



NOTES ON *RHOPALOPSOLE* KLAPÁLEK (PLECOPTERA: LEUCTRIDAE), WITH DESCRIPTIONS OF THREE NEW SPECIES FROM VIETNAM

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ABSTRACT

Rhopalopssole azun sp. n., *R. minima* sp. n. and *R. sapa* sp. n. are described from specimens collected in Vietnam, and compared to congeners known from the region. An additional unassociated female is described under informal designation, and a new name is provided for the Japanese species *R. longicercia* Sivec & Shimizu, *nomen nudum*. A list of *Rhopalopssole* species known for Vietnam is provided, and a key to males for the known Vietnamese species is presented.

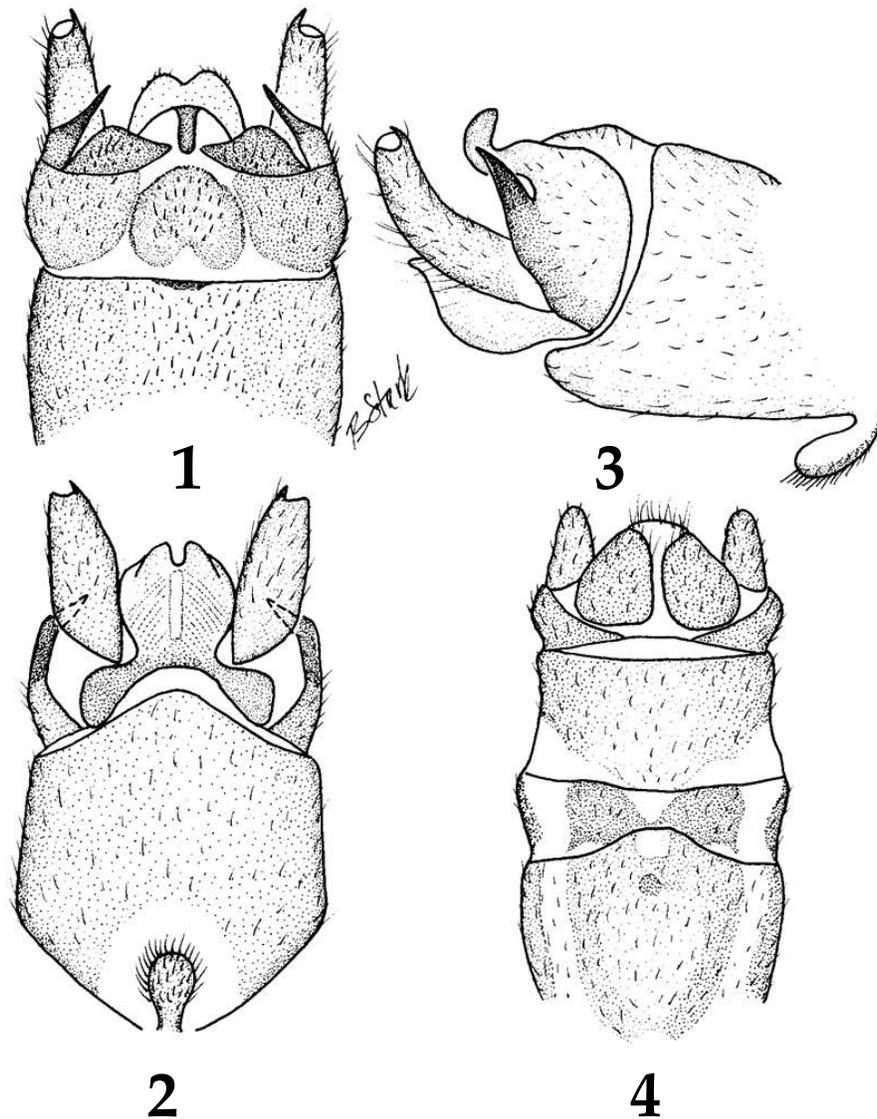
Keywords: *Rhopalopssole*, Plecoptera, Leuctridae, Vietnam, new species

INTRODUCTION

The genus *Rhopalopssole* was proposed by Klapálek (1912) for a Taiwanese species and Okamoto (1922) added the first records from Japan. Subsequently, numerous species have been discovered on the Asian mainland and on several Asian islands. DeWalt et al. (2012) listed 76 species, many of which have been described in the last decade by Sivec et al. (2008) and by Yang Ding and colleagues (e.g. Li et al. 2011; Yang & Li 2006; Yang et al. 2005). A result of this recent work is a dramatic increase in the known Chinese *Rhopalopssole* species to 35 (DeWalt et al. 2012). Other areas of Southeast Asia, however, remain poorly studied. In Vietnam, for example, only five *Rhopalopssole* species are currently recognized and all

but one are known from samples consisting of six or fewer specimens (Harrison & Stark 2008; Sivec et al. 2008).

