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**New species of *Apsilochorema* ULMER and *Rhyacophila* PICTET
from northern Borneo, with a note on *Rhyacophila isolata* BANKS
(Insecta: Trichoptera)¹**

W. MEY

A b s t r a c t : One new species of Hydrobiosidae, *Apsilochorema schulzei* nov. sp. and seven new species of Rhyacophilidae, genus *Rhyacophila* are described from Borneo (East Malaysia: Sarawak, Sabah): *R. gadingensis* nov. sp., *R. kinabaluensis* nov. sp., *R. langanana* nov. sp., *R. tawauensis* nov. sp., *R. mesilauensis* nov. sp., *R. malickyi* nov. sp. and *R. fragilis* nov. sp. In addition, *R. abimael* MALICKY is synonymised with *R. isolata* BANKS. The species are inhabitants of mountain streams at higher and lower elevations of Mount Kinabalu and other mountain ranges. Adult moths and the male genitalia are illustrated. The diagnostic characters of the new species are delineated and discussed. Species with similar wing patterns and genital traits are indicated and phylogenetic relationships are briefly discussed. The *obscura*- and the *tashidingpa*-groups are recorded from Sundaland for the first time.

Key words : taxonomy, distribution, new species descriptions, species groups, Borneo, Malaysia, Mt. Kinabalu.

Introduction

The genera *Apsilochorema* ULMER, 1907 and *Rhyacophila* PICTET, 1834 belong to the better known groups of caddisflies in maritime South-East Asia (= Sundaland, Philippines, Wallacea). In recent years a number of species descriptions were published and check-lists of species presented (HUISMAN 1992, HUISMAN & ARMITAGE 2010, MEY 1999a). For both genera biogeographical hypothesis have even been provided (MEY 1998, 1999b). New field work in Borneo resulted in the discovery of further new species which throws new light on the historical biogeography of both genera in the region. It is, however, beyond the scope of the present article to discuss the biogeographical significance of the new taxa. This should be the subject of a separate paper that has to include the Philippine species too, which are currently under study. Species of *Apsilochorema* and *Rhyacophila* are inhabitants of mountain streams. Most species occur at higher elevations above 1000 m whilst only one or two species of *Rhyacophila* are able to live in small lowland streams. They are rare elements, being usually found as only a few specimens. It is therefore difficult to estimate the species richness of the two genera. There should be some further, undetected species living in less known and less sampled mountain ranges in Sundaland and beyond.

The aim of this paper is to clarify the status of the “incertae sedis” species *R. isolata* BANKS and to provide descriptions of 8 new species which were discovered in Sarawak and Sabah (East Malaysia) during field work in the last 10 years. The collecting sites in Borneo are depicted in Fig. 26.

¹ This paper is dedicated to Prof. Dr. Hans Malicky on the occasion of his 75th birthday.

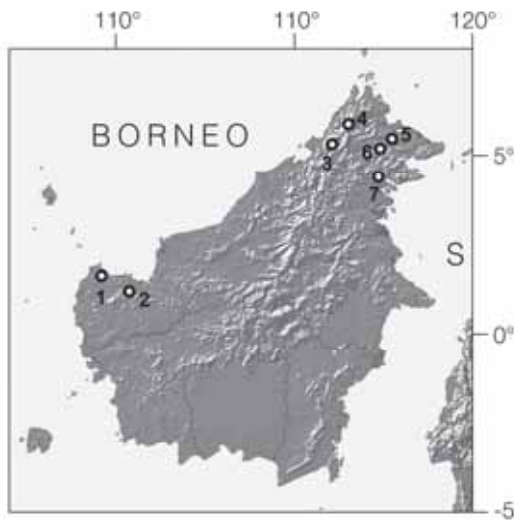


Fig. 26: Location of sampling sites in northern Borneo (1 – Gunung Gading, 2 – Anna Rais, 3 – Kota Kinabalu, Myog River, 4 – Mt. Kinabalu, 5 – Sepilok, 6 – Danum Valley, 7 – Tawau Hills).

Review of species

Abbreviations: BMNH – Natural History Museum, London (formerly British Museum, Natural History); MFN - Museum für Naturkunde, Berlin; FRCS - Forest Research Centre, Sepilok

Hydrobiosidae

Apsilochorema schulzei nov. sp. (Figs 1-2, 27)

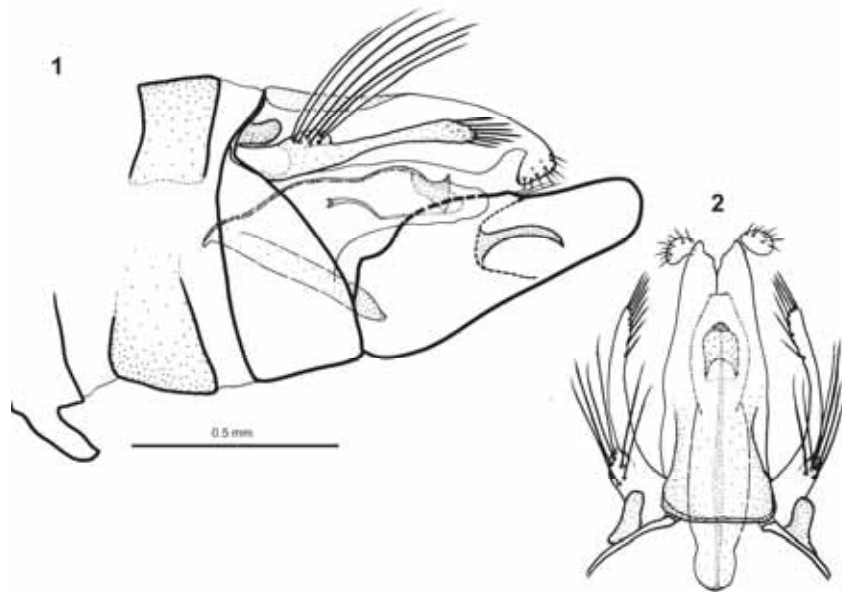
Holotype: ♂, Malaysia, Sabah, Kinabalu National Park, 1780 m, at light, 11.4.1999, leg. C. Schulze (MFN).

