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Five new *Potamometropsis* species (Insecta: Heteroptera: Gerridae) from Borneo

J.T. Polhemus* & H. Zettel**

Abstract

Five species of the genus *Potamometropsis* KIRKALDY from Borneo are decribed as new: *Potamometropsis crassifemur* sp.n., *P. kundesan* sp.n., *P. poring* sp.n., and *P. sabah* sp.n. from Sabah; and *P. bruneiensis* sp.n. from Brunei. *Potamometropsis nieseri* ZETTEL, 1994, is a new synonym of *Rhyacobates imadatei* MIYAMOTO, 1967. Keys to the ptilomerine genera and *Potamometropsis* species of Borneo are presented.

Key words: Gerridae, Ptilomerinae, *Potamometropsis*, new species, *Rhyacobates imadatei*, new synonymy, key, Borneo, Malaysia, Sabah, Brunei.

Zusammenfassung

Fünf Arten der Gattung *Potamometropsis* KIRKALDY aus Borneo werden neu beschrieben: *Potamometropsis crassifemur* sp.n., *P. kundesan* sp.n., *P. poring* sp.n., und *P. sabah* sp.n. aus Sabah; und *P. bruneiensis* sp.n. aus Brunei. *Potamometropsis nieseri* ZETTEL, 1994, ist ein neues Synonym von *Rhyacobates imadatei* MIYAMOTO, 1967. Bestimmungsschlüssel zu den Ptilomerinen-Gattungen und *Potamometropsis* Arten Borneos werden präsentiert.

Introduction

The phylogenetic position and identity of the genus *Potamometropsis* LUNDBLAD, 1933, is still unclear. As partly pointed out by ZETTEL (1994), *Potamometropsis* as presently construed is probably a polyphyletic genus comprising several clades within the genus group also containing the genera *Rheumatogonus* KIRKALDY, *Heterobates* BIANCHI, *Rhyacobates* ESAKI, *"Rhyacobates" imadatei* MIYAMOTO, *Pleciobates* ESAKI, and *Andersenius* ZETTEL & CHEN, 1996. The "true" *Potamometropsis* may well be monotypic, with the single species *P. obnubila* LUNDBLAD, 1933, from Sumatra. *Potamometropsis anomala* CHEN & NIESER, 1992, from Sulawesi represents another clade, whereas all remaining species from Borneo and the Philippines (four species and one subspecies) constitute a monophyletic group possibly warranting generic status. Whether all of these clades can be retained within a redefined genus *Potamometropsis* will be determined by a phylogenetic analysis of the ptilomerine genera planned by N.M. Andersen and J.T. Polhemus. In this paper we present the descriptions of several new species from Borneo which are, for the present, included in *Potamometropsis* sensu auctores.

Potamometropsis species usually inhabit small streams, mainly in the mountains, with relatively high current velocities that flow through forested areas, hence we have coined

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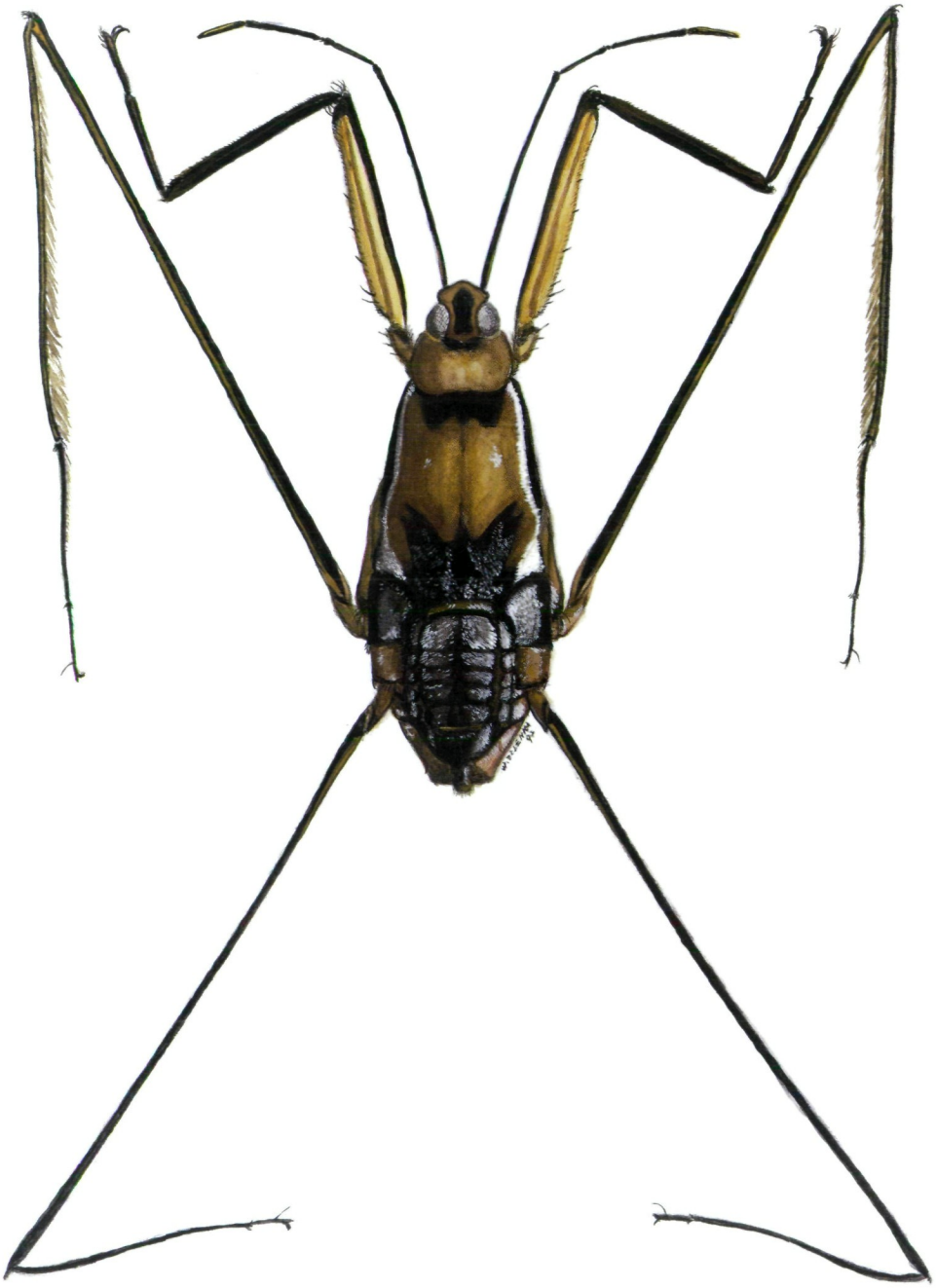

Fig. 1: *Potamometropsis poring* sp.n., female: habitus.

the name "torrent striders" for them. Their occurrence in these stable habitats may explain the low incidence of the macropterous morphs (which are usually found dealated), and therefore a low ability to migrate. As a consequence, many populations are today isolated due to the far-reaching destruction of the tropical rain forests. The morphological divergence evident in several populations of *P. kundesan* sp.n. may be due to this isolation.

All measurements are in millimetres. Measurements are taken from the male holotype and (as available) from the best intact female. To get the range of body sizes, all (or a higher number of) specimens were measured.

Abbreviations:

BMBB	Brunei Museum, Bandar Seri Begawan, Brunei
BPBM	B.P. Bishop Museum, Honolulu, Hawaii, U.S.A.
JTPC	Coll. J.T. Polhemus, Englewood, Colorado, U.S.A.
NHMW	Natural History Museum Vienna, Austria
NNC	Nico Nieser Collection, Tiel, The Netherlands
NNML	National Museum of Natural History, Leiden, The Netherlands
SPC	Sabah Parks, Entomological Collection, Sabah, Malaysia
UMS	Universiti Malaysia Sabah, Kota Kinabalu, Malaysia
USNM	U.S. National Museum, Smithsonian Institution, Washington, D. C., U.S.A.
ZMAN	Instituut voor Zoologische Taxonomie, Entomology Section, Amsterdam, The Netherlands
ZRCS	Zoological Reference Collection, Singapore

