



Three new species of Leptoceridae Leach 1815 (Insecta: Trichoptera) from Shan State, Myanmar

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Abstract

Three new species of Leptoceridae, including *Ceraclea satasookae* n. sp., *Setodes siribumrungsukhai* n. sp., and *S. salweenensis* n. sp. are described and figured from Shan State, Myanmar. Twenty-two species of Leptoceridae were found and 21 of them are new records to the country.

Key word: caddisfly, Oriental region, faunistics, Southeast Asia

Introduction

Myanmar is a country in Southeast Asia and part of the Oriental Region. The biodiversity of caddisflies in the Oriental Region is very high. Chantaramongkol *et al.* (2010) reported 1,005 species of Trichoptera from Thailand and 70% of the known species were described for the first time in that country. Armitage & Arefina-Armitage (2009) said that 400 species of caddisflies occur in Vietnam. According to the Trichoptera World Checklist (Morse 2015), there are 156 species known from Laos, but none from Bangladesh. Yang *et al.* (2005) reported 1,000 species from China, with 187 species from Yunnan Province alone. Saini *et al.* (2001) listed 1007 caddisfly species from India, with states adjoining Myanmar having 161, 135, and 12 species (in Arunachal Pradesh, Manipur, and Mizoram, respectively; Nagaland was not distinguished from Assam). Wityi *et al.* (2015) listed only 227 caddisfly species in Myanmar in 68 genera of 28 families; most of the relevant publications were mainly about specimens collected during British colonial times.

The species richness of the family Leptoceridae is at its highest in Southeast Asia, with 380 species in 14 genera, including *Triplectides*, *Symphitoneuria*, *Mystacides*, *Oecetis*, *Adicella*, *Tagalopsyche*, *Ceraclea*, *Poecilopsyche*, *Athripsodes*, *Triaenodes*, *Parasetodes*, *Trichosetodes*, *Leptocerus*, and *Setodes* (Malicky & Chantaramongkol 2006; Malicky 2010). However, only 20 species in 7 genera were shown in the Myanmar checklist (Wityi *et al.*, 2015).

Considering the number of Leptoceridae and other Trichoptera in the countries adjacent to Myanmar, Myanmar's size and habitat diversity, the low number of Trichoptera publications so far concerning its caddisfly fauna, and the old age of most of those publications, there are probably many species of Leptoceridae and other Trichoptera present in this country that have not yet been found and described.

This research surveys the biodiversity of Trichoptera and describes new species of Trichoptera in Shan State, Myanmar.

Materials and methods

Field study localities were selected in tributaries of the Mekong and Salween Rivers, Shan State, Myanmar.

Caddisflies were collected by a UV pan light trap (12 V, 10 W) near the waterfalls, streams and rivers overnight at each site. The Trichoptera specimens were preserved in 70% ethanol and manually sorted afterwards. The adult male genitalia were cut and macerated by heating in 10% KOH at 60°C for 30–60 minutes. Only male insects were identified and counted in this study. The identified specimens of species other than those described here as new are deposited in the Department of Fishery and Coastal Resources, Faculty of Science and Industrial Technology, Prince of Songkla University, Surat Thani campus. Permits to export the specimens from Myanmar to Thailand were not required. The specimen collection sites were as follows (see also Table 1):

