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The Mayfly Family Leptophlebiidae (Ephemeroptera) from Vietnam

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Abstract A comprehensive examination of larval and adult materials of mayflies collected throughout Vietnam in 2000-2001 resulted in the recognition of eight species of the Leptophlebiidae including two new species and three species new to Vietnam: *Choroterpes proba* Ulmer (new record), *C. trifurcata* Uéno, *C. vittata* sp. nov., *Choroterpides major* Ulmer (new record), *Habrophlebiodes prominens* Ulmer, *Isca fascia* sp. nov., *I. janiceae* Peters and Tsui, and *Thraulus bishopi* Peters and Edmunds (new record). A larval key, diagnoses for known stages of the genera and species, descriptions for new species, line-drawings, and material and distributional data are provided.

Key words *Choroterpes vittata, Choroterpides, Habrophlebiodes, Isca fascia,* taxonomy, *Thraulus*, Southeast Asia

INTRODUCTION

The Leptophlebiidae is a cosmopolitan family of mayflies that represents an extremely high degree of diversity in the southern hemisphere (Edmunds *et al.*, 1976). The larvae occur in a variety of lotic and lentic freshwater habitats and thus show a highly successful and diverse forms of adaptation. The family includes over 100 described genera in the world (Peters and Edmunds, 1970; Hubbard, 1990).

The Leptophlebiidae is well characterized by larval and adult characters (Peters and Edmunds, 1970; Edmunds *et al.*, 1976). The larvae are more or less elongated and depressed; if the body and head are strongly depressed, upper surface of the head is partially formed from mandibles. The maxillary and labial palpi are three-segmented. Gills are present on the abdominal segments 1-7, 1-6, or at least on the abdominal segments 2-6; they are forked or composed of two plates. Three caudal filaments bear whorled setae at apex of each segment. In adults, male eyes are distinctly divided into the upper portion of larger facets and the lower portion of smaller facets. Forewings lack short, free marginal intercalaries between longer veins; two to four long intercalaries are present between the veins CuA and CuP; the vein CuP is usually rather strongly recurved. Three or rarely two caudal filaments are present.

Members of the Letophlebiidae from tropical Southeast Asia have been studied by some mayfly taxonomists such as Eaton (1883-1888), Ulmer (1924, 1939), Uéno (1928, 1969), Gillies (1951), Peters and Edmunds (1970), Peters and Tsui (1972), Grant and Peters (1993), and Kang and Yang (1994), but they are still poorly known from the region. Although there were no taxonomic studies on the Vietnamese Leptophlebiidae, Nguyen *et al.* (2001) reported larvae of three species of Leptophlibiidae, *Choroterpes trifurcata* Uéno, *Habrophlebiodes*

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prominens Ulmer, and *Isca janiceae* Peters and Edmunds, in a faunistic study of aquatic insects from a mountain stream in Tam Dao National Park in northern Vietnam.

The purpose of this study is to describe the species of Leptophlebiidae based on larval and adult materials collected throughout Vietnam during the field trips in 2000-2001. Larvae (indicated as L in *Material examined*) were collected by Surber nets and kick nets. Male and female adults (indicated as M and F, respectively) were collected by light traps and sweeping nets. The materials are preserved in 80% ethyl alcohol and are deposited in the Aquatic Insect Collection of Seoul Women's University. In the future, the type materials will be appropriately returned to the places (e.g., Hanoi University of Science or authorized museums) where they originated.

TAXONOMIC ACCOUNTS

Key to genera and species of Vietnamese Leptophlebiidae

1. Gills on abdominal segments 2-7 2
- Gills on abdominal segments 1-7 4
2. Gills 2-7 ventrolaterally oriented (Fig. 19); gills 2-6 forked; gills 7 single ..... Genus *Isca*, 3
- Gills 2-7 laterally oriented (Fig. 12); gills 2-6 with 2 lamellae; each lamella with 2-3 processes at apex (Figs. 13, 16) ..... Genus *Choroterpides* ..... *Choroterpides major*
3. Abdominal terga 1-10 brown; sterna 1-10 light brown; posterolateral projections on abdominal segment 9 shorter than 1/2 × length of segment 10 (Fig. 19) ..... *Isca janiceae*
- Abdominal terga 1-2 and 7-9 black; terga 3-6 light brown (Fig. 20); sterna 1-6 and 10 light brown; sterna 7-9 black (Fig. 21); posterolateral spines on abdominal segmen 9 as long as segment 10 (Fig. 20) ..... *Isca fascia* sp. nov.
4. Gills on abdominal segments 2-7 slender and deeply forked (Fig. 18) ..... Genus *Habrophlebiodes* ..... *Habrophlebiodes prominens*
- Gills on abdominal segments 2-7 oval or plate-like with processes or fringes (Figs. 8, 28) 5
5. Lamellae of gills 2-7 with marginal fringes (Figs. 28) ..... Genus *Thraulus* ..... *Thraulus bishopi*
- Lamellae of gills 2-7 with 2 or 3 processes at apex (Figs. 2-5, 8) ..... Genus *Choroterpes*, 6
6. Upper and lower lamellae of gills 2-7, each with 3 processes at apex (Figs. 8, 11) 7
- Upper lamellae of gills 2-7 with 2 processes at apex; lower lamellae of gills 2-7 with 3 processes at apex (Figs. 2-5) ..... *Choroterpes proba*
7. Femora with 3 transverse dark brown markings dorsally (Fig. 7); posteriolateral projections on abdominal segment 9 as long as segment 10 (Fig. 6) ..... *Choroterpes trifurcata*
- Femora with longitudinal black stripe dorsally (Fig. 10); posterolateral projections on abdominal segment 9 1/3-1/2 × length of segment 10 (Fig. 9) ..... *Choroterpes vittata* sp. nov.

