A NEW SPECIES OF *SYMPHITONEURIA* (TRICHOPTERA: LEPTOCERIDAE) FROM SABAH, MALAYSIA [1]

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ABSTRACT: *Symphitoneuria sabaensis* n. sp. from Sabah (Borneo), East Malaysia is described and figured as male and female imago. The species is the second *Symphitoneuria* to be described from outside the Australian biogeographical region. A key to the adult males of *Symphitoneuria* is provided.

The genus *Symphitoneuria* was described by Ulmer (1906) for *Notanatolica exigua* (McLachlan). Later, Mosely (1936) described the genus *Loticana* for *Notanatolica opposita* (Walker), at that time only known from the female. Banks (1939) suggested that *Loticana* was a synonym of *Symphitoneuria*, an opinion formally confirmed by Mosely and Kimmins (1953). *Symphitoneuria* is characterized by the male forewing venation in which the media and cubitus are fused with the lower margin of the discoidal cell. In the female the wing venation is normal, and the hind wings are similar in both sexes. The male genitalia, however, closely resemble those found in the genus *Triplectides* Kolenati.

In his study on the phylogeny and classification of the longhorned caddisfly family Leptoceridae, Morse (1981) included *Symphitoneuria* in the tribe Triplectidini of the subfamily Triplectidinae. The phylogeny of Triplectidinae was outlined by Morse and Holzenthal (1987), but they did not resolve the phylogeny of *Triplectides* sensu lato, and were inclined to regard the various monophyletic lineages identified as subgenera only. By suggesting the alternative, that *Symphitoneuria, Lectrides* Mosely in Mosely and Kimmins, *Symphitoneurina* Schmid, and *Triplectidina* Mosely, presently considered separate genera, apparently evolved from within *Triplectides*, the latter genus would be rendered paraphyletic. As implied by Morse (1989) further studies on the taxonomy, morphology and zoogeography of the *Triplectides* complex are essential to resolve this problem.

Including the new species described here, the genus *Symphitoneuria* now comprises seven species. With the exception of *S. dammermanni* Ulmer, all previously described species appear to be restricted to the Australian biogeographic region (Morse, 1989). *Symphitoneuria dammermanni* was described by Ulmer (1951) from the Sumba Islands, Indonesia, just west of Weber's line. Ulmer (1906) recorded females of *S. opposita* from Sulawesi (Celebes). Later,

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Martynov (1931) reported a male of this species (as *Notanatolica opposita*), also from Sulawesi, but did not describe it, even though the male of *S. opposita* was not known at that time. Banks (1913) further recorded *S. opposita* (as *Notanatolica opposita*) from the Philippines. Neboiss (1977) listed *S. opposita* from Sulawesi, but Morse (1989) suggested that these records might be misidentifications of *S. dammermanni* or the specimens might belong to some yet undescribed species. With the distribution of *S. opposita* in doubt, the description of *S. sabaensis*, n. sp., from Sabah (Borneo) confidently extends the known range of the genus further into the Oriental biogeographic region.

The material treated here was collected by the junior author during several trips to Sabah, Sarawak and Brunei between 1986 and 1990. Habitats collected ranged from lowland to montane (50 to 3300 m a.s.l.) primary forest types.

MATERIAL AND METHODS

The material was collected predominately with light traps and the specimens were preserved in 70% alcohol. Methods used in preparing, examining, and illustrating genitalia are those commonly used in the study of Trichoptera. The terminology is adopted from Morse and Neboiss (1982). Measurements are reported as total lengths, antennae length is given as the longest measured. Measurements are given as ranges, followed by the mean when more than three measurements were taken, and (in parentheses) by the number of specimens measured.

