

# A Newly Recognized *Desmometopa* Loew, 1866 (Diptera: Milichiidae), A Commensalistic Dipteran Genus, in South Korea

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## 한국의 미기록속 이마줄불청객파리속(신칭)(파리목: 불청객파리과)에 대한 보고

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**ABSTRACT:** *Desmometopa* Loew, 1866 is newly recognized in the Korean Peninsula, based on *Desmometopa microps* Lamb, 1914 that is new to Korean insect fauna. The species is known to have commensalistic habits with predacious insects and spiders. Diagnosis, description, images and DNA barcode sequences are provided, based on the obtained adult specimens.

**Key words:** *Desmometopa*, Milichiidae, New record, South Korea, Taxonomy

**초 록:** 본 연구에서는 한국산 미기록속인 이마줄불청객파리속(신칭)과 미기록종인 작은눈이마줄불청객파리(신칭)를 처음으로 보고한다. 우리는 이 종이 포식성 거미의 섭식과정에 관여하는 phoretic relationship의 습성을 갖는 것을 확인하였다. 이 종의 성충에 대한 기재문과 사진 및 DNA바코드 서열을 제공한다.

**검색어:** 이마줄불청객파리속, 불청객파리과, 미기록, 한국, 분류

Milichiidae Meigen, 1830 is a small dipteran family, including 360 described species in 19 genera worldwide (Swann, 2016). In Korea, only two species in a single genus, *Aldrichiomyza* Hendel, 1914, were recorded (KSAE and ESK, 2021). Milichiid species, small-sized acalyptrate flies, are generally associated with decaying plants and animals (Sabrosky, 1959, 1983; Brake, 2009; Swann, 2016). In particular, *Desmometopa* Loew, 1866 of the family has commensalistic habits, more precisely the phoretic relationship and kleptoparasitism, that has been observed with predacious insects and spiders; adult flies feed on the juice of their hosts' preys (Sabrosky, 1983). Spiders cooperate

with *Desmometopa* species because these flies clean wet and sticky part around the chelicerae and mouths of spiders while feeding on preys (McMillan, 1975).

In the present study, we recognized *Desmometopa microps* Lamb, 1914 for the first time in the Korean Peninsula, representing the first record of the phoretic dipteran genus. Herein, we provide diagnosis, description, and color photographs of *D. microps* based on the Korean specimens, and DNA barcode sequences are also given for identification and phylogeny.

## Materials and Methods

The morphological terms mainly followed Cumming and Wood (2017), but we also followed Brake (2000) for genitalic

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terminology that were not described by Cumming and Wood (2017).

Total genomic DNA was extracted from the legs of a specimen using DNeasy Blood & Tissue Kit (Qiagen, Hilden, Germany) following the manufacturer's protocol. Three specimens were sequenced for 658 bp fragment of the mitochondrial cytochrome c oxidase I (COI) gene. The DNA barcode was amplified using the primer LCO-1490 (5'-GGTCAACAAATCATAAAGAT-ATTGG-3') and HCO-2198 (5'-TAAACTTCAGGGTGACC-AAAAAATCA-3') (Vrijenhoek, 1994). PCR conditions for amplification followed the manufacturer's protocol (Platinum Taq, Invitrogen, Carlsbad City, CA, USA). The amplicons were purified using the QIAquick® PCR Purification Kit (QIAGEN, Inc., Hilden, Germany) and were directly sequenced at Macro-gen (Seoul, Korea).

For phylogenetic analysis, we downloaded the barcode sequences of 70 individuals of *Desmometopa* and three individuals of *Madiza glabra* Fallén, 1820 (as outgroups), which are publicly available from the BOLD System ([www.boldsystems.org](http://www.boldsystems.org); as of Sep. 2023). The sequences were examined and edited using BioEdit (version 7.2.4, 2013; Hall, 1999). Alignment was not necessary for the COI barcode fragments because no indels were found. Neighbor-joining (NJ) analysis (Saitou and Nei, 1987) was performed in MEGA 11 (Tamura et al., 2021) using the Kimura 2-parameter model of nucleotide substitution (Kimura, 1980).