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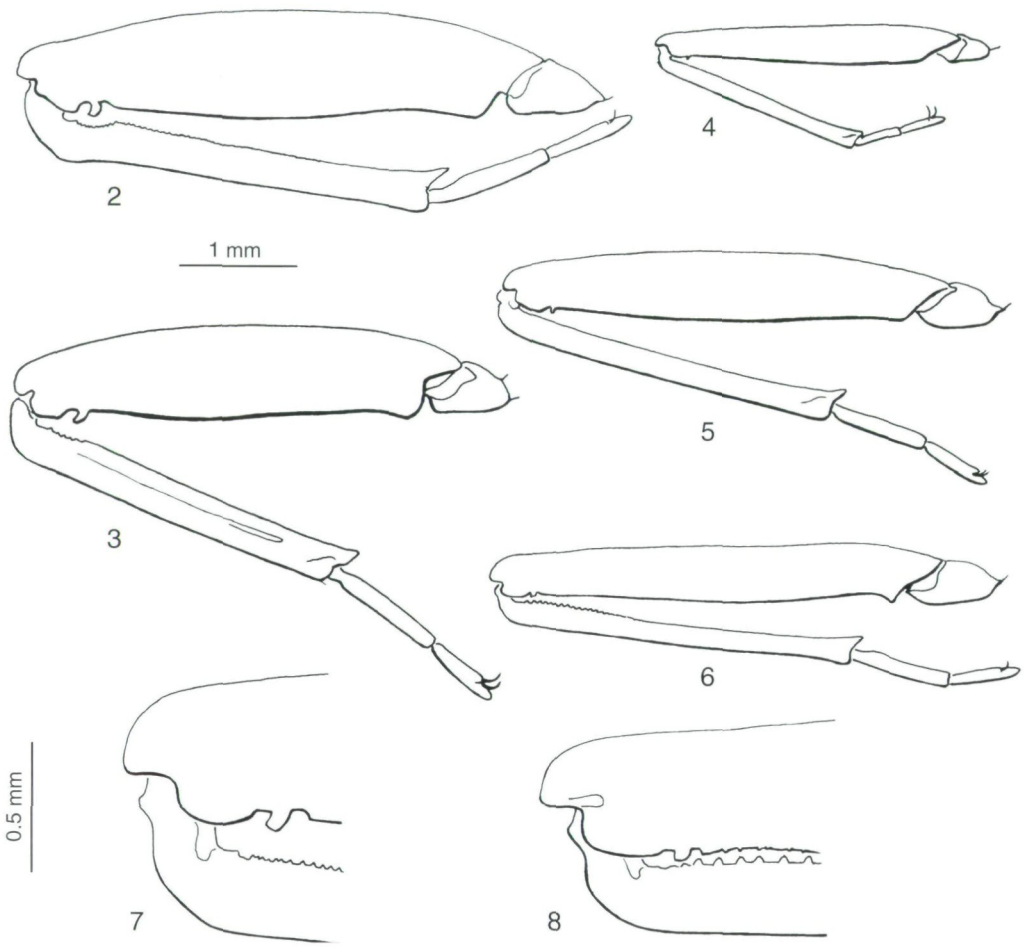
Key to the ptilomerine genera of Borneo

1 Very large species, body length more than 15 mm; metacoxa dorsally with a spine; mesofemur of male with a fringe of long black hairs (several species all over Borneo) ..... ***Ptilomera*** **AMYOT & SERVILLE**

\- Smaller species, body length less than 10 mm; metacoxa without a spine; mesofemur of male without a fringe of hairs 2

2 Metatarsus without claws; anterior margin of head rounded; antennal segment 1 distinctly shorter than segments 2 - 4 together; very small species, body length less than 6.5 mm, males distinctly smaller than females (several species all over Borneo) ..... ***Rheumatogonus*** **KIRKALDY**



Figs. 2 - 8: Fore legs of *Potamometropsis* males (coxae, hairs and bristles omitted): (2) *P. fischeri*, (3) *P. crassifemur* sp.n., (4) *P. bruneiensis* sp.n., (5) *P. sabah* sp.n., (6) *P. kundesan* sp.n.; 7 - 8: Higher magnification of apex of femur and base of tibia in (7) *P. sabah* sp.n. and (8) *P. kundesan* sp.n.

- Metatarsus with small, but distinct claws; anterior margin of head not rounded, angular at antennal insertion (Fig. 48); antennal segment 1 subequal to segments 2 - 4 together (Figs. 41 - 47); most species larger, males not or slightly smaller than females 3

3 Body dorsally black except part of pronotum; ♂: paramere bare (only with very short microtrichia) (Fig. 17); ♀: abdomen elongate, longer than thorax; connexivial spines present (Fig. 60); male distinctly smaller than female (Brunei, Kalimantan, Sabah, Sarawak) ..... ***"Rhyacobates" imadatei*** **MIYAMOTO**

- At least mesonotum with large orange marks (e.g. Fig. 1); ♂: parameres with numerous conspicuous hairs in distal part (Figs. 9 - 16); ♀: abdomen shortened, much shorter than thorax; connexivial spines lacking (Figs. 55 - 59); sexes of similar length ..... ***Potamometropsis*** **LUNDBLAD**

Potamometropsis LUNDBLAD, 1933

Potamometropsis LUNDBLAD, 1933, Archiv für Hydrobiologie, Suppl. 12: 415.
Potamometropsis: HUNGERFORD 1957: 125; HUNGERFORD & MATSUDA 1960: 8, 17; MATSUDA 1960: 281, 556; ANDERSEN 1982: 424; CHEN & NIESER 1992: 146, 154; ZETTEL 1994: 76.

Type species: *Potamometropsis obnubila* LUNDBLAD, 1933 (by monotypy).

Generic description: Thorax dorsolaterally with silvery or golden hair streaks; anterior margin of head in dorsal view with three angular projections (Fig. 1); first antennal segment almost as long as segments 2, 3 and 4 together; second antennal segment shorter, rarely somewhat longer than third (*P. anomala*); fourth antennal segment short, ventrodistally with a sulcus; antennal segments one and two ventrally with a row of widely spaced long slender setae. Profemur thickened, apicoventrally with a denticle, at least in male; protibia shorter than profemur, often flattened, with a ventral row of black denticles (usually smaller or not evident in females), and a distal spur; protarsus shorter than protibia, first segment 1/4 to 1/2 the length of second, with prominent curved claws; mesofemur usually at least somewhat longer than metafemur, ventrally without hair fringe and at most with a weak row of short spines or denticles; mesotibia about 2/3 as long as mesofemur, flattened ventrally, densely set with a fringe of long swimming hairs; meso- and metatarsi with claws, but often very small; first segment of metatarsi longer than second. Hemelytra with at least two closed cells basally, plus a large distal cell (usually open distally), and flight wings with one closed cell (see ZETTEL 1994: figs. 55 - 59). Abdomen without connexival spines, rarely with angulate projections posterolaterally; body length of male and female similar. Male: Profemur thicker than in female, often distinctly so, ventrally with numerous small black denticles. Pygophore lengthened, parameres long and slender; parameres with numerous prominent setae except for the genotype, *P. obnubila*, which has essentially bare parameres. Female: Abdomen not retracted into the thorax, but sometimes folded dorsad; seventh sternite very large, cup-shaped, frequently with a distinct, unique, characteristic shape or modification.

Distribution: Sumatra, Borneo, Sulawesi, Philippines (Luzon, Leyte, Mindanao).

Key to the *Potamometropsis* species of Borneo (apterous morphs)

1 Posterior margin of metanotum curved cephalad 2

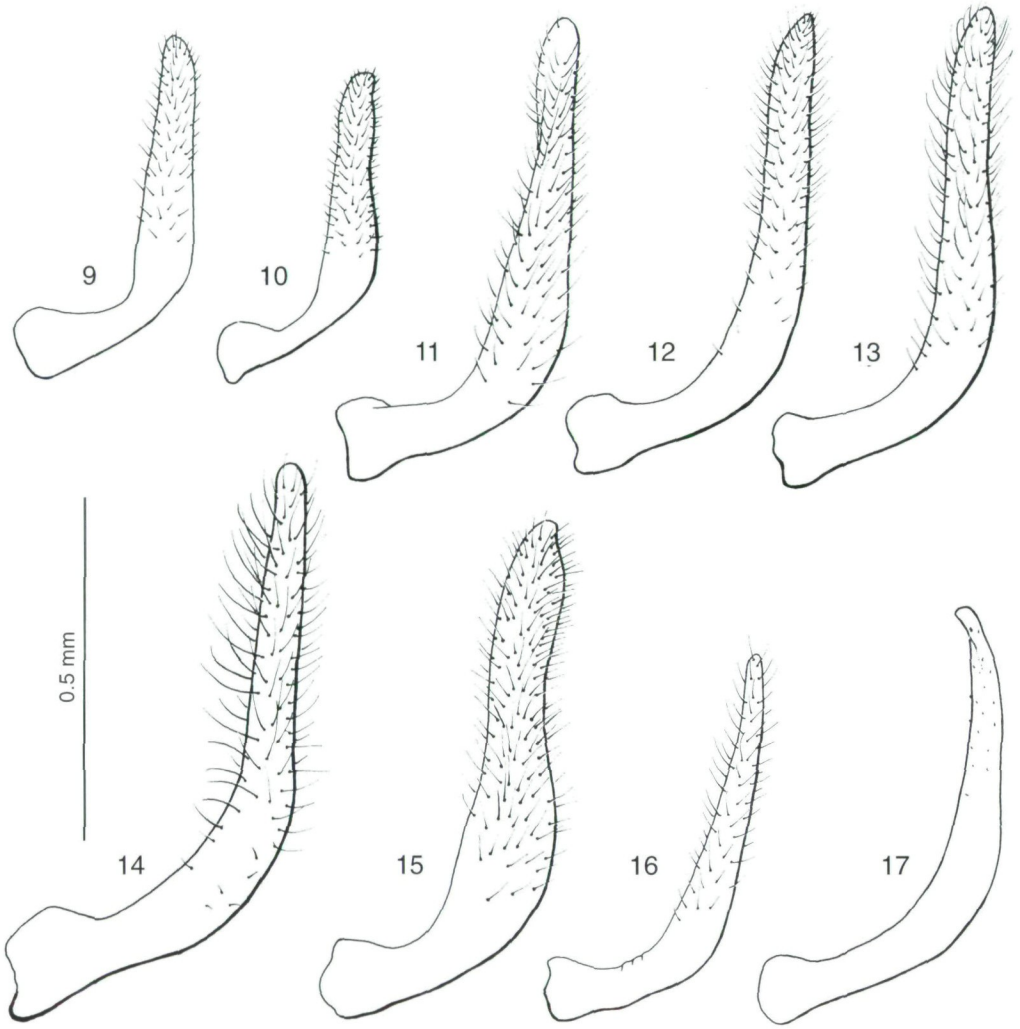
- Posterior margin of metanotum curved caudad, or straight 3

