



Four new species of *Rhyacophila* (Trichoptera: Rhyacophilidae) from Sabah, East Malaysia

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Abstract

Although the caddisfly genus *Rhyacophila* (Trichoptera: Rhyacophilidae) is exceptionally species-rich in southern and southeastern Asia, only 3 species were previously recorded from Borneo, 2 from Sabah and 1 from Sarawak. Examination of caddisfly specimens collected by the 1st author in 1986 through 1989 for the Leiden Museum (The Netherlands) has revealed 4 new species of *Rhyacophila*. Three of these, *R. bintil*, n. sp.; *R. ladam*, n. sp.; and *R. lepoh*, n. sp. are assigned to the *Rhyacophila curvata* Group. The 4th species, *R. kuku*, n. sp., although having affinities with the *Rhyacophila lieftincki* Group, is currently designated as *incertae sedis* within the genus. Finally, the female of *R. argentipunctella* Kimmins is described for the first time, and the species reported from Sabah.

Key words: Trichoptera, Rhyacophilidae, *Rhyacophila*, taxonomy, Sabah

Introduction

Borneo is the 3rd largest island in the world (748 168 km²), and includes the independent Sultanate of Brunei, and portions of Indonesia (Central, East, South and West Kalimantan), and East Malaysia (Sabah and Sarawak). Earlier, Huisman (1992) described 4 new species in the caddisfly genus *Apsilochorema* (Trichoptera: Hydrobiosidae) from Sabah and Sarawak. This family, with about 350 species, is most diverse on the southern continents of South America and Australia and the islands of New Zealand. Its sister family, the Rhyacophilidae, is among the most species rich in the order Trichoptera. Its largest genus, *Rhyacophila*, has more than 550 recorded species distributed across the northern continents of ancient Laurasia. Both families are present in Borneo and are members of the trichopteran suborder “Spicipalpia” (Weaver 1984).

Despite the great diversity of *Rhyacophila* on the Asian mainland (Schmid 1970), only 25 species were known previously from Indonesia (n=10), Malaysia (n=10), and the Philippines (n=5). A list of all *Rhyacophila* species now known from these countries is included in Table 1.

Of the 3 previously known Bornean species, *Rhyacophila isolata* Banks, 1934, and *R. abimael* Malicky, 2009, were collected in Sabah on Mount Kinabalu at elevations of 3080 m and 3320 m, respectively. *Rhyacophila argentipunctella* Kimmins, 1955, was collected in Sarawak on Mount Dulit at an elevation of 1232 m. In the present paper, we describe 4 new species of *Rhyacophila* from Sabah.

The new *Rhyacophila* species (89 males, 60 females) were found at 27 of 200 different collecting sites in Sabah visited by the first author in 1986 through 1989. Altitude of the sites ranged from 150-

1900 m. Collections were made with light traps and the specimens preserved in 70% alcohol. Genitalia were cleared in 10% KOH solution, examined, and illustrated in the standard manner for this order. Additional material was supplied by Dr. Wolfram Mey, Museum für Naturkunde, Berlin. Material of the species described in the present paper is deposited in the National Museum of Natural History, Leiden, The Netherlands (RMNH), the Museum für Naturkunde, Berlin (MFN), the Canadian National Collection, Ottawa, Canada (CNC), and the University of Minnesota Insect Collection, St. Paul, Minnesota (UMSP).

TABLE 1. Species of *Rhyacophila* from Indonesia, Malaysia, and the Philippines

Rhyacophila annulicornis Group

relegata Schmid, 1970, Malaysia (Pahang)

Rhyacophila castanea Group

abida Malicky, 2009, Malaysia (Johor)
ainola Malicky, 1989, Indonesia (Sumatra)
anakbakukau Malicky, 1995, Indonesia (Bali)
argentipunctella Kimmins, 1955, Malaysia (Sabah, Sarawak)
davao Ross, 1950, Philippines (Mindanao)
dolokana Malicky, 1978a, Indonesia (Sumatra)
jigme Schmid, 1970, Malaysia (Pahang-Perak border)
negrosana Mey, 1998, Philippines (Negros)
yora Malicky, 1989, Indonesia (Sumatra)

Rhyacophila curvata Group

abimael Malicky, 2009, Malaysia (Sabah)
anakbuah Malicky, 1995, Malaysia (Perak)
bintil Huisman & Armitage, NEW SPECIES, Malaysia (Sabah)
cameroni Banks, 1931, Malaysia (Pahang)
curvata Morton, 1900, Indonesia (Bali, Java, Sumatra)*
ladam Huisman & Armitage, NEW SPECIES, Malaysia (Sabah)
lepoh Huisman & Armitage, NEW SPECIES, Malaysia (Sabah)
malayana Banks, 1931, Malaysia (Pahang)

Rhyacophila lieftincki Group

donoana Malicky, 1978a, Indonesia (Sumatra)
dumogana Neboiss & Botosaneanu, 1988, Indonesia (Sulawesi)
krauskasseggae Malicky, 1978b, Indonesia (Sumatra)
lieftincki Ulmer, 1951, Indonesia (Java)

Rhyacophila tarkiya Group

perdita Banks, 1938, Malaysia (Pahang)

Rhyacophila yosiana Group

cataractae Mey, 1998, Philippines (Negros)
spinoseolata Mey, 1995, Philippines (Mindoro)
tenebrosa Mey, 1998, Philippines (Mindanao)

Incertae sedis

isolata Banks, 1934, Malaysia (Sabah)
javana Ulmer, 1951, Indonesia (Java)
kuku Huisman & Armitage, NEW SPECIES, Malaysia (Sabah)

* (Malicky, 2010).

