

One New Species and Four New Records of Caddisflies (Insecta: Trichoptera) from the Korean Peninsula

Sun Jin Park¹, Shu Inaba², Takao Nozaki³, Dongsoo Kong^{1,*}

¹Department of Life Science, Kyonggi University, Suwon 16227, Korea

²3-Chome 3-20, Shimoda-shi, Shizuoka 415-0023, Japan

³3-16-15, Midorigaoka, Ninomiya-machi, Kanagawa 259-0132, Japan

ABSTRACT

Adult caddisflies were collected from 11 sites in Cheongdo-gun (Gyeongsangbuk-do) and Miryang-si (Gyeongsangnam-do) in the southeastern part of the Korean Peninsula. Collections on August 28 to 30, 2015, by aerial sweeping and light trapping, included one new species and four newly recorded species from the Korean Peninsula. Description of the new species *Paduniella unmun* Inaba and Park (Psychomyiidae), and re-description of the four species (*Polyplectropus malickyi* Nozaki et al., 2010, *Tinodes furcatus* Li and Morse, 1997, *Cheumatopsyche tanidai* Oláh and Johanson, 2008, and *Diplectronea kibuneana* Tsuda, 1940) are provided. Additionally, we recognize that a larva described as *Diplectronea* KUa is the larval stage of *D. kibuneana*.

Keywords: Trichoptera, new species, new Korean records, Korea

INTRODUCTION

Collecting sites (Cheongdo-gun, Gyeongsangbuk-do and Miryang-si, Gyeongsangnam-do) are located in the southeastern part of the Korean Peninsula. These areas include high mountains and clean streams. Collecting sites (Fig. 1) are well conserved and far from human habitation except summer recreational activity. The collecting sites in Unmun are located near the Korean Ecological and Scenery Conservation Area of Mt. Unmun, and the sites in Miryang are close to the Ice Valley (Eoreumgol) where ice forms during hot summer months (June–August) and melts after August. Although these areas supposedly have diverse and endemic fauna, little study of adult caddisflies has occurred there. Thus, we started to survey the caddisfly fauna of these areas. In the course of study, we found one new species, and four newly recorded species from the Korean Peninsula. In this paper, we describe or redescribe these species. In addition, information of a larva described as *Diplectronea* KUa by Yoon and Kim (1988) is included.

MATERIALS AND METHODS

Eleven sites were sampled from August 28 to 30, 2015. Locality and date are shown in Table 1 with localities numbered.

Aerial sweeping was used during daytime hours and light trapping for 2–3 hours after dusk. UV pan light traps (12LED-1W) were used all night for microhabitats where it is hard to use screen type light traps.

Most specimens are preserved in 80% alcohol, but a paratype of *Paduniella unmun* was mounted in Euparal on a microscope slide. The type voucher specimens and newly recorded Korean species will be deposited in the National Institute of Biological Resources (NIBR), Incheon, Korea. Other specimens used in this study are deposited in Kyonggi University, Suwon, Korea and the personal collections of S. J. Park, Suwon, Korea and S. Inaba, Shizuoka, Japan.

The number of males and/or females, and locality numbers (Table 1) are provided. Morphological terminology is indicated in the figure legends.

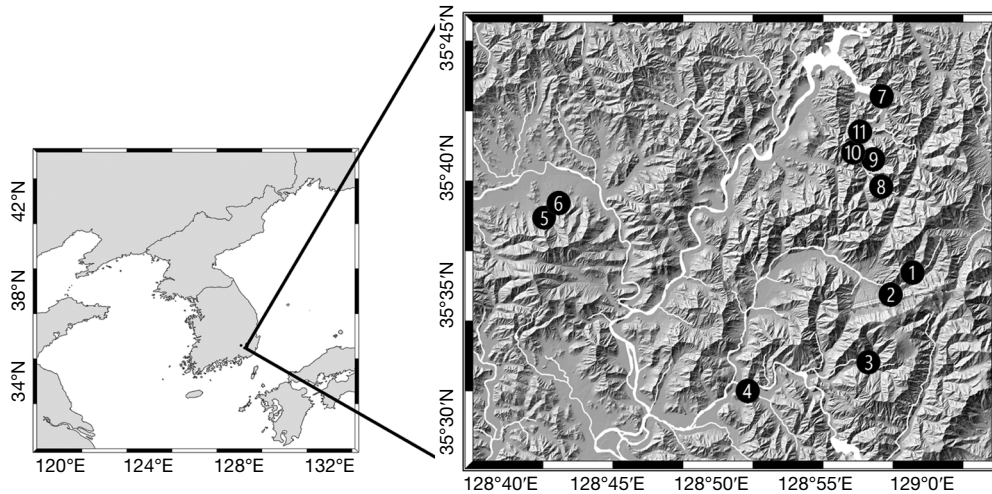


Fig. 1. Map showing sampling sites, Miryang and Cheongdo, Korea.