Paratype: ♀, same data as holotype (MFN).

Derivatio nominis: The species is dedicated to Christian SCHULZE, the collector of the new species.

Description: Length of forewing 12 – 14 mm. Head and thorax black, vestiture on frons and vertex brown, pale brown between scapi; antennae black, with light-brown base and brown annulations between flagellomeres; legs pale brown, coxae darker, spurs 2.4.4. Forewings brown, veins with erected black bristles, chorema on underside of male forewing present, very long, reaching beyond end of pterostima, discoidal cell closed, M1 terminates above apex, M4 bent upwards before wing margin and terminates at excision of outer wing margin, Cula also strongly bent apically, but downwards, in hindwings fork 3 absent. Ventral sternite on segment VI large, lateral filaments on sternite V short.

Male genitalia (Figs 1-2): hind margin of segment 9 evenly rounded, appendices praenales short quadrangular, filipods shortened not reaching tip of valva, bases enlarged dorsally and with 6-7 long bristles, apex with a bundle of short bristles, proctiger with diverging apical lobes, basal article of inferior appendages with convex dorsal margin, harpago inserted in the middle of basal article, only slightly curved ventrad, dorsal margin of phallosome curved, endophallus with large phallosomal sclerite.



Figs 1-2: *Apsilochorema schulzei* nov. sp., male genitalia; (1) lateral; (2) dorsal view.

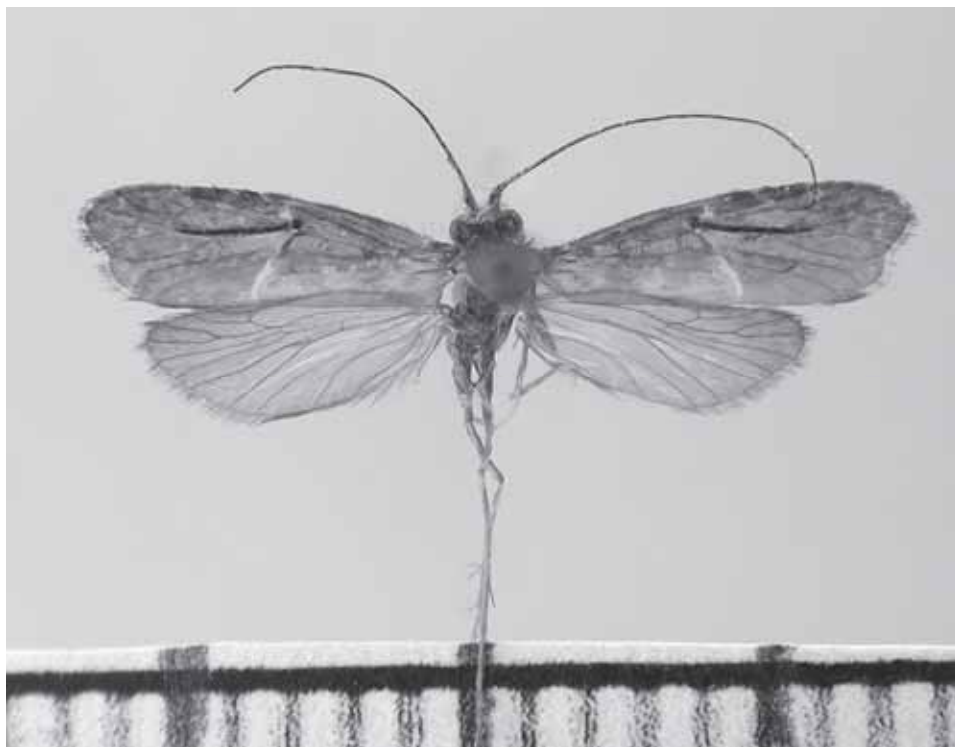


Fig. 27: *Apsilochorema schulzei* nov. sp., male holotype.

The species is a member of the *A. moselyellum* group, sharing nearly all diagnostic characters. The differing structure is the position of the harpago, which is not inserted in the apical third of the inferior appendage but in the middle. Unique traits of the new species are the dorsally enlarged bases of the filipods and the large phallotremal sclerite of the phallic apparatus. Concerning wing venation and the deep excision of forewing margins the species corresponds with *A. kinabalu* HUISMAN, 1992.

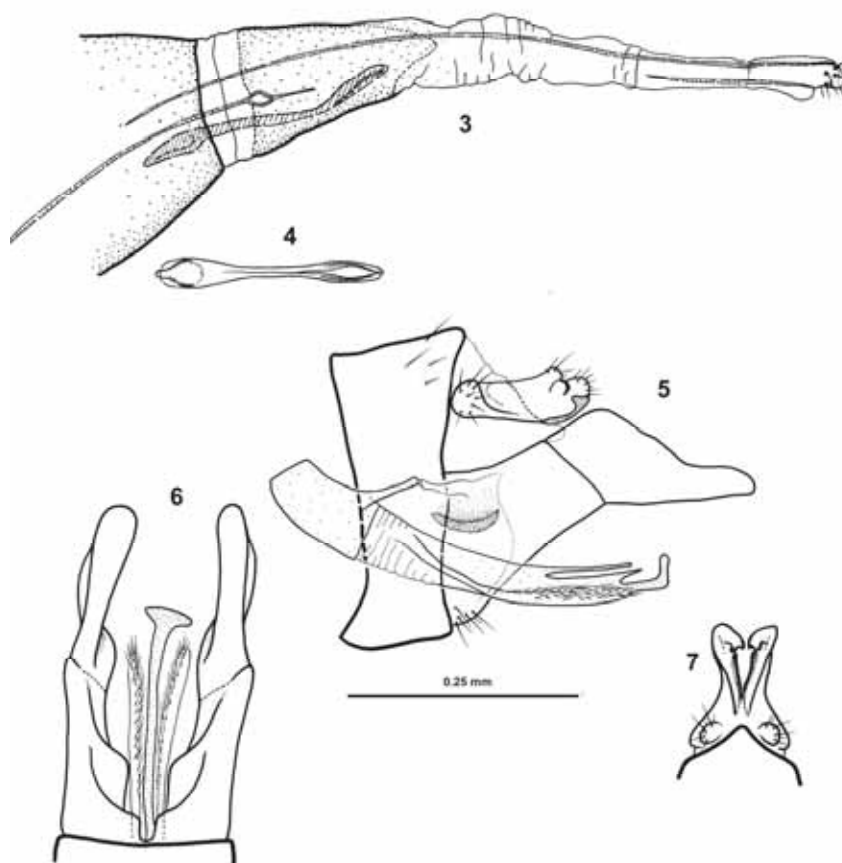
Rhyacophilidae

Rhyacophila isolata BANKS, 1934 (Figs 3-7)

Rhyacophila abimael MALICKY, 2009, syn. nov.

