



Taxonomic review of the genera *Bombylius* and *Bombylella* (Diptera: Bombyliidae) in Korea



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ABSTRACT

The bee fly genera *Bombylius* and *Bombylella* in Korea are taxonomically reviewed. They are among the most commonly encountered flower visiting pollinators that appear mimicking bumblebees. As a result of our investigation of these two closely related genera, we have recognized six *Bombylius* and one *Bombylella* species, including two newly recorded (marked by asterisks) and one new species in Korea: *Bombylius ambustus**, *Bls. callopterus**, *Bls. erythropleurus*, sp. nov., *Bls. lejustomus*, *Bls. major*, *Bls. shibakawae*, and *Bombylella koreanus*. *Bombylella koreanus* has been treated as either *Bombylella* or *Bombylius* in the recent literature, but we consider it as belonging to the former genus based on its diagnostic characteristics. *Bombylius erythropleurus*, sp. nov., is here described new to science based on both sexes collected in South Korea. We also provide a specific key, diagnoses and color photographs of adult external structures including male and female genitalia.

Introduction

The bee fly genera *Bombylius* and *Bombylella* in Korea are taxonomically reviewed. They are among the most commonly encountered flower visiting pollinators that share some similarities with bumblebees by having thick coat of furs in various coloration. Unlike bumblebees, however, these flies possess long and slender legs and proboscis. The immature stages of *Bombylius* species are known as ectoparasitoids of Hymenoptera (Andrenidae, Apidae and Vespidae), and *Bombylella* larvae emerged from scarab dung balls (Hull, 1973; Yeates and Greathead, 1997).

The genus *Bombylius* was erected by Linnaeus (1758) based on three species (*Bls. major*, *Bls. medius*, and *Bls. minor*), among which *Bls. major* was subsequently designated as a type species by Latreille (1810). *Bombylius* currently includes 336 valid species from five zoogeographical regions (150 Palearctic, 109 Nearctic, 12 Neotropical, 11 Oriental, and 23 Afrotropical species) (Evenhuis and Greathead, 1999; Catalogue of Life as of November 2016 – www.Catalogueoflife.org). Among the most important treatments of *Bombylius*, Engel (1936) provided a key to 75 Palearctic species, Hesse (1938) provided a key to males of 104 and females of 91 species in Afrotropical region, and Paramonov (1940) provided a key to males of 90 and females of 83 species and subspecies in Palearctic region. For the Chinese fauna, Yang et al. (2012) recognized 22 species including four new species. In the Japanese catalog, Masunaga (2014) listed eight genera and 20 species.

Based on a morphological cladistic analysis of a number of taxa

previously placed in the genus *Bombylius*, Greathead (1995) concluded that the genus *Bombylius* (sensu lato) is a paraphyletic group. He, therefore, erected the genus *Bombylella* based on 18 previous *Bombylius* species (type species: *Bombylius ornatus* Wiedemann, 1828). *Bombylella* currently includes 16 valid species from three zoogeographical regions (four Palearctic, one Oriental, and 13 Afrotropical species) (Evenhuis and Greathead, 1999; Catalogue of Life as of November 2016 – www.Catalogueoflife.org). In addition to *Bombylella*, Greathead (1995) erected the genera *Bombomyia*, *Beckerellus*, *Australoechus* and *Xerachistus* for the recognizable groups of previous *Bombylius* species.

The first recorded species of the genera *Bombylius* and *Bombylella* in Korea is *Bla. koreanus* described by Paramonov (1926; as *Bombylius*), based on North Korean type specimens. Since then, three additional species, *Bls. lejustomus*, *Bls. major*, and *Bls. shibakawae*, have been recognized for the Korean fauna (Doi, 1938; Zaitzev, 1989).

As a result of our investigation of these two closely related genera, we have recognized six *Bombylius* and one *Bombylella* species, including two newly recorded (marked by asterisks) and one new species in Korea: *Bombylius ambustus**, *Bls. callopterus**, *Bls. erythropleurus*, sp. nov., *Bls. lejustomus*, *Bls. major*, *Bls. shibakawae*, and *Bombylella koreanus*. *Bombylius erythropleurus*, sp. nov., is here described new to science based on both sexes collected in South Korea. We also provide a specific key, diagnoses and color photographs of adult external structures including male and female genitalia.