Table 1. Collection localities and sampling dates

Loc. No.	Localities	Latitude/longitude (elevation)	Date	Collector
1	Hobakso Valley, Gaji Mt., Nammyeong-ri, Sannae-myeon, Miryang-si, Gyeongsangnam-do	35°35'15.7"N, 128°59'47.8"E (386 m)	28 Aug 2015	Inaba S, Park SJ
2	Ice Valley, Nammyeong-ri, Sannae-myeon, Miryang-si, Gyeongsangnam-do	35°34'39.2"N, 128°58'58.2"E (345 m)	28 Aug 2015	Inaba S, Park SJ
3	Pyochungsa Temple, Gucheon-ri, Danjang-myeon, Miryang-si, Gyeongsangnam-do	35°31'54.8"N, 128°57'34.2"E (183 m)	29 Aug 2015	Inaba S, Park SJ
4	Small creek along the Road 1077, Taeryong-ri, Danjang-myeon, Miryang-si, Gyeongsangnam-do	35°30'56.9"N, 128°51'53.4"E (41 m)	29 Aug 2015	Inaba S, Park SJ
5	Small creek under a small bridge, Namsan Valley, Dongcheon-ri, Hwayang-eup, Cheongdo-gun, Gyeongsangbuk-do	35°38'13.1"N, 128°42'42.0"E (195 m)	29 Aug 2015	Inaba S, Park SJ
6	Namsan Valley, Dongcheon-ri, Hwayang-eup, Cheongdo-gun, Gyeongsangbuk-do	35°37'59.1"N, 128°42'26.1"E (249 m)	29 Aug 2015	Inaba S, Park SJ
7	Ojin-1 bridge, Ojin-ri, Unmun-myeon, Cheongdo-gun, Gyeongsangbuk-do	35°42'13.9"N, 128°58'19.3"E (170 m)	30 Aug 2015	Inaba S, Park SJ
8	Sariam, Sinwon-ri, Unmun-myeon, Cheongdo-gun, Gyeongsangbuk-do	35°38'49.3"N, 128°58'18.7"E (260 m)	30 Aug 2015	Inaba S, Park SJ, Kwon SJ
9	Small stream, Unmunsa Temple, Sinwon-ri, Unmun-myeon, Cheongdo-gun, Gyeongsangbuk-do	35°39'57.0"N, 128°57'39.4"E (212 m)	30 Aug 2015	Inaba S, Park SJ
10	Unmunsa Temple, Sinwon-ri, Unmun-myeon, Cheongdo-gun, Gyeongsangbuk-do	35°40'5.6"N, 128°57'26.7"E (218 m)	30 Aug 2015	Inaba S, Park SJ
11	Unmun Camping Area, Sinwon-ri, Unmun-myeon, Cheongdo-gun, Gyeongsangbuk-do	35°40'42.6"N, 128°57'29.0"E (199 m)	30 Aug 2015	Inaba S, Park SJ

SYSTEMATIC ACCOUNTS

Order Trichoptera Kirby, 1813
 Family Polycentropodidae Ulmer, 1903
 Genus *Polyplectropus* Ulmer, 1905

¹**Polyplectropus malickyi* Nozaki, Katsuma and Hattori, 2010 (Fig. 2)

Polyplectropus malickyi Nozaki, Katsuma and Hattori, 2010: 239–241, figs. 3a–g, 5a–c.

Material examined. 1 ♀, Loc. 2; 3 ♂ 17 ♀, Loc. 3; 3 ♀, Loc.

