

Taxonomic review of *Pseudovelicia* HOBERLANDT, 1950 (Hemiptera: Heteroptera: Veliidae) from Borneo

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Abstract

Seven new species of the genus *Pseudovelicia* HOBERLANDT, 1950 are described from Borneo: *P. bipenicillata* sp.n., *P. bruneiensis* sp.n., *P. makrimallis* sp.n., *P. semicirculata* sp.n., *P. setisbrevia* sp.n., *P. triangulata* sp.n., and *P. tumulosa* sp.n. A list and distribution maps of *Pseudovelicia* species occurring on Borneo and adjacent islands between the Isthmus of Kra and the Wallace-Huxley Line, and a key to the males of these species are provided.

Key words: Veliidae, Microveliinae, *Pseudovelicia*, new species, key, Borneo, Brunei, Sabah, Sarawak, distribution map.

Zusammenfassung

Sieben neue Arten der Gattung *Pseudovelicia* HOBERLANDT, 1950 werden von Borneo beschrieben: *P. bipenicillata* sp.n., *P. bruneiensis* sp.n., *P. makrimallis* sp.n., *P. semicirculata* sp.n., *P. setisbrevia* sp.n., *P. triangulata* sp.n. und *P. tumulosa* sp.n. Eine Liste und Verbreitungskarten der *Pseudovelicia*-Arten, die auf Borneo und den angrenzenden Inseln zwischen dem Isthmus von Kra und der Wallace-Huxley-Line vorkommen, sowie ein Bestimmungsschlüssel für die Männchen dieser Arten werden bereitgestellt.

Introduction

Borneo is the largest island of Asia and one of the Greater Sunda Islands. During the Pleistocene, it was connected to western Malaysia, Sumatra, and Java, but stayed separated from Sulawesi by the deep Makassar Strait (INGER 1966, POLHEMUS & POLHEMUS 1988), which is part of the biogeographical border between the Orientalis and the Wallacea (Fig. 1).

Hitherto, only one species of *Pseudovelicia* HOBERLANDT, 1950, was known to occur on Borneo (Fig. 1): *Pseudovelicia borneensis* ANDERSEN, 1983, was described from Sabah and Sarawak (ANDERSEN 1983) and additionally recorded from Brunei by NIESER (1995).

From western Malaysia and Singapore, five species were reported by ANDERSEN (1983), HECHER & ZETTEL (2006), and LI et al. (2022): *P. feuerborni* (LUNDBLAD, 1933), *P. hypodonta* (LUNDBLAD, 1933), *P. lundbladi* ANDERSEN, 1983, *P. plauta* LI, BU & YE, 2022, and *P. yangae* HECHER & ZETTEL, 2006. *Pseudovelicia sexualis* (PAIVA, 1917), *P. tjurupensis* (LUNDBLAD, 1933), and *P. hypodonta* (LUNDBLAD, 1933) were described from Sumatra, *P. feuerborni* (LUNDBLAD, 1933) from Java. On those Philippine islands west of the Wallace-Huxley Line, *Pseudovelicia lata* SEHNAL, 1999 was described from the southern part of Palawan, and *P. tenuis* SEHNAL, 1999 from Busuanga. The distribution of the previously known species occurring between the Isthmus of Kra and the Wallace-Huxley Line is shown in Figure 1.

A list of all *Pseudovelicia* species from this region and a key to males are provided within this study.

Material and methods

The examined material is deposited in the following collections: BM = Brunei Museum, Kota Batu, Brunei; CZW = Zettel Collection, Vienna, Austria; NHMW = Natural History Museum, Vienna, Austria; UBD = University Brunei Darussalam, UMS = University Malaysia Sabah, Kota Kinabalu, Malaysia; ZRCS = Zoological Reference Collection, National University of Singapore.

Further abbreviations: apt. = apterous, macr. = macropterous.

Label data are cited in brackets [].

Specimens examined are dry-mounted on cards except for 7 ♂♂ and 8 ♀♀ of *Pseudovelgia makrimallis* sp.n., which are stored in alcohol, as are all the nymphs.

Measurements are given in millimetres (mm) and were taken from at least three males and three females of each morph and each locality, or of all specimens, if fewer than three were available. The relative lengths of antennomeres 1, 3, and 4 are given in relation to the length of antennomere 2. The term “genitalia” is used functionally and thus includes segment 8 of males. Line drawings of the abdominal end of females were not made as they cannot be used for identification.

Taxonomy

List of *Pseudovelgia* species occurring on Borneo and adjacent regions west of the Wallace-Huxley Line and their distribution areas

Pseudovelgia bipenicillata sp.n.: East Malaysia (Sabah)

Pseudovelgia borneensis ANDERSEN, 1983: East Malaysia (Sarawak, Sabah), Brunei, Indonesia (Kalimantan)

Pseudovelgia bruneiensis sp.n.: Brunei, East Malaysia (Sarawak)

Pseudovelgia feuerborni (LUNDBLAD, 1933): Thailand, West Malaysia, Singapore, Java

Pseudovelgia hypodonta (LUNDBLAD, 1933): East Malaysia (Sabah), Sumatra, Singapore

Pseudovelgia lata SEHNAL, 1999: Palawan

Pseudovelgia lundbladi ANDERSEN, 1983: West Malaysia

Pseudovelgia makrimallis sp.n.: East Malaysia (Sabah), Brunei

Pseudovelgia plauta LI, BU & YE, 2022: West Malaysia

Pseudovelgia semicirculata sp.n.: East Malaysia (Sabah), Brunei

Pseudovelgia setisbrevia sp.n.: East Malaysia (Sabah)

Pseudovelgia sexualis (PAIVA, 1917): Pakistan, India, Bangladesh, Thailand, Sumatra

Pseudovelgia tenuis SEHNAL, 1999: Busuanga

Pseudovelgia tjurupensis (LUNDBLAD, 1933): Sumatra

Pseudovelgia triangulata sp.n.: East Malaysia (Sabah)

Pseudovelgia tumulosa sp.n.: East Malaysia (Sabah)

Pseudovelgia yangae HECHER & ZETTEL, 2006: West Malaysia, South Thailand

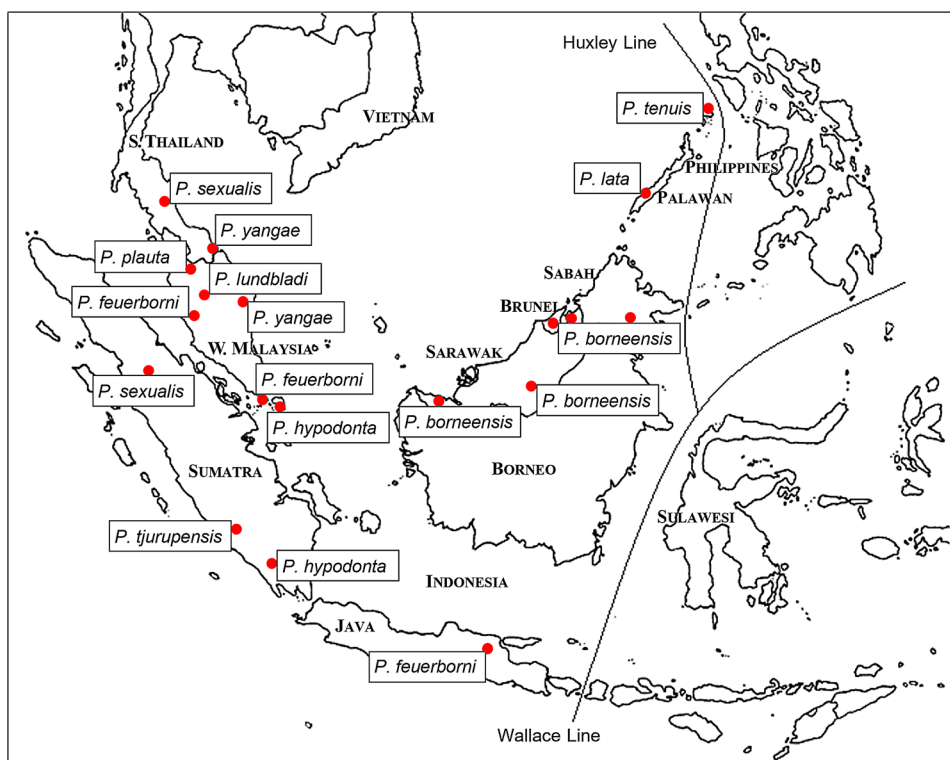


Fig. 1. Distribution of previously known *Pseudovelgia* species occurring between the Isthmus of Kra and the Wallace-Huxley Line.

**Key for males of *Pseudovelgia* species occurring on Borneo and adjacent regions
between the Isthmus of Kra and the Wallace-Huxley Line**

Note: *P. tjurupensis* is not included in the key, because it is known only from the female holotype.

- 1 Eyes densely pilose. *P. sexualis*
- Eyes hairless except for two ocular setae. 2
- 2 Sternum 7 with large tumosity (Fig. 35). *P. tumulosa* sp.n.
- Sternum 7 unmodified. 3
- 3 Metatibia apically with tuft of long, curved hairs or long bristles (Figs. 7, 10, 12). 4
- Metatibia apically without long hairs or bristles. 6
- 4 Metatarsomere 1 basally with tuft of very long hairs (Fig. 7). *P. bipenicillata* sp.n.
- Metatarsomere 1 with row of long hairs (Figs. 10, 12). 5
- 5 Body shape ovate (Fig. 5). Antennomere 4 about as long as antennomere 1. Pronotum less than 0.66 times as long as wide. Metatarsomere 2 without special pilosity (Fig. 10). Ventral depression of segment 8 basally with semicircular ridge beset with setae (Figs. 23, 24). *P. semicirculata* sp.n.

- Body shape parallel-sided. Antennomere 4 distinctly shorter than antennomere 1. Pronotum more than 0.66 times as long as wide. Metatarsomere 2 with long bristles (Fig. 12). Ventral depression of segment 8 basally with triangular table-like elevation densely beset with short hairs (Figs. 29, 30). ***P. triangulata* sp.n.**
- 6 Metatarsomere 1 flat and prolonged, about twice as long as metatarsomere 2. ***P. plauta***
- Metatarsomere 1 about as long as metatarsomere 2 or shorter. 7
- 7 Metatarsomere 1 without any long pilosity (Fig. 8). ***P. bruneiensis* sp.n.**
- Metatarsomere 1 with row of long hairs, at least over basal half. 8
- 8 Segment 8 ventrally with complex structures, tubercles and tufts of bristles. 9
- Segment 8 ventrally only with two shallow impressions separated by a low median ridge. ***P. feuerborni***
- 9 Segment 8 ventrally with tubercles and additionally with cup-shaped structure, table-like elevation or elevated lobes. 10
- Segment 8 ventrally only with depression surrounded by five tubercles or spines. 13
- 10 Segment 8 ventrally with cup-shaped structure. ***P. lundbladi***
- Segment 8 ventrally with table-like elevation or elevated lobes. 11
- 11 Segment 8 ventrally with table-like elevation. 12
- Segment 8 ventrally with two elevated lobes. ***P. lata***
- 12 Antennomere 4 more than 1.7 times as long as antennomere 2. ***P. tenuis***
- Antennomere 4 less than 1.6 times as long as antennomere 2. ***P. hypodonta***
- 13 Segment 8 ventrally with distance between caudal and basal spines rather long, about 1.5 times as long as the width of the depression. ***P. borneensis***
- Segment 8 ventrally with distance between caudal and basal spines shorter than width of the depression (Figs. 21, 27). 14
- 14 Long hairs on first metatarsomere very dense and shorter than one third of segment length. ***P. yangae***
- Long hairs on first metatarsomere sparse and at least as long as one third of segment length (Figs. 9, 11). 15
- 15 Grasping comb on protibia longer than half tibia length. Pronotum, metanotum and metatibia with short bristles. ***P. setisbrevia* sp.n.**
- Grasping comb on protibia as long as or shorter than half tibia length. Pronotum, metanotum and metatibia with long, bristle-like hairs. ***P. makrimallis* sp.n.**

***Pseudovelgia bipenicillata* sp.n.** (Figs. 2, 7, 14–16)

Type locality. Malaysia, Sabah, Sapulut, Batu Punggul, N04°36', E 116°35'.

