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Identification of the larval stage of *Micrasema hanasense* Tsuda based on laboratory rearing and *Triplectides misakianus* (Matsumura) new to the Korean Peninsula (Trichoptera: Brachycentridae, Leptoceridae)

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Immature and adult stages of *Micrasema hanasense* Tsuda, 1942 belonging to the family Brachycentridae previously known as *Micrasema* KUa were successfully associated based on laboratory larval rearing experiments. In addition, members of the genus *Triplectides* Kolenati, 1859 belonging to the family Leptoceridae have not been previously recorded in the Korean Peninsula. Here, the genus and the species of *Triplectides misakianus* (Matsumura, 1931) are recorded from the Korean Peninsula for the first time. Moreover, the mature larva of *M. hanasense* is redescribed in detail and illustrated, accompanied by habitus photographs. Diagnostic characters of both taxa, including line-drawing of morphological characters, wing venation, and habitat information, are provided.

Keywords: caddisflies, Korea, *Micrasema*, new record, taxonomy, *Triplectides*

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Introduction

There have been 86 species (including 17 species in the Palearctic region) of the genus *Micrasema* belonging to the family Brachycentridae, and 100 species (including one species in Palearctic region) of the genus *Triplectides* belonging to the family Leptoceridae found in the world (Morse, 2023).

Two species, *M. gelidum* McLachlan and *M. hanasense* Tsuda, of the genus *Micrasema*, which is in the family Brachycentridae, have been known in the Korean Peninsula (Hwang *et al*., 2021). According to Yoon (1988), they provided the informal epithet as *Micrasema* KUa based on the larval morphological characters. However, the larval types have not been associated with adult stages. We collected the larvae of *Micrasema* from the high mountain streams in the Korean national park and successfully reared them into adults in the laboratory. The larvae of the genus *Micrasema* are characterized by combination of the following characters: ventral apotome of head wider than long, without prosternal horn; transverse ridge extended to edge of pronotum; a pair of plates on mesonotum; mesonotal sa1 with many setae extending along anterior margin; abdominal segment I without dorsal or lateral humps; case cylindrical, composed of plant materials (Wiggins, 1998).

A total of 31 species in eight genera [*Athripsodes* Billberg; *Ceraclea* Stephens; *Leptocerus* Leach; *Mystacides* Berthold; *Oecetis* McLachlan; *Setodes* Rambur; *Triaenodes* McLachlan; *Trichosetodes* Ulmer] of family Leptoceridae are known to occur in the Korean Peninsula (Park and Kong, 2020; Hwang, 2021). However, the genus *Triplectides* has not yet been recorded from the Korean Penin-

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sula. Members of this genus typically inhabit lentic ecosystem, such as ponds, lakes, and paddy fields. Their larvae are functional feeding groups of shredders, known for constructing cases from hollowed-out twigs or woody debris (Katsuma and Kuranishi, 2016; Holzenthal and Calor, 2017).

Here, we redescribe the larva of *M. hanasense* Tsuda (=*Micrasema* KUa) with the genitalia of the male through larval rearing. In addition, *Triplectides misakianus* (Matsumura) is recorded from the Korean Peninsula for the first time. Larval morphological characters of *M. hanasense*, a diagnosis, wing venation, and habitat information are provided.

Materials and Methods

A number of larval *Micrasema* KUa belonging to the family Brachycentridae, were collected from two localities in Chiak and Naejang Mountain, Korean National Park. Approximately 30 larvae of *Micrasema* KUa were placed in small rearing cages with shallow water and coarse gravel using the portable air pump (Fig. 1A). The emerging adults were identified to the species level and preserved in 70% ethanol. Additionally, several adults of *T. misakianus* belonging to the family Leptoceridae, were collected using light traps (Fig. 1B) near wetlands or by sweeping nets around reservoirs. All specimens were preserved in 80% ethanol. The caddisfly specimens were carefully examined under a Nikon SMZ800N stereomicroscope. Two individuals of adults and larvae were dissected and mounted on slide in glycerol solution for detailed examination. Habitus photographs were captured using a Canon digital camera (EOS 5Ds) with 65 mm Macro Lens (Canon, Inc., Tokyo, Japan). Most of the samples collected for this study are currently deposited in the aquatic insects collection of the DASARI Research Institute of BioResources (DRIBR), Daejeon, Korea. One female specimen of *T. misakianus* is deposited in the National Institute of Biological Resources, Incheon, Korea (NIBR).