2 Larger species, males 6.93 to 7.46 mm long, females 7.10 to 7.92 mm long; paramere subapically more strongly dilated (Fig. 15) ..... ***P. poring* sp.n.**

- Smaller species, males (only sex known) 5.49 to 5.72 mm long; silvery lateral stripe narrow; paramere with finger-like shaped apex (Fig. 10) ..... ***P. bruneiensis* sp.n.**

3 Metanotum dark; propleura with a tuft of black hairs; meso- and metapleura set with longer setae in addition to short recumbent pubescence; female with posterior margin of metanotum clearly curved caudad ..... ***P. kundesan* sp.n.**

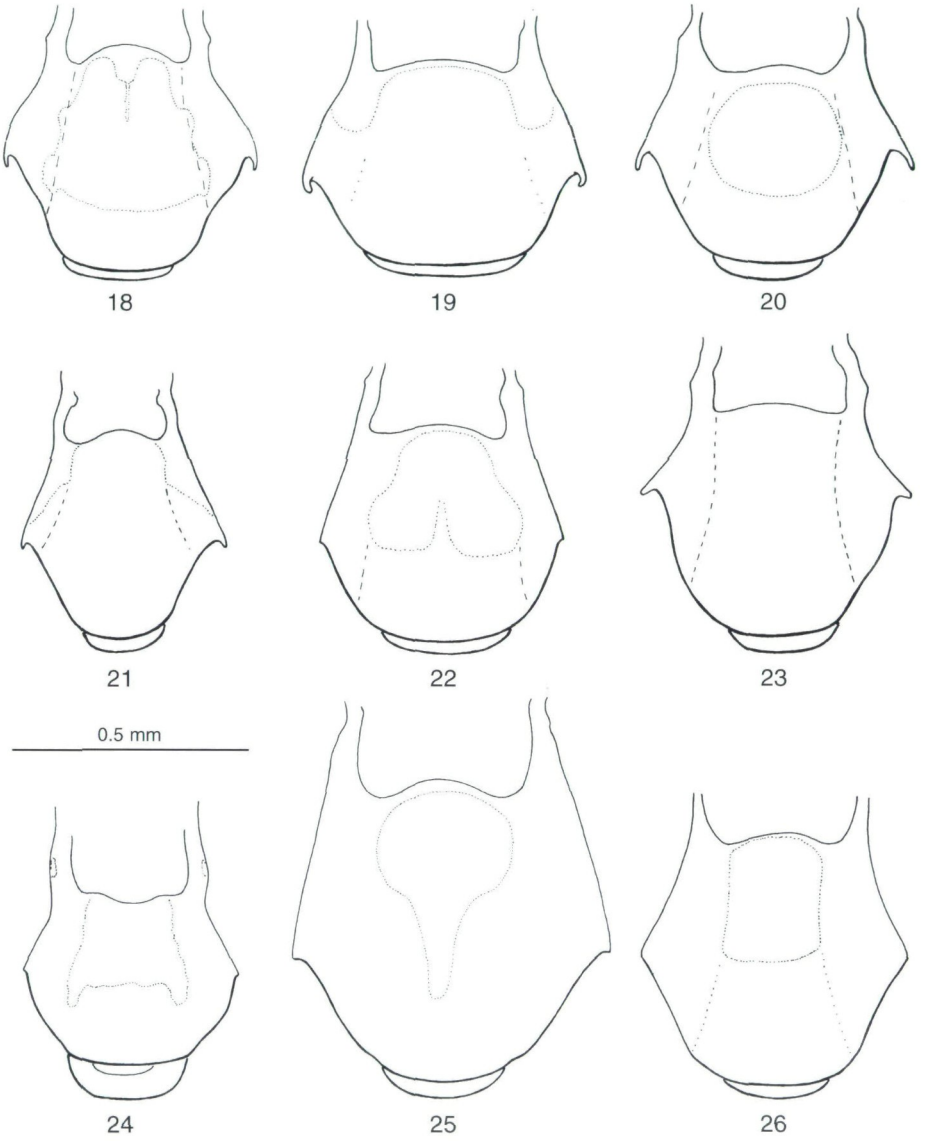
- Metanotum mostly or completely light colored; propleura without a tuft of black hairs; meso- and metapleura with only short recumbent pubescence, without longer setae; female with posterior margin of metanotum straight, or almost so 4



Figs. 9 - 17: Lateral aspects of left parameres in (9) *Potamometropsis fischeri*, (10) *P. bruneiensis* sp.n., (11 - 13) *P. kundesan* sp.n. (11 from Mesilau River, 12 from Maliau Basin, 13 from Crocker Range), (14) *P. crassifemur* sp.n., (15) *P. poring* sp.n., (16) *P. sabah* sp.n., and (17) "*Rhyacobates*" *imadatei*.

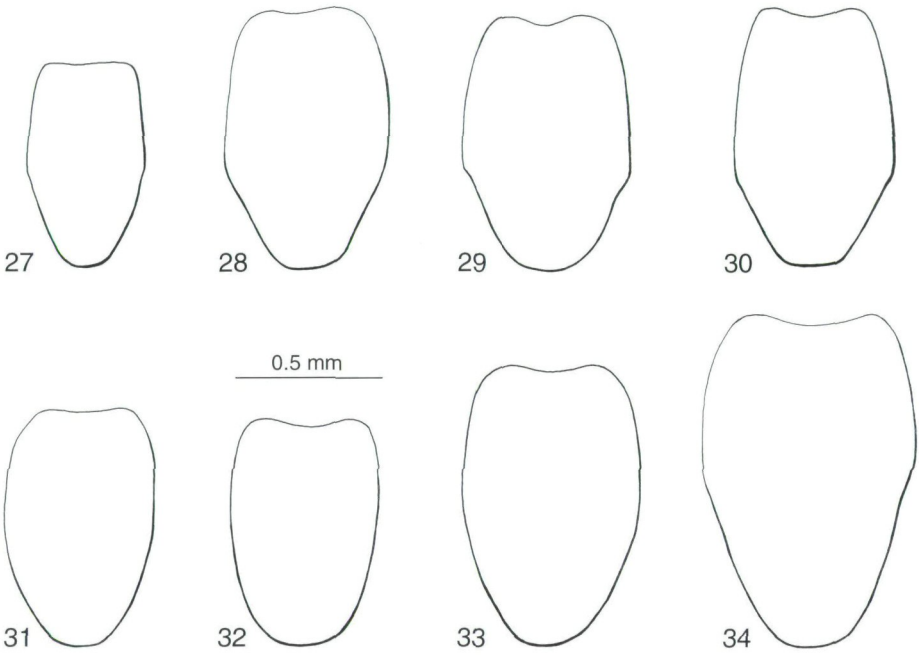
4 Female: sternite 7 without a median lobe, connexival angles rounded (Fig. 59). - Male: paramere short relative to body length (Fig. 9); mesofemur with a ventral row of stout black denticles (of decreasing length distally) terminating before middle .. .. ***P. fischeri*** **ZETTEL**

- Female: sternite 7 with a median, posteriorly directed lobe (often folded dorsad) (Figs. 51, 52), connexival angles sharp (Figs. 57, 58). - Male: paramere longer relative to body length (Figs. 14, 16); mesofemur with a ventral row of stout black denticles clearly extending beyond middle 5



Figs. 18 - 26: Dorsal aspects of male proctiger in (18 - 20) *Potamometropsis kundesan* sp.n. (18 from Mesilau River, 19 from Maliau Basin, 20 from Crocker Range), (21) *P. bruneiensis* sp.n., (22) *P. fischeri*, (23) *P. crassifemur* sp.n., (24) *P. sabah* sp.n., (25) *P. poring* sp.n., and (26) *"Rhyacobates" imadatei* (hairs omitted; dotted line showing outline of black mark).

5 Male: profemur and tibia slender (Fig. 5). - Female: sternite 7 with long median lobe (Figs. 52, 57); tergite 7 raised posteriorly, forming an apparent posterior margin, apparent length not more than 1.5 times that of tergite 6; connexiva often meeting medially over tergite 8 (Fig. 57) ..... ***P. sabah* sp.n.**



Figs. 27 - 34: Ventral aspects of pygophore in (27) *Potamometropsis bruneiensis* sp.n., (28 - 30) *P. kundesan* sp.n., (28 from Mesilau River, 29 from Maliau Basin, 30 from Crocker Range), (31) *P. sabah* sp.n., (32) *P. fischeri*, (33) *P. crassifemur* sp.n., and (34) *P. poring* sp.n.