Type material. Holotype: ♂ (apt.) labelled [Malaysia, Sabah, Batu Punggul Resort env., 24.VI.–\ 1.VII.1996. 11b, shaded stream 1.5–2.0 m wide flowing through dense primary forest] (NHMW).

Apterous male. Size of holotype: body length 2.70; length of mediotergites 1–7 to width of mediotergite 4 as 1 : 0.28; maximum width (across suture between metanotum and laterotergite 1) 1.00; width of pronotum 0.90; width of head 0.62.

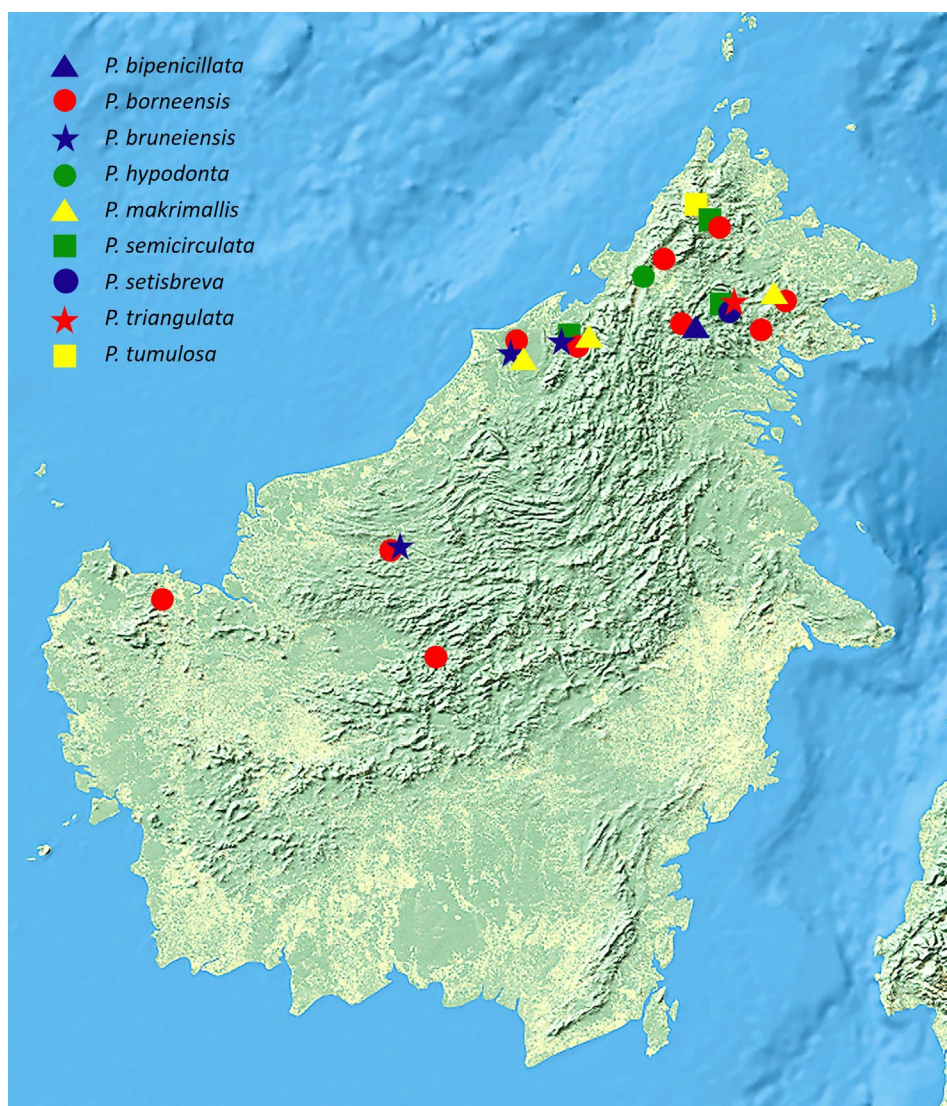
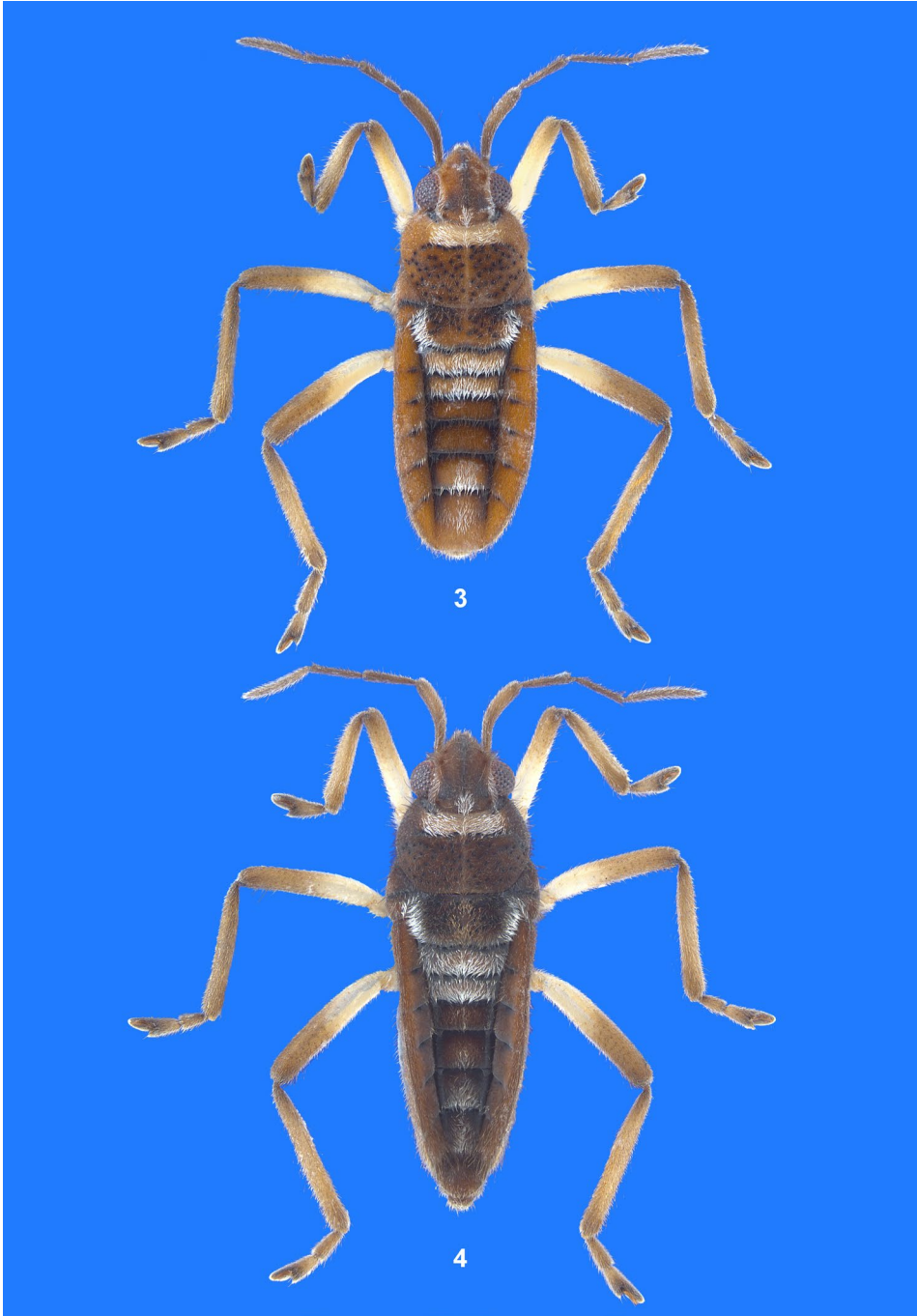
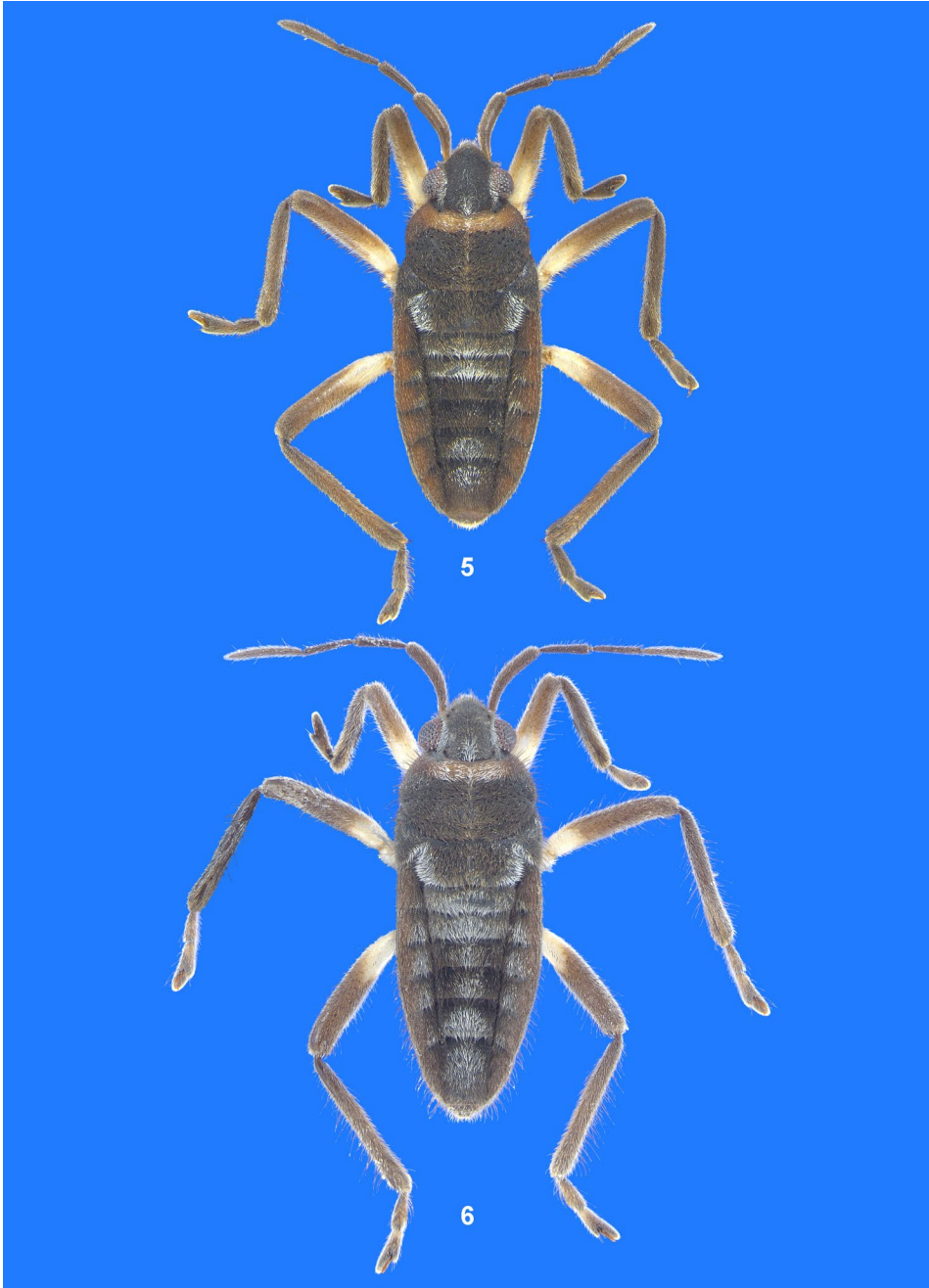


Fig. 2. Distribution of *Pseudovelia* species occurring on Borneo.