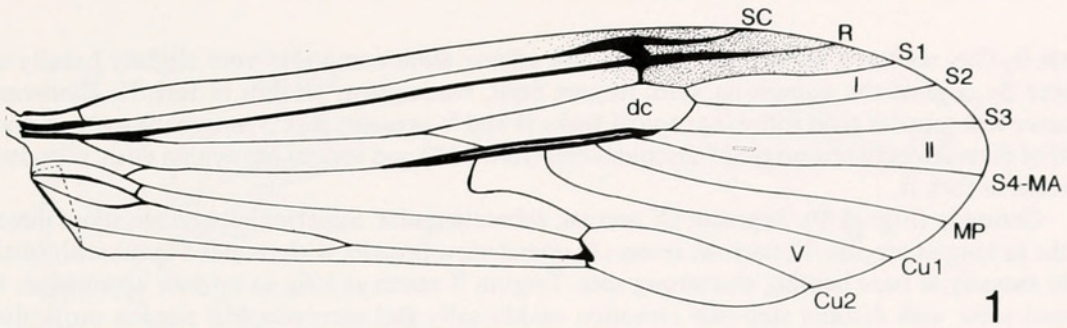
The holotype and paratypes of *Symphitoneuria sabaensis* n. sp. are deposited in the Nationaal Natuurhistorisch Museum (formerly Rijksmuseum van Natuurlijke Historie), Leiden, The Netherlands (RMNH); paratypes are also deposited in the University of Minnesota Insect Collection, St. Paul, Minnesota, USA (UMSP), the National Museum of Natural History, Smithsonian Institution, Washington, USA (USNM), and in the Museum of Zoology, University of Bergen, Norway (ZMBN).

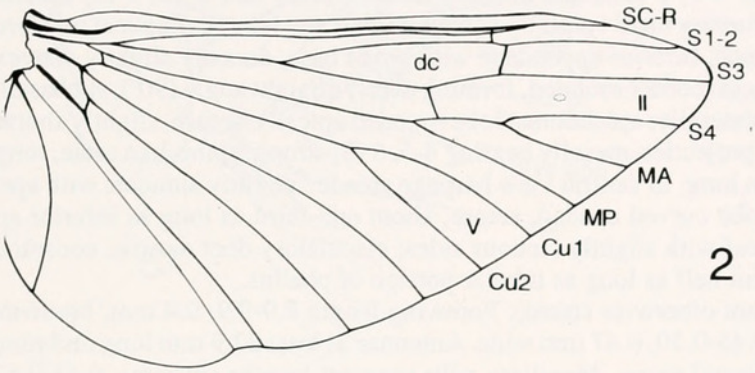
Symphitoneuria sabaensis, Andersen and Huisman, NEW SPECIES

