

New species and subspecies of the genus *Strongylovelia* ESAKI (Insecta: Heteroptera: Veliidae) from Borneo and the Philippines

I. Lansbury* & H. Zettel**

Abstract

Eight species and three subspecies of the genus *Strongylovelia* ESAKI are described as new: *Strongylovelia hirsutula* sp.n. (Sarawak), *S. connexivum* sp.n. (Sarawak), *S. esakii* sp.n. (Kalimantan Timur, Sarawak), and *S. aberrans* sp.n. (Kalimantan Timur) from Borneo, *S. palawanensis* sp.n. (Palawan, Busuanga), *S. philippinensis philippinensis* sp.n. (Luzon), *S. philippinensis sibuyana* ssp.n. (Sibuyan), *S. philippinensis boholensis* ssp.n. (Bohol), *S. philippinensis bukidnonica* ssp.n. (Mindanao), *S. mindoroensis* sp.n. (Mindoro), and *S. cebuana* sp.n. (Cebu) from the Philippines. No species was previously described from these areas. The record of *S. formosa* ESAKI from Luzon by POLHEMUS & REISEN (1976) probably belongs to *S. philippinensis philippinensis* ssp.n. Six of the eight new species are arranged within two morphologically distinct and geographically isolated species groups. The male of *S. formosa* is described for the first time.

Key words: Veliidae, *Strongylovelia*, new species, Philippines, Malaysia, Sarawak, Indonesia, Kalimantan, Borneo.

Zusammenfassung

Acht Arten und drei Unterarten der Gattung *Strongylovelia* ESAKI werden neu beschrieben: *Strongylovelia hirsutula* sp.n. (Sarawak), *S. connexivum* sp.n. (Sarawak), *S. esakii* sp.n. (Kalimantan Timur, Sarawak), und *S. aberrans* sp.n. (Kalimantan Timur) aus Borneo, *S. palawanensis* sp.n. (Palawan, Busuanga), *S. philippinensis philippinensis* sp.n. (Luzon), *S. philippinensis sibuyana* ssp.n. (Sibuyan), *S. philippinensis boholensis* ssp.n. (Bohol), *S. philippinensis bukidnonica* ssp.n. (Mindanao), *S. mindoroensis* sp.n. (Mindoro), und *S. cebuana* sp.n. (Cebu) von den Philippinen. Keine Art war bisher aus diesen Gebieten beschrieben. Der Nachweis von *S. formosa* ESAKI von Luzon durch POLHEMUS & REISEN (1976) bezieht sich wahrscheinlich auf *S. philippinensis philippinensis* ssp.n. Sechs der acht neu beschriebenen Arten werden in zwei morphologisch gut abgegrenzte und geografisch isolierte Artengruppen eingeordnet. Das Männchen von *S. formosa* wird erstmals beschrieben.

Introduction

The genus *Strongylovelia* ESAKI, 1924, is one of two described limnic genera of the subfamily Haloveliinae. Species of *Strongylovelia* are easily to recognize within this subfamily by yellow marks on thorax and frequently also on abdomen. From the other limnic genus *Entomovelina* ESAKI, 1930, *Strongylovelia* can be distinguished further by the longer second antennal segment, the longer first hind tarsal segment, and the much less hirsute body. Three *Strongylovelia* species are presently known: *Strongylovelia formosa* ESAKI, 1924 (type species), from Taiwan, *S. albicollis* ESAKI, 1926, from New Guinea, and

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S. priori LANSBURY, 1993, from New Britain (ESAKI 1924, 1926, LANSBURY 1993). LUNDBLAD (1933) described the alleged male of *S. formosa* from Sumatra, but this is probably a new species. The same taxon is recorded from Luzon, Philippines (POLHEMUS & REISEN 1976), the specimens mentioned are from the type area of *S. philippinensis philippinensis* ssp.n. and probably belong to this subspecies. POLHEMUS (1979) recorded *S. formosa* from Sri Lanka, these specimens are thought to belong to an undescribed species. ANDERSEN (1982) mentioned the genus for India and Thailand. Several additional species were recently collected by the junior author in Thailand, and further material is known from Vietnam and Sulawesi. Probably the genus is distributed in a major part of the Oriental, Wallacean, and Papuan Realms. The small size of the specimens and the discrete differences between the species probably accounts for the lack of further records of *Strongylovelia* in literature and the poorly known taxonomy of the genus.

The descriptions of new species and subspecies in this paper are mainly the results of several collecting trips of the junior author to the Philippines and Sarawak and represent a first step in the revision of the *Strongylovelia* species in these regions. Besides the two very aberrant species from Borneo, we recognize two groups of closely related species: The *S. esakii* group with three species from Borneo and Palawan (which is zoogeographically closely allied with Borneo) and closely allied to *S. formosa* from Taiwan; and the *S. philippinensis* group which shows a radiation within the Philippine archipelago. The classification of different island populations has proved to be rather difficult. One reason is, that in most *Strongylovelia* species no distinct differences in the male genitalia could be detected (see Figs. 66 - 75). The females exhibit a number of secondary sexual characters, e.g. abdominal features, connexiva and constant colour patterns. Unfortunately, of most taxa we had only single populations available, so that in future there will perhaps be taxonomic changes by downgrading of species or upgrading of subspecies in this group as more material becomes available. In this study, we treat four Philippine populations as subspecies of one widely distributed species (*S. philippinensis* sp.n.) to express their closer relationship to each other than to other Philippine species (*S. mindoroensis* sp.n. and *S. cebuana* sp.n.).

Abbreviations:

BMNH	The Natural History Museum, London [formerly: British Museum of Natural History]
CGL	Coll. V.P. Gapud, Los Baños, Philippines
CJP	Coll. J.T. Polhemus, Englewood, Colorado, U.S.A.
CNT	Coll. N. Nieser, Tiel, The Netherlands
CPC	Coll. P.P. Chen, Beijing, China
CZW	Coll. H. Zettel, Vienna, Austria
KUFJ	Kyushu University, Faculty of Agriculture, Entomological Laboratory, Fukuoka, Japan
NMW	Naturhistorisches Museum, Vienna, Austria
OUM	Oxford University Museum, England
UPLB	Museum of Natural History, University of the Philippines, Los Baños, Philippines

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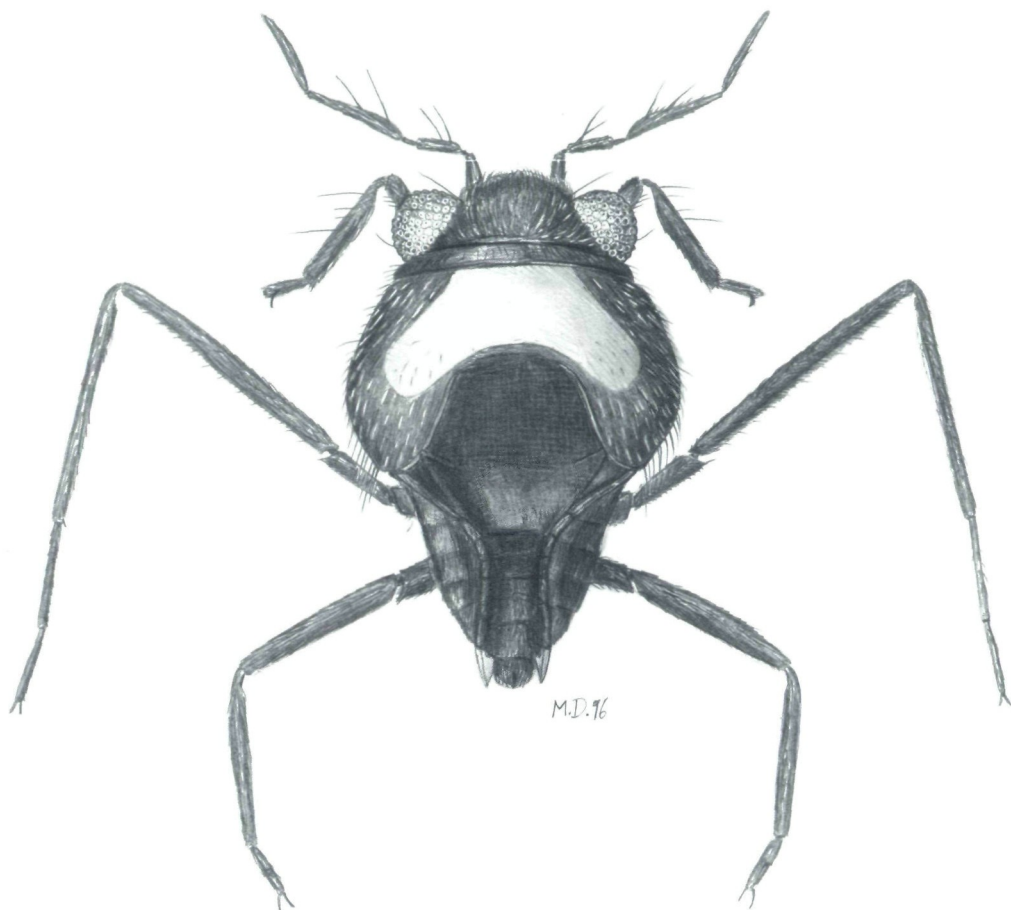


Fig. 1: Habitus of *Strongylovelia hirsutula* sp.n.

the loan of a male *Strongylovelia formosa*. Our thanks are also due to Dipl.Ing. Martin Donabauer (Vienna) for the excellent artwork of Fig. 1, to Mag. Christine Hecher (Vienna) for making most of the measurements listed in Tab. 1, and to Dr. Ping-ping Chen and Dr. Nico Nieser (Tiel) for critical comments on the manuscript.

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Notes on biology

All samplings collected by the junior author were made under similar conditions: Specimens of *Strongylovelia* are found only in running waters, preferably in small brooks, creeks and channels, rarely in larger habitats, where they occur in slow lotic-lentic shaded areas. They obviously prefer shady areas. Usually the water is more than 20 cm deep.

Strongylovelia tend to congregate in groups and there is no apparent separation of immature stages from adults unlike other lotic veliids, e.g. *Rhagovelia*. This may be due to the immature stages of some *Rhagovelia* species (e.g. of the *R. orientalis* group) preferring lower current velocities than the adults, but all stages of *Strongylovelia* live in areas with very low current. Adults of *Strongylovelia* are very agile and move very quickly for their size in straight lines. When caught in the net (out of the water) they are capable of jumping several centimetres high. In larger colonies many pairs may be found "in-cop", the smaller males on the females dorsum. Caught pairs separate fairly quickly compared with several other Gerromorpha with similar mating behaviour (e.g. *Rhagovelia phoretica* D. POLHEMUS, *Microvelia diluta* DISTANT).

Notes on morphology

Meso- and metanotum (apterous morph).

Haloveliinae have a very derived morphology of meso- and metathorax, which is mainly due to a different locomotion (ability to jump) within the Veliidae: the mesothorax, bearing the long middle legs, is strongly enlarged, the metathorax is much smaller. These conditions are convergently evolved to that in Gerridae (see ANDERSEN 1982).

In most apterous Haloveliinae the mesonotum is very large, with straight hind margin, and the metanotum is a narrow band (sometimes more or less fused with the mesonotum or the abdominal tergite 1). These condition should be regarded as typical (original) for Haloveliinae and is also represented in some *Strongylovelia* species: in *S. albicollis*, *S. priori*, and in one undescribed species from Thailand.