- (1) Sand Harvesting Station, Kheun River, Keng Tung Province, Shan State, Myanmar, 21°18' 24"N, 099°35'40"E, 788 m a.s.l., 14 Jan 2015, leg. Pongsak Laudee.
- (2) Pin Tao Waterfall, Keng Tung Province, Shan State, Myanmar, 21°26'37"N, 099°34'42"E, 977 m a.s.l., 28 Feb 2015, leg. Pongsak Laudee.
- (3) Tad waterfall, Keng Tung Province, Shan State, Myanmar, 21°14'44"N, 099°43'42"E, 1084 m a.s.l., 28 Feb 2015, leg. Pongsak Laudee.
- (4) Tad stream, Ban Klang, Keng Tung Province, Shan State, Myanmar, 21°14'33"N, 099°42'07"E, 854 m a.s.l., 28 Feb 2015, leg. Pongsak Laudee.
- (5) Pin Tao Waterfall, Keng Tung Province, Shan State, Myanmar, 21°26'39"N, 099°34'40"E, 1020 m a.s.l., 27 Feb 2015, leg. Pongsak Laudee.
- (6) Ban Ta Lay, Rean River, Keng Tung Province, Shan State, Myanmar, 20°42'37"N, 100°05'43"E, 410 m a.s.l., 27 Feb 2015, leg. Pongsak Laudee.
- (7) Water Electric Power Station, Jo Stream, Keng Tung Province, Shan State, Myanmar, 21°28'18"N, 099°34'40"E, 1149 m a.s.l., 28 Feb 2015, leg. Pongsak Laudee.
- (8) Mae Sai River, Tachilek Province, Shan State, Myanmar, 20°22'06"N, 100°05'09"E, 368 m a.s.l., 01 March 2015, leg. Pongsak Laudee.
- (9) Mekong River, Tachilek Province, Shan State, Myanmar, 20°22'13"N, 100°05'19"E, 364 m a.s.l., 01 March 2015, leg. Pongsak Laudee.
- (10) Nam Sim Stream, Tontar, Keng Tung Province, Shan State, Myanmar, 21°19'14"N, 099°17'39"E, 787 m a.s.l., 03 May 2015, leg. Sai Aye.
- (11) Nam Lab Stream, Moug Ping, Keng Tung Province, Shan State, Myanmar, 21°20'51"N, 099°01'33"E, 446 m a.s.l., 03 May 2015, leg. Sai Aye.
- (12) Nam Lok Stream, Moug Ping, Keng Tung Province, Shan State, Myanmar, 21°21'52"N, 099°00'51"E, 443 m a.s.l., 03 May 2015, leg. Sai Aye.
- (13) Nam Lok Stream, Moug Ping, Keng Tung Province, Shan State, Myanmar, 21°22'50"N, 099°00'49"E, 442 m a.s.l., 03 May 2015, leg. Sai Aye.
- (14) Nam Hlong Stream, Naw-awn, Keng Tung Province, Shan State, Myanmar, 21°13'17"N, 098°44'52"E, 374 m a.s.l., 04 May 2015, leg. Sai Aye.
- (15) Salween River, Naw-awn, Keng Tung Province, Shan State, Myanmar, 21°13'46"N, 098°42'32"E, 251 m a.s.l., 04 May 2015, leg. Sai Aye.
- (16) Salween River, Naw-awn, Keng Tung Province, Shan State, Myanmar, 21°12'32"N, 098°42'27"E, 256 m a.s.l., 04 May 2015, leg. Sai Aye.
- (17) Nam Hlong Stream, Naw-awn, Keng Tung Province, Shan State, Myanmar, 21°13'30"N, 098°43'11"E, 305 m a.s.l., 04 May 2015, leg. Sai Aye.

For the 3 new species discovered, the male genitalia were drawn by compound microscopy with a drawing tube, first with pencil and then with ink. Their holotypes and paratypes are stored in 70% ethanol and are deposited at Princess Maha Chakri Sirindhorn Natural History Museum (PSUNHM), Prince of Songkla University, Hat Yai Campus, Hat Yai District, Songkhla Province, Thailand. Some paratypes are deposited in the collection of Hans Malicky (CHM).

