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Four new species of caddisflies (Trichoptera: Polycentropodidae, Psychomyiidae, Hydropsychidae, Odontoceridae) from Khao Nan and Tai Rom Yen National Parks, southern Thailand

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Abstract

Males of four new species of caddisflies, *Polyplectropus hofmaierae* **n. sp.** (Polycentropodidae), *Eoneureclipsis chinachotiae* **n. sp.** (Psychomyiidae), *Hydropsyche khaonanensis* **n. sp.** (Hydropsychidae), and *Lannapsyche tairomyenensis* **n. sp.** (Odontoceridae) are described and illustrated. *Polyplectropus hofmaierae* **n. sp.** is distinguished from other species by the shape of the apical end of its inferior appendages and its sharp intermediate appendages. The posterior edges of their inferior appendages run slanting to the ventrodistal point and are densely covered by short and stiff bristles. *Eoneureclipsis chinachotiae* **n. sp.** is differentiated by characters of its phallus, as the first two thirds of its length are slender and slightly curved. The distal part has a dorsal hump with a very slender thread on its caudal edge and is slightly bent downward and dilated. *Hydropsyche khaonanensis* **n. sp.** can be differentiated from the other species by its phallus, in which the two apicolateral lobes in ventral view have rounded outer edges. *Lannapsyche tairomyenensis* **n. sp.** can be separated from the others by characteristics of the dorsal view of segment IX and the harpago of its inferior appendages. Segment IX is triangular with distinctly convex preanal appendages along the posterior edge of this segment, and the harpago and subapical lobes are relatively similar in shape and length.

Key words: Southeast Asia, taxonomy, aquatic insects, caddisfly

Introduction

As more than 1,000 species of Trichoptera have been recorded in Thailand, both the taxonomy and distribution of this aquatic insect group are now very well known (Chantaramongkol *et al*. 2010). However, there are still many locations, such as small streams close to mountain tops, that are protected from human activities and have not been surveyed. The montane evergreen forests at Khao Nan and Tai Rom Yen National Parks located in southern Thailand have not been surveyed for Trichoptera. This kind of forest is found only at high elevations, with high humidity and low temperature selecting the species living in such an ecosystem. Previous studies concerning caddisflies of southern Thailand focused on tropical rain forest and dry evergreen forest (Malicky & Prommi 2006; Laudee & Malicky 2014). For this reason, there are probably many undiscovered species of caddisflies in the montane evergreen forests in Khao Nan and Tai Rom Yen National Parks.

The Trichoptera genus *Polyplectropus* has been recorded in Thailand for 18 species. These currently include 3 species from southern Thailand, namely *P. matthatha* Malicky & Chantaramongkol 1993, *P. maiyarap* Malicky & Chantaramongkol 1993, and *P. saturnus* Malicky & Prommi 2006. Regarding the genus *Eoneureclipsis*, three species have been found in Thailand and none in southern Thailand. The genus *Hydropsyche* has been recorded for 30 species in Thailand, with 9 species in southern Thailand: *H. assarakos* Malicky & Chantaramongkol 2000, *H. atropos* Malicky & Chantaramongkol 2000, *H. biton* Malicky & Chantaramongkol 2000, *H. briareus* Malicky

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& Chantaramongkol 2000, *H. brontes* Malicky & Chantaramongkol 2000, *H. butes* Malicky & Chantaramongkol 2000, *H. camillus* Malicky & Chantaramongkol 2000, *H. clitumnus* Malicky & Chantaramongkol 2000, *H. doctersi* Malicky & Chantaramongkol 2000, *H. dolosa* Banks 1939, *H. formosana* Ulmer 1911, and *H. pallipenne* Banks 1938. In the genus *Lannapsyche*, the species *L. chantaramongkolae* Malicky 1989 has been found only in northern Thailand (Prommi 2007; Malicky 2010; Laudee & Malicky 2014)

In this article, we present new species of Trichoptera from montane evergreen forests in southern Thailand, representing the families Polycentropodidae, Psychomyiidae, Hydropsychidae, and Odontoceridae.