But in *Strongylovelia formosa*, all species described in this paper, and in further undescribed species (from Sulawesi, Vietnam, and Thailand) the morphology of the thorax is even more derived: The metanotum is medially reduced to a very thin, curved band and completely fused with the mesonotum; and the "meso-metanotum" forms posterio-lateral lobes or angles which reach postward (Figs. 1 - 8). Usually no trace of a suture is visible between meso- and metanotal parts, only sometimes the suture is laterally very weakly impressed and runs in a bow forward to the dorsal end of the meso-metapleural suture. In the medial part the border between meso- and metanotum is probably marked by the hind margin of the yellow area in several species. The abdominal tergite 1 is very large, especially in females, and inserted between the lobes of (meso-)metanotum; usually it is medially fused with the meso-metanotum (e.g. Fig. 24).

The species from the Papuan region and Thailand, which show the more primitive condition of meso- and metanotum, should be considered to belong to a different subgenus. They further differ in a longer antenna (more than $\frac{3}{4}$ of body length in both sexes, probably plesiomorph character), and a larger, lid-like, and ventrad directed female proctiger (apomorph character).

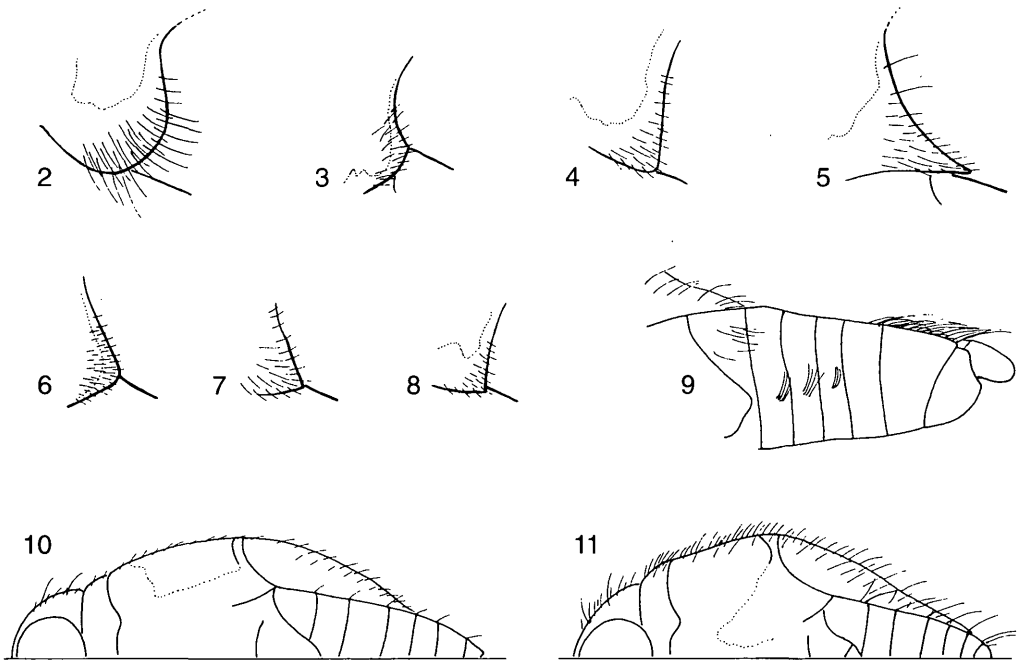
Macropterous morph and wing autotomy.

The macropterous morph of *Strongylovelia* was described and figured by ESAKI (1926) for the first time (*Strongylovelia* ? *albicollis*). Also ANDERSEN (1982) figured the fore wing of *Strongylovelia* sp. One fully winged male of *S. priori* is known from East New

Britain; winged specimens of *S. formosa* are unknown. Macropterous specimens are known in three out of eleven newly described taxa only. They are always very rare, and it is common that macropterous specimens are dealate. In this case the wings are always broken off at their extreme base (Figs. 58 - 59). Specimens examined are apterous if not otherwise mentioned.

Key to *Strongylovelia* species groups, species, and subspecies from Borneo and the Philippines (apterous specimens)

- 1 ♀♀ 2
- ♂♂ (♂♂ of *S. hirsutula* sp.n. and *S. aberrans* sp.n. unknown) 10
- 2 Posterio-lateral meso-metanotal lobes large and rounded, densely set with long black hairs (Figs. 1, 2). Tergites 1 - 3 fused. Connexiva partially covering tergites and tergites 4 - 5 deeply impressed (Fig. 1) (Sarawak) ***S. hirsutula* sp.n.**
- Meso-metanotum posteriorly simple or with small, angular lobes, which are not densely set with long black hairs (Figs. 3 - 5). At least tergites 1 and 2 or 2 and 3 not fused. Connexiva rarely covering tergites, if so all tergites flat 3
- 3 Connexiva covering a most of tergites. Abdomen long and slender (Fig. 12). Hind corners of meso-metanotum weakly produced (Fig. 3) (Sarawak)..... ***S. connexivum* sp.n.**
- Connexiva more or less erect or deflected outwards, rarely reflexed over distal tergites, but never covering them for the most part (Figs. 24, 30, 46, 60 - 65). Abdomen short and broad. Meso-metanotum with more or less extended, angulate hind corners (Figs. 4 - 5) 4
- 4 Tergites narrow, tergite 5 about 2 - 3 times as wide as long (Fig. 46, 61 - 65), tergites (1 -) 2 (- 3) yellowish and with a mediocaudal lobe (rarely not visible on tergite 2, if tergites 2 and 3 fused), tergites (4 -) 5 - 6 with a deep medial impression. Posterior corner of meso-metanotum produced, forming a sharp angle (Fig. 5). Tip of abdomen usually yellowish (*S. philippinensis* group) 5
- Tergites wider, tergite 5 at least 4 times as wide as long (Figs. 24, 30, 60), all tergites black, flat and with straight hind margin. Posterior corner of meso-metanotum less produced, forming an obtuse angle (Fig. 4). Tip of abdomen always blackish (*S. esakii* group) 8
- 5 Sternites 3 - 5 (or 3 - 4) with distinct tufts of black hairs laterally (Fig. 9, 61 - 63). Sternites 2 - 3 (- 4) always with yellow marks near to connexiva. Median length of pronotum slightly shorter than half length of eye ***S. philippinensis* sp.n.** 6
- Sternites 3 - 5 without tufts of black hairs laterally 7
- 6 The four subspecies of *S. philippinensis* sp.n. are distinguishable by the following sets of characters:
- Tergite 1 with a medial triangular yellowish mark (Fig. 46) usually confluent with yellowish meso-metanotal mark and with narrow yellowish hind margin. Protibia and mesofemur yellowish, apically brownish. Tergites broadest, tergite 5 about 3 times as wide as long. Tergites 2 and 3 not fused. Tergite 8 with a shallow, somewhat shining median impression. Suture between tergites 1 and 2 distinct (Philippines: Luzon) ***S. philippinensis philippinensis* ssp.n.**



Figs. 2 - 11: Posterior lobe of (meso-)metanotum in front view: (2) *S. hirsutula* sp.n., ♀, (3) *S. connexivum* sp.n., ♀, (4) *S. esakii* sp.n., ♀, (5) *S. philippinensis philippinensis* ssp.n., ♀, (6) *S. connexivum* sp.n., ♂, (7) *S. palawanensis* sp.n., ♂; (8) *S. philippinensis philippinensis* ssp.n., ♂, (9) lateral view of ♀ abdomen in *S. philippinensis philippinensis* ssp.n.; pilosity of dorsum in males of (10) *S. (?) esakii* sp.n. and (11) *S. philippinensis philippinensis* ssp.n.

- Tergite 1 with a narrow medial yellowish mark (very rarely lacking) not confluent with yellowish mark of mesonotum, with black hind margin (Fig. 62). Protibia brownish, mesofemur blackish. Tergites relatively broad, tergite 5 about 2.8 times as wide as long. Tergites 2 and 3 not fused. Tergite 8 with inconspicuous median impression. Suture between tergites 1 and 2 obsolete (Philippines: Bohol) *S. philippinensis boholensis* ssp.n.
 - Tergite 1 completely black. Protibia and mesofemur blackish. Tergites narrow, tergite 5 about 2.5 times as wide as long. Postero-median lobe of tergite 2 narrower and prominent (Fig. 61). Tergites 2 and 3 not fused. Tergite 8 without median impression. Tergites 1 and 2 of different colour, but suture obsolete (Philippines: Sibuyan) *S. philippinensis sibuyana* ssp.n.
 - Tergite 1 only with yellowish hind margin. Protibia and mesofemur blackish. Latero-tergite 2 with a few very long, mediad directed hairs, which are lacking in other subspecies (Fig. 63). Tergites very narrow, tergite 5 about 2.0 times as wide as long. Postero-median lobe of tergite 2 broad and shallow, or tergites 2 and 3 fused. Tergite 8 without median impression. Suture between tergites 1 and 2 distinct (Philippines: Mindanao) *S. philippinensis bukidnonica* ssp.n.
- 7 Sternites 2 - 3 with yellow marks near to connexiva. Tip of abdomen yellowish. Median pronotal length slightly shorter than half eye length. Abdomen more slender,

- all sternites partially visible from dorsal aspect (Fig. 65). Tergites 1 - 3 with larger middle lobes at hind margin (Philippines: Cebu) *S. cebuana* sp.n.
- All sternites and tip of abdomen completely black. Median pronotal length slightly longer than half eye length. Abdomen broader, only connexiva visible from dorsal aspect (Fig. 64). Tergites 1 - 3 with middle lobes at hind margin much smaller (Philippines: Mindoro) *S. mindoroensis* sp.n.
- 8 Sternite 2 laterally at connexiva without tufts of black hairs. Sternites laterally with a row of long bristles. Connexiva slightly inflexed, obscuring laterotergites 6 - 7 (Fig. 60). Length of antennal segment 2 subequal to length of segment 1 and half length of segment 3. Medial pronotal length as long as half eye length. Thorax with a complete black lateral stripe which is especially broad at anterior margin of mesothorax (Kalimantan) *S. aberrans* sp.n.
- Sternite 2 laterally at connexiva with distinct tufts of black hairs (Fig. 24, 40). Sternites laterally without row of bristles. Connexiva erect, all laterotergites visible (Fig. 24, 40). Antennal segment 2 distinctly longer than segment 1 and longer than half length of segment 3 (Figs. 29, 40). Median pronotal length slightly shorter than half eye length (Figs. 24, 40). Lateral stripe on thorax at anterior margin of mesothorax very thin or interrupted 8
- 9 Tergite 7 medially with a tuft of long black hairs (Fig. 30). Tergites 5 - 6 with reduced pilosity and somewhat shining in lateral areas (Philippines: Palawan, Busuanga) *S. palawanensis* sp.n.
- Tergite 7 medially without long black hairs. Tergites 5 - 6 tomentose and laterally not shining (Kalimantan, Sarawak) *S. esakii* sp.n.
- 10 Abdomen more slender (Fig. 13). Longest connexivial hairs slightly shorter than length of tergite 6. Paramere distal of middle strongly enlarged and then suddenly narrowing to a slender tip (Fig. 66) (Sarawak) *S. connexivum* sp.n.
- Abdomen stouter (Figs. 31, 47). Longest connexivial hairs longer, usually more than twice length of tergite 6, rarely only 1.3 times as long. Paramere not strongly enlarged (Figs. 67 - 75) 11
- 11 Dorsum of thorax and anterior tergites with short, suberect, bristle-like hairs in addition to the adpressed hair layer (best seen in lateral aspect, Fig. 10) (*S. philippinensis* group) 12
- Dorsum of thorax and anterior tergites with uniform adpressed hair layer (Fig. 11) (*S. esakii* group) 14
- 12 Apex of profemur, entire mesofemur, and apical half of metafemur blackish 13
- All femora yellowish to brownish. Parameres see Figs. 69, 71, 72, 74 *S. philippinensis* sp.n. (sspp.n. *philippinensis*, *boholensis*, *bukidnonica*) and *S. cebuana* sp.n.
- 13 Median pronotal length slightly shorter than half length of eye. Paramere see Fig. 70 (Philippines: Sibuyan) *S. philippinensis sibuyana* ssp.n.
- Median pronotal length slightly longer than half length of eye. Paramere see Fig. 73 (Philippines: Mindoro)..... *S. mindoroensis* sp.n.
- 14 Long hairs on connexiva about twice as long as tergite 6 (Philippines: Palawan) *S. palawanensis* sp.n.
- Long hairs on connexiva slightly longer than tergite 6 (Sarawak) *S. (?) esakii* sp.n.

