

Four New Species of Nemouridae (Plecoptera: Insecta) from Korea

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Key Words:

Nemouridae
Plecoptera
Amphinemura
Protonemura
Nemoura
New species
Korea

Four new nemourid species, *Amphinemura rai* n. sp., *Amphinemura baei* n. sp., *Protonemura villosa* n. sp., and *Nemoura espera* n. sp. are described and illustrated. *Amphinemura rai* n. sp. closely resembles *Amphinemura tragula* (Kimmins) externally, but differs from *Amphinemura tragula* by the projections on male terminalia and the shape of the female subgenital plate. *Amphinemura baei* n. sp. is similar to *A. bulla* Shimizu in body color, size, and structure of male and female terminalia, but distinguished by the ventral sclerites of epiproct, the knobs on the sides of the epiproct, and the shape of paraprocts. *Protonemura villosa* n. sp. is similar to *P. hotakana* Ueno in body color, size, and the structure of terminalia, but distinguished by the epiproctal flagellum and ventral sclerite, the shape of the tenth tergum. Finally, *Nemoura espera* n. sp. is close to *Nemoura alabeli* Zhiltzova in appearance, but differs by the shape and location of the ventral and dorsal sclerites of the epiproct.

The order Plecoptera is a small taxon comprising about 2000 species all over the world and among them Nemouridae is the largest in the number of species and distribution. About 600 species, which is equivalent to 30 percent of the total plecopteran species, were recorded in the Northern hemisphere and Asia.

Larvae of European and American Nemouridae were studied by Hynes (1941), Brink (1949) and Despax (1951), and adults by Ricker (1952), Aubert (1953), Baumann (1975) and Ravizza and Delmatteise (1976, 1979a, b, 1980) in morphology. In particular, the study of Zwick (1973a, b, 1990) contributed to the systematic accomplishment of European and North American Nemouridae. However in Asia, Zhiltzova (1971, 1976, 1979a, b, 1980, 1981a, b, 1982, 1986) examined far East Russian Nemouridae, and Kawai (1954, 1960, 1966, 1968a, b) and Shimizu (1994a, b, 1996, 1998) studied Asian Nemouridae centering on Japan.

Twelve species in three genera were reported from Korea, and seven of them were treated as uncertain species because only their larvae were described and unmatched to adults (Zwick, 1873a; Yoon, 1988; Ham and Lee, 1998). This number is relatively low, in comparison to adjacent countries, 24 species in four genera in far East Russia (Zhiltzova, 1986) and 34 species in three genera in Japan (Kawai, 1976) were recorded.

As a result of a comprehensive study regarding Nemouridae, two species of the genus *Amphinemura*, one species of the genus *Protonemura*, and one species of

the genus *Nemoura* are be added to the Korean fauna of Nemouridae.

Systematic Accounts

Family Nemouridae Newmann, 1853
Subfamily Amphinemurinae Baumann, 1975
Genus *Amphinemura* Ris, 1902

Amphinemura rai n. sp.
(Fig. 1. A-F)

Material examined. Holotype: 1 ♂ (CNU), Donghaksa, Mt. Keryong, 10 May 1998 (S. A. Ham). Paratypes: 1 ♀, same data as holotype; 3 ♂♂, Donghaksa, Mt. Keryong, 8 Jun. 1997 (S. A. Ham).

Description

Male: Body 5.2-6.0 mm long and brown. Forewing 7.6-8.1 mm long, hyaline and with setae along margins. Ninth sternite with a slender vesicle and slightly tapered. Subgenital plate expanded laterally and nearly parabolic, but apex tapered and elongated. Tergite IX elevated in posterior-median part, bearing some short setae posterior on either side near the midline, apex of epiproct covered, and hidden by hind margin. Tergite X with a circular membranous area below epiproct, and several short setae on either side. Paraprocts divided into three lobes: inner lobes fused and forming a broad triangular sclerite at base, then median lobe elongated upward to knob-like projection membranous on outer side; outer lobe linear, extended dorsally and then anteriorly, and lined with the projection, apex of which

