Zootaxa 5404 (1): 206–235
https://www.mapress.com/zt/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.5404.1.13
http://zoobank.org/urn:lsid:zoobank.org:pub:A902495B-8A81-4F33-BA18-B8E3E79FA6A9

A problematic species complex for *Lasioglossum* subgeneric diagnostics in North America (Hymenoptera: Halictidae)

THILINA HETTIARACHCHI[1,2] & JASON GIBBS[1*]
[1]*Department of Entomology, University of Manitoba, 12 Dafoe Rd. Winnipeg, MB, R3T 2N2, Canada.*
[2] *hettiart@myumanitoba.ca; https://orcid.org/0000-0003-4430-4105*
**Corresponding author: jason.gibbs@umanitoba.ca; https://orcid.org/0000-0002-4945-5423*

Abstract

A problematic species complex within *Lasioglossum* subgenus *Sphecodogastra* with unusual metallic reflections on the mesosoma is described from North America. Three new species in this complex are described and illustrated: *Lasioglossum* (*Sphecodogastra*) *iridescens* **sp. nov.**, *Lasioglossum* (*Sphecodogastra*) *dilisena* **sp. nov.**, and *Lasioglossum* (*Sphecodogastra*) *silveirai* **sp. nov.** Our study addresses the challenge of diagnosing *Lasioglossum* subgenera within North America. We present an updated key for the North American *Lasioglossum* subgenera.

Key words: Apoidea, classification, cryptic species, new species, taxonomy

Introduction

Lasioglossum Curtis (Hymenoptera: Halictidae) is the most species rich genus of bees, with approximately 1900 described species (Ascher & Pickering 2023). A defining characteristic of the genus is the weakened distal veins of the forewing, which is most evident in females (Danforth & Ji 2001; Michener 2007). The broad scope of *Lasioglossum* is due, in part, to the challenges in diagnosing taxa at lower levels (Ebmer 1969, 2002; Gibbs *et al.* 2012b; Michener 1944, 2007). The genus has among the highest diversification rates of all bees (Bossert *et al.* 2021; Cardinal 2018; Grab *et al.* 2019) and this has doubtlessly contributed to the well-documented taxonomic challenges of the group (Gibbs 2018b). Even at a local scale, diagnosing subgenera within *Lasioglossum* can be problematic (Gibbs *et al.* 2013; Pesenko 2007). Some authors have chosen to recognize multiple genera within *Lasioglossum sensu lato* (Mitchell 1960; Moure 2007; Pesenko *et al.* 2000), but this can lead to unstable taxa.

The subgenus *Lasioglossum* (*Sphecodogastra* Ashmead) was originally proposed for an unusual crepuscular species that specializes on Onagraceae (Ashmead 1899; McGinley 2003). The type species, *L. texanum* (Cresson) has enormous ocelli, modified scopa, and orange-red metasoma. Additional matinal and crepuscular species that specialize on Onagraceae, some with far less distinct anatomical characters were subsequently described (McGinley 2003). Phylogenetic studies later demonstrated that these specialists were nested within a larger clade often referred to as the 'carinate *Evylaeus* Robertson' (Danforth *et al*. 2003; Gibbs *et al*. 2012b). Other members of this larger clade do not show the same activity period, host plant specialization, or associated anatomical modifications (but see *L. pallidum* (Radoszkowski); Ebmer 2008). The type species of *L.* (*Evylaeus*) has repeatedly been found in a separate clade from most species historically placed in this genus group (Danforth *et al.* 2003; Gibbs *et al.* 2012b; a). With the goal of stabilizing nomenclature around monophyletic groups, the scope of *L.* (*Sphecodogastra*) was drastically increased to include most 'carinate *Evylaeus*', while 'true' *L.* (*Evylaeus*) was limited to a few North American species (Gibbs *et al.* 2013b).

Diagnosing *L.* (*Sphecodogastra*) is complicated by the highly modified forms of the Onagraceae specialists, but typically *L.* (*Sphecodogastra*) have the body black, vein 1rs-m weak, and the propodeum with strong lateral and oblique carinae. Males have long antennae and nearly bare sterna. In the Palaearctic Region, some *L.* (*Sphecodogastra*) have metallic reflections (Pesenko 2007), reminiscent of subgenus *L.* (*Dialictus* Robertson). In the Nearctic Region, this is not known to be the case, so nearly all metallic halictines with weak wing veins are *L.* (*Dialictus*). There

 Accepted by E. Almeida: 20 Nov. 2023; published: 25 Jan. 2024

is a single exception in *Lasioglossum s.s.*, but that is geographically restricted and easily diagnosable based on other characteristics (McGinley 1986). More recently, high elevation, metallic species in the Neotropics, with a single species, *L. aquilae* (Cockerell), extending into the USA, have been proposed as a distinct clade from *L.* (*Dialictus*) (Gibbs *et al.* 2013a). Furthermore, brilliant metallic species, sometimes treated as *L.* (*Habralictellus* Moure & Hurd), in the Antillean islands and southern Florida are considered distinct but may be nested within a broader *L.* (*Hemihalictus* Cockerell) (Gibbs 2018a). We document and describe a complex of three new species of Nearctic *L.* (*Sphecodogastra*) with subtle metallic reflections on the mesosoma that add additional challenges to subgeneric diagnostics of Nearctic *Lasioglossum*. We present modified subgeneric diagnoses for North American *L.* (*Sphecodogastra*) and a working key to *Lasioglossum*-subgenera of North America.