Systematics

Rhyacophila argentipunctella Kimmins (Fig. 1)

Rhyacophila argentipunctella Kimmins, 1955: 376

Female: Anterior wing length 6.5–7.5 mm. Genitalia (Fig. 1A–B): Simple, slender, long. Sternum VI with prominent mesal process. Segment VII with separate, setose tergum and sternum. Segment VIII synsclerotous, setose, roughly trapezoidal in shape when viewed laterally, tergum about half length of concave sternum; with pair of long slender apodemes extending anteriorly until middle of segment VI, basally each apodeme with eye-shaped sclerotization, subapicodorsally with short sclerotized point. Intersegmental membranes between VII–VIII and VIII–IX long, capable of protraction and retraction. Segment IX small, tubular, lightly sclerotized, anteriorly with pair of very long, slender apodemes extending well into or beyond segment VI. Segment X+XI membranous, with scattered thin setae, and pair of terminal papillae; internally with pair of small Y-shaped apodemes and pair of long anteriorly directed apodemes, dorsal apodemes extending to base of segment IX, each with anterior hook, ventral apodemes very thin and about twice length of dorsal apodemes. Vaginal apparatus heavily sclerotized, shaped as in Fig. 1B.

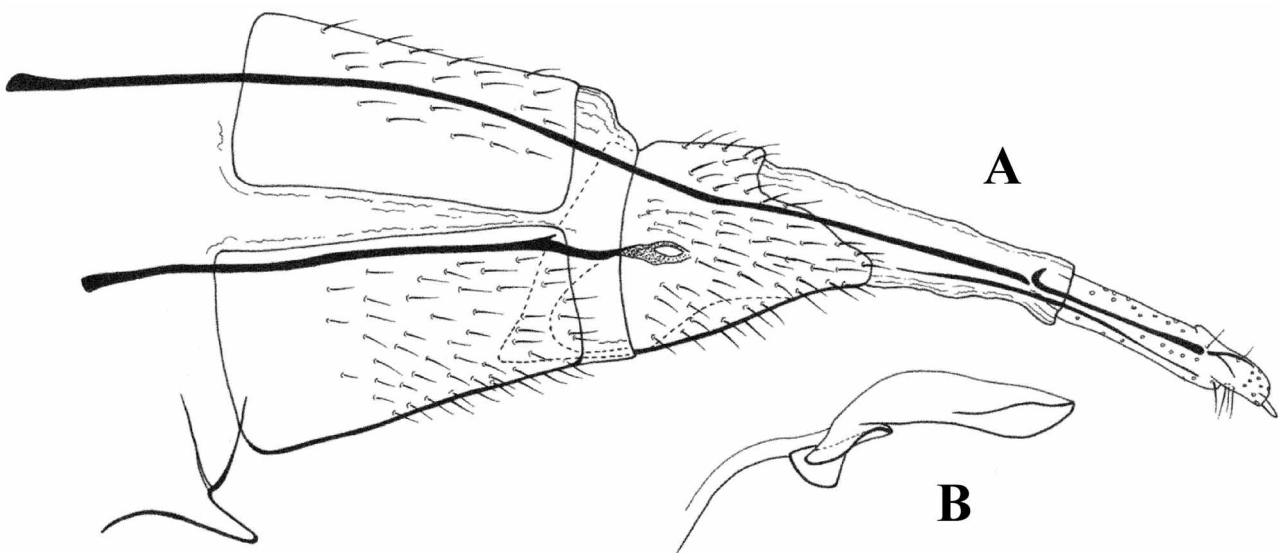


FIGURE 1. *Rhyacophila argentipunctella* Kimmins, female genitalia: A—segments VI–XII, left lateral; B—vaginal apparatus, left lateral.

Holotype male: MALYASIA: Borneo, Sarawak, Mount Dulit, 4000 ft., 18–19.X.1932, BMNH.

Material: 2 ♂, (RMNH), 60 km W Lahad Datu, Danum Valley Field Centre (DVFC), Sungai Segama, 04°58'N 117°48'E, 150 m, 19.III.1987, J. Huisman; 1 ♀, (RMNH), same locality, 17,18.III.1987, J. Huisman; 1 ♂, (RMNH), same locality, 20.III.1987, J. Huisman; 1 ♂, (UMSP), same locality, 18.X.1987, J. Huisman & R. de Jong; 1 ♀, (RMNH), 60 km W Lahad Datu, DVFC, brooklet W5, 04°58'N 117°48'E, 180 m, 13.IX.1986, J. Huisman; 2 ♀♀, (UMSP), 60 km W Lahad Datu, DVFC, brooklet above pond, 04°58'N 117°48'E, 150 m, 28.X.1987, J. Huisman; 6 ♂♂, 5 ♀♀, (RMNH), 5 km N Tenom, Sungai Noloyan, 05°10'N 115°55'E, 1010 m, 11.X.1986, J. Huisman; 1 ♂, (RMNH), Long Pa Sia, Sungai Pa Sia, 04°24'N 115°43'E, 1000 m, 1.IV.1987, J. Huisman; 1 ♂, (UMSP), same locality, 7.XII.1987, J. Huisman; 1 ♀, (RMNH), 10 km NW Long Pa Sia, confluence Sungai Maga, Sungai Pa Sia, 04°26'N 115°40'E, 1210 m, 18.X.1986, J. Huisman; 4 ♂♂, 3 ♀♀,