The abbreviations for collection provincial names of Korea are as follows: GW, Gangwon-do; JB, Jeollabuk-do; CN, Chungcheongnam-do; GN, Gyeongsangnam-do.

Systematic Accounts

Order Trichoptera
Family Brachycentridae Ulmer, 1903

Genus *Micrasema* McLachlan, 1876
Type species: *Oligoplectrum morosum* McLachlan, 1868.

***Micrasema hanasense* Tsuda, 1942 (Figs. 2–4)**
(Korean name: Dung-geun-eol-gul-nal-do-rae)
Micrasema hanasense Tsuda, 1942: 327–328 (type locality: Japan, 1♂, deposited in the Kanagawa Prefecture Museum) (for synonyms see Nozaki, 2022: A catalogue of Japanese Trichoptera, Family Brachycentridae).
Micrasema KUa: Yoon, 1988: 509 (larv. descr.); Yoon, 1995: 209 (key).

Diagnosis. Mature larva (Fig. 3). Total body length approximately 7 mm (Fig. 3A). Dorsal head dark brown, with light yellow V-shaped marking back of frontoclypeal apotome and around compound eyes. Ventral apotome nearly square. Mandibles stout, each bearing three or four small, rounded apical teeth. Dorsum of head slightly flatten. Pronotum (Fig. 3B) with transverse ridge and two setae on middle area; numerous setae covered along anterior and lateral margins. Mesonotal plates (Fig. 3I) longitudinally subdivided, with numerous marginal setae; satal area sa1

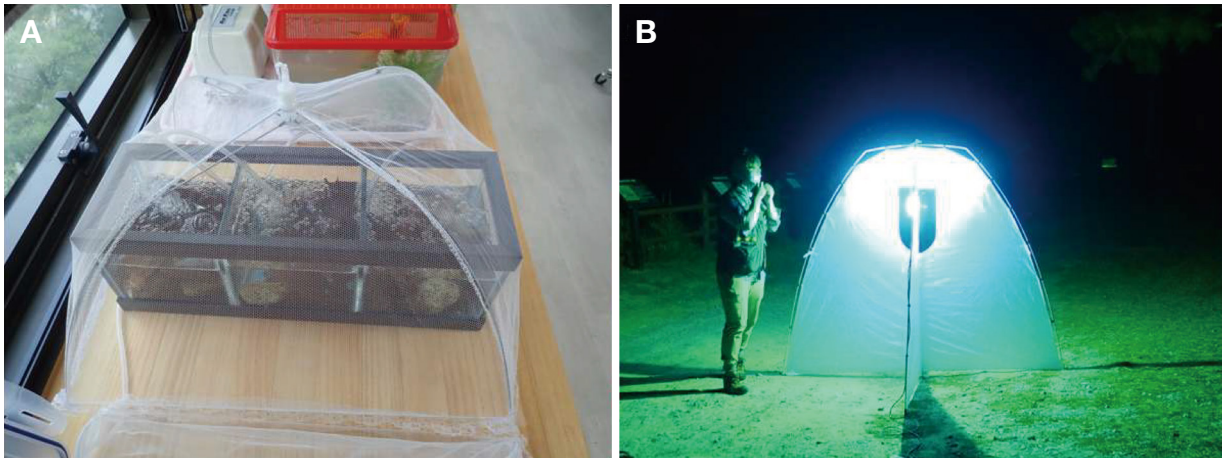


Fig. 1. Rearing cage (A) for caddisflies and light trap (B) for collecting adults.

