of femur which is vertically

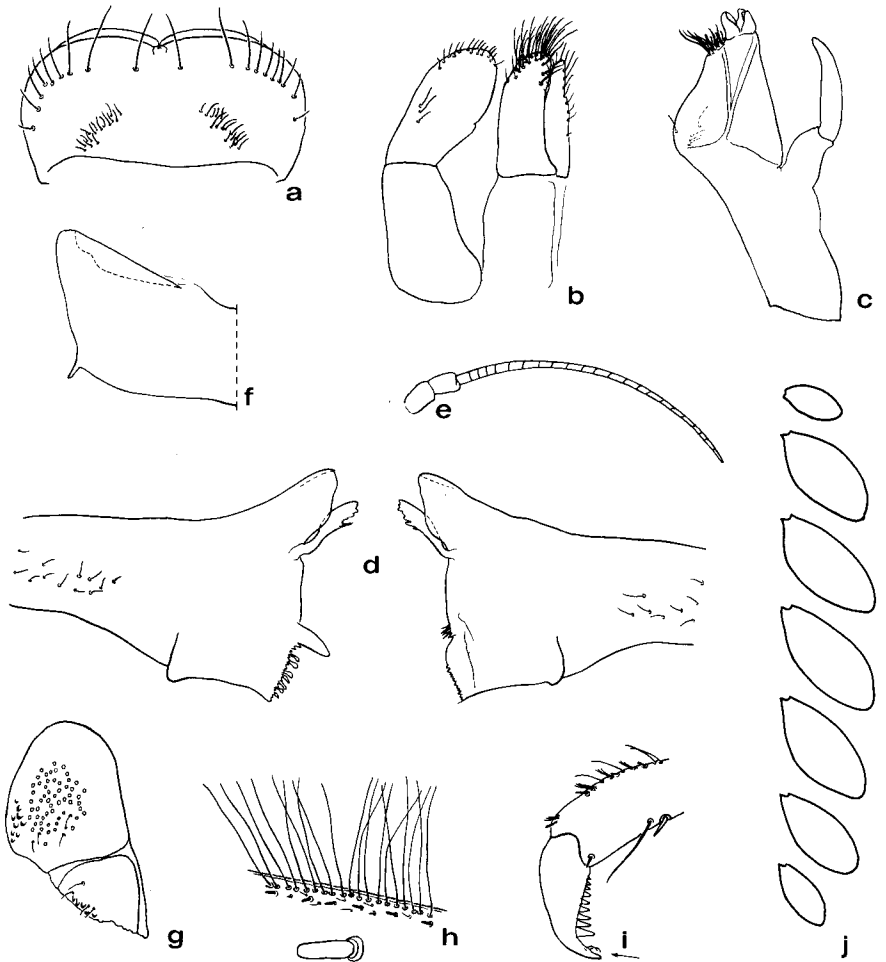


Fig. 5. *Pseudocloeon klapaleki* sp. n., nymph: a) labrum; b) left half of labium; c) maxilla; d) canini and molar area of left and right mandibles; e) antenna; f) left half of metatergum with minute hind wing pad; g) paraproct; h) section of outer margin of femur with long, fine bristles and with smaller submarginal bristles at higher magnification; i) claw; j) abdominal gills I—VII.

directed near base of femur. — Caudal filaments brownish. — Body length: ♂ 5.1 mm, cerci 4.9 mm; ♀ 5.9 mm, cerci 5.6 mm. — Labrum (Fig. 3 a): nearly equal in width at base and in frontal part, and about twice as broad as long. — Mandibles (Fig. 3 e): outermost group of canini fused into one blade. — Legs (Fig. 3 h, i, j, l): a number of broad and blunt submarginal bristles of different length on femur of all three legs. — Claw (Fig. 3 k): two apically bowed bristles near apex. Surface and posterior margin of t e r g a as shown in Fig. 12. Hyaline bristles on surface of different length; spines on posterior margin of terga broad based, blunt at apex.

