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## Five new species of the genus *Cheumatopsyche* (Trichoptera: Hydropsychidae) from the Phetchabun Mountains, Thailand

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### Abstract

Five new species of the genus *Cheumatopsyche* (Trichoptera: Hydropsychidae) from the Phetchabun Mountains, Thailand, are described and illustrated. The national parks and wildlife sanctuaries in the Phetchabun Mountains are recognized as areas with a high density of endemic species deserving protection. Four new species of *Cheumatopsyche* (*C. recta*, *C. diversa*, *C. triangula*, and *C. tongto*) have been found in Phu Khieo Wildlife Sanctuary, Phu Kradueng National Park and Thung Salaeng Luang National Park; a fifth new species (*C. cava*) has been found in Phu Kradueng National Park. Describing hydropsychid species is important not only to study diversity and distribution but also to facilitate eventual descriptions of larvae for use in freshwater biomonitoring programs to detect pollution.

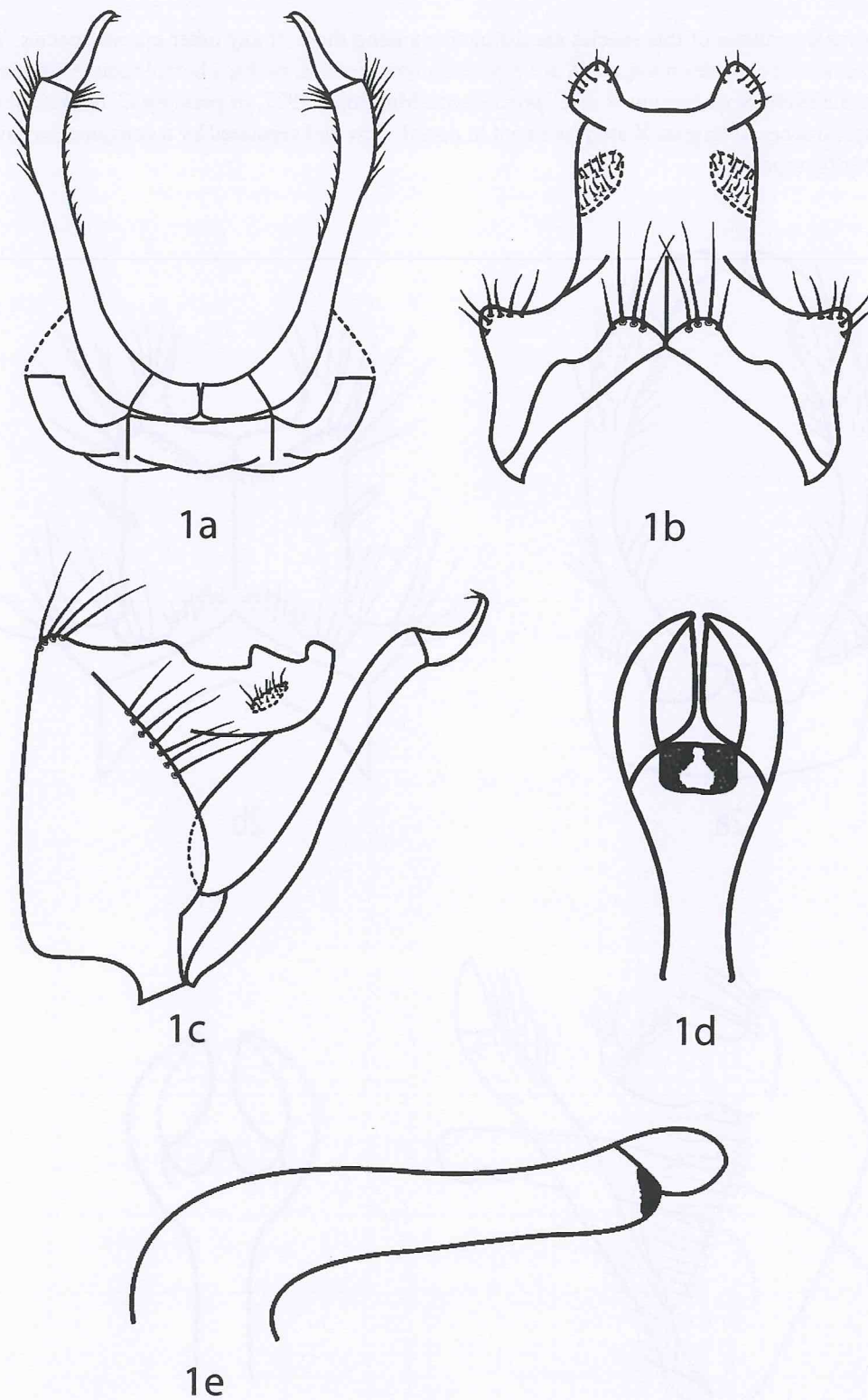
**Key words:** caddisfly, aquatic insects, biodiversity, freshwater biomonitoring, national park, wildlife sanctuary