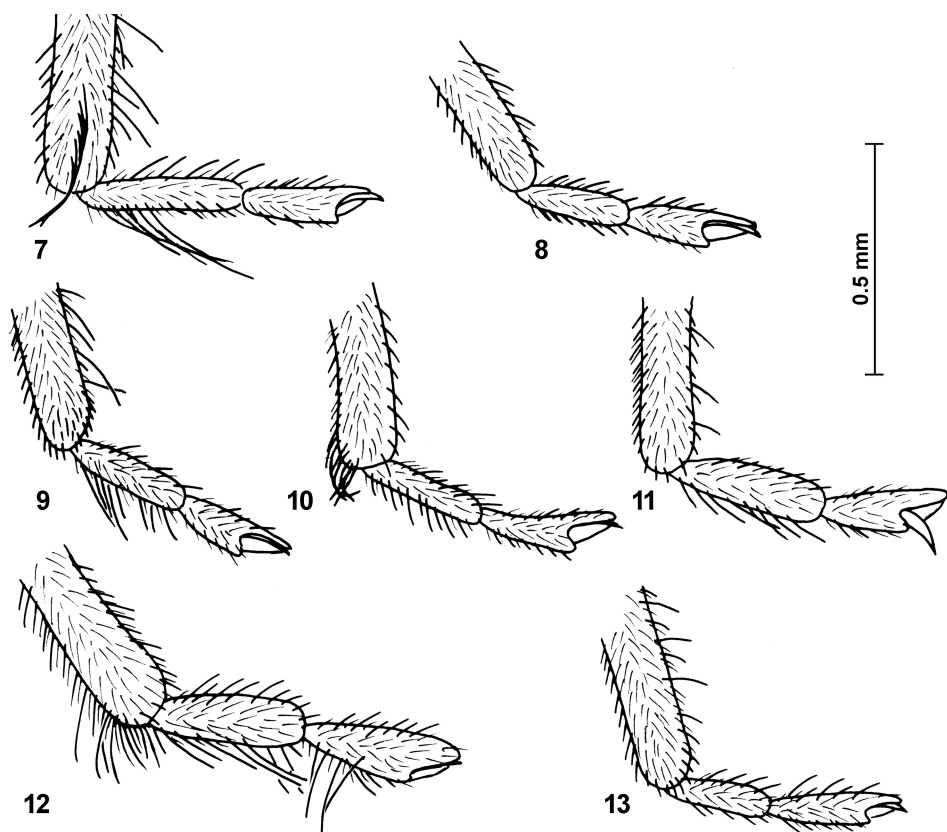
Colour. Head black; antenna dark brown. Pronotum dark brown, with horizontal stripe near anterior margin light to reddish-brown, extending over lateral portion and becoming broader; black, irregularly distributed pores on pronotum except on horizontal stripe. Metanotum dark brown. Legs dark brown, with basal part of femora yellowish. Mediotergites and laterotergite 1 dark brown, laterotergites 2–7 lighter brown to reddish-brown. Ventral surface of thorax and abdomen black, stripe on lateral margins of sterna brown to reddish-brown.



Figs. 3–4. Habitus of apterous *Pseudovelia bruneiensis* sp.n., dorsal: (3) male; (4) female. © NHMW Hemiptera Image Collection / Harald Bruckner.



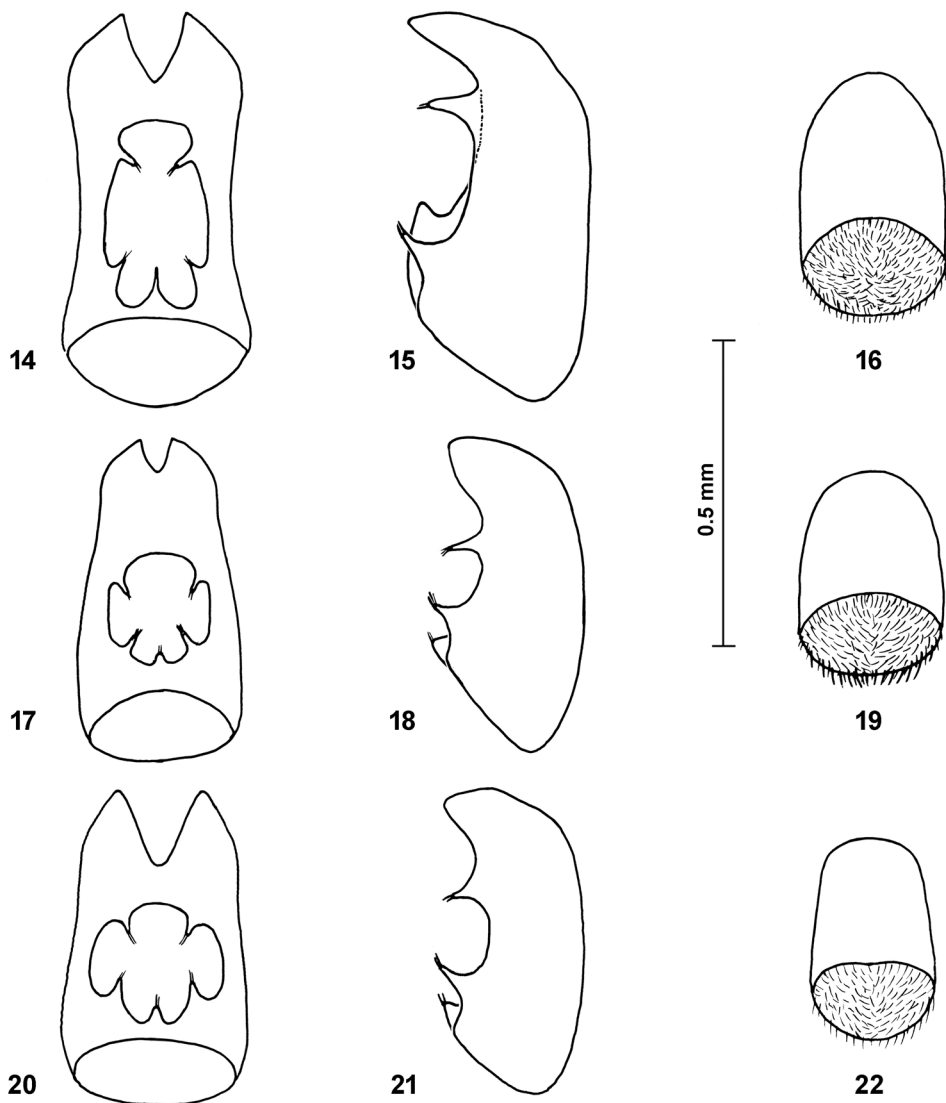
Figs. 5–6. Habitus of apterous male, dorsal: (5) *P. semicirculata* sp.n., but tuft of hairs on apex of metatibia not visible; (6) *P. borneensis*. © NHMW Hemiptera Image Collection / Harald Bruckner.



Figs. 7–13. Metatarsus (and apex of metatibia) of male: (7) *P. bipenicillata* sp.n.; (8) *P. bruneiensis* sp.n.; (9) *P. makrimallisi* sp.n.; (10) *P. semicirculata* sp.n.; (11) *P. setisbrevia* sp.n.; (12) *P. triangulata* sp.n.; (13) *P. tumulosa* sp.n.

Pilosity. Entire body surface covered with short, recumbent, silvery hairs. Long, erect hairs scattered on head, antenna, and legs, on mesofemora, mesotibia, and metatibia obviously long, hirsute on pronotum, metanotum, mediotergites, and laterotergites. Stout, silvery hairs forming stripes on vertex along margin of eyes, one very small patch on base of vertex, and covering lateral parts of mediotergite 1, almost entire mediotergites 2 and 3, medio-caudal parts of mediotergites 4–6, and posterior margin of laterotergite 1. Apex of metatibia and base of first metatarsomere with tuft of 5–7 very long, curved hairs (Fig. 7). Eyes hairless except for two ocular setae.

Structures. Ventral lobe of head not produced backward. Antenna 0.66 times as long as body, relative lengths of antennomeres 1–4 as 1.5 : 1 : 1.1 : 1.4; $1 > 4 > 3 > 2$. Pronotum 0.64 times as long as wide. Grasping comb on protibia 0.51 times as long as tibia; metatarsus 0.60 times as long as metatibia, first metatarsomere 1.16 times as long as second. Mediotergites and sterna partly fused. Second mediotergite 0.92 times as wide as head. Laterotergites 2–7 raised.



Figs. 14–22. Male genitalia: (14–16) *P. bipenicillata* sp.n.; (17–19) *P. bruneiensis* sp.n.; (20–22) *P. makrimallis* sp.n. (14, 17, 20) segment 8, ventral; (15, 18, 21) segment 8, lateral; (16, 19, 22) segment 9, ventral.

Genitalia. Segment 8 with ventral depression large and elongate, basally and caudally with pair of spines consisting of small tubercles beset with hairs, and with subtriangular, laterally flattened tubercle between caudal spines (Figs. 14, 15). Pygophore and proctiger caudally with short erect hairs (Fig. 16).

Diagnosis. Length of mediotergites 1–7 (8) to width of mediotergite 4 as 1 : 0.28 (apt. ♂); maximum width in apterous males across suture between metanotum and laterotergite

1. Relative length of antennomeres: $1 > 4 > 3 > 2$. Male: Grasping comb on protibia 0.64 times as long as tibia. First metatarsomere 1.16 times as long as second; metatarsus 0.60 times as long as metatibia. Apex of metatibia and base of first metatarsomere with tuft of 5–7 very long, curved hairs (Fig. 7). Structure of male genitalia as shown in Figures 14–16.

Etymology. The specific epithet “*bipenicillata*” refers to the tufts of hairs on metatibia and metatarsus of males.

Comparative notes. The male genitalia are very similar to those of *P. borneensis*, but the male of the new species can easily be distinguished by the tufts of long hairs on the metatibia and the metatarsus, and by the first metatarsomere being longer than the second.

Remark. Two apterous *Pseudovelia* females were collected together with the holotype, but as they are smaller than the male and belong to different unknown species, none of them can be identified as the female of *P. bipenicillata* sp.n.

Distribution. Sabah (Fig. 2).

***Pseudovelia bruneiensis* sp.n.** (Figs. 2, 3–4, 8, 17–19)

Type locality. Brunei, Sungai Belait area, Sg. Mendaram, N04°20' E 114°26'.

Type material. Holotype: ♂ (apt.) labelled [Brunei: Sungai Belait area\ 15.6.2007, Sg. Mendaram at\ road Labi – Teraya, 12 m\ N04°20' E 114°26' GPS, leg. H. Zettel (9)] (BM). Paratypes: 3 ♂♂, 6 ♀♀ (apt.), 1 ♂ (macr.) same data as holotype (NHMW, UBD); 1 ♂ (apt.) [Brunei: Belait, Wassai Wong\ Kadir Falls, 21.11.2008\ N04°20' E 114°26', 30–60 m\ GPS, leg. H. Zettel (14)] (NHMW); 1 ♂ (macr.) [Brunei: Temburong, Sg. Belalong\ at Kuala Belalong FSC, 30.11.2008, N04°32' E 115°09' 60 m GPS, leg. H. Zettel (29)] (NHMW); 1 ♂ (macr.) [SARAWAK (Borneo) 3.1994\ Rumah Tuen Mpearan\ pisang BT beleh (ca.15 km\ E Kapit), J.Kodada leg.] (NHMW).