Descriptions of species and subspecies

Strongylovelia hirsutula sp.n. (Figs. 1, 2)

Type material. - Holotype (♀): "SARAWAK (Borneo) III.1994\ Rumah Kabau anak muggot\ Ng sebong Baleh (ca 25 km\ E from Kapit), J. Kodada leg." (NMW).

Description.

Apterous female. Length 1.49 mm. Width 0.72 mm. Body drop-shaped, with globular thorax and strongly tapered abdomen (Fig. 1).

Colour. Black except a slender-reniform mark on meso-metanotum, prosternum, a major part of mesosternum, ventral half of mesopleura, two marks on metasternum, and base of profemur yellow.

Median pronotal length 0.3 times eye length. Meso-metanotum strongly developed, with broad, postero-lateral lobes, which restrict the tergite 1 to middle part. These lobes with densely set, long, black hairs (Fig. 2). Measurements of antenna and legs as listed in table 1. Long hairs on legs sparse, only on protibia with black bristles. Metafemur only with short pubescence.

Connexiva wrapped to middle and covering lateral parts of tergites, especially in posterior half (Fig. 1). Connexivum of segment 7 apically rounded and set with longer hairs. Tergites 1 - 3 completely fused to a steeply dropping plate. Following tergites narrow. Tergites 4 - 5 deeply impressed. Tergite 8 laterally with long black hairs, medially with a shallow, shining impression. Laterotergites not visible. Sternite 2 laterally with an inconspicuous tuft of black hairs.

Male and macropterous morphs unknown.

Comparative notes. *Strongylovelia hirsutula* sp.n. is very distinctive by the strongly developed and hirsute postero-lateral lobes of the meso-metanotum, the complete fusion of tergites 1 - 3, and the combination of wrapping connexiva and impressed tergites 4 - 5. The colour of *S. hirsutula* sp.n. is darker than in any other described species.

Distribution. Borneo: Sarawak: 25 km E of Kapit (type locality).

Etymology. Diminutive of *hirsutus* (Latin, adjective) meaning bristly, referring to the hirsute postero-lateral corners of meso-metanotum.

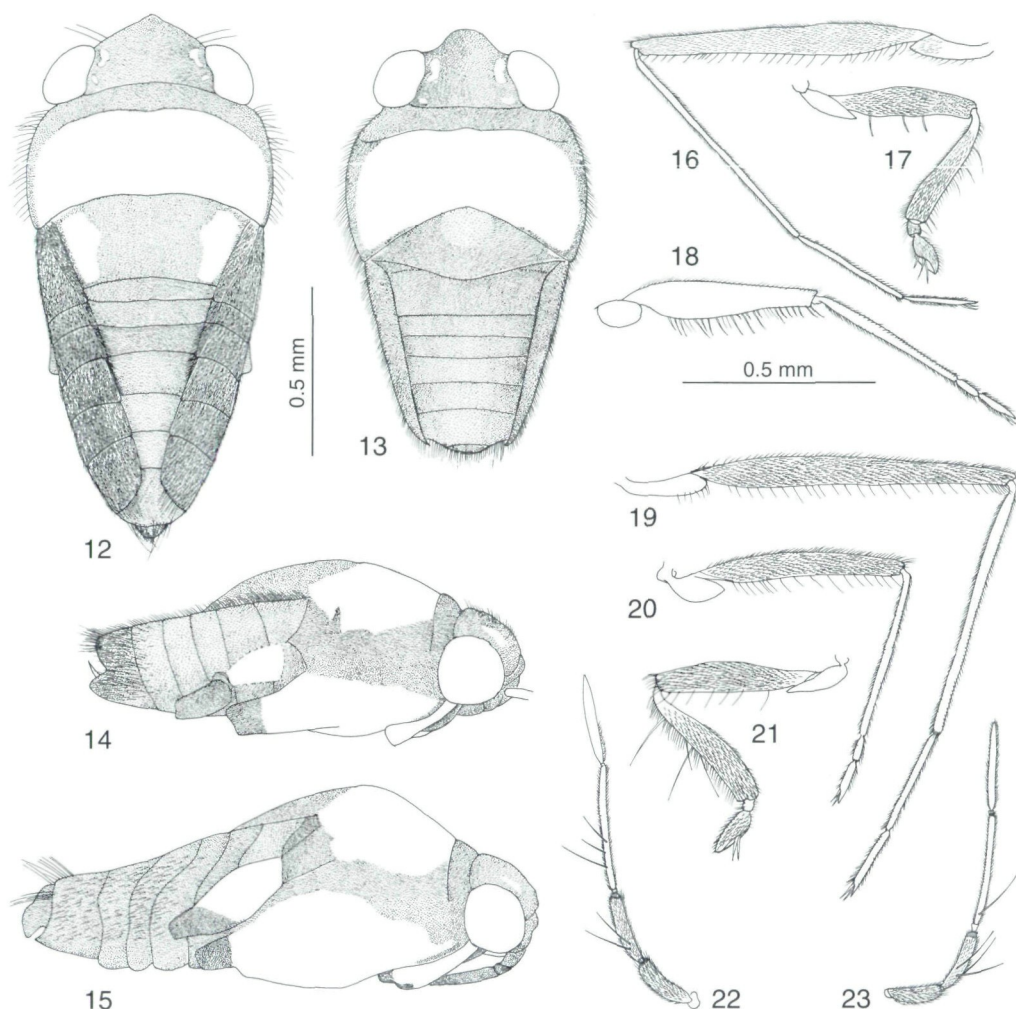
Strongylovelia connexivum sp.n. (Figs. 3, 6, 12 - 23, 66)

Type material. - Holotype (♀): "MALAYSIA: Sarawak\ Lambir Hills NP, 25 km\ S Miri, 24.-25.2.1993, leg. H. Zettel (9)", "(b) kleine Bäche in\ trop. Regenwald [= small brook in tropical rain forest]" (NMW); paratypes: 8 ♀♀, 9 ♂♂ same locality data (CJP, CNT, NMW, OUM); 5 ♂♂, 2 ♀♀ "MALAYSIA: Sarawak\ Bako NP, N Kuching\ 21.-22.2.1993\ leg. H. Zettel (8)" (NMW).

Description.

Apterous female. Length 1.54 - 1.62 mm. Width 0.66 - 0.70 mm. Body slender (Fig. 12).

Colour (Figs. 12, 15). Black except head along dorsal eye margin yellowish, meso-metanotum (except anterior corners), prosternum, mesosternum, mesopleura, a mark on metapleura, two small marks postero-laterally on tergite 1, basal two thirds of pro-



Figs. 12 - 23: *Strongylovelia connexivum* sp.n.: body of (12) female and (13) male, dorsal view; body of (14) male and (15) female, lateral view; (16) middle leg, (17) front leg, and (18) hind leg of male; (19) middle leg, (20) hind leg, and (21) front leg of female; antenna of (22) female and (23) male.

femur, and metatrochanter yellow. Between mesopleura and mesonotum with a broad black lateral stripe which is not interrupted or narrowed, but broadened in anterior part.

Median pronotal length 0.35 times eye length. Meso-metanotum with obtuse, weakly protruded hind corners (Fig. 3). Mesothorax laterally with a dense row of long black hairs. Sternites laterally with very few long black hairs. Tergite 8 with a row of long black hairs along hind margin. Body lacking other conspicuous pilosity. Measurements of antenna (Fig. 22) and legs (Figs. 19 - 21) as listed in table 1. Long hairs on legs sparse, only on protibia with black bristles. Pilosity on metafemur semierect and shorter than usually.

Connexiva wrapped to middle, covering major parts of all tergites. Connexivum of segment 7 apically rounded. Tergites broad and flat, not impressed, with rather dense pubescence, without special characters. Tergite 2 fused with tergite 1. Laterotergites not visible.

Apterous male. Length 1.31 - 1.41 mm. Width 0.66 - 0.70 mm. Body relatively slender (Fig. 13).

Colour (Figs. 13, 14) similar to that of female except tergite 1 completely black. Base of metafemur in some specimens yellowish.

Median pronotal length 0.4 times eye length. Posterior corners of (meso-)metanotum even more obtuse than in female (Fig. 6). Black hairs laterally on mesothorax less conspicuous than in female. Hairs along connexiva short, of about same length as tergite 6. Measurements of antenna (Fig. 23) and legs (Figs. 16 - 18) as listed in table 1. Long hairs on legs sparse, only on protibia with black bristles. Metafemur with several long, spiny bristles.

Abdomen rather long, anterior tergites (1 - 4) distinctively convex, the following nearly flat. Tergite 2 separated from tergite 1 by a more or less developed suture. Tergite 5 about 5 times as long as wide. Paramere very distinctive, distally of middle strongly enlarged and then suddenly narrowing to a slender tip (Fig. 66).

Macropterous morphs unknown.

Comparative notes. Very distinctive species with more slender body shape in both sexes than in all other species. Females are easy to distinguish by the strongly wrapped connexiva, which cover a large part of all tergites, and by the sparse pilosity. Males have a typical short pilosity along the connexiva and a distinctively shaped paramere.

Distribution. Borneo: Sarawak: Lambir Hills (type locality) and Bako NP.

Etymology. Named after the characteristic connexivum of the female (used as a noun in apposition).

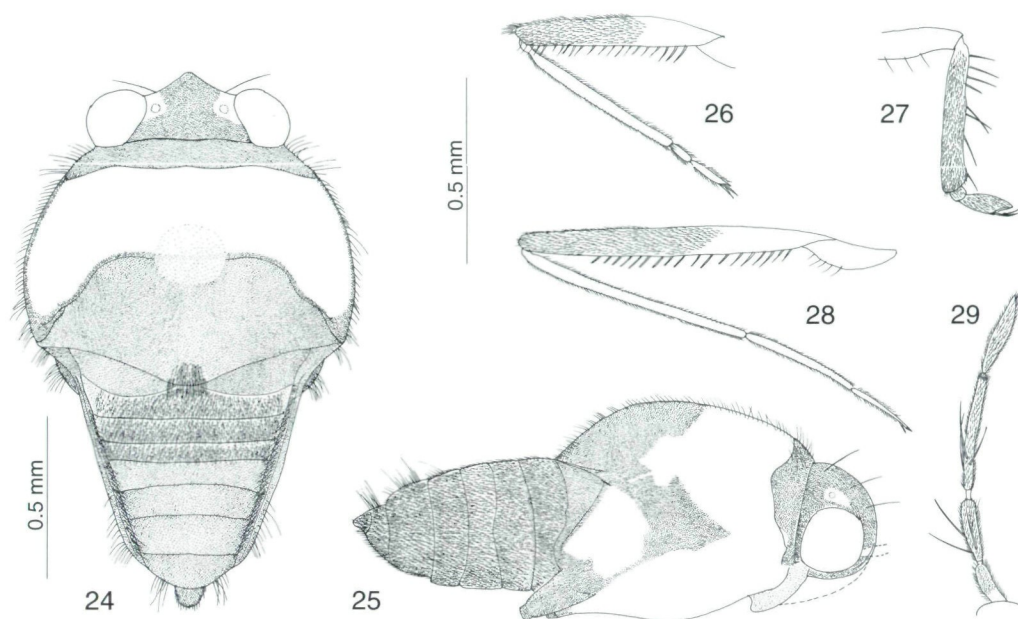
Strongylovelia esakii group

Diagnosis: Females with broad abdomen, especially with broad tergites, which are not or only slightly covered by connexiva, none of them impressed; and with meso-metanotum forming an obtuse hind angle. Males distinguishable from those of the *S. philippinensis* group by uniform hair layer on dorsum of thorax and anterior segments. Paramere with relatively slender distal part.