Korean name: ¹*말리키깃날도래 (신칭)

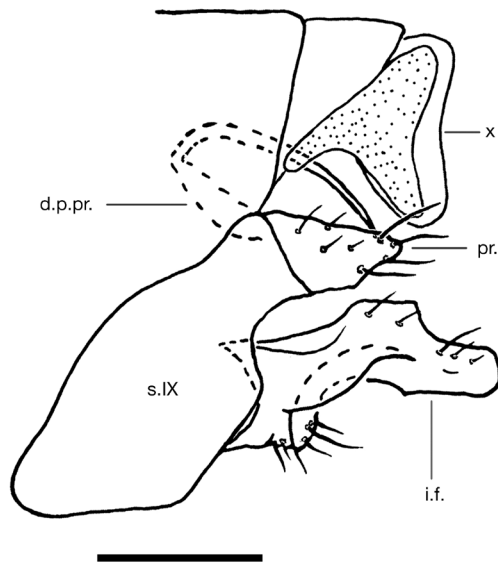


Fig. 2. Male genitalia of *Polyplectropus malickyi*. Left lateral. X, segment X; d.p.pr., dorsobasal process of preanal appendage; i.f., inferior appendage; s.IX, sternum IX; pr., preanal appendage. Scale bar=0.1 mm.

8; 1 ♀, Loc. 10.

Description. Male genitalia (Fig. 2). Sternum IX (s.IX) with square projection posterodorsally in lateral aspect. Segment X (X) triangular in lateral aspect, mostly membranous, but sclerotized laterally. Preanal appendages (pr.) short, triangular in lateral aspect, apex blunt in lateral aspect. Dorsobasal process of preanal appendage (d.p.pr.) slender, bent posteriorly at 2/5th distance from base; acute. Inferior appendage (i.f.) long, curved ventrad at midlength in lateral aspect, curved mesad in ventral aspect, apex dark pigmented.

Distribution. Korea, Japan (Honshu).

Remarks. This species is new to the Korean Peninsula. Nozaki et al. (2010) described the male and female of this species from Japan (Honshu), and the specimens examined in this study are identical. The male can be distinguished from other Korean *Polyplectropus* species by the short triangular preanal appendages in lateral aspect.

Family Psychomyiidae Walker, 1852

Genus *Paduniella* Ulmer, 1913

¹**Paduniella unmun* Inaba and Park sp. nov. (Fig. 3)

Material examined. Holotype, ♂, in alcohol, Korea: Gyeongsangbuk-do, Cheongdo-gun, Unmun-myeon, Sinwon-ri, Unmunsa Temple (35°40'5.6"N, 128°57'26.7"E), 30 Aug

2015, Inaba S, Park SJ, light pan trap, NIBR. Paratype, 1 ♂, mounted on microscopic slide, Korea: Gyeongsangbuk-do, Cheongdo-gun, Unmun-myeon, Sinwon-ri, Sariam (35°38'49.3"N, 128°58'18.7"E), 30 Aug 2015, Inaba S, Park SJ, Kwon SJ, light pan trap, NIBR.

Diagnosis. The shape of the superior appendages and two long median processes is similar to *Paduniella bilobata* Li and Morse, 1997. However, this species can be distinguished from that of *P. bilobata* by the following characters: Each superior appendage is about four times as long as the width in lateral aspect in this species, only twice as long as the width in *P. bilobata* (Li and Morse, 1997a, fig. 13); apicodorsal margin of each superior appendage in lateral aspect is slightly curved upward in this species, which is deeply curved with acute spine-like apex in *P. bilobata* (Li and Morse, 1997a, fig. 13; Yang, personal communication); each superior appendage has a blunt apicomesal lobe in this species, the lobe is vestigial in *P. bilobata* (Yang, personal communication); and two long, medial, sinuate processes directed posterad in this species, but curved ventrad in *P. bilobata* (Li and Morse, 1997a, fig. 13).

Description. Specimens in alcohol yellowish brown, forewings 2.7–2.9 mm long (n=2).

Male genitalia (Fig. 3). Tergum IX (t.IX) in dorsal aspect produced posteriorly as triangular lobe. Sternum IX (s.IX) in ventral aspect rectangular, anterior margin slightly convex mesally; in lateral aspect ventral part rectangular, each dorso-lateral part produced anterodorsally. Sclerotized strips (s.s.) of segment IX very narrow in lateral aspect. Each superior appendage (s.a.) with length about four times width in lateral aspect, with acute apex and blunt apicomesal lobe. Inferior appendages (i.f.) expanded distally, each with truncate apex in ventral aspect; mesal branch of each inferior appendage (m.b.i.f.) thumb-like in lateral aspect, apex extended ventromesad, with several short setae mesally. Two median processes (m.p.) long, sinuous in dorsal and lateral aspects, directed posterad; right process slightly shorter than left one, with several tiny spines on right lateral surface 1/5th to 2/5th of distance from base; left process extended posteriorly, slightly beyond tergum IX, without tiny spines. Phallicata (phc.) compressed laterally, very narrow in middle in lateral aspect; apex broad in lateral aspect, slightly expanded with median notch in ventral aspect; phallobase (phb.) as long as phallicata. Pair of parameres (para.) arising from base of phallicata dorsally, spine-like, straight, with acute apex.

