



NEW VIETNAMESE SPECIES OF THE GENUS *FLAVOPERLA* CHU (PLECOPTERA: PERLIDAE)

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ABSTRACT

Flavoperla Chu is reported for the first time from the Southeast Asian peninsula and three new species from Vietnam are recognized. *Flavoperla dao* sp. n. is described from Cao Bang province and *F. hmong* sp. n., and *F. pallida* sp. n. are described from Lao Cai.

Keywords: Plecoptera, Perlidae, *Flavoperla*, new species, Vietnam

INTRODUCTION

Chu (1929) established *Flavoperla* for a new Chinese species, *F. biocellata* Chu, but it was soon placed in synonymy with *Gibosia* by Wu (1935). This synonymy was accepted until Uchida (1990) presented data supporting re-establishment of *Flavoperla* as a valid genus distinct from *Gibosia*. Unfortunately, this study has not been published, but Harper (1994) treated *Flavoperla* as a valid genus in his key to nymphal Chinese Plecoptera.

The following list includes those species formerly placed in *Gibosia*, and recognized as members of *Flavoperla* by Uchida (1990) in his thesis. Two additional *Gibosia* species described by Kawai (1967, 1968) and one described by Okamoto (1912) are considered by Uchida (1990) to be synonyms of *F. thoracica* Okamoto and are not included in the list.

- F. biocellata* Chu 1929
- F. hagiensis* (Okamoto 1912)
- F. hatakeyamae* (Okamoto 1912)
- F. lucida* (Klapálek 1913)
- F. okamotoi* (Zhiltzova 1979)
- F. ovalolobata* (Wu 1948)
- F. thoracica* (Okamoto 1912)
- F. tobei* (Okamoto 1912)

The two genera share several features, including extension of the male hammer beyond the apex of abdominal sternum 9, and presence of a pair of spines on male abdominal tergum 10, but they differ conspicuously in body pigmentation, with *Gibosia* displaying a dark brown adult habitus and *Flavoperla* being very pale. In addition, Uchida (1990) reports the epiproct sclerite of male *Gibosia* is completely isolated from the body of tergum 10 by membrane, whereas in *Flavoperla* this structure is fused to tergum 10 along the anterior margin of the epiproct sclerite. *Flavoperla* species recognized by Uchida (1990) occur on Sakhalin, the Kurile Islands, Japan (Hokkaido, Honshu, Kyushu, Sado), the Ryukyu Islands, and Taiwan, and two species, *F. biocellata* and *F. ovalolobata* (Wu), are recognized from mainland China. It appears two additional species described by Wu could also be assigned to *Flavoperla* (*G. albopila* Wu 1948; *G. bispinata* Wu 1962), however, until specimens of these species are available for study, their generic placement is problematic.

The present study, based on a small series of *Flavoperla* adults collected in Vietnam by personnel of the Royal Ontario Museum and the Berlin Museum, includes three species distinguished on the basis of color pattern and external male genitalia. Internal