Genus *Choroterpes* Eaton

Choroterpes Eaton, 1881. Entomol. Month. Mag. 17: 191-197. Type-species: *Choroterpes lusitanica* Eaton.

Diagnosis. The larvae of *Choroterpes* can be distinguished from those of other leptophlebiid genera by the combination of the following characters: Gills (Figs. 1-5, 8, 11) present on abdominal segments 1-7; gills 1 slender, lanceolate; gills 2-7 alike, with dorsal and ventral portions, plate-like, and terminated in 2-3 slender processes.

Choroterpes proba Ulmer

(Figs. 1-5)

Choroterpes proba Ulmer, 1939: 493, 613.

Diagnosis. The larvae of *Choroterpes proba* can be distinguished from those of other congeners by the combination of the following characters: Gills 1 (Fig. 1) slender, single, with fine marginal setae; upper lamella of gills 2-7 (Figs. 2-5) with 2 apical processes (one relatively long, with fine setae laterally; the other relatively short); lower lamella of gills 2-7 with 3 apical processes (median process longer than lateral processes).

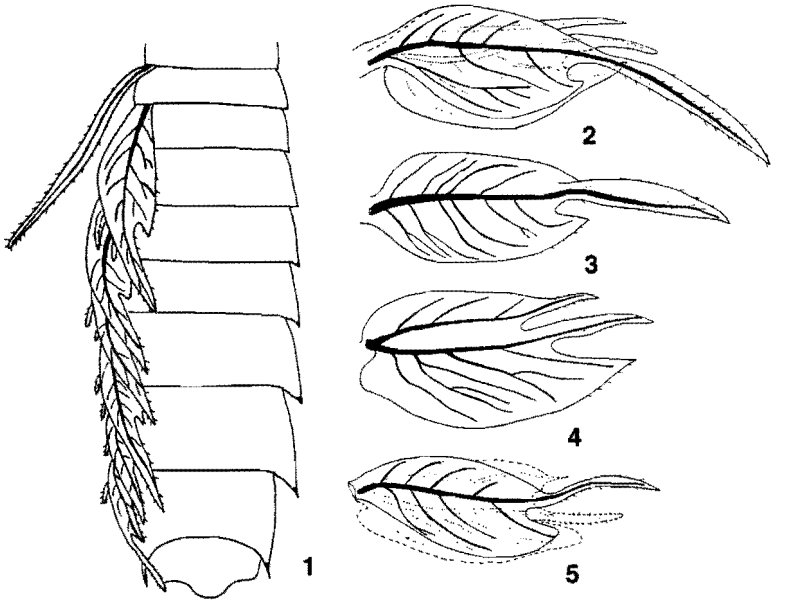
Material examined. 2 L, Cao Bang Prov., Pac Po, Lenin Cr., 15 XII 2000, VV Nguyen; 4 L, Nghe An Prov., Con Cuong, Khe Choang Cr., 12 I 2001, VV Nguyen; 4 L, Dak Lak Prov., Yok Don N.P., Dak Lau Cr., 13 II 2001, DH Hoang; 5 L, Dak Lak Prov., Yok Don N.P., Dak Ken Cr., 14 II 2001, DH Hoang.

Distribution. Sumatra, Vietnam.

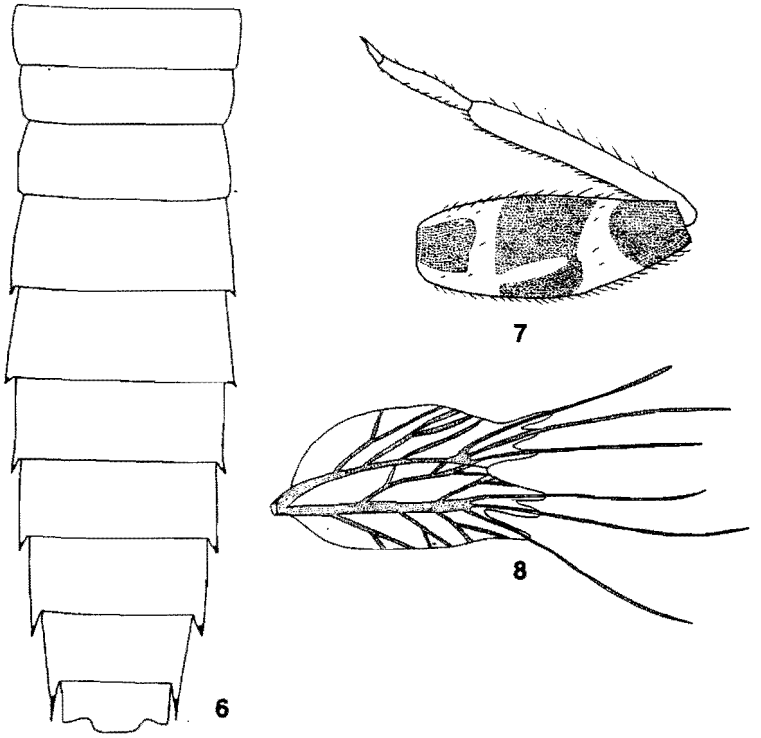
Choroterpes trifurcata Uéno

(Figs. 6-8)

Choroterpes trifurcata Uéno, 1928: 40; Ulmer, 1939: 612.



Figs. 1-5. *Choroterpes proba*: 1. larval abdomen, dorsal; 2. gill 2; 3. gill 3, upper lamella; 4. gill 3, lower lamella; 5. gill 7.