Holotype: Mature nymph; slide preparation. Ceylon, FC 25/c, Kirikatu-Oya, Belihuloya. 8. 12. 1970, leg. STARMÜHLNER.

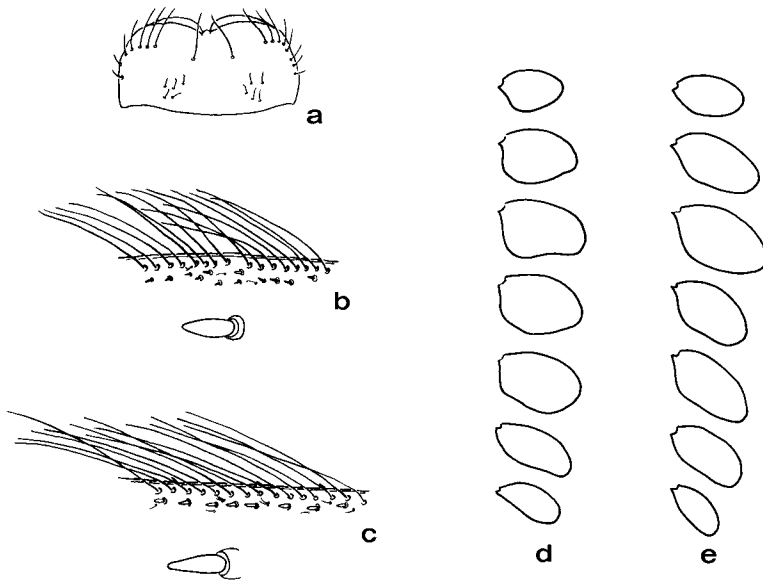


Fig. 6. *Pseudocloeon* sp. 1 (ULMER 1939), nymph: a) labrum; b) section of outer margin of femur with long, fine bristles and small, submarginal bristle at higher magnification; — *Pseudocloeon atoki*, nymph: c) section of outer margin of femur with long, fine bristles and with a small submarginal bristle at higher magnification; — d) *Pseudocloeon* sp. 1 ULMER (1939), nymph: abdominal gills I—VII; e) *Pseudocloeon atoki*, nymph: abdominal gills I—VII.

Paratypes: ca. 195 nymphs in alcohol, 3 slide preparations.

Holotype and some Paratypes are deposited at the Zool. Staatssammlung, München. Some Paratypes are deposited at Zool. Mus. Zool. Inst., University Hamburg, and at Florida A & M University, Entomology and Structural Pest Control, Tallahassee.

Pseudocloeon orientale sp. n. is the largest of the newly described species from Malaysia and Sri Lanka. It differs from the preceding species *Ps. verum* sp. n. and *Ps. difficilum* sp. n. in that the outermost group of canini on the mandibles is fused into one blade (also in the next species, *Ps. ambiguum* sp. n.). The submarginal bristles near outer margin of femur are broad and blunt, of different length, in *Ps. orientale* sp. n. (Fig. 3l), and short, narrow and pointed in *Ps. verum* sp. n. (Fig. 1i) whereas such bristles are not developed in *Ps. difficilum* sp. n. The spines on posterior margins of terga are basically broad and blunt at apex.

Ps. orientale sp. n. inhabits water courses at altitudes between 1,500—700 m and at water temperatures from 18.3—23.8 °C. Here the nymphs live under and on stones in stronger current and in the cascades.

Collecting sites in Sri Lanka (COSTA & STARMÜHLNER 1972): 6/c, 14/b, 16/a, 16/b, 16/c, 19/c, 20/b/c, 23/b, 24/3, 26/b, 27/b, 35/b.

Pseudocloeon ambiguum sp. n.

Figs. 4, 13

Material: 8 nymphs.