Consecutive digital images in different focal planes (usually 50 or more shots per specimen) were obtained with a Dhyana 400dc camera (Tucsen Photonics, Fuzhou, China) mounted on a Leica M205C compound microscope (Leica Microsystems, Wetzlar, HESSE, Germany). Genitalia photographs were taken with a Dhyana 400dc camera (Tucsen Photonics, Fuzhou, China) mounted on a Leica DM3000 LED microscope (Leica Microsystems, Wetzlar, HESSE, Germany). The images were stacked using Helicon Focus software (ver. 7.6.6, Helicon Soft, Ltd., Kharkiv, Ukraine). For visualization, we edited the images using Adobe Photoshop® (version 22.5, Adobe Systems Inc., San Jose, CA, USA).

All eight specimens used in this study are deposited in the Korea National Arboretum (KNA), Pocheon, Korea. Acronym of the other institution mentioned in the text is as follows: BMNH: The Natural History Museum, Department of Entomo-

logy, Cromwell Road, London SW7 5BD, England, UK.

## Taxonomic Accounts

### Family Milichiidae Meigen, 1830 불청객파리과

#### Genus *Desmometopa* Loew, 1866 이마줄불청객파리속 (신칭)

*Desmometopa* Loew, 1866: 184. Type species: *Agromyza m-atrum* Meigen, 1830: 170

See Swann (2016) for synonymy.

**Diagnosis.** This genus can be distinguished from other Palaearctic milichiid genera by the following combination of the characteristics [extracted and modified from the Palaearctic milichiid key (Papp and Wheeler, 1998)]: (1) head in profile quadrate or subquadrate (Figs. 1B, 2A); (2) frons with M-shaped black velvet area (Fig. 1C, D); (3) frons with two rows of setae on distinct grey interfrontal stripes (Fig. 1C); (4) posthumeral setae absent (Fig. 1A); (5) scutellar setae well-developed (Fig. 1A); and (6) costal vein extending to M<sub>1</sub> (Fig. 1B).

**Biology.** Adults of some *Desmometopa* species visit various flowers (Sabrosky, 1983), and sometimes they are found in decaying fruits and plants (Ferrari, 1987). Several species are also discovered on the corpses of animals including arthropods (Sabrosky, 1983).

**Remarks.** The genus *Desmometopa* was erected by Loew (1866) based on the type species, *Agromyza m-atrum* Meigen, 1830. The genus currently includes 51 species worldwide (Evenhuis and Pape, 2023), among which seven species are known in the Palaearctic region (*D. discipalpis*, *D. leptometopoides*, *D. microps*, *D. m-nigrum*, *D. singaporensis*, *D. sordida*, and *D. varipalpis*). The new Korean name given to the genus refers to its stripes on frons.

