European Journal of Taxonomy 137: 1–50
http://dx.doi.org/10.5852/ejt.2015.137
ISSN 2118-9773
www.europeanjournaloftaxonomy.eu
2015 · Murao R., Tadauchi O. & Lee H.-S.

Monograph

urn:lsid:zoobank.org:pub:0CB83C33-E198-4B4F-A8F6-96C59B066112

Synopsis of *Lasioglossum* (*Dialictus*) Robertson, 1902 (Hymenoptera, Apoidea, Halictidae) in Japan, the Korean Peninsula and Taiwan

Ryuki MURAO [1,*], Osamu TADAUCHI [2] & Heung-Sik LEE [3]

[1,2] Department of Biological Science, Faculty of Sciences, Kyushu University, Fukuoka, 812–8581 Japan.
[3] Animal and Plant Quarantine Agency, Suwon, Korea.
[*] Corresponding author: r.murao@mbr.nifty.com, murao.ryuki.969@m.kyushu-u.ac.jp

[1] urn:lsid:zoobank.org:author:7E665839-6675-4365-A7EA-169D4E4DA008
[2] urn:lsid:zoobank.org:author:1A22CC5E-A7A0-449E-994D-D939EEF5BF42
[3] urn:lsid:zoobank.org:author:BEA91CE0-9306-4AC4-8E90-5FD07A69B7AE

Abstract. Twelve species in total are recognized for the subgenus *Lasioglossum* (*Dialictus*) Robertson, 1902 from Japan, the Korean Peninsula and Taiwan. *Lasioglossum* (*Dialictus*) *alishanense* sp. nov. and *L.* (*D.*) *taiwanense* sp. nov. from Taiwan, are described as new. Four species are recorded from the following localities for the first time: *L.* (*D.*) *miyabei* Murao, Ebmer & Tadauchi, 2006 from the Korean Peninsula (South Korea); *L.* (*D.*) *ellipticeps* (Blüthgen, 1923), *L.* (*D.*) *virideglaucum* Ebmer & Sakagami, 1994 and *L.* (*D.*) *viridellum* (Cockerell, 1931) from South Korea. *Lasioglossum* (*Dialictus*) *atroglaucum* (Strand, 1913) is redescribed, *L.* (*D.*) *ellipticeps*, *L.* (*D.*) *problematicum* (Blüthgen, 1923), *L.* (*D.*) *virideglaucum*, and *L.* (*D.*) *viridellum* are supplementary described. A key to species is provided. Bionomical data, such as flight and flower records or habitat, are reported for some species. The distributions of all species are mapped. DNA barcodes of *L.* (*D.*) *miyabei*, *L.* (*D.*) *pseudannulipes* (Blüthgen, 1925), and *L.* (*D.*) *virideglaucum* are provided.

Key words. Halictidae, *Lasioglossum*, *Dialictus*, Far East Asia.

Murao R., Tadauchi O. & Lee H.-S. 2015. Synopsis of *Lasioglossum* (*Dialictus*) Robertson, 1902 (Hymenoptera, Apoidea, Halictidae) in Japan, the Korean Peninsula and Taiwan. *European Journal of Taxonomy* 137: 1–50. http://dx.doi.org/10.5852.ejt.137

Introduction

The cosmopolitan bee genus *Lasioglossum* Curtis, 1833 (Halictidae, Halictinae) is a highly diverse group and includes approximately 1800 species worldwide (Ascher & Pickering 2015). This group contains diverse social structures (solitary, parasocial, and primitively eusocial, etc., reviewed in, e.g., Michener 1974; Yanega 1997), and are some of the most abundant bees in the warm temperate zone and parts of the Neotropical Region (Sakagami *et al*. 1967; Sakagami & Fukuda 1973; Yamauchi *et al*. 1974; Ikudome 1992; Maeta *et al*. 2003; Gôukon 2006; etc.). It is divided into two informal group on the basis of the degree of strength of the second submarginal vein of the female fore wing (Michener 2000):

1) the *Hemihalictus* series (weak-veined *Lasioglossum*) includes all subgenera with a weak second submarginal vein (*Acanthalictus* Cockerell, 1924, *Austrevylaeus* Michener, 1965, *Capalictus* Pauly,

Gibbs & Kuhlmann, 2012, *Dialictus* Robertson, 1902, *Dialictus sensu lato*, *Eickwortia* McGinley, 1999, *Evylaeus* Robertson, 1902, *Evylaeus sensu lato*, *Hemihalictus* Cockerell, 1897, *Paradialictus* Pauly, 1984b and *Sphecodogastra* Ashmead, 1899).

2) the *Lasioglossum* series (strong-veined *Lasioglossum*) includes all subgenera (*Australictus* Michener, 1965, *Callalictus* Michener, 1965, *Chilalictus* Michener, 1965, *Ctenonomia* Cameron, 1903, *Glossalictus* Michener, 1965, *Homalictus* Cockerell, 1919, *Ipomalictus* Pauly, 1999, *Lasioglossum*, *Leuchalictus* Warncke, 1975, *Papualictus* Michener, 1980, *Parachilalictus* Pauly *et al*., 2013, *Parasphecodes* Smith, 1853, *Pseudochilalictus* Michener, 1965, *Quasilictus* Walker, 1986, *Rubrihalictus* Pauly, 1999 and *Urohalictus* Michener, 1980) with a strong second submarginal vein (modified from Michener (2007), including the subgenera proposed or re-established in recent phylogenetic and taxonomic studies (Gibbs *et al*. 2012, 2013; Pauly *et al*. 2012, 2013)).

Each series is monophyletic as supported by phylogenetic analyses based on molecular data (Danforth *et al*. 2003; Gibbs *et al*. 2012). However, there is no agreement among taxonomists with regard to the number and extent of the subgeneric classification of *Lasioglossum* and it is not necessarily applied when classifying the male. The Palaearctic subgenera *Acanthalictus*, *Evylaeus*, *Dialictus*, *Hemihalictus* and *Sphecodogastra* of the *Hemihalictus* series, e.g., have been treated as *L*. (*Evylaeus*) (e.g., Ebmer 2002; Murao & Tadauchi 2007; Pesenko 2007a, as the genus *Evylaeus*). Recent phylogenetic studies (Danforth 1999; Danforth *et al*. 2003; Gibbs *et al*. 2012, 2013) based on molecular data, however, do not recognize *L*. (*Evylaeus*), used by most Palaearctic researchers, as a monophyletic group. They will probably shed light on our understanding of the relationships among taxa, evolutionary patterns of sociality and the strict delimitation of genera and subgenera.

In eastern Asia, taxonomic studies of the *Lasioglossum* group, with 217 species (Murao 2015), have been provided from the following areas: East Palaearctic Region (Pesenko 2006); Mongolia (Ebmer 1982, 2005); Russian Far East (Ebmer 1996, 2006; Pesenko 2007b); China (Ebmer 1998, 2002); Japan (e.g., Murao & Tadauchi 2007; Murao *et al*. 2009b); Korean Peninsula (Ebmer 1978; Murao *et al*. 2014). However, the basic information on the *Lasioglossum* fauna in eastern Asia is still poor, particularly in the Oriental Region.

Dialictus Robertson, 1902 is one of the subgenera in *Lasioglossum*. This name has been applied to the majority of species with the metallic form, including the black one without complete lateral carina on the posterior surface of the propodeum (referred to as black *Dialictus*, acarinate, noncarinate or carinaless *Evylaeus*) in the *Hemihalictus* series (e.g., Michener 2000, 2007). On the other hand, *Dialictus* in the Palaearctic Region have been treated as the green *Lasioglossum* (*Evylaeus*) (Ebmer 2002; Pesenko 2007a). In the recent treatment of *Lasioglossum*, as outlined above, mostly metallic species in the *Hemihalictus* series are recognized as *Dialictus* (Gibbs *et al*. 2013). 420 *L*. (*Dialictus*) species are listed in the world (Ascher & Pickering 2015, including *Afrodialictus* Pauly, 1984). Recently, *L*. (*Dialictus*) species from Canada and part of North America were revised by Gibbs (2010, 2011), who provided useful identification keys and good photographs of many specimens, whereas for those of eastern Asia (Russian Far East and eastern Siberia) only an identification key is available (Pesenko 2007b, as *Evylaeus*).

A further 10 species of *Dialictus* have been partially described or reported from Japan, the Korean Peninsula and/or Taiwan by various researchers (Japan: Ebmer & Sakagami 1990; Ebmer *et al*. 1994; Murao & Tadauchi 2008; Murao *et al*. 2006, 2009a; Usui *et al*. 1976. Korean Peninsula: Ebmer 1978. Taiwan: Strand 1913). No revisional study has been conducted to date in these countries. In the course of a collaborative study of the Asian *Lasioglossum* fauna, we examined the *L*. (*Dialictus*) specimens collected from Japan, the Korean Peninsula and Taiwan. Through our examination, we recognized 12 *L*. (*Dialictus*) species in total for these countries. Among them, two new species were found from Taiwan

and four known species were recorded from South Korea for the first time. In this paper, two new species from Taiwan are described and the remainder are redescribed or additionally described, and drawings, photographs and scanning electron micrographs for diagnostically important characters are provided. DNA barcodes of some species and an illustrated key of all species are presented to facilitate species identification in these countries.

Material and method

Collection

This study is based on the specimens deposited in the following institutions and personal collections, which are referred to using the following abbreviations:

BPBM = Maa's collection in the Bernice P. Bishop Museum, Honolulu, Hawaii, USA
cGou = private collection of Mr. Katsuo Goukon, Miyagi, Japan
cMur = the first author's private collection, Fukuoka, Japan
ELKU = Entomological Laboratory, Faculty of Agriculture, Kyushu University, Fukuoka, Japan
MNHAH = the late Dr Shoichi F. Sakagami's collection, deposited in the Museum of Nature and Human Activities, Hyogo, Japan
OLML = Biologiezentrum/Oberösterreichisches Landesmuseum, Linz, Austria
QIA = Animal and Plant Quarantine Agency, Suwon, Korea
SDEI = Senckenberg Deutsches Entomologisches Institut, Müncheberg, Germany
SNU = Insect Systematics Laboratory, Seoul National University, Seoul, Korea
SULE = Dr Yasuo Maeta's collection, deposited in the Laboratory of Insect Ecology, Faculty of Life and Environmental Science, Shimane University, Shimane, Japan
ZISP = Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia

Terminology

Terminology and style used in the descriptions follow Murao *et al*. (2014). Abbreviations used in the text are as follows:

AOD = antennocular distance (shortest distance between outer margin of antennal socket and inner margin of compound eye)
BL = body length (from antennal base to tip of pygidial plate)
CAL = clypealveolar distance (between lower margin of antennal socket and lower margin of supraclypeus in frontal view)
CPL = clypeal length (between upper and lower margins of clypeus in frontal view)
EL = eye length
EW = eye width (maximum length and width of the compound eye)
Fn = nth antennal flagellomere
FnL = length of nth flagellomere (measured along the ventral surface)
FnW = width of nth flagellomere (measured from dorsal and ventral surfaces of flagellomere)
GW = genal width (maximum width of the genal area when seen in lateral view)
HL = head length (from top of vertex to lower margin of clypeus)
HW = head width (between outer margins of compound eyes in frontal view)
IAD = interantennal distance (between inner margins of antennal socket)
IOD = interocellar distance (between lateral ocelli)
IS = interspace between punctures (e.g., IS 0.5d means 1/2 of the diameter of a puncture)
LOD = lower interorbital distance
MNL = metanotal length
MOD = maximum interorbital distance

MPL = metapostnotal length
MsW = maximum mesosomal width
MtW = maximum metasomal width
OCD = ocelloccipital distance (shortest distance between margins of lateral ocellus and vertex when seen in upper view)
OOD = ocellocular distance (shortest distance between lateral ocellus and inner margin of compound eye)
PP = punctures
SCL = mesoscutellar length
Sn = nth metasomal sternum
SPL = scape length (a straight line from base to tip of scape)
Tn = nth metasomal tergum
UOD = upper interorbital distance
WL = wing length (length of fore wing from the apical point to the base including tegula)

Body measurements are given in ranges followed by the average and standard deviation.

Flower records

Records of flowers visited by each species are based on specimen label data. The scientific names of flowering plants visited by bees are cited from Yonekura & Kajita (2003–).

DNA barcoding

DNA extraction and PCR were conducted at the Kyushu University Museum (Fukuoka, Japan). DNA was extracted using a DNeasy Blood and Tissue Kit (Qiagen, Tokyo, Japan) following the manufacturer's instructions. A region of the cytochrome oxidase subunit I (COI) gene of mtDNA was amplified using polymerase chain reaction (PCR) with the primers LCO1490 (5′-GGTCAACAAATCATAAAGATATTGG-3′) and HCO2198 (5′-TAAACTTCAGGGTGACCAAAAAATCA- 3′) (Folmer *et al*. 1994). Each PCR mixture contained 2 µl of DNA template, 2.13 µl of 10× EX Taq Buffer (Takara bio), 0.75 µl of each primer (20 µM), 1.68 µl of dNTP (2.5 mM, Takara bio), and 0.25 µl of EX Taq DNA polymerase (Takara bio). MilliQ water was added to reach a total reaction volume of 20 µl. PCR conditions were as follows: 94 °C for 1 min, followed by 10 cycles of 94 °C for 1 min, 48 °C for 1 min 30 s, and 72 °C for 1 min 30 s, then 30 cycles at 94 °C for 1 min, 52 °C for 1 min 30 s, 72 °C for 1 min 30 s, and a final 72 °C for 5 min. PCR products were run on a 1% agarose gel for 20 min, and then purified with 2.6 µl of ExoSAP-IT (GE Healthcare Life Sciences). DNA sequencing was outsourced to the FASMAC Co., Ltd. (Kanagawa, Japan). The resulting sequences were aligned using the program MEGA (ver. 5; Tamura *et al*. 2011). The sequence data reported in the present paper are deposited at the DNA Data Base of Japan (DDBJ).

Comparative material examined

IRAN: *Lasioglossum* (*Dialictus*) *aeratum* (Kirby, 1802): 1 ♂, Kuhha-ye, Tu-Chal, N Iran, alt. 2000–2500 m, 18–19 Jul. 1970 (C. Elburz, MNHAH).

IRAN: *Lasioglossum* (*Dialictus*) *algirum* (Blüthgen, 1923): 1 ♂, Kopet Dagh, 30 km N Quchan, Paßhöhe, alt. 2000 m, 18 Jul. 1977 (J. Gusenleitner, MNHAH).

IRAN: *Lasioglossum* (*Dialictus*) *annulipes* (Morawitz, 1876): 1 ♂, Kopet Dagh, 30 km N Quchan, Paßhöhe, alt. 2000 m, 18 Jul. 1977 (J. Gusenleitner, MNHAH).

AUSTRIA: *Lasioglossum* (*Dialictus*) *leucopus* (Kirby, 1802): 1 ♂, Kärnten, Farchtnersee, 23 Aug. 1983 (J. Gusenleitner, MNHAH).

CHINA: *Lasioglossum* (*Dialictus*) *sanitarium* (Blüthgen, 1926): 15 ♀♀, 4 ♂♂, Fukien, Chungan, Bohea Hill, 6 May 1938 (T.C. Maa, BPBM).

CHINA: *Lasioglossum* (*Dialictus*) *sichuanense* Fan & Ebmer, 1992: 1 ♀ (paratype), Omei, Sichuan (label in Chinese), 10 May 1964 (MNHAH); 1 ♂, Lijiang, alt. 1800 m, Yunnan Prov., 26°53' N 100°18' E, 23 Jun.–21 Jul. 1992 (S. Becvar, cMur).

CHINA: *Lasioglossum* (*Dialictus*) *xizangense* Fan & Ebmer, 1992: 4 ♀♀, Fukien, Chungan, Bohea Hill, May 1938 (T.C. Maa, BPBM); 1 ♂ (paratype), Motuo, Xizang (label in Chinese), alt. 1300 m, 27 Nov. 1982 (Han Yin-heng, MNHAH).

Results

Class Hexapoda Blainville, 1816
Order Hymenoptera Linnaeus, 1758
Superfamily Apoidea Latreille, 1802
Epifamily Anthophila Latreille, 1804
Family Halictidae Thomson, 1869
Subfamily Halictinae Thomson, 1869
Tribe Halictini Thomson, 1869

Genus ***Lasioglossum*** Curtis, 1833

Lasioglossum (*Dialictus*) Robertson, 1902.

Paralictus Robertson, 1901: 229. Type species: *Halictus cephalicus* Robertson, 1892 (preoccupied by Morawitz 1873 = *Halictus cephalotes* Dalla Torre, 1896), by original designation.

Dialictus Robertson, 1902: 48. Type species: *Halictus anomalus* Robertson, 1892, by original designation and monotypy.

Chloralictus Robertson, 1902: 248. Type species: *Halictus cressonii* Robertson, 1890, by original designation.

Halictus (*Gastrolictus*) Ducke, 1902: 102. Type species: *Halictus osmioides* Ducke, 1902, by monotypy.

Halictomorpha Schrottky, 1911: 81. Type species: *Halictomorpha phaedra* Schrottky, 1911, by original designation.

Rhynchalictus Moure, 1947: 5. Type species: *Rhynchalictus rostratus* Moure, 1947, by original designation.

Halictus (*Smeathhalictus*) Warncke, 1975: 88. Type species: *Melitta smeathmanella* Kirby, 1802, by original designation.

Habralictellus Moure & Hard, 1982: 46. Type species: *Halictus auratus* Ashmead, 1900, by original designation.

Lasioglossum (*Afrodialictus*) Pauly, 1984: 142. Type species: *Halictus bellulus* Vachal, 1909, by original designation.

Evylaeus (*Viridihalictus*) Pesenko, 2007a: 26. Type species: *Halictus viridis* Brullé, 1840, by original designation.

Evylaeus (*Glauchalictus*) Pesenko, 2007a: 26. Type species: *Halictus problematicus* Blüthgen, 1923, by original designation.

Evylaeus (*Virenshalictus*) Pesenko, 2007a: 26. Type species: *Halictus virens* Erichson, 1835, by original designation.

Evylaeus (*Loethalictus*) Pesenko, 2007a: 26. Type species: *Halictus loetus* Brullé, 1840, by original designation.

Evylaeus (*Aerathalictus*) Pesenko, 2007a: 27. Type species: *Melitta aerata* Kirby, 1802, by original designation.

Diagnosis

This subgenus is usually separated from the other subgenera of *Lasioglossum* occurring in eastern Asia by having a combination of the head and mesosoma with brilliant or dull green-metallic luster in both sexes and the female fore wing with a weak second submarginal vein. In eastern Asia, the female of the

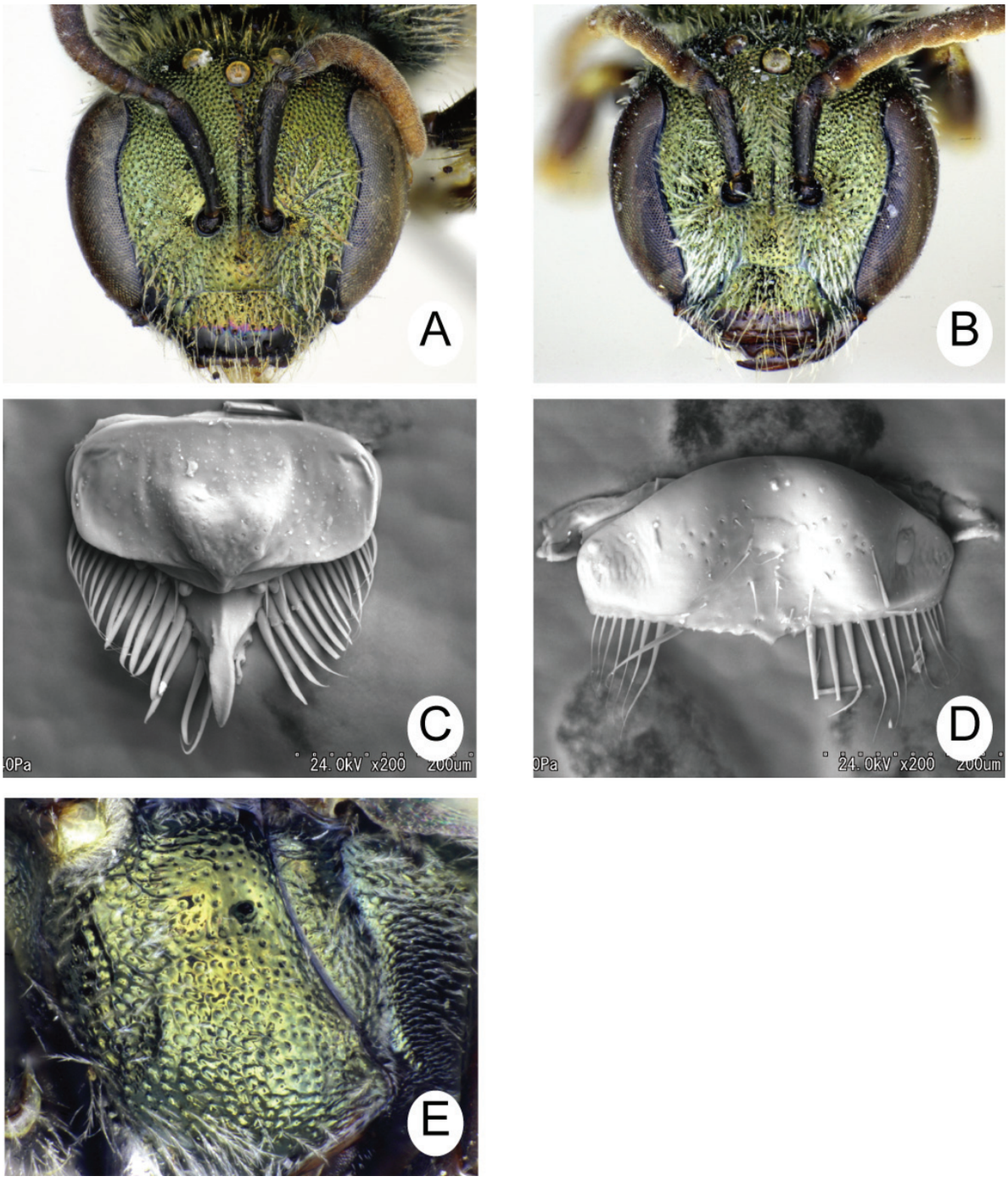

Fig. 1. A–E. *Lasioglossum* (*Dialictus*) *viridellum* (Cockerell, 1931). **A–B**. Head in frontal view. **C–D**. Labrum. **E**. Mesepisternum. A, C. ♀. B, D–E. ♂.

apristum group belonging to *L.* (*Sphecodogastra*) (corresponding to the carinate *L.* (*Evylaeus*) in the dissenting classification (Ebmer 2002; Pesenko 2007a, as the genus *Evylaeus*)) has the same character states as *L.* (*Dialictus*). However, the members of this group can easily be separated from *L.* (*Dialictus*) in having the mesepisternum coarse reticulate-rugulose, the posterior surface of the propodeum with strong complete carina, and the inner hind tibial spur finely serrate.

Comments

As stated above, the green *L.* (*Evylaeus*) used by most Palaearctic researchers corresponds to *L.* (*Dialictus*) in the recent classification. Pesenko (2007a) re-classified *Evylaeus sensu lato* into 29 subgenera for the Palaearctic Region. In his systematic study, 6 of the subgenera (*Aerathalictus* Pesenko, *Glauchalictus* Pesenko, *Loethalictus* Pesenko, 2007, *Smeathhalictus* Warncke, 1975, *Viridihalictus* Pesenko, 2007 and *Virenshalictus* Pesenko, 2007) correspond to *L.* (*Dialictus*) as shown above in the synonymy list (synonymies by Gibbs 2010). These subgenera *sensu* Pesenko (2007a) are treated as a species group in this paper.

The leucopus *group*

Species included in eastern Asia:
L. aeratum (Kirby, 1802)
L. algirum (Blüthgen, 1923)
L. angaricum (Cockerell, 1937)
L. leucopus (Kirby, 1802)
L. meakanense Murao & Tadauchi, 2009
L. pseudannulipes (Blüthgen, 1925)
L. viridellum (Cockerell, 1931)

Among the members of this group, both *L. meakanense* and *L. pseudannulipes* are known from Japan, and *L. viridellum* from the Korean Peninsula.

Diagnosis

Species of the *leucopus* group may be strictly characterized by a combination of the following character states: 1) male F2 short, approximately 1.2–1.5 × as long as F1; 2) mesepisternum reticulate-punctate on lower area in both sexes (Fig. 1E); 3) male metasomal sterna not modified (apical margin straight); 4) ventral retrorse lobe of male genitalia with moderately long setae only apically and distinct lineolation on surface (Fig. 2D, F–I).

The diagnostic characters of this group are also shown in Ebmer & Sakagami (1990, as the *leucopus* group) and Pesenko (2007a, as subgenus *Aerathalictus* Pesenko, 2007).

Distribution

Palaearctic to northern Oriental Region.

Comments

This group is assumed to be monophyletic, based on the ventral retrorse lobe of male genitalia with moderately long setae only apically and the distinct lineolation on the surface. This character state may be unique within the subgenus. A comprehensive comparative study of the ventral retrorse lobe has not been performed for the subgenus, but this state may be an autapomorphy for the *leucopus* group.