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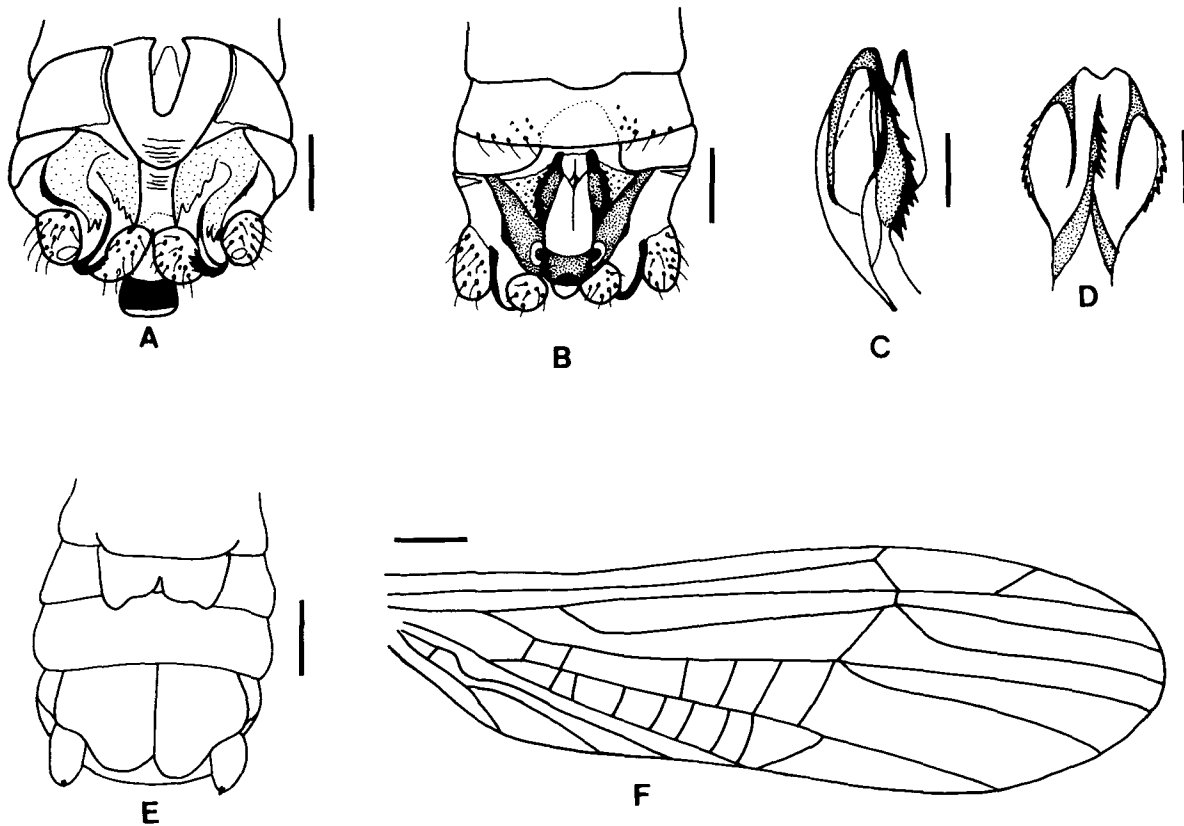


Fig. 1. *Ampinemura rai* n. sp. A, Ventral view of male terminalia. B, Dorsal view of male terminalia. C, Lateral view of epiproct. D, Ventral view of epiproct. E, Ventral view of female terminalia. F, Right forewing. Scale bars=0.1 mm (C, D), 0.2 mm (A, B), 0.3 mm (E), and 1.5 mm (F).

bears several stout setae along the border-line between and sclerotized areas. Cerci conical and weakly sclerotized. Epiproct dorsolaterally flattened, darkly colored along dorsomesal groove, with the area spinulose anterolaterally. Ventral sclerite extended along the mid-line, and bearing some setae anteriorly on the keel.

Female: Body 5.2-6.9 mm long. Forewing 8.9-9.2 mm long. Seventh sternum enlarged, sclerotized and postero-mesal area forming a round pregenital plate. Eighth sternum modified and forming a forked subgenital plate. Subgenital plate dark brown and strongly sclerotized. Ninth and tenth sternum sclerotized and unmodified, covered with many fine hairs. Cerci one-segmented and conic.