#### *Desmometopa microps* Lamb, 1914 (Figs. 1-3) 작은눈이마줄불청객파리(신칭)

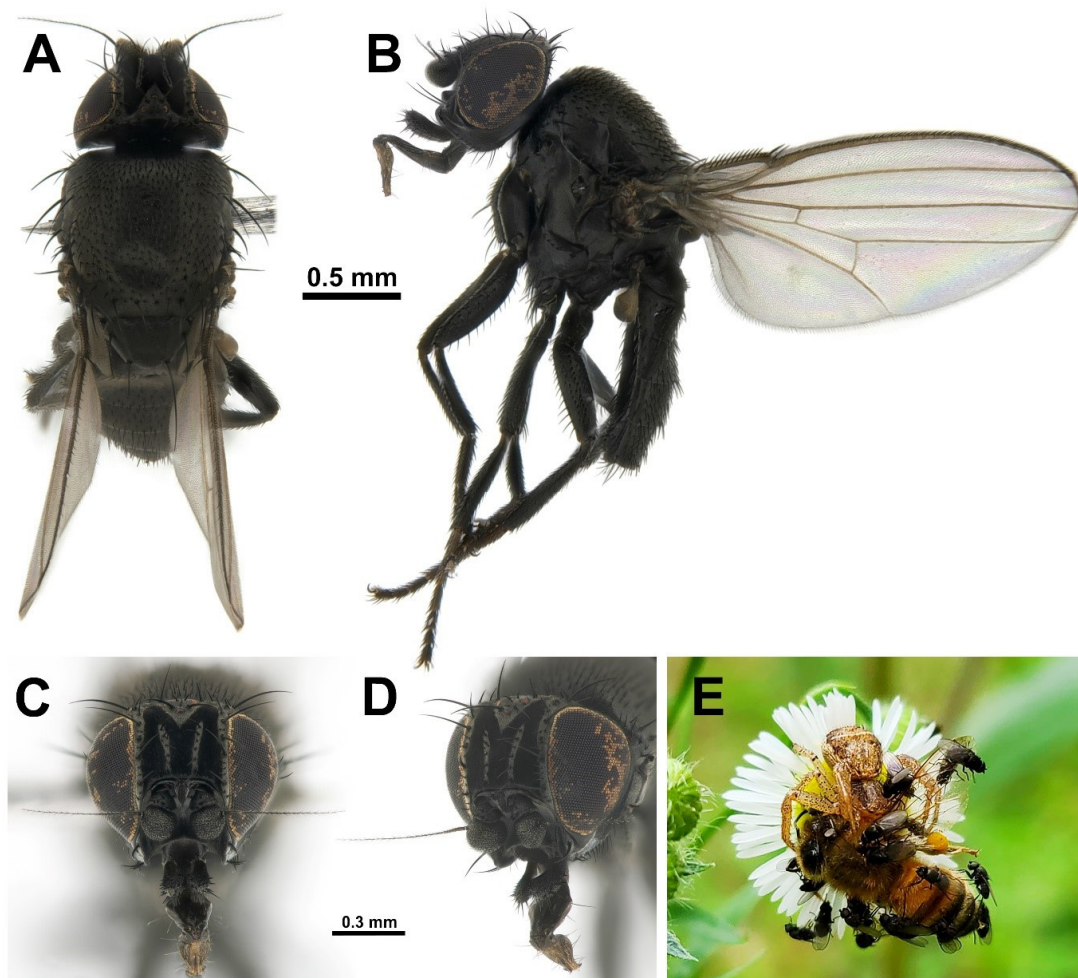
*Desmometopa microps* Lamb, 1914: 364. Type locality: Seychelles; type depository: BMNH.

*Desmometopa microps*: Sabrosky, 1983: 25 (in world revision); Papp, 1984: 114 (in Palaearctic catalog); Iwasa, 1996: 348 (in Japanese key); Brake, 2000: 98 (in world catalog).

**Diagnosis.** This species may be distinguished from other Palaearctic species by the combination of the following characteristics [extracted and modified from Sabrosky (1983) and Iwasa (1996)]: (1) gena with subocular polished sub-crescent area (Figs. 1B, 2A); (2) genal height at most 1/4 as high as eye height (Fig. 1B); (3) width of postgenal subshining area at least as wide as width of palpus in lateral view (Figs. 1B, 2A); (4) palpus black except for brown area basal one-third (Figs. 1B, 2A); (5) polished black area from ventral part of anepisternum to anterior part of katepisternum sublozenge-shaped and not bilobed (Fig. 2B); (6) knob of halter fuscous yellow (Fig. 1B); and (7) hind tibia of male not broadened (Fig. 1B).