This group contains three species: *Strongylovelia esakii* sp.n. and *S. aberrans* sp.n., both from Borneo, and *S. palawanensis* sp.n. from Palawan Province. *Strongylovelia formosa* from Taiwan possibly also belongs to this group.

Strongylovelia esakii sp.n. (Figs. 4, 10, 24 - 29, 67)

Type material. - Holotype (♀): "INDON., Kalimantan Timur\ Long Bagun Ulu,\ 14.1.1995\ lg.Seyfert & Graindl(9)" (NMW); paratype: 1 ♀ "MALAYSIA:Sarawak (12)\ Kelabit Highland\ 5 km E Bareo,Pa Ukat\ 1000 m, 27.2.1993", "(a) mäandrierender,\ ca. 6 m breiter Fluß [= meandering, ca. 6 m wide stream]\ leg. H. Zettel" (NMW).



Figs. 24 - 29: *Strongylovelia esakii* sp.n., ♀ paratype from Sarawak: body in (24) dorsal and (25) lateral view; (26) middle leg; (27) front leg; (28) hind leg; (29) antenna.

Additional material: 1 ♂ "MALAYSIA: Sarawak\ Mulu NP, 3.-5.3.\ 1993, leg.H.Zettel (14)", "(c) flache Tümpel im\ Regenwald [= shallow pools in rain forest] nahe dem\ Headquarter, 3.3." (NMW).

Description.

Apterous female. Length 1.59 - 1.70 mm. Width 0.90 - 0.98 mm. Body broad (Fig. 24). Colour (Figs. 24, 25). Black except head along dorsal eye margin orange, meso-meta-notum (except anterior corners and thin stripe along hind margin), prosternum, meso-sternum, mesopleura, a large mark on metapleura, basal three fourths of profemur, meta-trochanter, and basal half of metafemur yellow. Between mesopleura and mesonotum with a broad black lateral stripe which is strongly narrowed or interrupted before middle. Median pronotal length 0.35 times eye length. Mesothorax laterally with a dense row of long black hairs. Sternite 2 laterally at connexivum with a tuft of long black hairs. Connexiva 4 - 7 with erect black hairs, which increase in length. Tergite 8 with tufts of long black hairs at hind corners. Tergites with uniform fine silverish pubescence. Measurements of antenna (Fig. 29) and legs (Figs. 26 - 28) as listed in table 1. Pilosity of legs: protibia with black bristles. Ventral pilosity on metafemur semierect, somewhat longer in distal half.

Connexiva directed upward, not covering tergites. Laterotergites with short, dense pilosity all over their length, but restricted to external part on anterior laterotergites. Connexivum of segment 7 apically angular. Tergites broad and flat, not impressed, without special characters. Tergite 5 about 6 times as broad as long. Tergite 2 fused with tergite 1. Sternites 3 - 5 somewhat shining laterally.

Apterous male. The single male, collected in another site than the females, fits well in the general appearance of the species, but because of the similarity of species within the *S. esakii* group there must remain some doubts on its conspecific status.

Length 1.18 mm. Width 0.68 mm. Body relatively broad.

Colour similar to that of female except black stripe between yellow areas on mesonotum and mesopleura broad, not conspicuously narrowed before middle.

Median pronotal length 0.4 times eye length. Black hairs laterally on mesothorax shorter and less conspicuous than in female. Hairs along connexiva short, slightly longer than length of tergite 6 (about 1.3 times). Measurements of antenna and legs as listed in table 1. Pilosity of legs: protibia externally and mesofemur and metafemur internally with thinner black bristles, metafemur additionally with several long, spiny bristles.

Abdomen short, anterior tergites (1 - 4) slightly convex, the following tergites nearly flat. Tergite 1 - 3 fused with metanotum, suture between tergites 2 and 3 weakly developed. Tergite 5 about 7 times as long as wide. Paramere slender, distal part scantily indented (Fig. 67).

Macropterous morphs unknown.

Comparative notes. Similar to the following two species from which it differs mainly in structures of female abdomen, lengths of antennal segments, and colour pattern (see key).

Distribution. Borneo: Kalimantan Timur: Long Bagun Ulu (type locality); and Sarawak: Kelabit Highlands, ? Mulu NP.

Etymology: Named in honour of Teiso Esaki, who described the genus and two of three formerly described species.

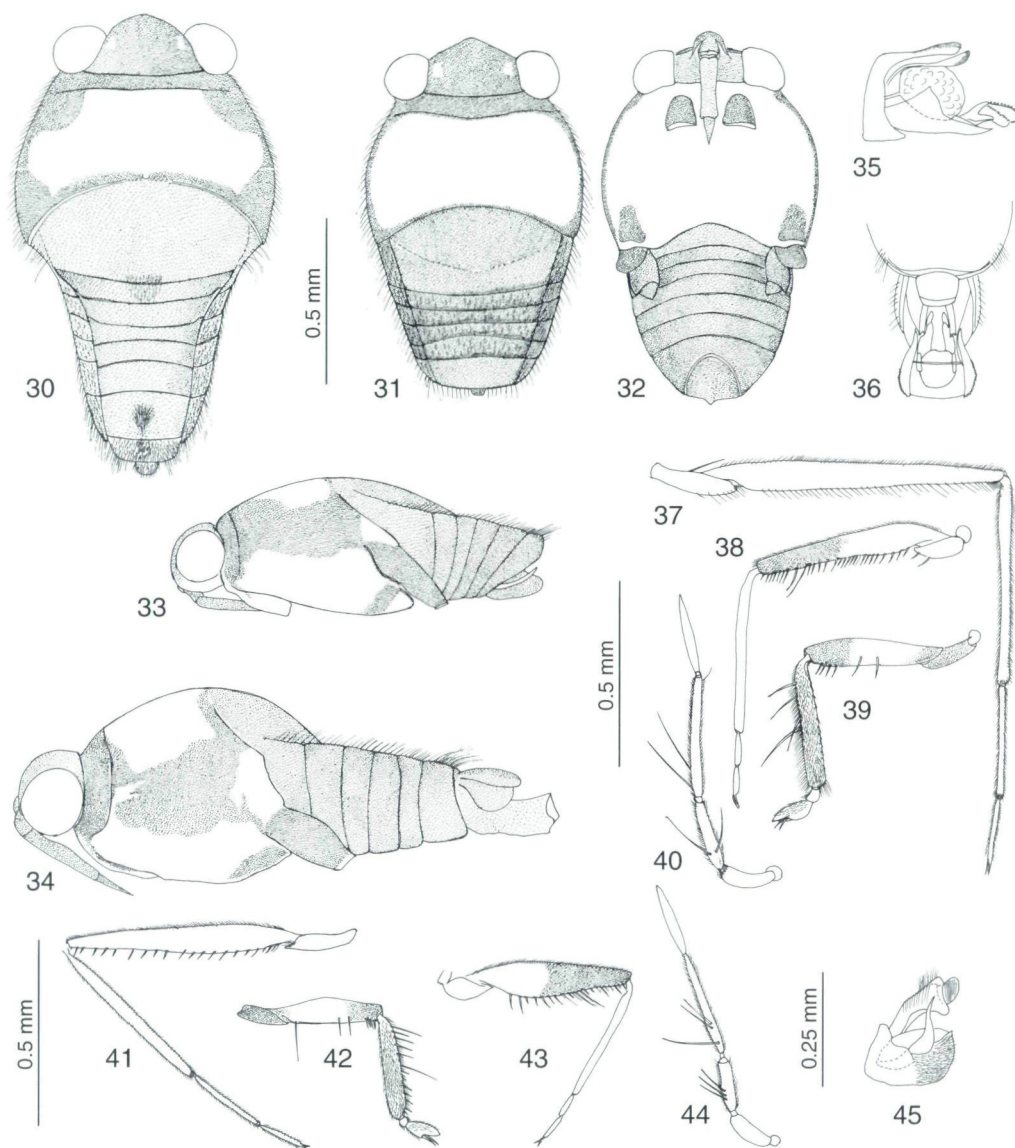
Strongylovelia palawanensis sp.n. (Figs. 7, 30 - 45, 58, 68)

Type material. - Holotype (♀): "PHILIPPINEN: Palawan\ 9 km W P. Princesa\ Iwahig, Balsahan riv.\ lg. Zettel, 24.3.1994(48)" (NMW); paratypes: 21 ♂♂ 12 ♀♀, same locality data (CJP, CNT, NMW, OUM, UPLB); 2 ♂♂ 2 ♀♀ "PHILIPPINEN: Palawan\ 9 km W P. Princesa\ Iwahig, Balsahan riv.\ lg. Zettel, 7.4.1994(60)" (NMW); 1 ♂ 1 ♀ "PHILIPPINEN: Palawan\ Sabang, 0 - 30 m\ 27.3.1994\ leg. H. Zettel (52b)" (NMW); 4 ♂♂ 3 ♀♀, 1 ♀ (macropterous, dealate) "PHILIPPINEN: Palawan\ Sabang, 0 - 30 m\ 29.3.1994\ leg. H. Zettel (52e)" (NMW, OUM); 13 ♂♂ 20 ♀♀, 2 ♂♂ 3 ♀♀ (macropterous, 1 ♂ dealate): "PHILIPPINEN: Palawan Pr.\ Busuanga Is., 13rd.km WNW\ Coron, Balulu Falls, 24.2.\ 1996, leg. H. Zettel (81)" (BMNH, CZW, NMW, OUM, UPLB); 2 ♂♂ 4 ♀♀, 1 ♂ 1 ♀ (macropterous, dealate) "PHILIPPINEN: Palawan Pr.\ Busuanga Is., 5 km NW Coron\ Mabintangan Riv., 25.-29.2.\ 1996, leg. H. Zettel (82)" (CZW, NMW).

Description.

Apterous female. Length 1.42 - 1.56 mm. Width 0.78 - 0.86 mm. Body broad (Fig. 30).

Colour (Figs. 30, 34). Black except head along dorsal eye margin orange, meso-metanotum (except anterior corners and a thin stripe along hind margin), prosternum, mesosternum, mesopleura, a large mark on metapleura, basal three fourths of profemur, meta-trochanter, and basal half of metafemur yellow. Between mesopleura and mesonotum with a broad black lateral mark posteriorly which is extended to anterior mark on mesonotum by a narrow stripe; in bright specimens this stripe is interrupted; in dark specimens the black mark is extended on mesopleura in a second black stripe reaching the anterior black area more ventrally.



Figs. 30 - 45: *Strongylovelia palawanensis* sp.n.: body of (30) female and (31) male, dorsal view; (32) body of male, ventral view; body of (33) male and (34) female, lateral view; female genitalia in (35) lateral and (36) dorsal view; (37) middle leg, (38) hind leg, (39) front leg, and (40) antenna of female; (41) middle leg, (42) front leg, (43) hind leg, and (44) antenna of male; (45) male genitalia, lateral view.

Median pronotal length 0.4 times eye length. Mesothorax laterally with a dense row of long black hairs. Sternite 2 laterally at connexivum with a tuft of long black hairs. Connexiva 4 - 7 with erect black hairs, which are only on segments 6 - 7 long and conspicuous. Tergite 8 with tufts of long black hairs at hind corners. Tergites with mainly

regular fine silverish pubescence, lacking laterally on tergites 5 - 6. Tergite 7 with a diagnostic median tuft of black hairs. Measurements of antenna (Fig. 40) and legs (Figs. 37 - 39) as listed in table 1. Pilosity of legs: on protibia with black bristles. Ventral pilosity on metafemur semierect, somewhat longer in distal half.