Larva: Unknown

Etymology: The specific name, *rai* is named after Dr. C. H. Ra, a Korean taxonomist on Plecoptera.

Remarks: This new species closely resembles *Amphinemura tragula* (Kimmins, 1950) externally, but differs from *A. tragula* by the following characters: (1) In the

male of the new species, a pair of projections with many setae come from both side below epiproct, which recurved to ventral side, while the male of *A. tragula* has no projection on the terminal. (2) The female subgenital plate forks evidently and reaches to anterior part of ninth sternum in the new species but in *A. tragula* it is round and short.

Amphinemura baei n. sp.
(Fig. 2. A-H, 3)

Material examined. Holotype: 1 ♂ (CNU), Donneko, Sug-yipo-si, Jeju-do, 26 May 1996 (Y. J. Bae). Paratypes: 5 ♀ ♀, 8 larvae, same data as holotype.

Description

Male: Body 6.1 mm long and tanned. Head and pronotum unicolored. Three ocelli membranous and compound eyes clear. Antennae dark brown and equivalent with body length. Forewings 8.4 mm long, semitransparent with brown veins vivid, X-mark distinct at right upper part of forewings. Gills on each side of pros-

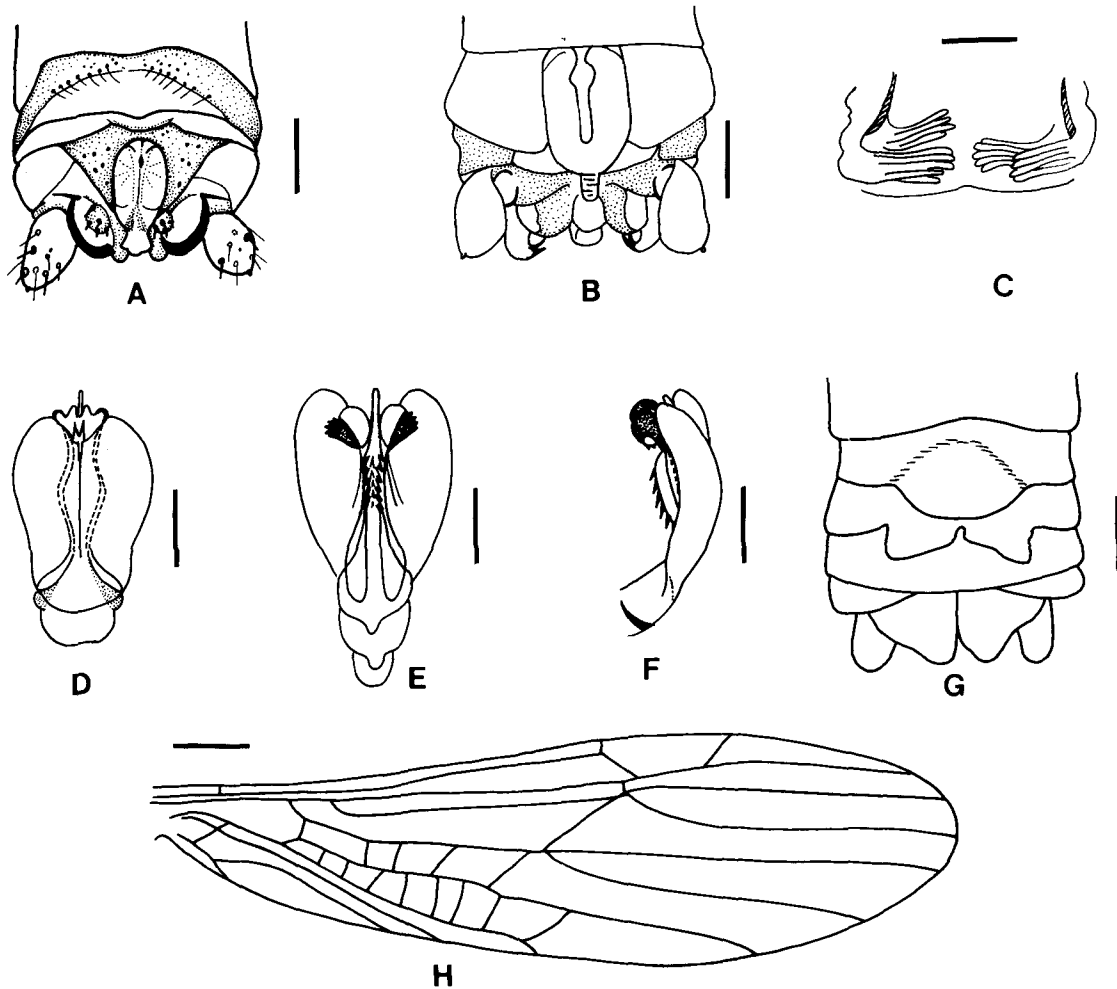


Fig. 2. *Ampinemura baei* n. sp. A, Dorsal view of male terminalia. B, Ventral view of male terminalia. C, Gills. D, Dorsal view of epiproct. E, Ventral view of epiproct. F, Lateral view of epiproct. G, Ventral view of female terminalia. H, Right forewing. Scale bars=0.15 mm (D, E, F), 0.3 mm (A, B, C), 0.35 mm (G), and 1.5 mm (H).