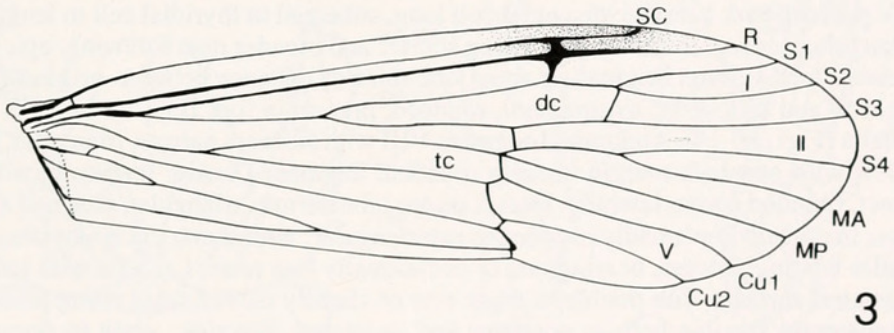
Figs. 1-16

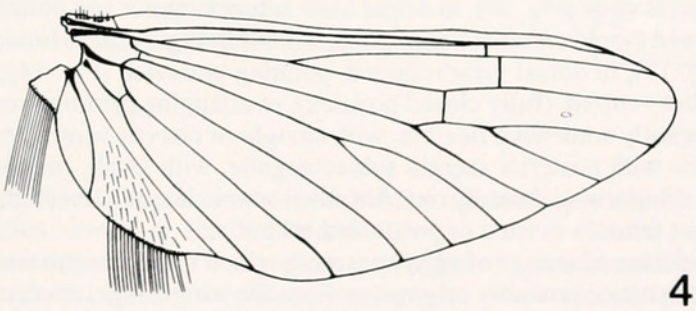
Adult male (n=10, if not otherwise stated). Forewing length 8.8-10.9, 10.0 mm; hindwing length 6.0-7.8, 7.2 mm. Eye 0.43-0.56, 0.51 mm wide. Antennae at least 35.2 mm long including 0.45-0.52, 0.48 mm long antennal scape. Maxillary palp segment lengths (in mm): 0.42-0.52, 0.46; 0.61-0.72, 0.67; 0.71-0.84, 0.76; 0.37-0.47, 0.42; 0.72-0.85, 0.81. Color (in alcohol) yellowish brown.

Wings (Figs. 1-2). Forewing with crossvein sc-r broadened, and stigma present; apical forks I, II, and V present, i.e. forks of S_{1+2}, S_{3+4}, and Cu_{1+2}; fork I reaching basally beyond S; discoidal cell short and broad, slightly shorter than its stem, and nearly as broad as fork II; thyridial cell vestigial, veins M and Cu seemingly forming single, thick, composite longitudinal vein with S_{3+4} for apical five-sevenths of discoidal cell, with five veins, S_3, S_4 + MA, MP, Cu_1, and Cu_2, arising









Figures 1-4. ***Symphitoneuria sabaensis*** **n. sp. wings. 1. Male forewing. 2. Male hindwing. 3. Female forewing. 4. Female hindwing.**

Abbreviations: Cu = cubitus, dc = discoidal cell, MA = anterior media, MP = posterior media, R = radius, S = sector, SC = subcosta, tc = thyridial cell; I, II, V = primary apical cells, or "forks", I, II, and V.

from it; Cu_2 recurved about 100° basally, and arising from composite vein slightly basally to where S_{3+4} joins the composite vein; nygma faint, rectangular, present in fork II. Hindwing shorter and broader than forewing; apical forks II and V present; fork V originating about one-half of distance between origin of discoidal cell (fork of S) and fork of M; nygma faint, rounded, present in fork II.

Genitalia (Figs. 5-9). Segment IX narrow, subrectangular. Superior appendage about three-fifths as long as tergum X, narrow, setose, in dorsal view broader with rounded apex; with small lobe mesally at base bearing one strong seta. Tergum X about as long as inferior appendage; in lateral view with distinct step-like elevation middorsally and narrow apical portion projecting caudad; in dorsal view rounded, deeply cleft apically, with broadly rounded projections laterally, single to partly double row of 6-9, 8 (5) setae dorsally on each side; and 6-10, 9 (5) sensilla apically; with transverse reinforcing band ventrally at base of cleft and lateral, diagonal reinforcing ridge internally towards base. Inferior appendage with broad base, dorsally slightly convex; in ventral view with posteromesal corner rounded, forming nearly straight angle (90°); subbasally bearing few, long setae ventrolaterally; apicodorsal lobe rounded apically, setose, slightly shorter than harpago, with accessory projection mesally bearing 4-5, 5 (5) strong, spine-like setae, longest 0.064-0.076, 0.069 (5) mm long; in ventral view harpago slender, slightly sinuous, with apex hooked mesad; basoventral lobe curved caudad, setose, about one-third as long as inferior appendage. Phallus subcylindrical with slightly sinuous sides; ejaculatory duct narrow, conspicuous; phallotremal sclerite about half as long as tubular portion of phallus.