Connexiva directed upward, not covering tergites. Laterotergites with short, dense pilosity over entire length, but restricted to external part on anterior laterotergites. Connexivum of segment 7 apically angular. Tergites broad and flat, not impressed, tergites 5 - 6 laterally shining. Tergite 5 about 6 times as broad as long. Tergite 2 more or less fused with tergite 1, but with indistinct suture. Sternites 3 - 5 laterally shining. Genitalia as in figures 35 - 36.

Apterous male. Length 1.10 - 1.16 mm. Width 0.64 - 0.67 mm. Body relatively broad (Fig. 31).

Colour (Figs. 31 - 33) similar to that of female except black stripe between yellow areas on mesonotum and mesopleura broad, not conspicuously narrowed before middle.

Median pronotal length 0.4 times eye length. Black hairs laterally on mesothorax as in female. Hairs along connexiva long, about twice as long as length of tergite 6. Measurements of antenna (Fig. 44) and legs (Figs. 41 - 43) as listed in table 1. Pilosity of legs: protibia externally and mesofemur and metafemur internally with thinner black bristles, metafemur additionally with several long, spiny bristles.

Abdomen short, anterior tergites (1 - 4) slightly convex, the following nearly flat. Suture between tergites 1 and 2 developed. Tergite 5 about 8 times as long as wide. Genitalia as in figure 45. Paramere slender, distally with numerous short bristles, weakly indented (Fig. 68).

Macropterous female: Length 1.54 - 1.60 mm. Width 0.82 - 0.86 mm. Length of fore wing (from base to apex) 1.4 - 1.5 mm.

Similar to apterous female, but pronotum much larger, with obtuse humeral corners, with a half-ovate yellow mark (Fig. 58). Wings clearly surpassing tip of abdomen, blackish, with some indications of longitudinal veins in basal third, without closed cells. In dealate specimens wings are broken at base (behind level of hind margin of pronotum) (Fig. 58). Abdomen without basal longitudinal keels, without shining areas on tergites 5 - 6. Tuft of hairs on tergite 7 present, but less obvious than in apterous morph. All sutures between tergites well developed.

Macropterous male: Length 1.20 - 1.22 mm. Width 0.71 - 0.74 mm. Length of fore wing (from base to apex) 1.35 mm.

Similar to apterous male, pronotum and wings as in macropterous female. Abdomen without longitudinal keels on basal tergites. All sutures between tergites well developed.

Comparative notes. Similar to and closely related with *S. esakii* sp.n. from Borneo and mainly different by a distinct tuft of hairs on tergite 7 of females. Further, females of *S. esakii* sp.n. are larger, but in males the difference in size is inconspicuous. Males of *S. palawanensis* sp.n. have much longer hairs on the thorax and the connexiva than the assumed male of *S. esakii* sp.n.

Distribution. Philippines: Palawan Province: Palawan Island (type locality: Balsahan River at Iwahig, W Puerto Princesa) and Busuanga Island.

Strongylovelia aberrans sp.n. (Fig. 60)

Type material. - Holotype (♀): "INDON., Kalimantan Timur\ Long Bagun Ulu,\ 14.1.1995\ lg.Seyfert & Graindl(9)" (NMW).

Description.

Apterous female. Length 1.42 mm. Width 0.81 mm. Body broad.

Colour. Black except head along dorsal eye margin orange, meso-metanotum (except anterior corners and a thin stripe along hind margin), prosternum, mesosternum, mesopleura, a large mark on metapleura, basal three fourths of profemur, metatrochanter, and basal half of metafemur yellow. Between mesopleura and mesonotum with a broad black lateral stripe which is not narrowed but regularly widened before middle.

Median pronotal length 0.5 times eye length. Mesothorax laterally with a dense row of long black hairs. Hind corners of meso-metanotum with some long hairs. Sternite 2 laterally at connexivum without a tuft of long black hairs. Connexiva without, but sternites laterally with a row of erect black bristles. Tergite 8 with long black hairs at hind corners (Fig. 60). Tergites with uniform fine silverish pubescence. Measurements of antenna and legs as listed in table 1. Pilosity of legs: protibia with long black bristles. Ventral pilosity on metafemur semierect, restricted to distal third.

Connexiva slightly bent inward, especially on segments 6 - 7, but not covering tergites (Fig. 60). Laterotergites without conspicuous dark pilosity. Connexivum of segment 7 apically angular. Tergites broad and flat, without special characters, tergites 7 - 8 shallowly impressed. Tergite 5 about 4 times as broad as long. Tergite 2 not fused with tergite 1, but sutures indicated laterally. Sternites laterally not shining.

Apterous male and macropterous morphs unknown.

Comparative notes. Although *S. aberrans* sp.n. and *S. esakii* sp.n. were collected in the same type locality, there is no doubt that both females represent different species. Differences are found in size, colour, measurements of antennal segments, length of pronotum, and pilosity and structure of female abdomen (see key).

Distribution. Borneo: Kalimantan Timur: Long Bagun Ulu (type locality).

Etymology. Named after the aberrant characters distinguishing this species from the similar *S. esakii* sp.n.

Strongylovelia philippinensis group

Diagnosis: Females with narrow abdomen, especially narrow tergites, which are not covered by connexiva, with tergites (4 -) 5 - 6 deeply impressed, with tergite 2 (- 3) with a mediocaudal lobe, and with mesonotum forming sharp hind angles. Males distinguishable from those of the *S. esakii* group by short semierect bristle-like hairs on thoracic dorsum. Paramere distally broader, usually with several distinct indentations.

This group contains three species, all from the Philippine Islands: *Strongylovelia philippinensis* sp.n. (with four subspecies), *S. mindoroensis* sp.n., and *S. cebuana* sp.n.

Strongylovelia philippinensis sp.n.*Strongylovelia philippinensis philippinensis* ssp.n. (Figs. 5, 8, 11, 46 - 57, 59, 69, 76)

Type material. - Holotype (♀): "PHILIPPINEN: Laguna\ Los Banos, Bach von\ Tampalit Falls, 15.11.\ leg. H. Zettel 1993(22b)" (UPLB); paratypes: 5 ♂♂ 5 ♀♀, 1 ♂ (macropterous, dealate), same locality data (NMW, OUM, UPLB); 2 ♂♂ "PHILIPPINEN: Laguna 1992\ Los Banos, Rest Area\ Bach von Tampalit Falls\ 17.11.,leg. H.Zettel (1a)" (NMW); 1 ♂, 1 ♂ 1 ♀ (macropterous, dealate) "PHILIPPINEN: Laguna Prov.\ Los Banos, Mt. Makiling\ Molawin Creek, Coll.For.\ 8.2.1996,leg.Zettel (72)" (CZW); 5 ♂♂ 2 ♀♀, 1 ♀ (macropterous), "PHILIPPINEN: Quezon Pr.\ W Atimonan, Quezon NP\ Old Zigzag Road,12.-13.2.\ 1996, leg.H.Zettel (79b)" (CZW, UPLB); 11 ♂♂ 14 ♀♀ "PHILIPPINEN: Luzon, Laguna\ Los Banos, Mt. Makiling\ Mud Springs, 1.11.1996\ leg. H. Zettel (88)" (CJP, CNT, NMW, UPLB).

Description.

Apterous female. Length 1.32 - 1.42 mm. Width 0.80 - 0.84 mm. Body drop-shaped (Fig. 46).

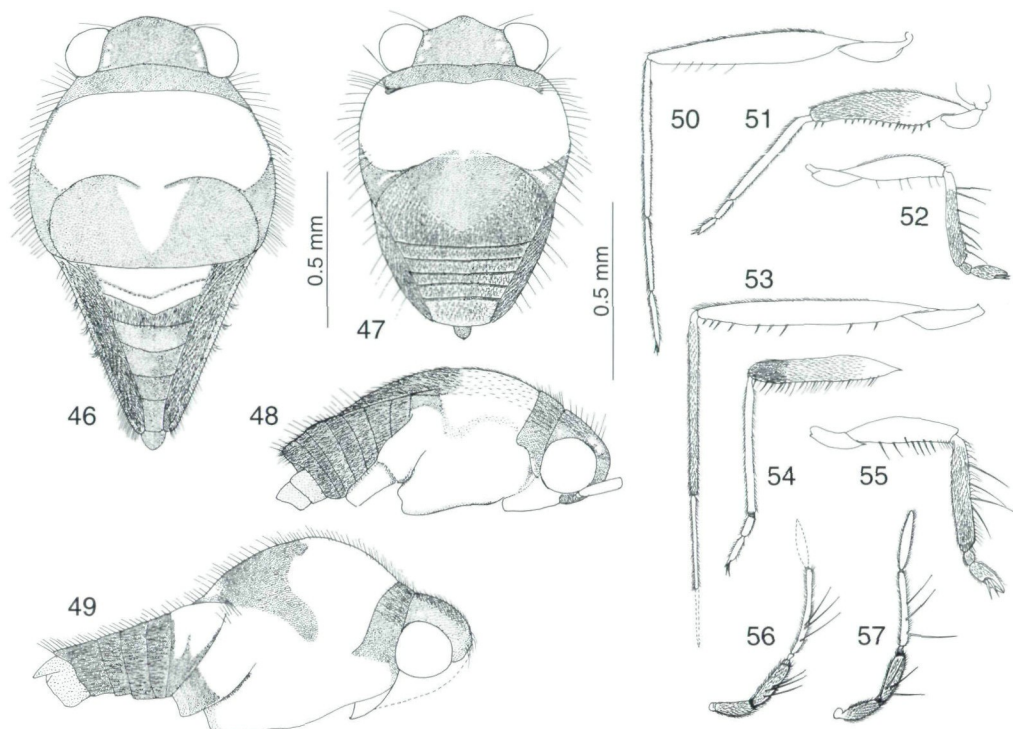
Colour (Figs. 46, 49). Black except head along dorsal eye margin orange, meso-metanotum (except posterior corners), a triangular mark on tergite 1 (usually at least partly confluent with that on meso-metanotum), a thin line along hind margin of tergite 1, tergites 2 - 4, prosternum, mesosternum, anterior three fourth of metasternum, mesopleura, metapleura, dorsal parts of sternites 2 - 4, median part of sternite 7, gonocoxae, and proctiger yellowish. Between mesopleura and mesonotum without black stripe. Antennal segment 1 yellowish, 2 - 4 brownish. Legs yellowish, tips of protibia, mesofemur, and metafemur, entire mesotibia and metatibia brownish, tarsi blackish.

Median pronotal length 0.45 times eye length. Mesothorax laterally with a dense row of long black hairs. Meso-metanotum with longer hairs in posterior corners. Sternite 2 laterally at connexivum with a few long black hairs. Sternites 3 - 5 laterally (in distance of connexiva) each with a tuft of black curved hairs. Connexiva without erect black hairs. Tergite 8 with a few long black hairs at hind corners. Tergites with very thin pubescence which is lacking in middle of tergites 5 - 6. Measurements of antenna (Fig. 56) and legs (Figs. 53 - 55) as listed in table 1. Pilosity of legs: protibia with black bristles. Ventral pilosity on metafemur semierect, somewhat longer in distal half.

In dorsal aspect shape of abdomen nearly equilateral-triangular and sternites not clearly visible. Connexiva directed upward, not covering tergites. Laterotergites 3 - 7 with relatively long, dense, golden hair layer. Connexivum of segment 7 apically angular. Tergites anteriorly broad, posteriorly strongly narrowed. Sutures between tergites 1 - 4 visible. Tergites 2 - 3 with a broad middle lobe on hind margin. Tergites 5 - 6 with a (rather shallow) median impression. Tergite 5 about 3 times as broad as long. Tergite 8 with a shallow median impression. Sternites 3 - 5 laterally shining.