Figs. 6-8. *Choroterpes trifurcata*: 6. larval abdomen, dorsal; 7. foreleg, dorsal; 8. gill 4.

Diagnosis. The larvae of *Choroterpes trifurcata* can be distinguished from those of other congeners by the combination of the following characters: Femora with 3 transverse dark brown markings dorsally (Fig. 7). Gills 1 slender, single, with fine marginal setae; gills 2-7 lamellae with distinct arborescent dark tracheae, and terminated with 3 long processes; median process slightly longer than lateral processes (Fig. 8). Abdominal segments 4-9 with posterolateral processes; posterolateral processes 9 as long as segment 10 (Fig. 6).

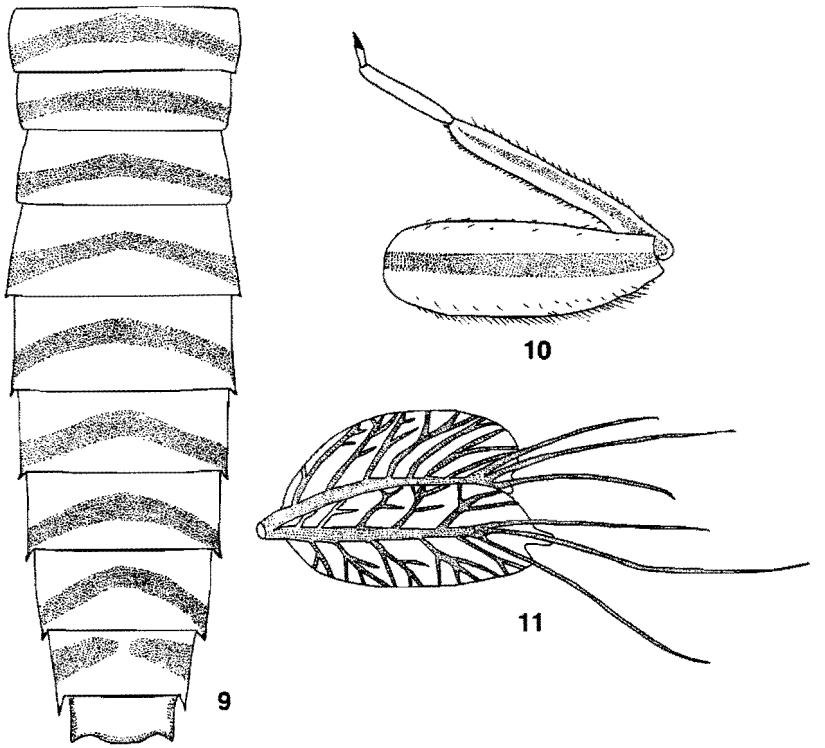
Material examined. 3 L, Ha Giang Prov., Vi Xuyen, Thanh Thuy, 8 XII 2000, VV Nguyen; 39 L, Cao Bang Prov., Ha Quang, Soc Ha, Giang Cr., 15 XII 2000, VV Nguyen; 15 L, Cao Bang Prov., Ha Quang, Soc Ha, Giang Cr., 16 XII 2000, VV Nguyen; 1 L, Cao Bang Prov., Ha Quang, Doc Lap, 18 XII 2000, VV Nguyen; 3 L, Lao Cai Prov., Sa Pa, Cat Cat Cr., 18 XII 2000, VV Nguyen; 1 L, Lao Cai Prov., Sa Pa, Thac Bac (alt. 2400 m), 19 XII 2000, VV Nguyen; 5 L, Lao Cai Prov., Sa Pa, Muong Hoa Cr., 20 X 2000, VV Nguyen; 24 L, Vinh Phuc Prov., Tam Dao N.P. (alt. 700 m), 15 II 2001, VV Nguyen; 1 L, Vinh Phuc Prov., Tam Dao N.P. (alt. 350 m), 15 II 2001, VV Nguyen; 3 L, Ha Tay Prov., Ba Vi N.P., Huong Cr., 22 XII 2000, VV Nguyen; 4 L, Ha Tay Prov., Ba Vi N.P , Tien Cr., 23 XII 2000, VV Nguyen; 26 L, Thanh Hoa Prov., Ben En N.P., 14 I 2001, VV Nguyen; 19 L, Nghe An Prov., Con Cuong, Khe Choang Cr., 12 I 2001, VV Nguyen; 55 L, Dak Lak Prov., Dak Mil, Dak Mol, Dak Pri' Cr. (alt. 450, 630, 700, 740, 770, 800, 970 m), 4/13 III 2001, DH Hoang; 5 L, Dak Lak Prov., Yol Don, Dak Clau Cr., 13 II 2001, DH Hoang.

Distribution. Java, Vietnam.

Choroterpes vittata sp. nov.
(Figs. 9-11)

Diagnosis. The larvae of *Choroterpes vittata* can be distinguished from those of other congeners by the combination of the following characters: Femora and tibiae with distinct longitudinal black stripe dorsally (Fig. 10); abdominal terga 1-9 brown, each with distinct transverse arched black stripe (Fig. 9); gills 1 slender, single, with fine marginal setae; posterolateral projections of abdominal segment 9 relatively short (1/3 to 1/2 × length of segment 10) (Fig. 9).