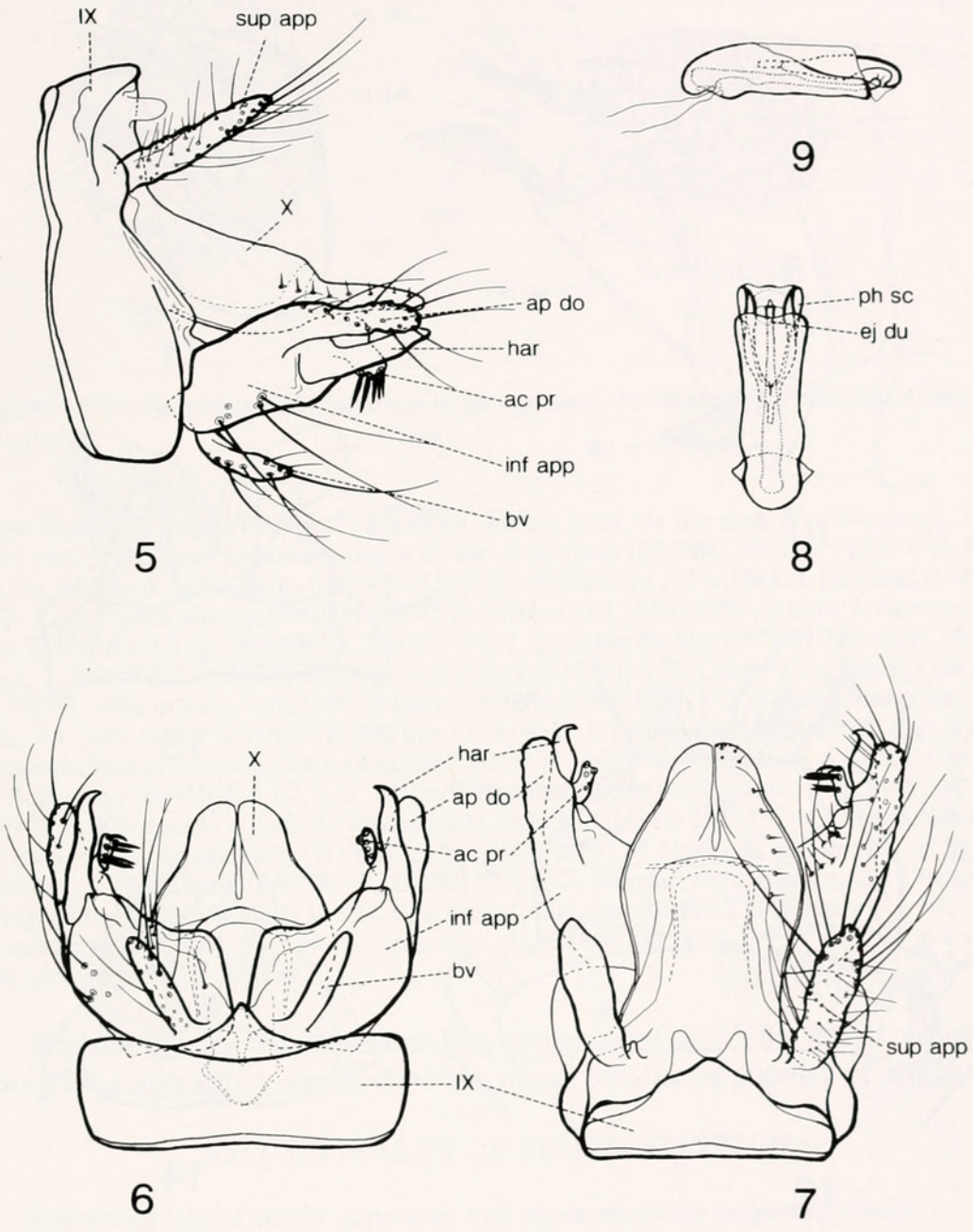
Adult female (n=10, if not otherwise stated). Forewing length 8.9-9.9, 9.4 mm; hindwing length 6.5-7.7, 7.2 mm. Eye 0.45-0.50, 0.47 mm wide. Antennae at least 27.9 mm long including 0.40-0.48, 0.45 mm long antennal scape. Maxillary palp segment lengths (in mm): 0.43-0.52, 0.47; 0.60-0.72, 0.68; 0.71-0.84, 0.79; 0.40-0.45, 0.42; 0.76-0.92, 0.85. Color (in alcohol) as in male.