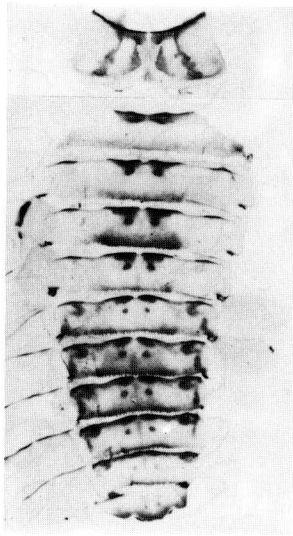


Fig. 7

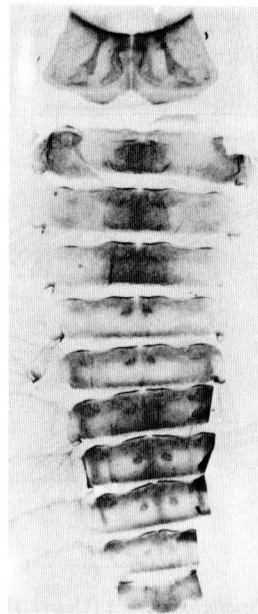


Fig. 9



Fig. 8

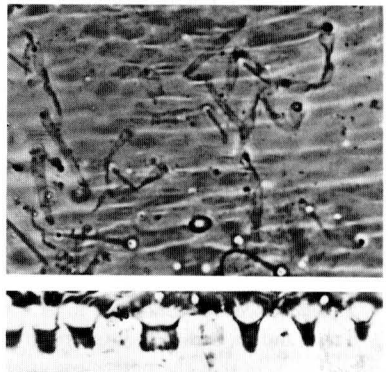


Fig. 10

Fig. 7. *Pseudocloeon verum* sp. n., nymphal exuvium.

Fig. 8. *Pseudocloeon verum* sp. n., surface and hind margin of nymphal tergum.

Fig. 9. *Pseudocloeon difficilum* sp. n., nymphal exuvium.

Fig. 10. *Pseudocloeon difficilum* sp. n., surface and hind margin of nymphal tergum.

Not fully mature nymph. — **COLORATION**: light brownish in general, similar to *Ps. difficilum* sp. n. (no suitable material is available for a photograph). The middle muscle insertion areas on pronotum similar to those of *Ps. difficilum* sp. n. (Fig. 9). — **BODY LENGTH**: ♂ 4.0 mm, cerci 3.8 mm. — **LABRUM** (Fig. 4a): about twice as broad as long, and of nearly same width at base as in distal part. — **MANDIBLES** (Fig. 4d): outermost group of canini fused into one blade. — **LEGS** (Fig. 4h): on femora of all three legs only a few extremely small blunt submarginal bristles, which are smaller than the bases of the long marginal bristles. — **CLAW** (Fig. 4i): two apically