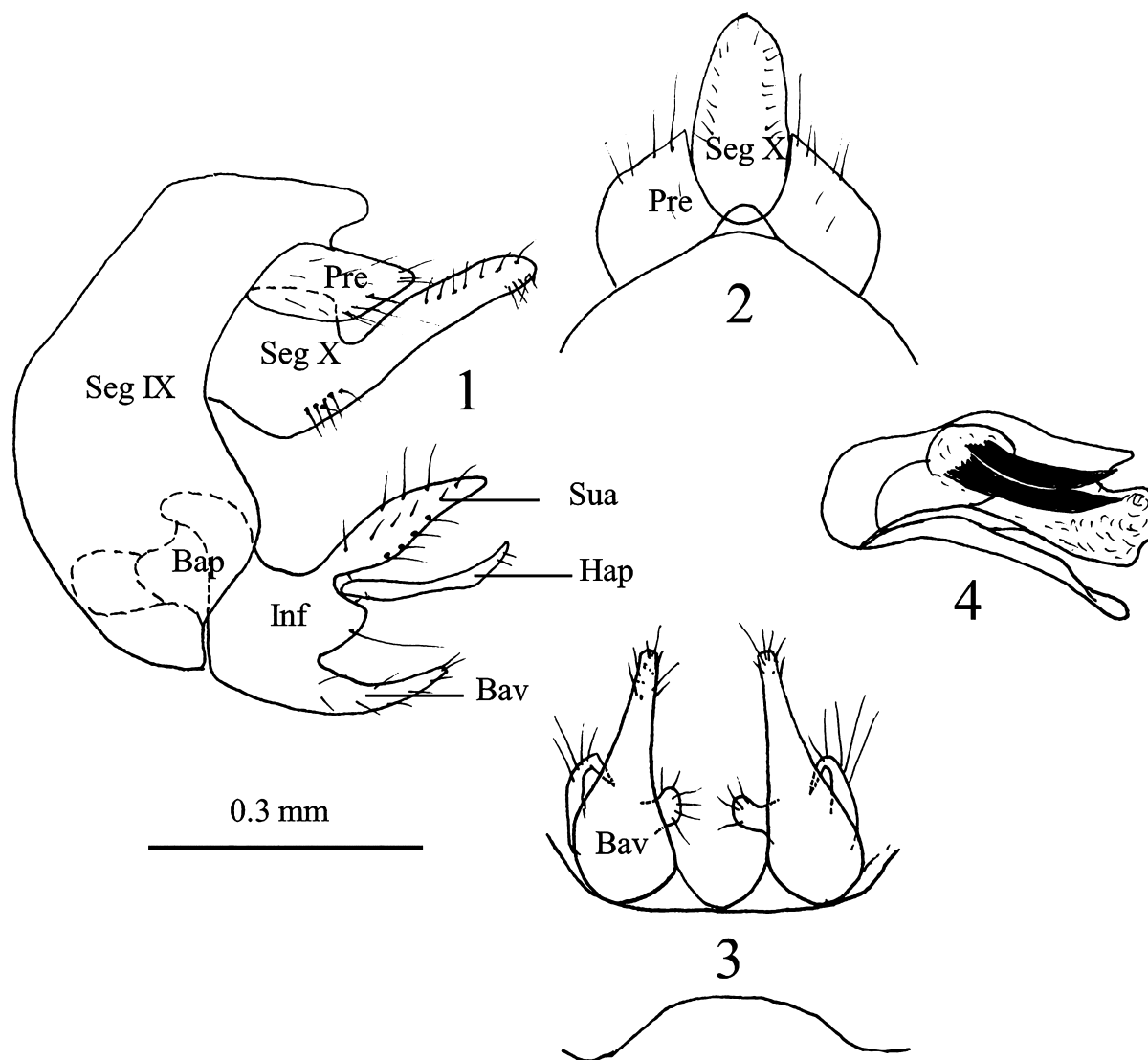
Taxonomy

Ceraclea satasookae n. sp.

(Figs. 1–4)

Type material. Holotype male (PSUNHM). **Myanmar:** Shan State, Keng Tung Province, Moung Ping, Nam Lok Stream, 21°21'52"N, 099°00'51"E, ca. 443 m a.s.l., 03 May 2015, leg. Sai Aye.

Paratypes: Myanmar: Same data as holotype, 1 male (PSUNHM). **Myanmar:** Shan State, Keng Tung Province, Naw-awn, Nam Hlong Stream, 21°13'17"N, 098°44'52"E, 374 m a.s.l., 04 May 2015, leg. Sai Aye, 1 male (CHM).



FIGURES 1–4. Male genitalia of *Ceraclea satasookae* n. sp. 1, genitalia, left lateral: preanal appendages (Pre), segment X (Seg X), basal plate (Bas), inferior appendages (Inf), subapicodorsal lobe (Sua), harpago (Har), basoventral lobe (Bav); 2, segment IX, dorsal: preanal appendages, and segment X (Seg IX); 3, segment IX and inferior appendages, ventral; 4, phallus, left lateral.

Etymology. Named for Assoc. Prof. Dr. Chutamas Satasook, who is the Director of the Princess Maha Chakri Sirindhorn Natural History Museum (PSUNHM).

Description. Length of each male forewing 9 mm (n=3); antennal length 1.6 mm (n=3); specimens in alcohol with head and thorax dark brown, mesoscutum dark brown in middle and light brown laterally, forewings brown, abdomen light brown with dark brown terga.