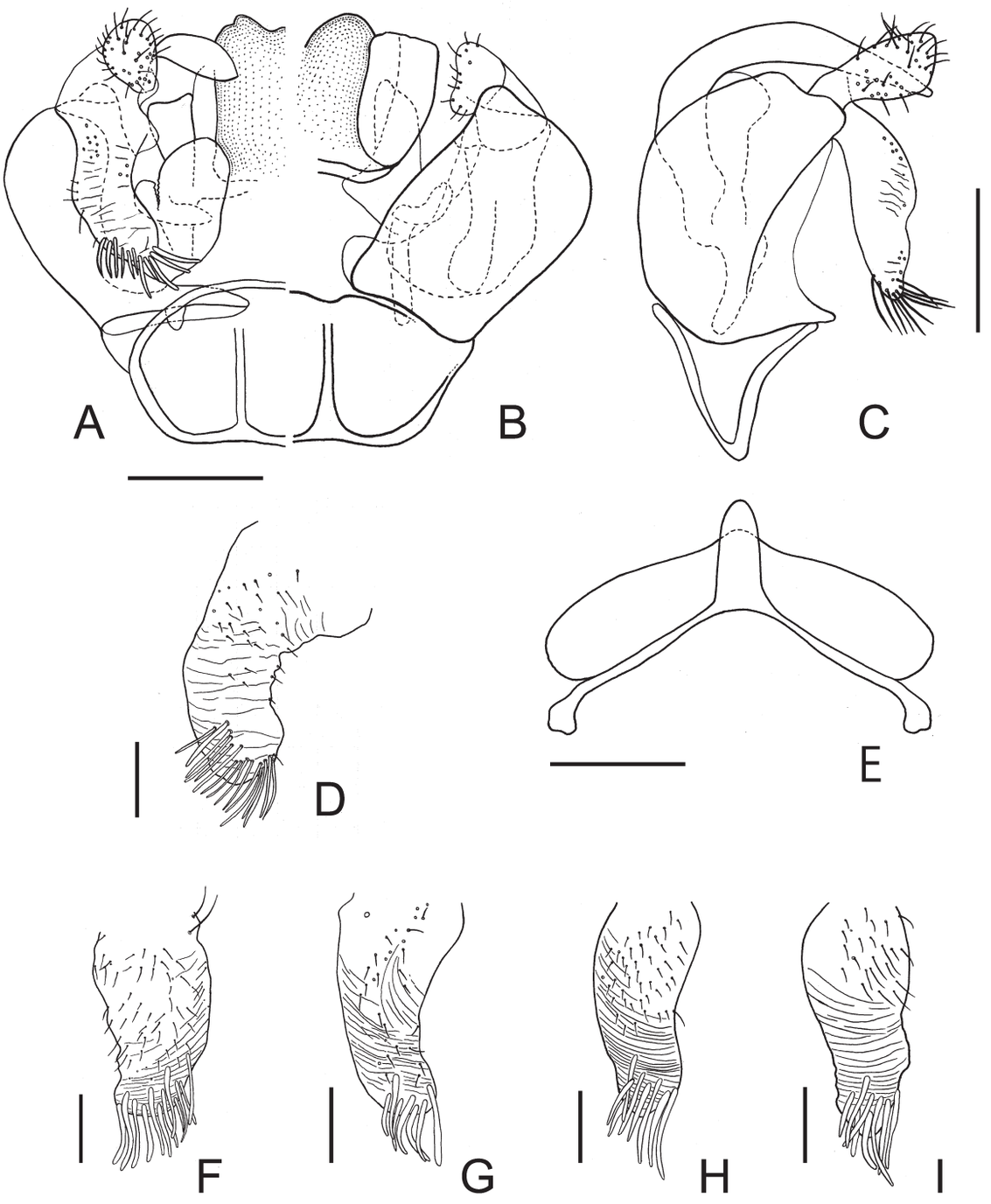

Fig. 2. — **A–E**. *Lasioglossum* (*Dialictus*) *viridellum* (Cockerell, 1931), ♂. — **F**. *L*. (*D*.) *aeratum* (Kirby, 1802), ♂. — **G**. *L*. (*D*.) *aligrum* (Blüthgen, 1923), ♂. — **H**. *L*. (*D*.) *annulipes* (Morawitz, 1876), ♂. — **I**. *L*. (*D*.) *leucopus* (Kirby, 1802), ♂. A. Genitalia in ventral view. B. Genitalia in dorsal view. C. Genitalia in lateral view. D, F–I. Ventral retrorse lobe of genitalia. E. S7–S8. Scale bars: A–C, E = 0.2 mm, D, F–I = 0.1 mm.

Lasioglossum* (*Dialictus*) *pseudannulipes (Blüthgen, 1925)
Figs 3A, 25B

Halictus pseudannulipes Blüthgen, 1925: 128 (holotype: Museum für Naturkunde Humboldt an der Universität zu Berlin, Germany, ♀; type locality: Kwangtung Prov. (Guangdong Prov.), China).

Halictus pseudannulipes – Hirashima 1957: 16.
Lasioglossum (*Evylaeus*) *algirum pseudannulipes* – Ebmer 1978: 313. — Ebmer & Sakagami 1990: 835–837.
Lasioglossum (*Evylaeus*) *pseudannulipes* – Murao *et al*. 2009a: 166–171 (♂).

Diagnosis

This species is similar to *Lasioglossum angaricum* (Cockerell, 1937) and *L. viridellum* (Cockerell, 1931) from eastern Asia in the *leucopus* group. It is separated from *L. angaricum* by the female T1 usually being without lineolation (sometimes T1 basally lineolate, but weaker than in *L. angaricum*) and the male sterna with sparse uniform hairs. In contrast, in *L. angaricum* the female T1 has distinct lineolation and the male S3–S5 is medially bare, laterally with tufts of long dense erect hairs (Pesenko 2007b). For the differences between females of this species and *L. viridellum*, see Key.

Material examined

JAPAN: Kyushu: 1 ♀, Matoishi wilderness, Aso-machi, Aso-shi, Kumamoto Pref., 37°27’15” N 128°1’10” E, 14 Aug. 2010 (R. Murao, cMur); 8 ♀♀, Aso-shi, Kumamoto Pref., 33°0’16.115” N 131°8’5.658” E, 21 Jul. 2013 (R. Murao, cMur).

Distribution

China (Guangdong Prov.), Japan (Hokkaido, Honshu, and Kyushu).

Flight records

Female: April to October.
Male: June to October.

Flower records

Thirty-two species in 6 families were reported as floral hosts in Japan by Goubara *et al*. (2004).

Habitat

This species was collected from grassland in the Kumamoto Pref., Kyushu, western Japan. One of the collecting sites there is shown in Fig. 23B.

DNA barcodes

The COI gene sequences are deposited as DNA barcodes of *L*. (*D*.) *pseudannulipes* in the DDBJ under accession numbers LC027534 and LC027535. These numbers are also available in GenBank.

Lasioglossum* (*Dialictus*) *viridellum (Cockerell, 1931)
Figs 1, 2A–E, 3B

Halictus (*Chloralictus*) *viridellus* Cockerell, 1931: 14 (holotype: American Museum of Natural History, New York, USA, ♀; type locality: Shanghai, China).

Halictus (*Chloralictus*) *viridellus* – Hirashima 1957: 24.

Lasioglossum (*Evylaeus*) *viridellum* – Ebmer 1978: 312–313 (♂). — Ebmer 1996: 283–284. — Ebmer 2006: 568.
Evylaeus (*Aerathalictus*) *viridellus* – Pesenko, 2007a: 27. — Pesenko 2007b: 85 (in key), 97 (in key), 114.

Diagnosis

This species is closely similar to *Lasioglossum angaricum* (Cockerell, 1937) and *L. pseudannulipes* (Blüthgen, 1925), as stated above. It is separated from *L. angaricum* by the disc of male sterna having sparse and uniform hairs. In contrast, in *L. angaricum*, the male S3–S5 are medially bare, laterally with tufts of long dense erect hairs (Pesenko 2007b).

Material examined

SOUTH KOREA: Gangwon-do: 2 ♀♀, 2 ♂♂, Hong Cheon, 5–6 Jun. 1984 (K. Morimoto, ELKU); Jeju-do, Jeju Is.: 11 ♀♀, Sanisu-dong Namjeju-gun, 23 Apr. 1997 (O. Tadauchi, ELKU); 1 ♀, Pijarim Forests Pukcheju-gun, 24 Apr. 1997 (O. Tadauchi, ELKU); 2 ♀♀, Kwangpyong-ri Namjeju-gun, 23 Apr. 1997 (O. Tadauchi, ELKU).

RUSSIA: 1 ♂, Primorsky Cray, 20 km SE of Spassk forest (label in Russian), 17 Jul. 1995 (Belokobylsky leg., ZISP).

Additional description

Labrum (Fig. 1C–D). Basal area approximately 2.0 × as wide as long in female; basal elevation moderately developed in both sexes, depressed centrally in male; distal process of female slender, nearly as long as basal area, and without lateral projection, that of male absent; keel of distal process narrow, apically pointed; labral fimbria acutely pointed at apex in both sexes. S7–S8 (Fig. 2E): S7 with moderately long, apex exceeding S8; S8 without median process.

Male genitalia (Fig. 2A–D). Gonobase flat at bottom, ventral arms connected with each other at upper ends; gonocoxite smooth, gently sloped in lateral view, inner and outer dorsal margins nearly parallel; gonostylus truncate apically in lateral view, located at top of gonocoxite, with sparse short hairs; ventral retrorse lobe long, reaching gonobase, with long and dense stetae apically (remaining parts with sparse short hairs) and distinct lineolation; penis valve higher than gonocoxite, without cleft on top.

Distribution

Russian Far East (Siberia, Khabarovsk, and Primorsky), China (Heilongjiang Prov., Shanghai), the Korean Peninsula (north, new record for south).

Flight records

Female: April to September.

Male: July to September.

Flower records

In South Korea, it was collected on the flowers of *Potentilla hebiichigo* Yonek. & H. Ohashi (Rosaceae) and *Brassica* sp. (Brassicaceae).

Comments

Male specimens from Primorsky and South Korea are studied in the present paper, including characters of the labrum and genitalia. Through this examination, we have concluded that the males of both this species and *L. pseudannulipes* cannot be clearly separated. A female specimen of this species examined in this study shows weak lineolation on T1 basally (female T1 basally usually with strong lineolation as in Fig. 25A). The character state of this female specimen overlaps with some female specimens

of *L. pseudannulipes* (see the description of Murao *et al*. 2009a). *Lasioglossum viridellum* and *L. pseudannulipes* could possibly represent the same species. It is difficult to resolve this, because we could not examine enough material of *L. viridellum* in this study. This problem needs to be addressed by including DNA analysis in a future study.

Lasioglossum* (*Dialictus*) *meakanense Murao & Tadauchi, 2009
Figs 3A, 26A, 28B

Lasioglossum (*Evylaeus*) *meakanensis* Murao & Tadauchi, 2009a (erroneous spelling): 113–117 (holotype: ELKU, ♂; type locality: Hokkaido, Japan).

Diagnosis

This species is separated from related species by the combination of the following characters: female supraclypeus with sparse PP (IS = 1–4.7), male labrum without basal elevation, and male S4–S5 (particularly S5) laterally with hair tufts that are longer than the surrounding hairs.

Distribution

Japan (Hokkaido). This species has only been collected from Mt. Meakan-dake in the eastern part of Hokkaido.

Flight records

Both sexes: August.

Flower records

Campanula lasiocarpa Cham. (Campanulaceae).

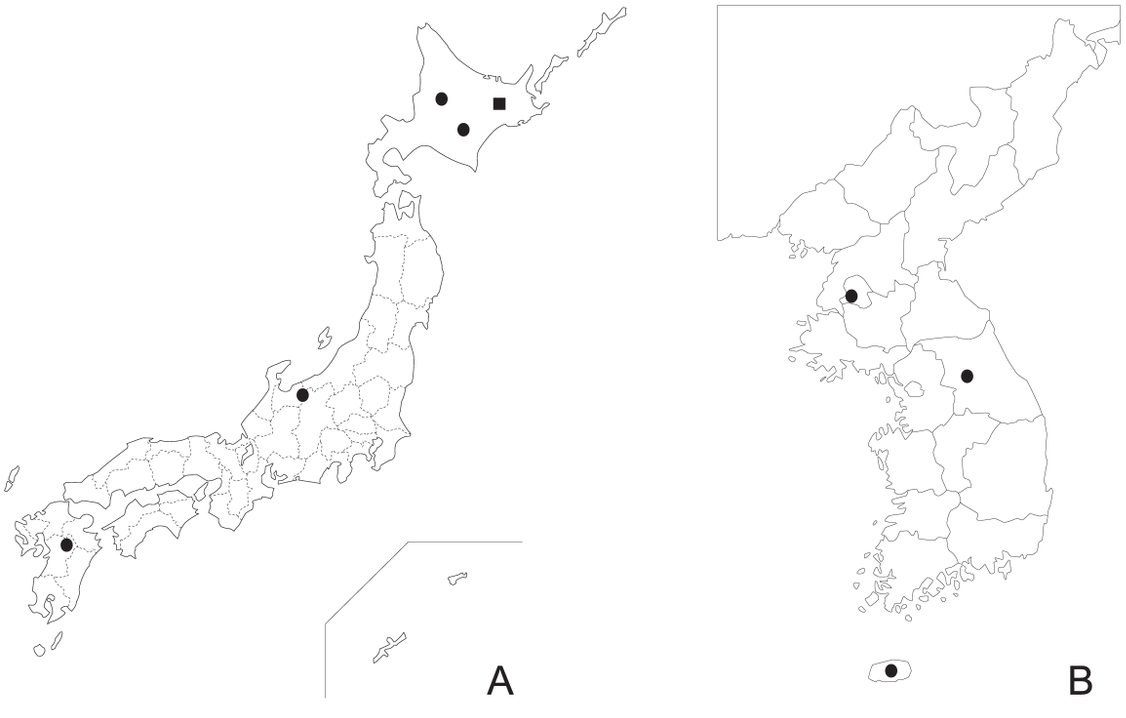

Fig. 3. Distribution maps. **A**. *Lasioglossum* (*Dialictus*) *pseudannulipes* (Blüthgen, 1925) and *L.* (*D.*) *meakanense* Murao & Tadauchi, 2009 in Japan (●: *L. pseudannulipes*. ■: *L. meakanense*). **B**. *Lasioglossum* (*Dialictus*) *viridellum* (Cockerell, 1931) in the Korean Peninsula.

The atroglaucum *group*

Species included:
L. alishanense Murao sp. nov.
L. atroglaucum (Strand, 1913)
**L. callophrys* Ebmer, 2002
**L. kintonense* (Blüthgen, 1926)
**L. mystaphium* Ebmer, 2002
L. negoroi Murao & Tadauchi, 2008
L. problematicum (Blüthgen, 1923)
L. taiwanense Murao sp. nov.
L. sanitarium (Blüthgen, 1926)
**L. sauterum* Fan & Ebmer, 1992
L. sichuanense Fan & Ebmer, 1992
**L. subversicolum* Fan & Ebmer, 1992
**L. versicolum* Fan & Ebmer, 1992
L. virideglaucum Ebmer & Sakagami, 1994
L. yamanei Murao, Ebmer & Tadauchi, 2006

The members of this group marked with an asterisk are tentatively included because the male has not yet been described. Seven species in total are known from the study area: three from Japan, one from Japan and the Korean Peninsula, and three from Taiwan.

Diagnosis

Species of the *atroglaucum* group may be strictly characterized by a combination of the following character states: 1) male F2 approximately 1.7–2.3 × as long as F1; 2) mesepisternum punctate over entire surface in both sexes (e.g., Fig. 6E); 3) male S4 or S5 modified, or with unique hair tufts as in Figs 4, 13–14; and 4) penis valve of male genitalia with high or low cleft on top (Figs 7C, 9C, 11C, 16C, 18C). The diagnostic characters of this group are also shown in Ebmer (2002) and Pesenko (2007a, as subgenus *Glauchalictus* Pesenko, 2007).

In addition, this group can be classified into two subgroups. The *atroglaucum* subgroup (*L. atroglaucum*, *L. negoroi*, *L. taiwanense* sp. nov., *L. virideglaucum*, and *L. yamanei*) is characterized by a combination of the male S5 with apical depression and without brush-like hairs (Fig. 5B, E, H, K, N), and the gonostylus of male genitalia without setae on the inner surface. The *problematicum* subgroup (*L. alishanense* sp. nov., *L. problematicum*, *L. sanitarium*, and *L. sichuanense*) is characterized by the male S5 with brush-like hairs along apical margin (Figs 13, 14B, E, H) and the gonostylus of male genitalia with dense short setae on the inner surface (Fig. 16D). The latter subgroup can be regarded as a monophyletic group by the characters of the male S5 and genitalia. These character states are unique in the subgenus and are considered to be autapomorphies.

Distribution

This group is distributed from the Far East to southern Asia. It is diverse in the northern Oriental Region.

Comments

Lasioglossum miyabei Murao, Ebmer & Tadauchi, 2006, *L. pronotale* Ebmer, 2002, and *L. xizangense* Fan & Ebmer, 1992 are included as members of the *atroglaucum* group *sensu* Ebmer (2002) and Murao *et al*. (2006). These three species, however, do not share character states 3) and 4). They are considered to constitute another, separate group of its own.

The atroglaucum *subgroup*

Lasioglossum* (*Dialictus*) *atroglaucum (Strand, 1913)
Figs 4A, 5A–C, 6, 7, 12A

Halictus atroglaucus Strand, 1913: 170 (holotype: SDEI, ♂; type locality: Suisharyo, Formosa).

Halictus atroglaucus – Hirashima 1957: 5.
Lasioglossum (*Evylaeus*) *atroglaucum* – Ebmer 2002: 860–861.

Diagnosis

This species is easily separated from other members of the *atroglaucum* subgroup by the male S4 having dense and curly plumose hairs (Fig. 4A) and by the shape of the gonostylus (Fig. 7C).

Material examined

Holotype

TAIWAN: ♂ (Code No. DEIGISHym10517), Suisharyo, 11 Oct. (Sauter leg., SDEI).

Additional material

TAIWAN: 1 ♂, Ya Kou, alt. 2800 m, Kao Hsiung Hsien, S-Taiwan, 1 Aug. 1986 (K. Baba, ELKU); 3 ♂♂, Yu Shih, (alt. 1900 m), Nao Tow Hsien, M-Taiwan, 4 Jul. 1986 (K. Baba, ELKU); 1 ♂, Hehuanxi, 23 Jun. 1976 (H. Makihara, ELKU).

Measurements (n= 5, unit mm)

BL = 5.57–7.29 (6.17 ±0.66), WL = 4.86–5.29 (5.06 ±0.22), HL = 1.29–1.42 (1.37 ±0.05), HW = 1.35–1.39 (1.38 ±0.01), IOD = 0.24–0.29 (0.26 ±0.02), OOD = 0.23–0.26 (0.24 ±0.01), OCD = 0.16–0.19 (0.18 ±0.01, n= 4), UOD = 0.84–0.87 (0.85 ±0.02), MOD = 0.97–1.00 (0.99 ±0.02), LOD = 0.50–0.58 (0.55 ±0.03), IAD = 0.19–0.23 (0.21 ±0.01), AOD = 0.16–0.18 (0.16 ±0.01), CAL = 0.23–0.27 (0.25 ±0.02), CPL = 0.34–0.37 (0.35 ±0.01), EL = 1.00–1.10 (1.06 ±0.04), EW = 0.45–0.50 (0.49 ±0.02), GW = 0.25–0.35 (0.30 ±0.04), SPL = 0.31–0.34 (0.32 ±0.01), F1L = 0.13–0.16 (0.14 ±0.01), F2L = 0.27–0.29 (0.28 ±0.01), F3L = 0.27–0.32 (0.31 ±0.02), F2W = 0.13–0.16 (0.15 ±0.01), MsW = 1.50–1.60 (1.55 ±0.06, n= 4), SCL = 0.34–0.38 (0.36 ±0.02), MNL = 0.18–0.23 (0.20 ±0.02), MPL = 0.30–0.34 (0.33 ±0.02), MtW = 1.00–1.15 (1.07 ±0.07).

Redescription

Male

Coloration. Body black except for the following parts: head dark green and mesosoma metallic green; clypeus yellow on lower half; mandible reddish brown apically; flagellum blackish brown ventrally; tegula blackish brown translucent; tibial spur yellow; metasomal terga narrowly brown translucent apically. Wings transparent, veins and stigma brown.

Pubescence. Body hairs whitish, and covered with erect and sparse fine, branched hairs except for the following parts: lower paraocular area with sparse tomentose; lower clypeus with sparse simple hairs; tibial and tarsal hairs nearly simple; disc of metasomal terga with sparse and simple short hairs; disc of S2–S3 apically with moderately dense fine, branched hairs; disc of S4 apically with dense and curly plumose hairs (Fig. 4A); disc of S5 with sparse short and simple hairs, mixed with sparse fine, branched hairs laterally; disc of S6 with sparse short and simple hairs.

Head. As long as wide; HW:HL = 1:0.99. Vertex rounded in frontal view. MOD:UOD:LOD = 1:0.86:0.56. IOD:OOD:OCD = 1:0.90:0.67. IAD:AOD = 1:0.76. Ocellocular and paraocular areas and frons dull,

with reticulate PP. Supraclypeal area weakly convex, dull, with sparse PP, IS distinctly tessellate (IS = 1–4). CPL:CAL = 1:0.72. Clypeus nearly flat, with sparse PP, IS weakly tessellate (IS = 1–4.5). EW:GW = 1:0.61. Genal area with straight ridges and distinct tessellation. Malar space linear. Occiput not carinate. Postgena weakly tessellate. Mandible edentate. Labrum (Fig. 6C) without basal elevation and distal process. Antenna long, reaching metasoma. F2L:F2W = 1:0.54; flagellum nearly flattened ventrally.

Thorax. Dorsolateral angle of pronotum obtuse; lateral surface without ridges; lateral lobe rounded. Tegula ovoid, nearly smooth. Mesoscutum (Fig. 6D) with moderately dense PP on marginal area,

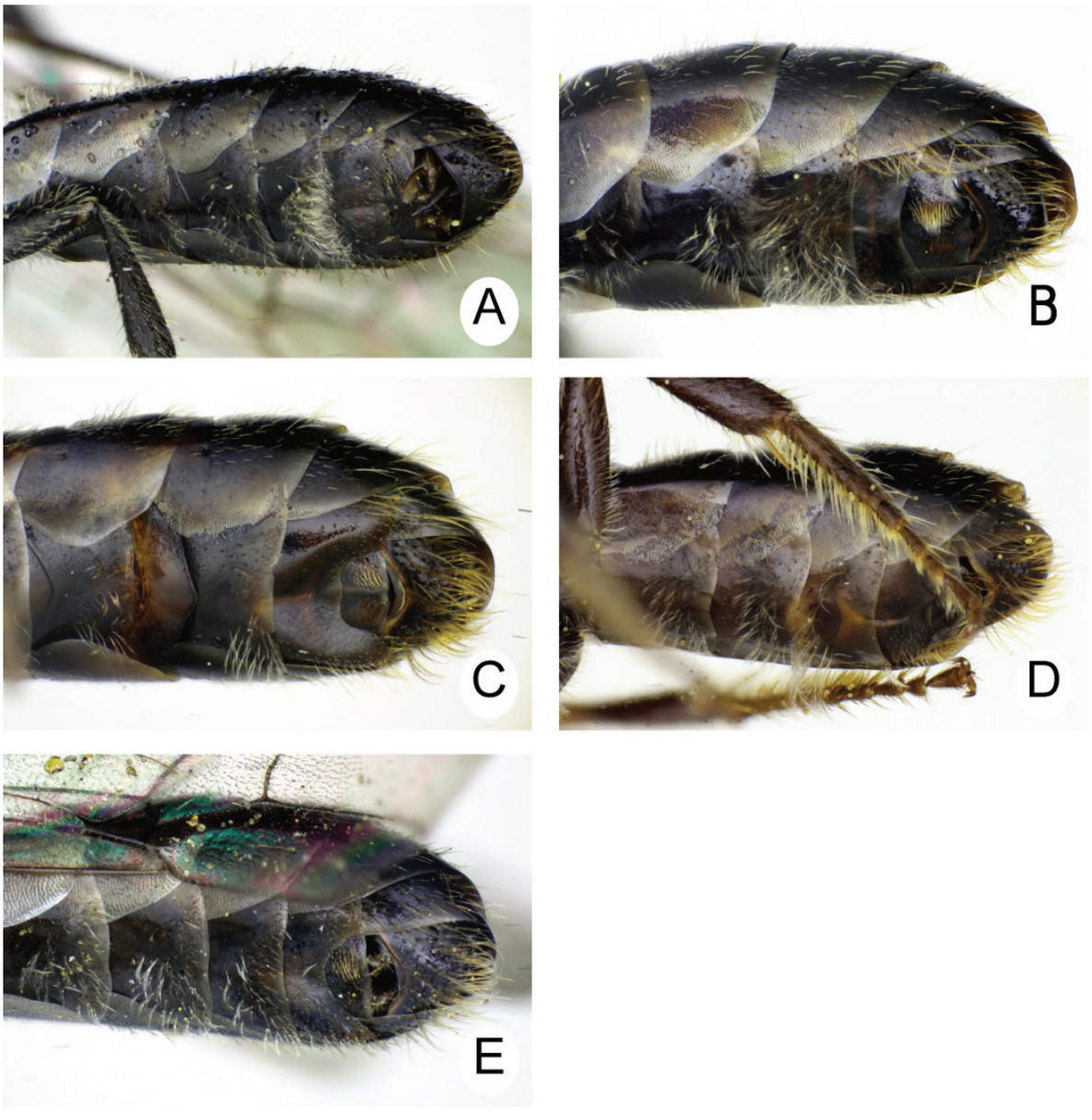

Fig. 4. Hairs on metasomal sterna in species of the *atroglaucum* subgroup, ♂. **A**. *Lasioglossum* (*Dialictus*) *atroglaucum* (Strand, 1913). **B**. *Lasioglossum* (*Dialictus*) *virideglaucum* Ebmer & Sakagami, 1994. **C**. *Lasioglossum* (*Dialictus*) *yamanei* Murao *et al*., 2006. **D**. *Lasioglossum* (*Dialictus*) *negoroi* Murao & Tadauchi, 2008, holotype. **E**. *Lasioglossum* (*Dialictus*) *taiwanense* Murao sp. nov., holotype.