Wings (Figs. 3-4). Forewing with crossvein sc-r broadened and stigma present; apical forks I, II, and V present; fork I sessile; discoidal cell long, subequal to thyridial cell in length; nygma faint, rectangular, present in fork II. Hindwing shorter and broader than forewing; apical forks II and V present; fork V long, originating about one-third of distance between origin of discoidal cell (fork of S) and fork of M; nygma faint, rounded, present in fork II.

Genitalia (Figs. 10-14). Abdominal segment VIII with sternum narrow, triangular, setose; in ventral view with posterior margin broadly rounded. Segment IX with tergum broad; pleuron with distinct, rounded corner laterally. Dorsal setose lobe narrow, triangular, attached along ventral surface; in dorsal view broadly rounded to subtriangular; with short, triangular semimembranous sensilla-bearing process, bearing one or occasionally two setae. Lamella with longitudinal striae on ventral surface; with double to triple row of slightly curved setae along posterolateral margin; apparently flexible both in posterior and in ventral direction, when in dorsal, (open) position narrowly triangular in lateral view (Fig. 10), in dorsal view subrectangular and pointing posterolaterad (Fig. 13); when turned more ventrad, (closed position), subtriangular with broadly rounded apex in lateral view (Fig. 11), in dorsal view rounded, pointing posteriad (Fig. 14); in some specimens apex turned further ventrad, (fully closed position), overlapping, forming roof-shaped hood. Gonopod plate apparently somewhat flexible, with straight or convex ventral margin in lateral view; in ventral view with posterior margin subrectangular, with small, rounded, median excavation. Spermathecal sclerite oval, broadly rounded anteriorly; in lateral view slightly curved, subrectangular; in all spent females twisted or positioned askew.

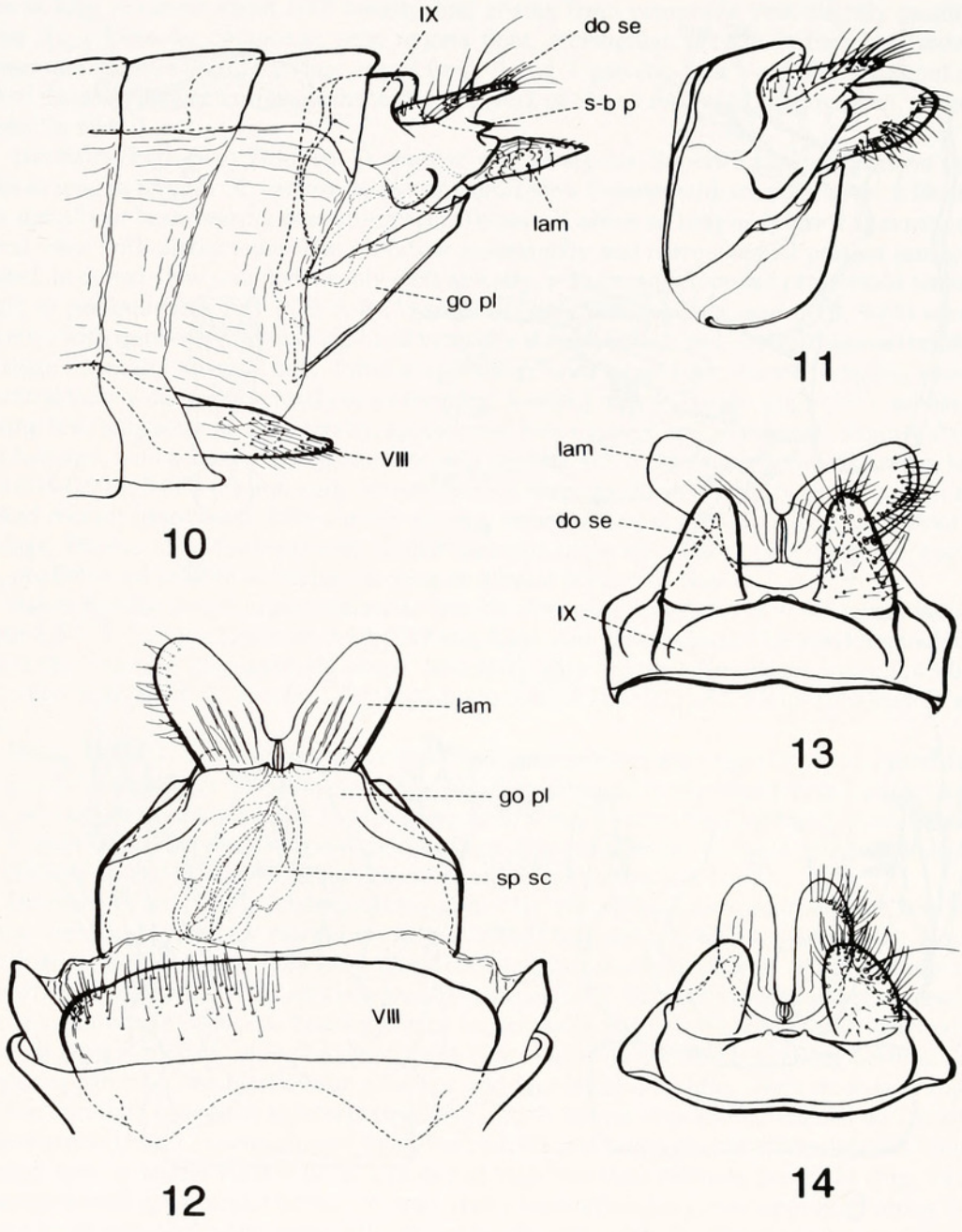
Egg mass (Figs. 15-16). Consisting of strings of eggs apparently glued together with transparent secretion, with scattered long setae, probably originating from the wing fringe, encrusted in the surface. Outline oval or slightly ovoid, with one side rounded, other side flatter with distinct groove where next layer of eggs begin. Egg mass 2.19-2.62 (2) mm long, 1.87-1.89 (2) mm wide, and 1.34-1.38 (2) mm thick.