Methods

As part of ongoing taxonomic studies on *Lasioglossum* in North America, 307 specimens of a new species complex were found in the University of California-Riverside Entomology Research Museum, Riverside, California, United States of America (UCRC); University of California-Berkeley, Essig Museum of Entomology, Berkeley, United States of America (EMEC); Arizona State University, Hasbrouck Insect Collection, Tempe, United States of America (ASUHIC); Natural History Museum of Los Angeles County, Los Angeles, California, United States of America (LACM); and Oregon State University Arthropod Collection, Corvallis, Oregon, United States of America (OSAC).

Morphological study was conducted iteratively combining qualitative measures with geographical patterns to determine potential species boundaries. Several measurements derived from Michener (2007) and Cane (1987) were taken from multiple individuals from each putative population and geographic location. Head length measurements follow Michener (2007) and Gibbs (2010) i.e. measured from the lower margin of the clypeus to the highest point of the vertex. Face length was taken from the lower margin of the clypeus to the median ocellus, following Gardner and Gibbs (2020). Measurements were taken using an ocular micrometer mounted in an Olympus SZX16 microscope or using Nikon Elements (Nikon) software on photographs taken using a camera mounted to a Nikon SMZ25. The structures being measured were viewed at the highest magnification possible that allowed the entire structure to be seen in focus within the viewing area.

Measurements were used in a linear discriminant analysis (LDA) to test the limits of species grouped by this holistic examination of specimens. LDA was performed using the *MASS* package (Venables and Ripley 2002) in R (R Core Team 2022). Specimens were categorized *a priori* into groups based on our qualitative determination of their variation. The results of the LDA were visualized in an ordination. These quantitative measurements were merged with a subset of qualitative characters for partitioning around medioids (PAM). Gower distances were calculated form this combined data set using the *cluster* package (Maechler *et al*. 2012). We used a silhouette analysis to determine the best number of groups (k) to include in the PAM based on the Gower distance matrix. We used T-distributed stochastic neighbour embedding to plot our PAM results, using the *Rtsne* package (Krijthe 2015).

Descriptions and imaging are consistent with those described in Gardner and Gibbs (2020). The morphological terms are based on Michener (2007) and supplemented with additional terms (e.g. metapostnotum and dorsolateral slope) following Gibbs (2010). Surface sculpture terms follow Harris (1979). The following abbreviations are used in the diagnoses, descriptions, and keys: IS = the interspaces between punctures, and PD = puncture diameter.

To ensure that the plant names recorded on the specimen labels were consistent with current taxonomy, the World Flora Online database (World Flora Online Consortium 2020) and the USDA online plant database (USDA, NRCS 2023) were used for the list of floral hosts.

Results

Three putative species were defined based on a holistic examination of specimens from southern California and Arizona. Three, non-overlapping clusters were recovered from the LDA (Fig. 1), supporting the distinction between the three putative species. A silhouette analysis of Gower distances based on the 11 measurements and ratios, and seven qualitative characters had the highest score for three groups. We set $k = 3$ for our PAM. Individuals were

assigned to clusters in close alignment (46/50 individuals) to our pre-defined groups (Fig. 2). The four individuals not matching expected group assignments, nevertheless cluster more closely to the expected groups. Based on the congruence between our holistic approach and the LDA and PAM results, we describe three new species below.

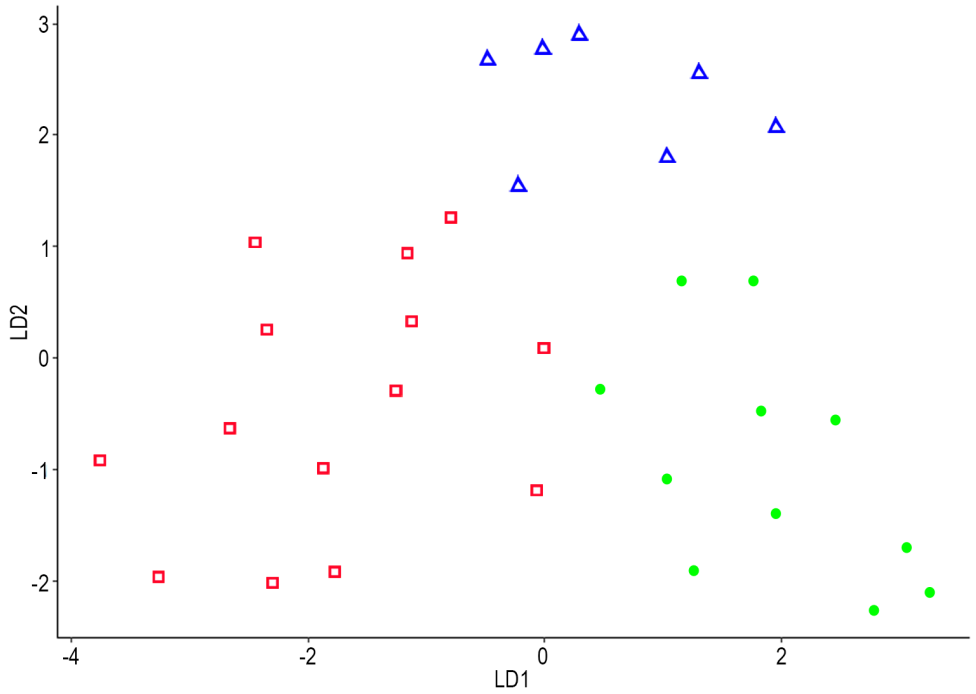

FIGURE 1. Ordination of linear discriminant analysis (LDA) based on 11 measurements and ratios supports three clusters aligning with new species designations: *L. iridescens* (green circles), *L. dilisena* (red squares), and *L. silveirai* (blue triangles).