**Description.** **Chaetotaxy of head** (Fig. 1A-D): four strong fronto-orbital setae, lower two inclinate, upper two exclinate

(anterior one antero-exclinate and posterior one postero-exclinate); 6-7 interfrontal setae slightly antero-inclinate; strong ocellar setae antero-exclinate; strong postocellar setae convergent; strong inner vertical setae reclinate; strong outer vertical setae exclinate; one vibrissa strong; **Head** (Figs. 1A-D, 2A): frons with M-shaped black velvet area; interfrontal plate narrower as wide as the width of ocelli, entirely grey microtomentose; fronto-orbital plate narrower as wide as or slightly wider than the width of ocelli, entirely grey microtomentose; ocelli reddish orange; lunule polished black; antennal fovea grey microtomentose; scape dark grey microtomentose with two setae; pedicel dark grey microtomentose with a row of setulae and one small median seta; first flagellomere black covered with yellowish grey hair entirely, subcircular shaped;



**Fig. 1.** *Desmometopa microps* female. A. Body, dorsal view; B. Body, lateral view; C. Head, frontal view; D. Head, frontolateral view; E. The commensalistic relationship between *Xysticus* sp. and *Desmometopa microps*.

arista slender and micropubescent, basal 1/5 slightly thicker; medium facial carina distinctly produced in lateral view; the vibrissal angled about 80 degrees; parafacial not visible in profile; gena black with grey microtomentose; genal height at most 1/4 as high as eye height; subocular polished area slightly angular sub-crescent shaped; width of postgenal subshining area at least as wide as width of palpus in lateral view; palpus black except for brown area basal one-third; proboscis conspicuously elongate and geniculate; prementum black; labella blackish yellow; postorbital area narrow in profile; **Thorax** (Figs. 1A, B, 2B): entirely black with dark grey microtomentose; polished black area from ventral part of anepisternum to anterior part of katepisternum sublozenge-shaped and not bilobed; proepisternum entirely black with grey microtomentose; anepimeron entirely black with grey microtomentose; knob of halter fuscous yellow; **Legs** (Fig. 1B): entirely black; fore coxae not elongate; fore femur not elongate; hind tibia slender; **Wing** (Fig. 1B): light grey; costa between humeral and subcostal breaks with 11-14 erect, well-spaced setae; **Abdomen** (Fig. 1A, B): entirely black; tergites 1-5 entirely covered with black small setulae except for the anterior half of tergite 1; tergite 5 not elongate; **Female terminalia** (Fig. 3): tergites 6-8 and sternites 6-8 retracted; tergite 6 and sternite 6 with a continued row of setae on posterior margin; tergite 7 and sternite 7 with some setae and setulae on posterior margin; tergite 8 pen

nib-shaped structure in dorsal view, joined with secondary ovipositor; secondary ovipositor egg-shaped in ventral view with reptile skin like surface; hypoproct subtriangular shaped in lateral view with densely covered by minute setulae; epiproct bare, broad U-shaped anteriorly in dorsal view.

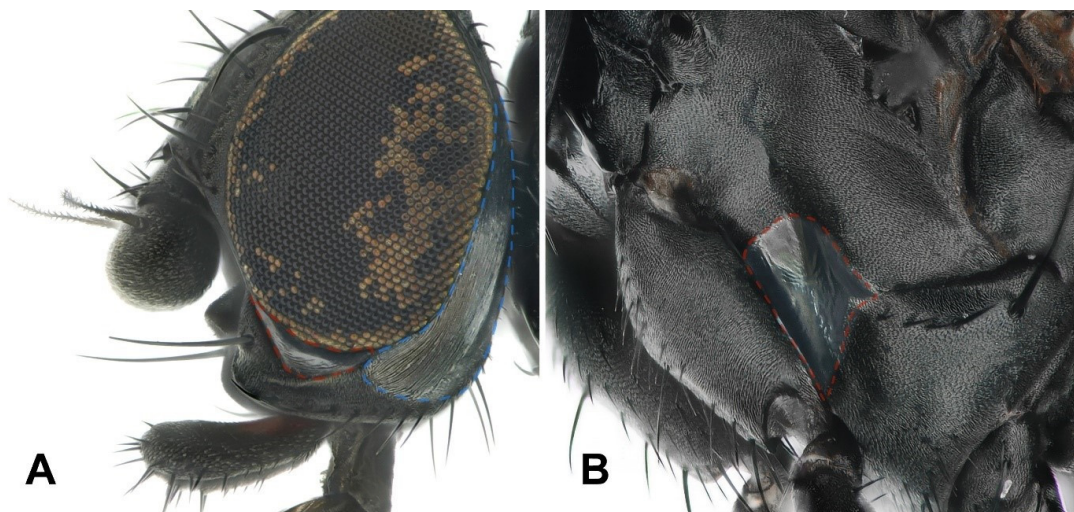
**Material examined.** Korea: 7 ♀, Chungcheongbuk-do, Jeungpyeong-gun, Jeungpyeong-eup, Yonggang-ri, Daehak-ro 61, Korean National University of Transportation, N36°46'06.5" E127°37'33.1", 12.VI.2022, S.-S. Euo and J.-H. Choi; 1 ♀, Daegu Metropolitan City, Dalseo-gu, Hwaam-ro 342, Daegu Arboretum, N35°47'47.6" E128°31'31.7", 12.IV.2023, S.-S. Euo, G.-Y. Han, D.-H. Park, and S.-W. Woo.