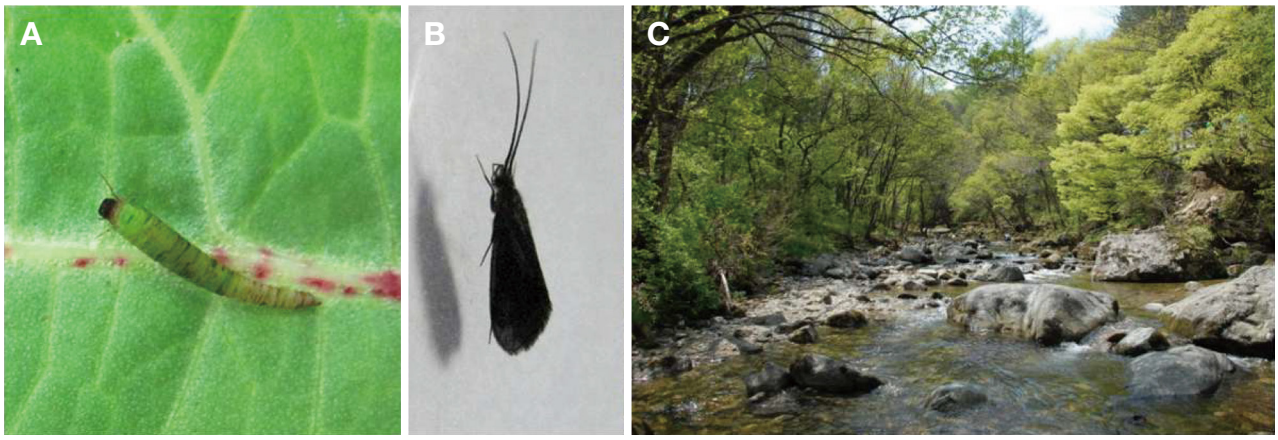


Fig. 2. Alive images and habitat of *Micrasema hanasense*. (A) larva; (B) adult; (C) Chiaksan National Park in Gangwon Province.