This study is based on specimens collected in Vietnam by personnel of the Royal Ontario Museum. We also take this opportunity to provide a valid name for *R. longicercia* Sivec & Shimizu 2008, a Japanese species proposed without designation of a holotype (Sivec et al. 2008). Holotypes and other specimens from Vietnam are deposited in the Royal Ontario Museum, Toronto, Ontario, Canada (ROM). Specimens from Japan are deposited in the Peter Zwick collection, Schlitz, Germany, or in the Lake Biwa Museum, Oroshimo, Kusatsu, Shige Prefecture, Japan, as indicated in the text.



Figs. 1-4. *Rhopalopsola azon* structures. 1. Male terminalia, dorsal. 2. Male terminalia, ventral. 3. Male terminalia, lateral. 4. Female terminalia, ventral.

RESULTS AND DISCUSSION

Rhopalopsola azon Stark & Sivec sp. n. (Figs. 1-4)

Material examined. Holotype ♂, Vietnam, Gia Lai, An Khe District, Tram Lap, Azun River, 2 km NW on trail from forestry building, 14° 27' N, 108° 33' E, 23 June 1996, ROM 961084, D.C. Currie, J. Swann (ROM). Paratype: Vietnam, Gia Lai, An Khe District,

Tram Lap, small stream 0.5 km NW on trail from forestry building to Azun River, 900 m, 14° 27' N, 108° 33' E, 22 June 1996, ROM 961081, D.C. Currie, J. Swann, 1♀ (ROM).

Male. General color in alcohol brown. Head and legs brown, without distinctive pattern. Wings uniformly brown with slightly darker veins. Forewing length 5.5 mm. Vesicle typical of the genus, rounded apically and attached to anterior margin of sternum 9 by narrow pedicel (Fig. 2). Posterior margin of

tergum 9 thickened slightly for a short section at midlength (Fig. 1). Tergum 10 with a cordate shaped mesal sclerite offset from other sclerites by narrow membranous strips. Posterolateral margins of tergum 10 bearing prominent thorn-like processes; each process wide basally and scalloped on the posterior margin to form a long, narrow, sclerotized spine (Figs. 1-3). Epiproct thick with rounded apex (Figs. 1, 3). Cerci moderately long, subcylindrical, curved upward slightly in lateral aspect and bearing a small spine on the inner dorsoapical margin (Figs. 1-3). Paraprocts fused into a caudally projecting process decurved at the tip and bearing numerous fine surface wrinkles; apex notched (Figs. 1-3).

Putative female. General habitus similar to male. Forewing length 6.0 mm. Posteromedian margin of sternum 7 projecting slightly over base of sternum 8; sternum 7 sclerotized over much of surface, but with a small, posteromedian, square unpigmented zone (Fig. 4). Sternum 8 with median transverse sclerite deeply incised on posteromedian margin. Sternum 9 sclerotized over most of surface, but with a small anteromedian unsclerotized lobe.