ternum, branched into several twigs, each gill divided by prosternal sclerite and distinctive. Seventh and eighth terga modified with many fine hairs, ninth tergum with several long setae on posterior margin, ninth sternum with long vesicle on the hypoproct, the middle part of hypoproct extended to tenth segment. Tenth sternum modified to form paraprocts. Paraprocts divided into three lobes: inner lobes small and sclerotized lightly, median lobes sclerotized and covered with short hairs and outer lobes elongated and recurved dorsally alongside cerci, outer part sclerotized with one stout spines at tip and inner part membranous with smooth fine hairs, seen dorsally rather than ventrally. Tenth tergum modified to form the part of an inverted triangle with setae, bearing epiproct on the middle and in particular being out a hump covered with several setae on each of epiproct. Epiproct curved dorsally, round and elongated longitudinally, symmetrical bilaterally and dorsal sclerite large and narrow at base, lightly sclerotized and with lateral arms on lateral edges and

ventral sclerite broad at base and much narrower to apex, in the middle forming keel-shape ridge with several spines, bearing triangular plate on ventral aspect of apex, crooked inwardly in lateral view and outer margin serrated. Cerci unmodified with many fine setae.

Female: Body 5.9-7.9 mm long and tan, forewings 5.9-7.9 mm long; 7th sternum enlarged medially and heavily sclerotized, the postero-mesal area forming a semicircular pregenital plate and extended into 8th segment. 8th sternum modified and forming a bifid subgenital plate. Subgenital plate dark brown and strongly sclerotized. 9th and 10th sternum sclerotized and unmodified, covered with many fine hairs. Cerci one-segmented and unmodified.

Larva: Body 5.8-7.6 mm long. Gills on each side of prosternum, one stalk arising inside and the other stalk arising outside of lateral prosternal sclerite, arising from each stalk and branched in buster-form, also in