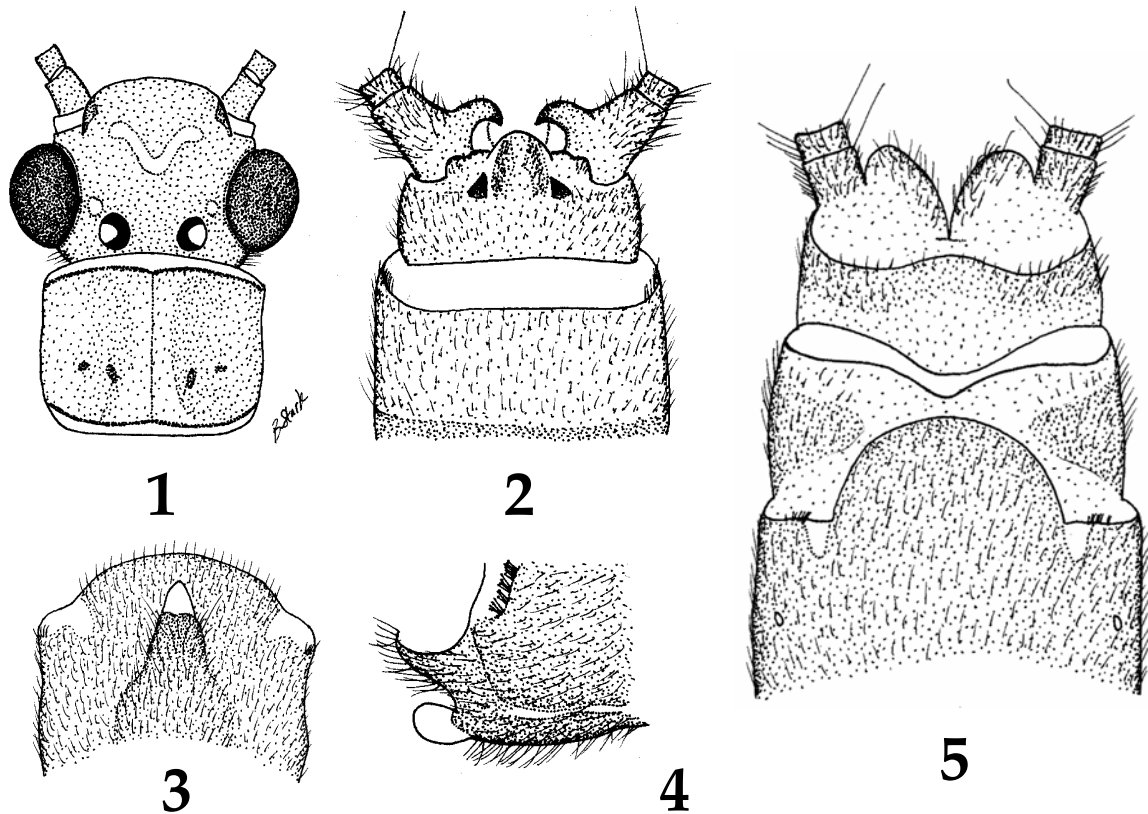
male genitalia, usually a reliable structure for species identification among perlid stoneflies, has not been helpful in this genus, primarily because the complexity of the structure renders it virtually impossible to evert once a specimen is preserved. Hopefully, future collections of this group will include squeezed specimens which will permit careful study of the internal male structure.

Specimens are placed in the Royal Ontario Museum, Toronto, Ontario, Canada (ROM), the Institute of Ecology and Biological Resources, Hanoi, Vietnam (IEBR), or the Zoologisches Museum der Humboldt-Universität, Berlin, Germany (ZMB) as indicated in the text. We thank B. Hubley and colleagues of the Royal Ontario Museum for providing most of the material used in this study.

RESULTS AND DISCUSSION

Flavoperla dao sp. n. (Figs. 1-5)

Material examined. Holotype ♂ and 2 ♂ paratypes from Vietnam, Cao Bang, Ba Be National Park, 3 km along trail to ethnic village overlooking river, 24 May 1995, ROM 956131, D. Currie, J. Swann (Holotype and paratype, ROM, paratype IEBR). Additional paratypes: Vietnam: Cao Bang, Ba Be National Park, between park gates and dorm building by pond, UV light, 22 May 1995, ROM 956119, J. Swann, M. McGuffin, 1 ♀ (ROM). Cao Bang, Ba Be National Park, dorm annex, UV light, 20 May 1995, ROM 956106, D. Currie, J. Whiting, 1 ♂, 3 ♀ (ROM, IEBR).



Figs. 1-5. *Flavoperla dao*. 1. Head and pronotum, 2. Male terminalia, dorsal, 3. Male sternum 9, 4. Male segment 9, lateral, 5. Female terminalia.

Adult habitus. Biocellate. General color pale yellow or white in alcohol. Head without dark markings, anterior and posterior pronotal margins dark brown

but midlateral margins pale (Fig. 1). Wings transparent, veins pale brown but basal third of R darker.

Male. Forewing length 8 mm. Tergum 10 with indistinct epiproct sclerite lying between, and caudal to, paired triangular spines (Fig. 2); epiproct sclerite divided by narrow, longitudinal membranous band. Paraprocts curved forward, pointed and dark brown at tips. Hammer apex unpigmented, hastate in ventral aspect (Fig. 3) and somewhat oval in lateral aspect (Fig. 4). Aedeagus not everted.