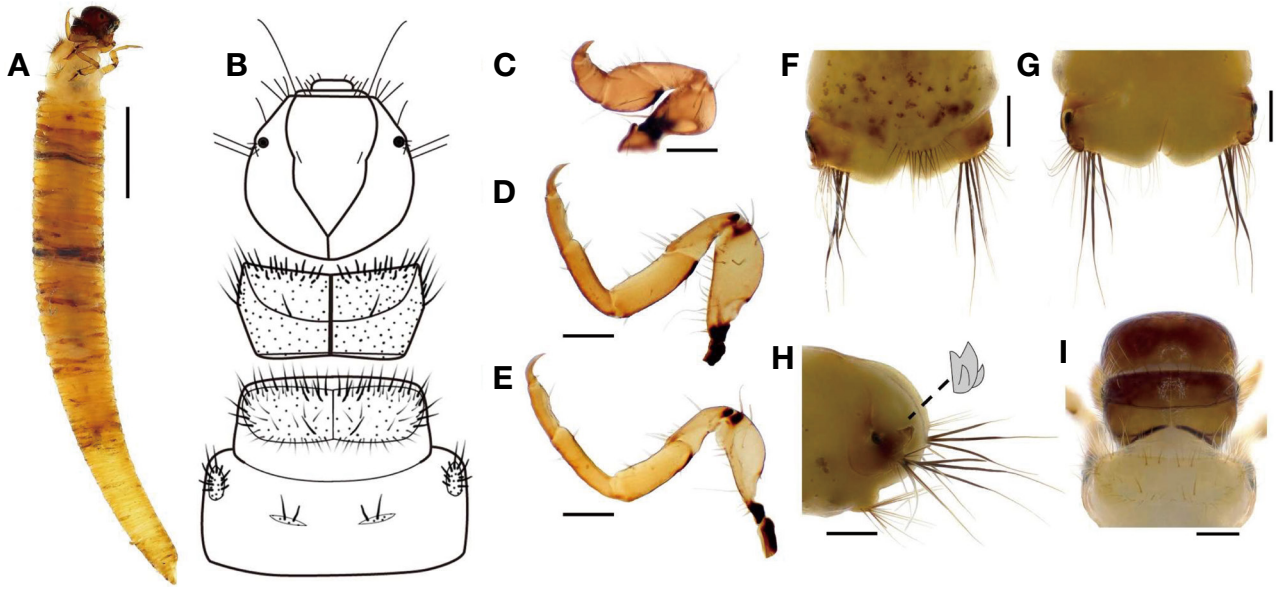


Fig. 3. Larva of *Micrasema hanasense*: (A) habitus with case, lateral view; (B) head, pronotum, meso- and metanotum in modified drawing by Yoon, 1988; (C) left fore leg; (D) left middle leg; (E) left hind leg; (F) segments VIII, IX and anal proleg, dorsal view; (G) segments VIII, IX and anal proleg, ventral view; (H) segments VIII, IX and anal proleg, lateral view; (I) thorax, dorsal view. Scale bars = 2 mm for A; 0.2 mm for C–I.

with two setae, sa2 with single seta, and sa3 without seta. Metanotum lacking sal, sa2 with two setae, and sa3 with 18 setae. Forelegs (Fig. 3C) shorter and stouter than mid- and hind legs, approximately half in length of mid- and hind legs; femora broad; tarsal claws short and weakly curved. Mid- and hindlegs (Fig. 3D, 3E) slender and approximately equal in length; coxae bearing many long setae; mid tarsal claws slender and slightly curved; hind tarsal claws slender and strongly curved. Dorsal hump of abdominal segment I absent. Abdominal gills lacking. Abdominal segment VIII with small lateral protuberance on each lateral side; segment XI with yellow dorsal sclerite bearing several setae (Fig. 3F) medially. Anal prolegs nearly membranous in dorsal and ventral views (Fig. 3G); posterior margins with several setae and four long dark setae. Lateral sclerite weakly sclerotized. Anal claw stout, with two dorsal accessory hooks (Fig. 3H).

Adult (Figs. 2B, 4). Body, antennae, wings, and legs almost black. Forewings 4.2–4.6 mm long in male (n = 4), 6.6–6.8 mm long in female (n = 4). Head shorter than width, with numerous setae; ocelli absent; with anterior setal warts oval, posterior setal warts slender and more or less broad. Male maxillary palpi 3-segmented, ratio of three segments approximately 1 : 2.2 : 1.8. Female maxillary palpi