Male genitalia (Figures 1–4). In lateral view (Fig. 1), segment IX subrectangular; preanal appendages subtriangular, ventral margins broadly rounded, with long setae subapicoventrally. Segment X long, subquadrate in basal 1/3, cylindrical in apical 2/3, apex blunt, with row of short setae subdorsoapically and tufts of short setae basoventrally and subapicoventrally; inferior appendages complex, connected with each other on huge basal plate; each with subapicodorsal lobe shuttle-like with long setae; its harpago tubular, as long as subapicodorsal lobe; basal part of basal segment rectangular with long, curved, acute basoventral lobe. In dorsal view (Fig. 2), segment IX rounded apically; preanal appendages semicircular, separated for most of their length by deep U; segment X oval with stout setae apical and laterally. In ventral view (Fig. 3), basoventral lobe of each inferior appendage bowling-pin-like, knob with short setae on mesal surface of basal segment of each inferior appendage and claw with long setae subbasolaterally. Phallus with two phallic spines curved upward, membranous apically, sclerotized apicoventrally (Fig. 4).

Diagnosis. The male genitalia of the new species are most similar to those of *C. senilis* (Burmeister 1839), which is common in European countries and Siberia. These two species have similar lateral character of genitalia and dorsal view of preanal appendages. However, they can be distinguished by (1) the length of the forewing which is 12–13 mm (n=5) in *C. senilis* and 9 mm in *C. satasookae* n. sp.; (2) the preanal appendages of *C. senilis* are fused about 1/4 their length and separated apically by a V-shaped incision, but those of *C. satasookae* n. sp. are fused only at the base and are much more widely separated by a U-shaped incision; (3) the harpago of each inferior appendage of *C. senilis* is 2/3 as long as its subapicodorsal lobe, but the harpago of the new species is subequal in length to its subapicodorsal lobe; and (4) the new species has a long pointed basoventral lobe of each inferior appendage, which is short and blunt in *C. senilis*.

***Setodes siribumrungsukhai* n. sp.**

(Figs. 5–8)

Type material. Holotype male (PSUNHM). **Myanmar:** Shan State, Keng Tung Province, Naw-awn, Salween River, 21°13'46"N, 098°42'32"E, ca. 251 m a.s.l., 04 May 2015, leg. Sai Aye.

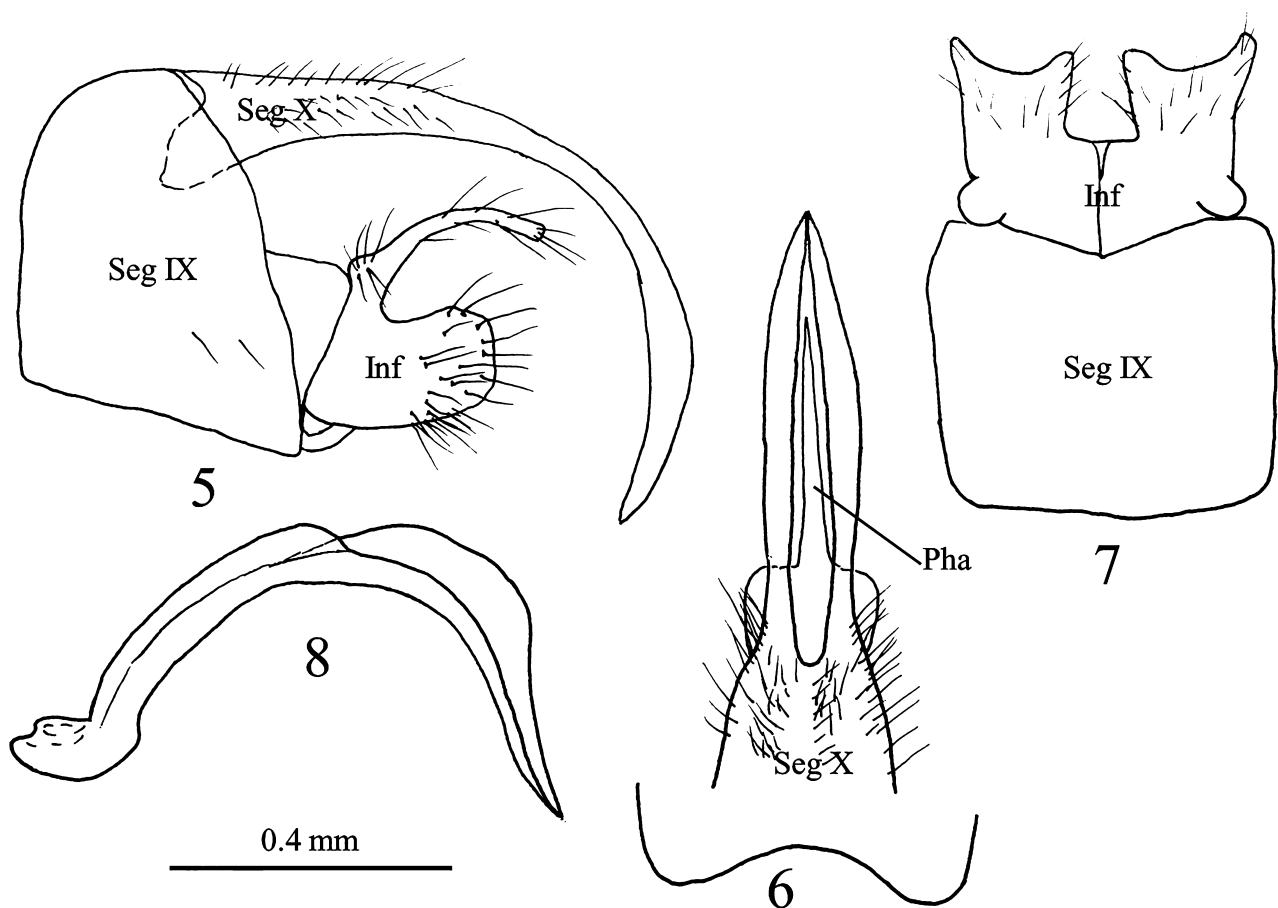
Paratypes: Same data as holotype, 2 males (PSUNHM); **Myanmar:** Shan State, Keng Tung Province, Nam Lok Stream, 21°22'50"N, 099°00'49"E, 442 m a.s.l., 03 May 2015, leg. Sai Aye, 2 males (CHM).