Female. Unknown.

Etymology. The specific name refers to the name of the area where this species was collected.

Distribution. Korea.

Korean name: ¹*운문통날도래 (신칭)

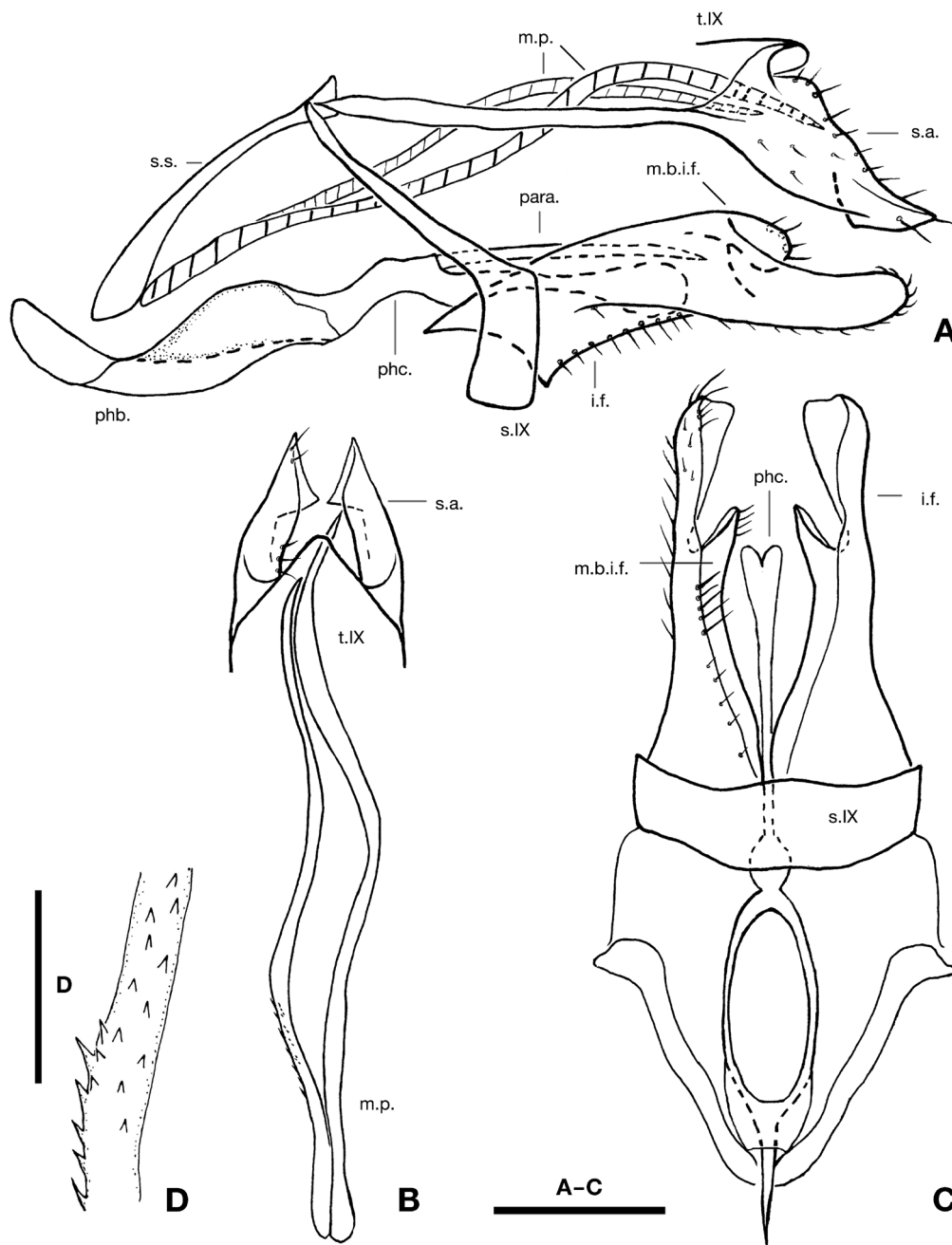


Fig. 3. Male genitalia of *Paduniella unmun*. A, Left lateral; B, Dorsal; C, Ventral; D, 1/5th to 2/5th distance from base of right median process, right lateral. i.f., inferior appendage; m.b.i.f., mesal branch of inferior appendage; m.p., median process; para., paramere; phb., phallobase; phc., phallicata; s.a., superior appendage; s.IX, sternum IX; s.s., sclerotized stripes; t.IX, tergum IX. Scale bars: A-C=0.1 mm, D=0.05 mm.

Genus *Tinodes* Curtis, 1834

¹**Tinodes furcatus* Li and Morse, 1997 (Fig. 4A)

Tinodes furcatus Li and Morse, 1997b: 278, figs. 7–9.

Material examined. 1♂, Loc. 1; 6♂, Loc. 3.

Description. Male genitalia (Fig. 4A). Tergum IX (t.IX) long, oval in lateral aspect, rectangular in dorsal aspect. In lateral aspect, sternum IX (s.IX) with ventral part triangular with

Korean name: ¹*갈래통날도래 (신칭)