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Materials and methods

Terminology and morphological interpretations mostly follow Hull (1973) and McAlpine (1981). Terminology for female genitalia follows Hakimian et al. (2012). The two lengths and five ratios used in the descriptions were modified from Han and Norrbom (2005): body length (anterior margin of head excluding antenna to posterior margin of abdomen); wing length (anterior margin of tegula to apex of vein $R_4 + 5$); eye ratio (longest eye diameter/shortest eye diameter); face-head ratio (face width/head width); antenna ratio (scape length: pedicel length: flagellomere length); basal cell ratio (longest first basal cell length/longest second basal cell length); and discal cell ratio (distance measured along main stem of M between lower branch of M and anterior small crossvein/distance measured along main stem of M between anterior small crossvein and anterior intercalary vein).

The majority of the examined specimens are deposited in the Division of Biological Science and Technology, Yonsei University, Wonju Campus, Korea (YSUW). The following depository acronyms for examined specimens not deposited in YSUW are indicated in the “Material examined” sections: KNA, Korea National Arboretum, Pocheon-si, Gyeonggi-do, Korea; KUK, Korea University, Seoul, Korea; NIBR, National Institute of Biological Resources, Incheon, Korea; SWU, Sungshin Women's University, Seoul, Korea; and YUK, Yeungnam University, Gyeongsangbuk-do, Korea. Since the most specimens are deposited in YSUW, only the specimens from the other institutions were indicated using their abbreviations in the materials examined sections. The abbreviations of the other institutions mentioned in the text are as follows: BMNH, The Natural History Museum, London, UK; EIHU, Entomological Institute, Hokkaido University, Sapporo, Japan; HMUG, Hunterian Museum, University of Glasgow, Glasgow, UK; LSUK, Linnaean Society, London, UK; MNVL, Museum d'Histoire Naturelle de Ville de Lille, Lille, France; NHRS, Naturhistoriska Riksmuseet, Stockholm, Sweden; NMW, Naturhistorisches Museum, Vienna, Austria; ZIS, Zoological Institute, Russian Academy of Science, St. Petersburg, Russia; and ZMHB, Museum für Naturkunde, Humboldt-Universität, Berlin, Germany.

Systematic accounts

Order Diptera Linnaeus, 1758

Family Bombyliidae Latreille, 1802

Key to the species of the genera *Bombylius* and *Bombylrella* in Korea

- Hairs mostly black with metallic hairs or scales on frons and abdomen (Figs. 1G, 3E, 3F) *Bombylrella koreanus*
- Hairs not as above 2 (Genus *Bombylius*)
- Wing hyaline except narrow pale yellowish brown areas along costal margin (Fig. 1D); femora black and tibiae yellow brown with about apical 1/6 dark brown (Fig. 1D) *Bombylius erythropleurus*, sp. nov.
- Wing pattern more extensive than above; femora and tibiae in same coloration 3
- Wing with blackish brown tinge only on basal-most area (Fig. 1A, B) 4
- Wing pattern more extensive than above 5
- Head predominantly covered with black hairs; scutum covered with brown hairs (Fig. 1A) *Bombylius ambustus* male
- Head covered with white hairs; scutum covered with white hairs (Fig. 1B) *Bombylius ambustus* female
- Wing with about nine dark elliptic to round spots along veins (Fig. 1C) *Bombylius callopterus*
- Wing without such dark elliptic to round spots 6
- Dark wing pattern clearly bordered against hyaline area (Fig. 1E) *Bombylius major*
- Dark wing pattern obscurely bordered against hyaline area (Fig. 1F) 7
- Long hairs around wing base mostly brown to dark brown (Fig. 1F-right) *Bombylius shibakawae*
- Long hairs around wing base mostly yellow (Zaitzev, 2004)

Bombylius lejostomus

Genus *Bombylius* Linnaeus, 1758

Bombylius Linnaeus, 1758: 606. Type species: *Bombylius major* Linnaeus, 1758.