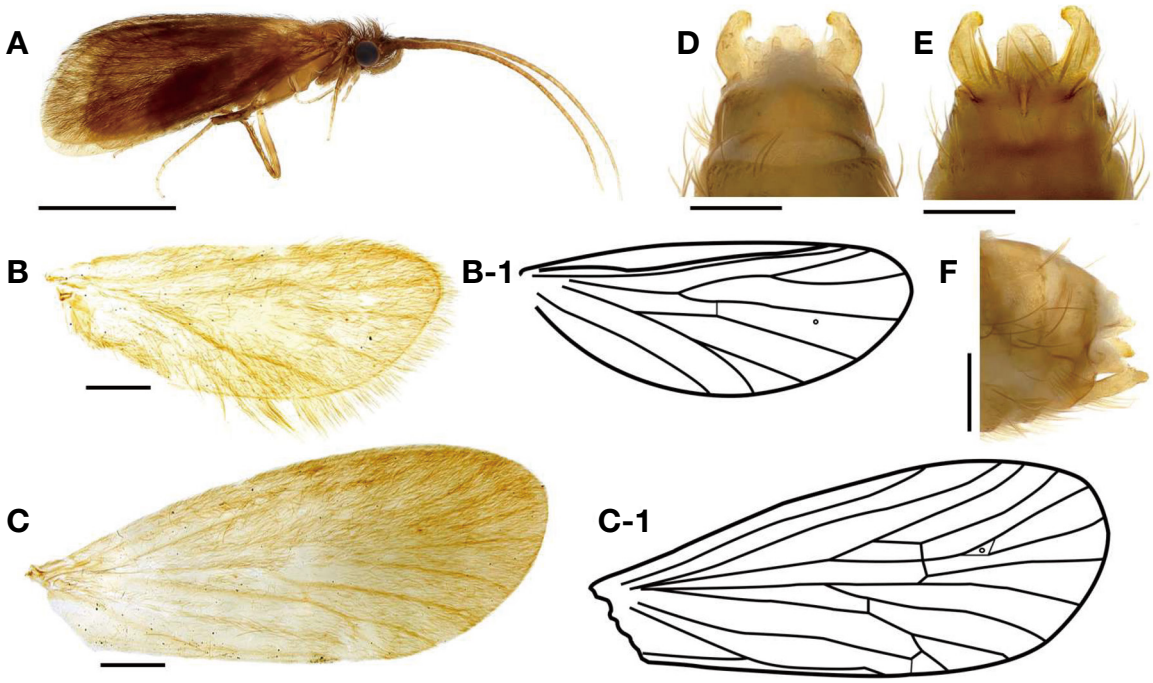


Fig. 4. Male of *Micrasema hanasense*. (A) habitus, lateral view; (B, B-1) right hindwing; (C, C-1) right forewing; (D) male genitalia, dorsal view; (E) male genitalia, ventral view; (F) male genitalia, lateral view; Scale bars = 2 mm for A; 0.2 mm for B–D; 0.5 mm for E, F.

Table 1. Rearing information of *Micrasema hanasense*.

Taxon (No. of individuals)	Collecting date	Collecting sites	Emerged data
Micrasema KUa (1 larva)	29-IV-2009	GW, Guryongsa, Chiaksan National Park	Male (1) emerged (25-V-2009)
Micrasema KUa (1 larva)	29-IV-2009	GW, Guryongsa, Chiaksan National Park	Male (1) emerged (27-V-2009)
Micrasema KUa (1 larva)	29-IV-2009	GW, Guryongsa, Chiaksan National Park	Male (1) emerged (30-V-2009)
Micrasema KUa (1 larva)	29-IV-2009	GW, Guryongsa, Chiaksan National Park	Female (1) emerged (5-VI-2009)
Micrasema KUa (4 larvae)	21-V-2009	JB, Naejangsa, Naejangsan National Park	Male (2), Female (2) emerged (25-V-2009)
Micrasema KUa (1 larva)	21-V-2009	JB, Naejangsa, Naejangsan National Park	Female (1) emerged (26-V-2009)
Micrasema KUa (18 larvae)	21-V-2009	JB, Naejangsa, Naejangsan National Park	Male (3), Female (15) emerged (27-V-2009)
Micrasema KUa (3 larvae)	21-V-2009	JB, Naejangsa, Naejangsan National Park	Male (1), Female (2) emerged (28-V-2009)

5-segmented. Labial palpi 3-segmented in both sexes, ratio of three segments approximately 1 : 1.3 : 2. Antennae nearly equal in forewings length. Pronotum with pare of anterior dorsal oval setal warts, closed to each other, and pair of ovoid lateral setal warts. Mesoscutal setal warts elongated, distinct; Mesoscutellar setal warts smaller than mesoscutal setal warts, indistinct. Legs long and slender with tibial spur formula 2, 2, 2 in both sexes. Abdominal sternite VI with small triangular process at middle of posterior margin. Male genitalia and wings as in Fig. 4B–4F.

Case. Ribbon-like pieces of plant materials wound around the circumference (Figs. 2A, 3A).