Materials and methods

The collecting sites are in Khao Nan National Park and Tai Rom Yen National Park which are in the Nakhon Si Thammarat Range. The forest type is lower mountain evergreen forest, dominated by *Lithocarpus encleisacarpus, L. curtisii, Quercus myrsinifolia, Caryota obtusa, Ficus attissima, and F. microcarpa*. The study sites are 1st and 2nd order streams with substrate dominated by bedrock, boulders, and cobble.

The caddisfly specimens were collected with a UV pan light trap (12 V, 10 W) operated along the streams overnight at the locations and the times indicated below. The Trichoptera specimens were preserved in 70% ethanol, then manually sorted from other insects. Adult male genitalia of the new species were excised and muscle tissue was macerated by heating in 10% KOH at 60°C for 30–60 minutes. Pencil templates of the male genitalia of the new species were drawn using a compound microscope equipped with a drawing tube, then final vector-graphics were prepared from the templates with Adobe Illustrator© software.

Holotypes and paratypes are stored in 70% ethanol and are deposited in the Princess Maha Chakri Sirindhorn Natural History Museum, Prince of Songkla University, Hat Yai Campus, Hat Yai District, Songkhla Province, Thailand (PSUNHM). Terminology for genitalic structures is that of Chamorro and Holzenthal (2011), Kimmins (1955), Flint *et al.* (1987), and Yang *et al.* (2017).

Taxonomy

Polycentropodidae

Polyplectropus hofmaierae sp. n. Malicky and Suwannarat

Figs. 1A–1D

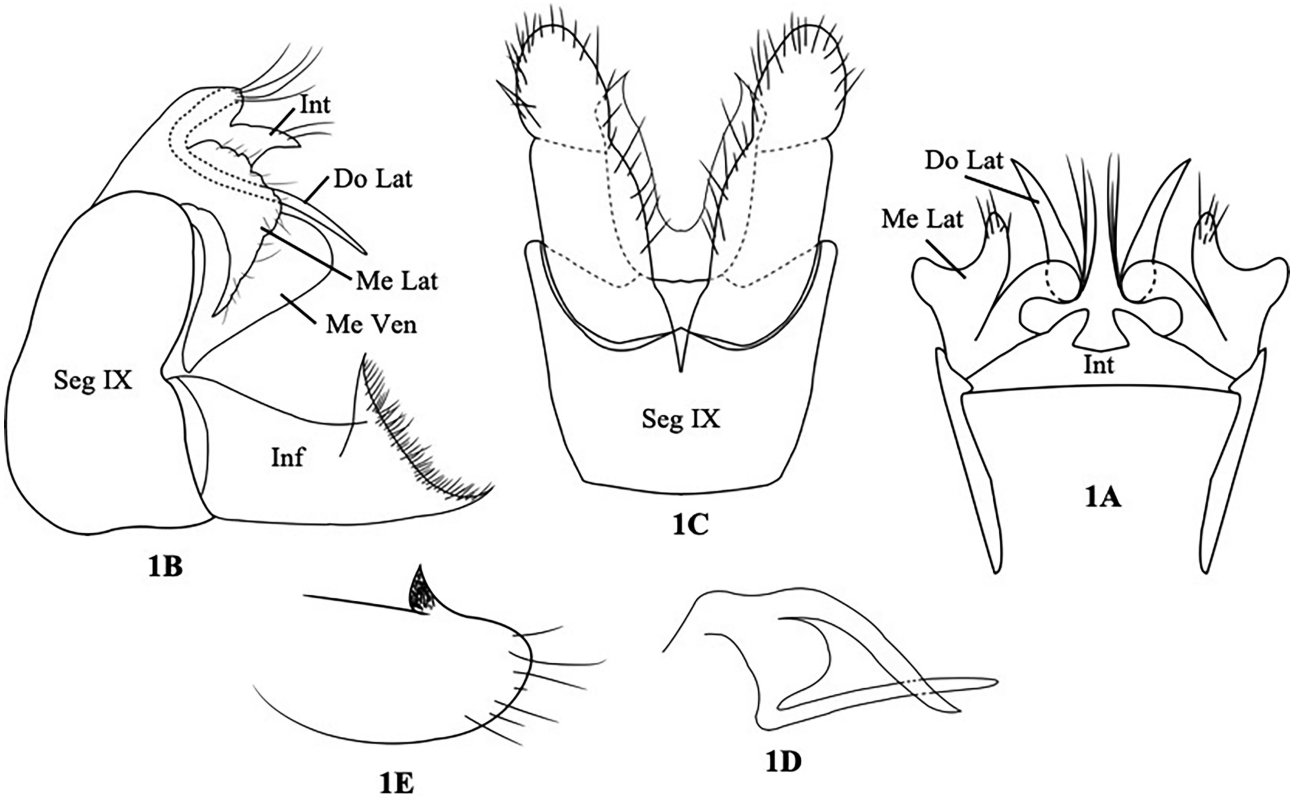
Type material. Holotype male (PSUNHM). Thailand, Surat Thani Province, Huai Khamin, Ban Song, Wiang Sa district, 8°42'N, 99°28'E, altitude 820 m, 30.x.2018, leg Nannaphat Suwannarat.