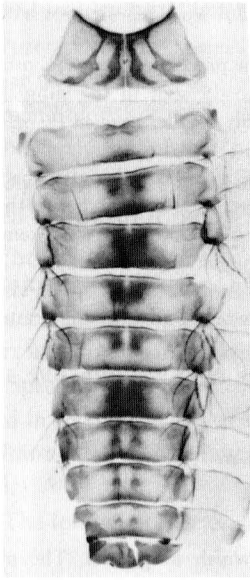


Fig. 11

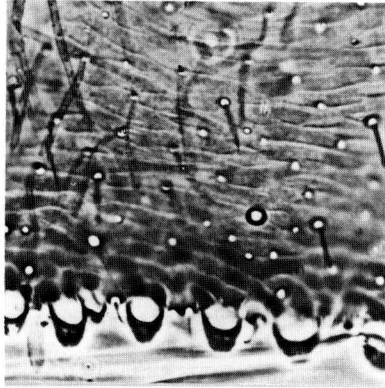


Fig. 13

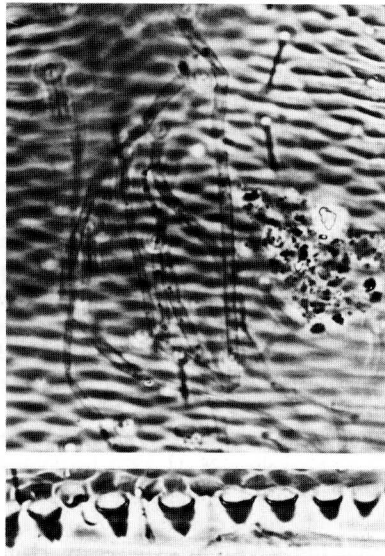


Fig. 14

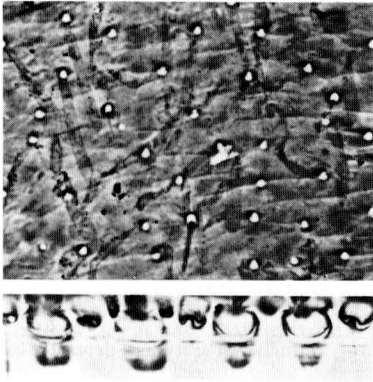


Fig. 12

Fig. 11. *Pseudocloeon orientale* sp. n., nymphal exuvium.Fig. 12. *Pseudocloeon orientale* sp. n., surface and hind margin of nymphal tergum.Fig. 13. *Pseudocloeon ambiguum* sp. n., surface and hind margin of nymphal tergum.Fig. 14. *Pseudocloeon klapaleki* sp. n., surface and hind margin of nymphal tergum.

bowed bristles near apex. Surface and posterior margin of t e r g a as shown in Fig. 13. Hyaline bristles on dorsum of different length; spines on posterior margin with broad base, blunt.

Holotype: Not fully mature nymph; slide preparation. Ceylon, FC 10/b., Katugas-Ela, Ratnapura, 18. 11. 1970, leg. Starmühlner.

Paratypes: Eight nymphs in alcohol.

Holotype and some Paratypes are deposited at the Zool. Staatssammlung, München. Two Paratypes are deposited at Zool. Mus. Zool. Inst., University Hamburg,

and the rest at Florida A & M University, Entomology and Structural Pest Control, Tallahassee, Florida.

Pseudocloeon ambiguum sp. n. is closely related to the preceding species *Ps. orientale* sp. n. A distinguishing morphological character is mostly seen in the submarginal bristles on outer margin of femur which are considerably smaller than in *Ps. orientale* (Figs. 3 l and 4 h).

More evident are the differences in body size of the nymphs and in their habitats. *Ps. ambiguum* sp. n. is considerable smaller than *Ps. orientale* sp. n. and whereas the few specimens of *Ps. ambiguum* sp. n. were collected at about 500–250 m at a water temperature of 25.1–27.2 °C, *Ps. orientale* sp. n. is frequent at higher altitudes of 1,200–700 m and at water temperatures ranging from 18.3–23.8 °C. As *Ps. orientale* sp. n., also the nymphs of *Ps. ambiguum* sp. n. prefer habitats on and under stones in stronger currents and in cascades.

Collecting sites in Sri Lanka (COSTA & STARMÜHLNER 1972): 9/c, 10/b, 10/c, 11/c.

Pseudocloeon klapaleki sp. n.

Figs. 5, 14

Material: 2 nymphs.

Mature nymph. — **Coloration:** light brownish in general. The middle muscle insertion areas on pronotum similar to those of *Ps. orientale* sp. n. (Fig. 11). — **Body length:** ♀ 3.9 mm, cerci 6.0 mm. — **Labrum** (Fig. 5 a): tapering basically, about twice as broad as long. — **Mandibles** (Fig. 5 d): although the mandibles of both specimens available appear to be worn, certainly the outermost group of canini is fused into a blade. — **Legs** (Fig. 5 h): blunt submarginal bristles on outer margin of femur of all three legs of about same length as distance between the bases of long marginal bristles. — **Claw** (Fig. 5 i): two apically bowed bristles near apex. **Abdominal gills** (Fig. 5 j) elongate. — **Surface and posterior margin of terga** as shown in Fig. 14. Transverse shagreened structures on terga are more evident than in other species, and only a few threadlike bristles are present in a median longitudinal row.