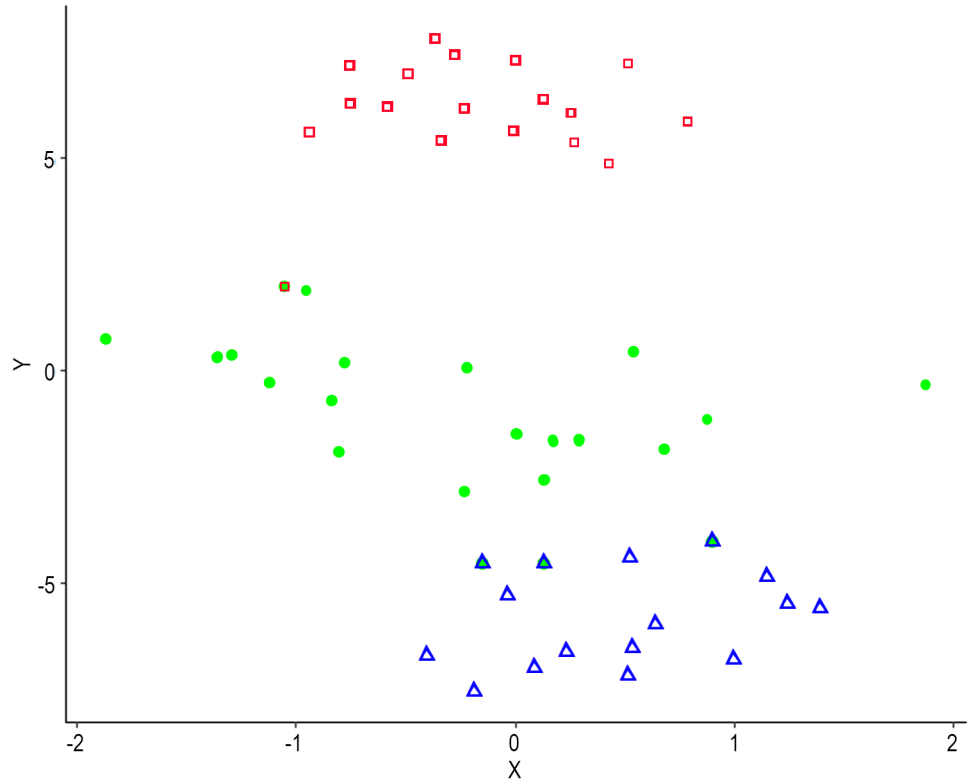

FIGURE 2. Two-dimensional representation of clusters created by partitioning around medoids (PAM). Three clusters were defined based on a silhouette analysis, which show close alignment (46/50 individuals) to *L. iridescens* (green circles), *L. dilisena* (red squares), and *L. silveirai* (blue triangles). The four individuals not matching expected group assignments (with overlapping shapes), nevertheless cluster more closely to the expected groups.

TABLE 1. Measurements and qualitative characters used in linear discriminant analysis (LDA) and partitioning around medioids (PAM).

Measurements	Qualitative characters
Face length	Mesepisternum sculpturing
Face length/head width ratio	Mesepisternum punctation
Eye length/width ratio	Supraclypeal area microsculpture
Upper ocular distance/lower ocular distance (UOD/LOD) ratio	Supraclypeal area punctation
Supraclypeal length/width ratio	Mesoscutum punctation (laterad of parapsidal line)
Clypeal length/width ratio	Mesoscutum punctation (mesad of parapsidal line)
Mesoscutum/metanotum ratio	Mesoscutum colouration
Mesoscutellum/metanotum ratio	
Parapsidal line distance	
Inter-tegular span (ITS)	
Mesoscutum length/ITS ratio	

Systematics

Genus *Lasioglossum* Curtis

Subgenus *Sphecodogastra* Ashmead 1899

Sphecodogastra Ashmead 1899: 92.

Type species: *Sphecodes texana* Cresson 1872, by original designation

Halictus (*Calchalictus*) Warncke 1975: 99.

Type species: *Apis calceata* Scopoli 1763, by original designation. Synonymy by Gibbs *et al*. 2013.

Halictus (*Inhalictus*) *Warncke* 1975: 96.

Type species: *Hylaeus interruptus* Panzer 1798, by original designation. Synonymy by Gibbs *et al*. 2013.

Minutulaeus Pesenko 2007: 11.

Type species: *Hylaeus minutulus* Schenck 1853, by original designation. Synonymy by Gibbs *et al*. (2013).

Nodicornevylaeus Pesenko 2007: 11.

Type species: *Halictus nodicornis* Morawitz 1889, by original designation and monotypy. Synonymy by Gibbs *et al*. (2013).

Monilevylaeus Pesenko 2007: 13.

Type species: *Halictus immunitus* Vachal 1895, by original designation and monotypy. Synonymy by Gibbs *et al*. (2013).

Tricinctevylaeus Pesenko 2007: 14.