**Distribution.** Afrotropical: Cameroun, Seychelles, Tanzania; widespread in Oriental; Palaearctic: Afghanistan, China, Czech Republic, Japan, Nepal (Brake, 2000; Roháček and Máca, 2010), and Korea (new record).

**Biology.** This species is commonly found around livestock farms and sewage water, but sometimes the adults visit flowers (Iwasa, 1996). In this study, we confirmed the commensalistic habit of this species (Fig. 1E); numerous individuals of the species were aggregating on a Western honey bee that was hunted or caught by a spider (*Xysticus* sp.).

**DNA barcode.** Sequences were uploaded to NCBI (Accession number: OR528776, OR528777, OR528778).

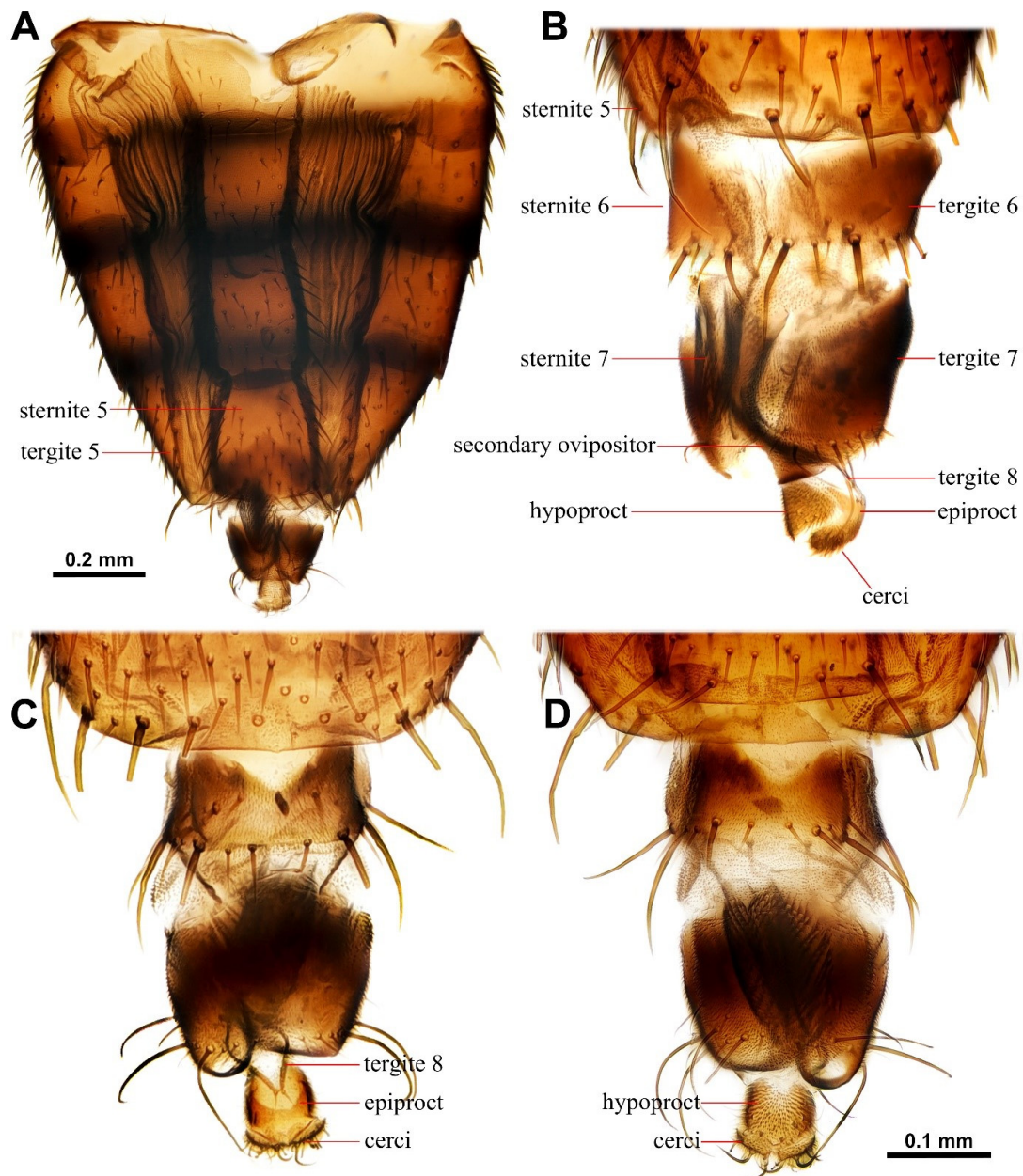
**Remarks.** This species is morphologically very similar to *D.*