Examined material: Holotype ♀, “B.N. Borneo/Mt. Kinabalu/Pakka/10.000 ft./24.Mar.1929” [front side of label, printed], “at light/H.M. Pendlebury/coll. F.M.S. Museum” [back side of label], “Ex. F.M.S./Museum/B.M. 1955-354”, “*Rhyacophila/isolata* Bks./type” [handwritten with black ink on white card with red frame], (BMNH); 1 ♂, Malaysia, Sabah, Mt. Kinabalu, Ulu Mentakl., 9.000 ft., 8.-9.4.1964, Royal Society Expedition, Coll. S. Kueh., B.M. 1964-250 (BMNH); 1 ♂, 1 ♀, Malaysia, Sabah, Kinabalu National Park, Mesilau, 26.2.2006, at light, leg. W. & M. Mey (MFN).

The holotype of *R. isolata* is a female, deposited in the BMNH and examined by the author recently. The copulatory apparatus is depicted in Figs 3-4, the male genitalia in Figs 5-7. The species was listed by MEY (1999) as incertae sedis but now has turned out to be the female of *R. abimael* MALICKY, 2009. The species clearly belongs to the *curvata* group. The taxon is a remarkable large species, by far the largest of all *Rhyacophila* species known so far from Borneo.



Figs 3-7: *Rhyacophila isolata* BANKS, 1934; (3) female copulatory apparatus, lateral; (4) processus spermatheca, ventral; male genitalia: (5) lateral; (6) ventral; (7) dorsal.

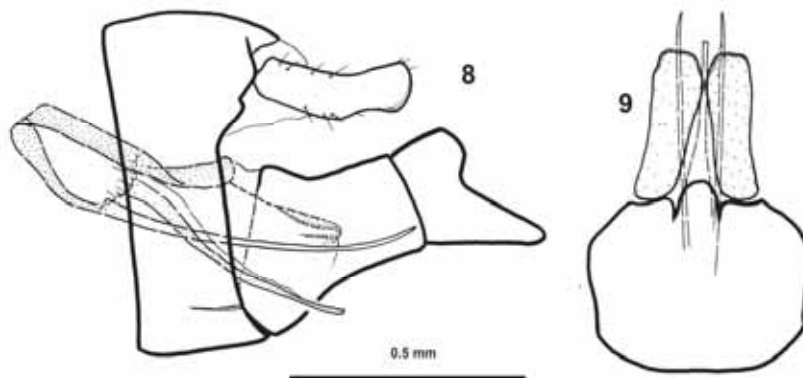
***Rhyacophila gadingensis* nov. sp. (Figs 8-9, 28)**

H o l o t y p e . ♂ [pinned], Malaysia, Sarawak, Gunung Gading National Park, 800 m, at light, 23.-26.10.2003, abdomen in glycerine, leg. W. Mey (MFN).

P a r a t y p e s : 2♂♂, 1♀, same data as holotype (MFN).

D e r i v a t i o n o m i n i s : The species is named after the type locality, Mount Gading.

D e s c r i p t i o n : Length of forewing 6,5 – 7 mm, wing expense 19 – 20 mm. Head and thorax brown dorsally, vestiture darker brown; antennae brown, with pale annulations; maxillary palpi long, brown, maxillary palpi with flattened articles; legs yellow-brown, spurs 3.4.4., sometimes one spur is absent in the forelegs; forewings pale brown, with some clear patches in the membrane, hind wings somewhat lighter.



Figs 8-9: *Rhyacophila gadingensis* nov. sp., male genitalia; (8) lateral; (9) dorsal.



Fig. 28: *Rhyacophila gadingensis* nov. sp., female paratype.

Male genitalia (Figs 8-9): Dorsal part of segment IX enlarged, with a very short apical process; lateral parts of segment X quadrangular in dorsal view, without appendages, slightly bent in lateral view, tips rounded; anal sclerites and sclerotised tergal strap absent; basal segment of inferior appendages concave ventrally, inner side developed into two ridges forming a hollow which serves as guidance for the phallic apparatus, second segment with excised apical margin; phallic apparatus with two slender, acute paramers, without spines or setae, aedeagus a slender tube, as long as paramers.

Belonging to the *curvata* group *R. gadingensis* nov. sp. resembles *R. lepoh* HUISMAN & ARMITAGE, 2010 by having a broad dorsal segment IX and a simple segment X. The striking difference between them are the paramers which are present in the former and absent in the latter species.

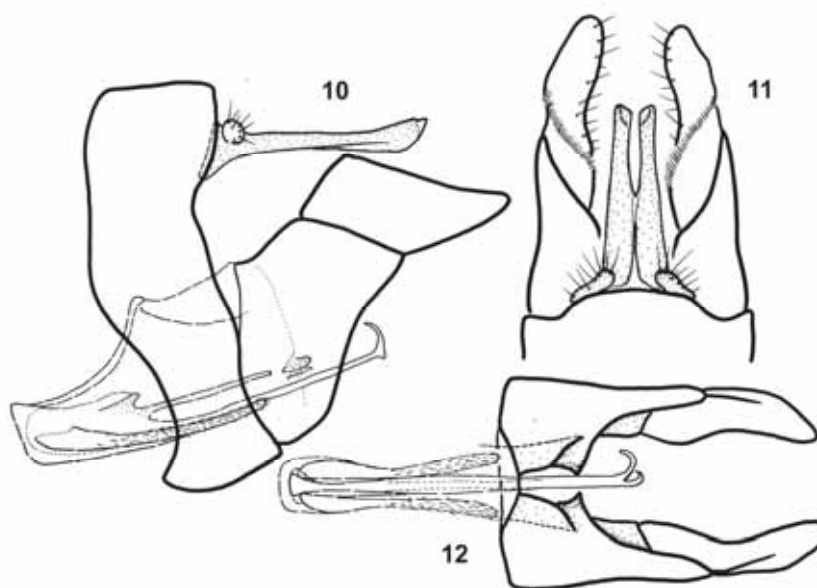
***Rhyacophila kinabaluensis* nov. sp. (Figs 10-12, 29)**

Holotype: 1♂ [pinned], Malaysia, Sabah, Kinabalu National Park, Silau-Silau river, 1600 m, 10.-13.11.2005, leg. W. Mey & K. Ebert, abdomen in glycerin (MFN).