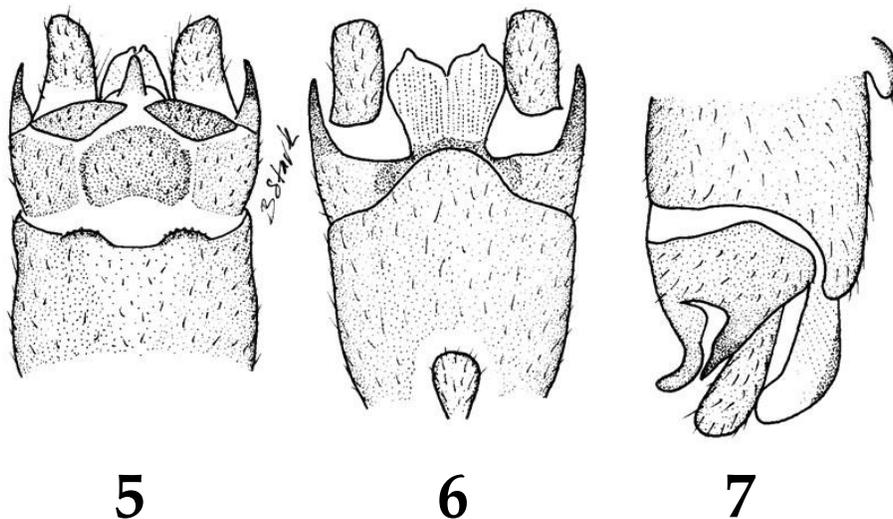
Larva. Unknown.

Etymology. The species name, used as a noun in apposition, is based on the Azun River type locality.

Diagnosis. The males of three species reported from Vietnam (*R. alobata* Harrison & Stark 2008; *R. sipang* Sivec & Harper 2008 in Sivec et al. 2008; *R. tamdao* Sivec & Harper 2008 in Sivec et al. 2008) also have

unforked, spine-like posterolateral processes on tergum 10. The former species, *R. alobata*, lacks a vesicle on male sternum 9, and *R. sipang* has much shorter posterolateral processes and a mesal spinule patch on tergum 9. The new species, an apparent member of the “*magnicerca* group” of Sivec et al. (2008), is similar to *R. tamdao*, and the two are distinguished by subtle characters of epiproct shape. The epiproct of *R. tamdao* is distinctly narrowed to an acute apex in dorsal aspect, whereas in *R. azon* this structure is scarcely narrowed in dorsal aspect and also appears thicker in lateral aspect (Figs. 1, 3). An additional distinction occurs on the posterior margin of tergum 9. *Rhopalopsola tamdao* has a thickened band of minute knobs extending across much of the dorsal margin of tergum 9, narrowly connected mesally and not projecting caudally (see Fig. 5.1 in Sivec et al. 2008). In *R. azon* the thickened band is restricted to a narrow mesal zone (Fig. 1). *Rhopalopsola minima*, described below, also shares many features with *R. tamdao* and *R. azon* but it differs from both species in having a pair of widely separated, thickened bands on the posterior margin of tergum 9 (Fig. 5).

The female is associated on the basis of proximity of collection sites and may represent a separate species. The plate on sternum 7 is similar to that of *R. tamdao*, but the small transparent area on the posteromedian margin in that species is triangular in shape, and the sclerite on sternum 8 is divided (see Fig. 5.5 in Sivec et al. 2008).



Figs. 5-7. *Rhopalopsola minima* structures. 5. Male terminalia, dorsal. 6. Male terminalia, ventral. 7. Male terminalia, lateral.

***Rhopalopsola minima* Stark & Sivec sp. n.**

(Figs. 5-7)

Material examined. Holotype ♂, Vietnam, Nghe An, ca. 25 km SW Con Cuong, Khe Moi River Forestry Camp, 4-9 June 1995, ROM 956154, B. Hubley, J. Swann (ROM).

Male. General color in alcohol brown. Head and legs without distinctive pattern, wings pale brown with darker veins. Forewing length 4.0 mm. Vesicle typical of genus, rounded apically and attached to anterior margin of sternum 9 by a narrow pedicel (Fig. 6). Posterior margin of tergum 9 thickened slightly for two short sublateral sections (Fig. 5). Tergum 10 with a cordate-shaped mesal sclerite, bordered on each side by a dark parenthesis-shaped sclerite. Posterolateral margin of tergum 10 bearing prominent thorn-like process; process wide basally and tapered to an acute point in dorsal and lateral aspect (Figs. 5-7); apical half of process darker than base. Epiproct rounded at apex and curved slightly forward in lateral aspect (Fig. 7). Cerci cylindrical, without terminal spine. Paraprocts fused into a caudally projecting process bearing fine striations on surface (Fig. 5); apex notched.

Female. Unknown.

Larva. Unknown.

Etymology. The species name is based on the diminutive size of the male.