### Introduction

Thailand is located in the tropical Oriental region where the density of endemic caddisfly species is high (Morse 2011). More than 900 species have been reported from Thailand, especially northern Thailand (Malicky 2010). The family Hydropsychidae is diverse, with 1,756 species presently known from all biogeographic regions and at least 120 species known in Thailand (Malicky 2010; Morse 2011). In particular, rare hydropsychid species have been reported in the national parks from northeastern Thailand. The Phetchabun Mountains are located in northern and northeastern Thailand and are the location for Phu Kradueng National Park, Nam Nao National Park, Thung Salaeng Luang National Park, Phu Hin Rong Kla National Park and Phu Khieo Wildlife Sanctuary. These protected areas include headwater streams with high diversity of endemic fauna and flora. The caddisflies species from headwater streams with high elevation such as the Phetchabun Mountains are poorly reported.

Thailand is experiencing rapid development and water pollution problems are a consequence of that development. Larvae of caddisflies are an important component of biomonitoring and water assessment programs and have been studied throughout northeastern Thailand. Caddisfly larvae are used widely in freshwater biomonitoring because of their great abundance and the wide range of pollution tolerances among their species. Research on larvae is limited, however, due to the inability to identify larvae to the species level (Sangpradub & Boonsoong 2006, Zhou et al. 2007, Geraci et al. 2010, Geraci et al. 2011). Describing the aquatic insect fauna is an important step toward establishing biomonitoring protocols (Geraci & Morse 2008).

In this work, we investigated the caddisfly fauna in the Phetchabun Mountains. This study describes and illustrates five new species of the genus *Cheumatopsyche* from two national parks and a wildlife sanctuary. Describing hydropsychid species is important for studying diversity and distribution, but research is necessary also to associate larvae and adults and provide descriptions of the larvae for use in freshwater biomonitoring programs to detect pollution.



**FIGURE 1.** *Cheumatopsyche recta* sp. nov., male genitalia. 1a, segment IX and inferior appendages, ventral; 1b, segment IX+X, dorsal; 1c, genitalia, left lateral; 1d, phallus apex, ventral; 1e, phallus, left lateral.

**Description.** (In alcohol) Head and thorax brown, abdominal segments pale cream. Legs pale with coxae and femora pale cream, tarsi light brown. Forewings grey and hind wings light grey.

Wings: Shape and venation characteristic of genus. Male forewing length 6.0–6.5 mm (n=6).

Male genitalia: Segment IX in lateral view with anterolateral margins angled 60° at 2/3rds height, posterolateral margins setose, straight and sloped. Inferior appendages in lateral view each with basal segment reaching top of tergum X and slightly sinuous, apical segment short and acute (Fig. 2c); in caudoventral view with basal segment curved, apical segment broad, apically blunt (Fig. 2a). Segment X in lateral view with dorsal margin deeply concave basally, with broad, setose, transversely sloping carina rising above body of tergum, and with apical lobes angled dorsad away from sloping body of tergum (Fig. 2c); in dorsal view with median ridge extending length of tergum, interrupting broad transverse carina, apical lobes curved mesad and separated by wide concavity (Fig. 2b). Phallus curved in lateral view, its apex broad (Fig. 2c); in ventral view with median projection (Fig. 2d).