Apterous male (Fig. 3). Size of holotype: body length 2.30; length of mediotergites 1–7 to width of mediotergite 4 as 1 : 0.27; maximum width (across suture between metanotum and laterotergite 1) 0.75; width of pronotum 0.73; width of head 0.60. Size of paratypes: body length 2.27–2.38; length of mediotergites 1–7 to width of mediotergite 4 as 1 : 0.25–0.27; maximum width (across suture between metanotum and laterotergite 1 or across mediotergite 4) 0.80–0.85; width of pronotum 0.72–0.75; width of head 0.54–0.60.

Colour. Head brown to dark brown and black; antenna brown to dark brown. Pronotum brown to dark brown, with transverse stripe near anterior margin yellow to light brown; black, irregularly distributed punctures or pores on pronotum, but missing on stripe. Metanotum brown to dark brown, sutures between pronotum and metanotum, and between metanotum and laterotergite 1 dark brown to black. Legs brown to dark brown, with base of femora yellow, transition of colours continuously. Mediotergites brown to dark brown, mediotergite 7 entirely or caudally lighter brown; mediotergite 1 with black pores and punctures. Laterotergite 1 brown, laterotergites 2–7 medially brown to dark brown, laterally or entirely lighter brown. Ventral surface of thorax and abdomen brown and black, stripe on lateral margins of sterna light brown.

Pilosity. Entire body surface covered with short, recumbent, silvery hairs and long, erect hairs, obviously dense and stout on laterotergites 2–7. Stout, silvery hairs forming very indistinct stripes on vertex along margin of eyes, indistinct patch on base of vertex, covering lateral areas of mediotergite 1, caudal area of mediotergites 2, 3, and 6, and scattered on mediotergite 7 and laterotergites 4–6. Metatibia and metatarsus without special pilosity (Figs. 3, 8). Eyes without hairs except for two ocular setae.

Structures. Ventral lobe of head not produced caudad. Antenna 0.69–0.73 times as long as body, relative length of antennomeres 1–4 as 1.5 : 1 : 1.1–1.2 : 1.4–1.5; $1 \geq 4 > 3 > 2$. Pronotum 0.63–0.69 times as long as wide. Grasping comb on protibia 0.54–0.58 times as long as tibia. Metatarsus 0.56–0.57 times as long as metatibia, first metatarsomere 0.93–1.00 times as long as second. Second mediotergite 0.83–0.93 times as wide as head. Laterotergites 2–7 moderately to strongly raised.

Genitalia. Segment 8 with five curved spines around ventral circular depression, each consisting of a small tuft of bristles on a small tubercle: two of them baso-lateral, two caudo-lateral, and a small one medio-caudal (Figs. 17, 18). Pygophore and proctiger caudally with dense short erect hairs (Fig. 19).

Macropterous male. Size of paratypes: body length 2.30–2.40; maximum width = width of pronotum 0.94–0.95; width of head 0.57–0.58.

Colour as in apterous male; forewing dark brown, with elongate white stripe at base and whitish patches in cells.

Pilosity as in apterous male (except for body parts covered by wings).

Structures. Antenna 0.62–0.67 times as long as body, relative length of antennomeres 1–4 as 1.5 : 1 : 1.0–1.2 : 1.4–1.5; $1 \geq 4 > 3 \geq 2$. Pronotum 0.85–0.89 times as long as wide. Grasping comb on protibia 0.52–0.54 times as long as tibia. Metatarsus 0.57–0.60 times as long as metatibia, first metatarsomere 0.90–1.07 times as long as second. One specimen macropterous, two males dealate, wings of macropterous specimens surpassing apex of abdomen. – **Genitalia** as in apterous male.

Apterous female (Fig. 4). Size of paratypes: body length 2.52–2.63; length of mediotergites 1–8 to width of mediotergite 4 as 1 : 0.20–0.21; maximum width across suture between metanotum and laterotergite 1: 0.85; width of pronotum 0.75–0.78; width of head 0.59–0.63.

Colour as in apterous male, but mediotergite 7 unicoloured and mediotergite 8 of same colour as remaining mediotergites; laterotergites 2–7 brown, sutures between laterotergites medially black; caudal margin of sternum 7 reddish-brown.

Pilosity as in apterous male, but long, erect hairs obviously dense on mediotergites 6–8 and laterotergites 7–8, but missing on mediotergites 4 and 5 and on sterna; stout, silvery hairs forming very indistinct stripes on vertex along margin of eyes, indistinct patch on base of vertex, covering lateral areas of mediotergite 1, almost entire mediotergites 2 and 3, caudal area of mediotergites 6 and 7, and scattered on laterotergites 2–4.

Structures. Antenna 0.59–0.65 times as long as body, relative length of antennomeres 1–4 as 1.4–1.6 : 1 : 1.2–1.4 : 1.6; $1 \leq 4 > 3 > 2$. Pronotum 0.61–0.63 times as long as wide. Protibia without grasping comb. Metatarsus 0.53–0.55 times as long as metatibia, first metatarsomere 0.74–0.83 times as long as second. Second mediotergite 0.80–0.85 times as wide as head. Laterotergites 2–7 strongly raised.

Genitalia. Gonocoxa 1 elongate, proctiger small, both with short, dense, erect hairs.

Diagnosis. Length of mediotergites 1–7 (8) to width of mediotergite 4 as 1 : 0.25–0.27 (apt. ♂♂), 1 : 0.20–0.21 (apt. ♀♀); maximum width in apterous males across suture between metanotum and laterotergite 1 or across mediotergite 4, in apterous females across suture between metanotum and laterotergite 1. Relative length of antennomeres: $1 \geq 4 > 3 \geq 2$ (♂♂), $1 \leq 4 > 3 > 2$ (♀♀). Male: Grasping comb on protibia 0.52–0.58 times as long as

tibia. First metatarsomere 0.90–1.07 times as long as second; metatarsus 0.56–0.60 times as long as metatibia. Metatibia and metatarsus without special pilosity (Fig. 8). Structure of male genitalia as shown in Figures 17–19.

Etymology. The specific epithet “*bruneiensis*” refers to the type locality in Brunei.

Comparative notes. *Pseudovelgia bruneiensis* sp.n. appears closely related to *P. makrimallis* sp.n. and *P. yangae*, for the structure of segment 8 is very similar in these species. But the males of *P. bruneiensis* sp.n. have no long hairs on the first metatarsomere as apparent in *P. makrimallis* sp.n. and *P. yangae*.

The structure of the male segment 8 of *P. epimekta* NIESER, 1995, and *P. affia* NIESER, 1995, both from Sulawesi, are also very similar, but *P. epimekta* differs in the obviously long antenna and the first antennomere in particular. In addition, the grasping comb on the protibia of *P. affia* is only one third of tibial length and thus distinctly shorter than in *P. bruneiensis* sp.n., where it is more than half of length.

Distribution. Brunei, Sarawak (Fig. 2).

***Pseudovelgia makrimallis* sp.n. (Figs. 2, 9, 20–22)**

Type locality. Malaysia, Sabah, Danum Valley, Sapat Kalisan, ca. N04°57', E117°41'.

Type material. Holotype: ♂ (apt.) labelled [MALAYSIA: Sabah\ Danum Valley, Sapat\ Kalisan, 12.2.1997\ leg. H. Zettel (15)] (UMS). Paratypes: 17 ♂♂, 15 ♀♀ (apt.), 4 ♂♂, 6 ♀♀ (macr.), 7 ♂♂, 8 ♀♀ (apt., in alcohol) same data as holotype (NHMW, UMS); 13 ♂♂, 17 ♀♀ (apt.) [MALAYSIA: Sabah\ Danum Valley, Palum\ Tambun, 2.–13.2.1997\ leg. H. Zettel (2)] (NHMW, UMS); 1 ♀ apt. [MALAYSIA: Sabah\ Danum Valley, Palum\ Tambun, 2.–12.2.1997\ leg. Zettel & al. P99] (NHMW); 1 ♂ (macr.) [Brunei: Temburong, Sg. Belalong\ at Kuala Belalong FSC, 30.11.\ 2008, N04°32' E115°09'\ 60m GPS, leg. H. Zettel (29)] (NHMW); 1 ♂ (macr.) [Brunei: Sungai Belait area\ 15.6.2007, Sg. Mendaram at\ road Labi – Teraya, 12m\ N04°20' E114°26'\ GPS, leg. H. Zettel (9)] (NHMW); 1 ♂ (macr.) [BRUNEI: Belait Distr.\ Sg. Ingei, upstream of Base\ Camp, site 2, 13.VI.2010\ leg. D.J.W. Lane (7)] (UBD).

Further material: 23 nymphs (in alcohol) same data as holotype (NHMW, UMS).

Apterous male. Size of holotype: body length 2.33; length of mediotergites 1–7 to width of mediotergite 4 as 1 : 0.95; maximum width (across mediotergite 4) 0.83; width of pronotum 0.76; width of head 0.55. Size of paratypes: body length 2.22–2.48; length of mediotergites 1–7 to width of mediotergite 4 as 1 : 0.26–0.28; maximum width (across suture between metanotum and laterotergite 1 or across mediotergite 4) 0.80–0.85; width of pronotum 0.70–0.78; width of head 0.52–0.58.

Colour. Head dark brown and black; antenna dark brown. Pronotum brown to dark brown, with transverse stripe near anterior margin light brown; black, irregularly distributed pores or punctures on pronotum, but missing on stripe. Metanotum dark brown, sutures between pronotum and metanotum, and between metanotum and laterotergite 1 black. Legs brown to dark brown, with base of femora yellow, change of colours abruptly. Mediotergites brown to dark brown, mediotergite 7 in some specimens caudally lighter brown; mediotergite 1 with black pores or punctures. Laterotergite 1 brown, laterotergites 2–7 medially brown to dark brown, laterally or entirely lighter brown. Ventral surface of thorax and abdomen dark brown to black, stripe on lateral margins of sterna brown.

Pilosity. Entire body surface covered with short, recumbent, silvery hairs and rather densely with long, erect hairs. Stout, silvery hairs forming stripes on vertex along margin of eyes,

small patch on base of vertex (in some specimens indistinct), covering lateral areas of mediotergite 1, almost entire mediotergites 2 and 3, medio-caudal area of mediotergite 6, and scattered on mediotergite 7, covering medio-caudal margin of laterotergites 3–5 and in some specimens also of laterotergite 6. Apical part of mesofemur and metafemur, entire mesotibia and metatibia, and first metatarsomere with obviously long hairs (Fig. 9). Eyes without hairs except for two ocular setae.

Structures. Ventral lobe of head not produced caudad. Antenna 0.67–0.75 times as long as body, relative length of antennomeres 1–4 as 1.5–1.6 : 1 : 1.1–1.3 : 1.4–1.7; $1 \geq$ or $\leq 4 > 3 > 2$. Pronotum 0.61–0.66 times as long as wide. Grasping comb on protibia 0.43–0.50 times as long as tibia. Metatarsus 0.55–0.60 times as long as metatibia, first metatarsomere 1.00–1.07 times as long as second. Second mediotergite 0.91–0.98 times as wide as head. Laterotergites 2–7 moderately raised.

Genitalia. Segment 8 with five curved spines around ventral circular depression, each consisting of a small tuft of bristles on a tubercle: two spines baso-lateral, two spines caudo-lateral, and a smaller one medio-caudal (Figs. 20, 21). Pygophore and proctiger caudally with short erect hairs (Fig. 22).

Macropterous male. Size of paratypes: body length 2.42–2.65; maximum width = width of pronotum 0.97–1.05; width of head 0.55–0.63.

Colour as in apterous male; forewing dark brown, with elongate white stripe at base and whitish patches in cells.

Pilosity as in apterous male (except for body parts covered by wings).