Etymology. Named for Assoc. Prof. Dr. Boonsom Siribumrungsukha who was President of Prince of Songkla University in 2006–2012.

Description. Length of each male forewing 6 mm (n=5); antennal length 11 mm; specimens in alcohol with head, thorax, abdomen, and forewings light yellowish brown.

Male genitalia (Figures 5–8). In lateral view (Fig. 5), segment IX trapezoidal; preanal appendages apparently absent (fused with base of segment X); segment X deeply divided apically into 2 saber-like blades, very long, gradually curved downward, with tuft of long subbasal setae dorsolaterally; inferior appendages each bilobed: dorsal lobe tubular with long setae, curved downward and ventral lobe scale-like, subapically with numerous long setae. In dorsal view (Fig. 6), segment X long, isosceles triangle, basal 1/4 fused, with many short and long setae subbasally, distal blades subparallel and convergent apically. In ventral view (Fig. 7), inferior appendages rectangular, fused in basal half, each with round knob basolaterally and broad and shallow incision apically, with numerous long setae subapically. Phallus long, curved downward, pointed apically; basal part larger than apical one and separated by a step, tapered and curved downward and pointed apically (Figure 8).

Diagnosis. This species belongs to the *Setodes hungaricus* Group of Schmid (1987). The male genitalia of *Setodes siribumrungsukhai* n. sp. appear very similar to those of *S. spinosellus* Ulmer 1930, found in the Philippines. However, the pictures by Ulmer are not very detailed. These species can be distinguished by the shapes of the inferior appendages. The inferior appendages of the new species were each divided into 2 obvious lobes, with the dorsal lobe cylindrical and curved downward. In contrast, *S. spinosellus* has undivided inferior appendages, with the dorsal part of each inferior appendage forming a short spine dorsoapically. The ventral lobe of each inferior appendage of the new species is round apically, but this region is truncated in *S. spinosellus*. The shape of the phallicata of *S. spinosellus* is falciform and the parameres are paired, long, and spine-like. However, the phallicata in *S. siribumrungsukhai* n. sp. is not so shaped and no parameres are shown.



FIGURES 5–8. Male genitalia of *Setodes siribumrungsukhai* n. sp. 5, genitalia, left lateral: segment IX (Seg IX), segment X (Seg X), inferior appendages (Inf); 6, segments IX and X and phallus (Pha), dorsal; 7, segment IX and inferior appendages, ventral; 8, phallus, left lateral.