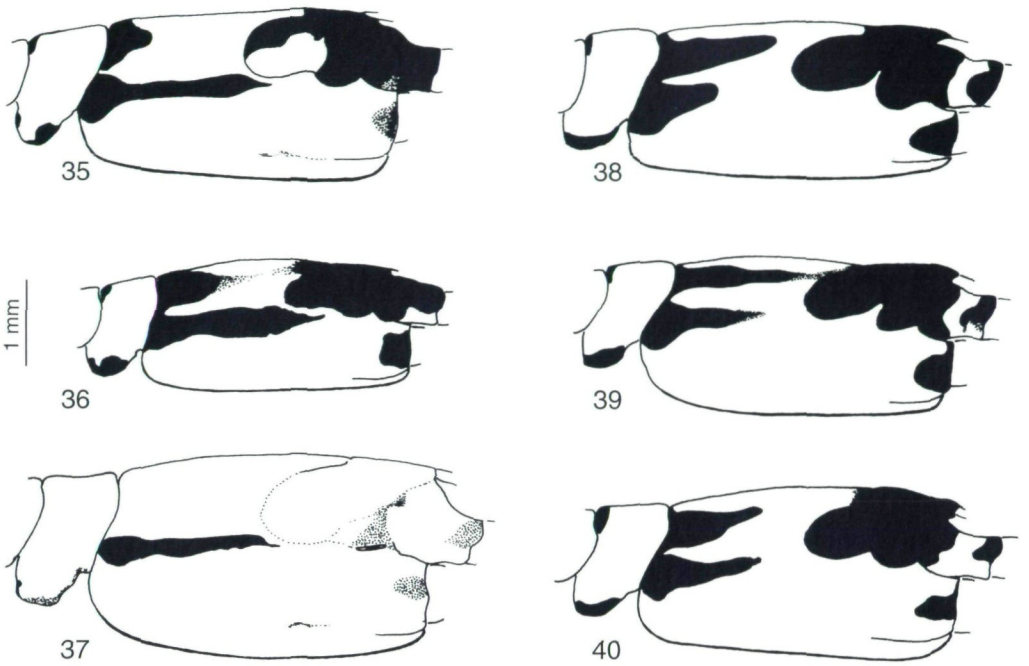
- Male: profemur and tibia stout (Fig. 3). - Female: sternite 7 with short median lobe (Figs. 51, 58); tergite 7 not raised posteriorly, length twice that of tergite 6; connexiva not meeting medially over tergite 8 ..... ***P. crassifemur* sp.n.**

Description of species

Potamometropsis poring sp.n. (Figs. 1, 15, 25, 34, 35, 45, 53, 56, 64)

Holotype (♂, apterous): Malaysia, Sabah, Sungai Langanan, Poring Hot Spgs., 550 m el., CL 2022, 2 Aug. 1985, J.T. & D.A. Polhemus (USNM). **Paratypes** (nymphs not paratypes), all from Malaysia, Sabah: 5 ♂♂ apterous, 3 ♂♂ macropterous (1 fully winged), 3 ♀♀ apterous, same data as holotype (JTPC, NHMW); 2 ♀♀ apterous, stream 1 km S Poring Hot Springs, CL 2023, 2 Aug. 1985, J.T. & D.A. Polhemus (JTPC, NHMW); 1 ♂ apterous, Kuamut River near Kampung Pisang Pisang, 3.-4.VII.1996, 14a, shaded stream in primary forest with submerged wood (NHMW); 1 ♂ apterous, 1 ♀ apterous, 2 ♀♀ macropterous, Sabah, Maliau Basin, fast flow stream, MB9a and MB10, 16.5.1996, leg. T.B. Lim (ZRCS, UMS, NHMW); 6 ♂♂ apterous, 10 ♀♀ apterous, S Lahad Datu, Danum Valley, Waterfall (Waterfall Trail), 3.2.1997, leg. H. Zettel (5) (NHMW, UMS, NNC).

Apterous male: Body length 6.93 - 7.46 mm. Head yellow, with an elongate dark spot on vertex and frons, clypeus, labrum and antennal tubercles black; first antennal segment ventrally yellow basally, darkening distally; pronotum with anterior margin behind vertex black, covered with yellowish setae; mesonotum with broad transverse figure on anterior part, the posterior margin sinuate; metanotum black except laterally; thoracic markings as in Fig. 35; connexiva, abdominal tergites 1 - 7, tergite 8 medially, sometimes



Figs. 35 - 40: Thoracic colour pattern of males (lateral aspect) in (35) *Potamometropsis poring* sp.n., (36) *P. bruneiensis* sp.n., (37) *P. sabah* sp.n., (38 - 40) *P. kundesan* sp.n. (38 from Mesilau River, 39 from Maliau Basin, 40 from Crocker Range).

triangular mark on proctiger, black; sternum yellow to leucine except margins of pro-acetabulae dark; legs with coxae, trochanters and femora yellowish, femora embrowned distally; profemur dorsally with a long black streak, ventrally with short dark setae basally; tarsi brown to black; dark region of metanotum, longitudinal band on lateral margin of mesonotum, two small areas (1 + 1) on either side of mesothroacic midline, abdominal tergites, meso- and metacetabulae, thickly set with silvery pubescence.

Head with large, coarsely faceted eyes; synthlipsis 0.38 of head width, length of antennal segments 1 - 4, 3.10 : 0.89 : 1.55 : 0.72 (Fig. 45); distoventral sulcus extending more half the length of segment four.

Prothorax 1.2 times head width, 1.9 times as wide as long; meso- and metanotum together somewhat longer than the abdomen including segment eight (1.30 times); profemur slender, 7.0 times as long as wide, ventrally set with numerous small denticles, one larger subapical denticle set in a small depression, and a few black setae; protibia not significantly flattened, 0.78 times profemur length, with a ventral row of black denticles; first protarsal segment length (0.67) 6.3 times the width, slightly longer than second (0.55); combined length of tarsi 0.49 that of protibia; mesofemur length 1.05 times metafemur length,1.34 times body length, ventrally with a row of black denticles becoming evanescent beyond middle; mesotibia and base of first mesotarsal segment with swimming hairs.

Abdomen: Connexivum strongly bent upward; tergites 1, 2 and 6 almost equal in length, 3 - 5 shorter and equal in length; seventh tergite 3.0 times as long as sixth, equal to 4 - 6

combined, 1.2 times as as wide as long; proctiger (suranal plate) rounded distally, laterally with sharp angles (Fig. 25); paramere relatively broad, set with numerous setae (Fig. 15); pygophore tapering distally (Fig. 34); aedeagal sclerites as in figure 64.

Apterous female: Body length 7.10 - 7.92 mm; general appearance broader than male (Fig. 1), abdomen short, length (2.55) shorter than that of meso- and metanotum combined (3.11); coloration similar to male, except black streak on profemur broader; profemur slender, length 7.9 times width, with dark setae ventrally and a small subapical denticle; protarsus 0.77 times protibia length, flattened, broader than in males, set with small denticles; first protarsal segment slightly longer (0.55) than second (0.47); mesofemur 1.35 times body length. Abdomen not folded, sternites 2 - 7 on same plane, curving slightly dorsad; connexiva 7 produced into flaps, covering tergite 8 laterally (Fig. 1). Seventh sternite (Fig. 56) large, about half the length of 2 - 6 taken together, with a large broad terminal lobe abruptly angled dorsad and rounded distally (Fig. 53).

Macropterous male (dealated): Body length 6.66 - 7.01 mm, to tip of abdomen.

Pronotum large, humeral angles prominent, posterior margin evenly rounded, yellowish except black transverse streak on anterior margin. Mesopleura with a elongate black region anteriorly, similar to apterous form, and a longitudinal band of silvery setae, widening posteriorly. Wings broken off, coloration of basal fragments dark brown.

Macropterous female: Body length 8.75 mm, to tip of hemelytra.

Pronotum and colouration as in macropterous male. Female characters as in apterous morph. Wings brown.

Differential diagnosis: This species and *P. bruneiensis* sp.n. are closely related (see diagnosis under latter). *Potamometropsis poring* sp.n. is much larger than *P. bruneiensis* sp.n., and has a broader silvery lateral stripe on the mesonotum.

Habitat notes. *Potamometropsis poring* sp.n. is an inhabitant of rushing rocky streams in forested and in open, cleared areas.

Distribution. Borneo: Sabah, Malaysia.

Etymology. This species is named for the type locality in Sabah.

Potamometropsis bruneiensis sp.n. (Figs. 4, 10, 21, 27, 36, 47, 66)

Holotype (♂, apterous): Brunei, waterfall, Sg. Belalong, S.L. Goh, 15.6.1995 (ZRCS). **Paratypes** (nymphs not paratypes): 1 ♂ apterous, same data as holotype (NHMW); 1 ♂ apterous, 2 ♀♀ nymphs, Brunei, Sg. Belalong, SL Goh, # 9501 (ZRCS, BMBB).