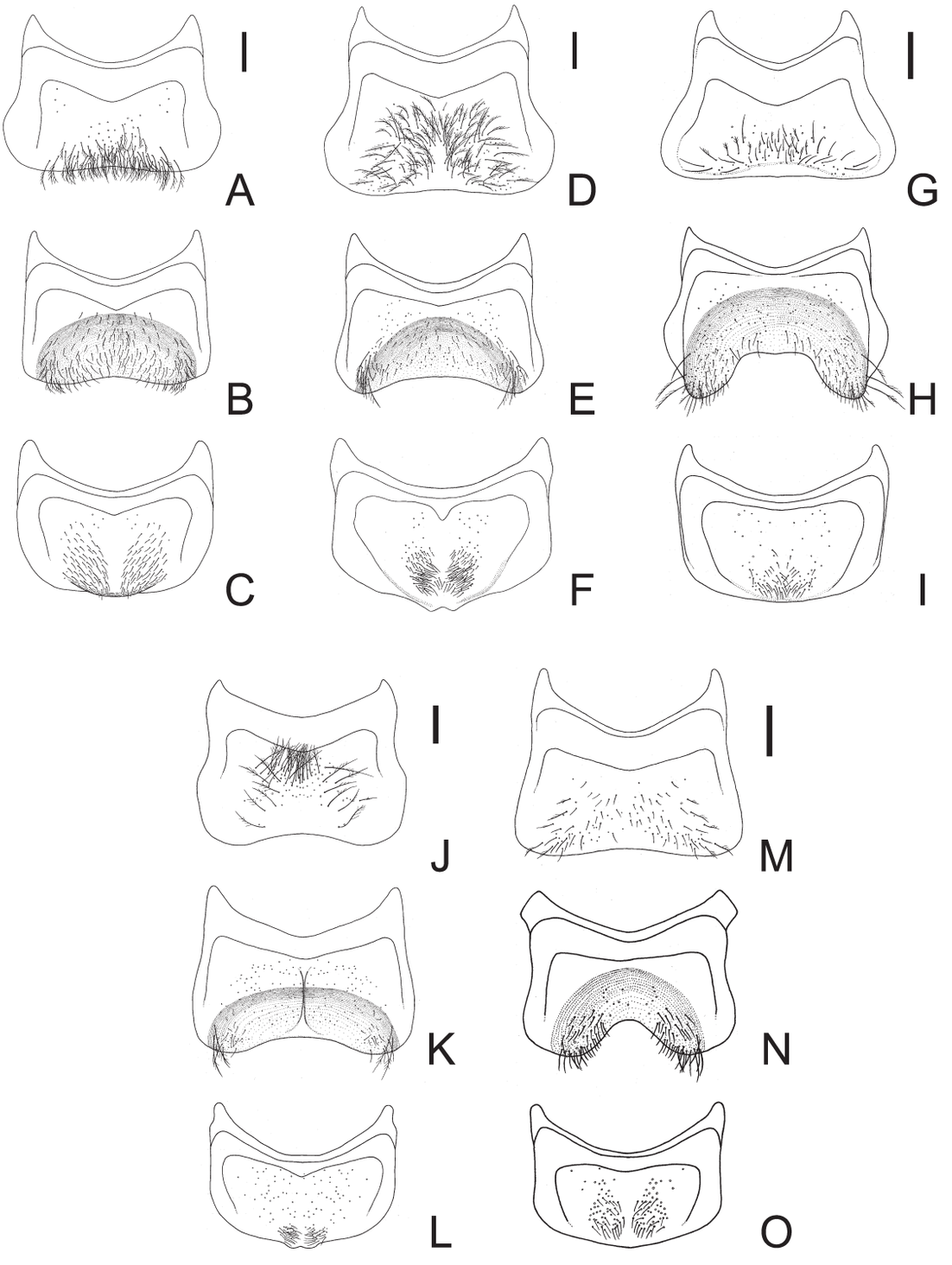

Fig. 5. S4–S6 in species of the *atroglaucum* subgroup, ♂. — **A–C**. *Lasioglossum* (*Dialictus*) *atroglaucum* (Strand, 1913). — **D–F**. *Lasioglossum* (*Dialictus*) *virideglaucum* Ebmer & Sakagami, 1994. — **G–I**. *Lasioglossum* (*Dialictus*) *yamanei* Murao *et al*., 2006 — **J–L**. *Lasioglossum* (*Dialictus*) *negoroi* Murao & Tadauchi, 2008, paratype. — **M–O**. *Lasioglossum* (*Dialictus*) *taiwanense* Murao sp. nov., paratype. A, D, G, J, M: S4. B, E, H, K, N: S5. C, F, I, L, O: S6. Dotted area on S5 shows the apical depression. Scale bars: 0.2 mm.

gradually sparse toward anterior to medial areas; IS weakly tessellate anteriorly, but nearly smooth medially and posteriorly (IS = 0.5–2 in marginal area, 1.5–4.5 in anterior to medial areas); parapsidal line a narrow groove. Mesoscutellum with dense PP over entire surface, IS smooth (IS = 1–2). Metanotum weakly rugulose. Mesepisternum (Fig. 6E) shiny, with sparse PP over entire surface, IS smooth (IS = 1.5–6). SCL:MNL:MPL = 1:0.55:0.91. Propodeum: metapostnotum (Fig. 6F) gently inclined, with longitudinal ridges not reaching posterior margin; junction between metapostnotum and posterior surface

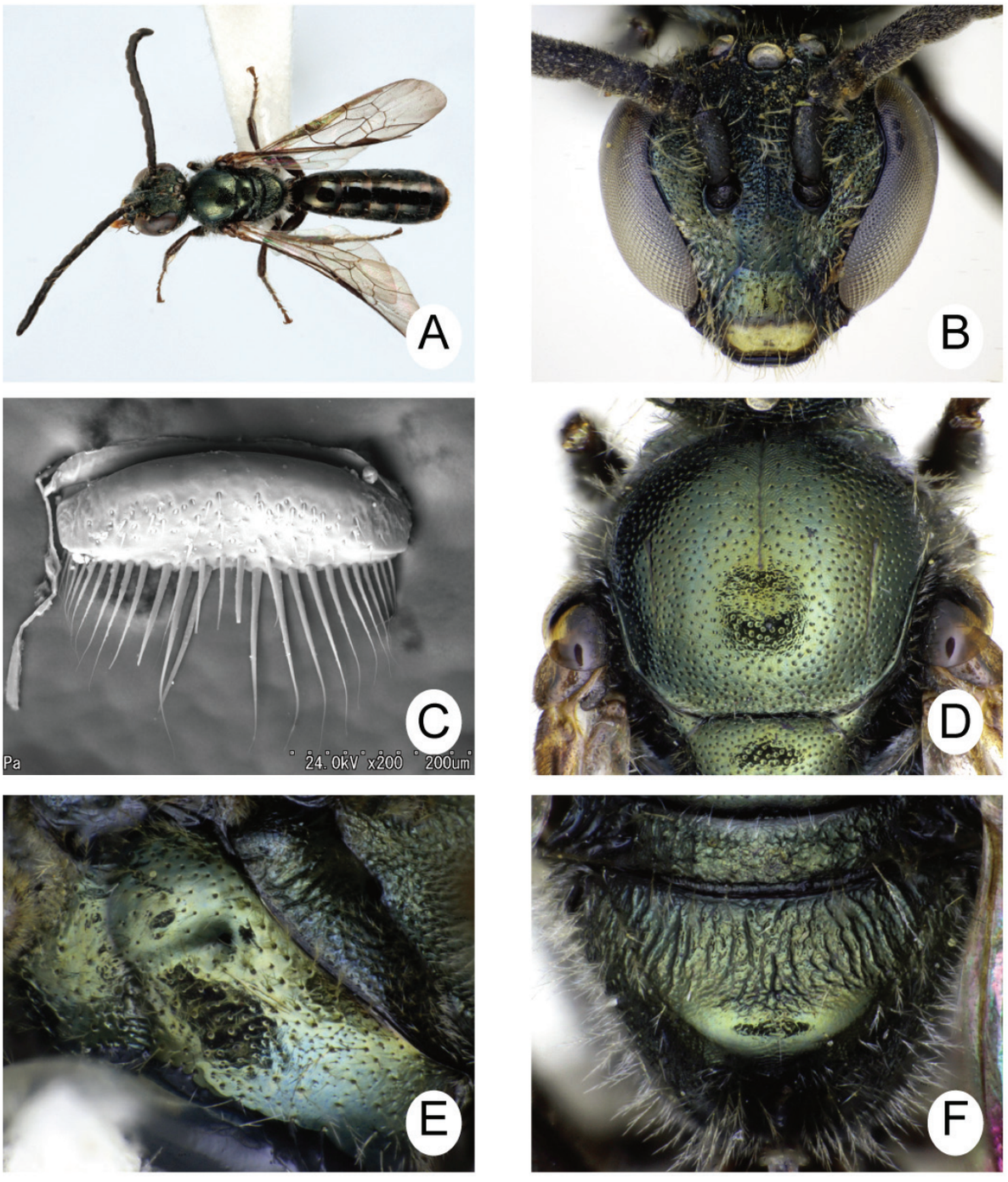

Fig. 6. *Lasioglossum* (*Dialictus*) *atroglaucum* (Strand, 1913), ♂. **A**. General habitus. **B**. Head in frontal view. **C**. Labrum. **D**. Mesoscutum. **E**. Mesepisternum. **F**. Metapostnotum.

smooth, not carinate; lateral surface weakly rugulose; posterior surface with lateral carina on lower half, without oblique carina. Fore trochanter narrow, longer than wide. Hind tibia without basitibial plate. Hind basitarsus slender, approximately 4.6 × as long as wide. Inner hind tibial spur finely serrate. Fore wing with three submarginal cells.

Abdomen. Discs of T1–T3 with sparse fine PP. T1 without lineolation. Lineolation on T2 basally, on T3–T5 over entire surface. Apical margin of S4–S6 nearly straight (Fig. 5A–C). S5 with shallow apical depression (Fig. 5B). S7–S8 (Fig. 7E): median process of S7 triangular, apex not exceeding S8; S8 without median process.

Genitalia (Fig. 7A–D). Gonobase flat at bottom, ventral arms not connected with each other at upper ends; gonocoxite smooth, gently sloped in lateral view, inner dorsal margin angulate at the approximately basal half; gonostylus small and thin, bud-like in lateral view, located on top of gonocoxite, and with

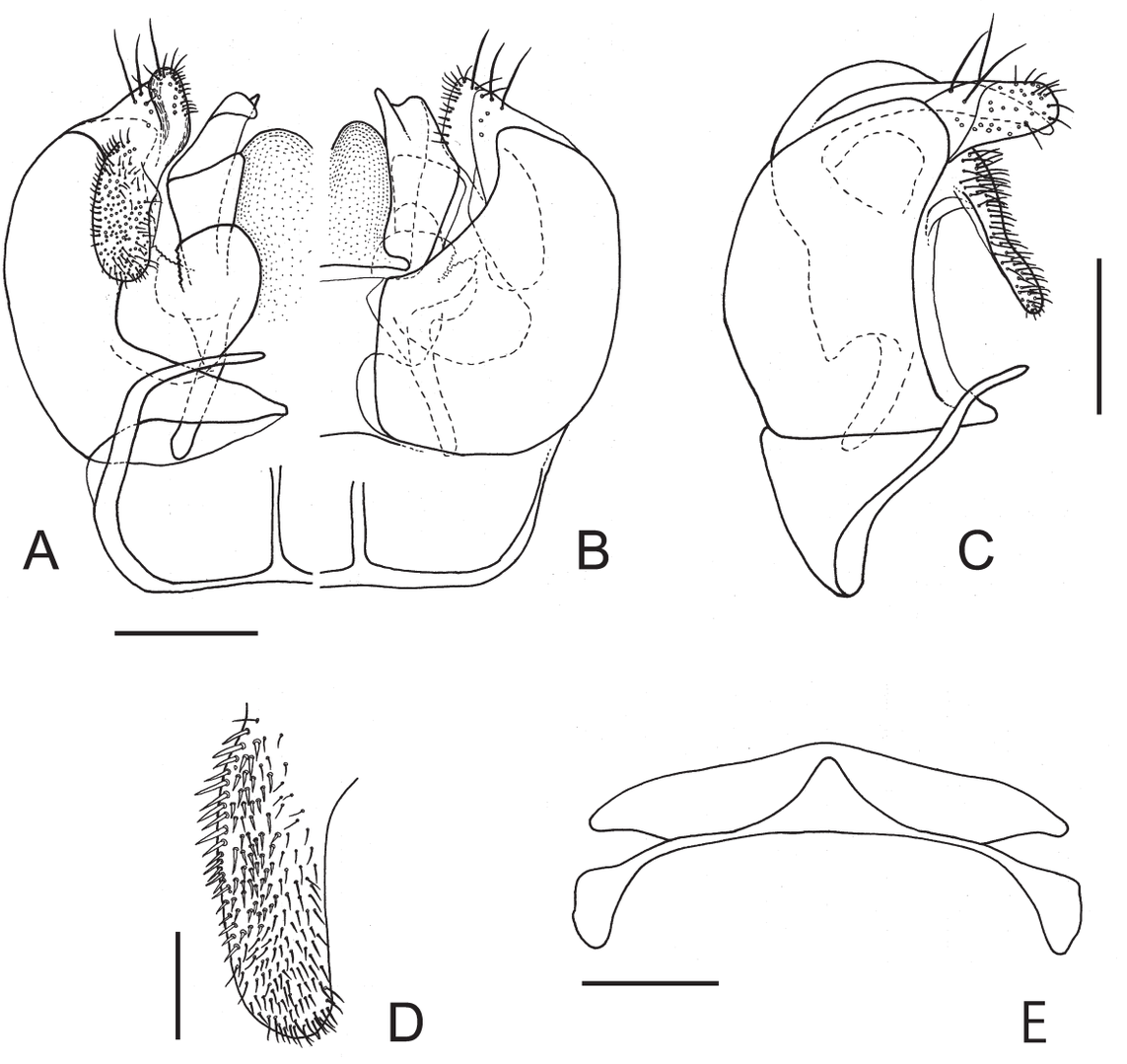

Fig. 7. *Lasioglossum* (*Dialictus*) *atroglaucum* (Strand, 1913), ♂. **A**. Genitalia in ventral view. **B**. Genitalia in dorsal view. **C**. Genitalia in lateral view. **D**. Ventral retrorse lobe of genitalia. **E**. S7–S8. Scale bars: A–C, E = 0.2 mm, D = 0.1 mm.

sparse short and a few relatively long hairs; ventral retrorse lobe tongue-like, moderately long but not reaching gonobase, with dense short setae; penis valve higher than gonocoxite, with low cleft on top.

Female

Unknown.

Distribution

Taiwan.

Flight period

Male: late June to early August.

Flower records

Not recorded.

Lasioglossum* (*Dialictus*) *virideglaucum Ebmer & Sakagami, 1994
Figs 4B, 5D–F, 8, 9, 12B–C, 24B

Lasioglossum (*Evylaeus*) *virideglaucum* Ebmer & Sakagami *in* Ebmer *et al*., 1994: 27–31 (holotype: Andreas Werner Ebmer's collection, Linz, Austria, ♂; type locality: Heishu, Yunnan Prov., China).

Lasioglossum (*Evylaeus*) *virideglaucum* – Ebmer 2002: 864–865. — Ebmer 2006: 564. — Murao *et al*. 2006: 50.
Evylaeus (*Glauchalictus*) *virideglaucus* – Pesenko 2007b: 85 (in key), 99 (in key), 115. — Pesenko 2007a: 26.

Diagnosis

This species is separated from the other members of the *atroglaucum* subgroup by a combination of the following characters: disc of male S4 with short and moderately dense hairs (Fig. 4B); male S6 with a pair of thin hair tufts (Fig. 4B); and the gonostylus of male genitalia nearly rounded on top (Fig. 9C).

Material examined

Paratypes

JAPAN: 2 ♂♂, Kosugidani-Hananoego, Yaku Is., Kagoshima Pref., 24 Jul. 1952 (Takeya & Hirashima, MNHAH).

Additional material

JAPAN: Honshu: 1 ♂, Kuzukawa (Hiraka), Aomori Pref., 26 Aug. 1983 (M. Yamada, MNHAH); 4 ♂♂, Ashiro, Iwate Pref., 19 Sep. 1976 (Y. Maeta, ELKU); 1 ♂, Takeshikakami-honiri, Ueda-shi, Nagano Pref., 18 Sep. 2011 (R. Murao, cMur); 1 ♂, Arimine, Ôyama-machi, Toyama Pref., 6 Oct. 1993 (H. Negoro, MNHAH); 3 ♂♂, Masutomi, Yamanashi Pref., 3 Sep. 1975 (J. Emoto, ELKU). Kyushu: 1 ♂, Mt. Hiko-san, Fukuoka Pref., 3 Oct. 1965 (S. Ibe, ELKU); Mt. Kujyu, alt. 1600–1700 m, Oita Pref., 8 ♀♀, 3 ♂♂, 19 Sep. 1972 (ELKU), 143 ♂♂, 29 Aug. 1978 (ELKU); 1 ♀, Mt. Taisen, Takeda-shi, Oita Pref., 7–9 Jun. 1978 (ELKU); 2 ♀♀, Matoishi, Aso-machi, Aso-gun, Kumamoto Pref., 12 Sep. 2004 (T. Sugimoto, ELKU); 1 ♂, Sobozan (Bungo), 9 Sep. 1933 (K. Yasumatsu, ELKU); 1 ♀, Mt. Sobo, Gokasho, Takachiho, Miyazaki Pref., 27 Apr. 2003 (O. Tadauchi, ELKU); 2 ♂♂, Kosugidani-Hananoego, Yaku Is., Kagoshima Pref., 24 Jul. 1952 (Takeya & Hirashima, ELKU).

SOUTH KOREA: Gangwon-do: 2 ♂♂, Mt. Gariwang-san, Jeongseon-gun, 30 Jul. 2013 (R. Murao, cMur); Bukdaesa temple, Mt. Odae-san, Jinbumyeon, Pyeongchang-gun, 3 ♂♂, 3 Sep. 1998 (H.S. Lee,

QIA), and 15 ♂♂, 2 Sep. 1999 (H.S. Lee, QIA); Mt. Jeombong-san, Jindongri, Inje-gun, 4 ♂♂, 21 Sep. 1998 (H.T. Kim, SNU), 3 ♂♂, 28 Aug. 1999 (H.T. Kim, SNU). Jeju-do: 1 ♂, Yonsil, Mt. Halla-san, Jeju Is., 27 Jul. 1990 (O. Tadauchi, ELKU).

Additional description

Labrum (Fig. 8C–D). Basal area approximately 2.6 × as wide as long in female, 3 × in male; basal elevation of female moderately developed, that of male absent; distal process of female slender, nearly as long as basal area, and without lateral projection, that of male absent; keel of distal process narrow, apically pointed in female; labral fimbria acutely pointed at apex in both sexes.

Sterna. S4 and S6 normal shaped, not modified. S7–S8 (Fig. 9E): S7 with long, apically rounded median process, apex exceeding S8; S8 without median process.

Male genitalia (Fig. 9A–D). Gonobase nearly flat at bottom, ventral arms connected with each other at upper ends; gonocoxite smooth, gently sloped in lateral view, and inner dorsal margin angulate at approximately basal 1/3; gonostylus large, located at top of gonocoxite, with sparse short and moderately long hairs; ventral retrorse lobe moderately long but not reaching gonobase, with moderately dense short setae ventrally; penis valve higher than gonocoxite, with low cleft on top.

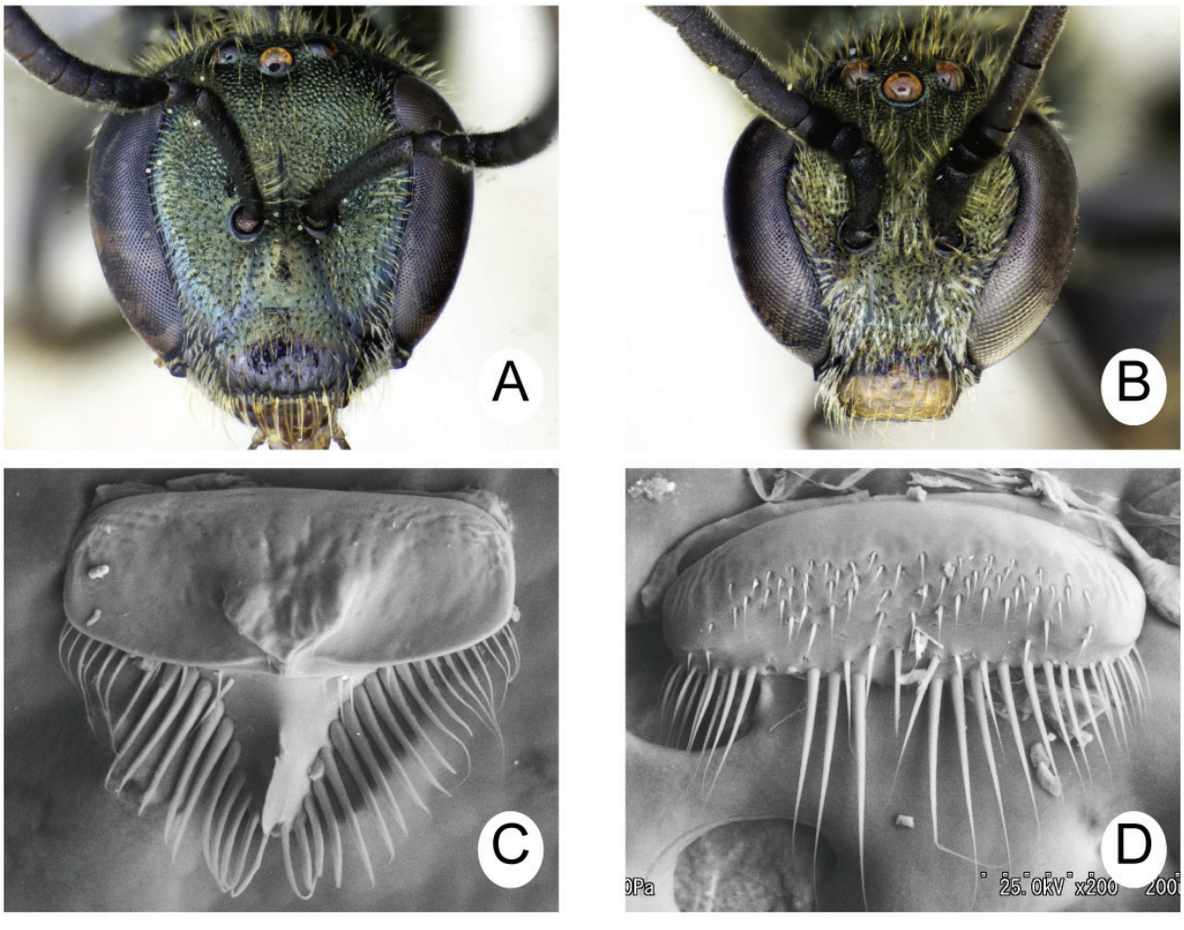

Fig. 8. *Lasioglossum* (*Dialictus*) *virideglaucum* Ebmer & Sakagami, 1994. **A–B**. Head in frontal view. **C–D**. Labrum. A, C. ♀. B, D. ♂.

Distribution

Russian Far East (Primorsky, Khabrovsk), the Korean Peninsula (new record), Japan (Honshu, Shikoku, Kyushu, Yaku Is.), China (Sichuan, Shanxi, Yunnan Provs.). While conducting our study, the male of this species was found from several localities in South Korea (the female cannot be clearly separated from that of some related species such as *L. problematicum*). On the Korean Peninsula, *Lasioglossum problematicum* has been recorded from North Korea based on female specimens (Ebmer 1978). Pesenko (2007b) regarded the continental records of *L. problematicum* as *L. virideglaucum*. Our results support Pesenko's opinion. It might be prudent to remove *L. problematicum* from the Korean fauna.

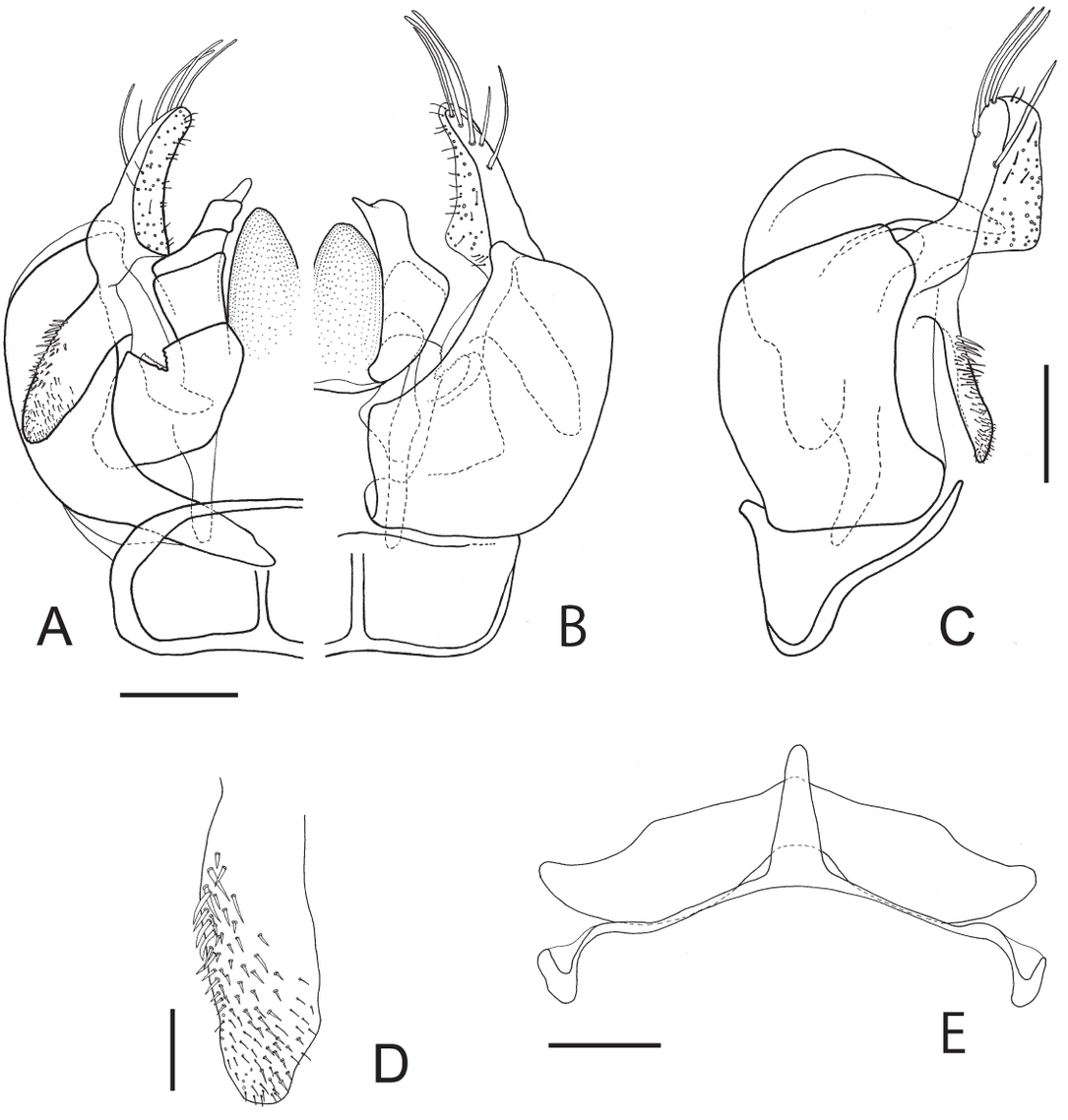

Fig. 9. *Lasioglossum* (*Dialictus*) *virideglaucum* Ebmer & Sakagami, 1994, ♂. **A**. Genitalia in ventral view. **B**. Genitalia in dorsal view. **C**. Genitalia in lateral view. **D**. Ventral retrorse lobe of genitalia. **E**. S7–S8. Scale bars: A–C, E = 0.2 mm, D = 0.1 mm.