***Setodes salweenensis* n. sp.**

(Figures 9–12)

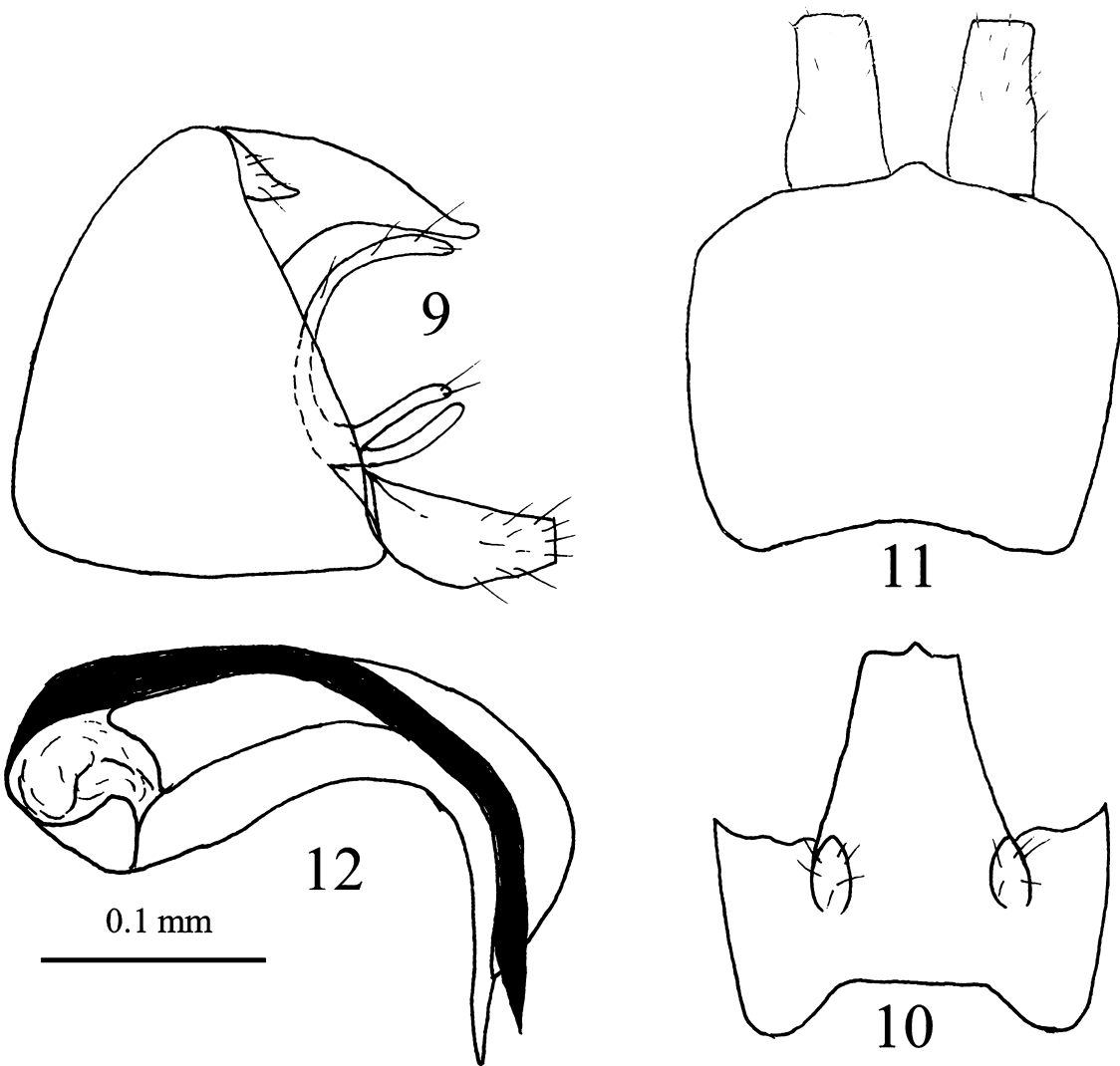
Type material. Holotype male (PSUNHM). **Myanmar:** Shan State, Keng Tung Province, Naw-awn, Salween River, 21°13'46"N, 098°42'32"E, ca. 251 m a.s.l., 04 May 2015, leg. Sai Aye.

Paratypes: Same data as holotype, 18 males (PSUNHM); **Myanmar:** Shan State, Keng Tung Province, Nam Lok Stream, 21°22'50"N, 099°00'49"E, 442 m a.s.l., 03 May 2015, leg. Sai Aye, 5 males (CHM).