Holotype: Mature nymph; slide preparation. Ceylon, FC 17/c, Gartmore-Estate-Dola, Maskeliya, 28. 11. 1970, leg. STARMÜHLNER.

Paratype: 1 nymph in alcohol.

Holotype is deposited at Zool. Staatssammlung, München. **Paratype** is deposited at Zool. Inst. Zool. Mus., University, Hamburg.

Pseudocloeon klapaleki sp. n. is clearly distinguished from the other species described herein by the labrum, third segment of labial palpus, submarginal bristles on outer margin of femur, gills and surface of terga. Concerning labrum and labial palp a certain relationship exists to *Ps. atoki* from the Philippines (MÜLLER-LIEBENAU 1982).

The cerci of this species are considerably longer than the body, which might indicate adaptation to extremely strong currents. The two nymphs in the collection were found under stones in cascades with water temperatures of 16.1–17.2 °C and at an altitude of 1,850 m above sea level at site 17/c (COSTA & STARMÜHLNER 1972).

Discussion

This study is the first attempt to give a hypothetical subgroup concept for the complex genus *Pseudocloeon* KLAPÁLEK (1905). However, it would be pre-

mature for the establishment of subgenera or new genera under the present interpretation. The species groups are mainly based on mouthparts as these appear to be stable, viz. the labrum, the 3rd segment of the labial palpus, and the mandibles.

Nevertheless it has to be taken in consideration that of some species only a few specimens were available for study and on the other side it is not possible to tell apart a great number of specimens in one vial, because often the mandibles, a good character for primary orientation, are worn and it is too time-consuming to make slide preparations of a great number of specimens. We do not yet know enough about interspecific variation of the morphological characters used for separation (except mouthparts).

Species which are morphologically not very distinct are clearly differentiated in ecological respects, for example *Ps. verum* sp. n. and *Pseudocloeon* sp. 1. ULMER (1939), *Ps. orientale* sp. n. and *Ps. ambiguum* sp. n. (see Verification Table).

The following species groups are considered:

species group	species	distribution
<i>verum</i> group	<i>Ps. verum</i> sp. n.	Malaysia
	<i>Ps. sp. 1</i> ULMER (1939)	South Sumatra
<i>difficilum</i> group	<i>Ps. difficilum</i> sp. n.	Sri Lanka
<i>orientale</i> group	<i>Ps. orientale</i> sp. n.	Sri Lanka
	<i>Ps. ambiguum</i> sp. n.	Sri Lanka
	<i>Ps. klapaleki</i> sp. n.	Sri Lanka
<i>atoki</i> group	<i>Ps. atoki</i>	Philippines

The groups are characterized as follows:

verum group (Fig. 1): both species of this group have a labrum which is a little wider at base than in frontal part and twice as broad as long (Figs. 1 a and 6 a). The third segment of the labial palpus is shorter than broad. Both species are differentiated from all other species considered herein by the serrated antennal segments (Fig. 1 e). *Ps. verum* sp. n. and *Pseudocloeon* sp. 1 ULMER (1939) are distinguished by the submarginal bristles near outer margin of femur: they are very small and pointed in *Ps. verum* sp. n., but less pointed and about the same length as distance between bases of long, fine bristles on outer margin of femur in *Pseudocloeon* sp. 1 ULMER (1939) (Figs. 1 i and Fig. 6 b, both same magnification).

difficilum group (Fig. 2): the single species has the labrum a little wider at base than in frontal part, but less broad than twice the length; 3rd segment of labial palpus as long as broad; the margin of antennal segments is not serrated (as in all following species). No submarginal bristles are developed near outer margin of femur (Fig. 2 h).