Paratypes: 3♂♂, same data as holotype (MFN, FRCS).

Derivatio nominis: The species is named after the type locality on Mt. Kinabalu.

Description: Length of forewing 8-9 mm, wing span 19-20 mm. Head and thorax brown dorsally, vestiture red-brown; antennae pale brown, with pale annulations; maxillary palpi long, brown, maxillary palpi short; legs light-brown, spurs 3.4.4.; forewings brown, with numerous paler patches in the membrane, fringe with alternating brown and yellow patches, cross-vein m-cu de-sclerotised, white; hind wings pale brown.



Figs 10-12: *Rhyacophila kinabaluensis* nov. sp., male genitalia; (10) lateral; (11) ventral; (12) dorsal.

Male genitalia (Figs 10-12): Dorsal part of segment IX simple, constricted in ventral part, apical process absent; lateral parts of segment X very long and slender, deeply cleft mesally, lateral parts excavated apically, straight in lateral view, tips acute, base with a bulbous and setose enlargement; anal sclerites and sclerotised tergal strap absent; basal segment of inferior

appendages concave ventrally, with a clear angle, inner side developed into two ridges, second segment with straight apical margin; phallic apparatus with two short, setose paramers, aedeagus tri-branched, ventral branch longest, apex bifid, u-shaped, distinctly longer as paramers.

R. kinabaluensis nov. sp. is also a member of the *curvata* group. It is closely related to the following two species based on similar architecture of segment X and the tri-branched aedeagus.

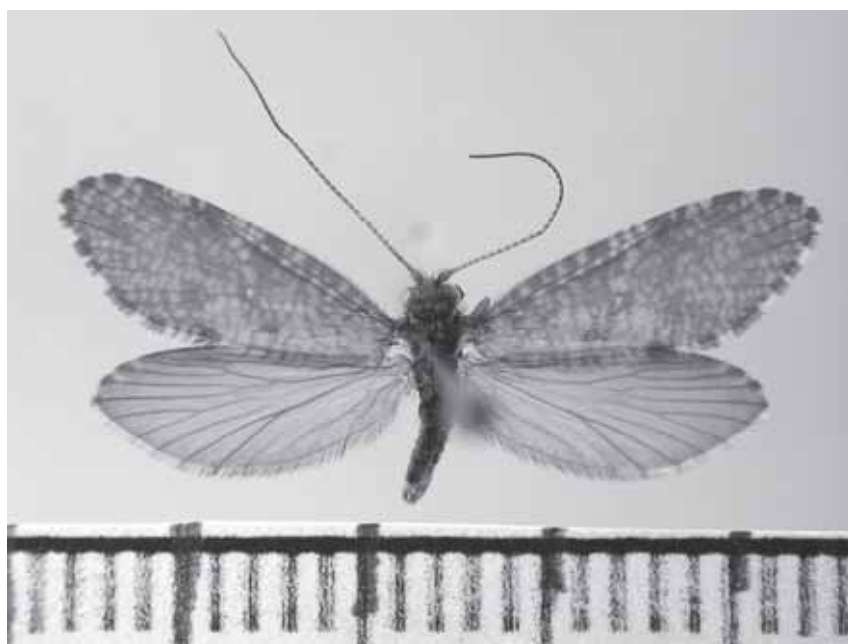


Fig. 29: *Rhyacophila kinabaluensis* nov. sp., male paratype.

***Rhyacophila langanana* nov. sp. (Figs 13-14, 30)**

H o l o t y p e : ♂ [pinned], Malaysia, Sabah, Kinabalu National Park, Poring Hot Springs, Langanan Waterfall, 1000 m, at light, 19.9.2006, leg. W. Mey, abdomen in glycerin (MFN).

P a r a t y p e s : 2♂♂, 2♀♀, same data as holotype (MFN, FRCS).

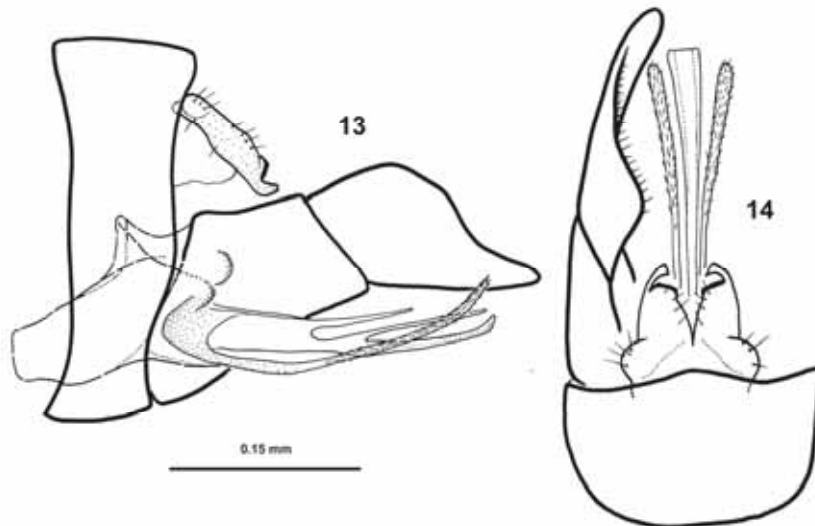
D e r i v a t i o n o m i n i s : The species is named after the type locality, the Langanan Waterfall near Poring at the foot-hills of Mt. Kinabalu.