Etymology. The species is dedicated to Mrs. Herta Hofmaier, who has supported us during our research visits to Austria.

Description. Body and appendages yellowish. Forewings greyish brown and hind wings hyaline. Length of each forewing 4 mm.

Male genitalia (Figures 1A–1D). Segment IX kidney-bean-like with pointed ventroposterior edge in lateral view (Fig. 1B); subrectangular with 1/3 of its length having pair of U-shaped incisions posteriorly in ventral view (Fig. 1C). Intermediate appendages each triangular with flask-bottle-like incision posteromesally in dorsal view (Fig. 1A), beak-like in lateral view (Fig. 1B). In dorsal view, dorsolateral processes of preanal appendages curved inward basally and curved outward and needle-like subapically, in lateral view (Fig. 1B) needle-like, first turned downward and then abruptly turned caudad, pointed apically; mesolateral processes curved outward, thumb-like in dorsal view (Fig. 1A), long, curved downward, beak-like with setae in lateral view (Fig. 1B); mesoventral process of each preanal appendage beak-like with moderate protrusion posteromesally in lateral view (Fig. 1B). In lateral view, inferior appendages straight, relatively broad, each divided into dorsal branch and ventral branch; dorsal branch very small, triangular with numerous bristles posteriorly, pointed dorsally; ventral branch short, pointed posteroventrally, with numerous setae (Fig. 1B). In ventral view, inferior appendages long oval; ventral branch of each inferior appendage parallel-sided with numerous long setae along posteromesal edge; dorsal branch cylindrical, bent inward, beak-like posteriorly (Fig. 1C). Phallus plough-handle-like with two long tube-like processes crossing subapically (Fig. 1D).

Diagnosis. The new species is very similar to *P. akrisios* Malicky 1997 with which it shares the unusual shape of the phallus; which may raise the question of the proper generic position. We leave both species in *Polyplectropus* until a new revision of Polycentropodidae is available. The characters that can differentiate the new species from *P. akrisios* are the shapes of the apical ends of the inferior appendages and the sharp intermediate appendages. *Polyplectropus hofmaierae* **n. sp.** has the posterior edge of each inferior appendage running diagonally to the posteroventral point and is densely covered by short, stiff bristles on that edge (Fig. 1E). In *P. akrisios* the posterior end of each inferior appendage is rounded with a prominent dorsal point and is covered with only sparse fine hairs. The intermediate appendages of the new species are beak-like in lateral view (Fig. 1B) but rounded in *P. akrisios*.



FIGURES 1A–1E. Male genitalia of *Polyplectropus* spp. 1A–1D, *Polyplectopus hofmaierae* **n. sp.**: 1A, dorsal; 1B, left lateral; 1C, ventral; 1D, phallus, left lateral. 1E, *P. akrisios* Malicky 1997, apical end of left inferior appendage, left lateral. Do Lat = dorsolateral process of preanal appendage (paired), Int = intermediate appendage (paired), Me Lat = mesolateral process of preanal appendage (paired), Me Ven = Mesoventral process of preanal appendage (paired), Seg IX = abdominal segment IX.