Female. Forewing length 10.5-11.5 mm. Subgenital plate broadly rounded, reaching beyond midpoint of sternum 9. Hind margin of sternum 9 poorly

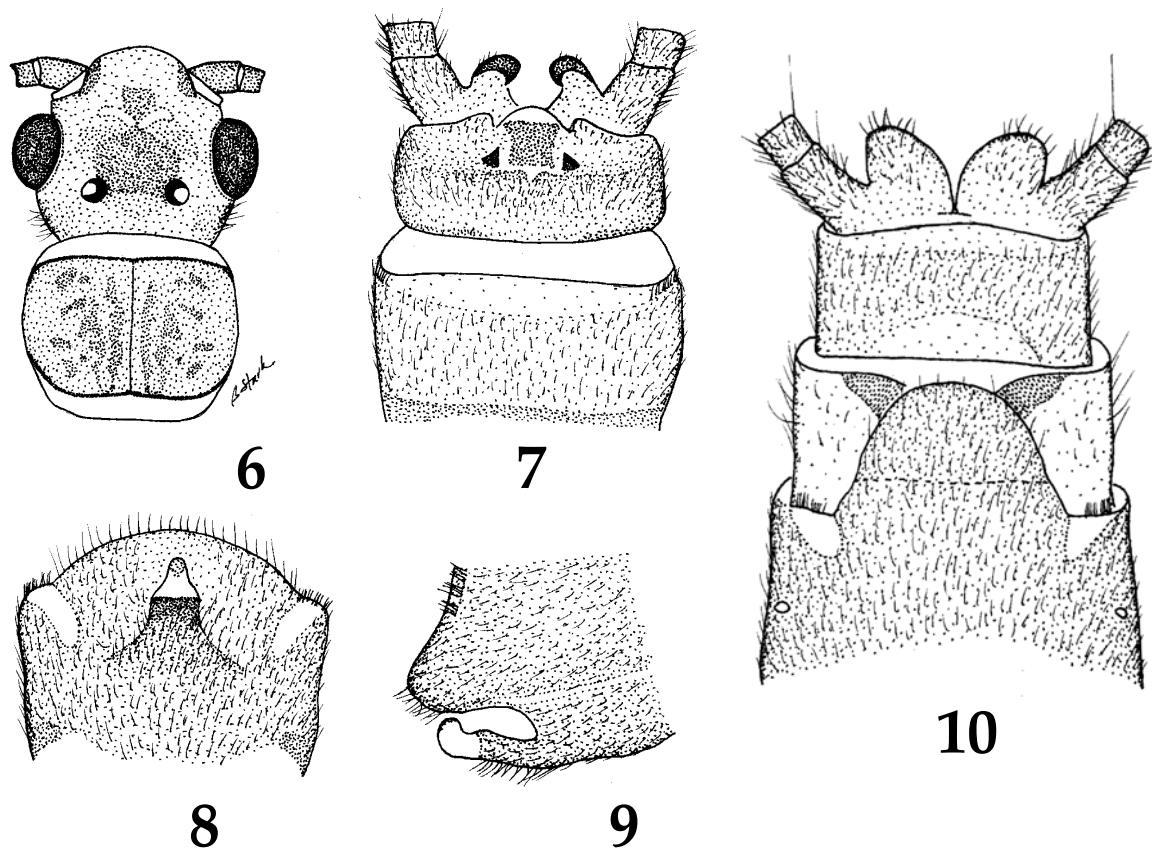
sclerotized and deeply emarginate mesally. Mesoanterior margin of sternum 10 membranous and projecting forward into emargination on sternum 9 (Fig. 5).

Egg. Spindle shaped, collar absent; anchor medusoid. Chorion covered throughout with fine aeropyles; opercular line indistinct.

Larva. Unknown.

Etymology. The species name, used as a noun in apposition, honors the Dao people of Vietnam.

Diagnosis. See below.



Figs. 6-10. *Flavoperla hmong*. 6. Head and pronotum. 7. Male terminalia, dorsal. 8. Male sternum 9. 9. Male segment 9, lateral. 10. Female terminalia.

Flavoperla hmong sp. n.
(Figs. 6-10, 17-19)

Material examined. Holotype ♂ and 1 ♂, 1 ♀ paratype from Vietnam, Lao Cai, Sapa, large waterfall on road from Sapa to Lai Chau, UV light, 8 May 1995, ROM 956022, D. Currie, B. Hubley, J.