Description. Mature larva. Male body length 4.5 mm; cerci 6.5-7.0 mm; terminal filament 9.0-10.5 mm. Female body length 5.6 mm; cerci 7.0-7.5 mm; terminal filament 10.0-11.5



Figs. 9-11. *Choroterpes vittata*: 9. larval abdomen, dorsal; 10. foreleg, dorsal; 11. gill 4.

mm. *Head*: Head 0.97 mm in length and 1.30 mm in width, brown. Male compound eyes divided into 2 portions; upper portion light brown; lower portion black; distance between compound eyes 0.17 mm. Female compound eyes black, 0.37 mm in length, 0.27 mm in width, and 0.72 mm in distance between compound eyes. Antennae 2.9–3.5 mm in length, light yellow. Clypeus light brown, with hairlike setae dorsally; lateral margin dark brown, slightly divergent apically. Labrum 0.65 mm in width, and 0.34 mm in length, with row of long hairlike setae on dorsal surface, divergent laterally; anterior margin with emargination. Mandible incisors forked apically; lateral margin of mandibles convex and with long hairlike setae. Maxillae light yellow, apicomedially with a tooth-like process and a large thick comb-shaped setae; maxillary palpi 3-segmented; segment 1, 2, and 3 0.21 mm, 0.17 mm, and 0.15 mm, respectively; segment 3 with numerous long hairlike setae. Hypopharynx well developed; lingua with well developed lateral processes, with short hairlike setae on apex of lateral processes, with anterior margin deeply cleft; superlinguae relatively broad, with row of hairlike setae along anterior margin. Labium glossae reniform, ventrally with clavate setae; paraglossae oval, ventrally with a transverse row of hairlike setae near anterior margin, dorsally with scattered setae on anterior area; labial palpi 3-segmented; segment 1, 2, and 3 0.25 mm, 0.20 mm, and 0.15 mm, respectively; lateral margin of segment 3 with 10–12 acute setae medially. *Thorax*: Pronotum brown, with light markings, with shallow emargination anteromedially; lateral margins light yellow; anterolateral margins round and with 6–8 acute setae. Forewingpads light brown. Hindwingpads small. Legs light yellow; femora and tibiae with distinct longitudinal black stripe dorsally (Fig. 10). Forefemora, foretibiae, foretarsi, and foreclaws 1.12 mm, 1.00 mm, 0.47 mm, and 0.12 mm, respectively; forefemora with 15–20 stout setae mixed with 22–24 long hairlike setae on posterior margin, with blunt setae in median area, with long hairlike setae on anterior margin; foretibiae with acute pinnate setae on lateral margins; foreclaws with 12–14 denticles apically. Midfemora, midtibiae, midtarsi, and midclaws 1.10 mm, 0.97 mm, 0.35 mm, and 0.10 mm, respectively; posterior margin of midfemora with acute setae sparsely. Hindfemora, hindtibae, hindtarsi, and hindclaws 1.05 mm, 0.95 mm, 0.30 mm, and 0.12 mm, respectively; hindfemora with long hairlike setae laterally; hindtibiae and hindtarsi with short hairlike setae laterally. *Abdomen*: Terga 1–9 (Fig. 9) brown, each with distinct transverse arched black stripe; tergum 10 brown, with dark brown marginal markings; sterna brown, without markings; terga 4–9 with posterolateral projections; posterolateral projections on tergum 9 relatively short, 1/3 to 1/2 × length of tergum 10. Gills on abdominal segments 1–7; gills 1 slender, with marginal setae; gills 2–7 alike, each included 2 broad plate-like lamellae; lamella with distinct arborescent dark tracheae; each lamella terminated with 3 processes, with median process longer than lateral processes (Fig. 11). Caudal filaments ca. 1.4 × length of body, with whorled setae at apex of each segment.

Adult. Unknown.

Type. Holotype: Female larva (SWU-EPH-3638), Vietnam, Cao Bang Prov., Ha Quang, Phu Ngoc, 17 XII 2000, V. V. Nguyen, deposited in the Aquatic Insect Collection of Seoul Women's University. Paratypes: 6 larvae (SWU-EPH-3639, 3640), same data as holotype.

Other material examined. 1 L, Vinh Phuc Prov., Tam Dao N.P. (alt. 350 m), 15 II 2001, VV Nguyen.

Distribution. Vietnam.

Etymology. The specific name *vittata* (striped) is Latin, an allusion to the abdominal black stripes.

Genus *Choroterpides* Ulmer

Choroterpides Ulmer, 1939. Arch. Hydrobiol. (Suppl.) 16: 443–692. Type-species: *Thraulus exigua* Eaton.

Diagnosis. The larvae of *Choroterpides* can be distinguished from those of other leptophlebiid genera by the combination of the following characters: gills (Figs. 12–16) present on abdominal segments 2–7; gills 2–7 alike, with dorsal and ventral portions, plate-like, and terminated in 2–3 processes; median process equal to or longer than lateral processes.

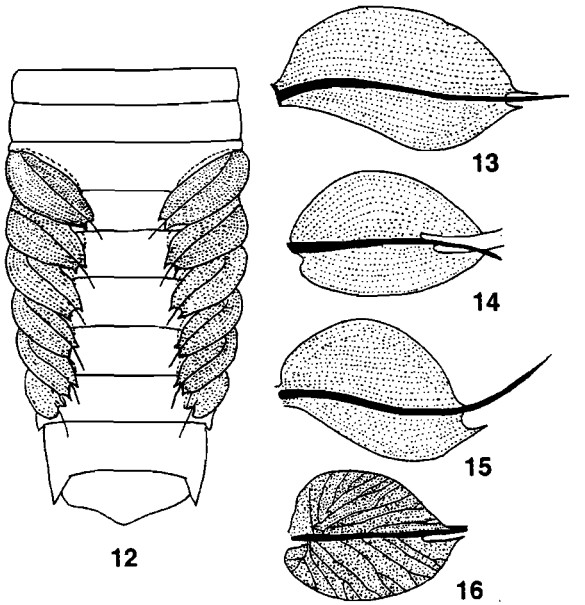
Choroterpides major Ulmer

(Figs. 12–16)

Choroterpides major Ulmer, 1939: 497, 619.