(RMNH), same locality, 2.IV.1987, J. Huisman; 1 ♀, (RMNH), 11 km S Long Pa Sia, 1520 m, 22.X.1986, J. Huisman; 1 ♀, (RMNH), 4.5 km SW Long Pa Sia, Sungai Ritan, 04°24'N 115°42'E, 1160 m, 8.IV.1987, J. Huisman; 1 ♀, (UMSP), 3.5 km SW Long Pa Sia, confluence Sungai Ritan, Sungai Rurun, 04°23'N 115°42'E, 1040 m, 29.XI.1989, J. Huisman; 2 ♂♂, 4 ♀, (UMSP), Gunung Kinabalu, Carsons fall, 06°02'N 116°33'E, 1900 m, 7.XI.1987, J. Huisman & R. de Jong; 1 ♀, (RMNH), Gunung Kinabalu, summit trail, Liwagu trail, 06°02'N 116°33'E, 1850 m, 17.VII.1986, J. Huisman; 1 ♂, (RMNH), Gunung Kinabalu, Sungai Tibabar, 06°02'N 116°33'E, 1750 m, 11.VIII.1986, J. Huisman; 1 ♀, (RMNH), same locality, 2.X.1986, J. Huisman; 1 ♂, 1 ♀, (UMSP), Gunung Kinabalu, Sungai Liwagu, 06°01'N 116°33'E, 1650 m, 12.viii.1986, J. Huisman; 5 ♂♂, 1 ♀, (RMNH), same locality, 30.IX.1986, J. Huisman; 6 ♂♂, (RMNH), same locality, 18.XI.1986, J. Huisman; 1 ♂, 3 ♀, (RMNH), same locality, 1500 m, 11.II.1987, J. Huisman; 1 ♀, (RMNH), Sungai Liwagu, 06°00'N 116°33'E, 1470 m, 10.VIII.1986, J. Huisman; 2 ♂♂, 2 ♀♀, (UMSP), same locality, 15.VIII.1986, J. Huisman; 2 ♂♂, 4 ♀♀, (RMNH), same locality, 26.IX.1986, J. Huisman; 1 ♂, 1 ♀, (RMNH), same locality, 15.XI.1986, J. Huisman; 2 ♂♂, (RMNH), same locality, 22.I.1987, J. Huisman; 6 ♂♂, 3 ♀♀, (RMNH), confluence Sungai Liwagu, Sungai Silau-Silau, 06°00'N 116°33'E, 1450 m, 22.VIII.1986, J. Huisman; 3 ♂♂, (RMNH), same locality, 1.X.1986, J. Huisman; 1 ♂, (RMNH), Kundassang, Sungai Liwagu, 06°00'N 116°34'E, 1185 m, 23.XI.1986, J. Huisman; 1 ♀, (RMNH), Gunung Kinabalu, Sungai Silau-Silau, 06°00'N 116°33'E, 1480 m, 9.II.1987, J. Huisman; 1 ♀, (RMNH), Gunung Kinabalu, Sungai Silau-Silau, 06°00'N 116°33'E, 1480 m, 9.II.1987, J. Huisman; 1 ♀, (RMNH), Gunung Kinabalu, Sungai Silau-Silau, 06°00'N 116°33'E, 1490 m, 21.XI.1986, J. Huisman; 1 ♂, (RMNH), same locality, 16.I.1987, J. Huisman; 1 ♀, (RMNH), Gunung Kinabalu, roadside in National Park, 06°00'N 116°33'E, 1500 m, 16.VII.1986, J. Huisman; 1 ♂, 1 ♀, (RMNH), Kundassang, Sungai Mesilau, 06°01'N 116°36'E, 1650 m, 3.X.1986, J. Huisman; 1 ♂, 1 ♀, (RMNH), Gunung Kinabalu, Marei-Parei, trickle, 06°05'N 116°31'E, 1670 m, 9.III.1987, J. Huisman; 1 ♂, (BCC), 10.5 km NNW Kundassang, Sungai Kijuhutan, 06°04'30"N 116°30'30"E, 1350 m, 10.III.1987, J. Huisman; 1 ♂, (RMNH), 12 km NNE Ranau, Poring Hot Springs, Sungai Kepungit II, 06°04'N 116°41'E, 700 m, 26.I.1987, J. Huisman; 1 ♀, (RMNH), 12 km NNE Ranau, Poring Hot Springs, Sungai Kepungit, 06°03'N 116°42'E, 480 m, 27.I.1987, J. Huisman; 1 ♂, (RMNH), 12 km NNE Ranau, Poring Hot Springs, Sungai Tananansad, 06°03'N 116°42'E, 560 m, 9.XII.1986, J. Huisman; 1 ♂, (RMNH), 12 km NNE Ranau, Poring Hot Springs, Sungai Kipogoh, 06°03'N 116°42'E, 550 m, 25.I.1987, J. Huisman; 1 ♀, (RMNH), same locality, 9.XII.1986, J. Huisman; 1 ♂, (RMNH), same locality, 31.I.1987, J. Huisman; 4 ♂♂, 4 ♀♀, (UMSP), 12 km NNE Ranau, Poring Hot Springs, staff quarters, 06°03'N 116°42'E, 550 m, 9.XI.1987, J. Huisman & R. de Jong.

Remarks: A member of the *R. castanea* Group, this is the first description for the female of this common species. It is very similar to the females of the other species from Borneo, except for the unique shape of the vagina and its larger size. The new material extends the range of the species to the north of the type locality (Sarawak) into Sabah.

Habitat: All sites were from reasonably undisturbed forests. Vegetation types varied depending on the elevation, which ranged from 150–1900 m.

Rhyacophila lepoh, n. sp. (Fig. 2)

Diagnosis: Assigned to the *R. curvata* Group, this new species resembles *R. shakangpa* Schmid, 1970 in the general shape of the male genitalia, but *R. lepoh* is easy to distinguish from it by the morphology of segment IX, the shape of segment X, and the absence of parameres.

Male: Anterior wing length 8.0 mm. Sternum V gland large, blister-like, surface reticulate. Genitalia (Fig. 2A–C): Segment IX with long, lightly sclerotized dorsal lobe, extending posteriorly over segment X. Segment X club-shaped in lateral view, dorsally with apicomasal cleft, basally with 4-5 long slender setae, apically with about 10 short setae. Inferior appendages heavily setose, 2-segmented; 1st segment rectangular in lateral view; 2nd segment short, apicoventrally extended, terete, mesal surface with about 50 very short, peg-like setae. Phallus simple, long, slender, tubular, parameres absent, phallic "tenons" (Schmid 1970) prominent, T-shaped (Fig. 2C, inset).