Apterous male: Body length 5.49 - 5.72 mm. Head yellow, with a large elongate dark spot on vertex and frons, clypeus, labrum and antennal tubercles black; first antennal segment ventrally yellow basally, darkening distally; pronotum with anterior margin behind vertex black, covered with yellowish setae; mesonotum with broad transverse figure on anterior part having a sinuate posterior margin, and broadly dark along median part of posterior margin; metanotum black; thoracic markings as in Fig. 36; connexiva, abdominal tergites 1 - 7, tergite 8 medially, triangular mark on proctiger, black; sternum yellow to leucine except margins of proacetabulae dark; legs with coxae, trochanters and base of femora, profemora, yellowish; meso- and metafemora blackish; profemur dorsally

with a long black streak, paralleled by another weaker dark streak on anterior face, ventrally with short dark setae basally; tarsi brown to black; metanotum medially, longitudinal band on lateral margin of mesonotum, two very small areas (1 + 1) on either side of mesothoracic midline, abdominal tergites, meso- and metacetabulae, thickly set with silvery pubescence.

Head with large, coarsely faceted eyes; synthlipsis 0.35 of head width, length of antennal segments 1 - 4, 2.39 : 0.78 : 1.33 : 0.67 (Fig. 47); distoventral sulcus extending more half the length of segment four.

Prothorax 1.2 times head width, 1.9 times as wide as long; meso- and metanotum together somewhat longer than the abdomen including segment eight (1.21 times); profemur slender, 9.0 times as long as wide, ventrally set with numerous small denticles, one larger subapical denticle (without subapical depression), and a few black setae (Fig. 4); protibia not significantly flattened, 0.64 times profemur length, with a ventral row of black denticles; first protarsal segment length (0.44) 5.7 times the width, slightly longer than second (0.39); combined length of tarsi 0.47 that of protibia; mesofemur length 1.09 times metafemur length, 1.32 times body length, ventrally with a row of black denticles becoming evanescent beyond middle; mesotibia with swimming hairs.

Abdomen: Connexivum strongly bent upward; tergites 1, 2 and 6 almost equal in length, 3 - 5 shorter and equal in length; seventh tergite 3.0 times as long as sixth, equal to 4 - 6 combined, 1.5 times as as wide as long; proctiger (suranal plate) rounded distally, laterally with sharp projections (Fig. 21); paramere relatively broad, set with numerous setae (Fig. 10); pygophore tapering distally (Fig. 27); aedeagal sclerites as in figure 66.

Female and macropterous form unknown.

Differential diagnosis: *Potamometropsis bruneiensis* sp.n. is very similar to *P. poring* sp.n., but smaller, with more extensive dark markings, with the mesofemur cylindrical rather than flattened, and the first mesotarsal segment without swimming hairs. The lateral angles of the proctiger are sharply produced in *P. bruneiensis* sp.n., sharply angled in *P. poring* sp.n.

Distribution. Borneo: Brunei.

Etymology. This species is named for country of origin, Brunei.

Potamometropsis kundesan sp.n.

(Figs. 6, 8, 11 - 13, 18 - 20, 28 - 30, 38 - 43, 48 - 50, 54, 55, 65)

Holotype (♂, apterous): Malaysia, Sabah, Mesilau River, 8 km. N Kundesan, CL 2020, 1921 m el., 1 Aug. 1985, J.T. & D.A. Polhemus (USNM). **Paratypes** (nymphs not paratypes), all from Malaysia, Sabah: 18 ♂♂ apterous, 6 ♂♂ macropterous (2 fully winged), 33 ♀♀ apterous, 8 ♀♀ macropterous (1 fully winged), 12 nymphs, same data as holotype (JTPC, NHMW, USNM, NNC); 8 ♂♂ apterous, 4 ♀♀ apterous, 6 nymphs, Liwagu River, at Kundesan, CL 2021,1 Aug. 1985, J.T. & D.A. Polhemus (JTPC); 2 ♂♂ apterous, 2 nymphs, Liwagu River, N of Kundesan, 16 - 17 Aug. 1972, W. L. & J. G. Peters (JTPC); 6 ♂♂ apterous, 5 ♀♀ apterous, Mt. Kinabalu NP, Liwagu River, 1450 m, 18.2.1997, leg. H. Zettel (20) (NHMW, SPC, UMS); 3 ♂♂ apterous, 2 ♀♀ apterous, Mt. Kinabalu NP, 1700 m, 17.2.1997, leg. H. Zettel (18) (NHMW, SPC, UMS); 3 ♂♂ apterous, 5 ♀♀ apterous, Mt. Kinabalu NP, Silau-Silau River, 1450 m, 17.2.1997, leg. H. Zettel (19) (NHMW, SPC, UMS); 1 ♀ apterous, NW Sabah, Kinabalu Park, W slope of Kinabalu, surr. Marai Parai, Sg. Kinataki, 10 Mar. 1987, leg. van Tol & Huisman (NNML); 1 ♂ macropterous, 2 ♀♀ apterous, 4 ♀♀ macropterous, small stream nr. km 62 on Keningau Hwy, CL 2035, 6 Aug. 1985, J.T. & D.A. Polhemus (JTPC); 1 ♂ apterous, 1 ♀ apterous, 1 ♀ macropterous (dealate), Maliau Basin, fast flow stream, 14.5.1996,

MB4, leg. T.B. Lim (ZRCS, UMS); 3 ♂♂ apterous, 1 ♂ macropterous (dealate), 1 ♀ apterous, same locality, 17.5.1996, MB11 (ZRCS, UMS, NHMW); 3 ♂♂ apterous, 3 ♀♀ apterous, same locality, 23.5.1996, MB26a (ZRCS, UMS); 3 ♂♂ apterous, 1 ♂ macropterous (dealated), 6 ♀♀ apterous, Crocker Range, around km 56 of road Kota Kinabalu Tambunan, Sunsuron Waterfall env., 1100 - 1200 m, 8.VI.1996, 5a (NHMW, JTPC); 2 ♀♀ Crocker Range, Mawar Waterfall env., 17.VI.1996, 9a, river about 4 - 6 m wide, flowing through primary forest, shaded (NHMW, JTPC).

Apterous male: Body length 6.75 - 7.20 mm. Head yellow, with broad V-shaped dark spot on vertex, clypeus, labrum and antennal tubercles black; first antennal segment basally yellow; pronotum with anterior margin behind vertex black, middle with golden setae, setae on pleura brown; mesonotum with two (1 + 1) widely separated finger-like black figures extending posteriorly from anterior margin to middle; metanotum black except laterally; thoracic markings as in Figs. 38, 48; connexiva, abdominal tergites 1 - 6, base of tergite 7, most of tergite 8, black; sternum yellow to leucine except margins of proacetabulae dark; legs with coxae, trochanters and femora yellowish, femora embrowned distally; profemur dorsally with a long black streak, ventrally dark; tarsi brown to black; dark regions of thorax, longitudinal band on lateral margin of mesonotum, abdominal tergites, meso- and metacetabulae thickly set with golden pubescence.

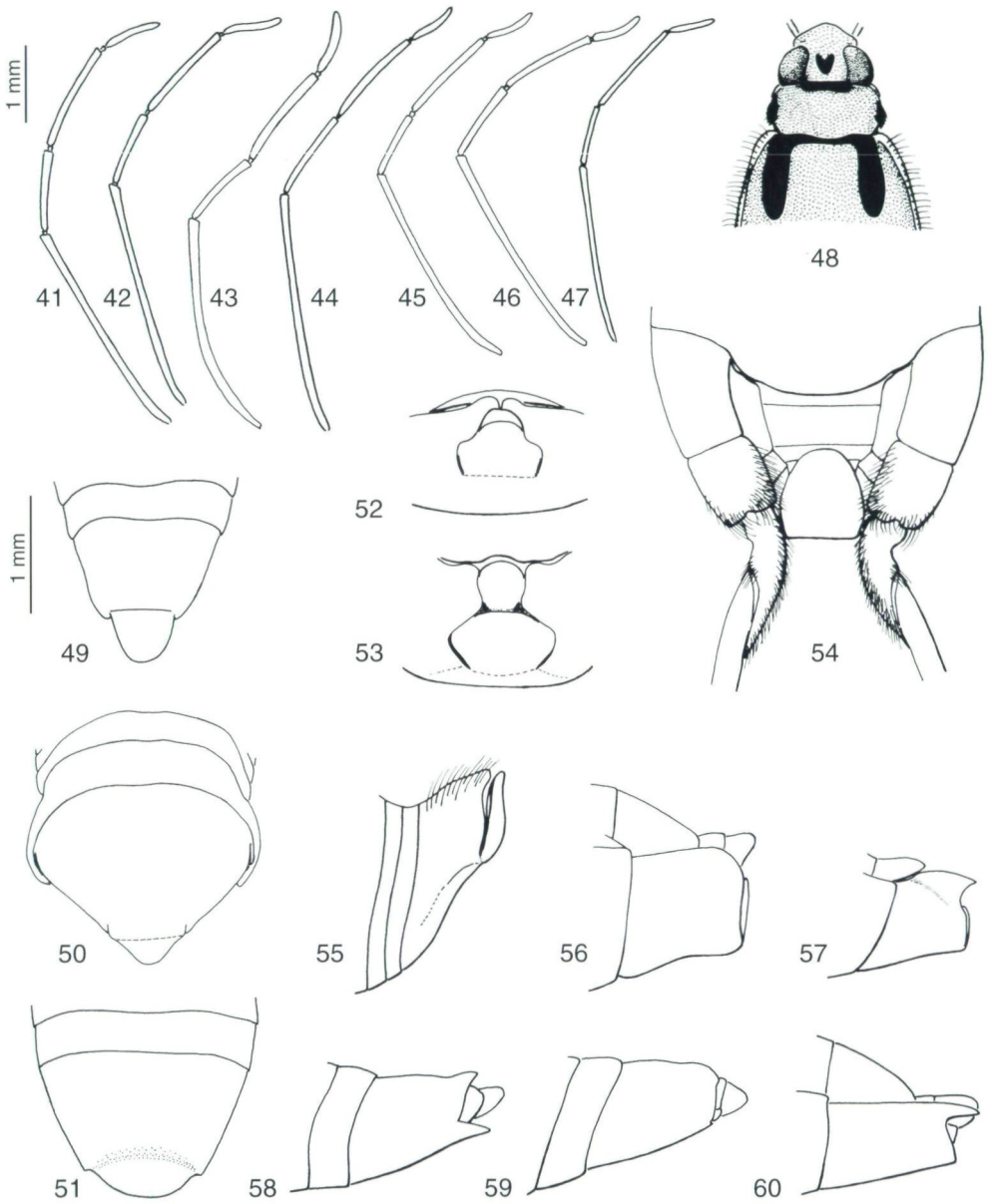
Head with large, coarsely faceted eyes; synthlipsis 0.46 of head width, length of antennal segments 1 - 4, 3.00 : 1.05 : 1.50 : 0.83 (Figs. 41 - 43); distoventral sulcus extending less than half the length of segment four.