**Etymology.** The species name is a Latin adjective “diversus (-a -um),” an adjective meaning “different, unlike,” referring to the fact that the male of this species is very different from that of any other known species.

Holotype: Male. THAILAND: Loei Province, Phu Kradueng National Park, Tard Hong Waterfall (N 16° 48' 11.6", E 101° 43' 25.1"), elevation 417 m, 9-iii-2011, Coll. Kitiya Thawarorit, Teerasak Muakpetch, and Narumon Sangpradub (CU).

Paratypes: THAILAND: Chaiyaphum Province, Phu Khieo Wildlife Sanctuary, Tongto Stream (N 16° 24' 48.0", E 101° 34' 58.9"), elevation 795 m, 14-iii-2011, Coll. Kitiya Thawarorit, Teerasak Muakpetch, and Narumon Sangpradub, 1 male (KKU); Chaiyaphum Province, Phu Khieo Wildlife Sanctuary, Prom Stream (N 16° 27' 36.6", E 101° 39' 20.5"), elevation 577 m, 16-i-2011, Coll. Kitiya Thawarorit, Teerasak Muakpetch, and Narumon Sangpradub, 1 male (KKU).

#### ***Cheumatopsyche triangula* Thawarorit, Sangpradub & Morse sp. nov.**

Figs. 3a–f.

**Diagnosis.** The male genitalia of this species are close to those of *Cheumatopsyche chryseis* Malicky & Chantaramongkol, 1997, but can be distinguished by segment X in lateral view being longer, curved slightly upward and apically acute (tergum X of *C. chryseis* shorter, slightly angled upward and blunt), and in dorsal view with the apicomesal portion broadly triangular and apicolateral lobes not produced (tergum X of *C. chryseis* rounded and apicolateral lobes produced). The inferior appendages each have an apical segment that is broader than that of *C. chryseis* in lateral view. Also, the phallus is more curved and longer, with its apex broader basally and the apicomesal projection is not produced.

**Description.** (In alcohol) Head and thorax brown. Abdominal segments light brown, legs light brown. Forewings brown and hind wings light brown.

Wings: Shape and venation characteristic of genus. Male forewing length 5.0–5.5 mm (n=10).

Male genitalia: Segment IX in lateral view with anterolateral margins convex, posterolateral margins each produced into tall, broadly rounded, setose lobe overlapping base of corresponding inferior appendage when fully retracted. Inferior appendages in lateral view nearly straight, each with apical segment broad, especially at base (Fig. 3d); in caudoventral view slightly curved, basal segment slender (Fig. 3a–b). Segment X in lateral view long, slightly curved dorsad and acute apically (Fig. 3d); in dorsal view apicomesal portion produced, broadly triangular, and apicolateral lobes not produced (Fig. 3c). Phallus curved and long, in ventral view apex broad and without apicomesal projection (Figs. 3e–f).

**Etymology.** Latin “triangulus (-a -um),” an adjective meaning “triangular,” to indicate the apicomesal portion of tergum X broadly triangular in dorsal view.

Holotype: Male. THAILAND: Chaiyaphum Province, Phu Khieo Wildlife Sanctuary, Tongto Stream (N 16° 24' 48.0", E 101° 34' 58.9"), elevation 795 m, 14-iii-2011, Coll. Kitiya Thawarorit, Teerasak Muakpetch, and Narumon Sangpradub (CU).

Paratypes: Same data as holotype, 5 males (KKU), 4 males (PNU).

***Cheumatopsyche tongto* Thawarorit, Sangpradub & Morse sp. nov.**

Figs. 4a–e.

**Diagnosis.** The male genitalia of this species are similar to those of *C. triangula* Thawarorit, Sangpradub & Morse, n. sp., and *C. chryseis* Malicky & Chantaramongkol, 1997. However, they differ in that segment X in lateral view is more curved than *C. triangula* on its dorsal margin (*C. chryseis* is angled dorsally) and blunt apically (*C. triangula* is acute apically). The inferior appendages each have an apical segment that is more sinuous in caudoventral view than either species. Like *C. triangula*, the apex of the phallus lacks an apicoventral projection in lateral view (present in *C. chryseis*).