Swann (ROM). Additional paratypes: Vietnam: Lao Cai, Sapa, Fan Si Pang Mts., 22-29 April 1995, 1600 m, 1 ♂, 1 ♀ (ZMB). Thua Thien Hue, Bach Ma National Park, near junction Rhododendron and Five Lakes trails, 1200 m, 16 June 2000, 16° 11' 10" N, 107° 50' 55" E, ROM 2000531, B. Hubley, D.C. Darling, 2 ♂, 6 ♀ (ROM, IEBR).

Adult habitus. Biocellate. General color yellow patterned with pale brown. Head with dark ocellar patch extending to M-line, and smaller brown area forward of M-line (Fig. 6). Pronotal margins completely dark brown but midlateral area turned downward, appearing pale in dorsal aspect; disc with scattered pale brown rugosities. Wings transparent, veins pale brown.

Male. Forewing length 10.5 mm. Epiproct sclerite completely dark, quadrangular; anterior margin set between bases of paired triangular spines (Fig. 7). Paraprocts slender, curved forward and hooked at tips. Hammer apex unpigmented and turned upward in lateral aspect (Figs. 8-9). Aedeagus not everted.

Female. Forewing length 12 mm. Subgenital plate broadly rounded and covering most of sternum 9

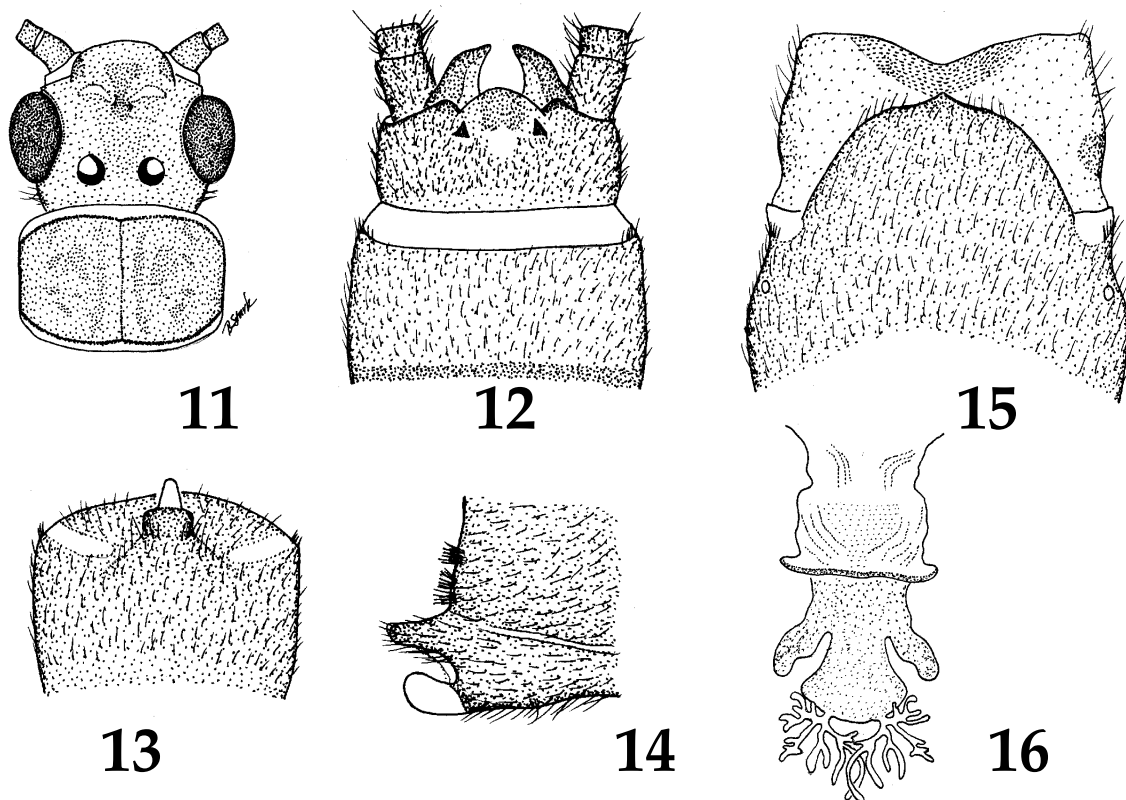
(Fig. 10); dorsum of plate bearing a sclerite whose margin is visible as a distinct line crossing plate near base. Sternum 9 with a V-shaped, median membranous area; membrane of V-shaped notch covered with rows of fine, linear microtrichia.