Flight period

Female: April to September in Kyushu, Japan.
Male: August to October.

The flight record of the female is based on specimens collected from Kyushu, Japan, because one of the related species, *L. problematicum*, does not sympatrically inhabit this area.

Flower records

The specimens examined in this paper were collected on the flowers of *Aster* var. *ovatus* (Franch. & Sav.) Soejima & Mot. Ito (Asteraceae), *Bellis perennis* L. (Asteraceae), *Brassica napus* L. (Brassicaceae), *Cimicifuga simplex* (DC.) Wormsk. ex Turcz (Ranunculaceae), *Isodon inflexus* (Thunb.) Kudô (Lamiaceae), *Persicaria* sp. (Polygonaceae), *Senecio cannabifolius* Less. (Asteraceae), and *Solidago virgaurea* L. subsp. *asiatica* (Nakai ex H. Hara) Kitam. ex H. Hara var. *asiatica* Nakai ex H. Hara (Asteraceae). The other floral records in Japan belong to 12 species in 4 families (Negoro 2012).

Habitat

This species has been collected in mountainous areas in Japan and South Korea. The collecting sites are shown in Fig. 23A, C (A = Nagano Pref., Japan; C = Mt. Gariwangsan, South Korea).

DNA barcodes

The COI gene sequences are deposited as DNA barcodes of *L.* (*D.*) *virideglaucum* in the DDBJ under accession numbers LC027537 and LC027538. These numbers are also available in GenBank.

Lasioglossum* (*Dialictus*) *yamanei Murao, Ebmer & Tadauchi, 2006
Figs 4C, 5G–I, 12D

Lasioglossum (*Evylaeus*) *yamanei* Murao, Ebmer & Tadauchi, 2006: 46–49 (holotype: ELKU, ♀; type locality: Ibaraki Pref., Japan).

Evylaeus (*Glauchalictus*) *yamanei* – Pesenko 2007a: 26.

Diagnosis

This species is separated from the other members of the *atroglaucum* subgroup by a combination of the following characters: disc of male S4 with sparse hairs (Fig. 4C); male S5 deeply ∩-shaped apically (Figs 4C, 5H); and gonostylus of male genitalia large, obliquely truncated in lateral view (Murao *et al*. 2006, Fig. 11B). It may be closely related to *L. taiwanense* Murao sp. nov. from Taiwan in sharing the male S5 without a groove, the apical margin of male S5 incurved, and the ventral retrorse lobe of male genitalia short.

Material examined

JAPAN: Honshu: 1 ♀, Ohokawara, Aomori Pref., 28 Jun. 1992 (K. Goukon, cGou); 2 ♀♀, Tomiya-cho, Miyagi Pref., 19 Apr. 2009 (K. Goukon, cGou); 1 ♀, Nishikawa-cho, Yamagata Pref., 15 Jul. 2001 (K. Goukon, cGou); 2 ♂♂, Ogawa, Saitama Pref., 15 Sep. 1971 (T. Nambu, ELKU); 1 ♂, Mt. Mitake, Tokyo Pref., 12 Sep. 1964 (H. Suda, ELKU). Shikoku: 1 ♂, Monobe village, Kochi Pref., 23 Sep. 1971 (S. Ikudome, ELKU). Kyushu: 1 ♂, Mizunashi (Chikuzen), Fukuoka Pref., 15 Sep. 1935 (K. Yasumatsu, ELKU); 7 ♂♂, Mt. Wakasugi, Fukuoka Pref., 4 Nov. 1973 (Y. Yoneda, ELKU); 1 ♂, Mt. Hiko, Fukuoka Pref., 16 Aug. 1973 (Y. Yoneda, ELKU); 2 ♀♀, 1 ♂, Matoishi wilderness, Aso-shi, Kumamoto Pref., 32°55’46.305” N 130°58’11.555” E, 5 Aug. 2013 (Y. & R. Murao, cMur); 1 ♂, Mt. Sobo, Nishiusuki, Miyazaki Pref., 29 Jun. 1985 (K. Kusumoto, ELKU).

Distribution

Japan (Honshu, Shikoku, Kyushu), China (Zhejiang Prov.).

Flight period

Female: April to October.
Male: June to November.

Flower records

Twelve species in 5 families were reported as the floral records in Japan by Goubara *et al*. (2004, as *Lasioglossum* sp. 3), 15 species in 9 families by Murao *et al*. (2006), and 9 species in 7 families by Negoro (2012). The total number of species is 36 in 13 families as follows. Apiaceae: *Angelica polymorpha* Maxim.; *A*. spp.; *Osmorhiza aristata* (Thunb.) Rydb. Asteraceae: *Aster ageratoides* Turcz. var. *ageratoides*; *A*. *glehnii* F.Schmidt var. *glehnii*; *Erigeron annuus* (L.) Pers.; *Ixeridium dentatum* (Thunb.) Tzvelev subsp. *dentatum*; *Lactuca indica* L.; *Solidago virgaurea* L. subsp. *asiatica* (Nakai ex H. Hara) Kitam. ex H. Hara var. *asiatica* Nakai ex H. Hara; *Solidago virgaurea* L. subsp. *leiocarpa* (Benth.) Hultén; *Taraxacum officinale* Weber ex F.H. Wigg. Brassicaceae: *Brassica rapa* L. var. *oleifera* DC.; *Capsella bursa-pastoris* (L.) Medik.; *Cardamine leucantha* (Tausch) O.E. Schulz; *Eutrema tenue* (Miq.) Makino. Caryophyllaceae: *Stellaria sessiliflora* Y. Yabe. Ericaceae: *Elliottia paniculata* (Siebold & Zucc.) *Hook.f.* f. *albiflora* (Y. Kimura) Yonek. Geraniaceae: *Geranium* sp.; *G*. *thunbergii* Siebold ex Lindl. et Paxton. Lamiaceae: *Mosla dianthera* (Buch.-Ham. ex Roxb.) Maxim. Liliaceae: *Allium thunbergii* G. Don. Polygonaceae: *Persicaria thunbergii* (Siebold et Zucc.) H. Gross. Ranunculaceae: *Ranunculus japonicus* Thunb. Rosaceae: *Geum japonicum* Thunb.; *Potentilla fragarioides* L. var. *major* Maxim.; *P. freyniana* Bornm.; *P. hebiichigo* Yonek. & H. Ohashi; *Rubus palmatus* Thunb.; *R. parvifolius* L. Salicaceae: *Salix* spp. Violaceae: *Viola obtusa* Makino; *V. rostrata* Pursh.

Habitat

This species has been collected in mountain areas in Japan. One of the collecting sites in Japan (Kumamoto Pref., Kyushu) is shown in Fig. 23B.

Lasioglossum* (*Dialictus*) *negoroi Murao & Tadauchi, 2008
Figs 4D, 5J–L, 12E

Lasioglossum (*Evylaeus*) *negoroi* Murao & Tadauchi, 2008: 37–40 (holotype: ELKU, ♂; type locality: Toyama Pref., Japan).

Diagnosis

This species is separated from other members of the *atroglaucum* subgroup by a combination of the following characters: male S4 basally with sparse and moderately long erect hairs (Murao & Tadauchi 2008; Fig. 2H); male S5 with a linear shallow groove (Fig. 5K); male S6 with a pair of thin hair tufts; and gonostylus of male genitalia truncated on top (Murao & Tadauchi 2008; Fig. 2B–C).

Material examined

Holotype

JAPAN: ♂ (Code No. ELKU3261), Kobo, Tateyama, Toyama Pref., Honshu, 10 Sep. 1997 (H. Negoro, ELKU).

Paratype

JAPAN: 1 ♂, Koganeyu, Minami-ku, Sapporo-shi, Hokkaido (label in Japanese), 18 Sep. 2004 (K. Kinota, ELKU).

Additional material

JAPAN: Honshu: 1 ♂, Nikko-Yumoto (Shimozuke), 15 Aug. 1937 (T. Esaki & K. Yasumatsu, ELKU); Mt. Zao, Miyagi Pref., 1 ♂, 4 Sep. 1980 (K. Goukon, cGou), 1 ♂, 1 Sep. 1982 (K. Goukon, cGou); 1 ♂, Mt. Zao, alt. 1300 m, Miyagi Pref., 28 Sep. 1996 (K. Goukon, cGou).

Female

Unknown.

Distribution

Japan (Hokkaido, northern and central Honshu).

Flight period

Male: August to October.

Flower records

Araliaceae: *Aralia continentalis* Kirag.. Asteraceae: *Aster microcephalus* (Miq.) Franch. & Sav. var. *ovatus* (Franch. & Sav.) Soejima & Mot. Ito; *Solidago virgaurea* L.

Lasioglossum* (*Dialictus*) *taiwanense Murao sp. nov.

urn:lsid:zoobank.org:act:C164E332-E591-4C50-A4BD-9E4C208276B8

Figs 4E, 5M–O, 10, 11, 12A

Diagnosis

This species is separated from other members of the *atroglaucum* subgroup by a combination of the following characters: male head wider than long; disc of male S4 with sparse and short hairs (Fig. 4E); male S5 gently incurved apically (Fig. 5N); and the shape of gonostylus of male genitalia (Fig. 11C–D).

Etymology

The specific name is derived from the type country, Taiwan.

Material examined

Holotype

TAIWAN: ♂, Hehuanxi, Songguangang, Nantou Pref., 24 Jun. 1976 (H. Makihara, ELKU).

Paratypes

TAIWAN: 4 ♂♂, Meishan-Tinchi (alt. 800–2300 m), Kao Hsiung Hsien, S-Taiwan, 29 Jun. 1986 (K. Baba, ELKU); 2 ♂♂, Pi Lu Chih, alt. 2500 m, Nan Tow Hsien, M-Taiwan, 5 Aug. 1986 (K. Baba, ELKU); 1 ♂, Tung Chih, alt. 1600 m, near Liu Kui, S-Taiwan, 30 Sep. 1986 (K. Baba, ELKU); 8 ♂♂, Hehuanxi, Songguangang, Nantou Pref., 24 Jun. 1976 (H. Makihara, ELKU); 3 ♂♂, Hehuanxi, 23 Jun. 1976 (H. Makihara, ELKU); 2 ♂♂, Sung Kang, alt. 2000–2300 m, Nantou IIsien, 29 Jun. 1965 (S. Kimoto, ELKU).

Measurements (n = 10, unit mm)

BL = 5.29–6.00 (5.65 ±0.32), WL = 4.43–5.14 (4.91 ±0.25), HL = 1.26–1.40 (1.32 ±0.06), HW = 1.32–1.45 (1.37 ±0.05), IOD = 0.19–0.26 (0.24 ±0.02, n= 9), OOD = 0.24–0.28 (0.27 ±0.01), OCD = 0.16–0.19 (0.18 ±0.02, n= 7), UOD = 0.84–0.90 (0.87 ±0.03), MOD = 0.92–1.03 (0.97 ±0.04), LOD = 0.55–0.61 (0.59 ±0.02), IAD = 0.23–0.26 (0.24 ±0.01), AOD = 0.16–0.19 (0.17 ±0.01), CAL = 0.19–0.28 (0.25 ±0.02), CPL = 0.31–0.35 (0.33 ±0.01), EL = 0.95–1.05 (1.00 ±0.04), EW = 0.45–0.50 (0.47 ±0.02), GW = 0.20–0.35 (0.28 ±0.04), SPL = 0.29–0.32 (0.31 ±0.01), F1L = 0.13–0.15 (0.14 ±0.01),

F2L = 0.23–0.27 (0.24 ±0.01), F3L = 0.24–0.27 (0.26 ±0.01), F2W = 0.15–0.16 (0.15 ±0.01, n= 9), MsW = 1.30–1.50 (1.44 ±0.07), SCL = 0.30–0.35 (0.33 ±0.02), MNL = 0.15–0.20 (0.17 ±0.02), MPL = 0.28–0.33 (0.31 ±0.02), MtW = 1.00–1.18 (1.07 ±0.06).

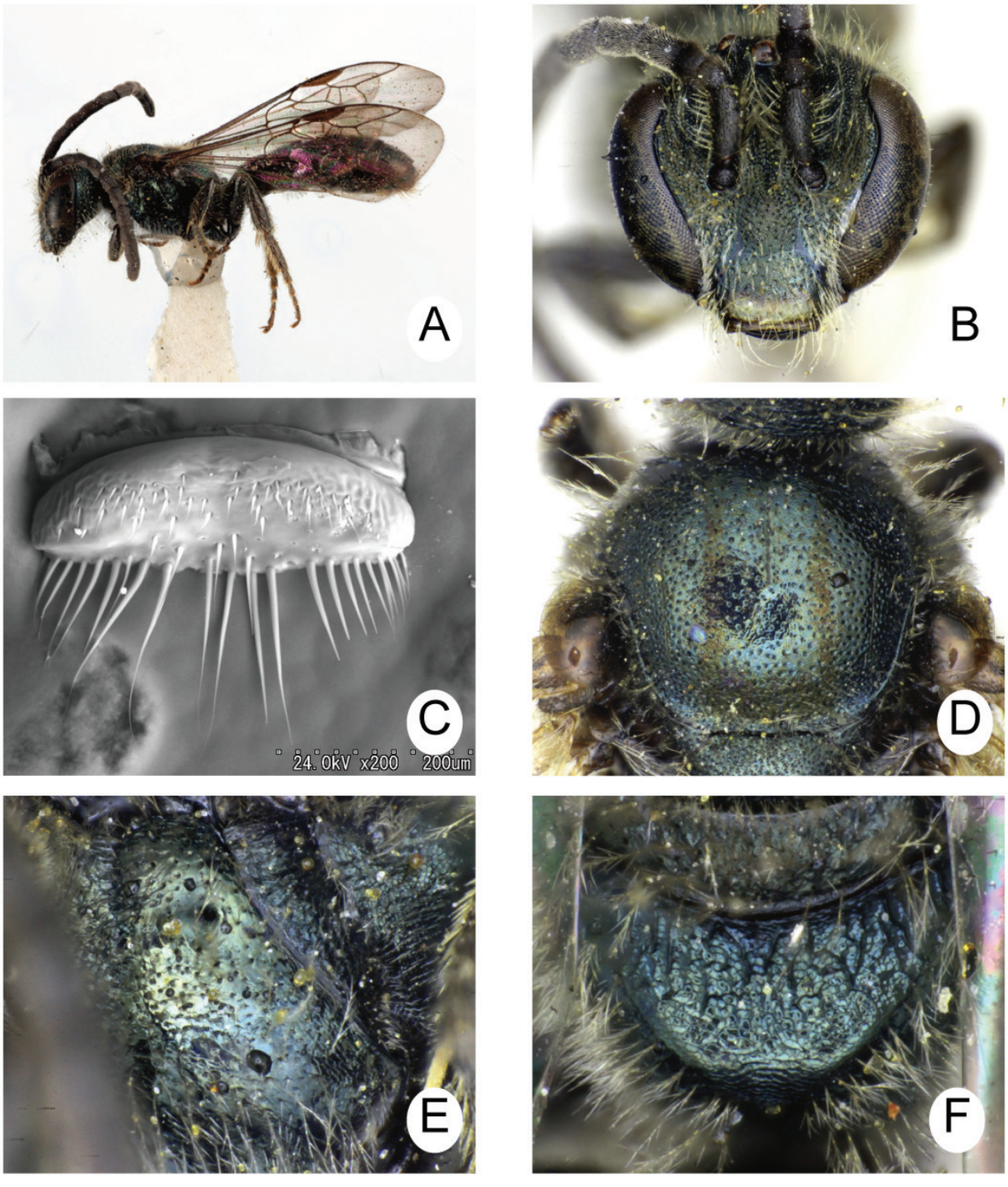

Fig. 10. *Lasioglossum* (*Dialictus*) *taiwanense* Murao sp. nov., ♂. **A**. Lateral habitus. **B**. Head in frontal view. **C**. Labrum. **D**. Mesoscutum. **E**. Mesepisternum. **F**. Metapostnotum. A–B, E–F. Holotype. C–D. Paratype.

Description

Male

Coloration. Body black except for the following parts: head dark green and mesosoma metallic green; clypeus yellow on lower half or lower 1/3; mandible reddish brown apically; flagellum blackish brown or brown ventrally; tegula blackish brown translucent; tibial spur yellow; metasomal terga narrowly brown translucent apically. Wings transparent, veins and stigma brown.

Pubescence. Body hairs whitish, and covered with erect and sparse fine, branched hairs except for the following parts: lower clypeus with sparse simple hairs; tibial and tarsal hairs nearly simple; disc of metasomal terga with sparse and simple short hairs. Metasomal sterna with sparse and short hairs, without special hair tufts.

Head. Wider than long; HW:HL = 1:0.96. Vertex rounded in frontal view. MOD:UOD:LOD = 1:0.90:0.61. IOD:OOD:OCD = 1:1.11:0.76. IAD:AOD = 1:0.71. Ocellocular areas, paraocular areas and frons dull, with reticulate PP. Supraclypeal area weakly convex, dull, with moderately dense PP,

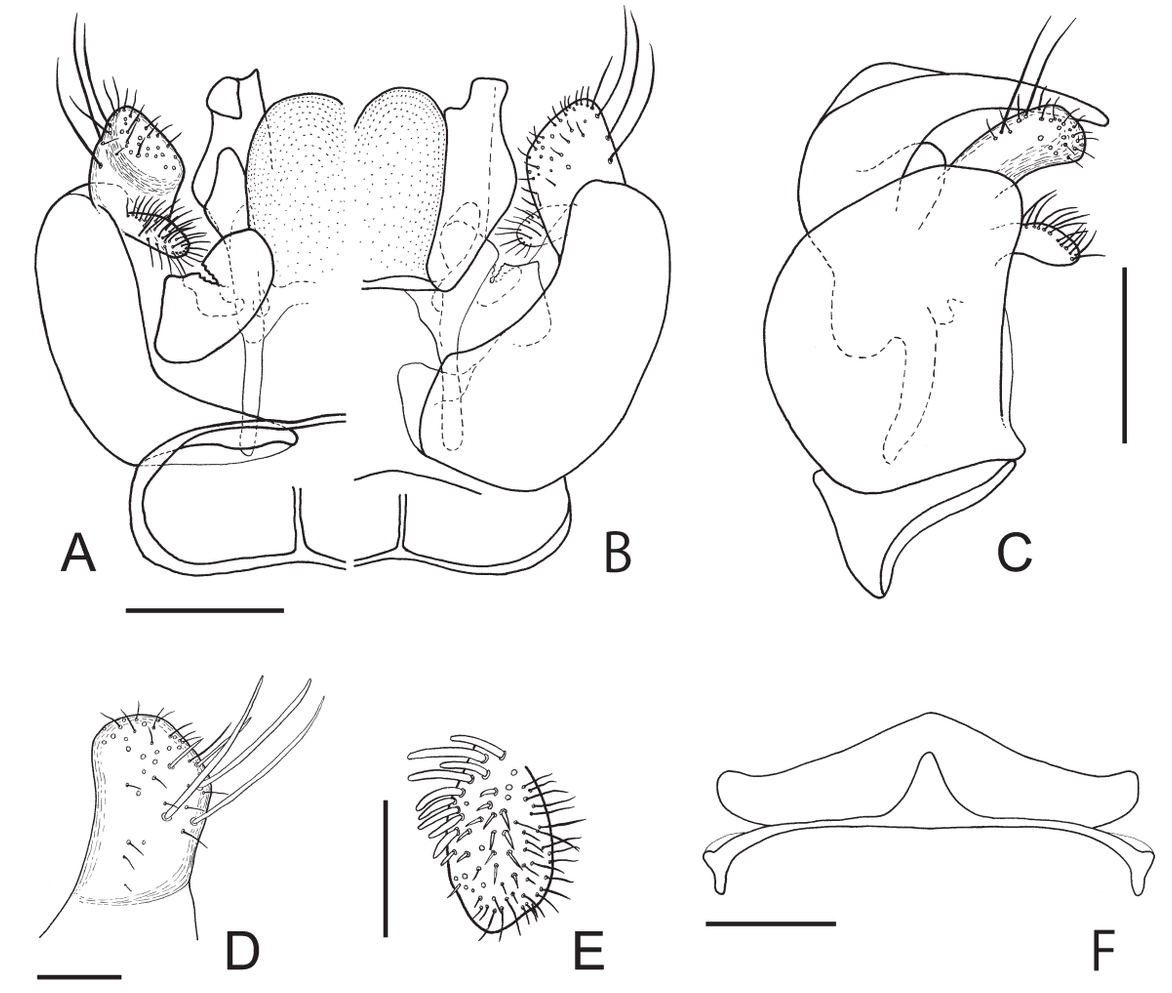

Fig. 11. *Lasioglossum* (*Dialictus*) *taiwanense* Murao sp. nov., paratype, ♂. **A**. Genitalia in ventral view. **B**. Genitalia in dorsal view. **C**. Genitalia in lateral view. **D**. Gonostylus in dorsal view. **E**. Ventral retrorse lobe of genitalia. **F**. S7–S8. Scale bars: A–C, F = 0.2 mm, D–E = 0.1 mm.

IS distinctly tessellate (IS = 0.5–2). CPL:CAL = 1:0.77. Clypeus nearly flat, its sculptures similar to supraclypeal area, IS = 1–3.5. EW:GW = 1:0.59. Genal area with straight ridges and distinct tessellation. Malar space linear. Occiput not carinate. Postgena weakly tessellate. Mandible edentate. Labrum (Fig. 10C) without basal elevation and distal process. Antenna long, reaching metasoma. F2L:F2W = 1:0.63; flagellum nearly flattened on lower side.

Thorax. Dorsolateral angle of pronotum obtuse; lateral surface without ridges; lateral lobe rounded. Mesoscutum (Fig. 10D) with dense PP on marginal area, gradually sparse anterior to medial areas; IS weakly tessellate (IS = 0.5–1.5 on marginal area, IS= 0.5–3.7 on anterior to medial areas); parapsidal line a narrow groove. Mesoscutellum with dense PP (IS = 0.5–1.5) over entire surface, IS smooth. Metanotum weakly rugulose. Mesepisternum (Fig. 10E) with sparse PP over entire surface, IS smooth (IS = 1–6). SCL:MNL:MPL = 1:0.53:0.95. Propodeum: metapostnotum (Fig. 10F) gently inclined, with longitudinal ridges on basal half, with distinct tessellation on apical half; the junction between metapostnotum and posterior surface weakly tessellate, not carinate; lateral surface weakly rugulose and distinctly tessellate; posterior surface with lateral carina on lower half. Fore trochanter narrow, longer than wide. Hind tibia without basitibial plate. Hind basitarsus slender, approximately 4.7 × as long as wide. Inner hind tibial spur finely serrate.

Abdomen. Discs of T1–T3 with sparse fine PP. T1 smooth except for punctures. T2 basally and apically lineolate, T3–T5 over entire surface. S4 and S6 normal shaped, not modified. S5 gently incurved apically (Fig. 5N). S7–S8 (Fig. 11F): S7 with triangular median process, apex not exceeding S8; S8 medially weakly projecting, but not forming median process.

Genitalia (Fig. 11A–E). Gonobase short, flat at bottom, ventral arms connected with each other at upper ends; gonocoxite smooth, gently sloped in lateral view, and inner dorsal margin angulate approximately at basal ⅓; gonostylus small, truncated apically in lateral view, located on top of gonocoxite, and with sparse short and a few long hairs; ventral retrorse lobe leaf-shaped, short, with moderately dense short setae ventrally; penis valve with low cleft on top.

Female

Unknown.

Variation

The postgena nearly smooth in five paratypes (holotype and rest of paratypes weakly tessellate).

Distribution

Taiwan.

Flight period

Male: June to September.

Flower records

Not recorded.

The problematicum *subgroup*

Lasioglossum* (*Dialictus*) *problematicum (Blüthgen, 1923)
Figs 13A, 14A–C, 15, 16, 19A, 27B

Halictus problematicus Blüthgen, 1923: 331–332 (lectotype: Institute of Systematic and Experimental Zoology, Polish Academy of Sciences, Krakow, Poland, ♀; type locality: unknown (Siberia?); designated by Pesenko, 2007b: 115).

Halictus problematicus – Hirashima 1957: 15.
Lasioglossum (*Evylaeus*) *problematicum* – Ebmer 1978: 311–312. — Ebmer 1996: 282; Ebmer 2002: 865–867 (♂). — Ebmer 2006: 563. — Murao *et al*. 2006: 50.
Evylaeus (*Glauchalictus*) *problematicus* – Pesenko 2007a: 26. — Pesenko 2007b: 85 (in key), 95 (in key), 115.