Structures. Antenna 0.62–0.68 times as long as body, length of antennomeres 1–4 as 1.4–1.6 : 1 : 1.0–1.2 : 1.5–1.7; $1 \leq 4 > 3 \geq 2$. Pronotum 0.82–0.91 times as long as wide. Grasping comb on protibia 0.42–0.48 times as long as tibia. Metatarsus 0.56–0.60 times as long as metatibia, first metatarsomere 0.94–1.05 times as long as second; two specimens macropterous, five males dealate, wings of macropterous specimens reaching apex of abdomen. – Genitalia as in apterous male.

Apterous female. Size of paratypes: body length 2.57–2.78; length of mediotergites 1–8 to width of mediotergite 4 as 1 : 0.22–0.25; maximum width across suture between metanotum and laterotergite 1: 0.87–0.93; width of pronotum 0.75–0.80; width of head 0.57–0.63.

Colour as in apterous male, but mediotergite 7 unicoloured and mediotergite 8 of same colour as remaining mediotergites; laterotergites 2–7 brown, sutures between laterotergites medially black; caudal margin of sternum 7 reddish-brown.

Pilosity as in apterous male, but long, erect hairs missing on mediotergites 4–5 and only scattered on mediotergites 6–7; stout, silvery hairs additionally forming large patch on mediotergite 7 and covering caudal margin of laterotergite 1, medio-caudal area of laterotergites 2–4, and in some specimens also of laterotergites 5 and 6. Long, erect hairs scattered on meso- and metafemur, and more dense on metatibia.

Structures. Antenna 0.59–0.64 times as long as body, relative length of antennomeres 1–4 as 1.5–1.6 : 1 : 1.1–1.2 : 1.5–1.7; $1 \leq 4 > 3 > 2$. Pronotum 0.58–0.63 times as long as wide. Protibia without grasping comb. Metatarsus 0.50–0.55 times as long as metatibia, first metatarsomere 0.70–0.81 times as long as second. Second mediotergite 0.89–0.96 times as wide as head. Laterotergites 2–7 strongly raised.

Genitalia. Gonocoxa 1 elongate, proctiger small, both with short, dense, erect hairs.

Macropterous female. Size of paratypes: body length 2.55–2.68; maximum width = width of pronotum 1.00–1.05; width of head 0.57–0.60.

Colour and pilosity as in apterous female; forewing as in macropterous male.

Structures. Antenna 0.57–0.62 times as long as body, relative length of antennomeres 1–4 as 1.4–1.6 : 1 : 1.1–1.2 : 1.5–1.7; $1 \leq 4 > 3 > 2$. Pronotum 0.80–0.85 times as long as wide. Protibia without grasping comb. Metatarsus 0.50–0.54 times as long as metatibia, first metatarsomere 0.72–0.77 times as long as second. All specimens macropterous, wings not reaching apex of abdomen. – Genitalia as in apterous female.

Diagnosis. Length of mediotergites 1–7 (8) to width of mediotergite 4 as 1 : 0.26–0.28 (apt. ♂♂), 1 : 0.22–0.25 (apt. ♀♀); maximum width in apterous males across suture between metanotum and laterotergite 1 or across mediotergite 4, in apterous females across suture between metanotum and laterotergite 1. Relative length of antennomeres: $1 \geq$ or $\leq 4 > 3 \geq 2$. Male: Grasping comb on protibia 0.42–0.50 times as long as tibia. First metatarsomere 0.94–1.07 times as long as second; metatarsus 0.55–0.60 times as long as metatibia. Apical part of meso- and metafemur, entire meso- and metatibia, and first metatarsomere with obviously long hairs (Fig. 9). Structure of male genitalia as shown in Figures 20–22.

Etymology. The specific epithet “*makrimallis*” refers to the long hairs on the legs.

Comparative notes. *Pseudovelia makrimallis* sp.n. appears closely related to *P. bruneiensis* sp.n., *P. setisbrevia* sp.n., and *P. yangae* because of the similar structure of the male genitalia. Males can be distinguished by the long pilosity on pronotum and legs, which is much shorter in *P. setisbrevia* sp.n. and *P. yangae*, and by the length of the grasping comb on the protibia, which is ≤ 0.50 times tibia length in *P. makrimallis* sp.n., but ≥ 0.50 in *P. setisbrevia* sp.n. and *P. yangae*.

Distribution. Sabah, Brunei (Fig. 2).

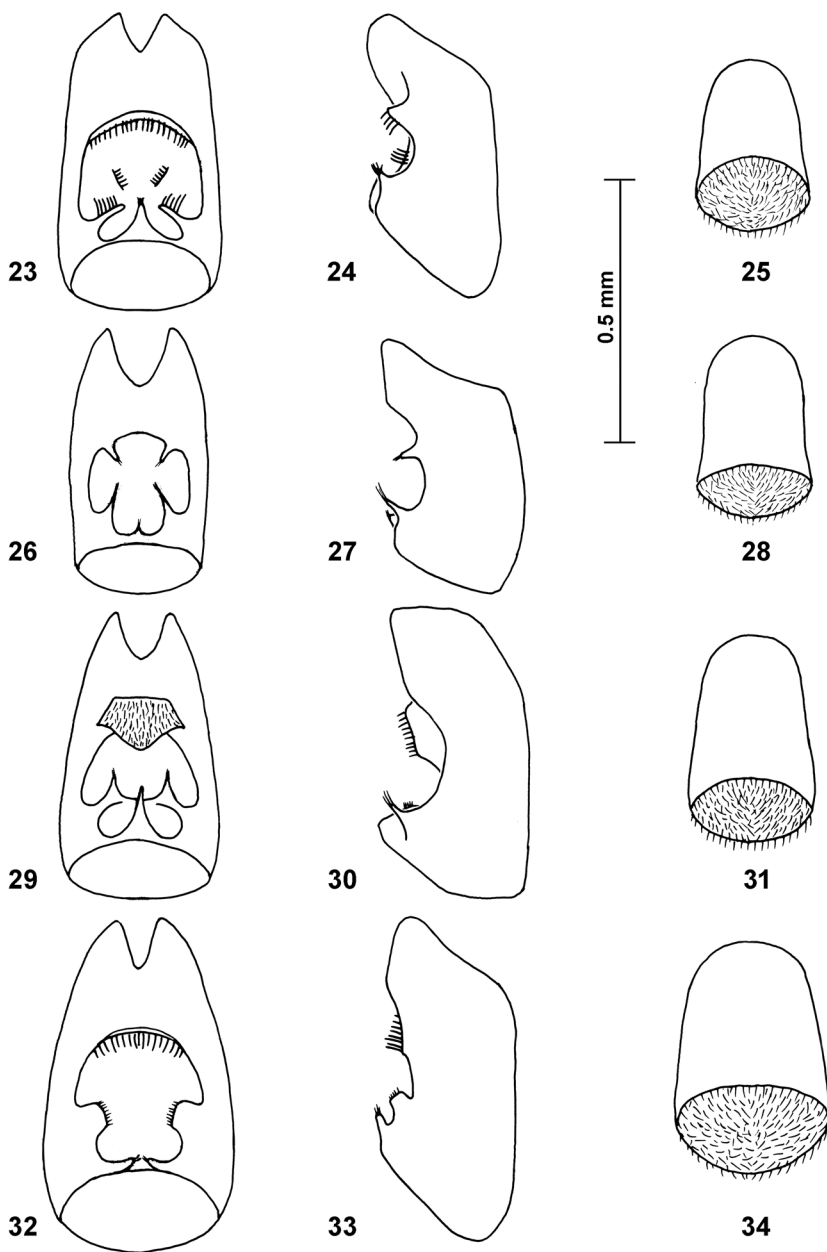
Pseudovelia semicirculata sp.n. (Figs. 2, 5, 10, 23–25)

Type locality: Malaysia, Sabah, Ranau, Liwagu river, ca. N5°54', E 116°41'.

Type material. Holotype: ♂ (apt.) labelled [Malaysia, Sabah Ranau\ Liwagu river, 1.06.1998\ J. Kodada & F. Čiampor lgt.] (NHMW). Paratypes: 2 ♂♂, 3 ♀♀ (apt.) same data as holotype (NHMW); 1 ♂, 3 ♀♀ (apt.) [Malaysia, Sabah, Ranau env.\ Liwagu river, 1.06.1998\ J. Kodada & F. Čiampor lgt.] (NHMW); 2 ♂♂ (apt.) [Brunei: Temburong, Sg. Belalong\ at Kuala Belalong FSC, 30.11.2008, N04°32' E 115°09' 60m GPS, leg. H. Zettel (29)] (NHMW, UBD); 1 ♂ (apt.), 1 ♂ (macr.), 2 ♀♀ (macr.) [MB9B; MAL, Sabah\ Maliau Basin\ Camp 881, \ TB Lim, 16–MAY–1996] (ZRCS).

Apterous male (Fig. 5). Size of holotype: body length 2.40; length of mediotergites 1–7 to width of mediotergite 4 as 1 : 0.31; maximum width (across suture between metanotum and laterotergite 1) 0.95; width of pronotum 0.80; width of head 0.60. Size of paratypes: body length 2.37–2.55; length of mediotergites 1–7 to width of mediotergite 4 as 1 : 0.29–0.37; maximum width (across suture between metanotum and laterotergite 1 or across mediotergite 4) 0.92–0.98; width of pronotum 0.80–0.86; width of head 0.57–0.60.

Colour. Head dark brown to black; antenna brown to dark brown. Pronotum dark brown, with transverse stripe near anterior margin light brown; black, irregularly distributed pores on pronotum, but missing on stripe. Metanotum dark brown to black, sutures between pronotum and metanotum, and between metanotum and laterotergite 1 dark brown or black. Legs brown, with base of femora yellow to light brown. Mediotergites dark brown,



Figs. 23–34. Male genitalia: (23–25) *P. semicirculata* sp.n.; (26–28) *P. setisbrevia* sp.n.; (29–31) *P. triangulata* sp.n.; (32–34) *P. tumulosa* sp.n. (23, 26, 29, 32) segment 8, ventral; (24, 27, 30, 33) segment 8, lateral; (25, 28, 31, 34) segment 9, ventral.

mediotergite 7 in most specimens caudally dark reddish-brown; mediotergite 1 with black pores. Laterotergite 1 dark brown, laterotergites 2–7 medially or entirely dark brown, laterally or entirely reddish-brown. Ventral surface of thorax and abdomen black, stripe on lateral margins of sterna dark brown or reddish-brown.

Pilosity. Entire body surface covered with short, recumbent, silvery hairs and long, erect hairs. Stout, silvery hairs forming indistinct stripes on vertex along margin of eyes, covering lateral areas of mediotergite 1, caudal margin of mediotergites 2, 3, and 6, and in most specimens caudal margin of laterotergite 1. Apical part of mesotibia with 5–7 long, bristle-like hairs. Apex of metatibia with tuft of 5–7 very long, bristle-like hairs, metatarsomere 1 with row of long, bristle-like hairs over entire length, metatarsomere 2 without special pilosity (Figs. 5, 10, but tuft of hairs on apex of metatibia on Fig. 5 not visible). Eyes without hairs except for two ocular setae.

Structures. Ventral lobe of head not produced caudad. Antenna 0.66–0.70 times as long as body, relative length of antennomeres 1–4 as 1.5–1.6 : 1 : 0.9–1.0 : 1.5–1.6; $1 \geq$ or $\leq 4 > 3 \leq 2$. Pronotum 0.58–0.63 times as long as wide. Grasping comb on protibia 0.63–0.67 times as long as tibia. Metatarsus 0.56–0.57 times as long as metatibia, first metatarsomere 0.95–1.07 times as long as second. Second mediotergite 0.96–1.06 times as wide as head. Laterotergites 2–7 moderately raised.

Genitalia. Segment 8 with characteristic structures on ventral surface: basal area with semicircular, high ridge with row of short bristles, central area with two oblique, small elevations with row of short bristles, and caudal area with two lateral spines beset with bristles and with one median spine consisting of a small tubercle with a tuft of short bristles (Figs. 23, 24). Pygophore and proctiger caudally with short erect hairs (Fig. 25).