Type species: *Halictus tricinctus* Schenck 1874, by original designation. Synonymy by Gibbs *et al*. (2013).

***Fratevylaeus* Pesenko 2007: 14.**

Type species: *Halictus fratellus* Pérez 1903, by original designation. Synonymy by Gibbs *et al*. (2013).

Subgeneric diagnosis

Lasioglossum (*Sphecodogastra*) can only be diagnosed by a combination of characters, which often have exceptions. This diagnosis is targeted at North American species only, but notes on Palaearctic species are provided. *Lasioglossum* (*Sphecodogastra*) belongs to the weak-veined *Lasioglossum*, also known as the *Hemihalictus* series, which have vein 1rs-m distinctly weaker than the more proximal wing veins (similar to the weakened 2rs-m and 2m-cu). Both sexes have the body entirely black, except the new species described below, which have the reflections restricted to the dorsal mesosoma (Palaearctic species in the *L. apristum* (Vachal), *L. laticeps* (Schenck), and *L. pauxillum* (Schenck) groups may have metallic green on the face and thorax). The propodeum has distinct, subparallel, lateral carinae that are complete, extending dorsally to fully separate the lateral and posterior propodeal surfaces and extend to reach oblique carinae that delimit the lower margin of dorsolateral slope of the propodeum (weak or indistinct in some Palaearctic species groups). In Onagraceae-specialists the carinae may be incomplete, such that the lateral and posterior surfaces of the propodeum are contiguous dorsally but in this case females have metafemoral scopa modified to a rake-like row of setae. Mesopleuron is rugulose to rugose without distinct punctures, although subtle punctation is visible in the new species described herein (the Palaearctic *L. nodicorne* (Morawitz) and the *L. minutulum* (Schenck) group have the mesopleuron punctate). Males have a rounded clypeus, long antennae, and the metasomal sterna bare except for sparse, short (< 1 ocellar diameter) pilosity; Onagraceae-specialists have longer setae but have S6 concave with a raised longitudinal area (the Palaearctic *L. malachurum* group also have longer sternal setae).

Vein 1rs-m is strong in *L.* (*Lasioglossum*) and *L.* (*Leuchalictus* Warncke). Most *Lasioglossum* (*Dialictus*), *L.* (*Habralictellus*), and most *L.* (*Eickwortia s.l.* McGinley) are more distinctly metallic, at least on the head and mesosoma. In *L.* (*Dialictus*), some species in the *L. ruidosense* (Cockerell) and *L. gattaca* Danforth & Wcislo species complexes are weakly metallic but lack complete propodeal carinae. Non-metallic *L.* (*Eickwortia*) have distinctly bidentate mandibles and lack complete propodeal carinae. *Lasioglossum* (*Hemihalictus*) and *L.* (*Evylaeus*) often lack complete propodeal carinae, but in some coarsely sculptured species there appear non-parallel lateral carinae extending to the dorsolateral slope. *Lasioglossum* (*Dialictus*) and *L.* (*Hemihalictus*) have the sculpturing and punctation of the mesopleuron variable but are sometimes smooth and punctate. Most *Lasioglossum s. s.* males (except *L. fuscipenne* (Smith), which is easily distinguished by its distinct sternal hairs) and *L.* (*Hemihalictus*) in the *L. fedorense* species complex have a distinctly flat clypeus. Most *Lasioglossum* (*Hemihalictus*) and *L.* (*Habralictellus*) have shorter antennae, reminiscent of females. *Lasioglossum* (*Dialictus*), *L.* (*Evylaeus*), *L.* (*Habralictellus*), and *Lasioglossum* (*Hemihalictus*) males have moderately long pubescence on the metasomal sterna (1–2.5 ocellar diameters). *Lasioglossum* (*Leuchalictus*) males are coarsely sculptured with distinctive hair patterns on metasomal sternum 6 (either an inverted V-shape in *L. leucozonium* (Schrank) or medial hair tufts in *L. zonulus* (Smith)).

***Lasioglossum (Sphecodogastra) iridescens* sp. nov.**
Figs 3–7, 8A, 9A, 10A, 11A, 11B

Diagnosis. *Females of L. iridescens* can be recognised by the combination of head short [Face length/width ratio = 0.80 (± 0.02 SD)]; presence of oily metallic sheen on mesoscutum and mesoscutellum (Fig. 8) (non-metallic in all other North American *L.* (*Sphecodogastra*); propodeum with lateral carinae reaching dorsal margin and oblique carina very strong; inner metatibial spur pectinate, basal branch longer than width of rachis (Figs. 11A, 11B); mesepisternum area with weakly rugose ventrally and reticulate-rugose to punctate dorsally (Fig. 9A); mesoscutum shiny, becoming tessellate to imbricate anteromedially.

Lasioglossum iridescens is quite similar to the other two species described herewith. The other two species have the basal branch on the inner metatibial spur shorter than or subequal to the width of the rachis (Figs. 11C–11F). *Lasioglossum iridescens* has the mesepisternum with reticulate-rugose surface structure with large puncture dorsally

(Fig. 9A) whereas the other two species have the mesepisternum rugose to reticulate-rugose mostly throughout (Figs. 9B, 9C), with punctation less distinct.

Lasioglossum silveirai **sp. nov.** has sparser punctures on the supraclypeal area, mesoscutum, and mesoscutellum (Figs. 8C, 8D, 10C). All three species have an oily metallic sheen on the mesoscutum (Figs. 8A, 8B, 8C), but in *L. silveirai* this may be less evident in some individuals (Fig 8D). T1 punctures appear deeper in *L iridescens* compared to others.