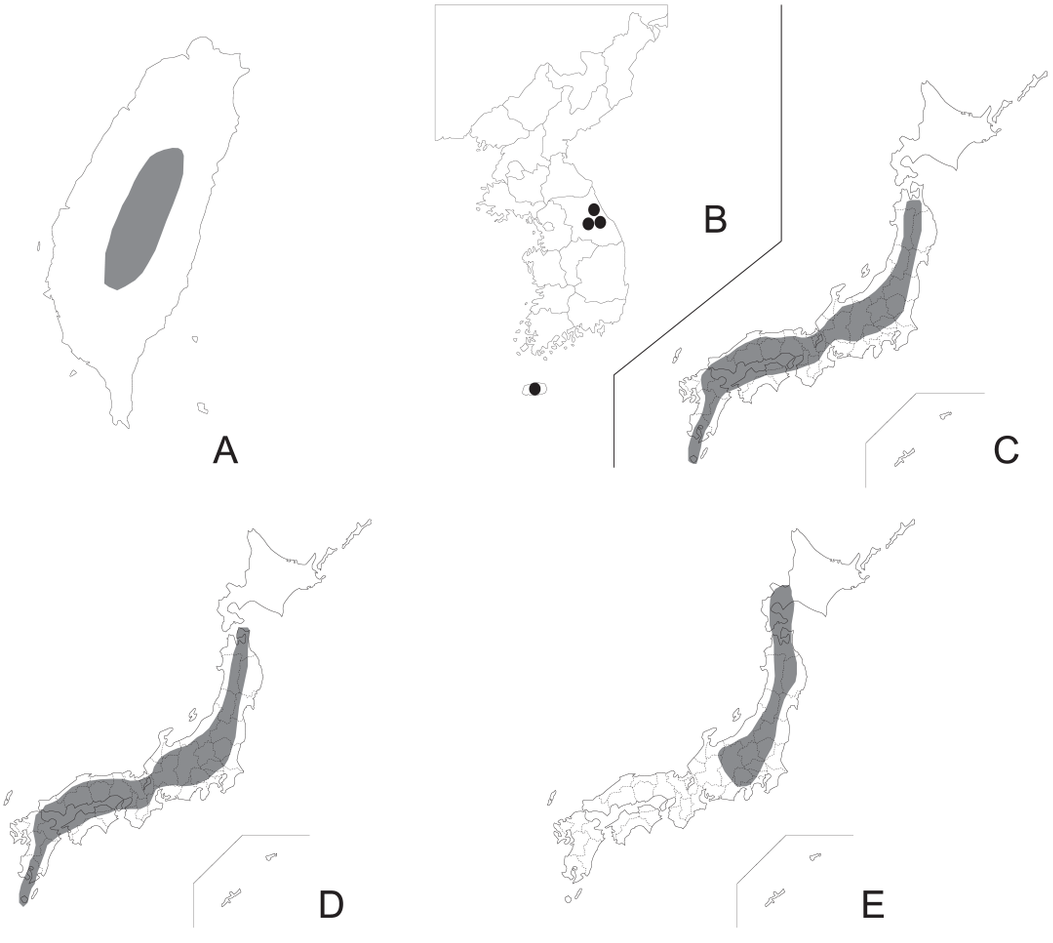

Fig. 12. Distribution maps. **A**. *Lasioglossum* (*Dialictus*) *atroglaucum* (Strand, 1913) and *L*. (*D*.) *taiwanense* Murao sp. nov. **B–C**. *Lasioglossum* (*Dialictus*) *virideglaucum* Ebmer & Sakagami, 1994 (B in the Korean Peninsula, C in Japan). **D**. *Lasioglossum* (*Dialictus*) *yamanei* Murao *et al*., 2006. **E**. *Lasioglossum* (*Dialictus*) *negoroi* Murao & Tadauchi, 2008.

Diagnosis

This species is closely related to *Lasioglossum alishanense* Murao sp. nov., *L. sanitarium* (Blüthgen, 1926) and *L. sichuanense* Fan & Ebmer, 1992 from the northern Oriental Region, as stated above. For the differences between this species and *L. alishanense*, see the Key. It is also separated from the remaining two species by having the disc of the male S5 without an apical depression (Fig. 14B). The female cannot be clearly separated from the related species, as stated above.

Material examined

JAPAN: Hokkaido: 3 ♀♀, Rausu-seseki, Shiretoko, 16 Jun. 1984 (O. Tadauchi, ELKU); 3 ♂♂, Rebun Is., Rebun-no-oka, 7–8 Sep. 2005 (K. Goukon, cGou); 27 ♂♂, Kabuka, Rebun Is., 19 Aug. 1984 (O. Tadauchi, ELKU); 1 ♂, Air Port Wakkanai, 16 Aug. 1984 (O. Tadauchi, ELKU); 2 ♂♂, Botanical Garden, Sapporo, 3 Aug. 1959 (S. F. Sakagami & H. Fukuda, MNHAH); 1 ♂, Hamakoshimizu, 9 Aug. 1967 (MNHAN); 10 ♂♂, Kami-Otoineppu, Nakagawa Exp. For., 14 Sep. 1969 (S. F. Sakagami & H. Fukuda, MNHAH); 1 ♂, Kitamoshiri, Hok. Uryu Exp. For., 14 Sep. 1969 (S. F. Sakagami & H. Fukuda, MNHAH); 2 ♂♂, Kussharo Lake, Teshikaga, 21 Jul. 1984 (O. Tadauchi, ELKU), 30 Aug. 1984 (O. Tadauchi, ELKU); 2 ♂♂, Nishiashoro, 9–10 Aug. 1955 (S. F. Sakagami & H. Fukuda, MNHAH); 1 ♂, Nissho Pass, Hidaka, 22 Sep. 1984 (O. Tadauchi, ELKU); 1 ♂, Cape Nosappu, Nemuro, 13 Sep. 1984 (O. Tadauchi, ELKU); 1 ♂, Nukabira, 10 Aug. 1965 (Y. Hirashima, ELKU); Sapporo, 1 ♂, 17 Aug. 1958, 4 ♂♂, 8 Sep. 1958 (S. Ueda, ELKU); 1 ♂, Shari Pass, Shari, 28 Jul. 1984 (O. Tadauchi, ELKU); 1 ♂, Shimamaki, Shiribetsu, 2 Sep. 1984 (O. Tadauchi, ELKU); 6 ♂♂, Shotoshibetsu, 20 Jul. 1984, 9 &

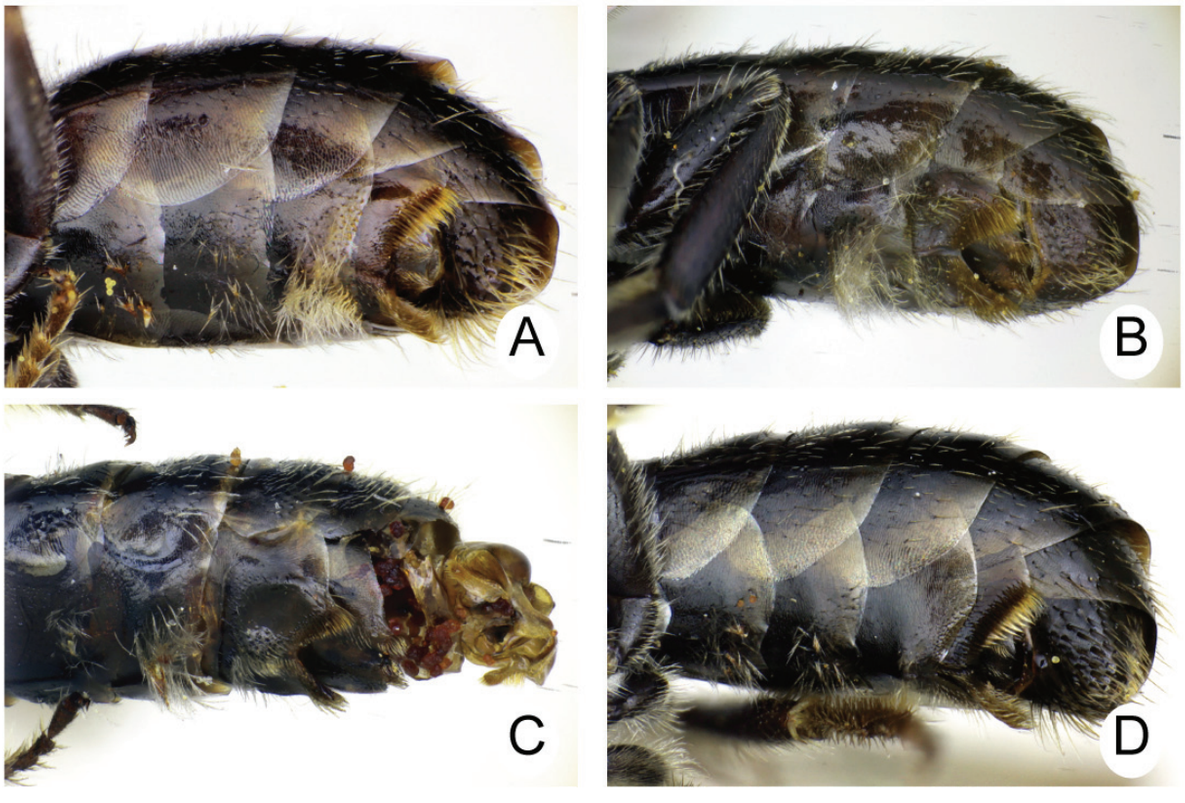

Fig. 13. Hairs on metasomal sterna in species of the *problematicum* subgroup, ♂. **A**. *Lasioglossum* (*Dialictus*) *problematicum* (Blüthgen, 1923). **B**. *Lasioglossum* (*Dialictus*) *sanitarium* (Blüthgen, 1926). **C**. *Lasioglossum* (*Dialictus*) *sichuanense* Fan & Ebmer, 1992. **D**. *Lasioglossum* (*Dialictus*) *alishanense* Murao sp. nov., holotype.

26 Aug. 1984 (O. Tadauchi, ELKU); 29 ♂♂, Sugatami, 6 Sep. 1967 (MNHAH); 2 ♂♂, Tenneru, north Kushiro, 1968 (E. Ohtsuka, MNHAH); 4 ♂♂, Tokachimitsumata, Kamishihoro, 27 Aug. 1984, 11 Sep. 1984 (O. Tadauchi, ELKU); 6 ♂♂, Rubetu, Etorofu Is., 31 Aug. 1940 (S. Kuwayama & Y. Sugihara, ELKU); 13 ♂♂, Sibetoru, Etorofu Is., 6–7 Sep. 1940 (S. Kuwayama & Y. Sugihara, ELKU). Honshu: 4 ♂♂, Kuzukawa (Hiraka), Aomori Pref., 20 & 26 Aug. 1983 (M. Yamada, MNHAH); 1 ♂, Minami-Hakkoda (Hiraka), Aomori Pref., 17 Aug. 1984 (M. Yamada, MNHAH); 6 ♂♂, Mt. Iwaki, Aomori Pref., 7 & 21 Sep. 1980, 29 Aug. 1981 (M. Yamada, MNHAH); 4 ♂♂, Sukayu (Towadako), Aomori Pref., 2 Aug. 1987 (M. Yamada, MNHAH); 1 ♂, Takinosawa, Aomori Pref., 4 Sep. 1982 (M. Yamada, MNHAH); 1 ♂, Hachimantai, Akita Pref., 28 Jul. 1961 (M. Shiga, ELKU); 6 ♂♂, Mt. Akitakoma, Akita Pref., 28 Aug. 1972 (M. Honda, ELKU); 1 ♂, Mt. Chôkai-san, Akita Pref., 27 Aug. 1972 (M. Honda, ELKU); 1 ♂, Fukenoyu spa, Kazono city, Akita Pref., 2 Aug. 1974 (T. & H. Suda, ELKU); 2 ♂♂, Mt. Zao, Shibakusadaira, Miyagi Pref., 27 Aug. 2004 (K. Goukon, cGou); 1 ♂, Mt. Zao, alt. 1300 m, Miyagi Pref., 28 Sep. 1996 (K. Goukon, cGou); 2 ♂♂, Mt. Zao, Miyagi Pref., 31 Aug. 1979 (K. Goukon, cGou), 24 Aug. 1979 (Y. Maeta, ELKU); 15 ♂♂, Kazawa, Nagano Pref., 17 Aug. 1972 (Y. Yoshiyasu, ELKU); 2 ♂♂, Shiga Highlands, Nagano Pref., 16 Aug. 1972 (Y. Yoshiyasu, ELKU); 2 ♂♂, Sugadaira Highlands, Sanada-machi, Nagano Pref., 22 Aug. 2002 (K. Mitai, cMur); 2 ♂♂, Asama, Karuizawa, Nagano Pref., 23 Aug. 1967 (T. & H. Suda, ELKU); 1 ♂, Shirakaba Lake, Chino city, Nagano Pref., 7 Sep. 1966 (T. & H. Suda, ELKU); 1 ♂, Arimine, Ôyama-machi, Toyama Pref., 11 Aug. 1994 (H. Negoro,

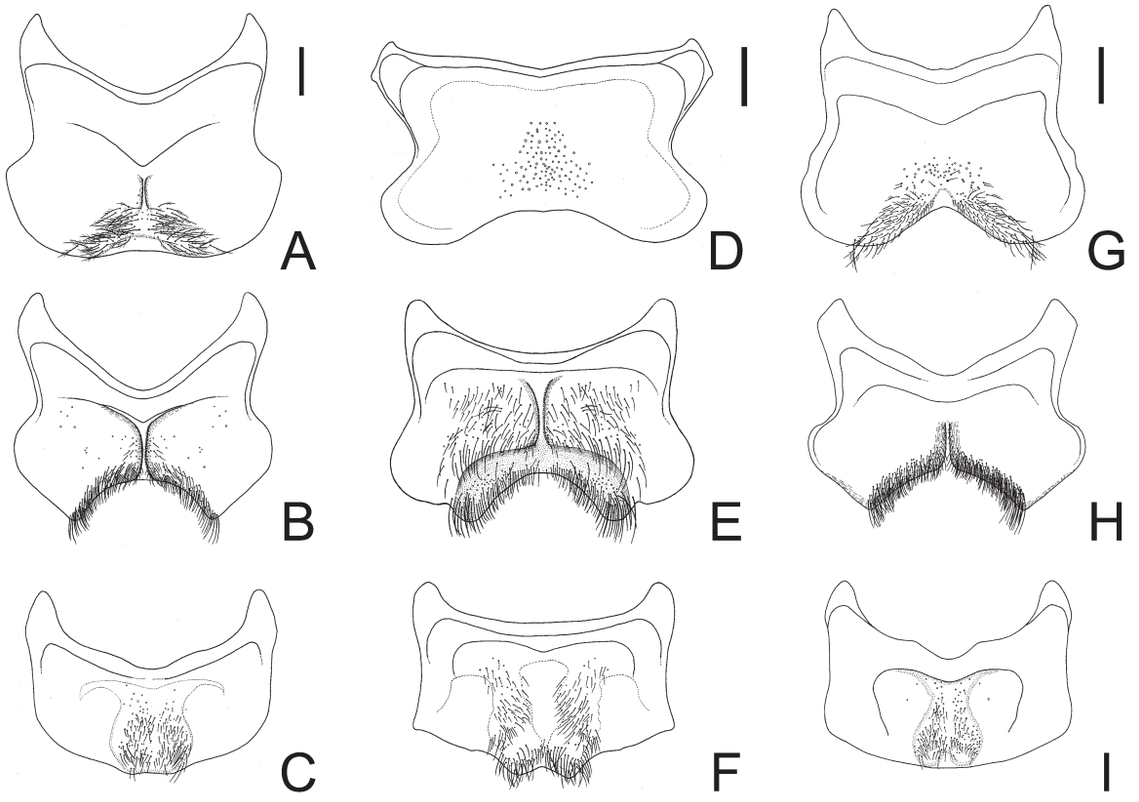

Fig. 14. S4–S6 in species of the *problematicum* subgroup, ♂. **A–C**. *Lasioglossum* (*Dialictus*) *problematicum* (Blüthgen, 1923). **D–F**. *Lasioglossum* (*Dialictus*) *sanitarium* (Blüthgen, 1926). **G–I**. *Lasioglossum* (*Dialictus*) *alishanense* Murao sp. nov., paratype. A, D, G: S4. B, E, H: S5. C, F, I. S6: Dotted area on S5 shows the apical depression. Scale bars: 0.2 mm.

MNHAH); 39 ♂♂, Migatahara, Mt. Tate-yama, Toyama Pref., 25 Aug. 2004 (T. Sugimoto, cMur); 1 ♂, Mt. Daicho, Katsuyama-shi, Toyama Pref., 27 Aug. 2004 (T. Sugimoto, cMur); 1 ♂, Sen-ninmori, near Mt. Ikenodaira, north Alps, Toyama Pref., 19 Aug. 2005 (H. Hirano, cMur); 1 ♂, Tateyama-Migatahara, Toyama Pref., 16 Oct. 1995 (H. Negoro, MNHAH); 2 ♂♂, Mt. Haku-san, Ishikawa Pref., 6 Aug. 1970 (K. Kanmiya, ELKU), 9 Aug. 1974 (I. Togashi, ELKU); 1 ♂, Mt. Haku-san, alt. 1750–1500 m, Ishikawa Pref., 22 Aug. 1988 (I. Togashi, ELKU).

Additional description

Labrum (Fig. 15C–D). Basal area approximately 2.3 × as wide as long in female, 3 × in male; basal elevation of female moderately developed, that of male absent; distal process of female slender, nearly as long as basal area, and without lateral projection, that of male absent; keel of distal process narrow, apically pointed; labral fimbria acutely pointed at apex in both sexes.

Sterna. S4 medially with shallow groove on apical half; apical margin nearly straight. S5 without apical depression, medially weakly swollen and apico-medially cleaved; apical margin gently incurved. S6 normally shaped, not modified. S7–S8 (Fig. 16F): S7 with elongate, apically rounded median process, apex exceeding S8; S8 without median process.

Male genitalia (Fig. 16A–E). Gonobase nearly flat at bottom, ventral arms connected with each other at upper ends; gonocoxite smooth, gently sloped in lateral view, and inner dorsal margin gently angulate

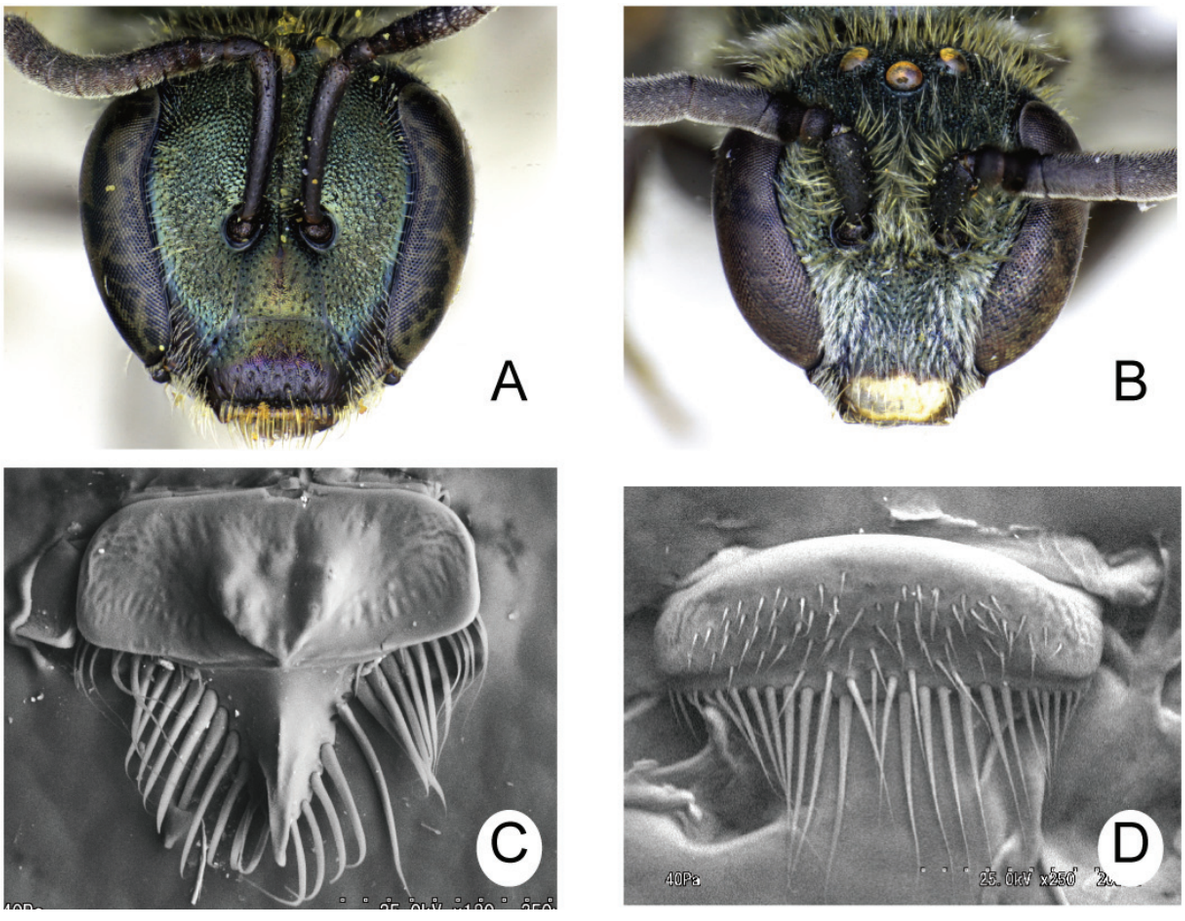

Fig. 15. *Lasioglossum* (*Dialictus*) *problematicum* (Blüthgen, 1923). **A–B**. Head. **C–D**. Labrum. A, C. ♀. B, D. ♂.

at approximately basal 1/3; gonostylus large, located at top of gonocoxite, with dense short setae on inner surface; ventral retrorse lobe moderately long but not reaching gonobase, with dense short setae ventrally and relatively long blunt setae laterally; penis valve higher than gonocoxite, with high cleft on top.

Distribution

Russian Far East (Sakhalin) and Japan (Hokkaido, northern to central Honshu). Ebmer (1978, 2006) recorded this species from Primorsky and North Korea, respectively, based on female specimens. These records are not included in this paper, because the female cannot be clearly separated from that of some of the related species.

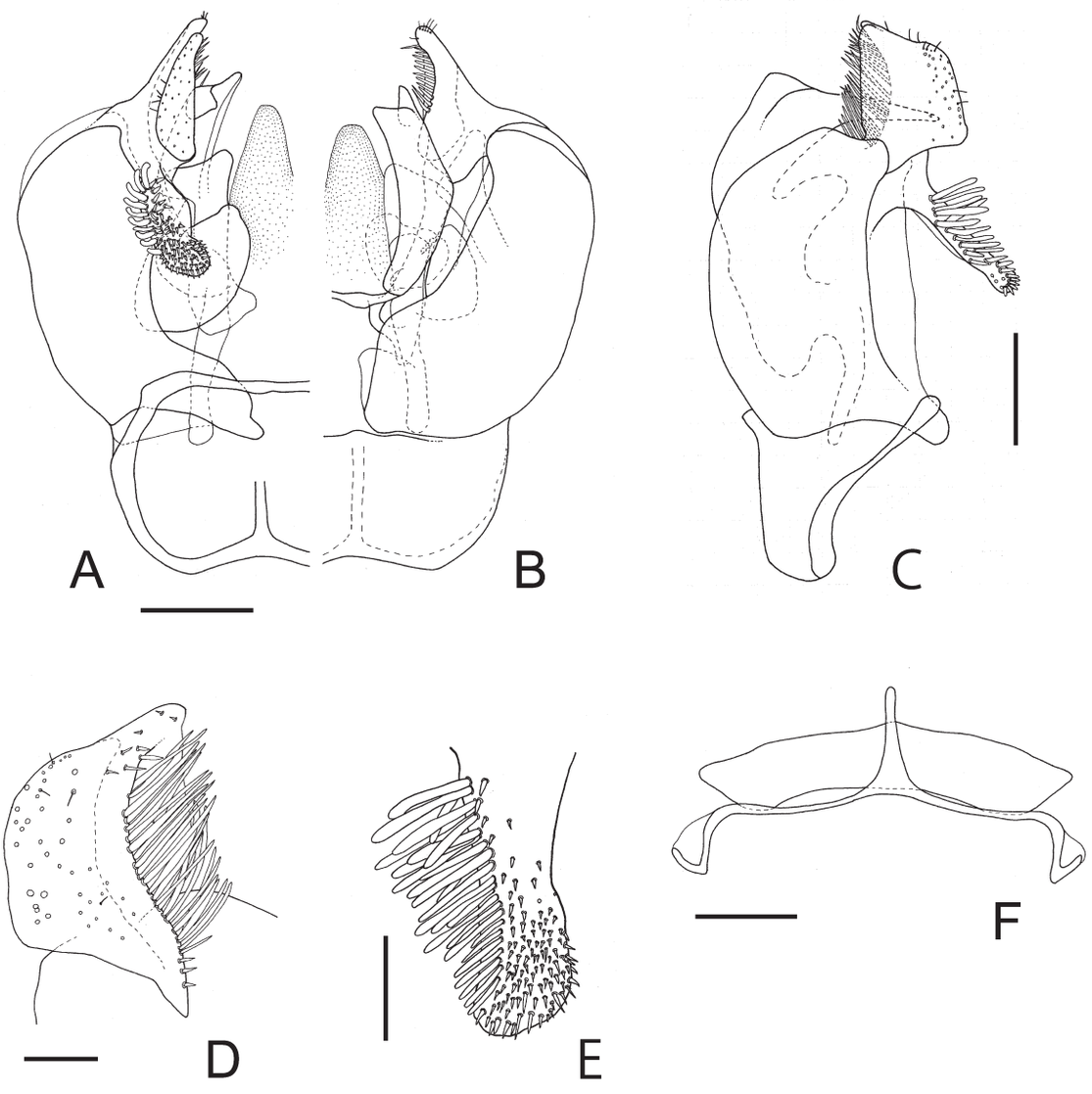

Fig. 16. *Lasioglossum* (*Dialictus*) *problematicum* (Blüthgen, 1923), ♂. **A**. Genitalia in ventral view. **B**. Genitalia in dorsal view. **C**. Genitalia in lateral view. **D**. Gonostylus in inner-lateral view. **E**. Ventral retrorse lobe of genitalia. **F**. S7–S8. Scale bars: A–C, F = 0.2 mm, D–E = 0.1 mm.

Flight period

Female: May to September in Hokkaido, Japan.
Male: August to October.

The flight record of females is based on specimens collected from the eastern part of Hokkaido, Japan. This record can be considered accurate, because one of the related species, *L. virideglaucum* Ebmer & Sakagami, does not sympatrically inhabit this area.