Prothorax 1.1 times head width, 1.9 times as wide as long; meso- and metanotum together somewhat longer than the abdomen including segment eight (1.26 times); profemur slender, 9.0 times as long as wide, ventrally set with numerous small denticles, one larger subapical denticle, and a few black setae, without ventral depression subapically (Fig. 6); protibia flattened, 0.84 times profemur length, with a ventral row of black denticles (Fig. 8); first protarsal segment length (0.89) 5.3 times the width, longer than second (0.67); combined length of tarsi 0.34 of tibia length; mesofemur length 1.03 times metafemur length,1.48 times body length, ventrally with a row of short spines becoming evanescent beyond middle; mesotibia and base of first mesotarsal segment with swimming hairs.

Abdomen: Connexivum strongly bent upward; tergites 1, 2 and 6 equal in length, 3 - 5 shorter and equal in length; seventh tergite 3.0 times as long as sixth, equal to 4 - 6 combined, as long as wide; proctiger (suranal plate) truncate distally, laterally with short projections (Fig. 18); paramere set with numerous setae (Figs. 11 - 13); pygophore tapering distally (Fig. 28 - 30); aedeagal sclerites as in figure 65.

Apterous female: Body length 5.85 - 6.39 mm; General appearance broader than male, abdomen short, usually folded dorsad, maximum length equal to that of metanotum; coloration similar to male; profemur slender, length 9.6 times width, with dark setae ventrally and a small subapical denticle; protarsus 0.65 times protibia length, smaller than in males; first protarsal segment (1.11) slightly longer second (1.00); mesofemur 1.62 times body length.

Abdomen usually folded (Fig. 55), an extreme example with sternite 7 dorsal shown in Fig. 54; connexiva of segment 7 produced into flaps and folded over dorsum of tergite 8, meeting or overlapping medially, slightly longer than tergite 7; length of tergite 7 about 1/2 of width. Seventh sternite large (Fig. 49; Fig. 50, shown strongly folded dorsad), longer than 2 - 6 taken together, with a large terminal lobe rounded distally (Fig. 54).



Figs. 41 - 60: (41 - 47) Antenna of males of (41 - 43) *Potamometropsis kundesan* sp.n. (41 from Crocker Range, 42 from Maliau Basin, 43 from Mesilau River), (44) *P. crassifemur* sp.n., (45) *P. poring* sp.n., (46) *P. sabah* sp.n., and (47) *P. bruneiensis* sp.n.; (48) dorsal aspect of head, pronotum and anterior part of mesonotum of *P. kundesan* sp.n.; ventral aspect of sternites 7 in females of (49 - 50) *P. kundesan* sp.n. (49 from Crocker Range, 50 from Mesilau River), and (51) *P. crassifemur* sp.n.; caudal aspect of tip of female abdomen of (52) *P. sabah* sp.n. and (53) *P. poring* sp.n.; (54) dorsal aspect of abdomen and base of hind legs of female of *P. kundesan* sp.n.; lateral aspect of tip of adomen in females of (55) *P. kundesan* sp.n. (from Maliau Basin), (56) *P. poring* sp.n., (57) *P. sabah* sp.n., (58) *P. crassifemur* sp.n., (59) *P. fischeri*, and (60) "*Rhyacobates*" *imadatei*.

Macropterous male: Body length 10.17 mm, to tip of hemelytra. Pronotum large, humeral angles prominent, posterior margin evenly rounded, yellowish except black transverse streak on anterior margin. Mesopleura with a large black region anteriorly, and a longitudinal band of golden setae. Wings exceeding tip of abdomen, coloration uniformly soft brown, veins not prominent.

Macropterous female (dealated): Body length 5.63 mm, to tip of abdomen. Pronotum and colouration as in macropterous male. Female characters as in apterous female.

Differential diagnosis: *Potamometropsis kundesan* sp.n. may be separated from the other species of Borneo by the dark pattern on the mesonotum, dark metanotum, and by the posterior margin of the mesonotum narrowly curved posteriorly in the male, broadly curved posteriorly in the female. The long setae on meso- and metapleura and the tuft of hairs on propleura (both more obvious in females) are not found in any other *Potamometropsis* species.

Discussion: Specimens of *P. kundesan* sp.n. from the type locality have a greater variation in several characters than seen at any other locality. The pubescence on the mesopleura may be either silvery or golden in colour, and may be well developed or sparse; the male parameres are sometimes flattened on the inferior face and slightly twisted distally (Fig. 11), and at the other extreme are almost cylindrical in cross section as in specimens from other areas (Figs. 12, 13). Also the proctiger of males is varying, sometimes with strongly raised middle part (Figs. 18 - 20). The female abdomen is of various shapes depending on the degree of folding (Figs. 49, 50, 54, 55). Specimens from the Maliau Basin are darker coloured than from other localities; females from this locality have a longer erect pilosity on the wrapped parts of sternite 7. Females from the Mt. Kinabalu area and the Crocker Range have a less broadened abdomen than from other localities.

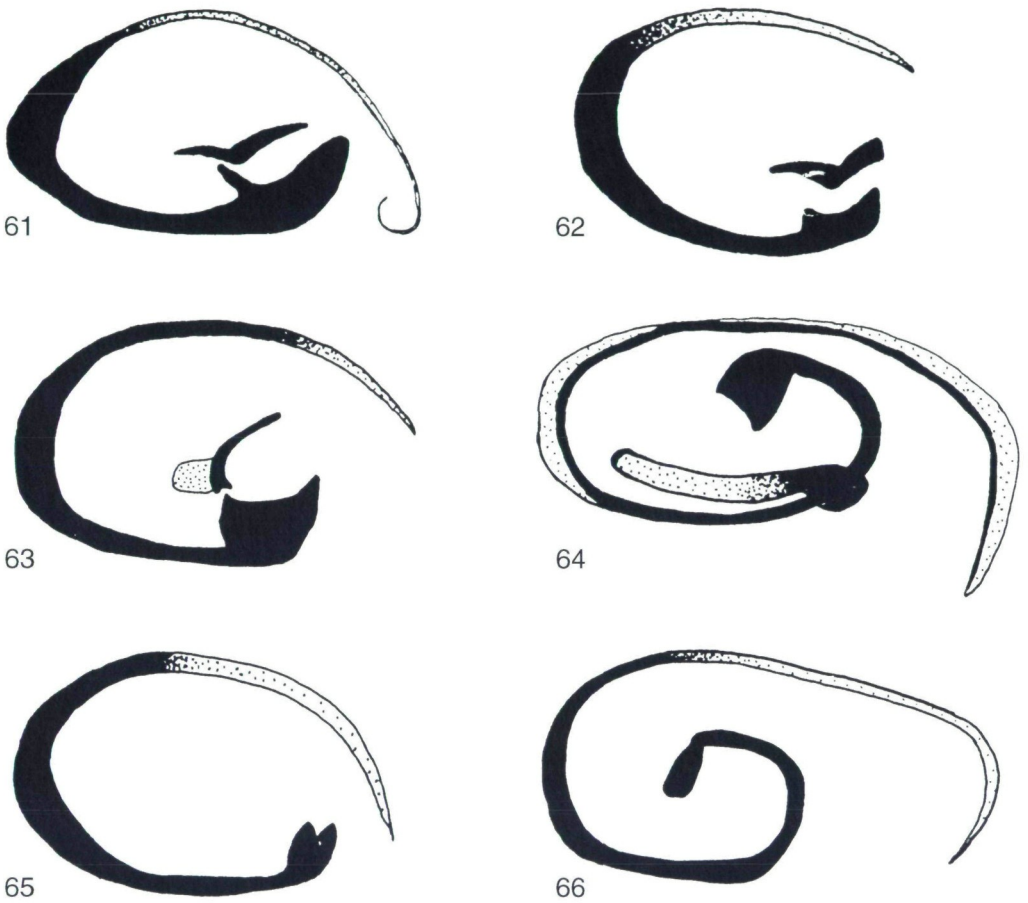
Habitat notes. *Potamometropsis kundesan* sp.n. is an inhabitant of small forest streams, where it skates on smooth current especially in the larger pools. It is often found in shaded places.