Diagnosis. This species, an apparent member of the “*magnicerca* group” of Sivec et al. (2008), is similar to *R. azun* and *R. tamdao* in having an unforked posterolateral process on tergum 10 and is distinguished from these species by the features discussed above under *R. azun*.

***Rhopalopsola sapa* Stark & Sivec sp. n.**

(Figs. 8-11)

Material examined. Holotype ♂ and ♀ paratype, Vietnam, Lao Cai, Sapa, large waterfall on road from Sapa to Lai Chau, 7 May 1995, ROM 956015, D.C. Currie, B. Hubley, J. Swann (ROM).

Male. General color in alcohol brown. Head and legs without distinctive pattern, wings pale brown with darker veins. Forewing length 6.0 mm. Vesicle typical of genus, rounded apically and attached to anterior margin of sternum 9 by a narrow pedicel (Fig. 9). Posterior margin of sternum 9 thickened,

darkly sclerotized and slightly produced as a pair of narrowly separated lobes (Fig. 8). Tergum 10 with mesal sclerite half rounded and offset from adjacent sclerites by narrow membranous strips. Posterolateral margins of tergum 10 bearing on each side a prominent blade-like process with truncate apex (Figs. 8-10). Epiproct curved forward over tergum 10, apex rounded. Cerci curved upwards in lateral aspect, subcylindrical, slightly swollen apically and without apical spine (Fig. 10). Paraprocts fused into a complexly folded, apically swollen structure with fine striations on surface (Figs. 8-10); apex broadly triangular without notch.

Putative Female. General habitus similar to male. Forewing length 7.0 mm. Sternum 7 prolonged as a narrow, triangular point extending over base of sternum 8. Sclerite on sternum 8 constricted mesally and shaped somewhat like an hour-glass (Fig. 11).

Larva. Unknown.

Etymology. The species name, used as a noun in apposition, is based on the type locality.

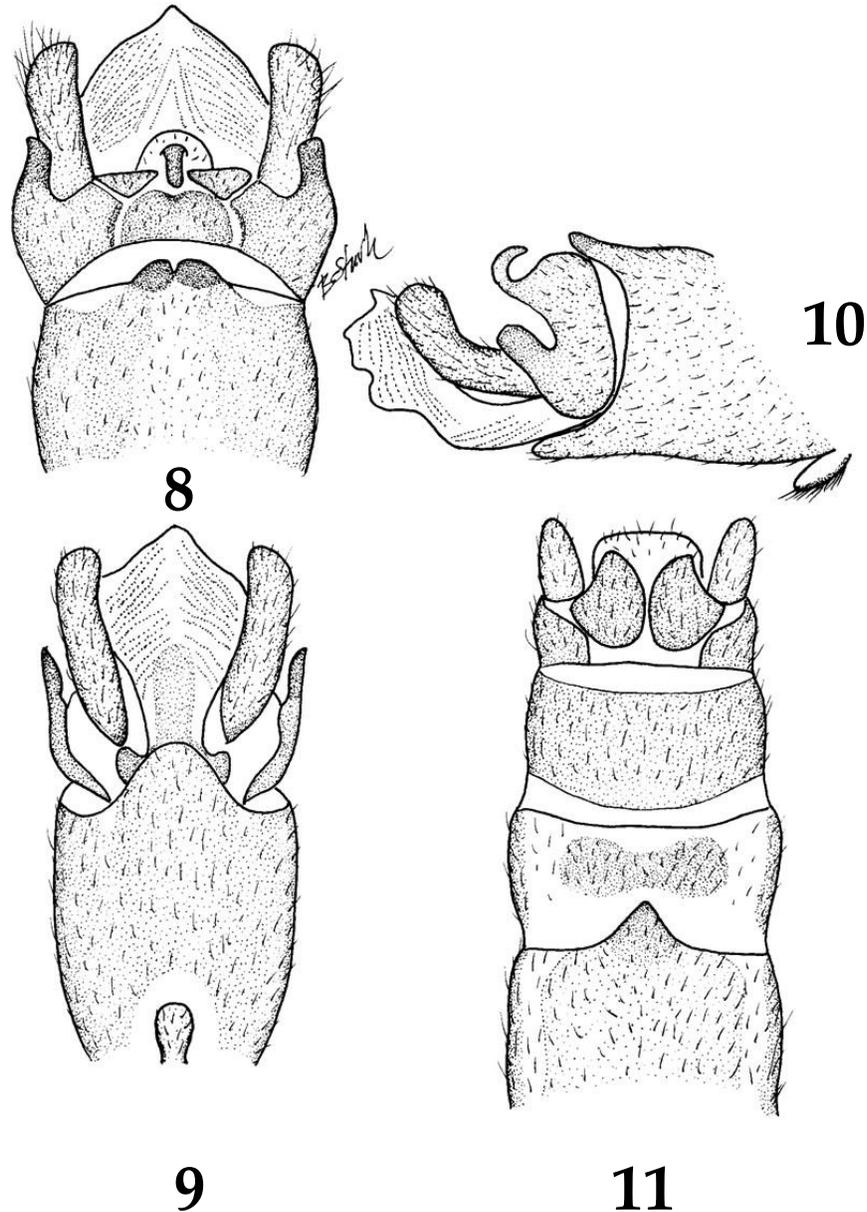
Diagnosis. Males share the modified posterior margin of tergum 9 with several other species, including *R. gladifera* Zwick 1977 and *R. emishan* Sivec & Harper 2008 in Sivec et al. 2008, although in *R. sapa* these structures appear thicker. In addition, *R. sapa* is the only known species in which the posterolateral processes of tergum 10 have truncate tips and are thin and blade-like.