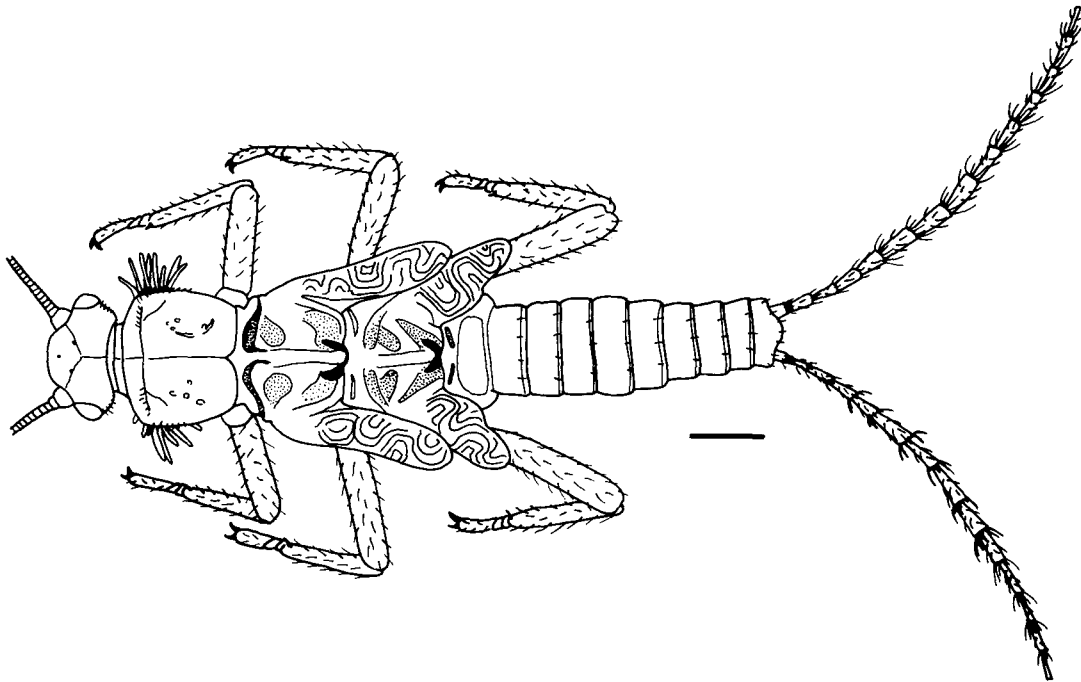


Fig. 3. *Ampinemura baei* n. sp. Larva in dorsal view. Scale bar=9 mm.

dorsal aspects, branched gills easily seen. Wing pads black and extended outwardly, in mature larva the pattern of folded vein obvious.

Etymology: The specific name, *baei*, is named after Prof. Y. J. Bae (Seoul Women's University) who donated the specimens.

Remarks: This species is similar to *A. bulla* (Shimizu, 1996) in body color, size, and the structure of male and female terminalia, but distinguished as follows. (1) This species has epiproct without flagellum but *A. bulla* with slender flagellum at the apex. (2) The epiproctal knobs bear sclerotized triangular plates on ventral aspect of apex, while *A. bulla* has no such knobs. (3) The shape of paraprocts modified into sub-paraprocts, but it is simple in *A. bulla*.

Genus *Protonemura* Kempny, 1898

Protonemura villosa n. sp.
(Fig. 4. A-F)

Material examined. Holotype: 1 ♂ (CNU), Sungbul-sa, Gwangyang-si, Chollanam-do, 21 Oct. 1990 (J. S. Kim). Paratypes: 1 Larva. same data as holotype; 2 ♂ ♂, Mt. Baekun, Gwangyang-si, Chollanam-do, 27 May 1997 (S. A. Ham); 1 ♂, Mt. Mudung, Kwangju-si, Chollanam-do, 18 Jun. 1998 (S. A. Ham).

Description

Male: Body brown and 7.4 mm long except the length

of antennae and cerci. Head light brown. Prothorax dark brown with irregular pattern and body covered with many short, distinctive hairs. Forewings 8.5 mm long and hyaline, venation yellow and X-mark distinct. Prosternal gills three: one on inner side and two on outer side separated by prosternal sclerite and finger-form in shape.

Seventh and eighth terga with many stout setae on median part and unmodified. Ninth tergum with stout setae on side of median and modified, ninth sternum with vesicle on the hypoproct, middle part of hypoproct extended to tenth sternum which modified to form paraprocts. Paraprocts divided into three lobes: inner lobes small and sclerotized lightly; median lobes sclerotized and covered with short hairs and outer lobes elongated, recurved dorsally alongside cerci, and bearing several long spines at tip.

Tenth tergum forming concave, with many stout setae alongside each side and modified. Epiproct recurved, not extended to ninth tergum and symmetrical bilaterally. Dorsal sclerite large and narrow at base and strongly sclerotized lateral arms on the lateral edges. Ventral sclerite broad at base, much narrower to apex and in the middle forming keel-shape ridge with many long spines on the triangular region.