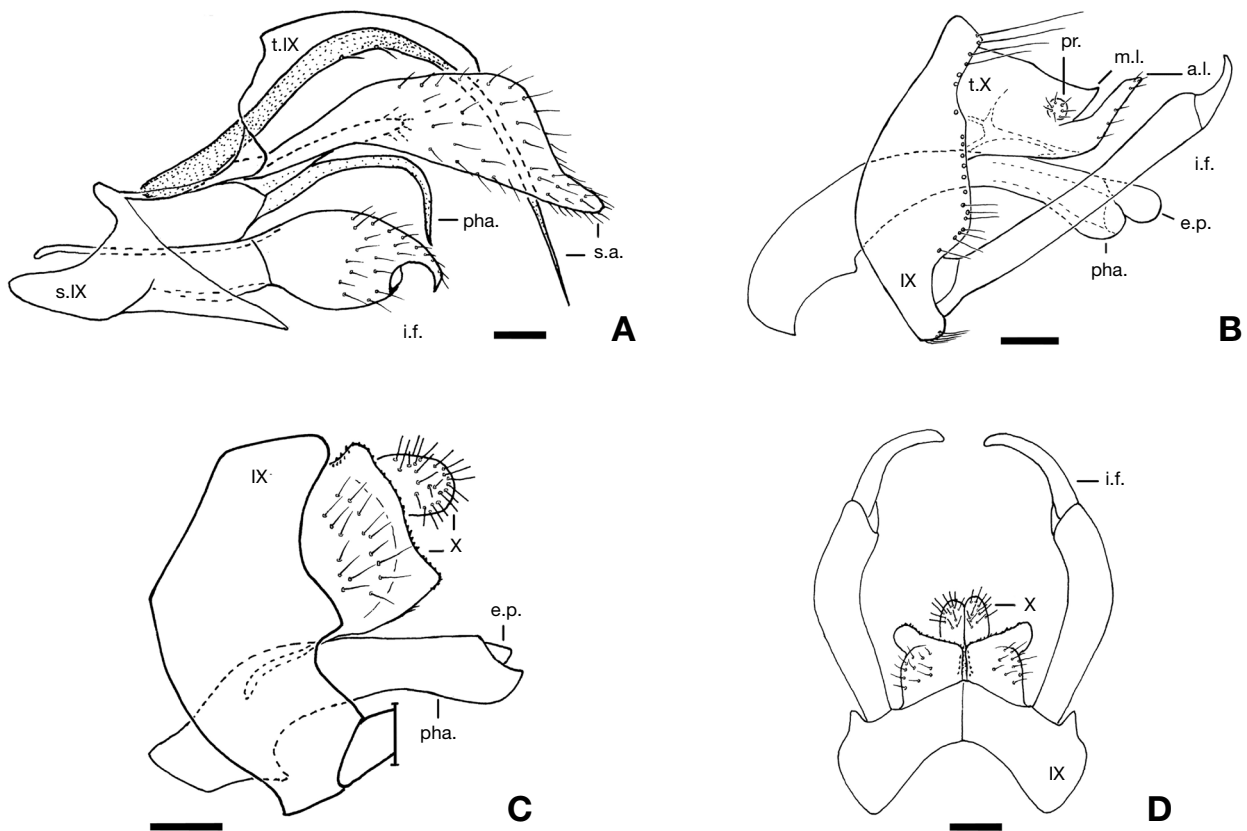


Fig. 4. Male genitalia. A, *Tinodes furcatus*, left lateral; B, *Cheumatopsyche tanidai*, left lateral; C, *Diplectrona kibuneana*, left lateral; D, *Ibid.*, dorsal. IX, segment IX; X, segment X; a.l., apicolateral lobe; e.p., endothecal process; i.f., inferior appendage; m.l., median lobe; s.a., superior appendage; s.IX, sternum IX; pha., phallus; pr., preanal appendage; t.IX, tergum IX; t.X, tergum X. Scale bars: A–D=0.1 mm.

concaved anterior margin; dorsal part narrow, posterior margin acute. Superior appendages (s.a.) forked; dorsal branch strongly sclerotized, slender, curved ventrad, with acute apex; ventral branch in lateral aspect narrow basally, middle part wide, tapering posteroventrally. Inferior appendages (i.f.) oval in lateral aspect; with claw-like lobe posterodorsally, distal segment absent. Phallus (pha.) slender, spine-like, curved ventrad at midlength.

Distribution. Korea, China (Jiangxi), Kazakhstan.

Remarks. The genus and species are new records for the Korean Peninsula. This species was described using male specimens collected from China (Hu-bei, Jiangxi, Si-chuan) by Li and Morse (1997b). Although each superior appendage examined in this study is slightly wider in lateral aspect than that illustrated in the original description, other genitalic characters of Korean males agree with those provided by Li and Morse (1997b).

Family Hydropsychidae Curtis, 1835

Genus *Cheumatopsyche* Wallengren, 1891

¹**Cheumatopsyche tanidai* Oláh and Johanson, 2008
(Fig. 4B)

Cheumatopsyche tanidai Oláh and Johanson, 2008: 184–185, figs. 303–306.

Material examined. 1♂⁹♀, Loc. 4; 1♂¹♀, Loc. 5; 4♂⁷♀, Loc. 7; 2♂⁷♀, Loc. 10; 4♀, Loc. 11.