Males of *L. iridescens* can be recognised by the combination of head short [Face length/width ratio 0.89 (± 0.03 SD)]; clypeus with yellow on distal half (Fig. 4B); mandible short, reaching near opposing clypeal angle; F2 long, nearly equal to scape (Fig. 4B); thorax with scattered tomentum; propodeum lateral carinae not reaching dorsal margin, oblique carina absent (Fig. 4D); metasomal sterna nearly bare, hairs present but very short (Fig. 4C). The retrorse lobe is long and broad, covered in short hairs, curved medially, which gives it a unique shape (Fig. 5). In combination with the short gonostylus with short setae, the genitalia should separate *L. iridescens* from most other *L.* (*Sphecodogastra*). Males of other two species described here are unknown.

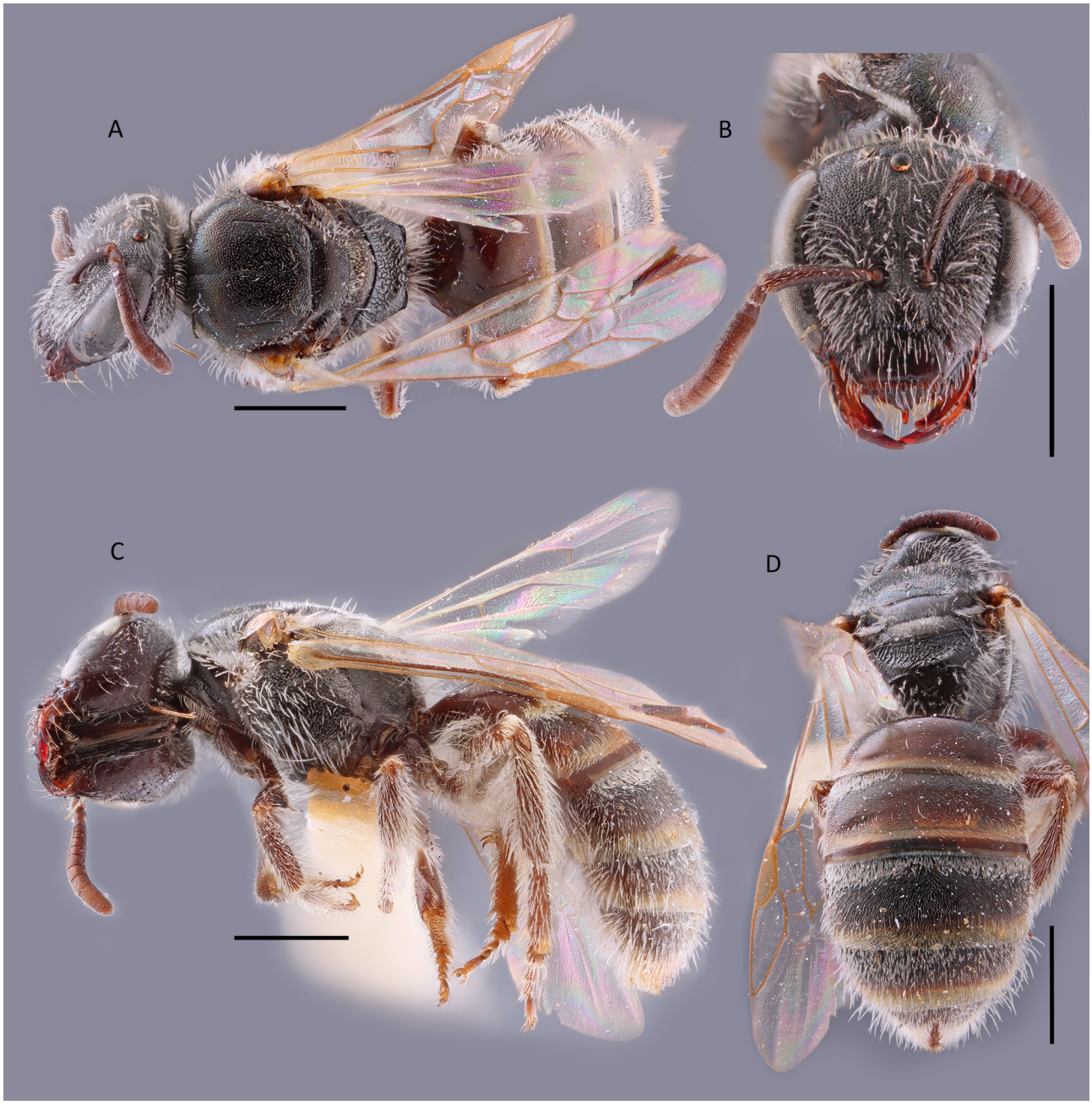

FIGURE 3. *Lasioglossum* (*Sphecodogastra*) *iridescens* **sp. nov.**, ♀, holotype. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars = 1 mm.

FIGURE 4. *Lasioglossum* (*Sphecodogastra*) *iridescens*, ♂, paratype. **A.** Dorsal habitus. **B.** Face **C.** Lateral habitus. **D.** Metasoma. Scale bars = 1 mm.