Macropterous male. Size of paratype: body length 2.65; maximum width = width of pronotum 1.13; width of head 0.63.

Colour as in apterous male; forewing brown, with elongate white stripe at base.

Pilosity as in apterous male (except for bodyparts covered by wings); erect hairs on veins of basal area of forewing.

Structures. Antenna 0.60 times as long as body, relative length of antennomeres 1–4 as 1.5 : 1 : 1.0 : 1.4; $1 > 4 > 3 = 2$. Pronotum 0.82 times as long as wide. Grasping comb on protibia 0.69 times as long as tibia. Metatarsus 0.56 times as long as metatibia, first metatarsomere 1.03 times as long as second. Wings surpassing apex of abdomen. – Genitalia as in apterous male.

Apterous female. Size of paratypes: body length 2.75–2.85; length of mediotergites 1–8 to width of mediotergite 4 as 1 : 0.24–0.31; maximum width across suture between metanotum and laterotergite 1 0.97–1.03; width of pronotum 0.85–0.90; width of head 0.62–0.65.

Colour as in apterous male, but mediotergites 1–7 in some specimens black, mediotergite 7 unicoloured and mediotergite 8 of same colour as remaining mediotergites; caudal margin of sternum 7 dark brown or reddish-brown.

Pilosity as in apterous male, but long, erect hairs missing on mediotergites 4–6 and basal part of mediotergite 7; additional stripe of stout, silvery hairs on caudal margin of mediotergite 7 and small patches on laterotergites 3–6; mesotibia, metatibia and metatarsus without special pilosity.

Structures. Antenna 0.58–0.59 times as long as body, relative length of antennomeres 1–4 as 1.5–1.6 : 1 : 0.9–1.1 : 1.5–1.6; $1 = 4 > 3 \geq$ or ≤ 2 . Pronotum 0.51–0.56 times as long as wide. Protibia without grasping comb. Metatarsus 0.50–0.55 times as long as metatibia, first metatarsomere 0.75–0.85 times as long as second. Second mediotergite 0.96–1.04 times as wide as head. Laterotergites 2–7 strongly to moderately raised.

Genitalia. Gonocoxa 1 elongate, proctiger small, both with short, dense, erect hairs.

Macropterous female. Size of paratypes: body length 2.85; maximum width = width of pronotum 1.20–1.25; width of head 0.64–0.66.

Colour and pilosity as in macropterous male, but apical part of mesotibia, apex of metatibia and metatarsus without long hairs.

Structures. Antenna 0.57 times as long as body, relative length of antennomeres 1–4 as 1.5 : 1 : 1.0 : 1.4; $1 > 4 > 3 = 2$. Pronotum 0.80–0.81 times as long as wide. Protibia without grasping comb. Metatarsus 0.50–0.54 times as long as metatibia, first metatarsomere 0.76–0.77 times as long as second. Wings surpassing apex of abdomen. – Genitalia as in apterous female.

Diagnosis. Length of mediotergites 1–7 (8) to width of mediotergite 4 as 1 : 0.29–0.37 (apt. ♂♂), 1 : 0.24–0.31 (apt. ♀♀); maximum width in apterous males across suture between metanotum and laterotergite 1 or across mediotergite 4, in apterous females across suture between metanotum and laterotergite 1. Relative length of antennomeres: $1 \geq$ or $\leq 4 > 3 \leq 2$ (♂♂), $1 = 4 > 3 \geq$ or ≤ 2 (♀♀). Male: Grasping comb on protibia 0.63–0.67 times as long as tibia. First metatarsomere 0.95–1.07 times as long as second; metatarsus 0.56–0.57 times as long as metatibia. Apex of metatibia with tuft of 5–7 very long, bristle-like hairs, metatarsomere 1 with row of long, bristle-like hairs over entire length (Figs. 5, 10, but tuft of hairs on apex of metatibia on Fig. 5 not visible). Metatarsomere 2 without special pilosity. Structure of male genitalia as shown in Figures 23–25.

Etymology. The specific epithet “*semicirculata*” refers to the semicircular ridge on segment 8 of males.

Comparative notes. Males of *Pseudovelia semicirculata* sp.n. can easily be distinguished from other species by the structure of segment 8. The tuft of hairs on the apex of the metatibia is also present in *P. bipenicillata* sp.n. and *P. triangulata* sp.n., but *P. semicirculata* sp.n. differs in the pilosity of the metatarsus. It has a row of long hairs on metatarsomere 1, whereas *P. bipenicillata* sp.n. has a tuft of long bristles at the base of this segment, and in *P. triangulata* sp.n. long bristles extend to the apex of metatarsomere 2.

Distribution. Sabah, Brunei (Fig. 2).

***Pseudovelia setisbrea* sp.n. (Figs. 2, 11, 26–28)**

Type locality. Malaysia, Sabah, Maliau Basin, Sungai Maliau, ca. N04°51', E 116°50'.

Type material. Holotype: ♂ (apt.) labelled [MB2;MAL,Sabah\ Maliau Basin; Sg. Maliau,\ upstream, nr. Camp 96,\ TB Lim & Yeo KL, 14–MAY–1996] (ZRCS). Paratypes: 5 ♂♂, 4 ♀♀ (apt.), 1 ♂, 3 ♀♀ (macr.) same data as holotype (ZRCS, NHMW); 1 ♂, 5 ♀♀ (apt.), 1 ♀ (macr.) [MB1A;MAL,Sabah,\ Maliau Basin; G. Gunsalam\ 14–MAY–1996] (ZRCS, NHMW); 3 ♂♂, 1 ♀ (apt.) [MB4;MAL, Sabah,\ Maliau Basin,\ Sg. Maliau, upstream, nr. Camp 96,\ TB Lim & Yeo KL, 14–MAY–1996] (ZRCS, NHMW); 1 ♂, 1 ♀ (apt.), 1 ♀ (macr.) [MB19;MAL,Sabah,\ Maliau Basin,\ Sg. Maliau, upstream,\ TB Lim & Yeo KL, 18–MAY–1996] (ZRCS, NHMW); 3 ♀♀ (apt.), 4 ♂♂ (macr.) [MB20; MAL,Sabah,\ Maliau Basin,\ Dhan waterfall,\ TB Lim, 19–MAY–1996] (ZRCS,

NHMW); 2 ♂♂, 5 ♀♀ (apt.) [MB24;MAL,Sabah,Maliau Basin,\ Sg. Maliau, upstream, \ TB Lim, 21–MAY–1996] (ZRCS, NHMW); 4 ♂♂, 3 ♀♀ (apt.), 1 ♂ (macr.) [MB26;MAL,Sabah,Maliau Basin,\ tributary of Sg. Maliau, upstream,\ TB Lim & Yeo KL, 23–MAY–1996] (ZRCS, NHMW).

Apterous male. Size of holotype: body length 2.53; length of mediotergites 1–7 to width of mediotergite 4 as 1 : 0.31; maximum width (across suture between metanotum and laterotergite 1) 0.93; width of pronotum 0.88; width of head 0.60. Size of paratypes: body length 2.35–2.50; length of mediotergites 1–7 to width of mediotergite 4 as 1 : 0.27–0.31; maximum width (across suture between metanotum and laterotergite 1 or across mediotergite 4) 0.85–0.91; width of pronotum 0.80–0.88; width of head 0.57–0.60.

Colour. Head brown to dark brown and black; antenna brown to dark brown. Pronotum brown to dark brown, with transverse stripe near anterior margin light brown; black, irregularly distributed pores or punctures on pronotum, but missing on stripe. Metanotum brown to dark brown, sutures between pronotum and metanotum, and between metanotum and laterotergite 1 black. Legs brown, with base of femora yellow, change of colours continuous. Mediotergites brown to dark brown, in some specimens mediotergite 7 caudally lighter brown; mediotergite 1 with black pores or punctures. Laterotergites brown, in some specimens laterotergites 2–7 medially darker brown. Ventral surface of thorax and abdomen dark brown to black, stripe on lateral margins of sterna brown.

Pilosity. Entire body surface covered with short, recumbent to suberect, silvery hairs and long, erect hairs. Stout, silvery hairs forming stripes on vertex along margin of eyes, small patch on base of vertex, covering lateral areas of mediotergite 1, almost entire mediotergites 2 and 3, medio-caudal area of mediotergite 6, and median patch on mediotergite 7 (in some specimens indistinct), covering caudal margin of laterotergite 1 and medio-caudal margin of laterotergites 3–6. Short bristles on pronotum and metanotum. Apical half of mesofemur and metafemur with long hairs, metatibia with short, bristle-like hairs and scattered long hairs, first metatarsomere with row of 8–10 long, sparse setae (Fig. 11). Eyes without hairs except for two ocular setae.

Structures. Ventral lobe of head not produced caudad. Antenna 0.69–0.75 times as long as body, relative length of antennomeres 1–4 as 1.4–1.6 : 1 : 1.1–1.2 : 1.2–1.5; $1 \geq 4 > 3 > 2$. Pronotum 0.62–0.71 times as long as wide. Grasping comb on protibia 0.51–0.58 times as long as tibia. Metatarsus 0.55–0.62 times as long as metatibia, first metatarsomere 1.00–1.17 times as long as second. Second mediotergite 0.83–1.00 times as wide as head. Laterotergites 2–7 moderately raised.

Genitalia. Segment 8 with five curved spines around ventral circular depression, each consisting of a small tuft of bristles on a tubercle: two spines baso-lateral, two spines caudo-lateral, and a very small one medio-caudal (Figs. 26, 27). Pygophore and proctiger caudally with short erect hairs (Fig. 28).

Macropterous male. Size of paratypes: body length 2.59–2.89; maximum width = width of pronotum 1.09–1.13; width of head 0.60.

Colour as in apterous male; forewing dark brown, with elongate white stripe at base and whitish patches in cells.

Pilosity as in apterous male (except for body parts covered by wings).

Structures. Antenna 0.60–0.67 times as long as body, relative length of antennomeres 1–4 as 1.4–1.5 : 1 : 1.1–1.2 : 1.3–1.4; $1 \geq 4 > 3 > 2$. Pronotum 0.86–0.87 times as long as

wide. Grasping comb on protibia 0.51–0.56 times as long as tibia. Metatarsus 0.57–0.63 times as long as metatibia, first metatarsomere 1.03–1.13 times as long as second. All specimens macropterous, wings distinctly surpassing apex of abdomen. – Genitalia as in apterous male.

Apterous female. Size of paratypes: body length 2.60–2.93; length of mediotergites 1–8 to width of mediotergite 4 as 1 : 0.23–0.28; maximum width (across suture between metanotum and laterotergite 1 or across mediotergite 4): 0.92–1.00; width of pronotum 0.80–0.88; width of head 0.60–0.64.

Colour as in apterous male, but mediotergite 7 unicoloured and mediotergite 8 of same colour as remaining mediotergites; sutures between laterotergites 2–7 medially black; caudal margin of sternum 7 reddish-brown.

Pilosity as in apterous male, but stout, silvery hairs in most specimens more dense on mediotergite 7 and on laterotergites; metatarsus without special pilosity, sterna with short, erect bristles, medial area of laterotergites 2–5 without long hairs.

Structures. Antenna 0.57–0.62 times as long as body, relative length of antennomeres 1–4 as 1.4–1.6 : 1 : 1.1–1.2 : 1.3–1.5; $1 \geq 4 > 3 > 2$. Pronotum 0.58–0.68 times as long as wide. Protibia without grasping comb. Metatarsus 0.50–0.57 times as long as metatibia, first metatarsomere 0.69–0.89 times as long as second. Second mediotergite 0.90–1.02 times as wide as head. Laterotergites 2–7 moderately to strongly raised.