Description. Male genitalia (Fig. 4B). Segment IX (IX) narrow in lateral aspect. Tergum X (t.X) trilobed in dorsal aspect, with pair of ovoid preanal appendages (pr.) apicolaterally; posterior margin of median lobe (m.l.) pointed in lateral aspect; pair of apicolateral lobes (a.l.) slender in lateral aspect, each apex higher than median lobe in lateral aspect. Inferior appendages (i.f.) each with basal segment long; apical segment short, finger-like, each apex curved upward in

Korean name: ¹*타니다꼬마줄날도래 (신칭)

lateral aspect. Phallus (ph.) simple, gently curved ventrad. Endothelial processes (e.p.) long ovoid, about 1/2 width of phallothecal apex in lateral aspect.

Distribution. Korea, Japan.

Remarks. This species is recorded from the Korean Peninsula for the first time. Oláh and Johanson (2008) described this species using a male specimen collected from Japan (Kyoto, central Honshu). This species is similar to *Cheumatopsyche brevilineata* (Iwata, 1927) and *C. infascia* Martynov, 1934, both occurring in Korea, but can be distinguished from the latter two species by the shape of Xth abdominal segment and phallus. In lateral aspect, apicolateral lobes of Xth segment are longer and more slender than those of the latter two species. In this species, the endothelial processes are about 1/2 the width of the phallothecal apex. The endothelial process are approximately the same width as the phallothecal apex in *C. brevilineata* and slightly narrower than the phallothecal apex in *C. infascia*.

Genus *Diplectrona* Westwood, 1840

¹**Diplectrona kibuneana* Tsuda, 1940 (Fig. 4C, D)

Diplectrona kibuneana Tsuda, 1940: 24–25, 33, figs. 1–2.

Diplectrona KUa Yoon and Kim, 1988: 462, fig. 12.

Material examined. 9♂3♀, Loc. 1; 10♂3♀, Loc. 2; 15♂6♀, Loc. 3; 1♂2♀, Loc. 5; 3♀, Loc. 6; 2♀, Loc. 9.