Diagnosis. The larvae of *Choroterpides major* can be distinguished from those of other congeners by the combination of the following characters: Maxillary and labial palpi greatly elongated and extended beyond sides of head; anterior margin of labrum with emargination; upper and lower lamellae of gills 2 (Figs. 13, 14) apically with 3 processes; upper lamellae of gills 7 (Fig. 15) apically with 2 processes; lower lamella of gills 7 (Fig. 16) with 3 processes (processes equal in length), with distinct tracheae.

Material examined. 4 L, Ha Giang Prov., Vi Xuyen, Thanh Thuy, 8 XII 2000, VV Nguyen; 7 L, Ha Giang Prov., Tay Con Linh, 9 XII 2000, VV Nguyen; 25 L, Cao Bang Prov., Ha Quang, Soc Ha, Giang Cr., 16 XII 2000, VV Nguyen; 2 L, Lao Cai Prov., Sa Pa, Muong Hoa Cr., 20 X 2000, VV Nguyen; 9 L, Lao Cai Prov., Sa Pa, Ta Van, 28 XII 2000, TKT Cao; 1 L, Lao Cai Prov., Sa Pa, Cat Cat Cr., 28 XII 2000, TKT Cao; 2 L, Lao Cai Prov., Sa Pa, Dong



Figs. 12-16. *Choroterpides major*: 12. larval abdomen, dorsal; 13. gill 2, upper lamella; 14. gill 2, lower lamella; 15. gill 7, upper lamella; 16. gill 7, lower lamella.

Tuyen, 29 XII 2000, TKT Cao; 15 L, Nghe An Prov., Con Cuong, Khe Choang Cr., 12 I 2001, VV Nguyen; 47 L, Dak Lak Prov., Dak Mil, Dak Mol, Dak Pri' Cr. (480, 630, 700, 740, 770, 800, 1000 m), 4/13 III 2001, DH Hoang; 7 L, Dak Lak Prov., Yol Don, Dak Clau Cr., 5 III 2001, DH Hoang.

Distribution. Java, Sumatra, Vietnam.

Genus *Habrophlebiodes* Ulmer

Habrophlebiodes Ulmer, 1919. Arch. Natur. 85: 1-80. Type-species: *Habrophlebia americana* Ulmer.

Diagnosis. The larvae of *Habrophlebiodes* can be distinguished from those of other leptophlebiid genera by the combination of the following characters: Gills (Fig. 18) present on abdominal segments 1-7; gills 1-7 alike, long, slender, and deeply forked; posterolateral projections present on abdominal segments 8 and 9, and those on segment 9 longer.

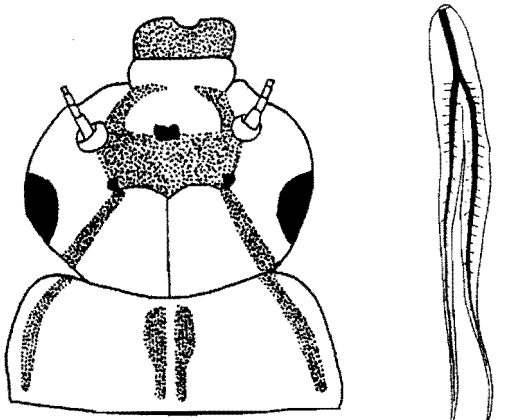
Habrophlebiodes prominens Ulmer

(Figs. 17-18)

Habrophlebiodes prominens Ulmer, 1939: 502, 623.

Diagnosis. The larvae of *Habrophlebiodes prominens* can be distinguished from those of other congeners by the combination of the following characters: Head and and thorax with distinct markings as in Fig. 17; gills on segments 1-7 alike, long, slender, and deeply forked, with distinct tracheae; gills 4 (Fig. 18) forked at 1/6 basally.

Material examined. 34 L, Vinh Phuc Prov., Tam Dao N.P. (alt. 900 m), 16 X 2000, 14 II 2001, VV Nguyen; 11 L, Vinh Phuc Prov., Tam Dao N.P. (alt. 700 m), 15 II 2001; 2 L, Vinh Phuc Prov., Tam Dao N.P. (alt. 350 m), 15 II 2001, VV Nguyen; 14 L, Ha Tay Prov., Ba Vi N.P., Huong Cr., 22 XII 2000; 11 L, Ha Tay Prov., Ba Vi N.P., Tien Cr., 23 XII 2000, VV Nguyen; 22 L, Dak Lak Prov., Dak Mil, Dak Mol, Dak Pri' Cr., (630, 1000 m) 7/9 III 2001, DH Hoang.



17 18

Figs. 17-18. *Habrophlebiodes prominens*: 17. larval head and pronotum, dorsal; 18. gill 4.

Distribution. Java, Sumatra, Vietnam.

Genus *Isca* Gillies

Isca Gillies, 1951. Proc. Roy. Entomol. Soc. London. 20: 121-130. Type-species: *Isca purpurea* Gillies.

Diagnosis. The larvae of *Isca* can be distinguished from those of other leptophlebiid genera by the combination of the following characters: Gills (Fig. 19) present ventrolaterally on abdominal segments 2-7; gills 2-6 (Fig. 22) alike, forked, slender; gills 7 (Fig. 23) unforked, slender.

Isca janiceae Peters and Edmunds

(Fig. 19)

Isca janiceae Peters and Edmund, 1970: 218.

Diagnosis. The larvae of *Isca janiceae* can be distinguished from those of other congeners by the combination of the following characters: Abdominal terga brown; abdominal sterna light brown; posterolateral projections of abdominal segment 9 (Fig. 19) relatively small; abdominal gills as in Fig. 19.