Apterous male. Length 1.02 - 1.10 mm. Width 0.62 - 0.66 mm. Body relatively broad (Fig. 47).

Colour (Figs. 47, 48) similar to that of female except black stripe between yellow areas on mesonotum and mesopleura sometimes lacking (as in females), sometimes present as a very narrow line, very rarely (1 specimen) as a broader stripe and then the anterior corners of metanotum also blackish. Tergite 1 black (rarely with a small yellowish mark), other tergites black, yellowish marks laterally on sternites 2 - 4 very small and usually inconspicuous, and middle femora sometimes more brownish.



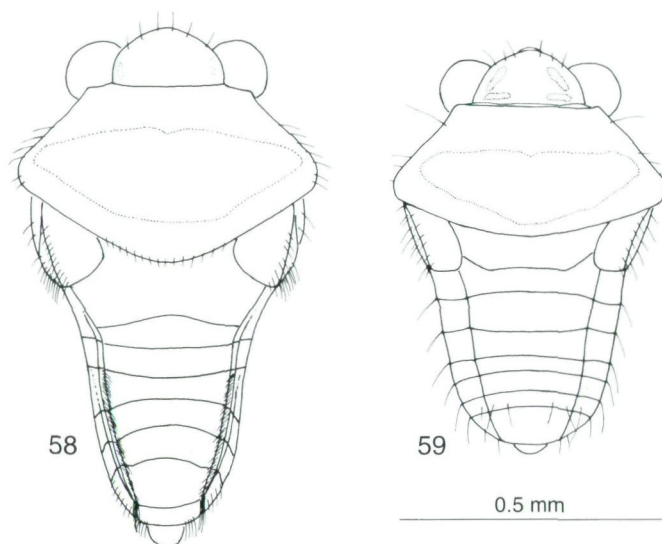
Figs. 46 - 57: *Strongylovelia philippinensis philippinensis* ssp.n.: body of (46) female and (47) male, dorsal view; body of (48) male and (49) female, lateral view; (50) middle leg, (51) hind leg, and (52) front leg of male; (53) middle leg, (54) hind leg, and (55) front leg of female; antenna of (56) female and (57) male.

Median pronotal length 0.4 times eye length. Black hairs laterally on mesothorax as in female. Hairs along connexiva long, more than twice as long as length of tergite 6. Measurements of antenna (Fig. 57) and legs (Figs. 50 - 52) as listed in table 1. Pilosity of legs: protibia externally and mesofemur and metafemur internally with thinner black bristles, metafemur additionally with several long, spiny bristles.

Abdomen short, anterior tergites (1 - 4) slightly convex, the following nearly flat. Tergite 1 fused with metanotum, suture between tergites 1 and 2 developed, but laterally inconspicuous. Tergite 5 about 8 times as wide as long. Paramere regularly curved, distally rather wide, bent posteriorly, and with scanty indentation (Fig. 69).

Macropterous female. Length 1.53 - 1.57 mm. Width 0.73 - 0.74 mm. Length of fore wing (from base to apex) ca. 1.55 mm.

Similar to apterous female, but pronotum much larger, with obtuse humeral corners, with half-ovate yellow mark, which has sometimes a brownish mid-line. Wings clearly surpassing tip of abdomen, blackish, with some indications of longitudinal veins in basal third, without closed cells. Abdomen without basal longitudinal keels, broader, tergites 5 - 6 without impression, tergites 2 - 3 without middle lobe, laterotergites less densely pubescent. All sutures between tergites well developed.



Figs. 58 - 59: Body of dealate specimens, dorsal view: (58) *Strongylovelia palawanensis* sp.n., ♀, (59) *S. philippinensis philippinensis* ssp.n., ♂.

Macropterous male. Length 1.14 - 1.16 mm. Width 0.73 - 0.74 mm. Both specimens dealate.

Similar to apterous male, pronotum as in macropterous female. Wings broken off at base (behind level of hind margin of pronotum) (Fig. 59). Abdomen without longitudinal keels on basal tergites. Sutures between tergites well developed, only that between tergites 1 and 2 laterally weak.

Comparative notes. *Strongylovelia philippinensis* sp.n. can be distinguished from the other two species of the group by the tufts of dark, curved hairs laterally on sternites 3 - 5 of females. The nominate subspecies is the most lightly coloured, with a large triangular yellow mark on tergite 1 of females. It further may be distinguished from other subspecies by the broadest abdomen (tergite 5 of female 3 times wider than long) and a shallow median impression on tergite 8 of females (see also key). Minute differences in shape of parameres were not proved in larger series.

Distribution. Philippines: Luzon: Laguna Province (type locality: Los Baños, Tampalit Falls), Quezon Province.

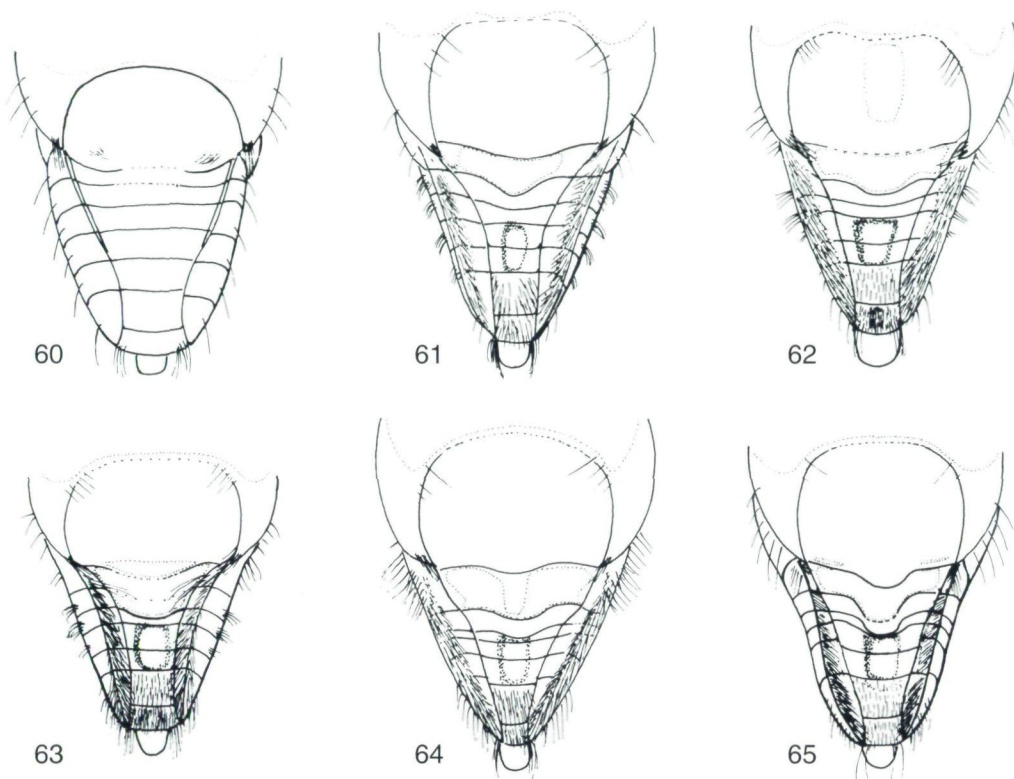
Strongylovelia philippinensis sibuyana ssp.n. (Figs. 61, 70)

Type material. - Holotype (♀): "PHILIPPINEN: Romblon Prov.\ Sibuyan, S Magdiwang\ Jao-asan, Fato-o river, 18.11.1994, leg. H. Zettel (67a)" (UPLB); paratypes: 14 ♂♂ 21 ♀♀, same locality data (NMW, CJP, CNT, CZW, OUM, UPLB); 1 ♂ 1 ♀ "PHILIPPINEN: Romblon Prov.\ Sibuyan, S Magdiwang, W\ Silum, Lambigan Falls, 21.11.1994, leg. H. Zettel (69)" (CZW).

Description. Similar to the nominate subspecies except in the following characters:

Apterous female. Length 1.47 - 1.50 mm. Width 0.84 - 0.88 mm.

Colour much darker: anterior corners and a thin stripe along hind margin of meso-meta-notum black, tergites (inclusively tergite 1) completely black except tergite 2 yellowish,



Figs. 60 - 65: Abdomina, dorsal view, of females of (60) *S. aberrans* sp.n., (61) *S. philippinensis sibuyana* ssp.n., (62) *S. philippinensis boholensis* ssp.n., (63) *S. philippinensis bukidnonica* ssp.n., (64) *S. mindoroensis* sp.n., (65) *S. cebuana* sp.n.

metacetabula blackish, ventral half of metapleura black, sternite 4 laterally without yellowish mark, antennal segments 2 - 4 blackish, legs blackish except coxae, trochanters, basal three fourth of profemur, and basal half of metafemur.

Median pronotal length 0.5 times eye length. Measurements of antenna and legs as listed in table 1. In dorsal aspect shape of abdomen slightly narrower, sternites slightly visible (Fig. 61). Tergites somewhat narrower, tergite 5 about 2.5 times as broad as long. Tergite 2 with a longer and narrower middle lobe at hind margin, tergite 3 with inconspicuous lobe. Tergites 5 - 6 with a deeper median impression. Tergite 8 without median impression.

Apterous male. Length 1.08 - 1.11 mm. Width 0.66 - 0.68 mm.

Colour similar to that of male specimens of *S. philippinensis philippinensis*, but darker: Stripe between yellow areas on mesonotum and mesopleura always present as a narrow stripe and anterior corners of meso-metanotum blackish, metanotum always black, mesacetabula and ventral half of metapleura blackish, yellowish marks laterally on sternites 2 - 4 lacking, and legs similar dark as in female.

Median pronotal length 0.45 times eye length. Measurements of antenna and legs as listed in table 1. Sutures between tergites 1 - 3 inconspicuous. Tergite 5 about 9 times as

wide as long. Parameres slightly angulated, distally more slender than in the nominate subspecies and bent mediad (Fig. 70).

Macropterous morphs unknown.

Comparative notes. *Strongylovelia philippinensis sibuyana* ssp.n. is the darkest subspecies, similar dark as *S. mindoroensis* sp.n., but belonging to *S. philippinensis* sp.n. based on the tuft of curved hairs on sternites 3 - 5 of females. Diagnostic characters of females are presented in the key. Minute differences in shape of parameres were not proved in larger series.

Distribution. Philippines: Romblon Province: Sibuyan Island (type locality: Jao-asan, S of Magdiwang).

***Strongylovelia philippinensis boholensis* ssp.n. (Figs. 62, 71)**

Type material. - Holotype (♀): "PHILIPPINEN: Bohol\ NE Tagbilaran, S Sikatuna\ nr. Dangay, 26.-27.11. 1996, leg. H. Zettel (111)" (UPLB); paratypes: 87 ♂♂, 25 ♀♀ same locality data (BMNH, CJP, CNT, NMW, OUM, UPLB).

Description. Similar to the nominate subspecies except in the following characters:

Apterous female. Length 1.34 - 1.44 mm. Width 0.80 - 0.86 mm.

Colour very similar except the more rectangular to lineate and in average smaller yellow mark on tergite 1, which is always separated from that on meso-metanotum by a narrow black line (yellow mark lacking in one very dark female), tergites 3 and 4 blackish, metasternum black, mesacetabula blackish in some specimens, metapleura black in ventral part, sternite 4 without yellowish mark, and tibiae and tarsi slightly darker.