Material examined. Korea. [GW] 1♂, 1 larva, Wonju-si, Socho-myeon, Hakgong-ri, Chiaksan National Park (37° 24′01″N, 128°03′02″E), 25.v.2009, J.M. Hur, W.J. Choi, S.Y. Song (DRIBR); 1♂, ditto but 27.v.2009 (DRIBR); 1♂, ditto but 30.v.2009 (DRIBR); 1♀, ditto but 5.vi.2009 (DRIBR); [JB] 2♂, 2♀, 4 larvae, Jeongeup-si Naejang-dong 59-10, Naejangsan National Park (35°29′17.9″N, 126°54′20.0″E), 25.v.2009, J.M. Hur, W.J. Choi, S.Y. Song (DRIBR); 1♀, ditto but 26.v.2009 (DRIBR); 3♂, 15♀, ditto but 27.v.2009 (DRIBR); 1♂, 2♀, ditto but 28.v.2009 (DRIBR); 6L, ditto but 19.v.2009 (DRIBR).

Distribution. Korean Peninsula, Japan, Russia, Taiwan.



Fig. 5. Alive images and habitat of *Triplectides misakianus*. (A) adult; (B) Doowoong wetland in Chungcheongnam Province; (C) Ojeon reservoir in Gyeonggi Province.

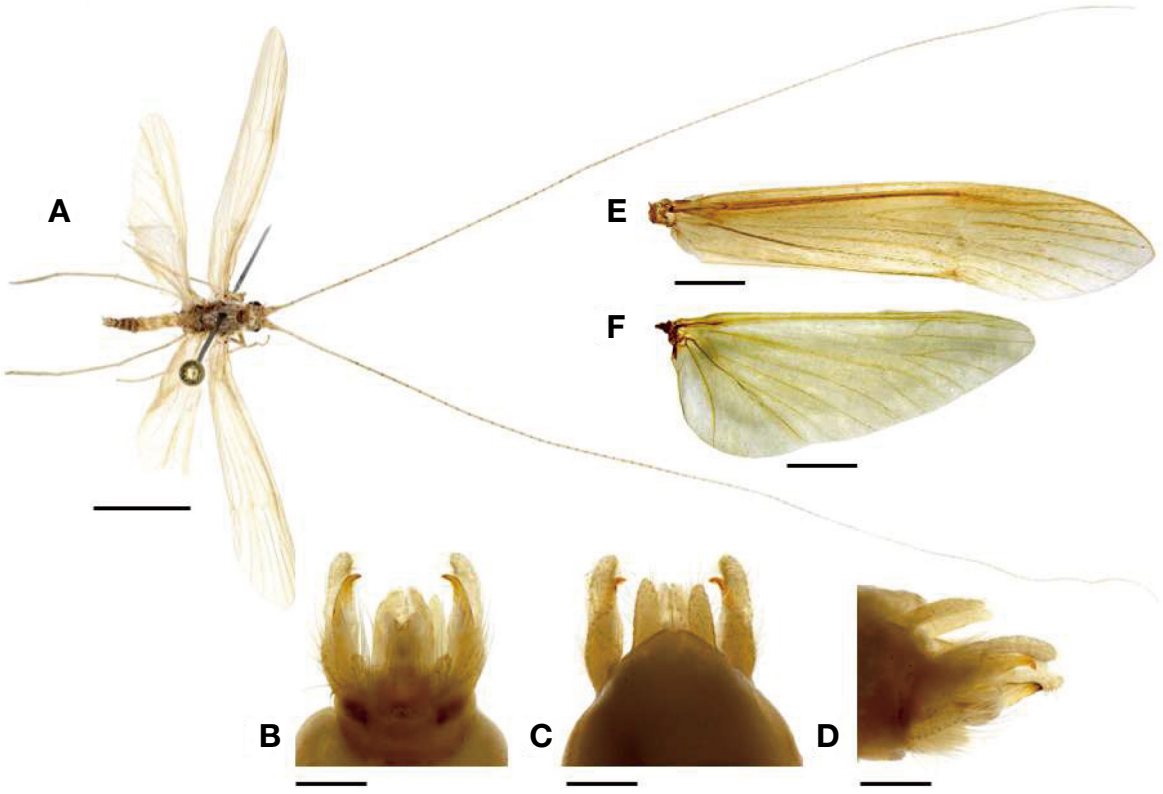


Fig. 6. Male of *Triplectides misakianus*. (A) habitus, dorsal view; (B) male genitalia, ventral view; (C) male genitalia, dorsal view; (D) male genitalia, lateral view; (E) right forewing; (F) right hindwing. Scale bars = 5 mm for A; 0.3 mm for B–D; 2 mm for E, F.