Material examined. 1 L, Ha Giang Prov., Vi Xuyen, Thanh Thuy, 8 XII 2000, VV Nguyen; 1 L, Ha Giang Prov., Vi Xuyen, Bac Viet Cr., 11 XII 2000, VV Nguyen; 5 L, Vinh Phuc Prov., Tam Dao N.P., Thac Bac Cr. (alt. 700 m), 16 X 2000, VV Nguyen; 1 L, Ha Tay Prov., Ba Vi N.P., Huong Cr., 22 XII 2000, VV Nguyen; 1 L, Ha Tay Prov., Ba Vi N.P., Huong Cr., 23 XII 2000, VV Nguyen; 75 L, Dak Lak Prov., Dak Mil, Dak Mol, Dak Pri' Cr. (430, 630, 700, 770, 800, 1000 m), 4/13 III 2001, DH Hoang.

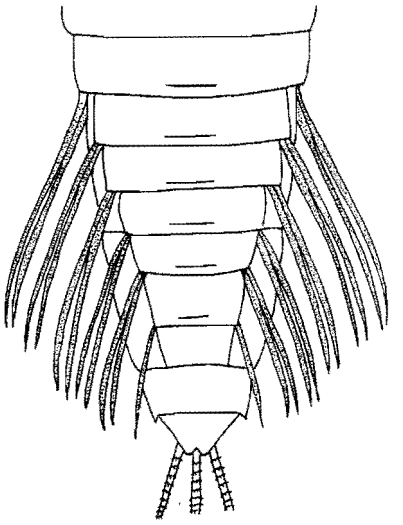


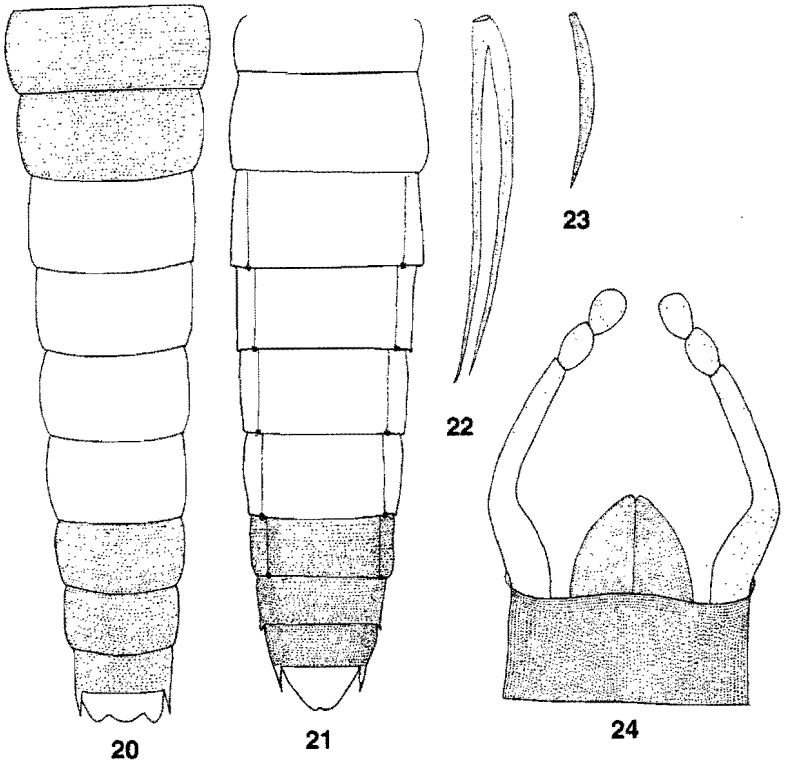
Fig. 19. *Isca janiceae*: ventral abdomen.

Distribution. Thailand, Vietnam.

Isca fascia sp. nov.
(Figs. 20–24)

Diagnosis. The larvae of *Isca fascia* can be distinguished from those of other congeners by the combination of the following characters: Abdominal terga (Fig. 20) 1–2 and 7–9 black; abdominal terga 3–6 light brown; abdominal sterna (Fig. 21) 1–6 and 10 light brown; abdominal sterna 7–9 black; posterolateral projections on segment 9 as long as abdominal segment 10. The adults of *I. fascia* can be distinguished by their abdominal markings: Terga 1–2 and 7–9 dark brown; terga 3–6 brown. In male adults, the subgenital plate is slightly convex and the penes are light yellow, relatively broad and flattened, fused, and weakly notched apically (Fig. 24).