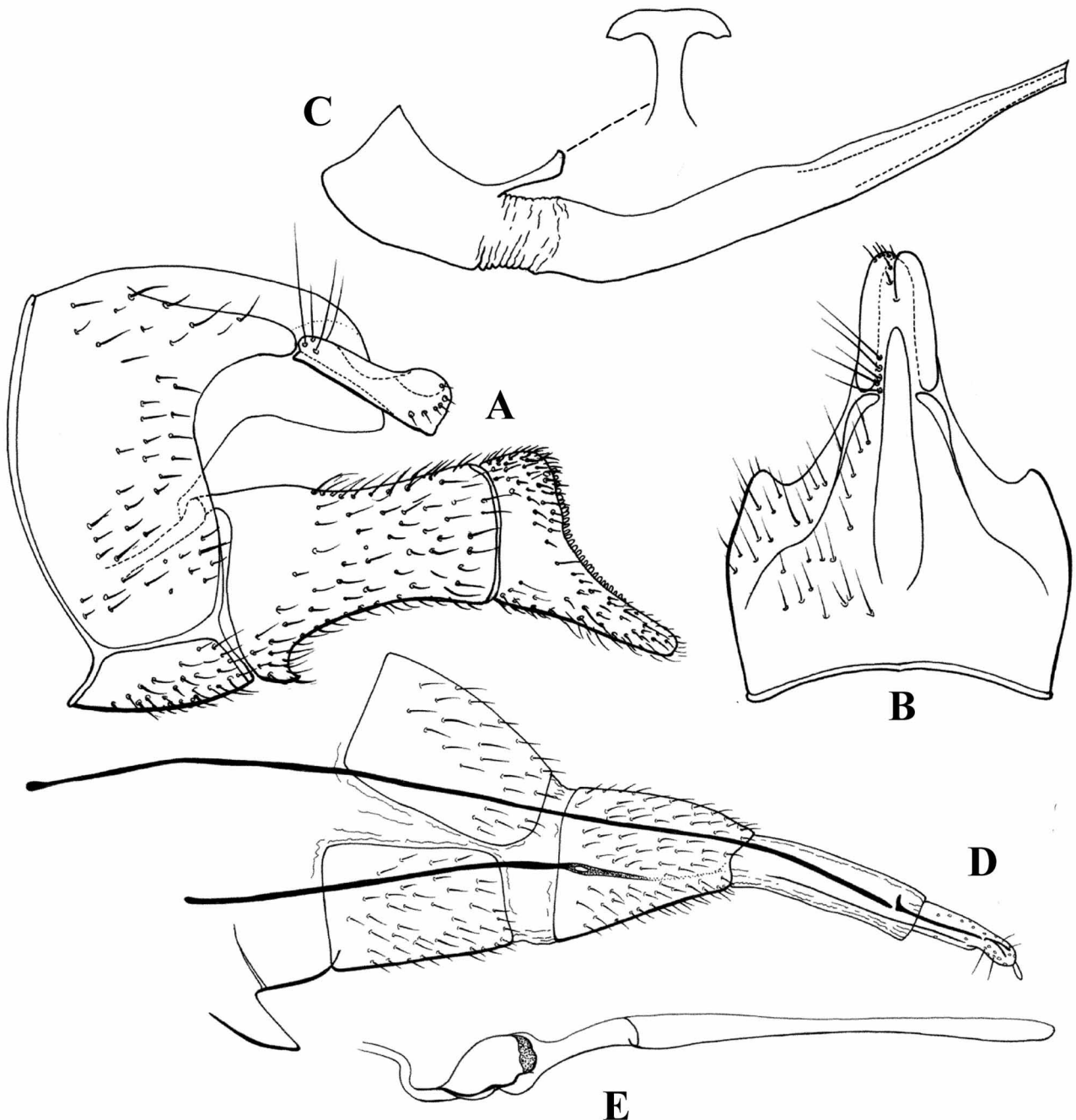


FIGURE 2. *Rhyacophila lepoh*, new species, male genitalia: A—segments IX, X, left lateral; B—same, dorsal; and, C—phallus, left lateral, (inset: "tenons," dorsal); and, female genitalia: D—segments VI–XII, left lateral; E—vaginal apparatus, left lateral.

Female: Anterior wing length 9 mm. Genitalia (Fig. 2D–E) as in *R. argentipunctella* (Fig. 1), except tergum and sternum VIII subequal and vaginal apparatus with very long, sword-shaped anterior sclerite.

Immatures: Unknown.

Holotype male: MALAYSIA: Sabah: Gunung Kinabalu, Sungai Liwagu, 06°00'N 116°33'E, 1470 m, 10.II.1987, J. Huisman (RMNH). **Paratypes: MALAYSIA:** Sabah: Gunung Kinabalu, confluence Sungai Liwagu, Sungai Silau-Silau, 06°00'N 116°33'E, 1450 m, 1.X.1986, J. Huisman, 2 ♀♀ (RMNH); Mt. Kinabalu, Kalangaan, tributary to Liwagu River, 1400 m, 9.- 13.VIII. 2005, W. Mey & K. Ebert, 2 ♂♂ (MFN).

Etymology: Malay—*lepoh*—“blister”, for the blister-shaped gland on abdominal segment V.

Habitat: Vegetation: wet, submontane oak forest. The river at the type locality was 10 m wide, with a bottom composed of large boulders, pebbles and leaf litter, and with steep banks. Water was clear, 18°C, and with pH 6.5 on the collection date.

Rhyacophila ladam, n. sp. (Fig. 3)

Diagnosis: Belonging to the *R. curvata* Group, *R. ladam* closely resembles *R. bintil*, n.sp. and *R. dikkaravasini* Schmid, 1970 from India in general appearance, but is easy to distinguish from them by the blade-like shape of segment X, the shape of the first segment of the inferior appendages, the shape of the aedeagus, and the unbranched, apically setose parameres.