D e s c r i p t i o n : Length of forewing 8 mm, wing span 19 mm. Head and thorax brown, vestiture red-brown; antennae pale brown, with pale annulations; maxillary palpi long, brown, maxillary palpi short; legs light-brown, apical spurs of foreleg small, spurs 3.4.4.; forewings brown, with numerous paler patches in the membrane especially in the costal area, fringe with alternating brown and yellow patches, cross-vein m-cu de-sclerotised, white, but not so conspicuous as in the former species; hind wings pale brown.

Male genitalia (Figs 13-14): Dorsal part of segment IX simple, apical process absent; lateral parts of segment X very short and triangular, deeply cleft mesally, lateral parts straight in lateral view, widely excavated apically and curved medially, seemingly forming a pair of appendages in dorsal view; tips acute, base with a bulbous and setose enlargement; anal sclerites and sclerotised tergal strap absent; basal segment of inferior appendages nearly straight, inner side developed into two ridges, second segment with slightly excised apical

margin; phallic apparatus with two long, setose paramers, aedeagus tri-branched, ventral branch longest, apex spatulate, as long as paramers.

R. langanana nov. sp. is a member of the *curvata* group. It is closely related to *R. kinabaluensis* nov. sp. and the following species based on similar segment X and the tri-branched aedeagus.



Figs 13-14: *Rhyacophila langanana* nov. sp., male genitalia; (13) lateral; (14) dorsal.

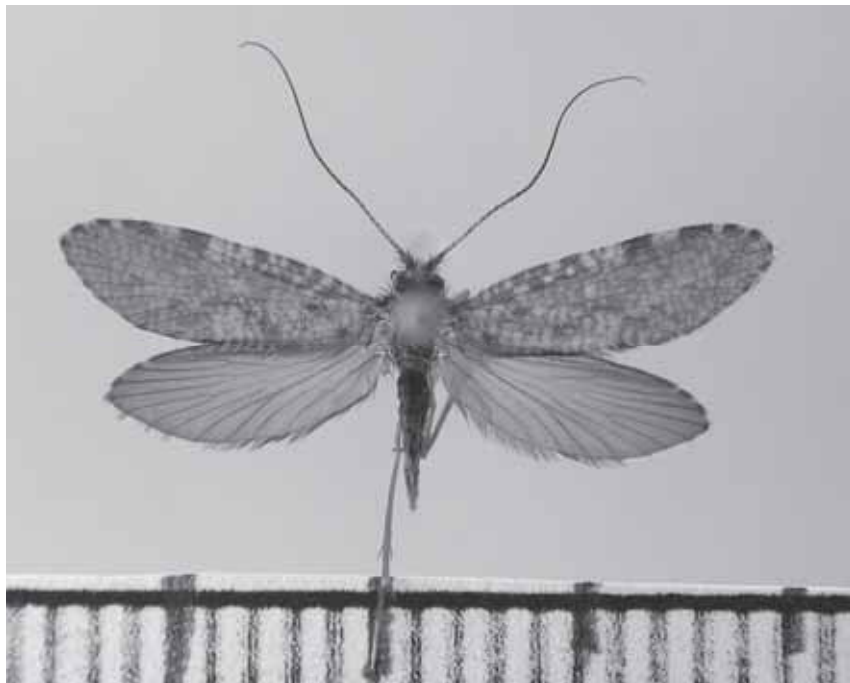


Fig. 30: *Rhyacophila langanana* nov. sp., male paratype.

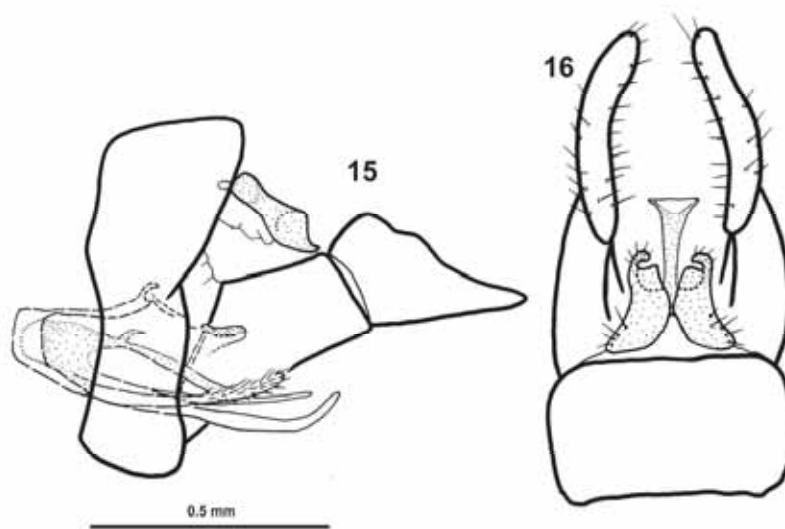
***Rhyacophila tawauensis* nov. sp. (Figs 15-16, 31)**

H o l o t y p e : ♂ [pinned], Malaysia, Sabah, Tawau Hills National Park, 18.-21.8.2005, leg. W. Mey & K. Ebert, abdomen in glycerin (MFN).

P a r a t y p e s : 1♂, 2♀, same data as holotype (MFN, FRCS).

D e r i v a t i o n o m i n i s : The species is named after the type locality, the Tawau Hills north of Tawau.

D e s c r i p t i o n : Length of forewing 5-6 mm, wing span 12-13 mm. Head light brown, thorax brown, vestiture red-brown; antennae light brown, with pale annulations; maxillary palpi long, brown, maxillary palpi short; legs light-brown, apical spurs of foreleg small, spurs 3.4.4.; forewings brown, with numerous paler patches in the membrane, veins dark brown, fringe monochrome, cross-vein m-cu de-sclerotised, white, but not so conspicuous as in the former species; hind wings pale brown.



Figs 15-16: *Rhyacophila tawauensis* nov. sp., male genitalia; (15) lateral; (16) dorsal.