Verification Table. *Pseudocloeon* Klapálek, 1905.

	<i>verum</i> sp. n. Malaysia	sp. 1 ULMER S. Sumatra	<i>difficilium</i> Sri Lanka	sp.n. <i>orientale</i> Sri Lanka	sp.n. <i>ambiguum</i> Sri Lanka	sp.n. <i>klapaleki</i> Sri Lanka	<i>atoki</i> Philippines
Labrum							
wider at base than in frontal part and							
twice as broad as long	x	x	—	—	—	—	—
less broad than twice the length	—	—	x	—	—	—	—
equal at base and in frontal part and							
twice as broad as long	—	—	—	x	x	—	—
tapering basically	—	—	—	—	—	x	x
Mandibles							
canini single	x	x	x	—	—	—	—
outermost canini fused	—	—	—	x	x	x	x
Labial palpus, 3rd segment:							
shorter than broad	x	x	—	—	—	—	—
as long as broad, apically rounded	—	—	x	—	—	—	—
as long as broad	—	—	—	x	x	—	—
tapering apically	—	—	—	—	—	—	—
elongate, tapering apically	—	—	—	—	—	x	x
Antennae							
inner margin serrated	x	x	—	—	—	—	—
inner margin not serrated	—	—	x	x	x	x	x
Caudal filaments							
fringed with swimming bristles	x	x	x	x	x	x	—
without swimming bristles	—	—	—	—	—	—	x
Terminal filament							
reduced, several segments	x	x	x	x	x	x	—
reduced, one segment	—	—	—	—	—	—	x
Femur							
with submarginal bristles (Figs. all of same magnification)							
pointed, shorter than distance between bases of marg. bristles Fig. 1 i	x	—	—	—	—	—	—
nearly same length as distance betw. bases of marg. bristles Fig. 6 b	—	x	—	—	—	—	—
broad, blunt, of different length, Fig. 3 l	—	—	—	x	—	—	—
rather blunt, shorter than distance betw. bases of marg. bristles, Fig. 4 h	—	—	—	—	x	—	—
blunt, about same length as distance between bases of marg. bristles Fig. 5 h	—	—	—	—	—	x	—
pointed, about same length as distance betw. bases of marg. bristles, Fig. 6 c	—	—	—	—	—	—	x
without submarg. bristles Fig. 2 h	—	—	x	—	—	—	—
Tibia of 3rd leg, outer margin with							
two rows of long bristles	x	x	x	x	x	x	—
one row of long bristles	—	—	—	—	—	—	x
Claw							
with two subapical bristles	—	—	—	x	x	x	x
without subapical bristles	x	x	x	—	—	—	—
Abdominal gills							
shorter, rounded	x	x	x	x	x	—	x
elongate	—	—	—	—	—	x	—
Spines on posterior margin of terga							
elongate, pointed	x	x	—	—	—	—	—
shorter, more or less pointed	—	—	x	—	—	x	x
broad-based, rounded	—	—	—	x	x	—	—
Number of specimens in collection							
	72	4	100	200	8	2	3
body length mm							
♂	3,1	3,5	3,8	5,1	4,0	—	6,1
♀	3,2	—	4,5	5,9	—	3,9	—
altitude of collecting site m above sea level							
	1200 - 30	—	650 - 30	1500 - 700	500 - 250	1850	2200 - 1600
water temperature °C							
	21,3 - 32,5	32,0 - 34,0	18,3 - 27,3	18,3 - 23,3	25,1 - 27,2	16,1 - 17,2	—

orientale group (Figs. 3, 4): both species correspond in having the labrum equal at base and apex and twice as broad as long; 3rd segment of labial palpus as long as broad at base, tapering apically; outermost group of canini of mandibles fused into a blade. *Ps. orientale* sp. n. and *Ps. ambiguum* sp. n. are distinguished by the submarginal bristles near outer margin of femur: they are of different size in *Ps. orientale* sp. n. (from very small to about the distance between the bases of long marginal bristles) whereas they are extremely small in *Ps. ambiguum* sp. n. (Fig. 3 l and Fig. 4 h, both same magnification).