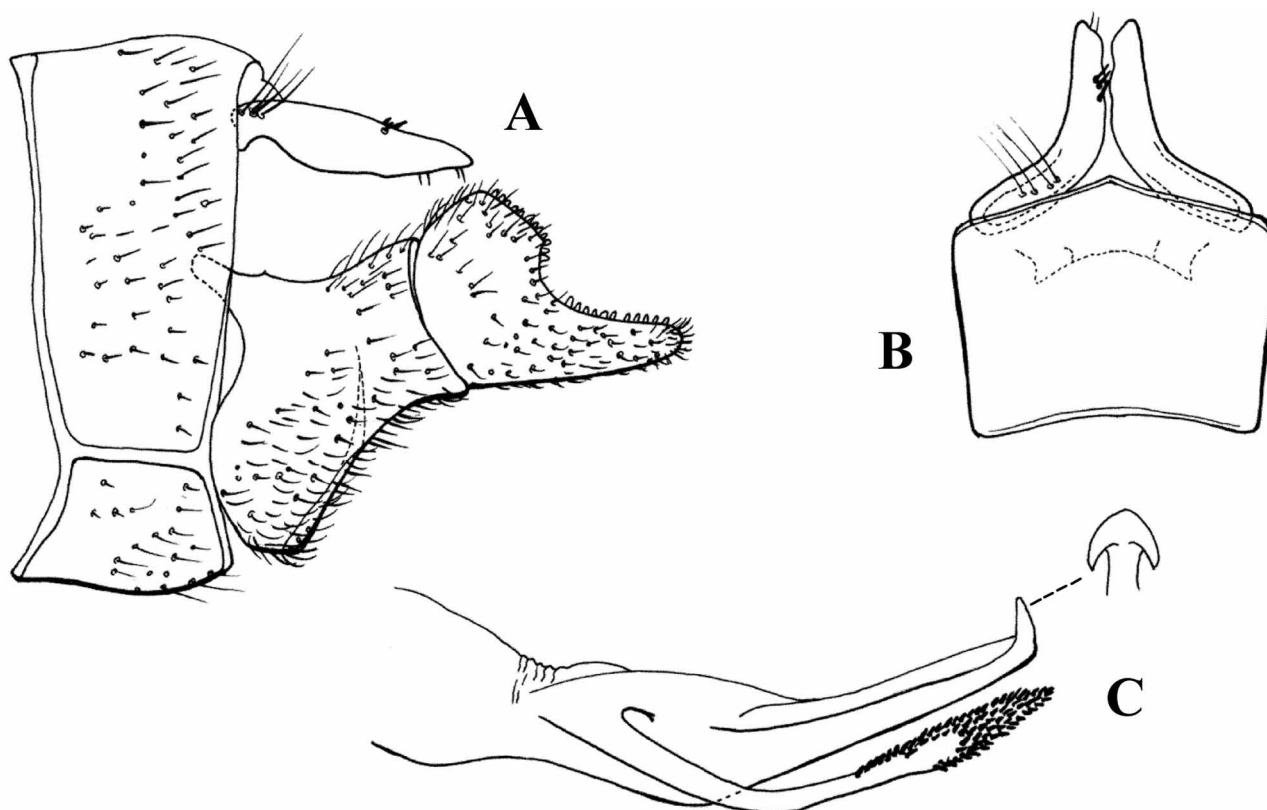


FIGURE 3. *Rhyacophila ladam*, new species, male genitalia: A—segments IX, X, left lateral; B—same, dorsal; and, C – phallus, left lateral (inset: apex of aedeagus, dorsal).

Male: Anterior wing length 7.0 mm. Sternum V gland simple, round. Genitalia (Fig. 3A–C): Segment IX simple, almost rectangular. Segment X simple, blade-shaped in lateral view,

boomerang-shaped in dorsal view, deeply cleft mesally, with slightly irregular apicomeral edges; basally with about 4 long slender setae, middorsally with 3 short, thick setae, apicoventrally with about 4 short, thin setae. Inferior appendages heavily setose, 2-segmented; 1st segment roughly quadrate in lateral view; 2nd segment short, apicoventrally extended, terete, mesal surface with about 30 very short, peg-like setae. Phallus long, tubular; aedeagus unbranched, apex bifid, U-shaped; parameres long, slender, narrow, slightly bent mesally, apical third with numerous short, stout setae.

Female and immatures: Unknown.

Holotype male: MALAYSIA: Sabah: 3.5 km SW Long Pa Sia, confluence Sungai Rurun, Sungai Ritan, 04°23'N 115°42'E, 1040 m, 29.XI.1989, J. Huisman (RMNH). **Paratype:** same data, 1 ♂ (RMNH).

Etymology: Malay—*ladam*—“horseshoe”, for the shape of the apex of the aedeagus.

Habitat: Vegetation: wet montane oak forest. The rivers at the type locality were ca. 7 m wide, with bottoms consisting of boulders, pebbles, tree trunks, and leaf litter. Banks were shallow. Water was clear, 20°C, and with pH 7.0 on the collection date.

Rhyacophila bintil, n. sp. (Fig. 4)

Diagnosis: *Rhyacophila bintil* closely resembles *R. abimael* Malicky, recently described from Sabah (Malicky, 2009). It differs from this species in the shape of tergum X and the shape and insertion point of the parameres. It differs from other, possibly related co-members of the *R. curvata* Group because of the membranous warts at the base of segment X and the processes on the aedeagus.

Male: Anterior wing length 10.0–10.5 mm. Abdominal segments II–VII with numerous very long setae, each arising from a small, elevated wart. Sternum V gland tubular. Genitalia (Fig. 4A–C): Segment IX simple, roughly rectangular, with slight middorsal projection. Segment X elongate, irregularly rectangular, mesally cleft to 2/3 length of segment, mesal surface excavated; basally segment X with numerous long setae arising from membranous wart, mesally with 3 short, thick, dark setae, apically with about 6 short, thick, yellow setae. Inferior appendages heavily setose, 2-segmented; 1st segment roughly quadrate in lateral view; 2nd segment short, apicoventrally extended, terete, mesal surface with about 50 very short, peg-like setae. Phallus complex, aedeagus with short thorn-shaped dorsal process at midlength; 2nd more apically situated, long, slender process, its apex bifid; and 3rd, subapical hook-shaped process; apex of aedeagus with pair of wing-like, lateral flared process (Fig. 4C); parameres long, slender, narrow, having apical half with numerous short, stout setae.