**Description.** (In alcohol) Head and thorax brown. Abdominal segments light brown, legs light brown. Forewings brown and hind wings light brown.

Wings: Shape and venation characteristic of genus. Male forewing length 5 mm (n=2).

Male genitalia: Segment IX in lateral view with anterolateral margins nearly straight in dorsal 3/4ths, posterolateral margins each produced into setose triangle above base of corresponding inferior appendage (Fig. 4c), in dorsal view anterior and posterior margins angled caudad, with lobes of setose ridge short. Inferior appendages each with slender basal segment (Figs. 4a, c), apical segment sinuous and acute in caudoventral view (Fig. 4a). Segment X in dorsal view with posterior margin rounded medially and with apicolateral lobes short and round, slightly protuberant, setose (Fig. 4b); in lateral view with dorsal margin curved dorsad, long, blunt apically (Fig. 4c). Phallus in lateral view curved, its apex lacking apicoventral projection (Fig. 4d–e).

**Etymology.** The species name derives from “Tongto Stream,” the type locality of this new species.

Holotype: Male. THAILAND: Chaiyaphum Province, Phu Khieo Wildlife Sanctuary, Tongto Stream (N 16° 24' 48.0", E 101° 34' 58.9"), elevation 795 m, 14-iii-2011, Coll. Kitiya Thawarorit, Teerasak Muakpetch, and Narumon Sangpradub (CU).

Paratype: Same data as holotype, 1 male (KKU).

***Cheumatopsyche cava* Thawarorit, Sangpradub & Morse sp. nov.**

Figs. 5a–f.

**Diagnosis.** The male genitalia of this species are close to those of *Cheumatopsyche lucida* Ulmer, 1907, but can be distinguished by segment X posterior margin in dorsal view having the outer margins of its apicolateral lobes shallowly concave; in lateral view its apicolateral lobes are digitate and slightly divergent from the body of the tergite (the outer margins of the apicolateral lobes are convex in dorsal view and they are capitate and not divergent in lateral view in *C. lucida*). The inferior appendages each have a basal segment more slender than in *C. lucida* and the apical segment has a basomesal angle in caudoventral view. The phallus in lateral view is more curved, longer and with its apex more slender.