Genitalia. Gonocoxa 1 elongate, proctiger small, both with short, dense, erect hairs.

Macropterous female. Size of paratypes: body length 2.75–2.83; maximum width = width of pronotum 1.12–1.20; width of head 0.60–0.63.

Colour and pilosity as in apterous female; forewing as in macropterous male.

Structures. Antenna 0.57–0.61 times as long as body, relative length of antennomeres 1–4 as 1.4–1.5 : 1 : 1.1 : 1.3; $1 \geq 4 > 3 > 2$. Pronotum 0.78–0.87 times as long as wide. Protibia without grasping comb. Metatarsus 0.50–0.55 times as long as metatibia, first metatarsomere 0.73–0.81 times as long as second. All specimens macropterous, wings surpassing apex of abdomen. – Genitalia as in apterous female.

Diagnosis. Length of mediotergites 1–7 (8) to width of mediotergite 4 as 1 : 0.27–0.31 (apt. ♂♂), 1 : 0.23–0.28 (apt. ♀♀); maximum width across suture between metanotum and laterotergite 1 or across mediotergite 4. Relative length of antennomeres: $1 \geq 4 > 3 > 2$. Male: Grasping comb on protibia 0.51–0.58 times as long as tibia. First metatarsomere 1.00–1.17 times as long as second; metatarsus 0.55–0.63 times as long as metatibia. Pronotum and metanotum with short bristles. Apical half of meso- and metafemur with long hairs, metatibia with short, bristle-like hairs and scattered long hairs, first metatarsomere with row of 8–10 long, sparse setae (Fig. 11). Structure of male genitalia as shown in Figures 26–28.

Etymology. The specific epithet “*setisbrevia*” refers to the short bristles on the pronotum, metanotum and metatibia.

Comparative notes as in *Pseudovelvia makrimallis* sp.n.

Distribution. Sabah (Fig. 2).

***Pseudovelgia triangulata* sp.n.** (Figs. 2, 12, 29–31)

Type locality. Malaysia, Sabah, Maliau Basin, Dhan waterfall, ca. N 04°51', E 116°50'.

Type material. Holotype: ♂ (apt.) labelled [MB20; MAL, Sabah, Maliau Basin; \ Dhan waterfall, TB Lim, 19–MAY–1996] (ZRCS). Paratypes: 9 ♂♂, 13 ♀♀ (apt.), 1 ♂, 8 ♀♀ (macr.) same data as holotype (ZRCS, NHMW).

Apterous male. Size of holotype: body length 2.93; length of mediotergites 1–7 to width of mediotergite 4 as 1 : 0.27; maximum width (across suture between metanotum and laterotergite 1) 1.06; width of pronotum 1.00; width of head 0.63. Size of paratypes: body length 2.97–3.05; length of mediotergites 1–7 to width of mediotergite 4 as 1 : 0.25–0.26; maximum width (across suture between metanotum and laterotergite 1) 1.06–1.08; width of pronotum 0.95–1.00; width of head 0.65.

Colour. Head dark brown to dark reddish-brown and black; antenna brown. Pronotum brown to dark brown, with transverse stripe near anterior margin light brown to yellow; black, irregularly distributed pores or punctures on pronotum, but missing on stripe. Metanotum brown to light brown, sutures between pronotum and metanotum, and between metanotum and laterotergite 1 black. Legs light brown to yellow, with apex of femora, base and apex of tibiae, and tarsi brown. Mediotergites brown to dark brown or reddish-brown; mediotergite 1 with black pores or punctures. Laterotergites light brown to reddish-brown, sutures between laterotergites black. Ventral surface of thorax and abdomen brown or reddish-brown to dark brown, stripe on lateral margins of sterna and caudal area of sternum 7 light brown.

Pilosity. Entire body surface covered with short, recumbent, silvery hairs and long, erect hairs. Stout, silvery hairs forming (indistinct) stripes on vertex along margin of eyes, covering lateral areas of mediotergite 1, more or less entire mediotergites 2 and 3, caudal margin of mediotergites 4–6, and in some specimens forming patch medially on mediotergites 6 and 7, and covering caudal margin of laterotergites 3–6. Apex of metatibia with tuft of long bristles, metatarsus densely hairy and with row of long, bristle-like hairs over entire length of metatarsomeres 1 and 2 (Fig. 12). Eyes without hairs except for two ocular setae.

Structures. Ventral lobe of head not produced caudad. Antenna 0.66–0.67 times as long as body, relative length of antennomeres 1–4 as 1.4–1.5 : 1 : 0.9–1.0 : 1.1–1.2; $1 \gg 4 > 3 \leq 2$. Pronotum 0.70–0.76 times as long as wide. Grasping comb on protibia 0.48–0.50 times as long as tibia. Metatarsus 0.59–0.62 times as long as metatibia, first metatarsomere 0.95–1.03 times as long as second. Second mediotergite 0.96–1.00 times as wide as head. Laterotergites 2–7 strongly raised.

Genitalia. Segment 8 with characteristic structures on ventral surface: basal area with triangular table-like elevation densely beset with short hairs; caudal area with one median tubercle, laterally flattened and with comb of short bristles, and two lateral spines consisting of a small tubercle with a tuft of bristles (Figs. 29, 30). Pygophore and proctiger caudally with short erect hairs (Fig. 31).

Macropterous male. Size of paratype: body length 3.15; maximum width = width of pronotum 1.30; width of head 0.68.

Colour as in apterous male; forewing brown, with elongate white stripes at base.

Pilosity as in apterous male (except for body parts covered by wings), but patch of stout, silvery hairs only on mediotergite 7; some erect hairs on basal part of anterior vein of forewing.

Structures. Antenna 0.63 times as long as body, relative length of antennomeres 1–4 as 1.4–1.5 : 1 : 0.9–1.0 : 1.1–1.2; $1 \gg 4 > 3 \leq 2$. Pronotum 0.88 times as long as wide. Grasping comb on protibia 0.53 times as long as tibia. Metatarsus 0.64 times as long as metatibia, first metatarsomere 0.98 times as long as second. Specimen dealate. – Genitalia as in apterous male.

Apterous female. Size of paratypes: body length 3.26–3.33; length of mediotergites 1–8 to width of mediotergite 4 as 1 : 0.24–0.25; maximum width across suture between metanotum and laterotergite 1 or across mediotergite 4: 1.05–1.10; width of pronotum 0.90–0.93; width of head 0.66–0.68.

Colour as in apterous male, but mediotergite 8 dark brown; stripe on lateral margins of sterna light brown to reddish-brown, caudal margin of sternum 7 dark brown to black.

Pilosity as in apterous male, but long, erect hairs missing on mediotergites 4–6, basal part of mediotergite 7, laterotergites 2–5, short on laterotergites 6 and 7, and missing or short on sterna; metatibia and metatarsus without special pilosity.

Structures. Antenna 0.56–0.59 times as long as body, relative length of antennomeres 1–4 as 1.5–1.6 : 1 : 0.9–1.0 : 1.2; $1 \gg 4 > 3 \leq 2$. Pronotum 0.73–0.75 times as long as wide. Protibia without grasping comb. Metatarsus 0.52–0.60 times as long as metatibia, first metatarsomere 0.71–0.76 times as long as second. Second mediotergite and laterotergites 2–7 as in apterous male.

Genitalia. Gonocoxa 1 elongate, proctiger small, both with short, dense, erect hairs.

Macropterous female. Size of paratypes: body length 3.34–3.38; maximum width = width of pronotum 1.32–1.39; width of head 0.67–0.70.

Colour and pilosity as in apterous female (except for bodyparts covered by wings), wings as in macropterous male.

Structures. Antenna 0.54–0.58 times as long as body, relative length of antennomeres 1–4 as 1.5 : 1 : 0.9 : 1.1–1.2; $1 \gg 4 > 3 \leq 2$. Pronotum 0.85–0.89 times as long as wide. Protibia without grasping comb. Metatarsus 0.53–0.56 times as long as metatibia, first metatarsomere 0.68–0.72 times as long as second. Macropterous specimens (n=4) with wings reaching apex of abdomen, or dealate (n=4). – Genitalia as in apterous female.

Diagnosis. Length of mediotergites 1–7 (8) to width of mediotergite 4 as 1 : 0.25–0.27 (apt. ♂♂), 1 : 0.24–0.25 (apt. ♀♀); maximum width in apterous males across suture between metanotum and laterotergite 1, in apterous females across suture between metanotum and laterotergite 1 or across mediotergite 4. Relative length of antennomeres: $1 \gg 4 > 3 \leq 2$. Male: Grasping comb on protibia 0.48–0.53 times as long as tibia. First metatarsomere 0.95–1.03 times as long as second; metatarsus 0.59–0.64 times as long as metatibia. Apex of metatibia with tuft of long bristles, metatarsus densely hairy and with row of long, bristle-like hairs over entire length of metatarsomeres 1 and 2 (Fig. 12). Structure of male genitalia as shown in Figures 29–31.

Etymology. The specific epithet “*triangulata*” refers to the triangular table-like elevation on segment 8 of males.

Comparative notes. Males and females of *Pseudovelia triangulata* sp.n. can easily be distinguished from all other species of this genus occurring on Borneo by the relative length of antennomere 4, which is much shorter than antennomere 1, and by the relative length of the pronotum in apterous specimens, which is more than 0.66 times as long

as wide. Males are also characterized by the tuft of hairs on the apex of the metatibia, in combination with the row of long bristles on the first and second metatarsomere. The structure of the male segment 8 is very similar to *P. hypodonta*, but the table-like elevation is more densely covered with hairs.

Distribution. Sabah (Fig. 2).

***Pseudovelia tumulosa* sp.n.** (Figs. 2, 13, 32–35)

Type locality. Malaysia, Sabah, Mt. Kinabalu, ca. N06°00', E 116°33'.

Type material. Holotype: ♂ (apt.) labelled [MALAYSIA: Sabah\ Mt. Kinabalu 1550 m\ 16.2.1997\ leg. H. Zettel (17)] (UMS). Paratypes: 2 ♂♂, 7 ♀♀ (apt.) same data as holotype (NHMW, UMS); 1 ♂, 1 ♀ (apt.) [MALAYSIA: Sabah\ Mt. Kinabalu Silau–Silau Riv.\ 1450 m 17.2.1997\ leg. H. Zettel (19)] (NHMW).

Apterous male. Size of holotype: body length 2.58; length of mediotergites 1–7 to width of mediotergite 4 as 1 : 0.28; maximum width (across mediotergite 4) 0.93; width of pronotum 0.90; width of head 0.63. Size of paratype: body length 2.75; length of mediotergites 1–7 to width of mediotergite 4 as 1 : 0.26; maximum width (across mediotergite 4) 0.96; width of pronotum 0.88; width of head 0.64.

Colour. Head dark brown and black; antenna dark brown. Pronotum light brown, with transverse stripe near anterior margin slightly lighter; black, irregularly distributed pores on pronotum except on transverse stripe, and punctures on mediotergite 1. Metanotum brown. Legs brown, with basal part of femora slightly lighter brown. Mediotergites and laterotergites brown to reddish-brown; sutures between metanotum and laterotergite 1 and between mediotergites and laterotergites dark brown to black. Ventral surface of thorax and abdomen reddish-brown and black, sutures between sterna black, stripe on lateral margins of sterna and caudal margin of sternum 7 reddish-brown.

Pilosity. Entire body surface covered with short, recumbent to suberect, silvery hairs and long, erect hairs. Stout, silvery hairs forming stripes on vertex along margin of eyes and covering lateral part of mediotergite 1, caudal margin of mediotergites 2, 3, and 6. Metatibia with scattered long hairs, first metatarsomere without special pilosity (Fig. 13). Eyes hairless except for two ocular setae.