Description. Mature larva. Male body length 4.6 mm; cerci 5.5–6.0 mm; terminal filament 7.5–8.2 mm. Female body length 4.9 mm; cerci 6.1–6.5 mm; terminal filament 8.5–9.2 mm. *Head*: Head 0.55 mm in length, and 1.12 mm in width, light yellow with large dark brown to black area in vertex. Compound eyes black. Male compound eyes 0.42 mm in width; distance between compound eyes 0.25 mm. Female compound eyes 0.18 mm in width; distance between compound eyes 0.75 mm. Antennae 3.2–3.5 mm in length, light yellow. Clypeus rectangular, straight in anterior margin, with weakly developed hairlike setae dorsally. Labrum slightly emarginated anteromedially, dorsally with rowed hairlike setae, ventrally with hairlike setae in submedian and anterolateral areas. Mandibles with field of hairlike setae on dorsolateral margin; incisors with 3 teeth; molar with 8–9 small teeth. Maxillae with rake-like spines on crown of galea-lacinia; maxillary palpi 3-segmented; segment 1, 2, and 3 0.17 mm, 0.11 mm, and 0.12 mm, respectively; segment 1 and 2 with scattered hairlike setae laterally; segment 3 triangular, with scattered hairlike setae apically. Hypopharynx well developed; lingua with well developed lateral processes, with anterior margin cleft; superlinguae relatively broad, with row of hairlike setae along anterior margin. Labium glossae and paraglossae with dense hairlike setae; labial palpi 3-segmented and laterally oriented; segment 1, 2, and 3 0.25 mm, 0.15 mm, and 0.18 mm, respectively; segment 3 triangular, with hairlike setae laterally. *Thorax*: Pronotum weakly expanded laterally with round anterolateral coners, light yellow with dark brown anterior margin. Mesonotum light yellow, with dark brown marking medially. Forewingpads black; hindwingpads absent. Forefemora, foretibiae, foretarsi, and foreclaws 0.97 mm, 0.82 mm, 0.45 mm, and 0.09 mm, respectively; forefemora light yellow, with scattered simple stout setae dorsally and on anterior and posterior margins; foretibiae light brown, with rowed sparse hairlike setae along outer margin and with field of stout setae along inner margin; foretarsi with sparse hairlike setae dorsally; foreclaws dark brown, apically hooked, with rowed denticles (denticles apically larger). Midfemora, midtibiae, midtarsi, and midclaws 0.87 mm, 0.85 mm, 0.37 mm, and 0.09 mm, respectively; midfermora with stout setae and hairlike setae dorsally; midtibiae and midtarsi with hairlike setae dorsally and laterally; midclaws dark brown with denticles apically. Hindfemora, hindtibae, hindtarsi, and hindclaws 1.17 mm, 1.15 mm, 0.67 mm, and 0.10 mm, respectively; hindfemora light yellow, with hairlike setae laterally; hindtibiae and hindtarsi with short hairlike setae laterally. *Abdomen*: Terga (Fig. 20) 1–2 and 7–9 black; terga 3–6 light brown; sterna (Fig. 21) 1–6 and 10 light brown; sterna 7–9 black. Posterolateral projections on segment 9 as long as segment 10. Gills on segments 2–7; gills 2–6 (Fig. 22) ventrolaterally oriented, forked; gills 7 (Fig. 23) single, slender. Caudal filaments with whorls of weakly developed hairlike setae; cerci ca. 1.3 × length of body; terminal filament ca. 1.8 × length of body.



Figs. 20–24. *Isca fascia*: 20. larval abdomen, dorsal; 21. larval abdomen, ventral; 22. gill 4; 23. gill 7; 24. genitalia, male adult.

Male adult. Body length 4.9 mm; cerci 6.5–7.5 mm; terminal filament 7.5–8.5 mm. *Head*: Head dorsally dark brown; compound eyes divided into large upper portion with larger light brown facets and smaller lower portion with smaller black facets; upper portion of compound eyes 0.52 mm in width and 1.20 mm in distance between compound eyes; ocelli dark brown basally, white apically. Antennae 0.7–0.9 mm, white. *Thorax*: Pronotum purplish brown. Mesonotum purplish brown, with white median and sublateral lines; posterior hump dark brown and V-shaped. Metanotum brown. Forelegs light brown to light yellow; foretibiae and foretarsi greatly elongated; foremora, foretibiae, and foretarsi 0.97 mm, 3.20 mm, and 2.92 mm, respectively; foretarsal segments 1, 2, 3, 4, and 5 0.1 mm, 0.92 mm, 0.91 mm, 0.80 mm, and 0.19 mm, respectively. Midlegs light brown to light yellow; midfermora, midtibiae, midtarsi 0.87 mm, 0.72 mm, and 0.32 mm, respectively. Hindlegs light brown to light yellow; hindfemora, hindtibiae, hindtarsi 1.10 mm, 0.82 mm, and 0.35 mm, respectively. Claws dissimilar. Forewings 5.9 mm in length, 2.2 mm in width, stained purplish brown; longitudinal

veins generally white; C, Sc, and R_1 slightly darker; posterior margin with numerous trichia; crossveins reduced, white; stigmatic area without crossveins; crossveins between C and Sc 4; crossveins between Sc and R_1 6; crossveins between R_1 and R_2 11; bullae on Sc, R_1 and R_{4+5}; MA_2 attached to MA_1 at base, with 1 intercalary; MP_2 attached to MP_1 at base, with 1 intercalary; area between MP_2 and CuA without intercalaries; area between CuA and CuP with 2 intercalaries; Rs forked 1/8 basally; MA forked 1/3 basally; MPs ca. 0.3 × length of MP_1; CuP strongly arched; anal veins 3. Hindwings absent. *Abdomen*: Abdominal segments brown to dark brown; terga 1–2 and 7–9 dark brown; terga 3–6 brown; segments 2–7 with white area 1/3 anteriorly; sterna 3–9 with pair of dark brown longitudinal stripes; posterolateral projections on segment 9 as long as segment 10. Genitalia as in Fig. 24; genital forceps 3-segmented, white; segment 1, 2, and 3 0.35 mm, 0.10 mm, and 0.10 mm, respectively; segment 1 arched; segments 2 and 3 nearly round; subgenital plate slightly convex; penes light yellow, relatively broad and flattened, fused, and notched apically. Cerci white, ca. 1.6 × length of body.