Etymology. The species is named for the type locality, the Salween River.

Description. Length of each male forewing 6 mm (n=6); antennal length 11 mm; specimens in alcohol with head, thorax, abdomen and forewings light yellowish brown.

Male genitalia (Figures 9–12). In lateral view (Fig. 9), segment IX subtriangular and long ventrally; preanal appendages very small, triangular with small setae; segment X triangular, slightly curved downward; inferior appendages each 4-lobed: dorsal lobe tubular with long setae and erect basally then curved caudad, two mesal lobes tubular and 1/3 as long as dorsal lobe with first mesal lobe having long apical setae, basoventral lobe somewhat pentagonal with dorsal margin straight and ventral margin convex and apical margin truncate with small subapical setae. In dorsal view (Fig. 10), segment X trapezoidal, basally slightly broader than apically, truncate apically with small spine in middle; preanal appendages small, oval, with short setae. In ventral view (Fig. 11), segment IX subspherical; inferior appendages subrectangular, truncate apically. Phallus long, curved downward, pointed apically; pair of spine-like parameres long, curved downward, pointed apically (Fig. 12).



FIGURES 9–12. Male genitalia of *Setodes salweenensis* n. sp. 9, genitalia, left lateral; 10, segment IX, preanal appendages, and segment X, dorsal; 11, segment IX and inferior appendages, ventral; 12, phallus, left lateral.

Diagnosis. This species belongs to the *Setodes argentiferus* Group (Schmid 1987, = *S. argentiguttatus* Group of Malicky & Chantaramongkol 2006). Among the species of that Group, the male genitalia of *S. salweenensis* n. sp. are most similar to those of *S. omphale* Malicky & Changthong 2006 (in Malicky & Chantaramongkol 2006), *S. okypete* Malicky & Chantaramongkol 2006, *S. okyrrhoe* Malicky & Chantaramongkol 2006, and *S. opheltes* Malicky & Chantaramongkol 2006 all from Thailand, *S. venustus* Ulmer 1951 from Sumatra, and *S. bispinus* Yang & Morse 1989 from China and Vietnam. All of these, including the new species, share the characteristics that segment X is triangular in lateral view and rectangular or trapezoidal in dorsal view, inferior appendages are 4-branched, and the phallus is long, curved downward, and pointed apically. However, the new species can be separated from the others by the character of the basoventral lobe of each inferior appendage. *Setodes salweenensis* n. sp. has a basoventral lobe that is pentagonal and is truncate apically in lateral view. In contrast, most of the other species have this basoventral lobe triangular and pointed apically. This lobe can be obliquely truncate in *S. venustus* (Ulmer 1951, pl. 21 fig. 649), but the preanal appendages are not apparent in the latter species and its tergum X is rectangular in dorsal view (trapezoidal in *S. salweenensis* n. sp.).

Faunistic data of Leptoceridae (Trichoptera) from Keng Tung Province, Shan State, Myanmar

The Leptoceridae species identified in this study are listed along with the relevant sample numbers in Table 1. Eight genera and 22 species were found. A list of Trichoptera from Myanmar was published by Wityi *et al.* (2015),

with 7 genera and 20 species of Leptoceridae. In the current study, 21 Leptoceridae species and 2 genera, *Triaenodes* and *Triplectides*, are new records for Myanmar. These results update the totals to 9 genera and 44 species, including 3 new species described here, of Leptoceridae in Myanmar's Trichoptera checklist.

TABLE 1. Leptoceridae species of Keng Tung Province, Shan State, Myanmar.