Female: Unknown

Larva: Body 7.3 mm long and deep brown. Posterior margin of compound eye with short spines. Prosternal gills finger-like in shape and three, one on inner and two on outer. Prothorax rectangular with setae along

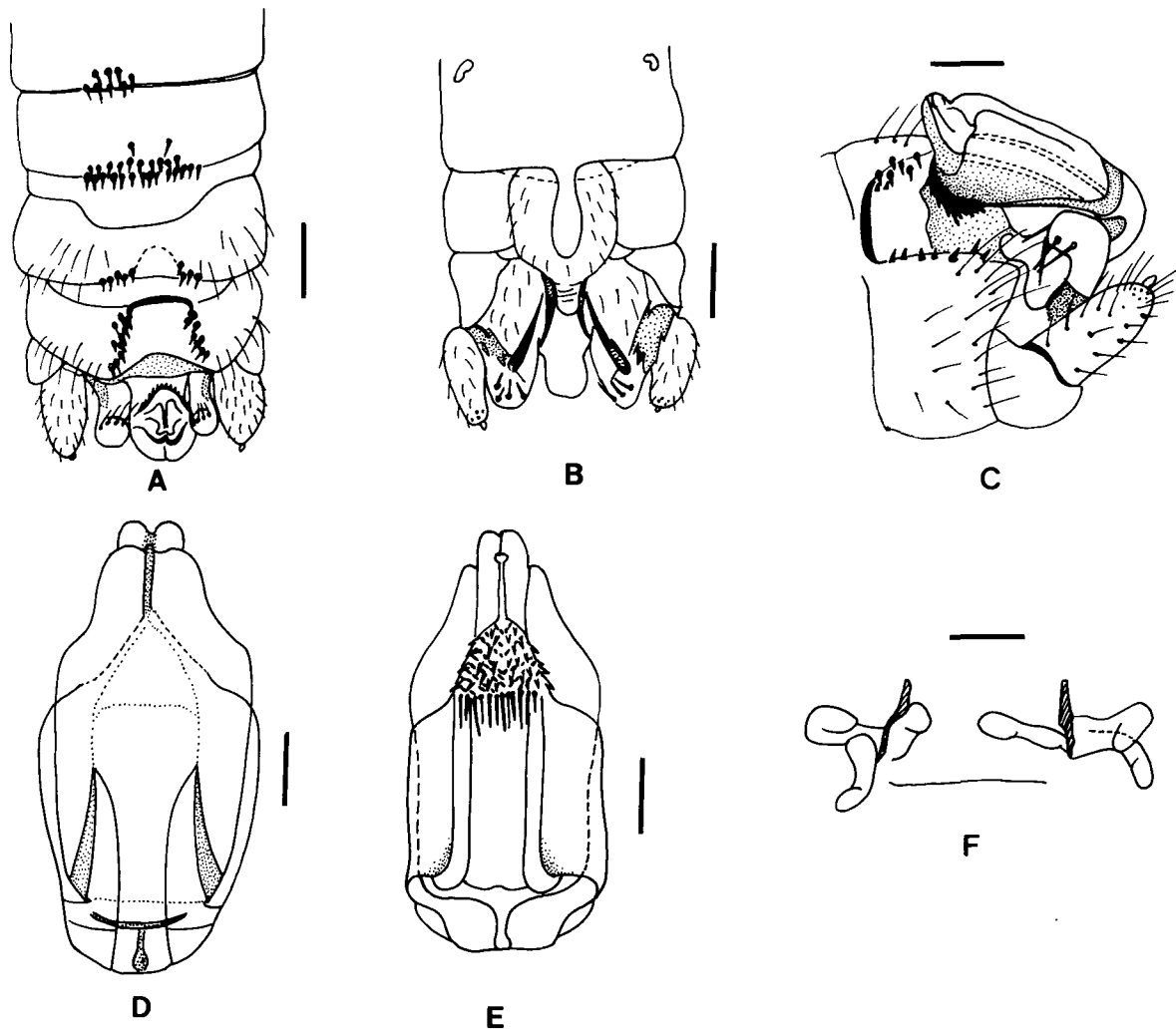


Fig. 4. *Protonemura villosa* n. sp., male. A, Dorsal view of male terminalia. B, Ventral view of male terminalia. C, Lateral view of male terminalia. D, Dorsal view of epiproct. E, Ventral view of epiproct. F, Gills. Scale bars=0.2 mm (D, E), 0.32 mm (A, B, C), and 0.35 mm (F).