Flower records

In Japan this species visits the following 19 species in 6 families: Apiaceae: *Angelica ursina* (Rupr.) Maxim. Asteraceae: *Anaphalis margaritacea* (L.) Benth. & Hook. f. subsp. *margaritacea*; *Aster glehnii* F. Schmidt; *Cirsium setosum* (Willd.) M. Bieb.; *Crepidiastrum denticulatum* (Houtt.) J.H. Pak & Kawano; *Erigeron annuus* (L.) Pers.; *Hieracium umbellatum* L.; *Picris hieracioides* subsp. *japonica* (Thunb.) Krylov; *Rudbeckia laciniata* L.; *Senecio pseudoarnica* Less.; *Solidago altissima* L.; *S. virgaurea* L. subsp. *asiatica* (Nakai ex H. Hara) Kitam. ex H. Hara var. *asiatica* Nakai ex H. Hara; *S. virgaulea* L. subsp. *leiocarpa* (Benth.) Hultén; *Sonchus brachyotus* DC.; *Taraxacum* sp. Brassicaceae: *Barbarea orthoceras* Ledeb. Geraniaceae: *Geranium thunbergii* Siebold ex Lindl. & Paxton. Lamiaceae: *Isodon* sp. Rosaceae: *Sorbaria sorbifolia* (L.) A. Braun.

Biological reference

According to Sakagami & Kuribayashi (1979) and Sakagami *et al.* (1984), some biological information is available. Nest place and structure: the female prefers to make a nest at the forest edge; the nest structure is the IIIa type of Sakagami & Michener (1962). Social structure and life cycle: the brooding period of the overwintered generation is from early May to late July, in Sapporo city, Hokkaido; most of the overwintering females stay communally in the natal nests; the nest are communally reused in the next brooding season, hence many colonies are semisocial or sometimes delayed eusocial from the beginning of spring activities; females living in the same nests are mostly of the same generation and seem to be sisters in most cases, although some nests are inhabited by a two-year-old female and her daughters; all cohabiting females are inseminated, but only one of them has fully developed ovaries at the peak of brooding season, the others with undeveloped ovaries participate in foraging.

Lasioglossum* (*Dialictus*) *alishanense Murao sp. nov.
urn:lsid:zoobank.org:act:34A726F0-E3B3-4E3F-B6B8-111E08F19BD2
Figs. 13D, 14G–I, 17, 18, 19B

Diagnosis

This species may be closely related to *Lasioglossum problematicum*, *L. sanitarium*, and *L. sichuanense*, as stated above. For the differences between this species and *L. problematicum*, see the Key. It is separated from the two other related species by the disc of the male S4 having short and sparse hairs (Fig. 13D), the male S5 without an apical depression (Fig. 14H), and the shape of gonostylus of male genitalia (Fig. 18C).

Etymology

The specific name is derived from the type locality, Mt. Alishan in Taiwan.

Material examined

Holotype

TAIWAN: ♂, Chiayi-Hsien Alishan, 27 Jul. 1966 (T. Tano, ELKU).

Paratypes

TAIWAN: 1 ♂, Taiheizan (Taihoku-shû), Toganoo-Minamotojobu-Kussha, 22 Jul. 1932 (T. Esaki, ELKU); 1 ♂, Chiayi-Hsien Shihtzulu, 29 Jul. 1966 (T. Tano, ELKU); 3 ♂♂, Chiayi-Hsien Alishan, 27 Jul. 1966 (T. Tano, ELKU); 1 ♂, Fenchifu, alt. 1405 m, 1 Sep. 1979 (Y. Hirashima, ELKU).

Measurements (n = 6, unit mm)

BL = 5.86–6.86 (6.38 ±0.43), WL = 5.43–6.00 (5.79 ±0.22), HL = 1.39–1.58 (1.51 ±0.07), HW = 1.42–1.58 (1.52 ±0.06), IOD = 0.23–0.24 (0.23 ±0.01), OOD = 0.27–0.35 (0.31 ±0.03), OCD = 0.23–0.24 (0.24 ±0.01), UOD = 0.90–1.03 (0.98 ±0.05), MOD = 1.02–1.13 (1.08 ±0.05), LOD = 0.61–0.74 (0.69 ±0.05), IAD = 0.24–0.31 (0.27 ±0.03), AOD = 0.16–0.21 (0.19 ±0.02), CAL = 0.24–0.27 (0.25 ±0.01), CPL = 0.35–0.39 (0.37 ±0.02), EL = 0.98–1.10 (1.03 ±0.05), EW = 0.50–0.53 (0.50 ±0.01), GW = 0.28–0.35 (0.33 ±0.03), SPL = 0.32–0.39 (0.36 ±0.02), F1L = 0.15–0.16 (0.15 ±0.01), F2L = 0.27–0.29 (0.28 ±0.01), F3L = 0.29–0.32 (0.30 ±0.01), F2W = 0.16–0.18 (0.16 ±0.01), MsW = 1.55–1.70 (1.60 ±0.06), SCL = 0.35 (0.35 ±0.00), MNL = 0.18–0.20 (0.19 ±0.01), MPL = 0.31–0.38 (0.34 ±0.03), MtW = 1.15–1.40 (1.29 ±0.09).

Description

Male

Coloration. Body black, except for the following parts: head dark green and mesosoma metallic green; clypeus yellow on lower half; mandible reddish brown apically; flagellum blackish brown ventrally; tegula dark brownish translucent; tibial spur yellow; metasomal terga narrowly dark brownish translucent apically. Wings transparent, veins and stigma brown.

Pubescence. Body hairs whitish, and covered with elect and sparse fine, branched hairs except for the following parts: lower paraocular area with sparse tomentose; lower clypeus with sparse simple hairs; tibial and tarsal hairs nearly simple; disc of metasomal terga with sparse and simple short hairs. S2–S4 medioapically with sparse erect hairs; in addition, S4 lateroapically with sparse short hairs. S5 with dense, brush-like, and brownish hairs along apical margin.

Head. As long as wide; HW:HL = 1:0.99. Vertex rounded in frontal view. MOD:UOD:LOD = 1:0.90:0.64. IOD:OOD:OCD = 1:1.33:1.01. IAD:AOD = 1:0.70. Ocellocular areas, paraocular areas and frons dull, with reticulate PP. Supraclypeal area weakly convex, dull, with sparse PP, IS distinctly tessellate (IS = 0.5–3). CPL:CAL = 1:0.68. Clypeus nearly flat, its sculptures similar to supraclypeal area, IS = 1–4. EW:GW = 1:0.64. Malar space linear. Occiput not carinte. Postgena nearly smooth. Mandible edentate. Labrum (Fig. 17C) without basal elevation and distal process. Antenna long, reaching metasoma. F2L:F2W = 1:0.57; flagellum nearly flattened ventrally.

Thorax. Dorsolateral angle of pronotum obtuse; lateral surface without ridges; lateral lobe rounded. Mesoscutum (Fig. 17D) with dense PP on marginal area, gradually sparse toward anterior to medial areas; IS weakly tessellate (IS = 0.5–1.5 on marginal area, 0.5–2.5 on anterior to medial area); parapsidal line a narrow groove. Mesoscutellum with dense PP over entire surface, IS smooth (IS = 1–2). Metanotum distinctly tessellate, not coarsely rugulose. Mesepisternum (Fig. 17E) with sparse PP over entire surface, IS smooth (IS= 1–6.5). SCL:MNL:MPL = 1:0.54:0.98. Propodeum: metapostnotum (Fig. 17F) gently inclined, with nearly longitudinal ridges not attaining posterior margin; junction between propodeal dorsum and shield smooth, not carinate; lateral surface weakly rugulose and distinctly tessellate; posterior surface weakly tessellate, with lateral carina on lower 1/3 and without oblique carina. Fore trochanter narrow, longer than wide. Hind tibia without basitibial plate. Hind basitarsus slender, approximately 4 × as long as wide. Inner hind tibial spur finely serrate. Fore wing with three submarginal cells.

Abdomen. Discs of T1–T3 with sparse fine PP. T1–T2 smooth except for punctures. T3–T5 with weak lineolation over entire surface. Apical margin of S4–S5 incurved (Fig. 14G, H); shape of S5 as in *L. problematicum*. S6 normally shaped, not modified. S7–S8 (Fig. 18E): S7 with narrow median process, apex as high as top of S8; S8 without median process.

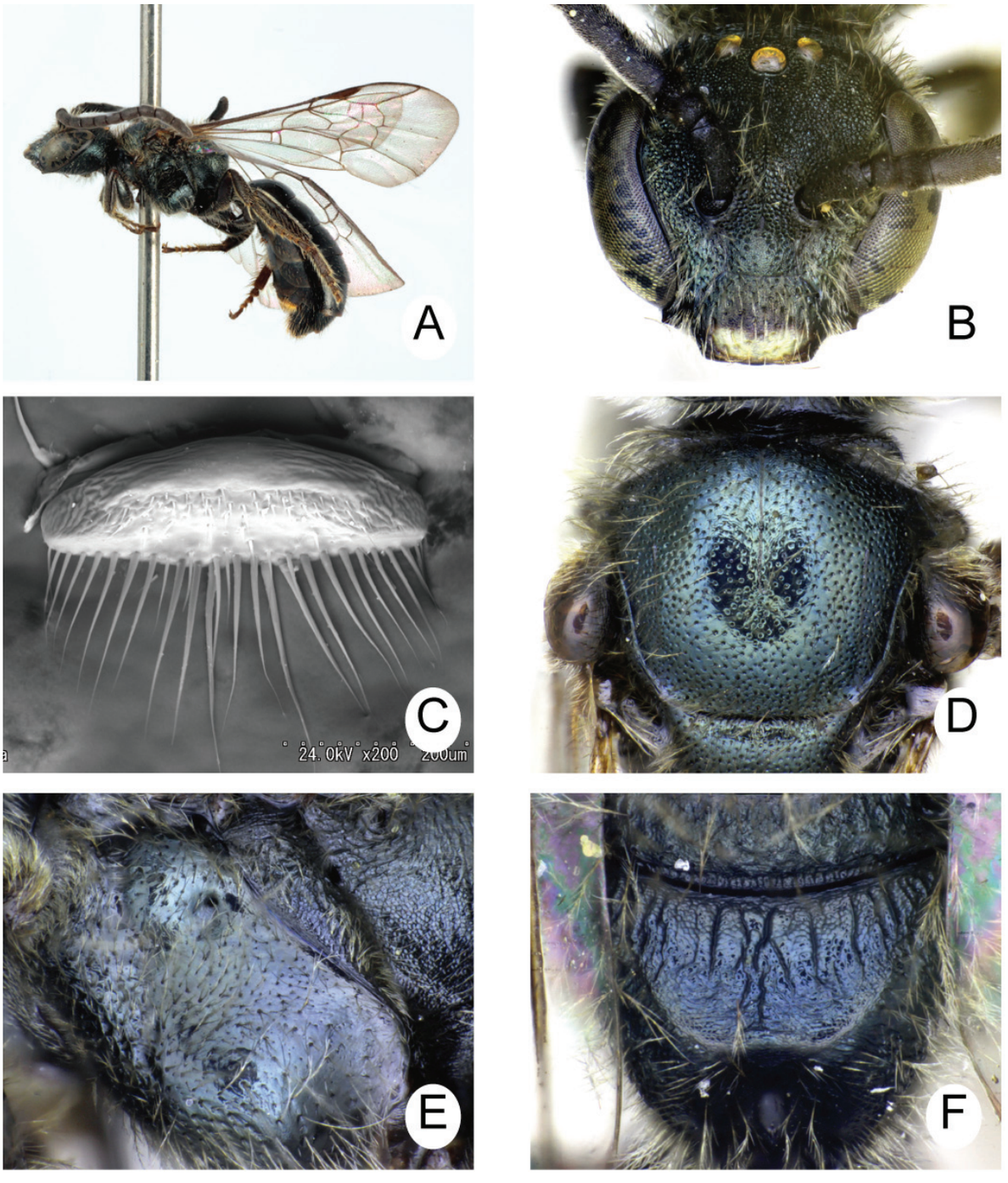

Fig. 17. *Lasioglossum* (*Dialictus*) *alishanense* Murao sp. nov., ♂. **A**. Lateral habitus. **B**. Head in frontal view. **C**. Labrum. **D**. Mesoscutum. **E**. Mesepisternum. **F**. Metapostnotum. A–B, E–F. Holotype. C–D. Paratype.

Genitalia (Fig. 18A–D). Gonobase flat at bottom, ventral arms not connected with each other at upper ends; gonocoxite smooth, gently sloped in lateral view, and inner dorsal margin gently angulate approximately at basal 1/3; gonostylus large, similar to that of *L. problematicum* in shape, located on top of gonocoxite, and with dense setae on inner surface; ventral retrorse lobe tongue-like, moderately long but not reaching gonobase, with dense short setae ventrally and relatively long blunt setae laterally; penis valve with high cleft on top.

Female

Unknown.

Distribution

Taiwan.

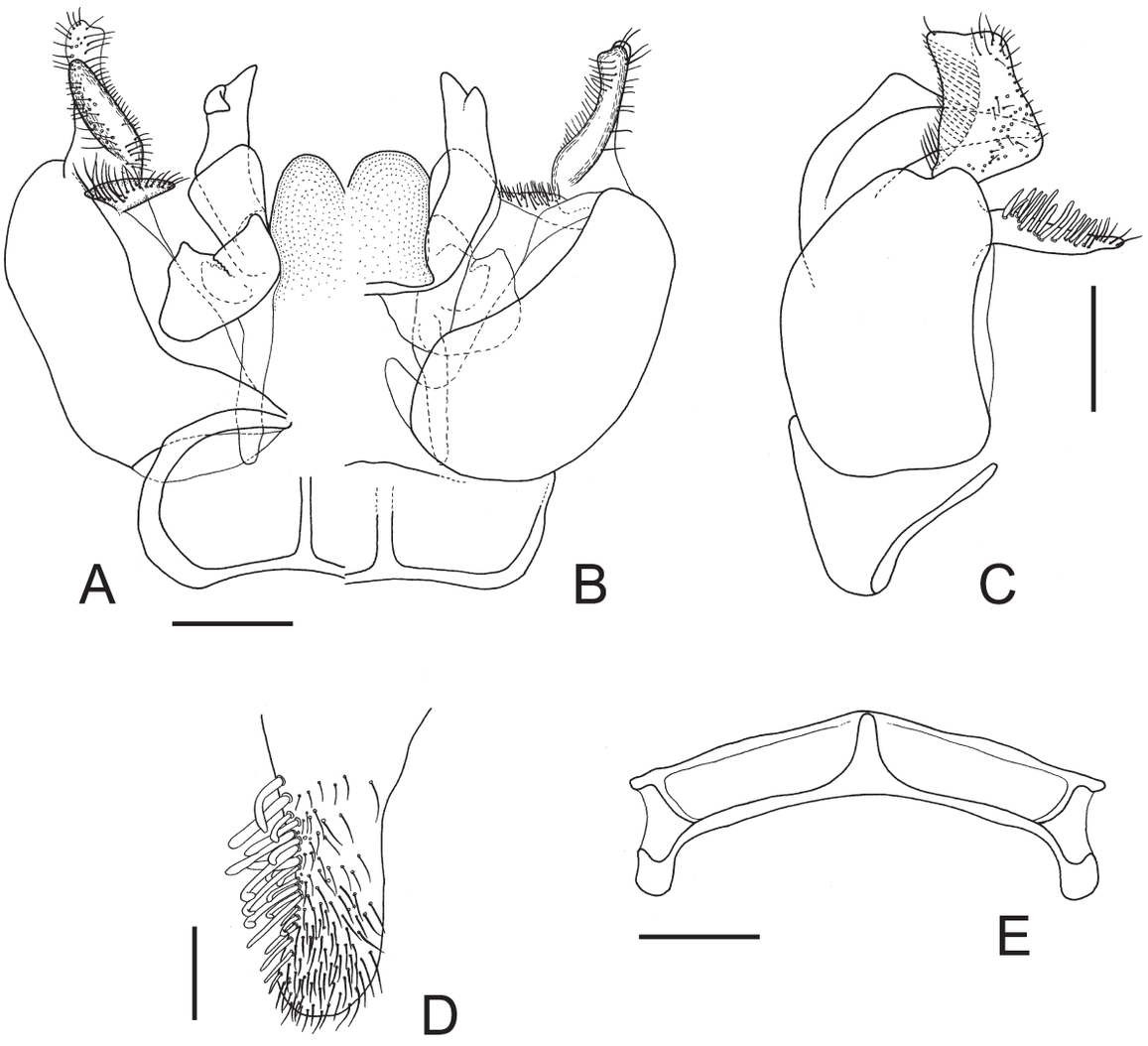

Fig. 18. *Lasioglossum* (*Dialictus*) *alishanense* Murao sp. nov., paratype, ♂. **A**. Genitalia in ventral view. **B**. Genitalia in dorsal view. **C**. Genitalia in lateral view. **D**. Ventral retrorse lobe of genitalia. **E**. S7–S8. Scale bars: A–C, E = 0.2 mm, D = 0.1 mm.

Flight period

Male: late July to September.

Flower record

Not recorded.

The morio *group*

Species included in eastern Asia:
L. briseis Ebmer, 2005
L. circe Ebmer, 1982
L. ellipticeps (Blüthgen, 1923)
L. eomontanus Ebmer, 2006
L. lambatum Fan & Ebmer, 1992
L. moros Ebmer, 2002
L. spinosum Ebmer, 1982

Only one species, listed below, is known to occur on the Korean Peninsula.

Diagnosis and comments

This group in the present paper corresponds to *Evylaeus* (*Smeathhalictus*) Warncke *sensu* Pesenko (2007a). According to Pesenko's key (2007a), this group is separated from the other Palaearctic groups by a combination of the following character states: 1) body small, body length = 4.0–6.5 mm in both sexes, 2) head usually longer than wide in both sexes, 3) male antenna long, reaching propodeum, 4)

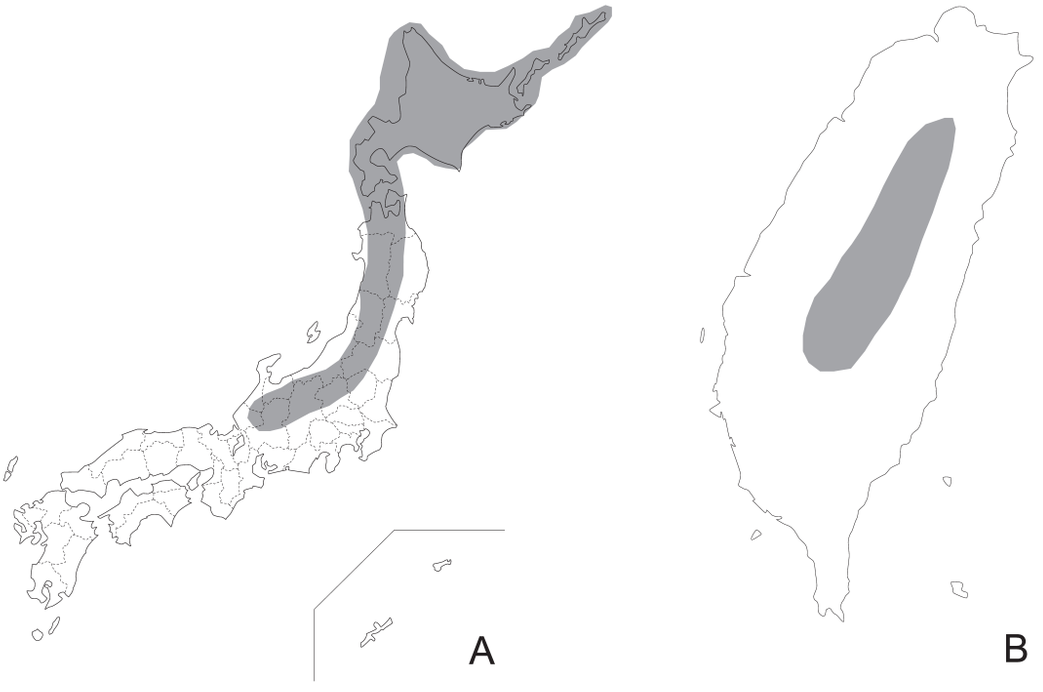

Fig. 19. Distribution maps. **A**. *Lasioglossum* (*Dialictus*) *problematicum* (Blüthgen, 1923) in Japan. **B**. *Lasioglossum* (*Dialictus*) *alishanense* Murao sp. nov.

male F2 1.5–1.7 × as long as its diameter, 5) female mesocutum and mesopleuron punctate, 6) length of metapostnotum as long as or longer than mesoscutellum in both sexes, 7) female metapostnotum striate, more or less shiny, 8) posterior surface of propodeum usually with complete lateral carina in both sexes, 9) male metasoma elongate, 10) female T1 apically with fine lineolate or shagreened, 11) T2–T4 with apical fimbriae or developed lateral spots in both sexes, 12) male metasomal sterna not modified, 13) gonostylus of male genitalia small, rounded triangular, trapeziform or elongate elliptical, and not narrowed at base and 14) ventral retrorse lobe of male genitalia rounded, elliptical, sometimes triangular. However, it is very difficult or impossible to separate from all other group based on these character states. This group needs a revision of the diagnostic characters through detailed morphological and phylogenetic studies.

Distribution

Palaearctic to northern Oriental Region. It is diverse in the western Palaearctic Region.

Lasioglossum* (*Dialictus*) *ellipticeps (Blüthgen, 1923)
Figs 20, 21, 22A, 26B

Halictus ellipticeps Blüthgen, 1923: 254 (holotype: Museum für Naturkunde, Humboldt Universität zu Berlin, Germany, ♀; type locality: Amur, Russia).
Halictus permicus Blüthgen, 1923: 330–331 (lectotype: Institute of Systematic and Experimental Zoology, Polish Academy of Sciences, Krakow, Poland, ♂; type locality: "Perm", designated by Pesenko, 2007b: 117). Synonymized by Ebmer, 1978.
Halictus (*Chloralictus*) *mayacensis* Cockerell, 1924: 582 (syntypes: U. S. National Museum of Natural History, Smithsonian Institution, Washington, DC, USA, ♀; type locality: Primorsky, Russia); Synonymy by Blüthgen 1931.

Halictus ellipticeps – Hirashima 1957: 7–8.
Lasioglossum (*Evylaeus*) *ellipticeps* Ebmer 1978: 310–311. — Ebmer 1982: 215–216. — Ebmer 1996: 282–283. — Ebmer 2005: 375. — Ebmer 2006: 565.
Evylaeus (*Smeathhalictus*) *ellipticeps* Pesenko 2007a: 28. — Pesenko 2007b: 117.

Diagnosis

This species is similar to *Lasioglossum briseis* Ebmer and *L. eomontanus* Ebmer from Far East Asia (Pesenko 2007b). For the differences between these species, see Pesenko (2007b).

Material examined

SOUTH KOREA: Gangwon-do: 2 ♀♀, Doam Myon Pyongchang-gun, 20 Aug. 2001 (Y. Maeta, SULE); 1 ♀, Mt. Hambaek-san, 14 Aug. 1999 (S. Park, SNU). Jeollabuk-do: JeongLyongChy, SanNaeMeon, NamWeon-gun, 14 ♀♀, 14 May 1991 (O. Tadauchi, ELKU), 1 ♀, 14 Jul. 1991 (K. Kanmiya, ELKU). Ulleung-do: 18 ♀♀, 1 ♂, Chusan, 11 Aug. 1999 (H. Kim, SNU); 3 ♀♀, 2 ♂♂, Jukdo, 12 Aug. 1999 (H. Kim, SNU); 2 ♀♀, Naesujeon, 12 Aug. 1999 (H. Kim, SNU); 1 ♀, 2 ♂♂, Naribunji, 11 Aug. 1999 (H. Kim, SNU); 2 ♂♂, Seoginbong, Dodong, 10 Aug. 1999 (H. Kim, SNU). Gyeongsangnam-do: 1 ♂, Sam-Jeong Ri, 14 Jul. 1991 (K. Kanmiya, ELKU). Jeollanam-do: 3 ♀♀, Jongseokdae, Mt. Jiri-san, 29 Jul. 1999 (H. Kim, SNU); 1 ♀, 1 ♂, Nogodan, Mt. Jiri-san, Gurye-gun, 29 Jul. 1999 (H. Kim, SNU). Jeju-do: Yonsil, Mt Halla-san, 50 ♀♀, 24 Jul. 1990 (O. Tadauchi, ELKU), 12 ♀♀, 2 ♂♂, 27 Jul. 1990 (O. Tadauchi, ELKU); 13 ♀♀, 3 ♂♂, Mt Halla-san, alt. 1400–1600 m, 25 Jul. 1990 (O. Tadauchi, ELKU); 1 ♀, Ryuzinkaku, alt. 1600 m, Mt. Hanna, 16 Jul. 1968 (T. Shirozu, ELKU).