Species of Leptoceridae	Location ¹ (and number of specimens)
<i>Ceraclea idaia</i> Malicky & Chaibu	8(1);9(2)
<i>Ceraclea iustitia</i> Malicky	13(1);15(3)
<i>Ceraclea harmonia</i> Malicky	14(1)
<i>Ceraclea hektor</i> Malicky & Bunlue	10(71);14(2);16(15)
<i>Ceraclea lirata</i> Yang & Morse	13(10);15(10)
<i>Ceraclea veiovis</i> Malicky	15(1)
<i>Leptocerus lanzenbergeri</i> Malicky & Chantaramongkol	6(1)
<i>Leptocerus skamandrios</i> Malicky & Prommi	16(1)
<i>Leptocerus ganymedes</i> Malicky & Chantaramongkol	10(3)
<i>Mystacides elongata</i> Yamamoto & Ross	4(1)
<i>Oecetis kurukchetra</i> Schmid	2(4)
<i>Oecetis pretakalpa</i> Schmid	12(3);17(1)
<i>Oecetis scutulata</i> Matynov	10(8); 13(1);15(17)
<i>Oecetis tripunctata</i> Fabricius	3(1);4(1);10(1);16(1)
<i>Oecetis villosa</i> Kimmins	5(1);11(1)
<i>Parasetodes respersellus</i> Rambur	10(1);13(1);15(2)
<i>Setodes isis</i> Malicky & Nawvong	8(1)
<i>Setodes megaira</i> Malicky & Cheunbarn	11(2)
<i>Setodes mercurius</i> Malicky & Bunlue	10(43);11(96);12(1);13(1);14(8);15(1);16(257)
<i>Setodes metis</i> Malicky & Thapanya	11(25);12(1)
<i>Triaenodes trivulcio</i> Schmid	7(1)
<i>Triplectides indicus</i> Walker	1(1);5(2)

¹Location numbers are in the text.

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References

- Armitage, B.J. & Arefina-Armitage, T.I. (2009) New country records of caddisflies (Insecta: Trichoptera) from Vietnam. *Insecta Mundi*, 68, 1–5.
- Burmeister, H. (1839) Neunte (15) Zunft, Pelzflügler Trichoptera Kirby, Synistatorum pars Fabr. Neuroptera plicipennia Latr., Einzige (40) Familie, Frühlingsfliegen, Wasserfalter. Phryganeodea. *Handbuch der Entomologie* 2 (2, 2nd half), 882–935.
- Chantaramongkol, P., Thapanya, D. & Bunlue, P. (2010) The Aquatic Insects Research Unit (AIRU) of Chiang Mai University, Thailand, with an updated list of the Trichoptera species of Thailand. *Denesia*, 29, 55–79.
- Leach, W.E. (1815) Entomology. In: Brewster, D. (Ed.), *Edinburgh Encyclopedia*, 9 (1), pp. 57–172.
- Malicky, H. (2010) *Atlas of Southeast Asian Trichoptera*. Faculty of Science Printing Unit, Chiang Mai University, Chiang Mai Province, 346 pp.
- Malicky, H. & Chantaramongkol, P. (2006) Beiträge zur Kenntnis asiatischer *Setodes*-Arten (Trichoptera, Leptoceridae). *Linzer Biologische Beiträge*, 38 (2), 1531–1589.
- Morse, J.C. (2015) *Trichoptera World Checklist*. Available from: <http://www.clemson.edu/cafls/departments/esps/database/trichopt/> (accessed 19 December 2015)
- Saini, M.S., Kaur, M. & Bajwa, P.K. (2001) An updated check-list of the Indian Trichoptera along with an illustrated key to its families. *Records of the Zoological Survey of India*, 99 (1–4), 201–256.
- Schmid, F. (1987) Considerations diverses sur quelques genres leptocerins (Trichoptera, Leptoceridae). *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Entomologie*, 57 (Supplement), 1–147, 29 pls.

- Ulmer, G. (1930) Trichoptera von den Philippinen und den Sunda-Inseln. *Treubia*, 11 (4), 373–498.
- Ulmer, G. (1951) Köcherfliegen (Trichoptera) von den Sunda-Inseln (Teil I). *Archiv für Hydrobiologie*, 19 (Supplement), 1–528, 28 pls.
- Wityi, H., Nozaki, T. & Fujino, T. (2015) A list of Myanmar caddisflies (Trichoptera including recently collected data). *Entomological Research Bulletin*, 31 (1), 41–55.
- Yang, L. & Morse, J.C. (1989) Setodini of the People's Republic of China (Trichoptera: Leptoceridae, Leptocerinae). *Contributions of the American Entomological Institute*, 25 (4), 1–77.
- Yang, L., Sun, C., Wang, B. & Morse, J.C. (2005) Present status of Chinese Trichoptera, with an annotated checklist. In: Tanida, K. & Rossiter, A. (Eds.), *Proceedings of the 11th International Symposium on Trichoptera (Sakai, Osaka and Kutsuki, Chiga, Japan, 12–19 June 2003)*. Tokai University Press, Kanagawa, pp. 441–465.