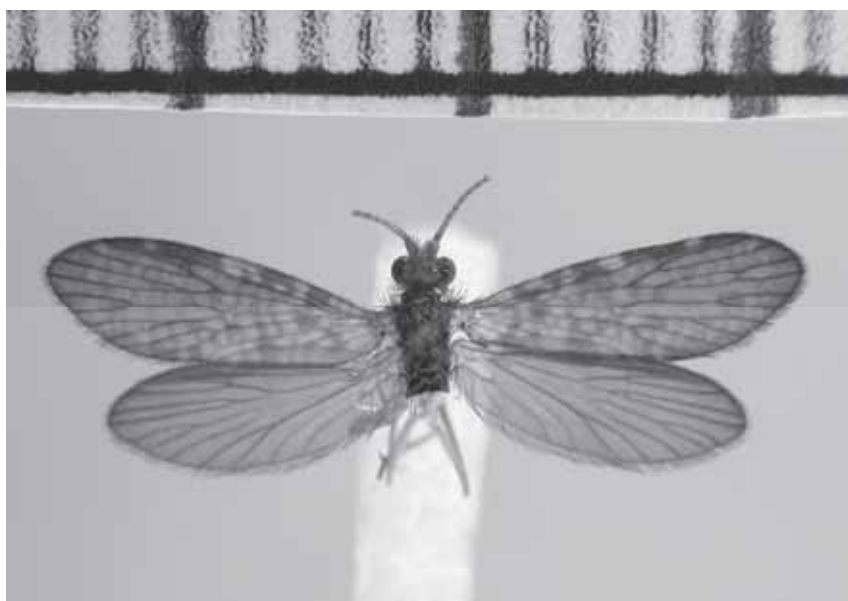


Fig. 31: *Rhyacophila tawauensis* nov. sp., male holotype.

Male genitalia (Figs 15-16): Dorsal part of segment IX simple, apical process absent; lateral parts of segment X short, somewhat triangular in dorsal view, deeply cleft mesally, lateral parts straight in lateral view, excavated apically and curved medially, seemingly forming a pair of appendages in dorsal view; tips rounded, base simple; anal sclerites and sclerotised tergal strap absent; basal segment of inferior appendages nearly straight, inner side developed into two ridges, second segment with nearly straight apical margin; phallic apparatus with two long, setose paramers, aedeagus tri-branched, basal branch very short, ventral branch longest, its apex curved dorsad and with spatulate tip, branch longer as paramers.

R. tawauensis nov. sp. is a member of the *curvata* group. It is closely related to the preceding species based on similar structure of segment X and the tri-branched aedeagus.

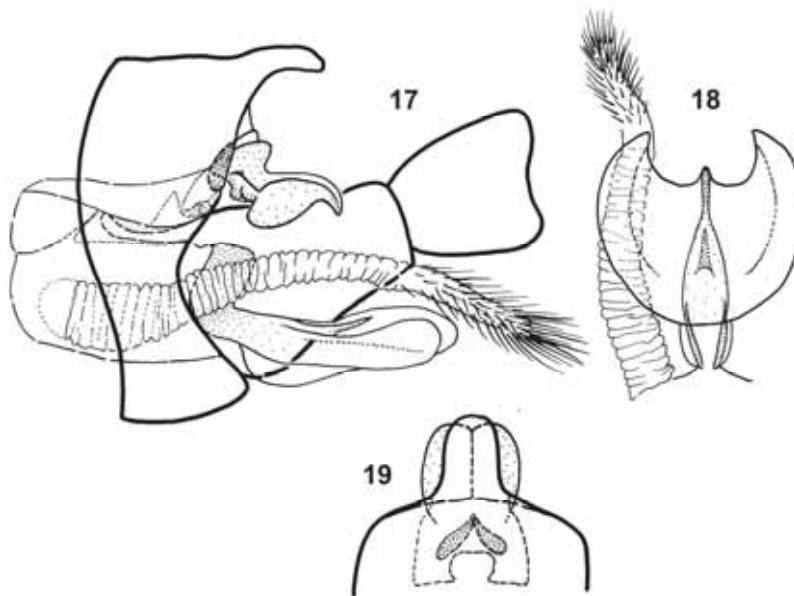
***Rhyacophila mesilauensis* nov. sp. (Figs 17-19, 32)**

H o l o t y p e : ♂ [pinned], Malaysia, Sabah, Kinabalu National Park, Mesilau River, 2000 m, 14.-17.11.2006, leg. W. Mey & K. Ebert (MFN).

P a r a t y p e s : 1♂, same data as holotype (MFN); 1♂, Malaysia, Mt. Kinabalu, Ulu Mentaki, 9000 ft., 8.-9.4.1964, Royal Society Expedition, coll. S. Kueh., BM 1964-250 (BMNH).

D e r i v a t i o n o m i n i s : The species is named after the type locality, the Mesilau River.

D e s c r i p t i o n : Length of forewing 7-8 mm, wing span 16-17 mm. Head yellow brown, thorax brown, vestiture red-brown; antennae light brown, with pale annulations; maxillary palpi long, yellow-brown, maxillary palpi short; legs light-brown, spurs 3.4.4.; forewings with short golden-brown hairs and with numerous small patches of white, shining hairs, costal area yellow, veins yellow-brown, hind wings pale brown.



Figs 17-19: *Rhyacophila mesilauensis* nov. sp., male genitalia; (17) lateral; (18) dorsal; (19) ventral plate of phallic apparatus, ventral.

Male genitalia (Figs 17-19): Dorsal part of segment IX enlarged, with a long apical process, rounded at tip; segment X of complicated structure, with two lateral plates articulating basally with a pair of anal sclerites and an u-shaped tergal strap, in lateral view apex curved ventrad; basal segment of inferior appendages nearly straight, inner side simple, second segment with

rounded, apical emargination; phallic apparatus with two long, thick and membranous paramers, setose in apical third; aedeagus with a short dorsal branch and a broad ventral plate, basal brach very short, ventral disk-like, aedeagus shorter than paramers.