Female: Anterior wing length 11.0–11.5 mm. Abdominal segments II–VII with numerous very long setae, each arising from small, elevated wart. Genitalia (Fig. 4D–E) as in *R. argentipunctella* (Fig. 1), except vaginal apparatus larger, less heavily sclerotized, and more constricted basally.

Immatures: Unknown.

Holotype male: MALAYSIA: Sabah: Gunung Kinabalu, Sungai Tibabar, 06°02'N 116°33'E, 1750 m, 11.VIII.1986, J. Huisman (RMNH). **Paratypes:** MALAYSIA: Sabah: same data as holotype, 4 ♂♂, (RMNH); same locality, 2.X.1986, J. Huisman, 1 ♂, 2 ♀♀ (RMNH); Gunung Kinabalu, Carsons fall, 06°02'N 116°33'E, 1900 m, 7.XI.1987, J. Huisman & R. de Jong, 3 ♂♂, (UMSP); Gunung Kinabalu, Sungai Silau-Silau, 06°00'N 116°33'E, 1480 m, 9.II.1987, J. Huisman, 1 ♂, (RMNH); Gunung Kinabalu, Sungai Liwagu, 06°01'N 116°33'E, 1650 m, 12.viii.1986, J. Huisman, 1 ♀, (UMSP); same locality, 18.XI.1986, J. Huisman, 1 ♂, 1 ♀, (RMNH); Sungai Liwagu, 06°00'N 116°33'E, 1470 m, 10.VIII.1986, J. Huisman, 1 ♀, (RMNH); same locality, 15.VIII.1986, J.

Huisman, 1 ♀, (RMNH); same locality, 26.IX.1986, J. Huisman, 1 ♀, (RMNH); Mt. Kinabalu, Mesilau, 2000 m, 14–17.XI. 2006, East Mesilau River, W. Mey & K. Ebert, 2 ♂♂, 1 ♀ (MFN); Mt. Kinabalu, 14–17.XI. 2006, Mesilau, 2000 m, West Mesilau River, W. Mey & K. Ebert, 1 ♂, 1 ♀ (MFN).

Etymology: Malay - *bintil*—“pimple”, for the small, raised warts around the abdominal setae.

Habitat: Vegetation: wet, montane oak forest (1470–1900 m); in the higher altitudes (1850–1900) it was lower, more open forest. The type locality was a small, narrow waterfall. The rivers at the other collecting sites varied from 4–10 m wide, with bottoms consisting of boulders of different sizes, pebbles, and leaf litter, and with steep banks. Water was clear, 17–19°C, and pH 6 at the type locality on the collection date.

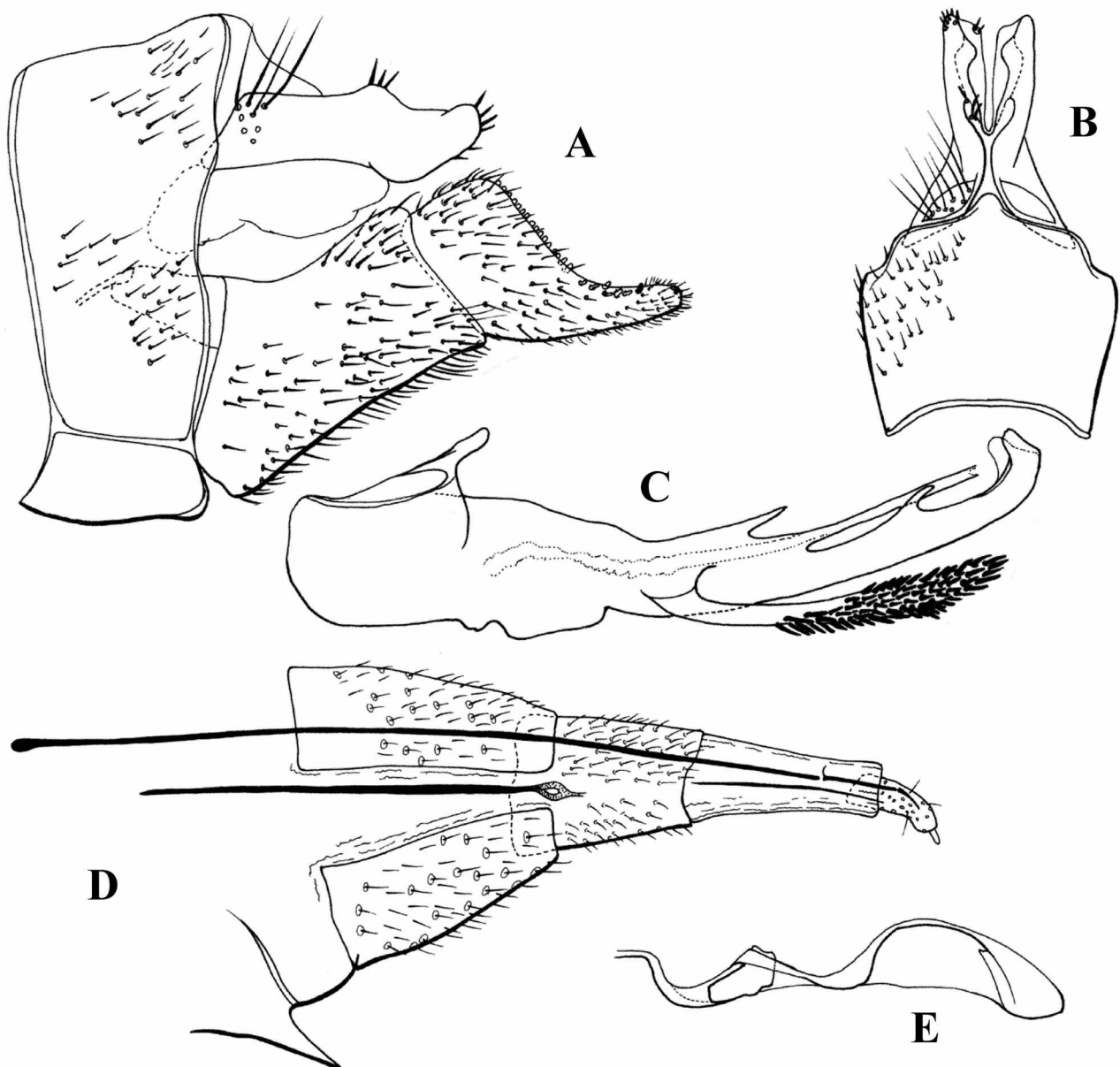


FIGURE 4. *Rhyacophila bintil*, new species, male genitalia: A—segments IX, X, left lateral; B—same, dorsal; C—phallus, left lateral; and, female genitalia: D—segments VI–XII, left lateral, E—vaginal apparatus, left lateral.