The female association is based on co-occurrence of male and female at the same site. The subgenital plate outline is generally similar to that of two Japanese species (*R. bulbifera* Sivec & Shimizu 2008 in Sivec et al. 2008, and *R. ebinokogen* Sivec & Shimizu 2008 in Sivec et al. 2008), but the relatively wide, mesally constricted sclerite on sternum 8 is typical of *R. sapa*. The species is an apparent member of the “*magnicerca* group” recognized by Sivec et al. (2008).

***Rhopalopsola sinuacercia* Sivec & Shimizu,
nom. nov.**

Rhopalopsola longicercia Sivec & Shimizu 2008:89. No holotype designated

Material examined. Holotype ♂, 5♂, 5♀ paratypes, Japan, Shizuoka Prefecture, Kiyozasa Pass, 24 May 1986, M. Satô (P. Zwick collection). Additional paratypes all from Japan: Oyana-gawa, 800 m, Kaji



Figs. 8-11. *Rhopalopsola sapa* structures. 8. Male terminalia, dorsal. 9. Male terminalia, ventral. 10. Male terminalia, lateral. 11. Female terminalia, ventral.

Zawa-cho, Yamanasi, 29 May 1993, T. Hattari, 3♂, 3♀ (Lake Biwa Museum). Kanagawa, Yamakita-machi, Yoki-zawa, small tributary, 10 May 1996, T. Shimizu, 8♂, 2♀ (Lake Biwa Museum). Shizuoka Prefecture, Haruno-San, 26 May 1986, M. Satô 4♂ (P. Zwick collection).

Detailed descriptions and figures are available in Sivec et al. 2008, pages 89-91. The new name is required because the original descriptions for adults of this species are presented as a species complex description without designation of a holotype. An additional problem occurs in selection of

“longicercia” as the original specific epithet because *R. longicerca* Kawai 1968 is rendered as *R. longicercia* Kawai on page 101 in Sivec et al. (2008).

Etymology. The species name refers to the slightly sinuate curvature of the cerci in dorsal and lateral aspect.

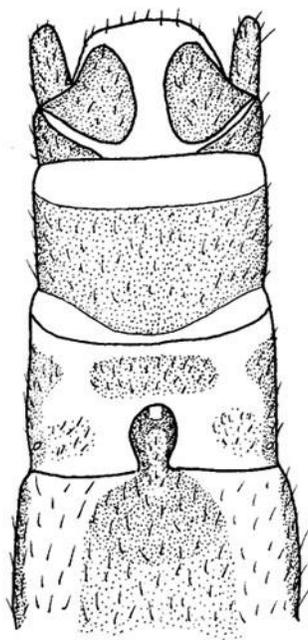
Diagnosis. Males of this species have a relatively long, acute epiproct, relatively short, unforked lateral processes with swollen bases on tergum 10, long sinuate cerci with terminal, inwardly-directed spine, and an unusual, warty process set near the posteromedian point of tergum 9. This combination of characters is otherwise unknown (Sivec et al. 2008), however as Sivec et al. (2008) indicate, additional, closely related species are expected.