R. mesilauensis nov. sp. is a member of the *obscura* group. It is the first species of this group recorded outside the hitherto known distribution which ranges from the Tianshan in Middle Asia to Northern Myanmar. The new species differs in some characters from continental species: segment IX has a well developed apical process, segment X is arranged horizontally, and takes a more ventral position. The inferior appendages and the structure of the aedeagus, especially the disk-like ventral plate have a similar architecture as in *R. obscura* MARTYNOV, 1927 or *R. bidens* KIMMINS, 1953. Despite the deeply split harpago *R. scissa* MORTON, 1900 should also be included in the group as already proposed by ROSS (1956).

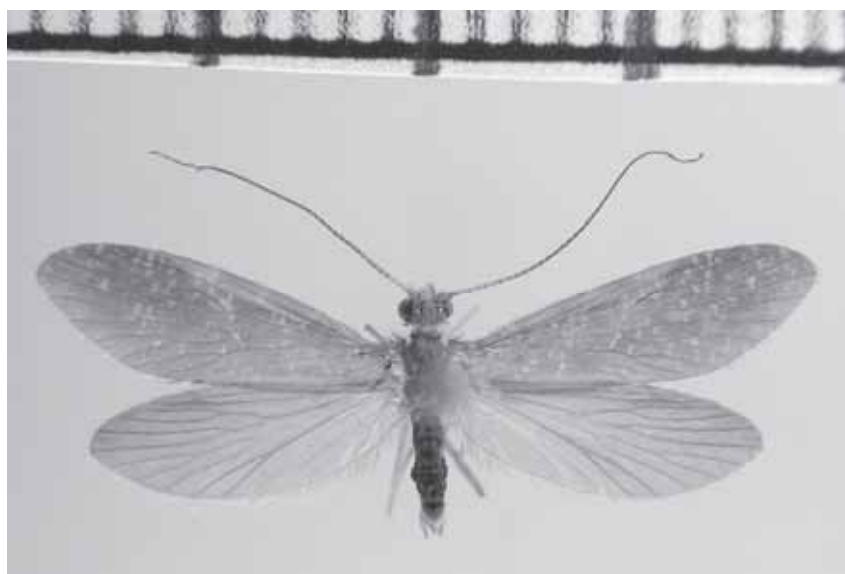


Fig. 32: *Rhyacophila mesilauensis* nov. sp., male holotype.

***Rhyacophila malickyi* nov. sp. (Figs 20-22, 33)**

H o l o t y p e : ♂ [pinned], Malaysia, Sabah, Kinabalu National Park, Park Headquarter, at light, 4.-6.11.2003, leg. W. Mey, cleared abdomen in glycerin (MFN).

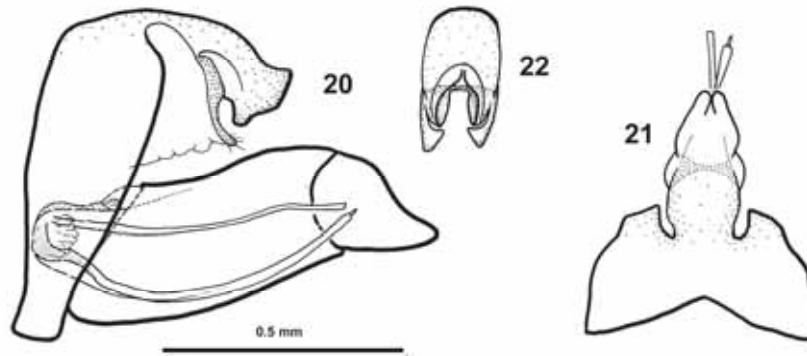
P a r a t y p e s : 1♂, 1♀, same data as holotype; 1♂, 1♀, Kinabalu National Park, Liwagu River, 1400 m, 22.2.2006, at light, leg. W. & M. Mey (MFN); 3♂♂, Kinabalu National Park, Mesilau, at light, 2000 m, 14.-17.9.2006, leg. W. Mey & K. Ebert (MFN, FRCS).

D e r i v a t i o n o m i n i s : The species is dedicated to **Hans MALICKY** on occasion of his 75th birthday, and with my thanks for good cooperation during the last 35 years.

D e s c r i p t i o n : Length of forewing 5.5- 6.5 mm, wing span 11-13 mm. Head and thorax black, vestiture black; antennae black, with pale annulations; maxillary palpi and maxillary palpi black; legs dark brown, apical spurs of foreleg small, spurs 3.4.4.; forewings black, without paler patches in the membrane, fringe black, hind wings with black hairs.

Male genitalia (Figs 20-22): Dorsal part of segment IX enlarged, apical process long, bent downwards and with a bifid tip seen from dorsal side; lateral parts of segment X narrow ribbons, situated below apical process and tightly attached to it, tips free and bent mesally, forming a pair of appendages in dorsal view; anal sclerites and sclerotised tergal strap absent;

basal segment of inferior appendages much longer than second, slightly curved, inner side without ridges, second segment excavated; phallic apparatus with two long and slender paramers with a minute apical spine, aedeagus a simple tube, as long as paramers.



Figs 20-22: *Rhyacophila malickyi* nov. sp., male genitalia; (20) lateral; (21) dorsal; (22) segment IX & X, caudal view.

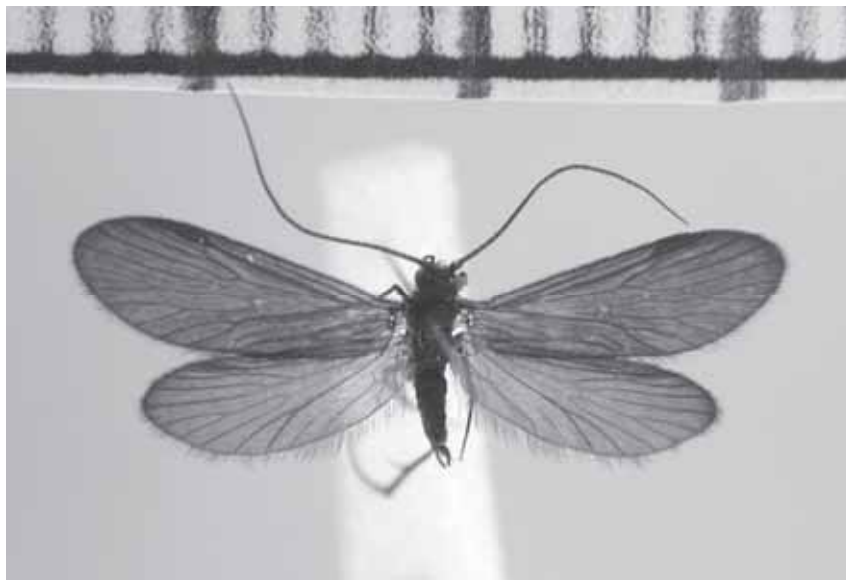


Fig. 33: *Rhyacophila malickyi* nov. sp., male paratype.