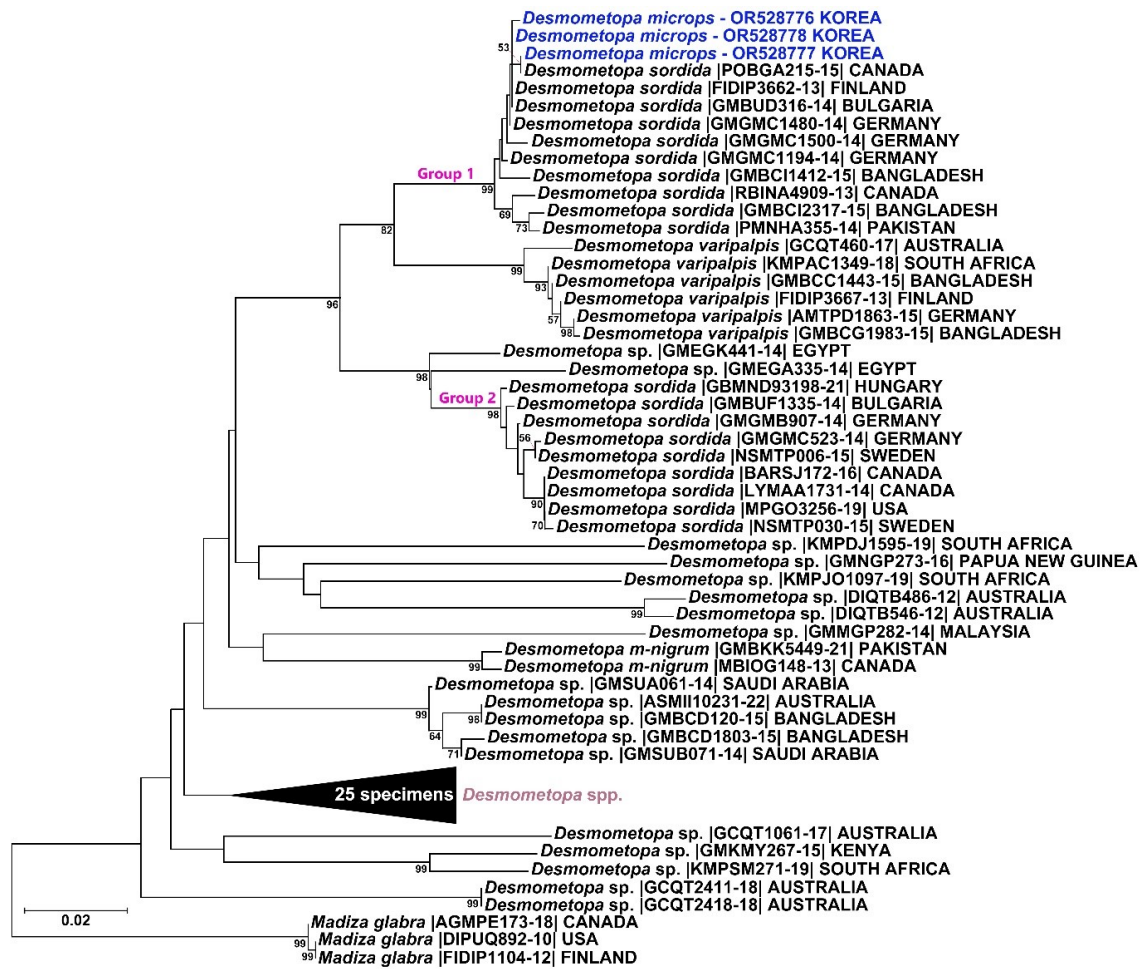
**Fig. 2.** Head and Thorax of *Desmometopa microps* female in lateral view. A. A red dot line indicating the subocular polished sub-crescent area and a blue dot line that the postgenal subshining area; B. A red dot line indicating the polished black area from ventral part of anepisternum to anterior part of katepisternum.