klapaleki group (Fig. 5): only one species. Labrum tapering basically; 3rd segment of labial palpus elongate, tapering apically; submarginal bristles near outer margin of femur comparatively large, about as long as distance between the bases of long marginal bristles (Fig. 5 h).

atoki group (Fig. 6 c, e): the single species has a number of characters in common with *Ps. klapaleki* sp. n. Otherwise this species is furnished with several characters that are unique among the discussed species groups. The most striking common characters of *Ps. atoki* and *Ps. klapaleki* sp. n. are 1) the apically tapering labrum, 2) the 3rd segment of labial palpus and 3) the mandibles. The deviating characters of *Ps. atoki* are: caudal filaments without swimming bristles, terminal filament reduced to only one segment, tibia of 3rd leg with only one row of long, finely feathered bristles.

With increasing knowledge of the *Pseudocloeon* complex it could be thinkable to establish a new genus for *Ps. atoki* and probably further closely related species.

Zusammenfassung

Die Larven von fünf neuen Arten der Gattung *Pseudocloeon* KLAPÁLEK (1905) aus der Orientalis werden ausführlich beschrieben: *Pseudocloeon verum* sp. n. aus Malaysia, sowie *Ps. difficile* sp. n., *Ps. orientale* sp. n., *Ps. ambiguum* sp. n. und *Ps. klapaleki* sp. n. aus Sri Lanka. Arten der Gattung *Pseudocloeon* waren bisher weder von Malaysia noch von Sri Lanka bekannt (HUBBARD & PETERS 1978). Die fünf Arten werden mit *Pseudocloeon* sp. 1 ULMER (1939) (Süd-Sumatra) (MÜLLER-LIEBENAU 1981) und mit *Ps. atoki* (Philippinen) (MÜLLER-LIEBENAU 1982) anhand einer Merkmalstabelle (S. 296) verglichen und ihre verwandtschaftlichen Beziehungen diskutiert.

Es wird erstmalig der Versuch gemacht, *Pseudocloeon*-Arten nach ihren larvalen Merkmalen in Arten-Gruppen aufzugliedern (S. 296), welche es erlauben, eine vorläufige Ordnung in die zur Zeit fast unüberschaubare Artenvielfalt dieser schwierigen Gattung zu bringen. Zukünftige taxonomische Studien könnten auf dem hier vorgelegten Konzept aufbauen.

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Literatur

- BISHOP, J.-E. (1973): Limnology of a small Malayan River Sungai Gombak. — *Monographiae Biologicae* 22: 1—485, W. Junk, The Hague.
- EDMUNDS, G. F., JR., JENSEN, ST. L. & BERNER, L. (1976): The Mayflies of North and Central America: 1—330. — University of Minnesota Press, Minneapolis.
- HUBBARD, M. D. & PETERS, W. L. (1978): A Catalogue of the Ephemeroptera of the Indian Subregion. — *Oriental Insects Suppl.* 9: 1—43, Dept. of Zool., Univ. Delhi.
- KLAPÁLEK, F. (1905): Plecopteren und Ephemeriden aus Java. — *Mitt. Nat. Mus. Hamburg* 22: 103—107.
- MÜLLER-LIEBENAU, I. (1981): Review of the original material of the baetid genera *Baetis* and *Pseudocloeon* from the Sunda Islands and the Philippines described by G. ULMER, with some general remarks (Insecta: Ephemeroptera). — *Mitt. hamb. Zool. Mus. Inst.* 78: 197—208.
- (1982): New species of the Family Baetidae from the Philippines (Insecta, Ephemeroptera). — *Arch. Hydrobiol.* 94: 70—82.

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