Larva and pupa. Unknown.

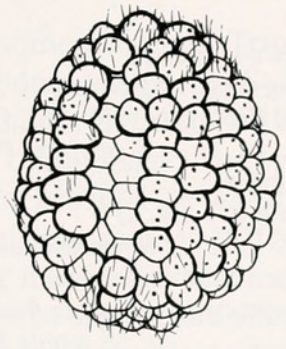


Figures 5-9. *Symphitoneuria sabaensis* n. sp. male genitalia. 5. Lateral. 6. Ventral. 7. Dorsal. 8. Phallus, ventral. 9. Phallus, lateral.

Abbreviations: ac pr = accessory projection of apicodorsal lobe of inferior appendage, ap do = apicodorsal lobe of inferior appendage, bv = basoventral lobe of inferior appendage, ej du = ejaculatory duct, har = harpago, inf app = inferior appendage, IX = segment IX, ph sc = phallotremal sclerite, sup app = superior appendage, X = tergum X.



Figures 10-14. ***Symphitoneuria sabaensis*** **n. sp. female genitalia. 10. Lateral, with lamella in open position. 11. Lateral, with lamella in closed position. 12. Ventral. 13. Dorsal, with lamella in open position. 14. Dorsal, with lamella in closed position.**
Abbreviations: do se = dorsal setose lobe, go pl = gonopod plate, IX = segment IX, lam = lamella, s-b p = sensilla-bearing process, sp sc = spermathecal sclerite, VIII = sternum VIII.



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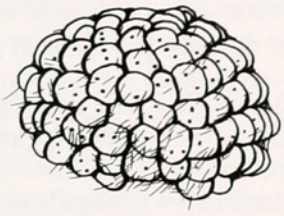

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Figures 15-16. *Symphitoneuria sabaensis* n. sp. egg mass. 15. Ventral (flat side). 16. Lateral (blunt end).