Median pronotal length 0.5 times eye length. Tuft of curved hairs laterally on segment 5 lacking or inconspicuous. Connexiva on segments 6 - 7 with a few erect hairs. Measurements of antenna and legs as listed in table 1. In dorsal aspect shape of abdomen slightly narrower (Fig. 62). Suture between tergites 1 and 2 obsolete. Tergite 2 with a broad middle lobe on hind margin, tergite 3 with inconspicuous lobe. Tergites 5 - 6 with deeper impression. Tergite 5 about 2.8 times as broad as long. Median impression on tergite 8 inconspicuous.

Apterous male. Length 1.04 - 1.08 mm. Width 0.62 - 0.65 mm.

Colour slightly darker than in female: black stripe between yellow areas on mesonotum and mesopleura usually complete, forming a narrow line, rarely interrupted in anterior part, or as a broader stripe, anterior corners of meso-metanotum black, ventral part of metapleura blackish, yellow marks laterally on sternites 2 - 4 lacking or, rarely, inconspicuously present on sternite 2, legs somewhat darker.

Median pronotal length 0.48 times eye length. Measurements of antenna and legs as listed in table 1. Suture between tergites 1 and 2 lacking, that between tergites 2 and 3 inconspicuous. Paramere relatively broad, especially in middle part, distally with several indentations (Fig. 62).

Macropterous morphs unknown.

Comparative notes. Rather light coloured and broad subspecies, very similar to the nominate subspecies but somewhat darker. The shape of the yellow mark on tergite 1 of female (which is lacking in one specimen) is usually typical for this subspecies. Tergite 5 of female slightly narrower than in the nominate subspecies and tergites more fused in both sexes. Further differences to other subspecies are presented in the key. Minute differences in shape of parameres were not proved in larger series.

Distribution. Philippines: Bohol (type locality: Dangay, S of Sikatuna, NE of Tagbilaran).

Strongylovelia philippinensis bukidnonica ssp.n. (Figs. 63, 72)

Type material. - Holotype (♀): "PHILIPPINEN: Mindanao\ Bukidnon Pr., Malaybalay\ Woodstock, 650m, 5.11.1996, leg.H.Zettel (89)" (UPLB); paratypes: 10 ♂♂ 23 ♀♀, 5 ♂♂ 1 ♀ (macropterous, 4 ♂♂ dealate), same locality data (CJP, CNT, NMW, OUM, UPLB).

Description. Similar to the nominate subspecies except in the following characters:

Apterous female. Length 1.44 - 1.52 mm. Width 0.78 - 0.83 mm. Body, especially abdomen, more slender.

Colour darker: anterior corners of meso-metanotum black, tergite 1 black with yellow hind margin, tergite 4 black, mesopleura ventrally in some specimens with dark mark, metapleura ventrally black, metasternum black, sternite 4 laterally without yellow mark. Between mesonotum and mesopleura with a large black spot, which is rarely fused with black marks on anterior corners of mesonotum. Legs darker, especially mesofemur brown and tibiae and tarsi blackish.

Median pronotal length 0.4 times eye length. Pronotum in middle with slightly concave hind margin. Connexiva 7 with semierect dark hairs. Laterotergite 2 with a few very long, thin, internally directed hairs. Measurements of antenna and legs as listed in 1.

In dorsal aspect shape of abdomen more slender than in other subspecies and sternites clearly visible (Fig. 63). Connexiva directed slightly inward, but not covering tergites. Tergites more slender, tergite 5 about 2 times broader than long. Suture between tergites 2 and 3 lacking or inconspicuous. Middle lobe on hind margin of tergite 3 (and tergite 2 if separated) very broad. Tergites 5 and 6 with deep impression.

Apterous male. Length 1.08 - 1.13 mm. Width 0.62 - 0.66 mm. Body slightly more slender.

Colour darker: with continuous broad black stripe between yellow areas on mesonotum and mesopleura and blackish anterior corners of mesonotum, tergite 1 always black, yellowish marks laterally on sternites 2 - 3 usually inconspicuous, on tergite 3 frequently lacking.

Median pronotal length 0.38 times eye length. Measurements of antenna and legs as listed in table 1. Sutures between tergites 1, 2, and 3 very inconspicuous. Tergite 5 about 9 times as wide as long. Paramere (Fig. 72) as in *S. philippinensis philippinensis*.

Macropterous female. Body length 1.50 mm. Width 0.83 mm. Length of fore wing (from base to apex) 1.5 mm.

Similar to apterous female, but pronotum much larger, with obtuse humeral corners, with a half-ovate yellow mark. Wings clearly surpassing tip of abdomen, blackish, with

some indications of longitudinal veins in basal third, without closed cells. Abdomen broader, tergites 5 - 6 without impression, tergites 2 - 3 without middle lobe, laterotergites less densely pubescent.

Macropterous male. Body length 1.24 - 1.28 mm. Width 0.72 - 0.76 mm. Length of fore wing (from base to apex) 1.45 mm.

Similar to apterous male, pronotum and wings as in macropterous female. In dealate specimens wings broken off at base (at level of hind margin of pronotum). Abdomen only slightly wider than in apterous males, without longitudinal keels on basal tergites. In three specimens tergites 2 - 3 with yellowish marks.

Comparative notes. *Strongylovelia philippinensis bukidnonica* ssp.n. is the most slender subspecies, especially regarding the female abdomen which is very characteristic. Both sexes are rather dark coloured, but the legs are lighter than in ssp. *sibuyana*. The more or less complete fusion of female tergites 2 and 3 is also typical. The pronotum is extremely short in both sexes. Further differences to other subspecies are mentioned in the key. Paramere similar as in the nominate subspecies (Fig. 72).

Distribution. Philippines: Mindanao: Bukidnon Province (type locality: Malaybalay, Woodstock area).

Strongylovelia mindoroensis sp.n. (Figs. 64, 73)

Type material. - Holotype (♀): "PHILIPPINEN: Mindoro or. \ Big Tabinay riv., 4km SE \ Puerto Galera, 12.11.1994 \ leg. H. Zettel (62)" (UPLB); paratypes: 3 ♂♂ 16 ♀♀, same locality data (CJP, CNT, CZW, NMW, OUM); 2 ♂♂ 2 ♀♀ "PHILIPPINEN: Mindoro or. \ S Puerto Galera \ Big \ Tabinay River, 27.11. \ leg. H. Zettel 1993 (36)" (NMW, UPLB).

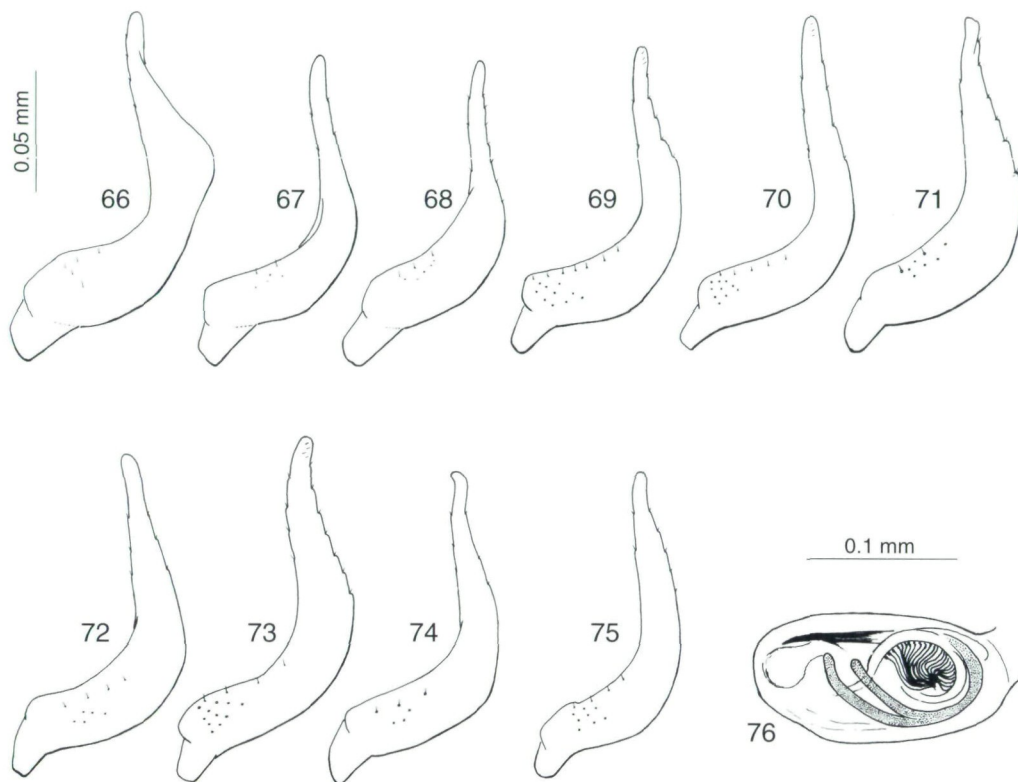
Description.

Apterous female. Length 1.42 - 1.50 mm. Width 0.81 - 0.89 mm. Body drop-shaped, relatively broad.

Colour. Black except head along dorsal eye margin with obscure orange marks, mesonotum (except anterior and posterior corners), tergites 2 (usually with a dark midline) and 3, prosternum in anterior half, mesosternum, mesopleura except dark mark on mesacetabula, metapleura in dorsal half yellowish, median part of sternite 7, gonocoxae, and proctiger brownish. Between mesopleura and mesonotum with a very broad black band which is rarely interrupted anteriorly. Antennal segment 1 yellowish, 2 - 4 blackish. Legs yellowish, procoxa brownish, mesofemur, distal half of metafemur, and all tibiae and tarsi blackish.

Median pronotal length 0.5 times eye length. Mesothorax laterally with dense row of long black hairs. Mesonotum with longer hairs in posterior corners. Sternite 2 laterally at connexivum with a few long black hairs. Sternites 3 - 5 laterally without long black hairs. Connexiva without erect hairs, only on segments 6 - 7 with semierect black hairs. Tergite 8 with a few long black hairs at hind corners. Tergites with very thin pubescence which is lacking on tergites 4 - 6.

Measurements of antenna and legs as listed in table 1. Pilosity of legs: protibia with black bristles. Ventral pilosity on metafemur semierect, in distal half longer.



Figs. 66 - 76: Parameres of (66) *Strongylovelia connexivum* sp.n., (67) *S. esakii* sp.n., (68) *S. palawanensis* sp.n., (69) *S. philippinensis philippinensis* ssp.n., (70) *S. philippinensis sibuyana* ssp.n., (71) *S. philippinensis boholensis* ssp.n., (72) *S. philippinensis bukidnonica* ssp.n., (73) *S. mindoroensis* sp.n., (74) *S. cebuana* sp.n., (75) *S. formosa* sp.n.; endosoma of (76) *S. philippinensis philippinensis* ssp.n.

In dorsal aspect shape of abdomen nearly equilateral-triangular and sternites not clearly visible (Fig. 64). Connexiva directed upward, not covering tergites. Laterotergites 3 - 7 with relatively long, dense, golden hair layer. Connexivum of segment 7 apically angular. Tergites anteriorly broad, posteriorly strongly narrowed. Tergite 1 fused with metanotum, with shallow lobe in middle of hind margin. Sutures between tergites 1 - 4 visible. Tergites 2 - 3 with broad, shallow middle lobe on hind margin. Tergites 4 - 6 with deep impression. Tergite 5 long, about 2.3 times as broad as long. Tergite 8 without median impression. Sternites 3 - 5 laterally less shining than in other species of this group.

Apterous male. Length 1.08 - 1.14 mm. Width 0.64 - 0.68 mm. Body relatively broad. Colour similar as in female except very broad, black stripe between yellow areas on mesonotum and mesopleura not interrupted, all tergites black, and yellow mark on meta-pleura reduced to a small spot or lacking.

Median pronotal length 0.5 times eye length. Black hairs laterally on mesothorax as in female. Hairs along connexiva long, more than twice as long as length of tergite 6.