fringes and in particular 5-6 spines on corners. Wing-pads extended outwardly. Mesothorax and metathorax with many setae anteriorly. Each abdominal segment with 2-3 long setae along posterior fringe.

Etymology: The specific name *villosa* (L. *villus*, shaggy hair) refers to the shape of ventral sclerite with long spines of epiproct.

Remarks: This new species is similar to *P. hotakana* (Ueno, 1931) in body color, size, and the structure of terminalia, but distinguished from *P. hotakana* in the following aspects. (1) Epiproct of *P. hotakana* has flagellum but the new species does not. (2) In the new species, 10th tergum concaved with many stout setae along each side and ventral sclerite of epiproct bears many long spines on the triangular region, but in *P. hotakana* without stout setae on 10th and without long spines on the region of epiproct.

Subfamily Nemourinae Newmann, 1853
Genus *Nemoura* Latreille, 1796

Nemoura espera n. sp.
(Fig. 5. A-G)

Material examined. Holotype: 1 ♂ (CNU), Won-ri, Buk-myun, Hwasun-gun, Chollanam-do, 14 Mar. 1998 (S. A. Ham). Paratypes: 3 ♂ ♂, same data as holotype; 2 ♂ ♂, Won-ri, Buk-myun, Hwasun-gun, Chollanam-do, 8 Apr. 1997 (S. A. Ham).

Description

Male: Body 7.2-8.8 mm long and forewings 9.5-11 mm long. Antennae, head, and prothorax dark brown. Wings semitransparent, veins brown and evident. Ninth sternum with hypoproct on median sclerotized and terminal protruded to 10th sternum. Tenth sternum modified into bilobed paraprocts, inner lobes small, hidden by