Type material. HOLOTYPE: ♂, Malaysia, Sabah, Long Pa Sia area E of kampong, 25.xi-8.xii.1987, 1000 m a.s.l., Malaise trap 4, C. van Achterberg (RMNH). PARATYPES: 1 ♂, Long Pa Sia, riverbank near airstrip, 04°25'N 115°43'E, 1000 m a.s.l., 21.x.1986, J. Huisman (UMSP); 5 ♀, Long Pa Sia, airstrip, 04°24'N 115°43'E, 1000 m a.s.l., 16.iv.1987, at light, J. Huisman & J. van Tol (RMNH 3 ♀, NMNH ♀, ZMBN ♀); 1 ♀, Long Pa Sia, 04°25'N 115°43'E, 1000 m a.s.l., 1. xii.1987, J. Huisman & C. van Achterberg (UMSP); 4 ♀, Long Pa Sia, airstrip, 04°24'N 115°43'E, 1000 m a.s.l., 7.xii.1987, at light, J. Huisman (RMNH); 1 ♂, Sapulut, kampong, roadside, 4.v.1987, 04°42'N 116°29'E, 290 m a.s.l., at light, J. Huisman (ZMBN); 5 ♂, 4 ♀, 7 km S Nabawan, near old airstrip, pond, 14.xi.1987, 05°02'N 116°27'E, 400 m a.s.l., at light, J. Huisman & R. de Jong (RMNH); 1 ♂, 2 ♀, 11 km S Nabawan, pond on roadside, 15.xi.1987, 04°57'N 116°27'E, 400 m a.s.l., at light, J. Huisman & R. de Jong (UMSP); 1 ♂, 1 ♀, 12.5 km S Nabawan, on road to Kg. Pamuntariah, 1st bridge, 16.xi.1987, 04°57'N 116°27'E, 400 m a.s.l., at light, J. Huisman & R. de Jong (RMNH ♂, ZMBN ♀); 3 ♂, Kundassang kampong, Sg. Liwagu, on bridge, 23.viii.1986, 06°00'N 116°34'E, at light, J. Huisman (UMSP 2 ♂, ZMBN ♂); 1 ♂, 1 ♀, Kundassang kampong, Sg. Liwagu, on bridge, 23.xi.1986, 06°00'N 116°34'E, 1185 m a.s.l., J. Huisman (NMNH ♂, UMSP ♀).

Etymology: named after Sabah, the northeastern part of the Island of Borneo, using the Latin suffix *-ensis*, denoting place, locality or country of origin.

KEY TO MALES OF *SYMPHITONEURIA*

1 Apicodorsal lobe of inferior appendage with setose, accessory projection mesally 2
1' Apicodorsal lobe of inferior appendage lacking setose, accessory projection mesally 6
2 Tergum X about as long as inferior appendage; fork I in forewing sessile 3
2' Tergum X distinctly longer than inferior appendage, in dorsal view triangular, pointed, with deeply cleft apex; fork I in forewing with short stem (Mosely and Kimmins, 1953: 260, figs. 180-181) ..... *S. exigua* (McLachlan)
3 Forewing with discoidal cell short and broad, with crossvein r-s reaching discoidal cell in distal one-fifth; fork V in hindwing long, originating distinctly closer to base than fork of M 4

3' Forewing with discoidal cell long and narrow, with crossvein r-s reaching discoidal cell about two-thirds from base; fork V in hindwing short, originating about the same distance from base as fork of M (Mosely and Kimmins, 1953: 263, fig. 183) ..... *S. opposita* (Walker)

4 Tergum X in dorsal view with apex rounded to bluntly triangular 5

4' Tergum X in dorsal view with apex subtruncate (Morse, 1989: 207, fig. 2) ..... *S. dammermanni* Ulmer

5 Tergum X in dorsal view gradually widened basally, with apex bluntly triangular; accessory mesal projection of apicodorsal lobe of inferior appendage with more than 6 spine-like setae (Neboiss, 1987: 140, fig. 40) ..... *S. ampla* Korboot

5' Tergum X in dorsal view with broadly rounded and projecting sides and rounded apex; accessory mesal projection of apicodorsal lobe of inferior appendage with 4-5 strong spine-like setae (Figs. 5-7) ..... *S. sabaensis* n. sp.