Additional description

Labrum (Fig. 20C–D). Basal area approximately 2.2 × as wide as long in female; basal elevation moderately developed in female, absent in male; distal process of female slender, nearly as long as basal

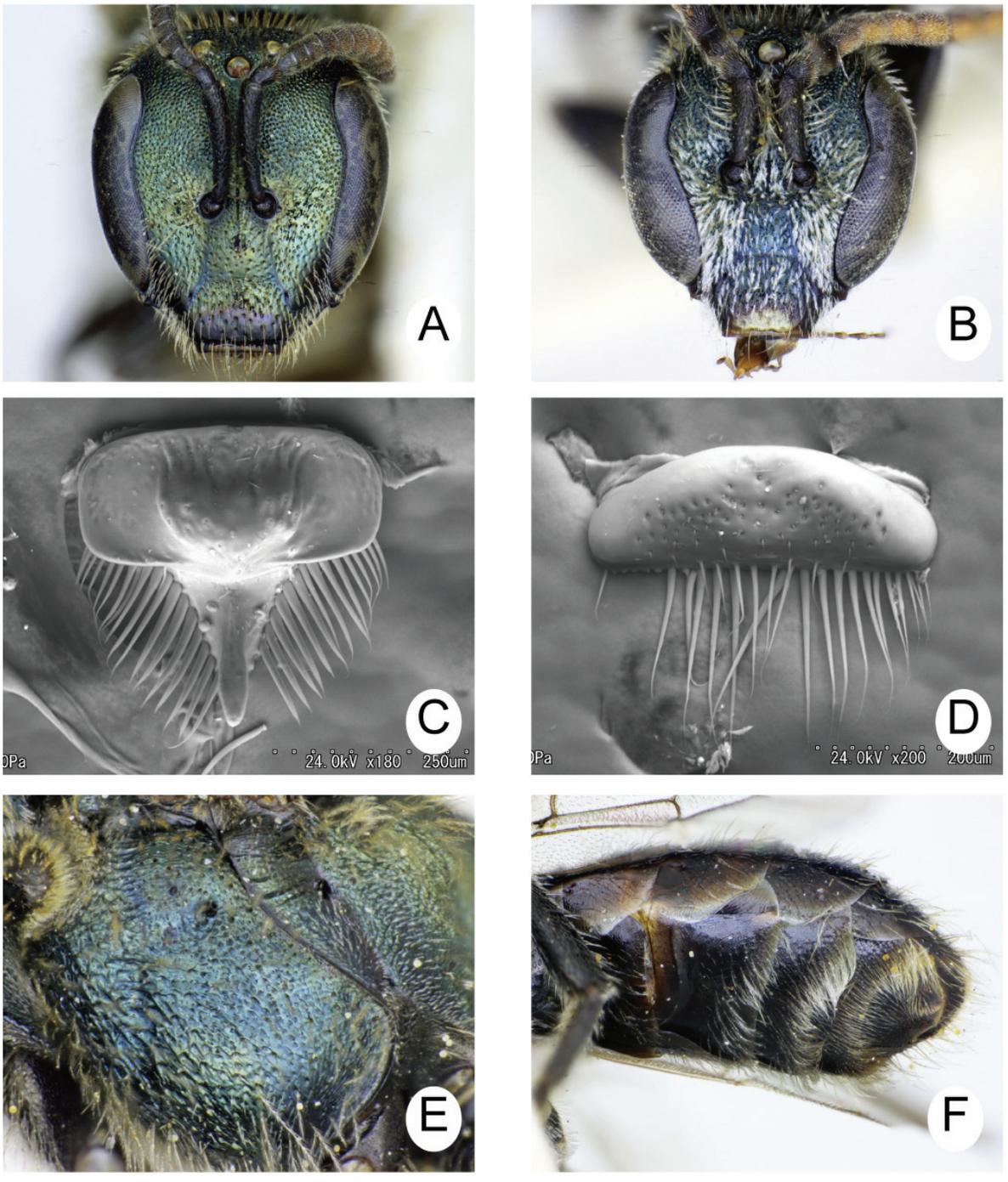

Fig. 20. *Lasioglossum* (*Dialictus*) *ellipticeps* (Blüthgen, 1923). **A–B**. Head. **C–D**. Labrum. **E**. Mesepisternum. **F**. Hairs on metasomal sterna. A, C, E: ♀. B, D, F: ♂.

area, and without lateral projection, that of male absent; keel of distal process narrow, apically bluntly pointed; labral fimbria acutely pointed at apex in both sexes.

Sterna. S7–S8 (Fig. 21E): S7 with short, apically rounded median process; median process of S8 slightly present, round or truncate apically, with sparse short hairs.

Male genitalia (Fig. 21A–D). Gonobase nearly flat at bottom, ventral arms connected with each other at upper ends; gonocoxite smooth, gently sloping in lateral view, inner and outer dorsal margins nearly parallel; gonostylus small, bud-like in lateral view, located at top of gonocoxite, with sparse short hairs; ventral retrorse lobe tongue-like, long, apex reaching gonobase, with short hairs ventrally, apical hairs longer than around one; penis valve higher than gonocoxite, without cleft on top.

Distribution

Russian Far East (Yakutia, Khabarovsk and Primorsk Terr., Irkutsk Prov.), Mongolia and the Korean Peninsula (north, new record for south).

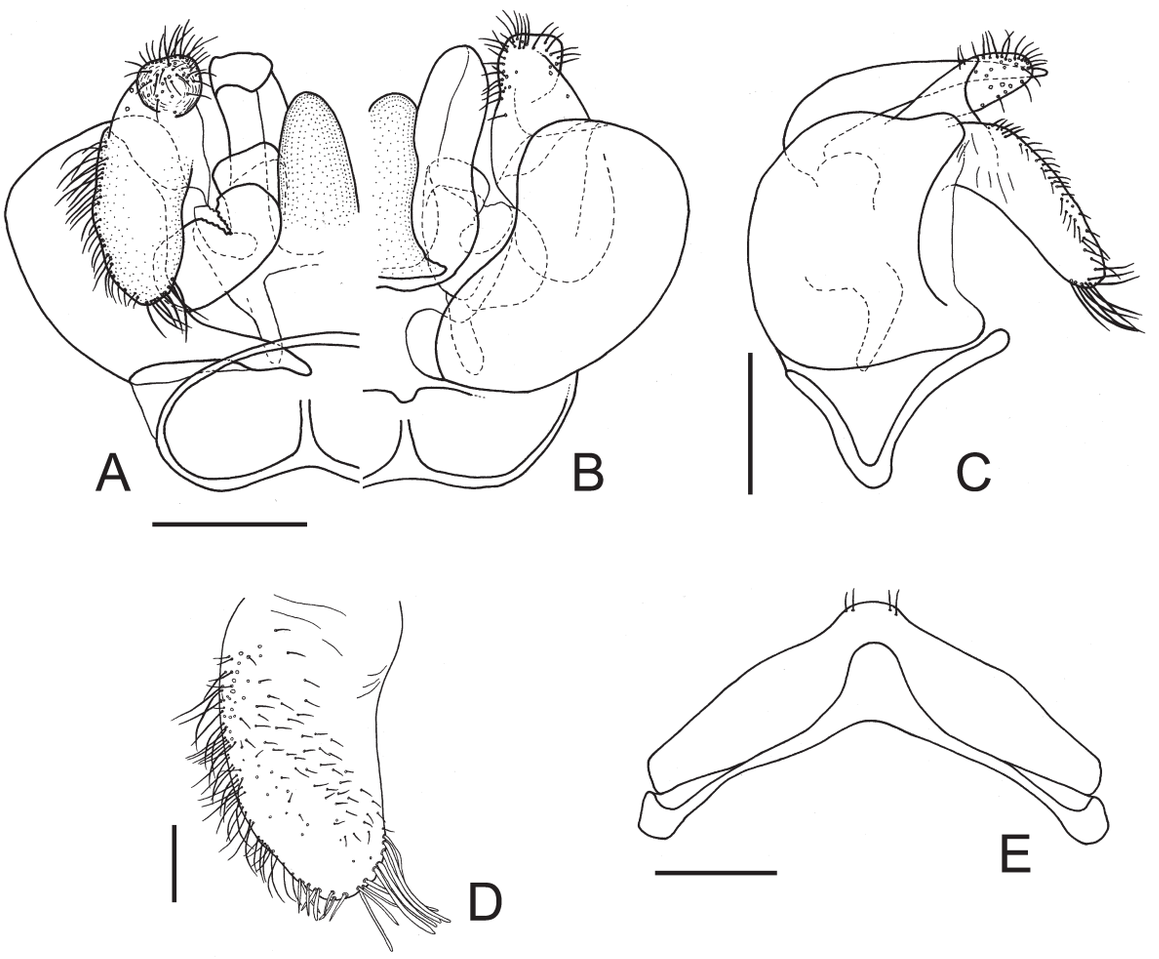

Fig. 21. *Lasioglossum* (*Dialictus*) *ellipticeps* (Blüthgen, 1923), ♂. **A**. Genitalia in ventral view. **B**. Genitalia in dorsal view. **C**. Genitalia in lateral view. **D**. Ventral retrorse lobe of genitalia. **E**. S7–S8. Scale bars: A–C, E = 0.2 mm, D = 0.1 mm.

Flight records

Female: May to August.
Male: July.

Flower records

In South Korea, this species visits the following 10 species in 6 families. Asteraceae: *Erigeron annuus* (L.) Pers., *Lactuca indica* L. Balsaminaceae: *Impatiens balsamina* L., *I. noli-tangere* L. Campanulaceae: *Campanula takeshimana* Nakai, *Codonopsis lanceolata* (Siebold & Zucc.) Trautv., *Platycodon grandiflorus* (Jacq.) A. DC. Geraniaceae: *Geranium* sp. Lamiaceae: *Agastache rugosa* (Fisch. & C.A. Mey.) Kuntze. Lythraceae: *Lythrum anceps* (Koehne) Makino.

Incertae sedis

Lasioglossum* (*Dialictus*) *miyabei Murao, Ebmer & Tadauchi, 2006
Figs 22B–C, 23D, 28A

Lasioglossum (*Evylaeus*) *miyabei* Murao, Ebmer & Tadauchi, 2006: 42–46 (holotype: ELKU, ♀; type locality: Hokkaido, Japan).

Lasioglossum (*Evylaeus*) *miyabei* – Ebmer 2006: 564–565.
Evylaeus (*Glauchalictus*) *miyabei* – Pesenko 2007a: 26. — Pesenko 2007b: 85 (in key), 99 (in key), 114–115.

Diagnosis

This species is separated from other eastern Asian species of *Lasioglossum* (*Dialictus*) by a combination of the following character states: 1) head wider than long in both sexes (HL/HW ratio = 0.91–0.94 in female, = 0.94–0.98 in male); 2) metepisternum punctate in both sexes; 3) female metasomal terga dimly

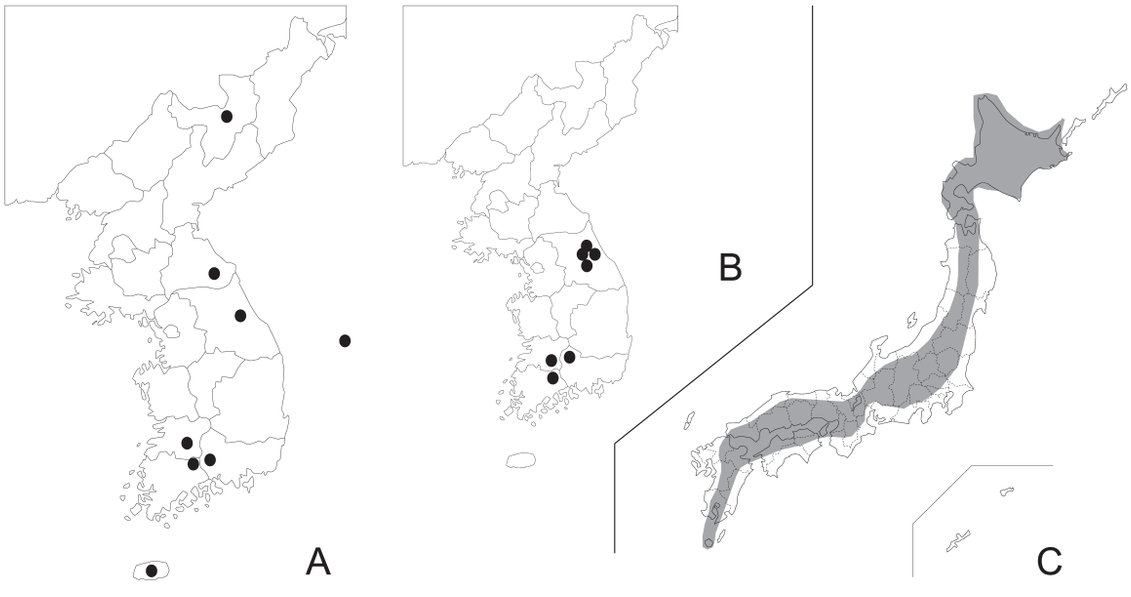

Fig. 22. Distribution maps. **A**. *Lasioglossum* (*Dialictus*) *ellipticeps* (Blüthgen, 1923) in the Korean Peninsula. **B–C**. *Lasioglossum* (*Dialictus*) *miyabei* Murao *et al*., 2006 (B in the Korean Peninsula, C in Japan).

shiny; 4) male metasomal sterna not modified and 5) and the structure of the male genitalia (Murao *et al*. 2006; Fig. 9 A–E).

Material examined

JAPAN: Honshu: 2 ♀♀, 13 ♂♂, Ashiro, Iwate Pref., 19 Sep. 1976 (Y. Maeta, ELKU); 2 ♀♀, Nishikawa-cho, Yamagata Pref., 3 Jun. 2001 (K. Goukon, cGou); 1 ♂, Mt. Zao, Yokokawa-rindo, Miyagi Pref., 21 Aug. 2004 (K. Goukon, cGou); 1 ♂, Agano, Saitama Pref., 23 Oct. 1971 (T. Nambu, ELKU); 1 ♂, Sengataki, Karuizawa, Nagano Pref., 27 Sep. 1972 (H. Suda, ELKU); 1 ♀, Mt. Haku-san, Ishikawa Pref., 30 Jul. 1962 (Y. Haneda, ELKU).

SOUTH KOREA: Gangwon-do: 1 ♀, Ohsaenk-ri, Yangyang-gun, 17 Apr. 1994 (O. Tadauchi, ELKU); 1 ♀, Taewallyong, Myongju-gun, 19 Apr. 1994 (O. Tadauchi, ELKU); 3 ♀♀, Mt. Gariwang-san, Jeongseon-gun, 30 Jul. 2013 (R. Murao, cMur); 3 ♀♀, Mt. Gariwang-san, alt. 1100 m, 37°27’15” N 128°1’10” E, 10 Jun. 2013 (O. Tadauchi, ELKU); 4 ♀♀, Mt. Odae-san, alt. 900 m, 37°47’0” N 128°32’19 E, 9 Jun. 2013 (O. Tadauchi, ELKU); Mt. Odae-san, 1 ♀, 10 May 1996 (H.S. Lee, SNU), 1 ♀, 24 May 2002 (H.S. Lee, QIA); 1 ♀, Odaesanjang, Mt. Odae-san, Jinbueup, Pyengchang-gun, 24 Apr. 1997 (H.S. Lee, QIA). 14 ♀♀, Mt. Seokbyung-san, Imgye-ri, Imgyemyeon, Jeongseon-gun, 22 May 2002 (Y. Lee & J. Yeo, QIA); Baekdamsa temple, Mt. Seolak-san, Sokchosi, 1 ♀, 13 May 2010 (J. Jeong, QIA), 4 ♀♀, 6 Sep. 2010 (H.S. Lee, QIA); 1 ♀, Hwacheondong, Imgyemyeon, Jeongseon-gun, 24 Apr. 1997 (J. Son, QIA); 1 ♀, Hwang-i-ri, Seomyeon, Yangyang-gun, alt. 256 m, 37°56’25.8” N 128°31’19.7” E, 29

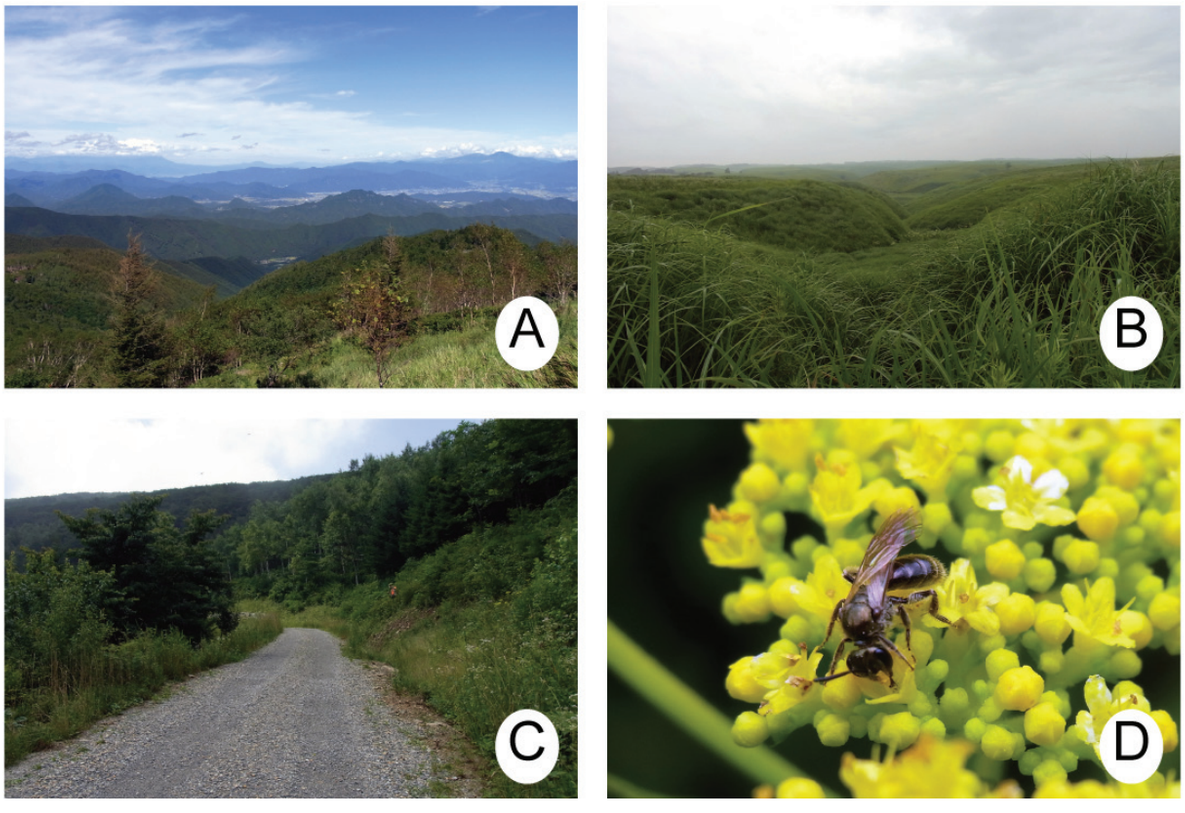

Fig. 23. Habitats in Japan and South Korea. **A**. Takeshikakami-honiri, Ueda-shi, Nagano Pref., Japan. **B**. Matoishi wilderness, Aso-shi, Kumamoto Pref., Japan. **C**. Mt. Gariwangsan, Gangwon-do, South Korea. **D**. *Lasioglossum* (*Dialictus*) *miyabei* Murao *et al*., 2006, ♀ on flowers of *Patrinia scabiosifolia* Fisch. ex Trevir. in South Korea.

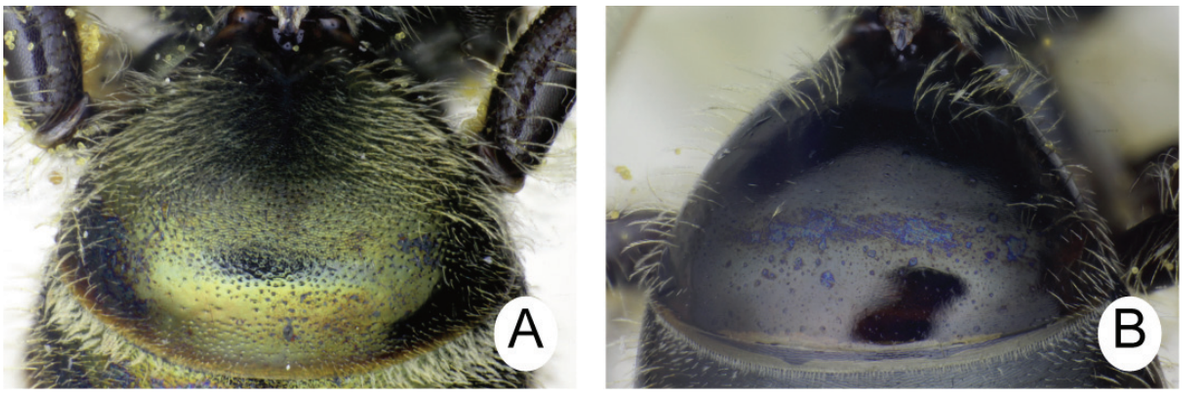

Fig. 24. Photographs for keys: T1 of female. **A**. *Lasioglossum* (*Dialictus*) *viridellum* (Cockerell, 1931). **B**. *L*. (*D*.) *virideglaucum* Ebmer & Sakagami, 1994.

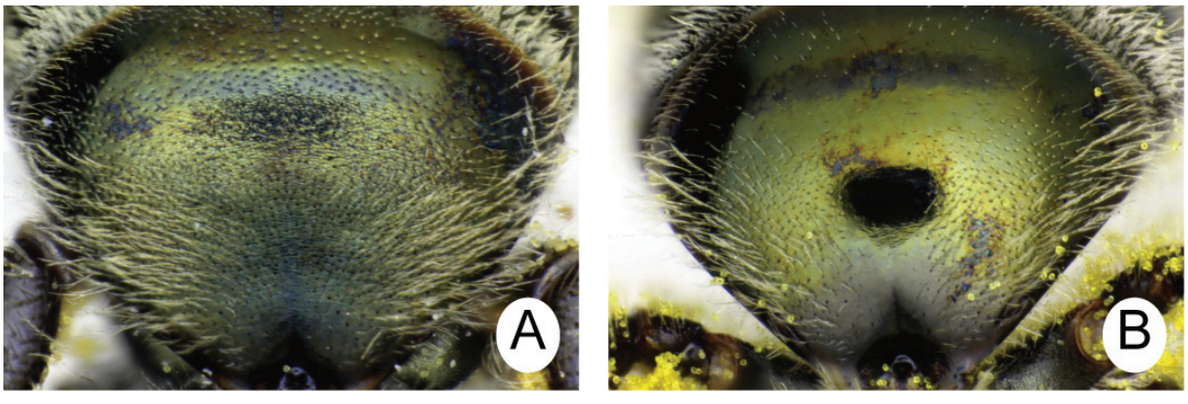

Fig. 25. Photographs for keys: T1 of female. **A**. *Lasioglossum* (*Dialictus*) *viridellum* (Cockerell, 1931). **B**. *L*. (*D*.) *pseudannulipes* (Blüthgen, 1925).

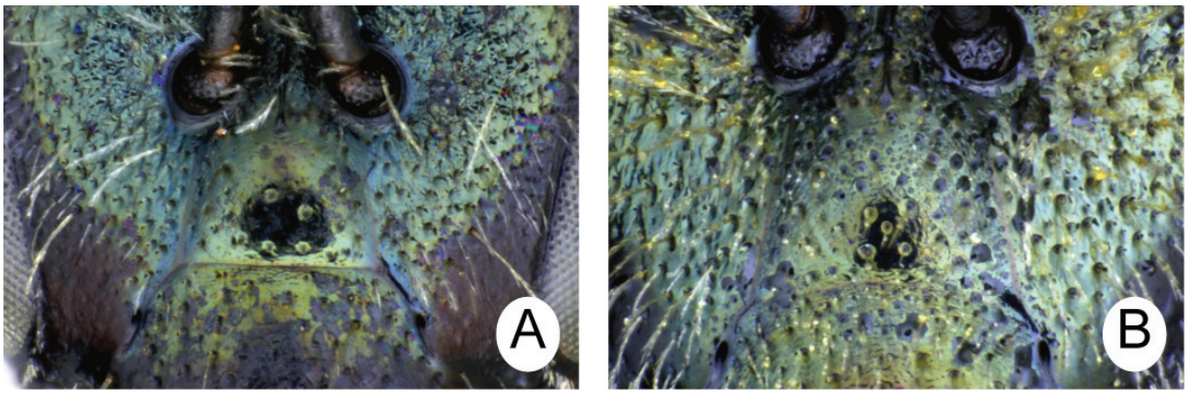

Fig. 26. Photographs for keys: PP on supraclypeal area of female. **A**. *Lasioglossum* (*Dialictus*) *meakanense* Murao & Tadauchi, 2009. **B**. *L*. (*D*.) *ellipticeps* (Blüthgen, 1923).

Apr. 2007 (H.S. Lee, QIA); Mt. Jeombong-san, 1 ♀, 28 Aug. 1999 (H. Kim, SNU), 1 ♀, 29 Aug. 1999 (H. Kim, SNU). Jeollabuk-do: 1 ♀, Jeonglyongchy, Sannaemeon, Namweon-gun, 14 May 1991 (T. Saigusa, ELKU); 1 ♀, Sanlyong-ri, Sannao-myon, Namweon-gun, 29 Apr. 1992 (O. Tadauchi, ELKU). Gyeongsangnam-do: 1 ♀, Sam Jeong Li Ma Cheong Meon, Hamyang-gun, 15 May 1991 (T. Saigusa, ELKU). Jeollanam-do: 1 ♀, Nogodan, Mt. Jiri-san, Gurye-gun, 26 May 1997 (H.S. Lee, QIA).

Distribution

Russian Far East (Primorsky), the Korean Peninsula (new record) and Japan (Hokkaido, Honshu, Shikoku, Kyushu, northern Ryukyus).

Flight period

Female: April to October.
Male: July to October.

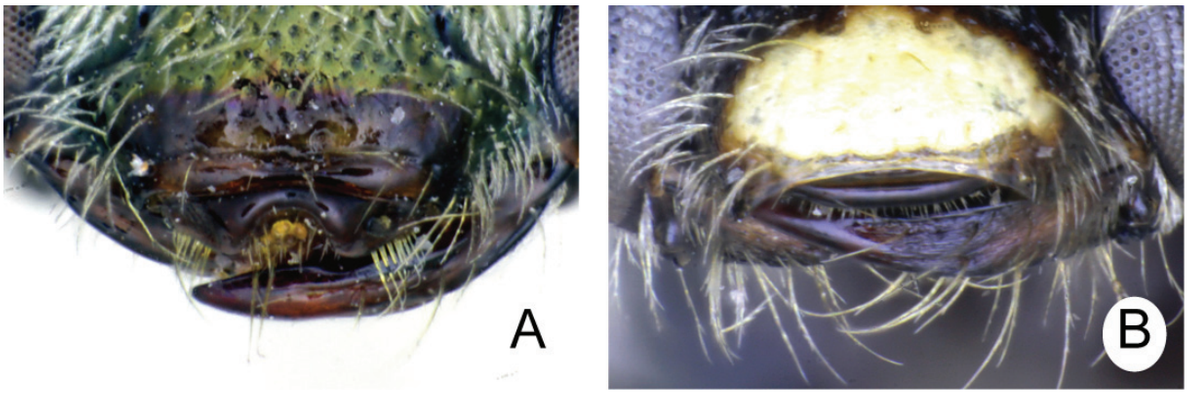

Fig. 27. Photographs for keys: labrum of male. **A**. *Lasioglossum* (*Dialictus*) *viridellum* (Cockerell, 1931). **B**. *L*. (*D*.) *problematicum* (Blüthgen, 1923).