Rhyacophila kuku, n. sp. (Fig. 5)

Diagnosis: This unusual new species, with its complex genitalia, somewhat resembles *R. impar* of the *R. lieftincki* Group, having tergum IX extending posterad over tergum X and the sclerotized portion of tergum X fused to the ventral portion of tergum IX. *Rhyacophila kuku* differs from this species and other species in the *R. lieftincki* Group in having very long parameres, by the shape of the aedeagus, and by the distinctive 2nd segment of the inferior appendages. Until additional material is collected and analyzed, including females and larvae, we are designating this species as *incertae sedis* within the genus, with the above similarities to the *R. lieftincki* Group noted.

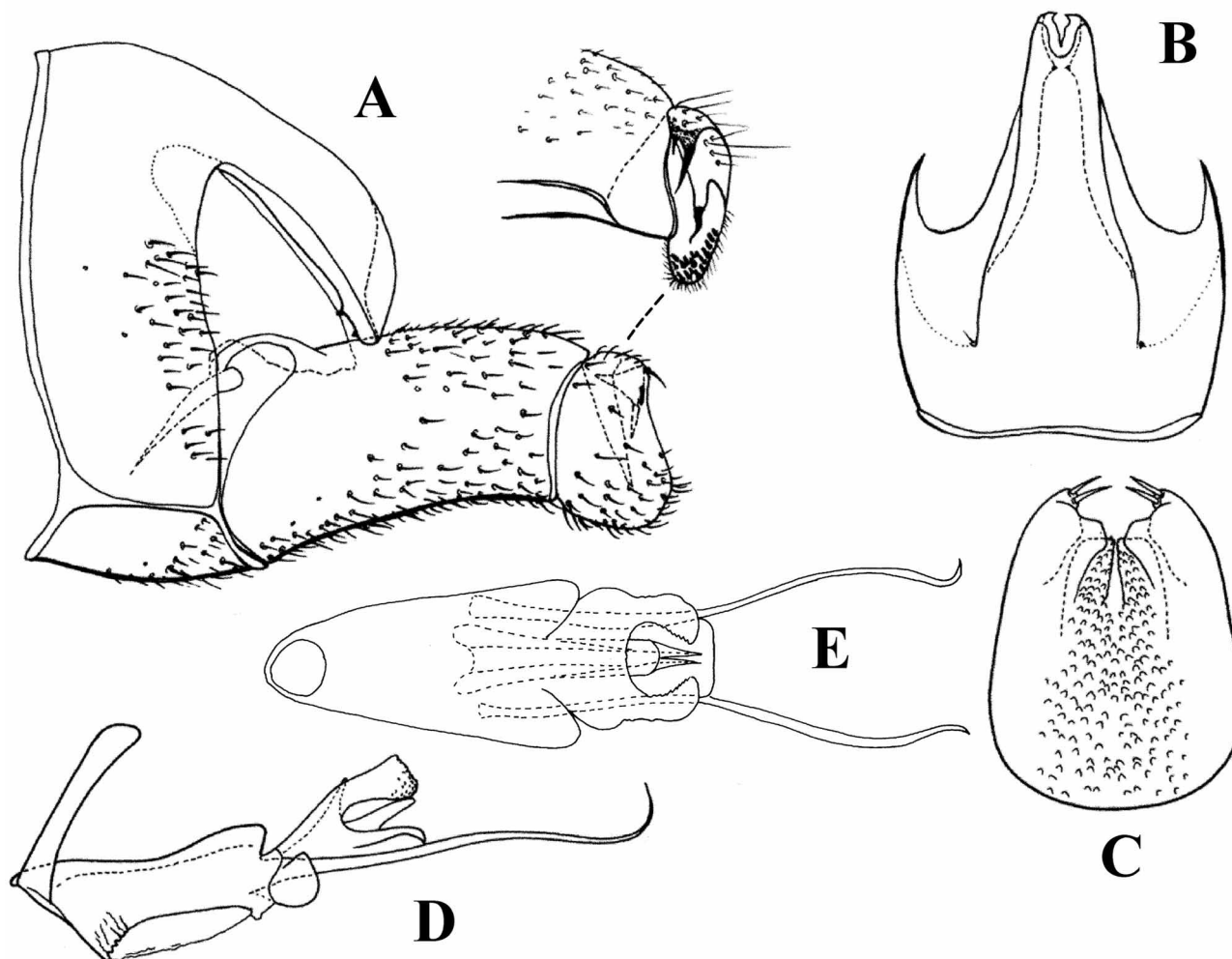


FIGURE 5. *Rhyacophila kuku*, new species, male genitalia: A—segments IX, X, left lateral (inset: 2nd segment of right inferior appendage, mesal); B—segment IX, dorsal; C—apex of segment IX, caudoventral, enlarged; D—phallus, left lateral; and, E—phallus, dorsal.