Description. Male genitalia (Figs. 4C–4D). Segment IX (IX) with anterior margin convex in lateral aspect. Segment X (X) with pair of apical lobes; each lobe long, oval in dorsal aspect, setose, touching mesally; pair of lateral lobes short, rectangular in lateral aspect, posterior margins lined with small spines, projected outward in dorsal aspect. Preanal appendages indistinct, represented by setose area on lateral lobe of segment X. Inferior appendages (i.f.) each with basal segment bent slightly mesad in dorsal aspect; apical segment about 1/2 length of basal segment, curved mesad in dorsal aspect. Phallus (pha.) short, simple; apex scoop-like in lateral aspect, with pair of short endothelial processes (e.p.).

Distribution. Korea, Japan.

Remarks. This is the first adult record of this genus from the Korean Peninsula. Although the genus *Diplectrona* has been reported from Korea, the record was based on an unidentified larva (Yoon and Kim, 1988). *Diplectrona kibuneana* was described from Japan (Kyoto, central Honshu) by Tsuda (1940), and is widespread there (Nozaki, 2016). Korean males and females examined in this study are identical to the Japanese material. Additionally, the larva described as

Diplectrona KUa by Yoon and Kim (1988) and the larva of *Diplectrona kibuneana*, originally described as *Diplectrona* sp. DB by Akagi (1956) in Japan, were found to be the same.

ACKNOWLEDGMENTS

We thank Mr. David E. Ruitter for critical reading of our manuscript. We are also grateful to Prof. L. Yang, Nanjing Agricultural University, Nanjing, for providing precise genital characteristics of paratypes of *Paduniella bilobata* and valuable suggestions on our description of *Paduniella unmun* sp. nov., and Dr. SJ Kwon for his help on collecting at Sariam, Unmun Temple. This work was supported by a grant from the National Institute of Biological Resources (NIBR), funded by the Ministry of Environment (MOE) of the Republic of Korea (NIBR201601203).

REFERENCES

- Akagi I, 1956. Miyama-shima-tobikera-zoku youchu no kenkyu [Study on larvae of the genus *Diplectrona*]. Kansai Shizenkagaku Kenkyu-kai Kaishi, 9:23–25 (in Japanese).
- Iwata M, 1927. Nihon-san moshi-moku yochu (Trichoptera larvae from Japan). Zoological Magazine, Tokyo, 39:209–272 (in Japanese).
- Li YJ, Morse JC, 1997a. The *Paduniella* (Trichoptera: Psychomyiidae) of China, with a phylogeny of the world species. Insecta Mundi, 11:281–299.
- Li YJ, Morse JC, 1997b. *Tinodes* species (Trichoptera: Psychomyiidae) from The People's Republic of China. Insecta Mundi, 11:273–280.
- Martynov AV, 1934. Tableaux Analytiques de la Faune de l'URSS, 13: Rucheyniki, Trichoptera, Annulipalpia, I. Institute Zoologique de l'Académie des Sciences, Leningrad, pp. 1–343 (in Russian).
- Nozaki T, 2016. A catalogue of Japanese Trichoptera Family Hydropsychidae Curtis. Accessed 8 Jul 2016, <<http://tobikera.eco.coocan.jp/catalog/Hydropsychidae.html>>.
- Nozaki T, Katsuma N, Hattori T, 2010. Redescription of *Polyplectropus protensus* Ulmer, 1908 and description of two new *Polyplectropus* species from Japan (Trichoptera, Polycentropodidae). Denisia, 29:235–242.
- Oláh J, Johanson KA, 2008. Generic review of Hydropsychinae, with description of *Schmidopsyche*, new genus, 3 new genus clusters, 8 new species groups, 4 new species clades, 12 new species clusters and 62 new species from Oriental and Afrotropical regions (Trichoptera: Hydropsychidae). Zootaxa, 1802:1–248.
- Tsuda M, 1940. Zur kenntnis der Japanischen Hydropsychiden

Korean name: ¹*산골줄날도래 (신칭)

(Trichoptera). *Annotationes Zoologicae Japonenses*, 19: 23-34.

Yoon IB, Kim KH, 1988. VI. Order Trichoptera. In: *Illustrated encyclopedia of fauna and flora of Korea*, Vol. 30, Aquatic insects (Ed., Yoon IB). Ministry of Education of Korea,

Seoul, pp. 430-551 (in Korean).

Received August 16, 2016
Revised December 17, 2016
Accepted December 19, 2016