Psychomyiidae

Eoneureclipsis chinachotiae n. sp. Malicky & Laudee

Figs. 2A–2C

Type Material. Holotype male (PSUNHM). Thailand, Tai Rom Yen National, Dad Fah waterfall 2, 8°50'N, 99°30'E, altitude 960 m, 22.iv.2018, leg. Nannaphat Suwannarat.

Paratypes: 3 males from the same site or from sites nearby, altitudes 911–1100 m, collected on 22.iv.2018; 6 males from Kao Nan National Park, altitude 1147–1263 m, collected on 7.iv.2018 and 19.x.2018; all leg. Nannaphat Suwannarat (PSUNHM).

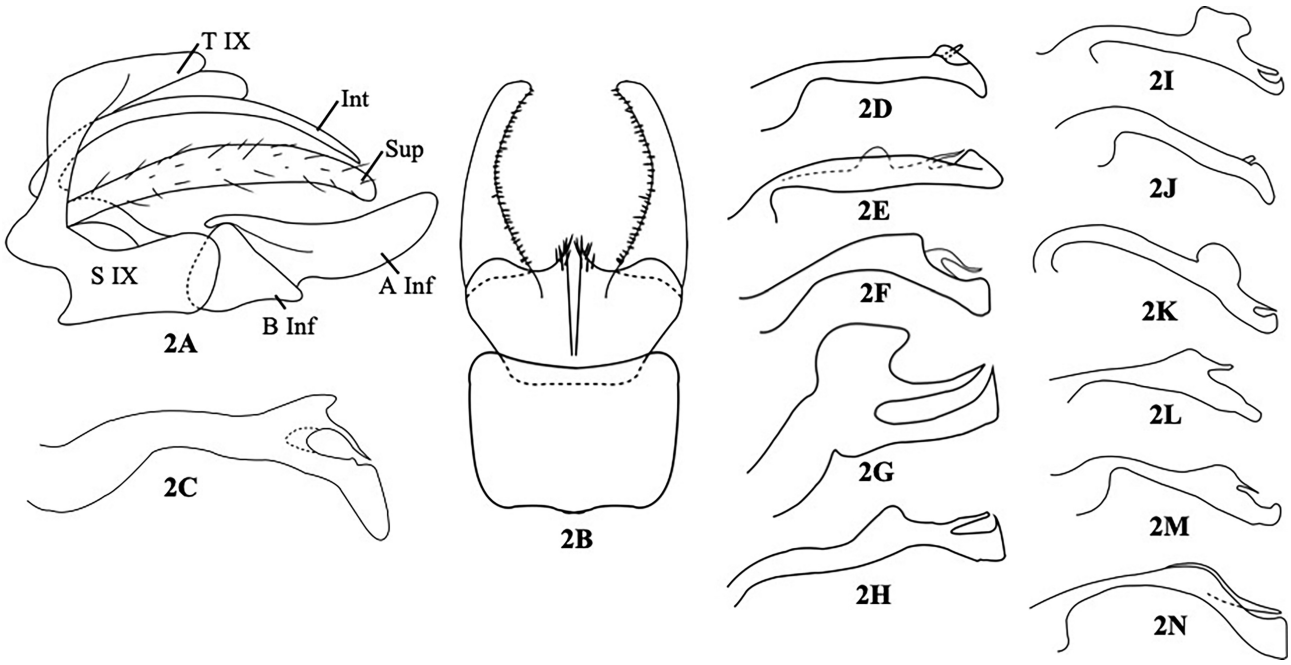
Etymology. The species is dedicated to Prof. Dr. Pavinee Chinachotiae, who was Dean of Faculty of Agroindustry, Prince of Songkla University, Hat Yai Campus.

Description. Body and wings unicolorous yellowish brown, eyes and genital structure dark yellowish brown. Length of each forewing 7–9 mm (n = 10).