Egg. Spindle shaped, lid broadly rounded (Fig. 19). Collar absent (Fig. 17), anchor medusoid, consisting of a cushion with multiple finger-like lobes (lobes broken in Fig. 17). Chorion finely punctate throughout; opercular line present, lid covered with follicle cell impressions which enclose ca. 30 punctations. Micropyles simple (Fig. 18).

Larva. Unknown.

Etymology. The species name, used as a noun in apposition, honors the Hmong people of Vietnam.

Diagnosis. See below.



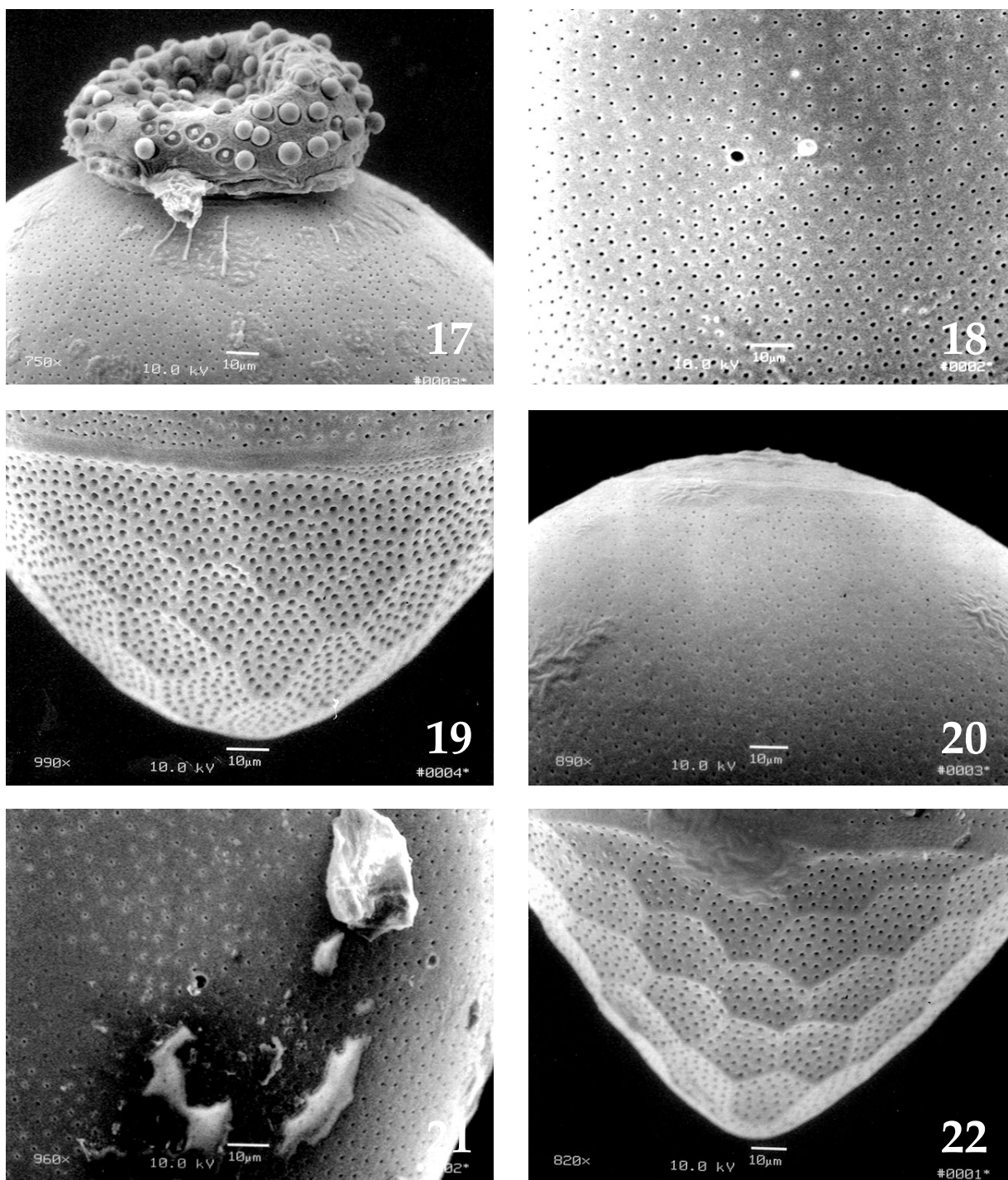
Figs. 11-16. *Flavoperla pallida*. 11. Head and pronotum, 12. Male terminalia, dorsal, 13. Male sternum 9, 14. Male segment 9, lateral, 15. Female terminalia, 16. Uneverted male aedeagus, dorsal aspect in situ.