Diagnosis. The following diagnosis is summarized from the Palaearctic generic key (Greathead and Evenhuis, 1997), the Nearctic generic key (Hall, 1981), and the genus *Bombylius* description by Greathead (1995).

Body approximately 5–15 mm long; body densely covered with variously colored long hairs; hairs sometimes tufted or in clipped appearance; scape over twice as long as pedicel; upper facets of male eyes enlarged; legs long and slender with strong bristles present on at least apical half of hind-femora; crossvein r-m placed at or beyond middle of cell dm; cell br much longer than cell bm; vein M_1 ending in vein R_5 some distance from wing margin; alula large; abdomen broad or ovate, at least not elongate.

Distribution. All zoogeographical regions except for Australasia.

1. *Bombylius ambustus* Pallas and Wiedemann, new Korean record (Figs. 1A, B, 2A, B, 4A, 5A)

(Korean name: am-su-da-reun-jae-ni-deung-e, new name)

Bombylius ambustus Pallas and Wiedemann in Wiedemann, 1818: 21 (type-locality: “In australibus campis ad Irтин fl. tantum” (= Kazakhstan (see Pont, 1995: 150)), NMW).

Bombylius dispar Meigen, 1820: 196 (type-locality: “Oesterreich” (probably = Austria), syntype destroyed, NMW).

Bombylius senex Rondani, 1863: 69 (type-locality: “Caucasicae” (probably = Gruzia), type depository unknown).

Diagnosis. Body 9.6–12.6 mm and wing 9.9–11.2 mm long. This species shows an extreme sexual dimorphism (Fig. 1A vs. B). Males can be distinguished from the other Korean *Bombylius* species by the combination of the following characteristics (Fig. 1A): 1) head covered with black hairs, and occiput with brown hairs; 2) anterior half of scutum predominantly brown, but posterior half looks blackish; 3) legs entirely black; and 4) wings hyaline with blackish brown tinge at basal-most area.

Male genitalia are similar to those of other Korean *Bombylius* species except for the epandrium more or less rectangular in lateral view (Fig. 4A).

Females can be distinguished by the followings (Fig. 1B): 1) head covered with whitish hairs; 2) anterior half of scutum predominantly covered with white hairs, but posterior half looks blackish; 3) pre-abdominal tergites covered mostly with black hairs with white hairs on anterior part of tergite 2, lateral parts of tergite 4, and center of tergites 2–6 each; 4) legs predominantly black, but with white hairs at basal half of femora; and 5) wings hyaline with blackish brown tinge at basal-most area.

Female genitalia (Fig. 5A): 1) spermathecal reservoir brown, egg-shaped with apex slightly pointed; 2) neck of spermathecal reservoir at least $3 \times$ as long as sperm pump, apical 2/7 distinctly swollen; 3) sperm pump dark brown, tube-like, without any distinct knob, at least twice as long as spermathecal reservoir; 4) spermathecal duct short, subequal to sperm pump; 5) furca as two separates T-shaped bars; and 6) acanthophorite with 14 dark brown tubular spines each side.

Material examined. KOREA: Gangwon-do: Hongcheon-gun, Naemyeon, Bangnae-ri, Mt. Maenghyeonbong, 10.IX.2000, H.Y. Han & K.E. Ro, 1 ♀. Gyeonggi-do: Gapyeong-gun, Mt. Cheonggyesan, 31.VII.1989, K.D. Han, 1 ♀ (SWU). Incheon: Ongjin-gun, Baengnyeong-myeon, Is. Baengnyeongdo, 26.VII.1987, H.J. You, 1 ♀ (SWU). MONGOLIA: Khentii: Binder, mountain w/many flowers, N 48°39'30", E 110°31'54", 1143 m, 30.VII.2014, H.Y. Han et al., 1 ♂. Övörkhangai: 17 Km W of Rashaant, near sand dune, Reserch and Experimental Centre for Combating Desertification, N 47°19'48", E 103°41'28", 1251 m, 23.VII.2015, H.Y. Han & Y.B. Lee, 6 ♂. Töv: Manjushir, 5 km NNE of

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