Male genitalia (Figures 2A–2C). Tergum IX in lateral view produced posteriorly into broad triangle, rounded

posteriorly; sternum IX rectangular with prominent triangular projection on each side anteriorly, posterior end of sternum IX rounded in lateral view (Fig. 2A); sternum IX in ventral view somewhat rectangular with broad and shallow incision posteriorly (Fig. 2B). Superior appendages club-shaped, slightly bent downward in lateral view (Fig. 2A). Intermediate appendages needle-like, long, pointed apically in dorsal view; in lateral view, intermediate appendages long, slender, curved downward, pointed apically (Fig. 2A). Inferior appendages each divided into two parts, basal segment somewhat triangular, apical segment banana-like and about twice as long as basal segment in lateral view; in ventral view, basal segments of inferior appendages trapezoidal and separated by deep incision mesoposteriorly, each with setose acute angle mesoposteriorly; apical segments each curved inward with stout black teeth on mesal edge, rounded posteriorly (Fig. 2B). Phallus hammer-like, curved downward with needle-like process apicodorsally (Fig 2C).

Diagnosis. Male genitalia structures of this species are very similar to those of its congeners, which are constructed in the same pattern, but differences are seen in the details and form of the phallus and can easily be seen in by comparison with figures of the phalli of other species (Figs. 2D–2N). The new species is similar to *E. akrichalakchmi* Schmid 1972 from the state of Manipur, in that the distal part of the phallus is shorter than in most species (Fig. 2L), and the inner edge of each inferior appendage has a sub-basal hump. However, in *E. chinachotiae* **n. sp.**, the basal two-thirds of the phallus is slender and sinuate; the distal part has a dorsal hump with a very slender spine on its caudal edge and is bent downward and dilated more than for *E. akrichalakchmi.*



FIGURES 2A–2N. Male genitalia of *Eoneureclipsis* spp., 2A–2C, *E. chinachotiae* **n. sp.**: 2A, left lateral; 2B, ventral; 2C, phallus, left lateral. 2D–2N, phalli of *Eoneureclipsis* spp., left lateral: 2D, *E. pravrisija*; 2E, *E. quangi*; 2F, *E. tieni*; 2G, *E. nykteus*; 2H, *E. varsikiyja*; 2I, *E. alekto*; 2J, *E. sebulon*; 2K, *E. limax*; 2L, *E. akrichalakchmi*; 2M, *E. querquobad*; 2N, *E. afonini*. A Inf = apical segment of an inferior appendage (paired), B Inf = basal segment of an inferior appendage (paired), Int = intermediate appendages (paired), Sup = Superior appendage (paired), T IX = abdominal tergum IX, S IX = abdominal sternum IX.

Hydropsychidae

Hydropsyche khaonanensis n. sp. Malicky & Suwannarat

Figs. 3A–3E

Type material. Holotype male (PSUNHM). Thailand, Tai Rom Yen National Park, Dad Fah waterfall 3, 8°50'N, 99°19'E, 911 m, 22.iv.2018, leg. Nannaphat Suwannarat.