Males of other *L.* (*Sphecodogastra*) lack the combination of thoracic tomentum, metasomal sterna bare, and the genital characters. Most *L.* (*Sphecodogastra*) lack the tomentum and have elongate gonostyli, usually with elongate setae. Onagraceae-specialist *L.* (*Sphecodogastra*) may have similar pilosity and genitalia but have more evident sternal setae. *Lasioglossum* (*Evylaeus*) *amicus* (Cockerell) has an overall similar appearance, but again differs in the sternal setae, and the structure of the genitalia.

Etymology. The specific epithet refers to the iridescent colouration of the new species.

Holotype. USA—California • ♀; Riverside Co., 1.5 mi. W of Perris [33. 7820° N, 117.2547° W]; 1 April 1936; ex *Salvia mellifera*; P.H. Timberlake leg.; UCRC, GIBBS-12353. [Verbatim label: 1 ½ miles W. / Perris, Cal. // on *Salvia mellifera* // Timberlake Coll. / Apr 1, 36 // Lasioglossum GIBBS-12353 // Holotype / *Lasioglossum* (*Sphecodogastra*) *iridescens* Hettiarachchi and Gibbs]

Paratypes. MEXICO—**Baja California** • 1 ♀; Ejido Piedras Gordas, Ensenada; 31.9369° N, 116.33833° W; 13 May 2021; A. Castañeda leg.; ex yellow pan trap; A. Castañeda Research Collection. USA—**Arizona** • 1 ♀; Pinal Co., Ray; [33.183° N, 110.998° W]; 28 Mar 1961; J.C. Bequaert leg.; ASUHIC • 1 ♀; Pinal Co., Superior, Boyce Thompson Arboretum; [33.2678° N, 111.1583° W]; 03 May 1953; G.D. Butler leg.; ex Thistle; ASUHIC • 1 ♀; ibid.; 03 May 1953; G.D. Butler leg.; ex Poppy; ASUHIC • 1 ♀; ibid.; 03 May 1953; G.D. Butler leg.; ex *Opuntia;* ASUHIC • 1 ♀; ibid.; 04 Jun 1962; F. Werner, J. Bequaert leg.; ASUHIC—**California** • 1 ♀; Kern Co., 1 mi. S of Red Rock Canyon; [35.3590° N, 117.9814° W]; 01 Apr 1959; G.I. Stage leg.; ex *Tamarix gallica;* UCRC • 1 ♀; Kern Co., Mojave-Deep Creek; [34.2712° N, 117.1307° W]; 26 Apr 1936; P. M. Opitz leg.; UCRC • 1 ♀; Los Angeles Co., 5 mi. S of Pearblossom; [34.4336° N, 117.9094° W]; 12 May 1956; E.G. Linsley leg.; EMEC • 1 ♀; Los Angeles Co., Littlerock—Palmdale Dam; [34.4856° N, 118.0247° W]; elev. 1036.3 m.; 02 May 1970; R.R. Snelling leg.; LACM • 1 ♂; Los Angeles Co., Vincent; [34.098242° N, 117.9228° W]; 04 Aug 1952; P.H. Timberlake leg.; ex flying about junipers; UCRC • 3 ♂♂; Riverside Co., 1.5 mi. W of Perris; [33.7820° N, 117.2547° W]; 13 Jun 1938; Timberlake leg.; ex *Eriogonum fasciculatum;* UCRC • 1♀; ibid.; 07 Apr 1940; P.H. Timberlake leg.; ex *Salvia columbariae;* UCRC • 1 ♀; ibid.; 04 May 1940; P.H. Timberlake leg.; ex *Cryptantha intermedia;* UCRC • 1 ♀; ibid.; 18 May 1940; P.H. Timberlake leg.; ex either *Calylophus* sp. or *Camissonia* sp. (verbatim: nr. *Oenothera*); nr. *Oenothera ;* UCRC • 1 ♀; ibid.; 29 May 1940; P.H. Timberlake leg.; ex *Eriogonum fasciculatum;* UCRC • 2 ♂♂; ibid.; 21 Jun 1940; P.H. Timberlake leg.; ex *Eriogonum fasciculatum;* UCRC • 1 ♂; ibid.; 17 May 1941; P.H. Timberlake leg.; ex *Cryptantha intermedia;* UCRC • 1 ♀; Riverside Co., 2 mi. W of Perris; [33.7824° N, 117.2639° W]; 19 May 1936; P.H. Timberlake leg.; ex *Lasthenia gracilis ;* UCRC • 1 ♀; Riverside Co., 3 mi. NE of Moreno; [33.9607° N, 117.2045° W]; 12 Apr 1963; J. Powell leg.; UCRC • 1 ♀; Riverside Co., 3 mi. W of Perris; [33.7821° N, 117.28° W]; 16 Apr 1939; P.H. Timberlake leg.; ex *Lasthenia gracilis;* UCRC • 1 ♀; Riverside Co., 4 mi. W of Perris; [33.7822° N, 117.2981° W]; 10 Apr 1946; P.H. Timberlake leg.; ex *Platystemon californicus Benth.;* UCRC • 1 ♀; Riverside Co., 4.5 mi. W of Perris; [33.7821° N, 117.3068° W]; 27 May 1946; P.H. Timberlake leg.; ex *Gilia achilleifolia* subsp. *multicaulis;* UCRC • 1 ♀; ibid.; 27 May 1946; P.H. Timberlake leg.; ex *Cryptantha intermedia;* UCRC • 1 ♀; Riverside Co., 5 mi. S of Sage; [33.5081° N, 116.9321° W]; 16 Apr 1965; C. A. Toschi leg.; UCRC • 2 ♀♀; ibid.; 16 Apr 1965; J. Powell leg.; UCRC • 1 ♀; Riverside Co., Aguanga ; [33.4422 ° N, 116.8669° W]; elev. 605 m.; 09 May 1936; P.H. Timberlake leg.; ex *Prosopis* sp.