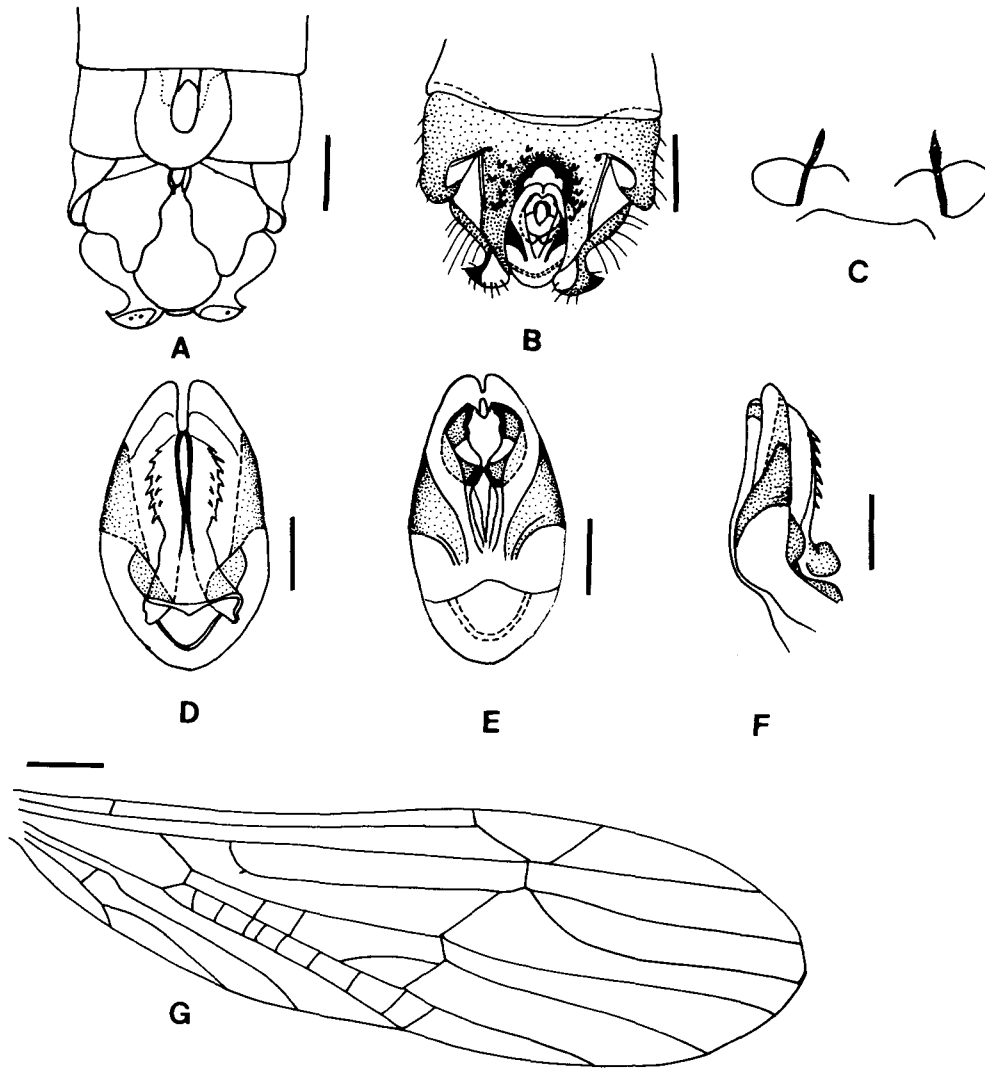


Fig. 5. *Nemoura esepa* n. sp., male. A, Ventral view of male terminalia. B, Dorsal view of male terminalia. C, Gills. D, Ventral view of epiproct. E, Dorsal view of epiproct. F, Lateral view of epiproct. G, Right forewing. Scale bars=0.3 mm (A, B, C), 0.2 mm (D, E, F), and 1.2 mm (G).

hypoproct and outer lobes large and black, strongly sclerotized and elongated alongside cerci. Vesicle present. Cerci strongly sclerotized except inner part and terminal curved outwardly with a sharp-pointed prong, short hairs scattered at apex, the remainder with long hairs. Ninth tergum unmodified and covered with fine hairs. Tenth tergum heavily sclerotized and modified into the region of reverse-diamond in shape on center, diamond region with many stout spines, except a central, membranous part. Epiproct lemon-like in shape and recurved to dorsum completely, apex rounded, recurved and bilaterally symmetrical, dorsal sclerite large and broad at base of epiproct, extending dorso-laterally, becoming narrow around lateral knobs and then very large and triangular, usually completely covering lateral aspects of epiproct, part of ventral aspect, most darkly sclerotized areas at base and near dorsoposterior margin immediately ahead of basal

cushion, anterior area usually lightly sclerotized but bearing spines in some species, basal sclerites as two large, broad, triangular or rectangular patches located near basolateral corners of epiproct, ventral sclerite darkly sclerotized, broad at base, with lateral knobs at basolateral corners, becoming narrower toward apex, forming parallel ridges, one on each side of midline, each bearing a row of spines, usually covered by dorsal sclerite near tip of epiproct, extending upward to dorsal surface, visible portion paired, quite variable in shape and often bearing spines or hooks.

Female: Unknown

Larva: Unknown

Etymology: The specific name, *esepa*, is named after the shape of epiproct in ventral view.

Remarks: This new species is close to *Nemoura alabeli* (Zhiltzova, 1976) seemingly in appearance, but distinguished by the shape and location of the ventral and dorsal sclerites of epiproct. In the new species 10th tergum modified to form the region of a reverse-diamond in shape on center and especially the region bears many stout spines except a central membranous part, but *N. alabeli* has the reverse-diamond without any spines and any membranous part on the center.

Acknowledgements

We thank T. Shimizu, Aqua Restoration Research Center (Japan), who helped us to determine the new species, and Prof. Y. J. Bae of Seoul Women's University. This study was supported partly by the Korean Research Foundation (1998).

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[Received March 30, 1999; accepted April 23, 1999]