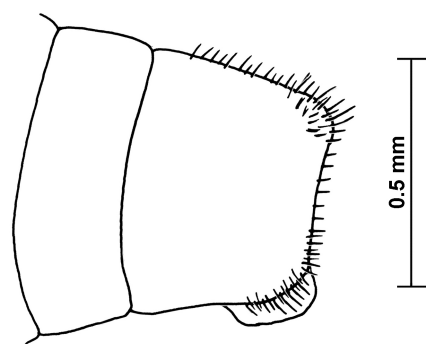


Fig. 35. End of abdomen, lateral, of male of *P. tumulosa* sp.n. (genitalia dissected).

Structures. Ventral lobe of head not produced backward. Antenna 0.63–0.67 times as long as body, relative length of antennomeres 1–4 as 1.5 : 1 : 1.0–1.1 : 1.4–1.5; $1 \geq 4 > 3 \geq 2$. Pronotum 0.58–0.60 times as long as wide. Grasping comb on protibia 0.59–0.61 times as long as tibia. Metatarsus 0.49–0.51 times as long as metatibia, first metatarsomere 0.64–0.68 times as long as second (Fig. 13). Mediotergites and sterna partly fused. Second mediotergite 0.88–0.90 times as wide as head. Laterotergites 2–7 raised. Sternum 7 with large tumosity (Fig. 35).

Genitalia. Segment 8 with ventral depression deep and subcircular, basally with low lobe, caudo-laterally with higher lobe, both beset with

hairs, caudal margin of depression with pair of tubercles beset with hairs (Figs. 32, 33). Pygophore and proctiger caudally with short erect hairs (Fig. 34).

Apterous female. Size of paratypes: body length 2.75–2.90; length of mediotergites 1–8 to width of mediotergite 4 as 1 : 0.21–0.25; maximum width (across suture between metanotum and laterotergite 1) 0.90–0.98; width of pronotum 0.82–0.88; width of head 0.60–0.65.

Colour. Head and antenna as in apterous male. Pronotum light to dark brown, with transverse stripe near anterior margin slightly lighter; black, irregularly distributed pores or punctures on pronotum except on transverse stripe and on mediotergite 1. Metanotum brown to reddish-brown. Legs brown to dark brown, with basal part of femora slightly lighter brown. Mediotergites and laterotergites as in male. Ventral surface of thorax and abdomen dark brown to black, stripe on lateral margins of sterna and caudal margin of sternum 7 brown to reddish-brown.

Pilosity as in apterous male, but mediotergites 4–7 almost hairless except for stout silvery hairs on caudal margin of mediotergite 6, in some specimens also of mediotergite 5 and 7.

Structures. Antenna 0.57–0.59 times as long as body, relative length of antennomeres 1–4 as 1.5–1.6 : 1 : 1.1–1.2 : 1.3–1.5; $1 \geq 4 > 3 > 2$. Pronotum 0.51–0.58 times as long as wide. Protibia without grasping comb. Metatarsus 0.47–0.51 times as long as metatibia, first metatarsomere 0.58–0.62 times as long as second. Mediotergites and sterna as in male. Second mediotergite 0.92–0.96 times as wide as head. Mediotergite 8 sloping and with dorsal depression. Laterotergites 2–7 strongly raised.

Genitalia. Gonocoxa 1 elongate, proctiger small, both with short, dense, erect hairs.

Diagnosis. Length of mediotergites 1–7 (8) to width of mediotergite 4 as 1 : 0.26–0.28 (apt. ♂♂), 1 : 0.21–0.25 (apt. ♀♀); maximum width in apterous males across mediotergite 4, in apterous females across suture between metanotum and laterotergite 1. Relative length of antennomeres: $1 \geq 4 > 3 \geq 2$. Male: Grasping comb on protibia 0.59–0.61 times as long as tibia. First metatarsomere 0.64–0.68 times as long as second, without special pilosity (Fig. 13); metatarsus 0.49–0.51 times as long as metatibia. Sternum 7 with large tumosity (Fig. 35). Structure of male genitalia as shown in Figures 32–34.

Etymology. The specific epithet “*tumulosa*” refers to the large tumosity on sternum 7 of males.

Comparative notes. Males of the new species can easily be determined by the large tumosity on sternum 7, which is unique within all known species of *Pseudovelia*. Females are characterized by the depression on the sloping mediotergite 8.

Distribution. Sabah (Fig. 2).

***Pseudovelia borneensis* ANDERSEN, 1983 (Fig. 6)**

Description of the macropterous morph from Sabah and Sarawak, Malaysia, by ANDERSEN (1983: p. 264, figs. 35–38); notes on apterous morph from Brunei by NIESER (1995: p. 83, figs. 7, 9).

Material examined. 1 ♂ (apt.), 2 ♂♂ (macr.) [Brunei: Temburong, Sg. Tukul\ Libut (tributary to Sg. Temburong)\ 1.12.2008, N04°34' E 115°07' 29m GPS, leg. H. Zettel (35)] (NHMW); 3 ♂♂ (macr.) [Brunei: Temburong, Sg. Engkang (tributary to Sg. Belalong), 29.11.2008\ leg. H. Zettel (28)] (NHMW); 16 ♂♂, 3 ♀♀ (apt.), 3 ♂♂, 1 ♀ (macr.) [MALAYSIA: Sabah\ Danum Valley, Segama\ River, 2.2.1997\ leg. H. Zettel (1)] (NHMW); 1 ♂ (apt.) [MALAYSIA: Sabah\ Danum

Valley, Palum\ Tambun, 7.-12.2.1997\ leg. Zettel & al. P 49] (NHMW); 2 ♂♂, 4 ♀♀ (apt.), 4 ♂♂, 2 ♀♀ (macr.) [MALAYSIA: Sabah\ Danum Valley, Palum\ Tambun, 2.-13.2.1997\ leg. H. Zettel (2)] (NHMW); 3 ♂♂ (apt.), 1 ♀ (macr.) [MALAYSIA: Sabah\ Danum Valley, Palum\ Tambun, 7.-12.2.1997\ leg. Zettel & al. P 65] (NHMW); 1 ♀ (macr.) [MALAYSIA: Sabah\ Danum Valley, Sapat\ Kalisan, 12.2.1997\ leg. H. Zettel (15)] (NHMW); 1 ♂ (apt.) [Malaysia, Sabah Ranau\ Liwagu river, 1.06.1998\ J. Kodada & F. Ciampor lgt.] (NHMW); 1 ♀ (apt.), 1 ♂ (macr.) [Malaysia, Sabah, Batu\ Punggul Resort env., 24.VI. - 1.VII.1996. 11b, shaded stream\ 1.5 - 2.0 m wide\ flowing through\ dense primary forest] (NHMW); 1 ♂ (apt.) [Malaysia, Sabah, Sabalangan\ river in primary forest ca. 25\ km SE Sapulut, 26.06.1998\ J. Kodada & F. Ciampor lgt.] (NHMW); 1 ♂ (apt.) [Malaysia, Sabah, Keningau \ J. Kodada & F. Ciampor lgt.] (NHMW); 1 ♀ (apt.), 1 ♂, 1 ♀ (macr.) [Borneo: C. Kalimantan\ junction of Kahayan & Derajoi Rivers, 21.7\ 2004, leg. P. Mazzoldi (8)] (CZW).

Comparative notes. *Pseudovelgia borneensis* sp.n. shares several characters with *P. bruneiensis* sp.n., *P. makrimallis* sp.n., *P. setisbrevia* sp.n., and *P. yangae* HECHER & ZETTEL, 2006, but the combination of diagnostic characters is unambiguous. From all these species it can be distinguished by the structure of the male segment 8. From *P. bruneiensis* sp.n. it can additionally be distinguished by the pilosity of the metatarsus, because *P. borneensis* has long hairs on the tarsomere 1, which are not present in *P. bruneiensis* sp.n. From *P. makrimallis* sp.n. it can also be separated by the grasping comb on the foretibia, which is longer than half tibia length in *P. borneensis*, but as long as or shorter than half tibia length in *P. makrimallis* sp.n. From *P. setisbrevia* sp.n. it can be distinguished by the length and the pilosity of the metatarsus. In *P. borneensis*, tarsomere 1 is shorter than tarsomere 2 and beset with a row of several bristle-like hairs decreasing in length from the base to the apex of the segment. In *P. setisbrevia* sp.n., tarsomere 1 is as long as or longer than tarsomere 2 and the bristle-like hairs forming the row are of equal length. *Pseudovelgia yangae* is larger than *P. borneensis*, and the row of bristle-like hairs on the metatarsomere 1 extends only over the basal half or at least two thirds of the segment in *P. yangae*.

On the other hand, the male genital structure of *P. borneensis* is very similar to that of *P. bipenicillata* sp.n., from which it easily can be distinguished by the tufts of long hairs on the apex of the metatibia and the base of the metatarsus present in *P. bipenicillata* sp.n.

Distribution. Sabah, Sarawak, Brunei, Kalimantan (Figs. 1, 2).

Pseudovelgia hypodonta (LUNDBLAD, 1933)

Description of the apterous morph from Sumatra by LUNDBLAD (1933: p. 329-331, fig. 104); redescription of the apterous morph and description of the macropterous morph from Singapore by HECHER & ZETTEL (2006: p. 703, figs. 1-4).

Material examined. 1 ♂ (apt.), 1 ♀ (apt.) [Malaysia, Sabah, Crocker\ Range, Tenom env., Kalang\ Waterfall, 16.-18.V.1998\ J. Kodada & F. Ciampor lgt.] (NHMW).

Size. body length 2.25 mm (♂), 2.70 mm (♀); length of mediotergites 1-7 (♂♂) or 1-8 (♀♀) to width of mediotergite 4 as 1 : 0.31 (♂), 1 : 0.26 (♀); maximum width across suture between metanotum and laterotergite 1: 0.84 mm (♂) or across mediotergite 4: 0.95 mm (♀); width of pronotum 0.78 mm (♂), 0.80 mm (♀); width of head 0.58 mm (♂), 0.63 mm (♀).

Comparative notes. *Pseudovelgia hypodonta* is firstly recorded from Borneo. The maximum width of the male specimen from Sabah is slightly broader, the antenna in relation to the body length, the grasping comb on the protibia, and the metatarsus in relation to the metatibia are slightly longer than described in HECHER & ZETTEL (2006). All other characters, especially the structure of the genitalia, correspond with the descrip-

tion. The body of the female specimen is generally longer, broader, and darker, but the pilosity and the structure of the antenna, the metatibia, the metatarsus, and the genitalia correspond with the description.

Distribution. Sumatra, Riau Island, Bintan Island, Singapore, Sabah (Figs. 1, 2).

***Pseudovelgia yangae* HECHER & ZETTEL, 2006**

Description of the apterous and macropterous male and the macropterous female from West Malaysia and southern Thailand by HECHER & ZETTEL (2006: p. 705, figs. 9–13).

Additional material examined. 1♂, 5♀♀ (apt.) [MALAYSIA–Johor, Endau, Rompin, Sg. Jasen, jetty\ CM Yang et al.\ 12–JUL–2001 YCM0250] (NHMW).

Comparative notes. *Pseudovelgia yangae* shares several characters with *P. borneensis*, *P. makrimallis* sp.n., and *P. setisbrevia* sp.n. From *P. borneensis* it can be distinguished by the structure of the male segment 8. The distance between the caudal and basal spines is shorter than the width of the depression in *P. yangae*, but longer than the depression width in *P. borneensis*. From *P. makrimallis* sp.n. and *P. setisbrevia* sp.n. it differs by the pilosity of the first metatarsomere. The hairs on this segment are very dense and shorter than one third of the segment length in *P. yangae*, but sparse and at least as long as one third of the segment length in *P. makrimallis* sp.n. and *P. setisbrevia* sp.n.

Distribution. West Malaysia, Thailand (Fig. 1).

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