*;* UCRC • 1 ♀; Riverside Co., Lake Elsinore; [33.6733° N, 117.3361° W]; elev. 440 m.; 13 Apr 1965; C. A. Toschi leg.; UCRC • 1 ♀; Riverside Co., Gavilan Hills; [33.7944° N, 117.3558° W]; elev. 620 m.; 09 May 1936; P.H. Timberlake leg.; ex *Prosopis* sp.*;* UCRC • 7 ♀♀; ibid.; 19 May 1936; P.H. Timberlake leg.; ex *Rhus trilobata ;* UCRC • 1 ♂; ibid.; 29 May 1936; P.H. Timberlake leg.; ex *Keckiella antirrhinoides;* UCRC • 1 ♀; ibid.; 02 May 1937; P.H. Timberlake leg.; ex *Salix ;* UCRC • 2 ♀♀; ibid.; 02 Mar 1938; P.H. Timberlake leg.; ex *Salix lasiolepis;* UCRC • 1 ♀; ibid.; 16 Mar 1938; P.H. Timberlake leg.; ex *Ceanothus crassifolius;* UCRC • 1 ♀; ibid.; 16 Mar 1938; P.H. Timberlake leg.; ex *Salix laevigata;* UCRC • 1 ♀; ibid.; 01 Apr 1938; P.H. Timberlake leg.; ex *Rhus trilobata ;* UCRC • 1 ♀; ibid.; 01 Apr 1938; P.H. Timberlake leg.; ex *Plagiobothrys collinus*; UCRC • 1 ♀; ibid.; 08 Apr 1938; P.H. Timberlake leg.; ex *Rhus trilobata ;* UCRC • 3 ♀♀; ibid.; 17 Apr 1938; P.H. Timberlake leg.; ex *Lasthenia coronaria;* UCRC • 1 ♀; ibid.; 17 Apr 1938; P.H. Timberlake leg.; ex *Rhus trilobata*; UCRC • 1 ♀; ibid.; 16 May 1938; P.H. Timberlake leg.; ex *Salix laevigata ;* UCRC • 1 ♀; ibid.; 21 Jun 1938; P.H. Timberlake leg.; ex *Eriastrum virgatum;* UCRC • 1 ♀; ibid.; 24 Jun 1938; P.H. Timberlake leg.; ex *Eriastrum virgatum;* UCRC • 1 ♀; ibid.; 07 Apr 1939; P.H. Timberlake leg.; ex *Camissonia contorta;* UCRC • 1 ♀; Riverside Co., Gavilan Hills; [33.7944° N, 117.3558° W]; elev. 620 m.; ex flying near ground; 07 Apr 1939; P.H. Timberlake leg.; UCRC • 1 ♀; Riverside Co., Gavilan Hills; [33.7944° N, 117.3558° W]; elev. 620 m.; 07 Apr 1939; P.H. Timberlake leg.; ex *Cryptantha intermedia;* UCRC • 1 ♀; ibid.; 16 Apr 1939; P.H. Timberlake leg.; ex *Camissonia contorta;* UCRC • 1 ♀; ibid.; 16 Apr 1939; P.H. Timberlake leg.; ex *Cryptantha intermedia;* UCRC • 1 ♀; ibid.; 07 Apr 1940; P.H. Timberlake leg.; ex *Salvia columbariae;* UCRC • 1 ♀; ibid.; 14 Apr 1940; P.H. Timberlake leg.; ex *Salvia mellifera;* UCRC • 1 ♀; ibid.; 14 Apr 1940; P.H. Timberlake leg.; ex *Salvia columbariae ;* UCRC • 1 ♀; ibid.; 14 Apr 1940; P.H. Timberlake leg.; ex *Chaenactis glabriuscula;* UCRC • 2 ♀♀; ibid.; 14 Apr 1940; P.H. Timberlake leg.; ex *Minuartia douglasii;* UCRC • 1 ♀; ibid.; 14 Apr 1940; P.H. Timberlake leg.; ex *Salvia mellifera;* UCRC • 2 ♀♀; ibid.; 18 Apr 1940; P.H. Timberlake leg.; ex *Salvia columbariae ;* UCRC • 2 ♀♀; ibid.; 18 Apr 1940; P.H. Timberlake leg.; ex *Lasthenia gracilis;* UCRC • 2 ♀♀; ibid.; 12 May 1950; P.H. Timberlake leg.; ex *Hirschfeldia incana;* UCRC • 1 ♀; ibid.; 12 May 1950; P.H. Timberlake leg.; ex *Erysimum cheiranthoides;* UCRC • 6 ♂♂; ibid.; 12 May 1950; P.H. Timberlake leg.; ex *Eriogonum fasciculatum;* UCRC • 1 ♀; ibid.; 16 May 1950; P.H. Timberlake leg.; ex *Cryptantha intermedia;* UCRC • 5 ♂♂; ibid.; 09 Jun 1950; P.H. Timberlake leg.; ex *Eriogonum fasciculatum*;