Distribution. Borneo: Sabah, Malaysia.

Etymology. This species is named for the type locality in Sabah.

Potamometropsis sabah sp.n. (Figs. 5, 7, 16, 24, 31, 37, 46, 52, 57, 63)

Holotype (♂, apterous): Malaysia, Sabah, small forest stream nr. km 60 on Keningau Hwy, east of summit, CL 2036, 6 Aug. 1985, J.T. & D.A. Polhemus (USNM). **Paratypes** (nymphs not paratypes), all from Malaysia, Sabah: 4 ♂♂ apterous, 1 ♂ macropterous, 3 ♀♀ apterous, same data as holotype (JTPC); 2 ♂♂ apterous, 2 ♀♀ apterous, 1 ♂ macropterous, 1 nymph, small stream nr. km 62 on Keningau Hwy, CL 2035, 6 Aug. 1985, J.T. & D.A. Polhemus (JTPC); 1 ♂ apterous, 2 ♀♀ apterous, Liwagu River, at Kundesan, CL 2021,1 Aug. 1985, J.T. & D.A. Polhemus (JTPC); 5 ♂♂ apterous, 7 ♀♀ apterous, 3 nymphs, small stream, 12 km S. Ranau, CL 2027, 3 Aug. 1985, J.T. & D.A. Polhemus (JTPC, NHMW, NNC); 3 ♂♂ apterous, 9 ♀♀ apterous, "British N. Borneo", Tenompok, 48 km E. of Jesselton, 1460 m, 26-31.I.1959, leg. T.C. Maa (BPBM, NHMW); 1 ♀ apterous, Crocker Range, Mawar Waterfall env., 17.VI.1996, 9a, river about 4 - 6 m wide, flowing through primary forest, shaded (NHMW); 3 ♂♂ apterous, 4 ♀♀ apterous, Crocker Range, around km 56 of road Kota Kinabalu Tambunan, Sunsuron Waterfall env., 1100 - 1200 m, 8.VI.1996, 5a (NHMW, JTPC); 1 ♂ apterous, 5 ♀♀ apterous, Crocker Range, Rafflesia Centre, around km 61 of road Kota Kinabalu Tambunan, 13.-14.VI.1996, 6b (NHMW, JTPC); 1 ♂ apterous, Crocker Range, around km 59 of road Kota Kinabalu - Tambunan, ca. 1300 m, 19.VI.1996, 3a (NHMW).



Figs. 61 - 66: Median aedeagal sclerites of (61) *P. fischeri*, (62) *P. crassifemur* sp.n., (63) *P. sabah* sp.n., (64) *P. poring* sp.n., (65) *P. kundesan* sp.n., and (66) *P. bruneiensis* sp.n.

Apterous male: Body length 7.19 - 7.37 mm. Head yellow, with two elongate dark spots on vertex (not connected to form V); clypeus, labrum and antennal tubercles black; first two antennal segments ventrally yellow basally, darkening distally; pronotum with anterior margin behind vertex narrrowly black, covered with yellowish setae; mesonotum either completely orange yellow, or with two (1 + 1) small widely separated semicircular black figures behind lateral margins of pronotum; metanotum orange brown except laterally; thoracic markings as in Fig. 37; connexiva, abdominal tergites 1 - 6 brown, tergite 7 brownish yellow, tergite 8 dark on distal 2/3; sternum yellow to eucine except margins of proacetabulae dark; legs with coxae, trochanters and femora yellowish, femora embrowned distally; profemur dorsally with a long black streak, ventrally with a long broad dark streak;

tarsi brown to black; scattered regions of metanotum, longitudinal band on lateral margin of mesonotum, abdominal tergites, part of meso- and metacetabulae, thickly set with golden pubescence.

Head with large, coarsely faceted eyes; synthlipsis 0.34 of head width, length of antennal segments 1 - 4, 3.10 : 1.28 : 1.55 : 0.78 (Fig. 46); distoventral sulcus extending less than half the length of segment four.

Prothorax 1.3 times head width, 2.1 times as wide as long; meso- and metanotum together somewhat longer than the abdomen including segment eight (1.24 times); profemur thickened, 6.3 times as long as wide, ventrally set with numerous small denticles, one larger subapical denticle set in a depression (Figs. 5, 7), and a few black setae; protibia somewhat flattened, length 0.83 that of profemur, with a ventral row of black denticles; first protarsal segment length (0.89) 6.4 times the width, slightly longer than second (0.72); combined length of tarsi 0.47 that of tibia; mesofemur length 1.02 times metafemur length,1.45 times body length, ventrally with several rows of black denticles becoming evanescent beyond middle; mesotibia with long swimming hairs.

Abdomen: Connexivum bent upward, dorsally flattened and broad; tergites 1 and 6 almost equal in length (0.19), shorter than 2 (0.28), 3 - 5 shortest and almost equal in length; seventh tergite almost 3.0 times as long as sixth, equal to 4 - 6 combined, 1.2 times as as wide as long; proctiger (suranal plate) broad, truncate distally, laterally with sharp angles (Fig. 24); paramere relatively broad, set with numerous setae (Fig. 15); pygophore tapering distally, sides evenly curved (Fig. 31); aedeagal sclerites as in figure 63.

Apterous female: Body length 6.93 - 7.82 mm; general appearance broader than male, abdomen short, length (2.33) shorter than that of meso- and metanotum combined (3.22); coloration similar to male, except black streak on profemur narrower, dorsum almost entirely orange yellow; profemur slender, length 9.5 times width, with dark setae and a subapical denticle ventrally; protarsus 0.48 times tibia length; tibia cylindrical, narrower than in males, set with small denticles; first protarsal segment much longer (0.94) than second (0.61); mesofemur 1.34 times body length.

Abdomen not folded, sternites 2 - 7 on same plane, curving slightly dorsad. Seventh sternite (Fig. 57) not large, about the length of 4 - 6 taken together, with the terminal lobe abruptly angled dorsad and rounded distally (Fig. 52).

Macropterous male (dealated): Body length 6.75 mm, to tip of abdomen.

Pronotum large, humeral angles prominent, posterior margin almost straight medially, yellowish except black transverse streak on anterior margin. Mesopleura with a elongate black region anteriorly, similar to apterous form, and a longitudinal band of silvery setae, widening posteriorly. Wings broken off, coloration of basal fragments dark brown.

Differential diagnosis: See under *P. crassifemur* sp.n.

Habitat notes. *Potamometropsis sabah* sp.n. is found in small to moderate sized rocky streams, usually with cascades interspersed with pools.

Distribution. Borneo: Sabah, Malaysia.

Etymology. This species is named for Sabah, where it is widely distributed.

Potamometropsis crassifemur sp.n. (Figs. 3, 14, 23, 33, 44, 51, 58, 62)

Holotype (♂, apterous): Malaysia, Sabah, Gn. Antulai, ca. 5 km S Sapulut, 2.VII.1996\ 13 a, river about 7m wide, flowing through secondary forest (NHMW). **Paratypes**, all from Malaysia, Sabah: 2 ♀♀ apterous, same locality data (NHMW); 2 ♀♀ apterous, Batu Punggul Resort env., 24.VI.-1.VII.1996, 11b, shaded stream, 1.5 - 2.0 m wide, flowing through dense primary forest (NHMW, JTPC).

Apterous male: Body length 7.44 mm. Head yellow, with two small elongate dark spots on vertex (not connected to form V); labrum and margins of antennal tubercles black; first antennal segment ventrally and basally yellow, darkening distally; pronotum with anterior margin behind vertex narrrowly black, covered with yellowish setae; mesonotum with two (1 + 1) small widely separated semicircular black figures behind lateral margins of pronotum; metanotum orange brown except laterally; thoracic markings similar to Fig. 37, except black streak on mesopleura shorter; connexiva brown on basal segments, abdominal tergites 1 - 6 brown, tergite 7 brownish yellow, tergite 8 dark medially on distal 1/2; sternum yellow to leucine except margins of proacetabulae dark; legs with coxae, trochanters and femora yellowish, femora embrowned distally; profemur dorsally with a long brown streak, ventrally with a long broad dark streak; tarsi brown to black; scattered regions of metanotum, longitudinal band on lateral margin of mesonotum, abdominal tergites, part of meso- and metacetabulae, thickly set with golden pubescence.

Head with large, coarsely faceted eyes; synthlipsis 0.29 of head width, length of antennal segments 1 - 4, 3.16 : 1.28 : 1.50 : 0.78 (Fig. 44); distoventral sulcus extending less than half the length of segment four.