Habitat. We found all the Korean specimens under the moss of submerged stones in clean mountain streams (Fig. 2C).

Remarks. This species is common and widely distributed throughout the Korean Peninsula. The unidentified *Micrasema* larvae reported by Yoon (1988) and Yoon (1995) (Fig. 3B) are herein confirmed to belong to this species, collected in the mountain streams of the national park. Larvae of *Micrasema hanasense* were reliably associated with conspecific adults using a rearing system, and the emergence records are summarized in Table 1.

Family Leptoceridae Leach, 1815

Genus *Triplectides* Kolenati, 1859

Type species: *Mystacides gracilis* Burmeister, 1839.

***Triplectides misakianus* (Matsumura, 1931) (Figs. 5A, 6)**

(Korean name: Hae-byeon-na-bi-nal-do-rae)
Tobikera misakiana Matsumura, 1931: 1129 (type locality: Japan, 1♀, deposited in Hokkaido University) (for synonyms see Katsuma, 2019: A catalogue of Japanese Trichoptera, Family Leptoceridae).

Description. Adult (male and female), Larva, and Pupa. See Katsuma and Kuranishi (2016) for a full description.
Diagnosis. According to Katsuma and Kuranishi (2016), the larva of *T. misakianus* can be distinguished by the following combination of characters: head oblong, reddish brown to dark brown, with several orange spots; ventral apotome elongated, widest at the anterior margin and gradually narrowing to the middle part; left mandible with three teeth and right mandible with five teeth; pronotum and mesonotum each covered by pair of large sclerites; metanotum with three pairs of sclerites; metasternum with pair of small, oval sclerites, each bearing three setae; legs long and slender, sparsely setose; hind tibiae each divided into two subequal parts; abdomen cylindrical; abdominal segment I with dorsal and lateral humps; anal proleg well-developed; anal claw with single dorsal accessory hook. The adult of *T. misakianus* can be recognized by the following characters: body entirely yellowish brown (Fig. 5A), very long and slender antennae (Fig. 6A), tibial spur formula 2-2-2, maxillary palpi 5-segmented in both sexes, and male genitalia with long and slender harpago on inferior appendage (Fig. 6B). Male genitalia and wings morphology are illustrated in Fig. 6B–6F.
Material examined. Korea. [GG] 1♂, 1♀, Uiwang-si, Ojeon-dong, Ojeon reservior (37°21′24.5″N, 127°00′03.8″E), 20.vi.2022, S.W. Jung (DRIBR); [CN] 19♂, 28♀, Taean-gun, Wonbuk-myeon, Sindu-ri (36°50′10.8″N, 126°11′44.6″E), 18.vi.2019, S.W. Jung (DRIBR); 1♀, ditto but deposited in NIBR (ULFUIN0000010807).
Distribution. Korean Peninsula (new record), Japan.
Habitat. All Korean specimens were collected in close proximity to a wetland (Fig. 5B) and a reservoir (Fig. 5C). According to Katsuma and Kuranishi (2016), this species has been recorded from lowland habitats, including ponds, coastal lakes, paddy fields, and wetland vegetation.
Remarks. Adults of *T. misakianus* were collected using light traps in a coastal wetland located along the western seashore of the Korean Peninsula. The research site was situated in an area influenced by costal environmental conditions rather than a strictly freshwater ecosystem. In Japan, *T. misakianus* has been reported as a rare species with a fragmented distribution (Katsuma and Kuranishi, 2016).

Conflicts of Interest

The authors of this paper have no affiliation with any interests and are solely responsible for the paper.

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