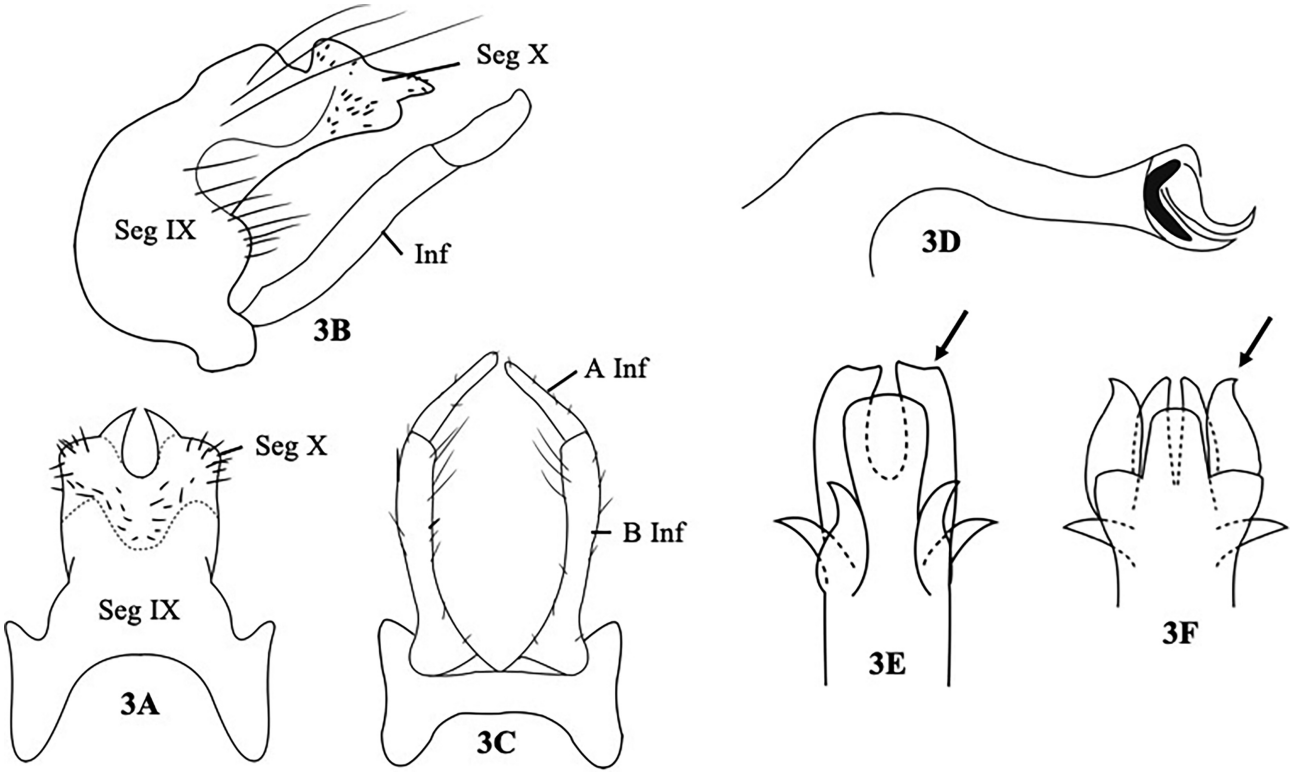
Paratype: 1 male, Thailand, Kao Nan National Park, Klong Gray river 5, 8°45'N, 99°32'E, 1132 m, 6.iv.2018, leg. Nannaphat Suwannarat (PSUNHM).

Etymology. The species is named for the type locality, Khao Nan National Park.

Description. The whole insect is yellowish grey with comparatively dark eyes. Length of each forewing 8–10 mm (n = 2).

Male genitalia (Figures 3A–3E). In dorsal view (Fig. 3A), segment IX forming isosceles trapezoid with U-shaped incision for one-third of its length anteriorly; posterior part of segment IX fused with segment X at shallow M-shaped line of fusion; lateral lobes of segment IX triangular and acute apically; in lateral view (Fig. 3B), segment IX C-shaped with anterolateral margins convex; posterior margins of segment IX setose; in ventral view (Fig. 3C), segment IX subrectangular with anterolateral lobes. Segment X in dorsal view (Fig. 3A) short with numerous of setae, posteromesal margin with 2 pointed processes; in lateral view (Fig. 3B), segment X somewhat triangular, beak-like posteriorly. Inferior appendages slender and long, each with basal segment slender and more than twice as long as apical segment; apical segment slender and short, apex rounded and slightly upturned in lateral view; in ventral view, inferior appendages tubular, slightly curved inward (Fig. 3C). Phallus axe-shaped, expanded and downcurved basally, apicodorsal end abruptly truncate and apicoventral portion curved caudad and pointed in lateral view (Fig. 3D).

Diagnosis. The phallus of *H. khaonanensis* **n. sp.** is similar to that of *H. arcturus* Malicky & Chantaramongkol 2000, but a clear difference is seen in the ventral view of the phallus (Figs. 3E, 3F); the two distal lateral lobes have rounded outer edges in *H. khaonanensis* **n. sp.** (3E), but in *H. arcturus* these lobes have short distal points which are directed outward (Fig. 3F).