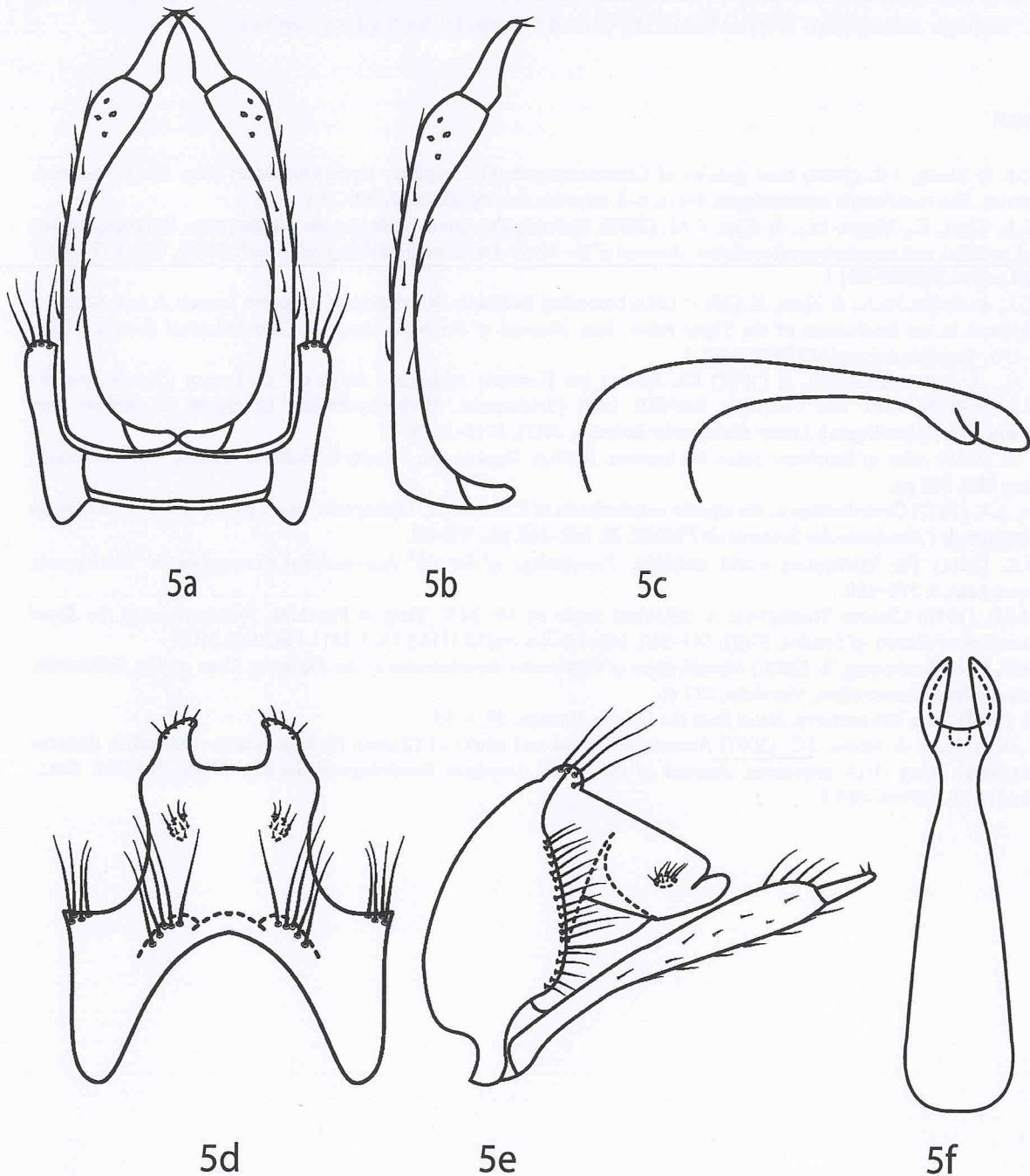
**Description.** (In alcohol) Head and thorax brown. Abdominal segments light brown. Legs with coxae and femora brown, tibiae and tarsi light brown. Forewings and hind wings light brown.

Wings: Shape and venation characteristic of genus. Male forewing length 5 mm (n=1).

Male genitalia: Segment IX in lateral view with anterolateral margins convex through most of its height, posterolateral margins each produced into setose, rounded angle at 1/3rd of its height (Fig. 5e). Inferior appendages each with basal segment slender in caudoventral and lateral views (Figs. 5a, b, e), apical segment broad basally and slightly angled at 1/5th length in caudoventral view (Figs. 5a–b). Segment X posterior margin with apicolateral lobes curved slightly mesad, widely separated, and each with shallow concavity in otherwise convex lateral margin in dorsal view (Fig. 5d); in lateral view with apicolateral lobes digitate and slightly divergent from body of tergite (Fig. 5e). Phallus in lateral view long, deeply curved (slightly recurved), apically slender (Fig. 5c); in ventral view apex long, slender, and with lobes widely separated (Figs. 5f).

**Etymology.** The species name is a Latin adjective “cavus (-a -um),” an adjective meaning “hollow,” which refers to the outer margins of the apicolateral lobes being shallowly concave.

Holotype: Male. THAILAND: Loei Province, Phu Kradueng National Park, Tard Hong Waterfall (N 16° 48' 11.6", E 101° 43' 25.1"), elevation 417 m, 9-iii-2011, Coll. Kitiya Thawarorit, Teerasak Muakpetch, and Narumon Sangpradub (CU).



**FIGURE 5.** *Cheumatopsyche cava* sp. nov., male genitalia. 5a, segment IX and inferior appendages, ventral; 5b, left inferior appendage, ventral; 5c, phallus, left lateral; 5d, segment IX+X, dorsal; 5e, genitalia, left lateral; 5f, phallus, ventral.

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