Male: Anterior wing length 7.0 mm. Sternum V gland dome shaped. Genitalia (Fig. 5A–E): Segment IX rectangular, middorsally enlarged, dome-shaped, extended posterad, its apical region complex, dorsally with papillate depression, apicoventrally anal sclerite with small, teeth-like setae (Fig. 5 C, inset). Abdominal segment X membranous, situated below dorsal extension of segment IX. Inferior appendages setose, 2-segmented; 1st segment rectangular in lateral view; 2nd segment roughly rectangular, broader than long, apex blunt, mesal surface complex (Fig. 5A, inset), with 2

claw-like flaps, each with large, sharply pointed apical setae, ventromesal corner of 2nd segment with about 25 very short, peg-like setae. Phallus small, but very complex (Fig. 5D–E), dorsal phallic appendages long, wing-shaped; ventral lobe of aedeagus constituting single plate, its apex truncate; dorsal lobe of aedeagus notched middorsally to form 2 lobes with serrate inner margins; aedeagus ending in pair of acute teeth; parameres very long and slender.

Female and immatures: Unknown.

Holotype male: MALAYSIA: Sabah: Mount Kinabalu, Sungai Liwagu, 06°00'N 116°33'E, 1470 m, 15.XI.1986, J. Huisman (RMNH).

Etymology: Malay—*kuku*—“claw”, for the mesal structures on the 2nd segment of the inferior appendages.

Habitat: Vegetation: wet, submontane oak forest. The river at the type locality was 10 m wide, with a bottom of large boulders, pebbles, and leaf litter, and with steep banks. Water was clear, 18°C, and with pH 6.5 on the date of collection.

Discussion

Five of the 7 Bornean species of *Rhyacophila* are members of 2 of the 78 species groups defined by Schmid (1970): the *R. castanea* Group (*R. argentipunctella* Kimmins) and the *R. curvata* Group (*abimael* Malicky, *R. bintil*, *R. ladam*, and *R. lepoh*). *Rhyacophila kuku*, described from a single male specimen, appears related to some members of the *R. lieftincki* Group, a conclusion shared by Dr. Fernand Schmid (deceased, earlier personal communication). However, we have chosen not to formally assign it to this group pending collection and examination of additional material. Finally, *Rhyacophila isolata* was described from a single female and was considered *incertae sedis* within the genus by Schmid (1970). No additional material of this species has been found, but it is possible that it is conspecific with 1 of the new species described in this paper. For a description of the genus, including its systematics and zoogeography, the reader is referred to the monumental work of Schmid (1970).

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References

- Banks, N. (1931) Some neuropteroid insects from the Malay Peninsula. *Journal of the Federated Malay States Museums*, 16, 377–409.
- Banks, N. (1934) Supplementary Neuropteroid insects from the Malay Peninsula, and from Mt. Kinabalu, Borneo. *Journal of the Federated Malay States Museums*, 17, 567–578.
- Banks, N. (1938) Further Neuropteroid insects from Malaya. *Journal of the Federated Malay States Museums* 18, 220–235.

- Huisman, J. (1992) New species of *Apsilochorema* (Trichoptera: Hydrobiosidae) from Sabah, East Malaysia. *Zoologische Mededelingen (Leiden)*, 66, 127–137.
- Kimmins, D.E. (1955) Results of the Oxford University expedition to Sarawak, 1932. Order Trichoptera. *Sarawak Museum Journal*, 6 (5), 374–442.
- Malicky, H. (1978a) Beiträge zur Kenntnis der Insektenfauna Sumatras. Teil 7: Köcherfliegen (Trichoptera) aus Sumatra und West Neuguinae I. Rhyacophilidae, Glossosomatidae, Stenopsychoidea, Goeridae. *Beiträge Naturkundlichen Forschung Südwest Deutschland*, 37, 159–173.
- Malicky, H. (1978b) *Rhyacophila krauskasseggae* n.sp., eine neue Köcherfliege (Trichoptera) aus Sumatra. *Zeitschrift der Arbeitsgemeinschaft Österreichischer Entomologen*, 30, 41–42.
- Malicky, H. (1989) Köcherfliegen (Trichoptera) von Sumatra und Nias: Die Gattungen *Chimarra* (Philopotamidae) und *Marilia* (Odontoceridae), mit Nachträgen zu *Rhyacophila* (Rhyacophilidae). *Mitteilungen der Schweizerischen Entomologischen Gesellschaft*, 62, 131–143.
- Malicky, H. (1995) Weitere neue Köcherfliegen (Trichoptera) aus Asien. *Braueria*, 22, 11–26.
- Malicky, H. (2009) Beiträge zur Kenntnis asiatischer Trichopteren. *Braueria*, 36, 11–58.
- Malicky, H. (2010) *Atlas of the Southeast Asian Trichoptera*. Biology Department, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand. 346 pp.
- Mey, W. (1995) Beitrag zur Kenntnis der Köcherfliegenfauna der Philippinen, I. (Trichoptera). *Deutsche Entomologische Zeitschrift für Natur Forschung*, 42, 191–209.
- Mey, W. (1998) Contribution to the knowledge of the caddisfly fauna of the Philippines, III (Insecta: Trichoptera). *Entomofauna*, 19, 1–32.
- Neboiss, A. and Botosaneanu, L. (1988) Caddis-flies (Trichoptera) of the families Rhyacophilidae, Hydrobiosidae and Glossosomatidae from Sulawesi. *Bulletin. Zoologisch Museum, Universiteit van Amsterdam*, 12 (7), 157–168.
- Ross, H.H. (1950) A new Philippine *Rhyacophila* of unusual interest (Trichoptera: Rhyacophilidae). *Entomological News*, 61, 131–134.
- Schmid, F. (1970) Le genre *Rhyacophila* et la famille des Rhyacophilidae (Trichoptera). *Mémoire de la Société Entomologique du Canada*, 66, 1–230.
- Ulmer, G. (1930) Trichopteren von den Philippinen und von den Sunda-Inseln. *Treubia*, 11, 373–498.
- Ulmer, G. (1951) Köcherfliegen (Trichoptera) von den Sunda-Inseln (Teil I). *Archive für Hydrobiologia*, Supplement 19, 1–528.
- Weaver, J.S., III (1984) The evolution and classification of Trichoptera, Part I: The groundplan of Trichoptera. In: Morse, J.C. (Ed.), *Proceedings of the 4th International Symposium on Trichoptera*, The Hague, pp. 413–419.