Flavoperla pallida sp. n.
(Figs. 11-16, 20-22)

Material examined. Holotype ♂ and ♀ paratype

from Vietnam, Lao Cai, Sapa, large waterfall on road from Sapa to Lai Chau, UV light, 8 May 1995, ROM 956022, D. Currie, B. Hubley, J. Swann (ROM).

Adult habitus. Biocellate. General color pale yellow.



Figs. 17-22. *Flavoperla* eggs. 17-19. *F. hmong*. 17. Collar region with anchor (finger lobes broken), 18. Subequatorial region of chorion with micropyle, 19. Operculum and lid. 20-22. *F. pallida*. 20. Collar region, anchor removed, 21. Subequatorial region of chorion with micropyle, 22. Operculum and lid.

Head with indistinct pale brown area forward of M-line and on lappets (Fig. 11). Pronotum with dark margins and obscure pale brown rugosities on disc. Wings transparent, veins pale.

Male. Forewing length 9 mm. Epiproct sclerite about as long as wide, mostly sclerotized, but with small anterior membranous notch (Fig. 12); anterior margin set between bases of paired spines. Paraprocts broad, upright and without apical hook. Hammer apex unpigmented, triangular and somewhat oval in lateral aspect (Figs. 13-14). Aedeagus not everted, but Fig. 16 shows the dorsal aspect in contracted position.

Female. Forewing length 13 mm. Subgenital plate shield shaped, with small mesal point approaching posterior margin of sternum 9 (Fig. 15). Mesal field of sternum 9 with a broad, shallow membranous area; membrane of notch covered with fine, linear microtrichia.

Egg. Spindle shaped, lid pointed (Fig. 22). Collar absent (Fig. 20), anchor medusoid (removed in Fig. 20). Chorion finely punctate throughout; opercular line present but indistinct; lid covered with follicle cell impressions which enclose ca. 40 punctations. Micropyles simple (Fig. 21).

Larva. Unknown.

Etymology. The name refers to the pale pigmentation of this species.

Diagnosis. *Flavoperla dao* is similar to *F. hmong* in paraproct structure, but the latter species is distinguished on the basis of the dark ocellar patch (Fig. 6), a wider and completely sclerotized epiproct (Fig. 7), and by the upturned apex of the hammer (Fig. 9) as seen in lateral aspect. The color pattern (Fig. 1) and hammer shape (Fig. 4) of *F. dao* are more similar to *F. pallida* (Figs. 11, 14) but that species has broader, more triangular paraprocts (Fig. 12) which are more upright and lack an apical curved point. Females of the three species are also similar, but subtle differences occur in shape of the subgenital plate and in sternum 9. *Flavoperla pallida* is distinctive by virtue of the mesoapical point on the subgenital plate (Fig. 15), whereas the other two species have broadly rounded plates (Figs. 5, 10). *Flavoperla hmong* can be distinguished from *F. dao* by the faint transverse line which crosses the subgenital plate near the plate base (Fig. 10). Eggs of the three species are very similar but those of *F. pallida* have a more pointed lid than the eggs of the other species.

Unfortunately, no comparisons can be made between these three species from Vietnam and their Chinese congeners until fresh specimens are available. The following key is offered to assist in distinguishing adults of these three species.

Provisional key to Vietnamese *Flavoperla*

- 1 Head with brown quadrangular area between ocelli extending to M-line (Fig. 6); male hammer curved slightly dorsad at tip (Fig. 9); female subgenital plate broadly rounded, and bearing a faint transverse line near base (Fig. 10) *hmong*
- 1' Head without brown ocellar area (Fig. 1); male hammer straight in lateral aspect (Fig. 4); female subgenital plate variable, but without transverse line near base 2
- 2 Male paraprocts curved forward and hooked apically (Fig. 2); female subgenital plate broadly rounded (Fig. 5) *dao*
- 2' Male paraprocts broad, upright and without apical hook (Fig. 12); female subgenital plate shield shaped with small apical point (Fig. 15) *pallida*

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