Female adult. Body length 5.3 mm; cerci 7.5–8.0 mm; terminal filament 8.5–9.0 mm. *Head*: Head dark brown; compound eyes dark grey in alcohol, 0.20 mm in width, and 0.74 mm in distance between compound eyes; ocelli dark brown basally, white apically. Antennae white, 0.8–0.9 mm in length. *Thorax*: Color and shape as in male. Forelegs light brown to light yellow, foremora, foretibiae, and foretarsi 0.75 mm, 0.70 mm, and 0.25 mm, respectively. Midlegs light brown to light yellow; midfermora, midtibiae, and midtarsi 0.78 mm, 0.80 mm, and 0.25 mm, respectively. Hindlegs light brown to light yellow; hindfemora, hindtibiae, and hindtarsi 1.15 mm, 0.90 mm, and 0.23 mm, respectively. Claws dissimilar. Forewings 6.3 mm in length, 2.60 mm in width; shape, color, and venation similar to male. Hindwings absent. *Abdomen*: Color and markings similar to male. Cerci white, ca. 1.5 × length of body.

Type. Holotype: Female larva (SWU-EPH-3648), VIETNAM, Lao Cai Prov., Sapa, Thac Bac Cr. (alt. 2400 m), 19 X 2000, VV Nguyen, deposited in the Aquatic Insect Collection of Seoul Women's University. Paratypes: 44 male adults (SWU-EPH-3651, 3652) and 48 larvae (SWU-EPH-3649, 3650), same data as holotype.

Other material examined. 8 M, 2F & 47 L: Lao Cai Prov., Sapa, Thac Bac Cr. (2000 m, 2400 m), 19 X 2000, VV Nguyen.

Distribution. Northern Vietnam.

Etymology. The specific name *fascia* (band) is Latin, an allusion to the abdomen black bands.

Genus *Thraulus* Eaton

Thraulus Eaton, 1881. Entomol. Month. Mag. 17: 191–197. Type-species: *Thraulus bellus* Eaton.

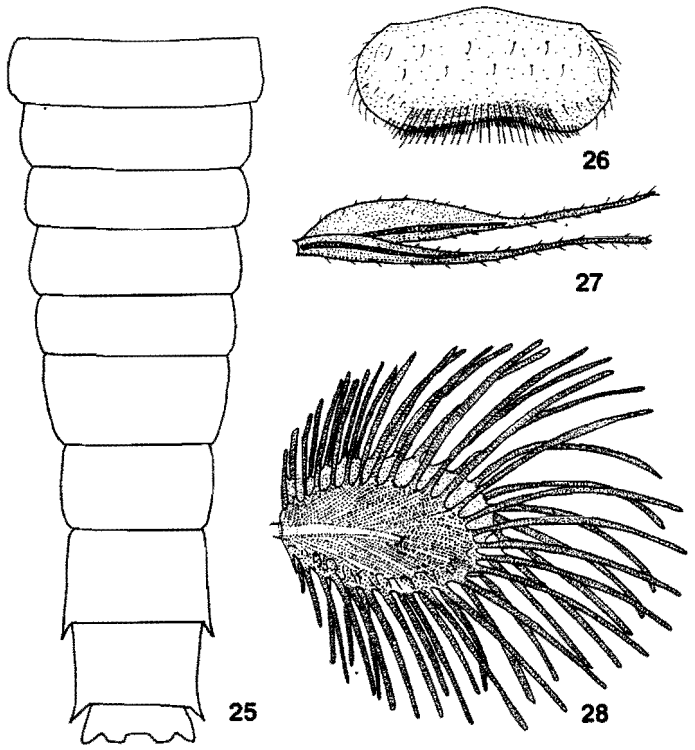
Diagnosis. The larvae of *Thraulus* can be distinguished from those of other leptophlebiid genera by the combination of the following characters: Gills present on abdominal segments 1–7, with dorsal and ventral portions; gills 1 (Fig. 27) slender, lanceolate; gills 2–7 (Fig. 28) oval, with marginal fringes; lateral tips of hypopharynx superlinguae emarginated.

Thraulus bishopi Peter and Tsui

(Figs. 25–28)

Thraulus bishopi Peter and Tsui, 1972: 8.

Diagnosis. The larvae of *Thraulus bishopi* can be distinguished from those of other congeners by the combination of the following characters: Labrum (Fig. 26) emarginated anteromedially, without denticles on anteromedian emargination; abdominal segments 8–9



Figs. 25–28. *Thraulus bishopi*: 25. larval abdomen, dorsal; 26. labrum, dorsal; 27. gill 1; 28. gill 4.

(Fig. 25) with relatively short posterolateral projections.

Material examined. 6 L, Cao Bang Prov., Pac Po, Lenin Cr., 15 XII 2000, VV Nguyen; 1 L, Cao Bang Prov., Ha Quang, Phu Ngoc, 17 XII 2000, VV Nguyen; 2 L, Lao Cai Prov., Sa Pa, Thac Bac Cr. (alt. 2000 m), 19 X 2000, VV Nguyen.

Distributions. Malaysia, Vietnam.

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SUPPLEMENTAL NOTE

Correction and Addition to A Pictorial Key to the Mosquito Genera of the World, Including Subgenera of *Aedes* and *Ochlerotatus* (Diptera: Culicidae)

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Since A Pictorial Key to the Mosquito Genera of the World, including Subgenera of *Aedes* and *Ochlerotatus* (Huang, 2002) was published, and error has been discovered by Dr. Maria Anice Mureb Sallum.

This supplement was prepared to correct the error and also to add the subgenus *Pseudoskusea* of genus *Ochlerotatus* which was not included in the key.

The format used in this supplement conforms to that used in the World key (Huang, 2002). Addition and correction to the key can conveniently be made by: (1) replacing Page 48b with new Page 48b, and (2) replacing Page 95 with new Page 95 and Page 95a.

I am most grateful to Dr. Maria Anice Mureb Sallum, University of São Paulo, São Paulo, Brazil, for her kindly called my attention to the error in the key.

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