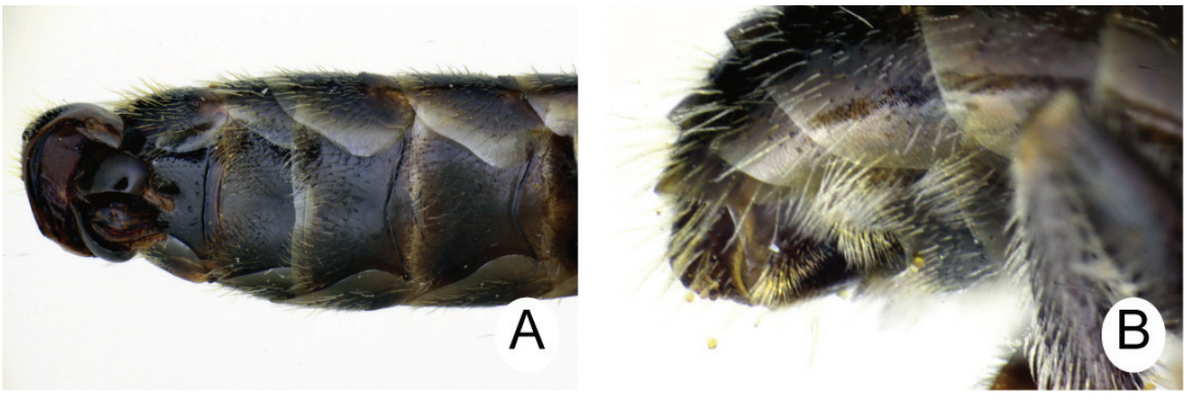

Fig. 28. Photographs for keys: hairs on metasomal sterna of male. **A**. *Lasioglossum* (*Dialictus*) *miyabei* Murao *et al*., 2006. **B**. *L*. (*D*.) *meakanense* Murao & Tadauchi, 2009.

Flower records

The floral records in Japan are reported as 36 species in 13 families by Murao *et al*. (2006). The specimens from South Korea were collected on the flowers of *Aster ageratoides* Turcz. (Asteraceae), *Potentilla verticillaris* Stephan ex Willd. (Rosaceae), *Rhododendron mucronulatum* Turcz. (Ericaceae), *Salix* sp. (Salicaceae), *Sisymbrium luteum* (Maxim.) O.E. Schulz (Brassicaceae), and *Syringa* sp. (Oleaceae).

Habitat

This species has been collected in mountain areas in both Japan and South Korea. One of the collecting sites (Mt. Gariwangsan) in South Korea is shown in Fig. 23C.

DNA barcodes

The COI gene sequences are deposited as DNA barcodes of *L*. (*D*.) *miyabei* in the DDBJ under accession number LC027536. This number is also available in GenBank.

Comments

This species belongs to the *atroglaucum* group in the dissenting systematic study (Murao *et al*. 2006; Pesenko 2007a, as subgenus *Glauchalictus*). It differs, however, considerably with regard to the male character states of the *atroglaucum* group shown in the present study in having the metasomal sterna without unique hair tufts (Fig. 28A), S4 or S5 not modified (Fig. 28A), and the penis valve of male genitalia without a cleft on top. The systematic status of this species could not be decided in the present study. It will need to be correctly determined using phylogenetic analysis in a future study.

Key to female Lasioglossum (Dialictus) *of Japan, the Korean Peninsula and Taiwan:*

1. T1 basally covered with thin, appressed hairs (Fig. 24A) ……2
– T1 basally with sparse and erect hairs (Fig. 24B) ……3

2. T1 usually with strong lineolation on basal to medial area (Fig. 25A) …… ……***Lasioglossum* (*Dialictus*) *viridellum*** (Cockerell, 1931)
– T1 without lineolation or with weak lineolation on basal area (Fig. 25B) …… ……***L.* (*D.*) *pseudannulipes*** (Blüthgen, 1925)

3. Head wider than long (HL/HW ratio 0.91–0.94, n = 10) ……***L.* (*D.*) *miyabei*** Murao *et al.*, 2006
– Head nearly as long as wide or longer than wide (HL/HW ratio 0.98–1.12, n = 30) ……4

4. Mesepisternum reticulate punctate on lower area (Fig. 20E) ……5
– Mesepisternum sparsely shallow punctate on lower area (e.g., Fig. 6E) ……6

5. Supraclypeus sparsely punctate as in Fig. 26A (IS = 1–4.7) …… ……***L.* (*D.*) *meakanense*** Murao & Tadauchi, 2009
– Supraclypeus densely punctate as in Fig. 26B (IS = 1–2) ……***L.* (*D.*) *ellipticeps*** (Blüthgen, 1923)

6. Mesoscutum posteriorly nearly smooth ……***L.* (*D.*) *yamanei*** Murao *et al*., 2006
– Mesoscutum posteriorly weakly or strongly tessellate …… ……***L.* (*D.*) *problematicum*** (Blüthgen, 1923) and ***L.* (*D.*) *virideglaucum*** Ebmer & Sakagami, 1994

Key to male Lasioglossum (Dialictus) *of Japan, the Korean Peninsula, and Taiwan:*

1. Clypeus without yellow spot; labrum with basal elevation depressed centrally (Fig. 27A) ……***L.* (*D.*) *pseudannulipes*** (Blüthgen, 1923) and ***L.* (*D.*) *viridellum*** (Cockerell, 1931)
– Clypeus yellow on lower half; labrum without basal elevation (Fig. 27B) ……2

2. Hind tibia yellow basally and apically, tarsi yellow ……3
– Legs black, without yellow coloration ……4

3. Head wider than long (HL/HW ratio 0.94–0.98, n = 10); metasomal sterna with uniform and sparse hair, without hair tuft (Fig. 28A) ……***L.* (*D.*) *miyabei*** Murao *et al*., 2006
– Head longer than wide (HL/HW ratio 1.07–1.12, n = 5); S5 laterally with moderately long hair tufts (Fig. 28B) ……***L.* (*D.*) *meakanense*** Murao & Tadauchi, 2009

4. S5 flat on whole surface, without apical depression ……5
– S5 with shallow or deep apical depression (Fig. 5B, E, H, K, N) ……7

5. S4–S5 flat, laterally with moderately long hair tufts (Fig. 20F); penis valve of genitalia without cleft on top (Fig. 21C) ……***L.* (*D.*) *ellipticeps*** (Blüthgen, 1923)
– S4–S5 weakly swollen medially; S5 with brush-like hairs along apical margin (Figs 13, 14B, H); penis valve of genitalia with cleft on top (e.g., Fig. 16C) ……6

6. Apical margin of S4 straight (Fig. 14A); gonostylus wider than that of *L. alishanense* (Fig. 16C) ……***L.* (*D.*) *problematicum*** (Blüthgen, 1923)
– Apical margin of S4 incurved (Fig. 14G); gonostylus narrower than that of *L. problematicum* (Fig. 18C) ……***L.* (*D.*) *alishanense*** Murao sp. nov.

7. Apical margin of S5 incurved ……8
– Apical margin of S5 nearly straight ……9

8. Clypeus dull, with strong tessellation; S5 gently incurved (Fig. 5N); gonostylus of genitalia small (Fig. 11C) ……***L.* (*D.*) *taiwanense*** Murao sp. nov.
– Clypeus more shiny, with weak tessellation; S5 deeply incurved (Fig. 5H); gonostylus of genitalia large (Murao *et al*. 2006: fig. 11) ……***L.* (*D.*) *yamanei*** Murao *et al*., 2006

9. S5 with a longitudinal, shallow groove (Fig. 5K) ……***L.* (*D.*) *negoroi*** Murao & Tadauchi, 2008
– S5 without groove ……10

10. Hair pattern of S4 as in Fig. 4B; S6 with a distinct pair of hair tufts (Fig. 4B); gonostylus of genitalia large (Fig. 9C) ……***L.* (*D.*) *virideglaucum*** Ebmer & Sakagami, 1994
– Hair pattern of S4 as in Fig. 4A; S6 with sparse hairs (Fig. 4A); gonostylus of genitalia small and bud-like (Fig. 7C) ……***L.* (*D.*) *atroglaucum*** (Strand, 1913)

A checklist of Lasioglossum (Dialictus) *in Japan, the Korean Peninsula and Taiwan:*

The *leucopus* group:

Lasioglossum (*Dialictus*) *pseudannulipes* (Blüthgen, 1925): Japan
Lasioglossum (*Dialictus*) *viridellum* (Cockerell, 1931): Korean Peninsula
Lasioglossum (*Dialictus*) *meakanense* Murao & Tadauchi, 2009: Japan

The *atroglaucum* group:

The *atroglaucum* subgroup:

Lasioglossum (*Dialictus*) *atroglaucum* (Strand, 1913): Taiwan
Lasioglossum (*Dialictus*) *virideglaucum* Ebmer & Sakagami, 1994: Japan, Korean Peninsula
Lasioglossum (*Dialictus*) *yamanei* Murao, Ebmer & Tadauchi, 2006: Japan
Lasioglossum (*Dialictus*) *negoroi* Murao & Tadauchi, 2008: Japan
Lasioglossum (*Dialictus*) *taiwanense* Murao sp. nov.: Taiwan

The *problematicum* subgroup:

Lasioglossum (*Dialictus*) *problematicum* (Blüthgen, 1923): Japan
Lasioglossum (*Dialictus*) *alishanense* Murao sp. nov.: Taiwan

The *morio* group:

Lasioglossum (*Dialictus*) *ellipticeps* (Blüthgen, 1923): Korean Peninsula

Incertae sedis:

Lasioglossum (*Dialictus*) *miyabei* Murao, Ebmer & Tadauchi, 2006: Japan, Korean Peninsula

Discussion

Twelve species in total are recognized in the countries studied. All species, except for *Lasioglossum* (*Dialictus*) *ellipticeps* and *L*. (*D*.) *virideglaucum*, are endemic in Far East Asia. The number of species per country is as follows: 7 in Japan, 4 in the Korean Peninsula and 3 in Taiwan. We could not examine enough material of *L*. (*Dialictus*) from either the Korean Peninsula (particularly, from the sample of North Korea) or Taiwan in the present study to definitively survey the fauna. The number of species in both countries will likely increase, resulting in additional taxonomic studies of the *L*. (*Dialictus*) fauna. In the present study, all *L*. (*Dialictus*) species from Taiwan are endemic. The other subgenera of Taiwanese *Lasioglossum* may include many endemic species according to the first author's preliminary examination of Taiwanese *Lasioglossum* specimens (Murao unpublished). In eastern Asia, Taiwan (as a consequence of the isolation from or land-bridge formation with the continent) and the Ryukyu Islands (Japan, with its many endemic *Lasioglossum* species, see Murao 2012; Murao & Tadauchi 2006, 2009b; Murao *et al*. 2009b, 2010) would be important areas to consider in order to investigate the allopatric speciation of *Lasioglossum*.

Acknowledgements

We would like to express our thanks to Dr. Layne Julian Westover (ELKU) for his kindness in brushing up an early draft. Ryuki Murao would especially like to thank Dr. Yulia Astafurova (ZISP), Mr. Fritz Gusenleitner (OLML), Mr. Maximilian Schwarz (Linz, Austria), Mr. Andreas Werner Ebmer (Puchenau, Austria), Dr. Andreas Taeger (SDEI), Mr. Andrew Liston (SDEI) and Dr. Frank Koch (Museum für Naturkunde an der Humboldt Universität zu Berlin, Germany) for their help in my examining their Palaearctic and Oriental *Lasioglossum* collections. He also thanks Prof. Emeritus Dr. Yasuo Maeta (Shimane, Japan), Mr. Katsuo Goukon (Miyagi, Japan), and Dr. Ryoichi Miyanaga (Shimane University, Japan) for loan of valuable specimens and literature. This research was supported by the JSPS Institutional Program for Young Researcher Overseas Visits (to Murao), the Environment Research and Technology Development Fund (S-9-2(8)) of the Ministry of the Environment, and the Grant-in-Aid for Scientific Research (B) from the Japan Society for the Promotion of Science (No. 24405016) (Head Researcher: Osamu Tadauchi).

References

Ascher J.S. & Pickering J. 2015. Discover Life bee species guide and world checklist (Hymenoptera: Apoidea: Anthophila). Available from http://www.discoverlife.org./mp/20q?guide=Apoidea_species (accessed 27 Jan. 2015)

Blüthgen P. 1931. Beiträge zur Synonymie der Bienengattung *Halictus* Latr. VII. (Hym. Apid.). *Deutsche Entomologische Zeitschrift* 1930: 209–215.

Danforth B.N. 1999. Phylogeny of the bee genus *Lasioglossum* (Hymenoptera: Halictidae) based on mitochondrial COI sequence data. *Systematic Entomology* 24: 377–393. http://dx.doi.org/10.1046/j.1365-3113.1999.00087.x

Danforth B.N., Conway L. & Ji S. 2003. Phylogeny of eusocial *Lasioglossum* reveals multiple losses of eusociality within a primitively eusocial clade of bees (Hymenoptera: Halictidae). *Systematic Biology* 52: 23–36. http://dx.doi.org/10.1080/10635150390132687

Ebmer A.W. 1978. Die Bienen der Gattungen *Halictus* Latr., *Lasioglossum* Curt. und *Dufourea* Lep. (Hymenoptera, Halictidae) aus Korea. *Annales Historico-Naturales Musei Nationalis Hungarici* 70: 307–319.

Ebmer A.W. 1982. Zur Bienenfauna der Mongolei: Die Arten der Gattungen *Halictus* Latr. und *Lasioglossum* Curt. (Hymenoptera: Halictidae). Ergebnisse der Mongolisch-Deutschen Biologischen Expedition Seit 1962, Nr. 105. *Mitteilungen aus dem zoologischen Museum in Berlin* 58: 199–227.

Ebmer A.W. 1996. Asiatische Halictidae, 5. Daten zur Aculeaten-Fauna der Ussuri-Region unter Berücksichtigung der angrenzenden Gebiete (Insecta: Hymenoptera: Apoidea: Halictidae: Halictinae). *Linzer Biologische Beiträge* 28: 261–304.

Ebmer A.W. 1998. Asiatische Halictidae, 7. Neue *Lasioglossum*-Arten mit einer Übersicht der *Lasioglossum* s. str.-Arten der nepalischen und yunnanischen Subregion, sowie des nördlichen Zentral-China (Insecta: Hymenoptera: Apoidea: Halictidae: Halictinae). *Linzer Biologische Beiträge* 30: 365–430.

Ebmer A.W. 2002. Asiatische Halictidae, 10. Neue Halictidae aus China sowie diagnostische Neubeschreibungen der von Fan & Ebmer 1992 beschriebenen *Lasioglossum*-Arten (Insecta: Hymenoptera: Apoidea: Halictidae: Halictinae). *Linzer Biologische Beiträge* 34: 819–934.

Ebmer A.W. 2005. Zur Bienenfauna der Mongolei: Die Arten der Gattungen *Halictus* Latr. und *Lasioglossum* Curt. (Insecta: Hymenoptera: Apoidea: Halictidae: Halictinae). Ergänzungen und Korrekturen. *Linzer Biologische Beiträge* 37: 343–392.

Ebmer A.W. 2006. Daten zur Aculeaten-Fauna der Ussuri-Region unter Berücksichtigung der angrenzenden Gebiete – 2. Arten der Gattungen *Halictus*, *Lasioglossum*, *Dufourea*, *Macropis* aus dem Lazovski Zapovednik-Naturreservat Laso (Insecta: Hymenoptera: Apoidea: Halictidae, Melittidae). *Linzer Biologische Beiträge* 38: 541–593.

Ebmer A.W. & Sakagami S.F. 1990. *Lasioglossum* (*Evylaeus*) *algirum pseudannulipes* (Blüthgen) erstmals in Japan gefunden, mit Notizen über die *L.* (*E.*) *leucopus*-gruppe (Hymenoptera, Halictidae). *Japanese Journal of Entomology* 58: 835–838.

Ebmer A.W., Maeta Y. & Sakagami S.F. 1994. Six new halictine bee species from southwest archipelago, Japan (Hymenoptera, Halictidae). *Bulletin of the Faculty of Agriculture, Shimane University* 28: 23–36.

Folmer O., Black M., Hoeh W., Lutz R. & Vrijenhoek R. 1994. DNA primers for amplification of mitochondrial cytochrome c oxidase subunit I from diverse metazoan invertebrates. *Molecular Marine Biology and Biotechnology* 3: 294–299.

Gibbs J. 2010. Revision of the metallic species of *Lasioglossum* (*Dialictus*) in Canada (Hymenoptera, Halictidae, Halictini). *Zootaxa* 2591: 1–382.

Gibbs J. 2011. Revision of the metallic *Lasioglossum* (*Dialictus*) of eastern North America (Hymenoptera: Halictidae: Halictini). *Zootaxa* 3073: 1–216.

Gibbs J., Brady S.G., Kanda K. & Danforth B.N. 2012. Phylogeny of halictine bees supports origin of eusociality for *Halictus* and *Lasioglossum* (Apoidea: Anthophila: Halictidae). *Molecular Phylogenetics and Evolution* 65: 926–939. http://dx.doi.org/10.1016/j.ympev.2012.08.013

Gibbs J., Packer L., Dumesh S. & Danforth B.N. 2013. Revision and reclassification of *Lasioglossum* (*Evylaeus*), *L.* (*Hemihalictus*) and *L.* (*Sphecodogastra*) in eastern North America (Hymenoptera: Apoidea: Halictidae). *Zootaxa* 3672: 1–117. http://dx.doi.org/10.11646/zootaxa.3672.1.1

Goubara M., Sugimoto Y. & Sugiura N. 2004. Discovery of 12 species of the genus *Lasioglossum* from Kyushu Island, Japan (Hymenoptera: Halictidae). *Tsunekibachi* 3: 51–58. (In Japanese)

Gôukon K. 2006. Flower-visiting insects and their seasonal flunctuation at tideland and sand dune in Gamo Beach, Sendai, northern Japan. *Chugoku Kontyu* 20: 51–69. (In Japanese)

Hirashima Y. 1957. A tentative catalogue of the genus *Halictus* Latreille of Japan, and her adjacent territories (Hymenoptera, Halictidae). *Science Bulletin of the Faculty of Agriculture, Kyushu University* 16: 1–30.

Ikudome S. 1992. The environment and the wild bee fauna of a natural park in a city, with the result taken at Shiroyama Park in Kagoshima City, Japan, and with the appendix of a revised bee list recorded from the mainland of Kagoshima Prefecture (Hymenoptera, Apoidea). *Bulletin of Kagoshima Women's Junior College* 27: 99–135. (In Japanese)

Maeta Y., Miyanaga R. & Kitamura K. 2003. Ecological studies on the wild bee fauna at Mt. Sanbe in Shimane Prefecture, Japan (Hymenoptera, Apoidea). *New Entomologist* 52: 19–47. (in Japanese)

Michener C.D. 1974. *The Social Behavior of the Bees*. Belknap Press of Harvard University Press, Cambridge, Massachusetts.

Michener C.D. 2000. *The Bees of the World*. The Johns Hopkins University Press, Baltimore & London.

Michener C.D. 2007. *The Bees of the World*, 2nd ed. The Johns Hopkins University Press, Baltimore & London.

Morawitz F. 1873. Die Bienen Daghestans. *Horae Societatis Entomological Rossicae* 10: 129–189.

Murao R. 2012. *Lasioglossum* (*Evylaeus*) *tadauchii* sp. nov. (Hymenoptera, Halictidae) from Amami-Oshima, southwestern Japan. *Esakia* 52: 91–94.

Murao R. 2015. Notes on the distribution of the genus *Lasioglossum* (Hymenoptera, Halictidae) in eastern Asia. *Japanese Journal of Systematic Entomology* 21: 1–3.

Murao R & Tadauchi O. 2006. A new species of the subgenus *Evylaeus* of the genus *Lasioglossum* (Hymenoptera, Halictidae) from the Ryukyus, southwestern Japan. *Japanese Journal of Systematic Entomology* 12: 203–206.

Murao R. & Tadauchi O. 2007. A revision of the subgenus *Evylaeus* of the genus *Lasioglossum* (Hymenoptera, Halictidae) in Japan. Part I. *Esakia* 47: 169–254.

Murao R. & Tadauchi O. 2008. A new species of the subgenus *Evylaeus* of the genus *Lasioglossum* from northern and central Japan (Hymenoptera: Halictidae). *Esakia* 48: 37–40.

Murao R. & Tadauchi O. 2009a. Description of a new species belonging to the subgenus *Evylaeus* of the genus *Lasioglossum* (Hymenoptera, Halictidae) from Hokkaido, northern Japan. *Biogeography* 11: 113–117.

Murao R. & Tadauchi O. 2009b. Two new taxa of the *leiosoma* species-group of the genus *Lasioglossum* from the Ryûkyû Islands, Japan (Hymenoptera, Halictidae). *Japanese Journal of Systematic Entomology* 15: 389–399.

Murao R., Ebmer A.W. & Tadauchi O. 2006. Three new species of the subgenus *Evylaeus* of the genus *Lasioglossum* from eastern Asia (Hymenoptera: Halictidae). *Esakia* 46: 35–51.

Murao R., Ebmer A.W. & Tadauchi O. 2009a. Taxonomic position of *Lasioglossum* (*Evylaeus*) *algirum pseudannulipes* (Insecta: Hymenoptera: Halictidae). *Species Diversity* 14: 165–171.

Murao R., Lee H.S. & Tadauchi O. 2014. *Lasioglossum* (*Acanthalictus*) *dybowskii* (Hymenoptera, Halictidae) newly recorded from South Korea, with a checklist of the genus *Lasioglossum* in Korean Peninsula. *Journal of Hymenoptera Research* 38: 141–153. http://dx.doi.org/10.3897/JHR.38.7572

Murao R., Tadauchi O. & Yamauchi T. 2009b. Taxonomic revision of the subgenus *Ctenonomia* of the genus *Lasioglossum* (Hymenoptera, Halictidae) in Japan. *Esakia* 49: 75–94.

Murao R., Tadauchi O., Goubara M. & Maeta Y. 2010. Taxonomy of the carinaless group of *Lasioglossum* (*Evylaeus*) (Hymenoptera, Halictidae) from the Ryukyu Islands, Japan, with description of seven new species. *Zootaxa* 2669: 1–33.

Negoro H. 2012. Flower-visiting habits of wild bees in Toyama Prefecture, Hokuriku, Japan. *Bulletin of the Toyama Science Museum* 36: 55–128. (In Japanese)

Pauly A., Gibbs J. & Kuhlmann M. 2012. *Capalictus*, a new subgenus of *Lasioglossum* Curtis, 1833 from South Africa, with description of three new species (Hymenoptera, Apoidea, Halictidae). *European Journal of Taxonomy* 28: 1–28. http://dx.doi.org/10.5852/ejt.2012.28

Pauly A., Walker K., Munzinger J. & Donovan B. 2013. Endémisme insulaire et cleptoparasitisme chez les *Lasioglossum* Curtis 1833 (Hymenoptera: Apoidea: Halictidae) de Nouvelle-Calédonie. *Annales de la Société entomologique de France* (*N. S.*) 49: 127–153. http://dx.doi.org/10.1080/00379271.2013.815036

Pesenko Y.A. 2006. Contributions to the halictid fauna of the Eastern Palaearctic Region: genus *Lasioglossum* Curtis (Hymenoptera: Halictidae, Halictinae). *Zoosystematica Rossica* 15: 133–166.

Pesenko Y.A. 2007a. Subgeneric classification of the Palaearctic bees of the genus *Evylaeus* Robertson (Hymenoptera: Halictidae). *Zootaxa* 1500: 1–54.

Pesenko Y.A. 2007b. A taxonomic study of the bee genus *Evylaeus* Robertson of Eastern Siberia and the Far East of Russia (Hymenoptera: Halictidae). *Zoosystematica Rossica* 16: 79–123.

Sakagami S.F. & Fukuda H. 1973. Wild bee survey at the campus of Hokkaido University. *Journal of the Faculty of Science, Hokkaido University, Series VI, Zoology* 19: 190–250.

Sakagami S.F. & Kuribayashi S. 1979. On the semisocial halictine bees. *Anima* 79: 54–60. (In Japanese)

Sakagami S.F. & Michener C.D. 1962. *The Nest Architecture of the Sweat Bees (Halictinae), a Comparative Study*. University of Kansas Press, Lawrence.

Sakagami S.F., Hoshikawa K. & Fukuda H. 1984. Overwintering ecology of two social halictine bees, *Lasioglossum duplex* and *L. problematicum*. *Researches on Population Ecology* 26: 363–378.

Sakagami S.F. Laroca S. & Moure J.S. 1967. Wild bee biocoenotics in São José dos Pinhais (PR), South Brazil. Preliminary report. *Journal of the Faculty of Science, Hokkaido University, Series VI, Zoology* 16: 253–291.

Strand E. 1913. H. Sauter's Formosa-Ausbeute. Apidae II (Die *Halictus*-Arten von Formosa). *Archiv für Naturgeschichte* 79A: 147–171.

Tamura K., Peterson D., Peterson N., Stecher G., Nei M. & Kumar S. 2011. MEGA5: Molecular evolutionary genetics analysis using maximum likelihood, evolutionary distance, and maximum parsimony methods. *Molecular Biology and Evolution* 28: 2731–2739. http://dx.doi.org/10.1093/molbev/msr121

Usui M., Nishijima Y., Fukuda H. & Sakagami S.F. 1976. A wild bee survey in Obihiro Eastern Hokkaido. *Research Bulletin of Obihiro University, Series I* 10: 225–251.

Yamauchi K., Murakumo Y., Ogura M. & Sakagami S.F. 1974. Biofaunistic survey of wild bees in Minami (Gifu Prefecture), Central Japan. *Science Report of the Faculty of Education, Gifu University* (*Natural Science*) 5: 220–232. (In Japanese)

Yanega D. 1997. Demography and sociality in halictine bees (Hymenoptera: Halictidae). *In*: Choe J.C. & Crespi B.J. (eds) *The Evolution of Social Behavior in Insects and Arachnids*: 293–315. Cambridge University Press, Cambridge, U.K.

Yonekura K. & Kajita T. 2003–. BG Plants Japanese-scientific names index (Ylist). Available from http://ylist.info/index.html [accessed 11 Aug. 2015].

Manuscript received: 11 March 2015
Manuscript accepted: 3 June 2015
Published on: 14 September 2015
Topic editor: Koen Martens
Desk editor: Kristiaan Hoedemakers

Printed versions of all papers are also deposited in the libraries of the institutes that are members of the *EJT* consortium: Muséum National d'Histoire Naturelle, Paris, France; Botanic Garden Meise, Belgium; Royal Museum for Central Africa, Tervuren, Belgium; Natural History Museum, London, United Kingdom; Royal Belgian Institute of Natural Sciences, Brussels, Belgium; Natural History Museum of Denmark, Copenhagen, Denmark.