6 Inferior appendage with harpago fused almost entirely to apicodorsal lobe, basoventral lobe not forked (Mosely and Kimmins, 1953: 268, fig. 187) ..... *S. wheeleri* Banks

6' Inferior appendage with harpago free, basoventral lobe forked (Neboiss, 1986: 222, figs. 38-40) ..... *S. licmetica* Neboiss

DISCUSSION

The male wing venation of *S. sabaensis* most closely resembles that of *S. ampla* Korboot and *S. dammermanni*, especially in the comparatively short and broad forewing discoidal cell and the long hindwing fork V. However, it differs from both in having Cu_2 arising from composite vein slightly basally to where S_{3+4} joins the vein. The setose mesal accessory projection on the apicodorsal lobe of the inferior appendage of the male genitalia, groups *S. sabaensis* with *S. ampla, S. dammermanni, S. exigua,* and *S. opposita.* It can be distinguished, however, from all known species of *Symphitoneuria* by the rounded apex and broadly rounded and projecting sides of tergum X.

The female of *S. sabaensis* can be separated from other described females except *S. exigua* in having the posterior margin of the gonopod plate subrectangular, with a small, rounded, median excavation. However, *S. exigua* appears to have the posterior margin of sternite VIII with a shallow, broadly V-shaped, median excision, while the posterior margin in *S. sabaensis* is evenly rounded.

Biology. Little seems to be known about the ecology and habitat requirements of most of the *Symphitoneuria* species. St Clair (1994) described the larvae of *S. exigua* and stated that it is usually found in small, sluggish, often turbid lowland streams and swamps. According to Illies (1969) *S. ampla* appeared to be the most abundant Trichoptera species in Lake Pinde and Lake Aunde at about 3,600 m a.s.l. on Papua New Guinea. The present specimens were taken in localities ranging from 290 to 1185 m a.s.l., mostly along fast flowing rivers, but also close to stagnant blackwater pools.

In some genera of Triplectidini the females carry egg masses at the tip of their abdomen (see e.g. St Clair, 1993). Korboot (1963) studied the life history of *S. exigua*, figuring and describing the egg mass as spherical and covered in a layer of mucilage. The egg mass was dropped by the female from a height of 3 to 4 inches into the water. Although none of the females of *S. sabaensis* n. sp. had their egg masses still attached when studied, the females apparently carry the egg mass between sternum VIII and the gonopod plate. Sternum VIII appears to be movable and a cavity is formed in the pleural region of segment VIII. Setae probably originating from the wing fringe and imbedded in the egg mass were seen inside the cavity in several of the females. The apparent flexibility of the lamella, which allow for movement in both posterior and ventral directions, might also be an adaptation for manipulation of the egg mass.

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The junior author received financial support for the field work in Sabah from Uyttenboogaart-Eliasen Foundation, Melchior Treub Foundation, and the National Museum of Natural History in Leiden. In Sabah, the staff of Kinabalu National Park was very supportive particularly Anthea Lamb-Phillips and Fui-Lian Inger-Tan; Jan van Tol, Cees van Achterberg and Rienk de Jong participated in the fieldwork.

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(continued from page 20)

The Basmati rice was immediately detained by FDA after live insects were found and the presence of khapra beetle suspected. Once the larvae found in the rice were positively confirmed as khapra beetle by USDA, the rice shipment was fumigated with methyl bromide under USDA supervision. A reconditioning plan was proposed by the importer to salvage the rice, but it was subsequently refused. After no further response by the consignee, the shipment was issued a notice of refusal and was ordered to be exported or destroyed under U.S. Custom's supervision.

A personal communication with J. F. Cavey, Entomologist, USDA-APHIS-PPQ in Riverdale, MD, provided additional records of khapra beetle interceptions into the United States. He stated that within the last five years, 35 interceptions of khapra beetle by USDA-APHIS-PPQ officers were recorded at ports of entry into the United States, with the majority of these interceptions occurring in Texas, Georgia, and California. Ours is the only record of the khapra beetle found entering Baltimore, MD during this time.

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