Prothorax 1.2 times head width, 2.0 times as wide as long; meso- and metanotum together slightly longer than the abdomen including segment eight (1.02 times); profemur strongly thickened, 4.8 times as long as wide, enlarged basally, ventrally set with numerous small denticles, one larger subapical denticle set in a depression (Fig. 3), and a few black setae; protibia somewhat flattened, length 0.83 that of profemur, with a ventral row of black denticles; first protarsal segment length (1.05) 6.3 times the width, much longer than second (0.72); combined length of tarsi 0.38 that of protibia; mesofemur length 1.10 times metafemur length, 1.34 times body length, ventrally with several rows of black denticles becoming evanescent beyond middle; mesotibia with long swimming hairs.

Abdomen: Connexivum bent upward, dorsally very narrowly flattened; tergites 1 and 6 almost equal in length (0.22), shorter than 2 (0.36), 3 - 5 shortest and almost equal in length; seventh tergite almost 3.0 times as long as sixth, equal to 4 - 6 combined, 1.2 times as as wide as long; proctiger (suranal plate) broad, truncate distally, laterally with sharp angles (Fig. 23); paramere relatively large and broad, set with numerous setae (Fig. 14); pygophore tapering distally, sides evenly curved (Fig. 33); aedeagal sclerites as in figure 62.

Apterous female: Body length 6.88 - 7.55 mm; general appearance broader than male, abdomen short, length (2.39) shorter than that of meso- and metanotum combined (2.94); coloration similar to male, except black streak on profemur narrower and darker, dorsal coloration similar to male except abdominal tergites lighter in color; profemur slender, length 8.1 times width, with dark setae and a subapical denticle ventrally; protarsus 0.43 times tibia length; tibia flattened dorsally, narrower than in males, set with

small denticles; first protarsal segment much longer (1.00) than second (0.72); mesofemur 1.30 times body length.

Abdomen not folded, sternites 2 - 7 on same plane, curving slightly dorsad. Seventh sternite (Fig. 51) large, about the length of 2 - 6 taken together, with the terminal lobe not abruptly angled dorsad, rounded distally (Fig. 58). Seventh tergite twice as long as tergite 6, not raised posteriorly. Connexiva not meeting medially over tergite 8.

Macropterous form unknown.

Differential diagnosis: This species is closest to *P. sabah* sp.n., differing in the larger male profemur and pronotum, longer female tergite 7, shorter terminal lobe on female sternite 7, and different ratios of lengths of protibia/protarsi (*P. sabah* = 2.19; *P. crassifemur* = 1.87). *Potamometropsis crassifemur* sp.n. is closely related to *P. fischeri* as these species share the strongly enlarged profemur and protibia of the male, and reduced median lobe on sternite 7 of the female; they may be separated by the characters given in the key.

Distribution. Borneo: Sabah, Malaysia.

Etymology. This species name *crassifemur* is derived from the large male profemur.

Potamometropsis fischeri ZETTEL, 1994 (Figs. 2, 9, 22, 32, 59, 61)

Potamometropsis fischeri ZETTEL, 1994: 89.

Differential diagnosis: *Potamometropsis fischeri* is a large species with strongly enlarged profemur and protibia of male (Fig. 2). The paramere of male is small and of typical shape (Fig. 9). The female is lacking the median lobe on sternite 7. The aedeagal sclerite is figured for the first time (Fig. 61).

Distribution. Borneo. Only known from the type locality in Sarawak, Kelabit Highlands (see ZETTEL 1994).

"Rhyacobates" imadatei MIYAMOTO, 1967 (Figs. 17, 26, 60)

Rhyacobates imadatei MIYAMOTO, 1967: 238.
Rhyacobates imadatei: ZETTEL 1994: 79 - ANDERSEN & CHEN 1995: 64.
Potamometropsis nieseri ZETTEL, 1994: 84, **syn.n.**

Material examined: Brunei: 2 ♂♂ apterous, 2 ♀♀ apterous, Amo, 24 Feb. 1962, G. Imadate, det. Miyamoto (paratypes; JTPC); 6 ♂♂ apterous, 2 ♀♀ apterous, Sg. Belalong, 14.6.1995, # 9501, leg. S.L. Goh (ZRCS, BMBB); 7 ♂♂ apterous, 4 ♀♀ apterous, same locality, # 9505, 17.6.1995 (ZRCS, BMBB, NHMW); **Sabah:** 2 ♂♂ apterous, 1 ♀ apterous, Liwagu River at Ranau, CL 2025, 2 Aug. 1985, J.T. & D.A. Polhemus (JTPC); 1 ♂ apterous, 8 ♀♀ apterous, Samalang River, 7 km S. of Ranau, CL 2026, 3 Aug. 1985, J.T. & D.A. Polhemus (JTPC); 3 ♂♂ apterous, 2 ♀♀ apterous, 6 nymphs, Tempasuk River, 27 km S. of Kota Belud, CL 2029, 4 Aug. 1985, J.T. & D.A. Polhemus (JTPC); 1 ♀ apterous, 10 km S. of Tambunan, 2 Sept. 1983, G. F. Hevel & W. E. Steiner (USNM); 7 ♂♂ apterous, 5 ♀♀ apterous, Danum Valley, Segama River, currents, 11.2.1997, ♂ 11, leg. H. Zettel & G. Grabenweger (NHMW, UMS); **Kalimantan**: 4 ♂♂ apterous, 4 ♀♀ apterous, C. Borneo, Sg. Boh, leg. Mjöberg 1925, coll. Dr. D. Mac Gillavry (ZMAN, JTPC, NHMW).

Synonymy. *Potamometropsis nieseri* ZETTEL, 1994, described from a single male from Brunei, is now regarded as a synonym of *"Rhyacobates" imadatei* MIYAMOTO, 1967. When describing *P. nieseri*, Zettel could only study a single male of *imadatei* from

Central Kalimantan, which differed in size and the apically hooked paramere (see Fig. 17) from the holotype of *P. nieseri* (see ZETTEL 1994: fig. 10) which was then thought to be closely related to *P. obnubila* from Sumatra. Since then larger numbers of specimens from the type locality of *nieseri* became available which clearly belong to *imadatei*. The holotype of *nieseri* is an extremely small specimen of *imadatei* with an aberrant paramere shape.

Comparative notes. "*Rhyacobates*" *imadatei* may be separated from other described ptilomerine genera of Borneo by the characters given in the key above. In ANDERSEN's (1982: 423-424) key to the world genera of Ptilomerinae, this genus keys to *Potamometropsis*. Recent workers on the subfamily Ptilomerinae (i.e., ANDERSEN & CHEN 1995, ZETTEL 1994, ZETTEL & CHEN 1996; J.T. Polhemus, unpublished) have consistently recognized that "*Rhyacobates*" *imadatei* does not comfortably settle into any described genus. ANDERSEN & CHEN (1995), in a limited phylogenetic analysis, showed that "*Rhyacobates*" *imadatei* does not fall in the genus group comprising *Pleciobates*, *Heterobates* and *Rhyacobates*, a group now also containing the recently described genus *Andersenius* ZETTEL & CHEN, 1996. The distinct row of spines ventrally on the mesofemur, and distinct claws on the meso- and metatarsi ally "*Rhyacobates*" *imadatei* with *Potamometropsis*, and the completely dark mesonotum is shared with *Potamometropsis obnubila* (type species) and some other *Potamometropsis* species, but the presence of short connexival spines, and elongate abdomen in "*Rhyacobates*" *imadatei* separate it from the latter. The endosomal sclerites of "*Rhyacobates*" *imadatei* seem to be unique in possessing, in addition to the normal medial sclerites, very large lateral sclerites that upon eversion display a complex array of lobes and comb-like structures. Several other species clades now held in *Potamometropsis* are also defined by unusual complements of endosomal sclerites. A further clarification of the relationships of this genus group will be presented in a phylogenetic analysis of the entire subfamily planned by N.M. Andersen and J.T. Polhemus.

Habitat notes. "*Rhyacobates*" *imadatei* is an inhabitant of large rivers, where it skates with great speed and agility in areas of strong current, thus they are quite difficult to capture. On the Tempasuk River, a rocky river 27 km south of Kota Belud, Sabah, specimens were seen to skate rapidly in the swift current for a time, then rapidly approach a large mid-stream boulder and jump up about 12 to 15 cm. onto the wet shady side, and cling there on the near vertical surface, apparently to rest before leaping off onto the water to pursue prey once again. When "tickled" with the net hoop, the striders would leap off sideways into the net, which was the only effective way to capture them on this stream. Similar observations were made at the Segama River, a large river south of Lahad Datu: the rapidity in which they skate against the current is astonishing. Even females in copula, with the males on their back, are able to skate and jump against a current which was about 1.5 m/s.

Distribution. Borneo: Brunei; Central Kalimantan, Indonesia; Sabah, Sarawak, Malaysia; Thailand (?)[1].

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[1] MIYAMOTO (1967) described *imadatei* after specimens from Brunei (including the holotype) and Thailand. Despite intensive collections in Thailand, this species was never collected again. Therefore the record seems to be doubtful.

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