FIGURES 3A–3F. Male genitalia of *Hydropsyche* spp. 3A–3E, *H. khaonanensis* **n. sp.**: 3A, dorsal; 3B, left lateral; 3C, ventral; 3D, phallus, left lateral; 3E, phallus apex, ventral. 3F, *H. arcturus*, phallus apex, ventral. A Inf = apical segment of inferior appendage (paired), B Inf = basal segment of inferior appendage (paired), Inf = inferior appendage (paired), Seg IX = abdominal segment IX, Seg X = abdominal segment X.

Odontoceridae

Lannapsyche tairomyenensis n. sp. Malicky & Suwannarat

Figs. 4A–4F

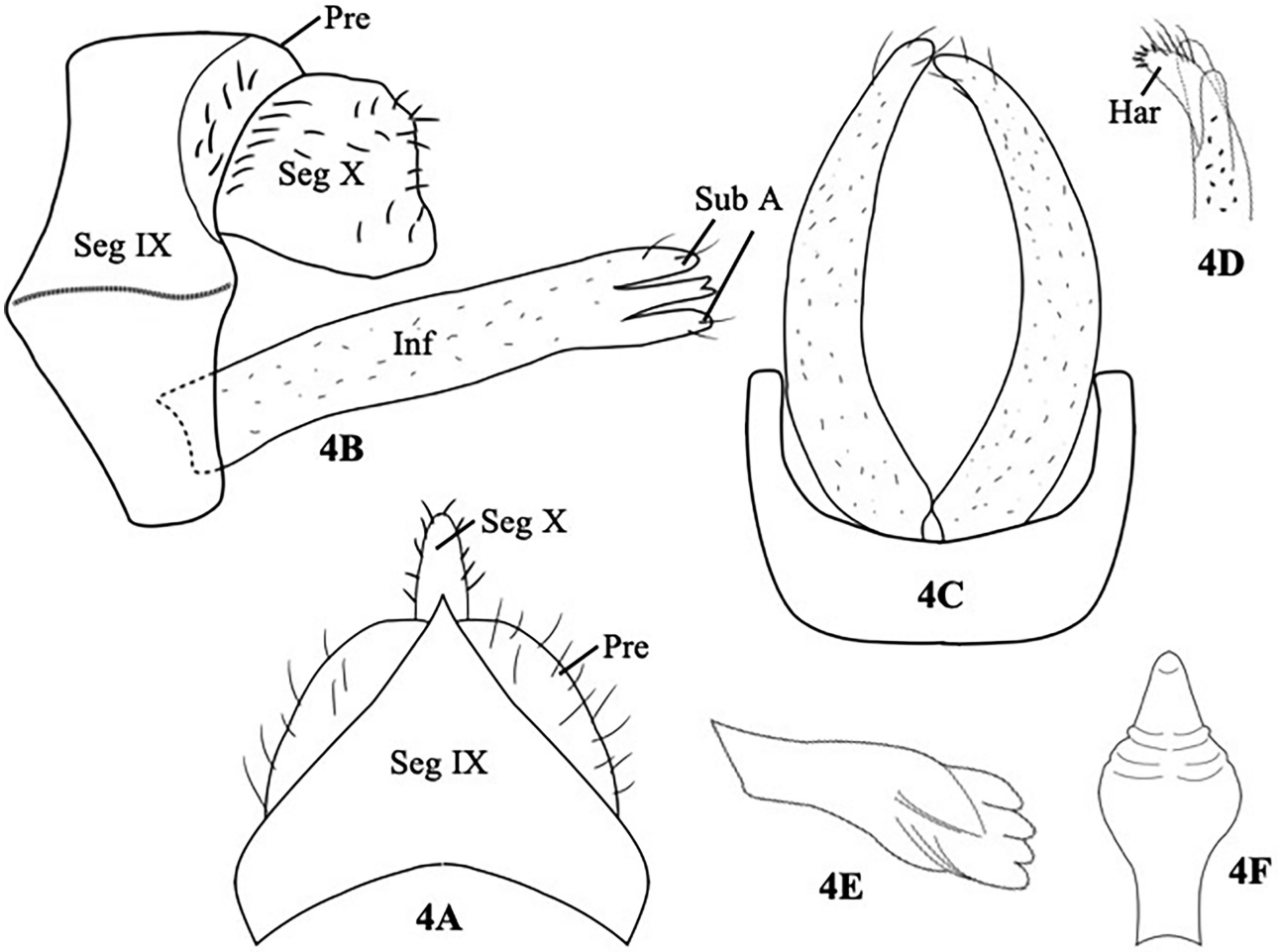
Type Material. Holotype male (PSUNHM). Thailand, Tai Rom Yen National Park, Dad Fah waterfall 3, 8°50’N, 99°19’E, 911 m, 31.x.2018, leg. Nannaphat Suwannarat.