*sordida* (Fallén, 1820), but these two species can be separated by the width of postgenal subshining area (width of postgenal subshining area at most half as wide as width of palpus in *D. sordida*). The NJ tree (Fig. 4) showed that our *D. microps* sequences and some *D. sordida* sequences from the BOLD System formed a clade (Group 1 in Fig. 4). However, our Korean specimens agree well with the original description (Lamb, 1914) as well as the redescrptions (Sabrosky, 1983; Iwasa,

1996) of *D. microps*. Moreover, the analysis result indicated that the *D. sordida* barcode sequences deposited in the BOLD System were not of a single species, representing two distinct biological species as being split into two different clades (Groups 1 and 2 in Fig. 4). This means that many samples identified as *D. sordida* in the BOLD System might have been misidentified. The new Korean species name refers to the meaning of its scientific name.



**Fig. 3.** Abdomen of *Desmometopa microps* female. A. Abdomen, ventral view; B. Ovipositor, lateral view; C. Ovipositor, dorsal view; D. Ovipositor, ventral view.



**Fig. 4.** The neighbor-joining tree based on the Kimura 2-parameter distances of 76 milichiid DNA barcode sequences mostly downloaded from the BOLD System ([www.boldsystems.org](http://www.boldsystems.org), as of Sep. 2023), including three newly obtained *Desmometopa microps* sequences (highlighted in blue; number after the scientific name indicates the GenBank accession number). Bootstrap support values above 50% are shown on the corresponding nodes.

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## Statements for Authorship Position & Contribution

Euo, S.-S.: Korea National Arboretum, Researcher; Data assembly, analysis, visualization, and writing—original draft  
 Choi, J.-H.: Korea National Arboretum, Researcher; Analysis and data curation

Kim, I.-K.: Korea National Arboretum, Researcher; Conceptualization, supervision, writing—review and editing  
 Kim, A.Y.: Korea National Arboretum, Researcher; Project administration, supervision, funding acquisition, writing—review and editing

All authors read and approved the manuscript.

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