Measurements of antenna and legs as listed in table 1. Pilosity of legs: protibia externally and mesofemur and metafemur internally with thin black bristles, metafemur additionally with several long, spiny bristles.

Abdomen short, anterior tergites (1 - 4) slightly convex, the following nearly flat. Tergite 1 fused with metanotum, suture between tergites 1, 2, and 3 developed, but laterally inconspicuous. Tergite 5 about 9 times as wide as long. Paramere distally slightly denser indented than in *S. philippinensis* sp.n. (Fig. 73).

Macropterous morphs unknown.

Comparative notes. Females of *S. mindoroensis* sp.n. are larger and darker than all subspecies of *S. philippinensis* sp.n. except *S. philippinensis sibuyana* ssp.n. They can be distinguished by the lack of yellowish marks on sternites 2 - 4 and of tufts of erect bristles laterally on sternites 3 - 5, which is regarded as important enough to regard this taxon as separate species. The pronotum of both sexes is longer than in *S. philippinensis* sp.n. (except in the light coloured ssp. *bohollensis*, where the differences are not obvious). Males can be recognized by the character combination of black mesofemur and long pronotum. Minute differences in shape of parameres were not proved in larger series.

Distribution. Philippines: Mindoro Oriental (type locality: Big Tabinay River, 4 km SE Puerto Galera).

Strongylovelia cebuana sp.n. (Figs. 65, 74)

Type material. - Holotype (♀): "PHILIPPINEN: Cebu, S Badian\ Matutinao, Kawasan Falls\ 2-50m, 29.-30.11.1996\ leg. H. Zettel (112)" (UPLB); paratypes: 15 ♂♂, 1 ♀, same locality data (CJP, CNT, NMW, OUM, UPLB); 19 ♂♂, 11 ♀♀ "Philippinen: Cebu, S Badian\ Matutinao, Kawasan Falls\ 2-50 m, 23.-24.2.1997\ leg. H. Zettel (116)" (CZW, OUM, UPLB).

Apterous female. Length 1.40 - 1.49 mm. Width 0.78 - 0.81 mm. Body drop-shaped, relatively slender.

Colour. Black except head along dorsal eye margin orange, mesonotum (except anterior and posterior corners), hind margin of tergite 1, tergite 2, thoracic sterna, mesopleura (except a ventral dark mark), metapleura (except ventral third), dorsal parts of sternites 2 - 3, median part of sternite 7, gonocoxae, and proctiger yellowish. Between mesopleura and mesonotum with a black mark in posterior half. Antennal segment 1 yellowish, 2 - 4 brownish to blackish. Legs yellowish, tips of protibia, mesofemur, and metafemur, entire mesotibia and metatibia, and all tarsi brownish.

Median pronotal length 0.45 times eye length. Mesothorax laterally with a dense row of long black hairs. Mesonotum without longer hairs in posterior corners. Sternite 2 laterally at connexivum with a few long black hairs. Sternites 3 - 5 laterally without tufts of longer hairs. Connexiva without erect hairs, only on segment 7 posteriorly with semierect hairs. Tergite 8 with a few long black hairs at hind corners. Tergites with very thin pubescence, which is lacking in middle of tergites 5 - 6.

Measurements of antenna and legs as listed in table 1. Pilosity of legs: protibia with black bristles, ventral pilosity on metafemur semierect, in distal half somewhat longer.

In dorsal aspect shape of abdomen narrow-triangular and sternites clearly visible (Fig. 65). Connexiva directed upward, not covering tergites. Laterotergite 2 without thin, long hairs. Laterotergites 3 - 7 with relatively long, dense, golden hair layer (reduced on

Tab. 1: Lengths of antennal and leg segments in apterous specimens (1 unit = 0.008 mm). Means of five random selected specimens of each sex. Fe = femur, Ta = tarsus, Ti = tibia (1, 2, 3 = fore, middle, and hind leg); I - IV = antennal segments; * = less than 5 specimens available).

	I	II	III	IV	Fe ₁	Ti ₁	Ta ₁	Fe ₂	Ti ₂	Ta ₂	Fe ₃	Ti ₃	Ta ₃
<i>hirsutula</i> ♀*	15	18	32	25	33	36	3+12	80	66	31+19	54	44	7+8
<i>connexivum</i> ♀	20	25	44*	31*	48	50	5+16	112	88	34+22	72	58	10+13
<i>connexivum</i> ♂	19	22	41	31	44	46	5+14	101	80	30	21	52	9+11
<i>esakii</i> ♀*	19	24	45	29	42	51	4+15	100	81	36+20	70	56	9+11
<i>esakii</i> ♂*	16	19	33	25	33	38	3+12	81	61	26+19	52	42	5+9
<i>aberrans</i> ♀*	16	18	34	24	36	41	4+13	93	75	34+21	63	51	7+9
<i>palawanensis</i> ♀	16	22	44	25	41	45	3+12	99	77	35+20	64	53	9+10
<i>palawanensis</i> ♂	15	19	36	25	34	39	3+11	82	65	30+18	56	43	8+9
<i>p. philippinensis</i> ♀	14	19	35	24	38	42	4+14	82	66	31+20	60	47	9+11
<i>p. philippinensis</i> ♂	13	17	31	21	33	37	3+12	74	59	28+19	52	40	8+9
<i>p. sibuyana</i> ♀	17	22	42	25	42	48	5+14	97	79	35+20	67	54	9+11
<i>p. sibuyana</i> ♂	14	18	35	23	35	40	4+12	84	70	29+19	55	44	8+10
<i>p. boholensis</i> ♀	15	20	40	24	41	45	4+14	93	74	35+21	65	52	10+11
<i>p. boholensis</i> ♂	13	17	33	22	32	37	3+12	77	61	28+19	53	40	7+9
<i>p. bukidnonica</i> ♀	16	21	40	25	44	45	4+14	95	74	35+22	64	53	9+11
<i>p. bukidnonica</i> ♂	14	18	34	23	35	39	3+12	83	65	29+20	58	43	7+9
<i>mindoroensis</i> ♀	16	20	39	25	40	45	4+13	93	77	36+21	67	54	10+11
<i>mindoroensis</i> ♂*	13	18	34	23	33	39	4+12	83	88	32+19	57	45	8+11
<i>cebuana</i> ♀	15	20	39	23	39	44	4+13	88	70	32+20	61	50	9+11
<i>cebuana</i> ♂	15	18	34	21	33	38	3+12	79	61	27+18	54	42	7+9
<i>formosa</i> ♀*	25	30	50	31	52	50	5+17	132	92	45+27	75	70	12+12
<i>formosa</i> ♂*	19	22	39	30	45	49	5+13	107	-	-	74	63	-

laterotergite 4). Connexivum of segment 7 apically angular. Tergites anteriorly broad, posteriorly strongly narrowed. Tergite 1 fused with metanotum, with a small middle lobe on hind margin. Sutures between tergites 1 - 4 distinct. Tergites 2 - 3 with large middle lobes on hind margin, lobe of tergite 3 nearly covering tergite 4. Tergites 5 - 6 with deep impression. Tergite 5 about 2.5 times as broad as long. Tergite 8 without median impression. Sternites 3 - 5 laterally shining.

Apterous male. Length 1.08 - 1.16 mm. Width 0.62 - 0.66 mm. Body relatively slender. Colour darker than in female: with a broad black stripe between yellow areas on mesonotum and mesopleura, which is strongly narrowed anteriorly and usually interrupted near anterior margin, metanotum and all tergites black, yellowish mark laterally on sternite 2 small and usually inconspicuous, that on sternite 3 inconspicuous or lacking.

Median pronotal length 0.4 times eye length. Black hairs laterally on mesothorax as in female. Hairs along connexiva long, more than twice as long as length of tergite 6.

Measurements of antenna and legs as listed in table 1. Pilosity of legs: protibia externally and mesofemur and metafemur internally with thinner black bristles. Metafemur additionally with several long, spiny bristles.

Abdomen short, anterior tergites (1 - 4) slightly convex, the following nearly flat. Tergite 1 fused with metanotum, suture between tergites 1, 2, and 3 inconspicuous. Tergite 5 about 9 times as wide as long. Paramere distally more slender than in other species of the group, very scanty indented, with slightly curved apex (Fig. 74).

Macropterous morphs unknown.

Comparative notes. Females of *S. cebuana* sp.n. are well distinguishable from other taxa of the species group by the slender abdomen, by the lacking of tufts of long hairs laterally on sternites 3 - 5, and by the larger middle lobes on hind margin of tergites 1 - 3. Further it differs from *S. philippinensis* sp.n. by the lack of black bristles in hind corners of mesonotum. Males are nearly indistinguishable from several subspecies of *S. philippinensis* sp.n. Minute differences in shape of parameres were not proved in larger series.

Distribution. Philippines: Cebu (type locality: Matutinao, Kawasan Falls).

Appendix:

Strongylovelia formosa ESAKI, 1924 (Fig. 75)

Material examined. Holotype (♀): Northern Formosa, Taihoku, July 21, 1921, leg. Takahashi (KUFJ). Further material: 1 ♂ "Shinten\ TAIHOKU\ FORMOSA\ 14.vi.1940\ COLL. S. MIYAMOTO", "Strongylovelia\ formosa\ Esaki\ det. Teiso Esaki" (BMNH).

Strongylovelia formosa was described after a single female. We present the first description of an apterous male deposited in BMNH.

Apterous female (holotype). Length 1.66 mm. Width 1.04 mm. Body drop-shaped, broad. Colour probably faded after conservation in alcohol (although the specimen is now mounted on a card point), so that black parts, especially on legs, are now brownish: Yellow. Head black except yellowish markings along eye margin. Antennal segment 1 pale greyish yellow, 2 - 4 black. Tibiae, tarsi, tip of profemur, and apical third of metafemur brownish. Pronotum, fore and hind margin of mesonotum, mesacetabula, metanotum, metapleura, and abdomen blackish brown. Prosternum, metasternum, and rostrum dark reddish black.

Measurements of antenna and legs as listed in table 1. Postero-lateral margin of mesothorax with a pair (1 + 1) of hair-tufts.

Abdomen short, triangular. Connexiva erect and converging, caudally partially overlapping tergites and with tufts of long hairs.

Apterous male. Length 1.30 mm. Width 0.80 mm.

Colour. Yellow. Head black except along eye margins reddish. Pronotum, fore and hind margin of mesonotum, mesacetabula, metanotum, metapleura, and abdomen black. Antennal segments 2 - 4, tibiae and tarsi, tip of profemur, mesofemur, and distal half of metafemur dark brownish to black.

Measurements of antenna and legs as listed in table 1. Median pronotal length 0.5 times eye length.

Male genitalia similar to that of *S. palawanensis* sp.n., *S. esakii*, and species of the *S. philippinensis* group. Paramere regularly curved, distally rather slender, bent posteriad, and with scanty indentation (Fig. 75).

Remarks and comparative notes: *Strongylovelia formosa* was described from Taiwan and later recorded from Luzon by POLHEMUS & REISEN (1976). This record is probably based on specimens of *S. philippinensis philippinensis* ssp.n. *Strongylovelia formosa* differs from all Philippine species by distinctly larger size of apterous morphs: body length of male 1.30 mm (maximum 1.16 mm in Philippine species), of female 1.66 mm (ESAKI 1924) (maximum 1.56 mm in Philippine species). The colour pattern is also different, e.g. the completely black metapleura is unique, and the yellowish marks of mesonotum and mesopleura are confluent, which is only found in *S. philippinensis philippinensis* ssp.n., but in this species the mesofemur is yellowish. Parameres are most similar to that of *S. philippinensis* sp.n., but more slender and less indented in apical part. Judging after the body shape of female and the uniform short dorsal pubescence of male, *S. formosa* seems to be closely related with or belonging to the *S. esakii* species group.

Distribution: Taiwan.

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