Paratypes: 5 males from the same site and from nearby sites, altitudes 854–960 m, collected on 22.iv.2018 and 30.x.2018, leg. Nannaphat Suwannarat; one male: Tai Rom Yen National Park, Pha San Yen stream, 1100 m, 30.x.2018, leg. Nannaphat Suwannarat; 3 males: Huai Khamin, Ban Song, Wiang Sa district, 8°42'N, 99°29'E, 820 m, 30.x.2018, leg. Nannaphat Suwannarat; one male: Khao Nan National Park, Klong Gray river 3, 8°45'N, 99°32'E, 1147 m, 6.iv.2018, leg. Nannaphat Suwannarat (PSUNHM).

Etymology. The species is named for the type locality, Tai Rom Yen National Park.

Description. Unicolorous brown with darker eyes. Length of each forewing 7–8 mm.

Male genitalia (Figs. 4A–4F). In dorsal view (Fig. 4A), segment IX somewhat triangular and with shallow U-shaped excision anteriorly; in lateral view (Fig. 4B), segment IX hexagonal, lateral margins slightly concave anterodorsally and posterodorsally; segment IX divided by lateral horizontal grooves into two parts, dorsal part slightly taller than ventral part. Preanal appendages semicircular along posterior edges of segment IX in dorsal view (Fig. 4A); in lateral view, preanal appendages transversely crescent-shaped and with setae; segment X small, tubular, rounded posteriorly with setae in dorsal view (Fig. 4A); in lateral view, segment X scale-like with setae present mostly parallel with posterior edge of preanal appendages (Fig. 4B). Inferior appendages each with coxopodite straight, long and cylindrical with two subapical lobes nearly identical in shape and size in lateral view, separated by harpago (Fig. 4B); harpago slender, setose, inserted between subapical lobes (Fig. 4B) in lateral view. In ventral view, inferior appendages long, bent inward and tapered apically (Fig. 4C), with harpago scarcely visible (Fig. 4D). Phallus short and stout, hand-shaped in lateral view, and bulb-shaped in ventral view (Figs. 4E, 4F)



FIGURES 4A–4F. Male genitalia of *Lannapsyche tairomyenensis* **n. sp.** 4A, dorsal. 4B left lateral. 4C, ventral. 4D, right inferior appendage apex, ventral. 4E, phallus, left lateral. 4F, phallus, ventral. Har = harpago (paired), Inf = inferior appendage (paired), Pre = preanal appendage (paired), Seg IX = abdominal segment IX, Seg X = abdominal segment IX, Sub A = dorsal and ventral subapical lobes of basal segment of inferior appendage (paired).

Diagnosis. The genitalia of the new species are similar to those of *L. chantaramongkolae* found in northern Thailand (Malicky 1989) and in southern China (Yang *et al* 2017). They can be distinguished by characteristics of the dorsal view of segment IX. In *L. chantaramongkolae*, segment IX is rectangular with relatively small, concave preanal appendages along posterior edge of segment IX, but in *L. tairomyenensis* n sp. segment IX in dorsal view is triangular with distinctly convex preanal appendages along posterior edges of this segment. In dorsal view, segment X of *L. chantaramongkolae* is long and triangular, but short and tubular in the new species. Moreover, the harpago of *L. chantaramongkolae* appears distinctly longer than the subapical lobes of inferior appendages, but in the new species the harpago and subapical lobes are relatively similar in shape and length.

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