R. malickyi nov. sp. principally resembles species of the *curvata* group, but cannot be placed there, because segment IX has a long curved apical process, and segment X is reduced. These traits, though in reduced form, are present in *R. tashidingpa* SCHMID, 1970, forming the monotypic *tashidingpa* group which is distributed in the Eastern Himalayan Region (SCHMID 1970). The new species and the following species are placed in this group. They are distinguished from all other *Rhyacophila* species in Borneo by black wings bearing no white spots.

***Rhyacophila fragilis* nov. sp. (Figs 23-25)**

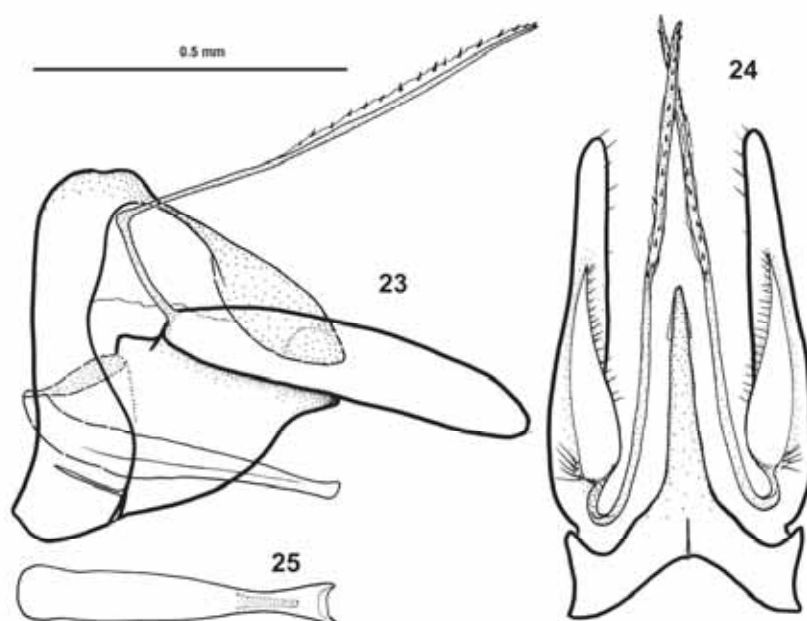
H o l o t y p e : ♂, Malaysia, Sabah, Kinabalu National Park, small tributary to Liwagu River, 4.-6.11.2003, leg. W. Mey, cleared abdomen in glycerin (MFN).

P a r a t y p e s : 2♂♂, same data as holotype (MFN).

D e r i v a t i o n o m i n i s : The specific epithet refers to the long, thin process of the harpago, which gives the impression of a very fragile structure.

D e s c r i p t i o n : Length of forewing 4,5 mm, wing span 10-13 mm. Head and thorax dark brown, vestiture black; antennae brown, with pale annulations; maxillary and maxillary palpi dark brown; legs pale brown, apical spurs of foreleg very small, spurs 3.4.4.; forewings black, without paler patches in the membrane, fringe black, hind wings with black hairs.

Male genitalia (Figs 23-25): Dorsal part of segment IX not larger than ventral part, apical process long, straight, enlarged and laterally compressed apically; segment X vestigial and attached to ventral side of apical process; anal sclerites and sclerotised tergal strap absent; basal segment of inferior appendages much shorter than second, thick and without ridges on inner side, second segment long and elliptical, with a conspicuous long and thin, spiny processus originating from dorsal base of harpago, harpagal process angled shortly after its base and with a dorsal membrane along the apical half bearing about 10-13 small thorns; phallic apparatus simple, without paramers, aedeagus tube-like, with spatulate tip.



Figs 23-25: *Rhyacophila fragilis* nov. sp., male genitalia; (23) lateral; (24) dorsal; (25) phallic apparatus, ventral.

R. fragilis nov. sp. is placed in the *tashidingpa* group because segment IX has a long curved apical process, and segment X is reduced. The harpagal process is a unique feature. Such a process occurs at a similar position in *R. lhopa* SCHMID, 1970, described from India. This species belongs to the *curvata* group. The inferior appendages of the new species resembles *R. fletcheri* KIMMINS, 1952, which form a group of its own, but is related to the *curvata* group too. *R. fragilis* nov. sp. is the smallest *Rhyacophila* species in Borneo. It is unmistakable and not closely related to the preceding *R. malickyi* nov. sp.

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Zusammenfassung

Eine neue Hydrobiosidae, *Apsilochorema schulzei* nov.sp. und sieben neue Arten aus der Familie Rhyacophilidae, Gattung *Rhyacophila*, werden von Borneo (Ost-Malaysien: Sarawak, Sabah) beschrieben: *R. gadingensis* nov. sp., *R. kinabaluensis* nov. sp., *R. langanana* nov. sp., *R. tawauensis* nov. sp., *R. mesilauensis* nov. sp., *R. malickyi* nov. sp. und *R. fragilis* nov. sp. *R. abimael* MALICKY wird mit *R. isolata* BANKS synonymisiert. Alle Arten sind Bewohner von Bergbächen unterschiedlicher Höhenlage am Mount Kinabalu und anderer Gebirgsszüge. Der Habitus der Adulten sowie das männliche Genital werden abgebildet. Die diagnostischen Merkmale der neuen Arten werden dargestellt und diskutiert. Arten mit ähnlichen Flügel- und Genitalmerkmalen werden gesondert besprochen und ihre phylogenetische Beziehung kurz umrissen. Die *obscura*- und die *tashidingpa*-Gruppe werden erstmals von Sundaland gemeldet.

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