Male. Unknown.

Female. Pigment pattern obscured by teneral specimen condition. Forewing length 6.0 mm. Sternum 7 prolonged as a narrow, apically rounded, tongue-shaped projection; lateral margins of projection sclerotized, median field and apex membranous (Fig. 12). Sternum 8 with a broad, transverse sclerite near posterior margin, and a membranous, hairy basolateral area (Fig. 12).

Larva. Unknown.

Diagnosis. The subgenital plate of this female does not closely match that of any of the known species, however, the projection from sternum 7 is generally similar to that of *R. gladifera* (Zwick 1977, Sivec et al. 2008), a species known from Bhutan.



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Fig. 12. *Rhopalopsale* Vn A. 12. Female abdominal sterna 7-8.

Rhopalopsale Vn A (Fig. 12)

Material examined. Vietnam: Cao Bang, Ba Be National Park, jct road to Lake Ba Be and trail to ethnic village, 19 May 1995, ROM 956101, D.C. Currie, K. Ciruna, J. Whiting, 1♀ (ROM).

Vietnam *Rhopalopsale* Species List

Eight, formally recognized *Rhopalopsale* species, and one species identified by informal designation are listed below, together with their known provincial distributions in Vietnam. Only *R. sinensis*, also known from China, is currently known outside of Vietnam.

<i>R. alobata</i> Harrison & Stark 2008	Vinh Phu
<i>R. azun</i> sp. n.	Gia Lai
<i>R. minima</i> sp. n.	Nghe An
<i>R. sapa</i> sp. n.	Lao Cai
<i>R. sinensis</i> Yang & Yang 1993	Lao Cai
<i>R. sipang</i> Sivec & Harper 2008	Lao Cai
<i>R. tamdao</i> Sivec & Harper 2008	Vinh Phu
<i>R. vietnamica</i> Sivec & Harper 2008	Province unknown
<i>R. Vn A</i>	Cao Bang

Key to Male Vietnamese *Rhopalopsale*

- 1 Abdominal sternum 9 without vesicle (Fig. 2 in Harrison & Stark 2008) *R. alobata*
- 1' Vesicle present on abdominal sternum 9 (Fig. 2) 2
- 2 Spine-like process on segment 10 forked (Figs. 6, 8 in Harrison & Stark 2008) 3
- 2' Spine-like process on segment 10 unforked (Fig. 1) 4
- 3 Fused paraprocts deeply notched, posteromedian margin of tergum 9 with a slender, wide sclerotized area (Fig. 6 in Harrison & Stark 2008) *R. sinensis*

- 3' Fused paraprocts without notch, posteromedian margin of tergum 9 with a minute, triangular sclerotized area (Fig. 20.1 in Sivec et al. 2008) *R. vietnamica*
- 4 Posteromedian margin of tergum 9 bearing a single dark sclerotized area (Fig. 1) 5
- 4' Dark sclerotized area on posteromedian margin of tergum 9 divided or notched (Fig. 8) 6
- 5 Posterolateral spine on tergum 10 acute, well-developed, cerci with small terminal spine (Fig. 1) *R. azun*
- 5' Posterolateral spine on tergum 10 poorly developed, scarcely projecting, cerci without spine (Fig. 40.1 in Sivec et al. 2008) *R. sipang*
- 6 Dark sclerotized areas on posterior margin of tergum 9 widely separated (Fig. 5) *R. minima*
- 6' Dark sclerotized areas on posterior margin of tergum 9 separated by a narrow gap or notch (Fig. 8, and Fig. 5.1 in Sivec et al. 2008) 7
- 7 Dark sclerotized area on posterior margin of tergum 9 upturned and projecting beyond margin (Fig. 8); spine on tergum 10 apically truncate (Figs. 8,10) *R. sapa*
- 7' Dark sclerotized area on posterior margin of tergum 9 flat and not projecting beyond margin (Fig. 5.1 in Sivec et al. 2008); spine on tergum 10 acute (Fig. 5.3 in Sivec et al. 2008) *R. tamdao*
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