UCRC • 1 ♀; ibid.; 14 Apr 1959; P.H. Timberlake leg.; ex *Phacelia distans*; UCRC • 1 ♀; ibid.; 24 June 1938 to 24 July 1938; P.H. Timberlake leg.; ex *Eriastrum virgatum*; UCRC • 2 ♂♂; ibid.; 24 June 1938 to 24 July 1938; P.H. Timberlake leg.; ex *Adenostoma fasciculatum*; UCRC • 1 ♀; Riverside Co., Lake Mathews; [33.825° N, 117.500° W]; elev. 260 m.; 11 Apr 1954; P.H. Timberlake leg.; ex *Platystemon californicus*; UCRC • 2 ♀♀; Riverside Co., Seven Level Hill, , ~10 Rd. mi. SW of Palm Desert; [33.6067° N, 116.4272° W]; elev. 1160 m.; 12 Apr 1963; J. Powell leg.; UCRC • 22 ♂♂; Riverside Co., Spring Crest, Ribbonwood; [33.5683° N, 116.4897° W]; elev. 1400 m.; 02 Jul 1936; P.H. Timberlake leg.; ex *Eriogonum fasciculatum*; UCRC • 1 ♂; Riverside Co., Spring Crest, Ribbonwood; [33.5683° N, 116.4897° W]; elev. 1400 m.; 13 Jun 1938; P.H. Timberlake leg.; ex *Eriogonum fasciculatum*; UCRC • 1♀; Riverside Co., Riverside; [33.9556° N, 117.3722° W]; elev. 290 m.; 22 Feb 1937; P.H. Timberlake leg.; ex *Salix lasiolepis*; UCRC • 2 ♀♀; Riverside Co., Riverside; [33.9556° N, 117.3722° W]; elev. 290 m.; 17 Apr 1925; P.H. Timberlake leg.; ex *Eschscholzia californica;* UCRC • 1♀; ibid.; 14 May 1925; P.H. Timberlake leg.; ex *Eschscholzia californica;* UCRC • 1 ♀; ibid.; 14 May 1925; P.H. Timberlake leg.; ex *Encelia farinosa;* UCRC • 1 ♀; ibid.; 24 May 1925; P.H. Timberlake leg.; ex *Eschscholzia californica;* UCRC • 1 ♀; ibid.; 06 Apr 1927; P.H. Timberlake leg.; ex *Eschscholzia californica*; UCRC • 2 ♀♀; ibid.; 07 Apr 1927; P.H. Timberlake leg.; ex *Eschscholzia californica;* UCRC • 1 ♀; ibid.; 20 Apr 1927; P.H. Timberlake leg.; ex *Eschscholzia californica*; UCRC • 1 ♀; ibid.; 27 Apr 1927; P.H. Timberlake leg.; ex *Eschscholzia californica*; UCRC • 1 ♀; ibid.; 08 May 1927; P.H. Timberlake leg.; ex *Eschscholzia californica*; UCRC • 1 ♀; ibid.; 23 May 1927; P.H. Timberlake leg.; ex *Eschscholzia californica*; UCRC • 1 ♀; ibid.; 24 May 1927; P.H. Timberlake leg.; ex *Eschscholzia californica;* UCRC • 1 ♀; ibid.; 30 Mar 1928; P.H. Timberlake leg.; ex *Eschscholzia californica;* UCRC • 1 ♀; ibid.; 31 May 1928; P.H. Timberlake leg.; ex *Eschscholzia californica;* UCRC • 2 ♀♀; ibid.; 28 Mar 1931; P.H. Timberlake leg.; ex *Eschscholzia californica*; UCRC • 1 ♀; ibid.; 16 May 1932; P.H. Timberlake leg.; ex *Cylindropuntia californica*; UCRC • 1 ♀; ibid.; 29 Mar 1934; P.H. Timberlake leg.; ex *Cryptantha intermedia*; UCRC • 1 ♀; ibid.; 15 May 1934; P.H. Timberlake leg.; ex *Cryptantha intermedia*; UCRC • 1 ♀; ibid.; 10 Apr 1935; P.H. Timberlake leg.; ex *Lasthenia gracilis*; UCRC • 1 ♀; ibid.; 10 Apr 1935; P.H. Timberlake leg.; ex *Phacelia minor*; UCRC • 1 ♀; ibid.; 31 Mar 1939; P.H. Timberlake leg.; ex *Phacelia minor*; UCRC • 1 ♀; ibid.; 30 Apr 1939; P.H. Timberlake leg.; ex *Lasthenia coronaria*; UCRC • 1 ♀; ibid.; 28 Feb 1940; P.H. Timberlake leg.; ex *Cryptantha intermedia*; UCRC • 1 ♀; ibid.; 07 May 1940; P.H. Timberlake leg.; ex *Cryptantha intermedia*; UCRC • 1 ♀; ibid.; 08 May 1940; P.H. Timberlake leg.; ex *Cryptantha intermedia*; UCRC • 1 ♀; ibid.; 27 May 1945; P.H. Timberlake leg.; ex *Senecio californicus*; UCRC • 1 ♀; ibid.; 14 Apr 1952; P.H. Timberlake leg.; ex *Gilia achilleifolia* subsp. *multicaulis*; UCRC • 1 ♀; Riverside Co., Sage; [33.5081° N, 116.9321° W]; 15 Apr 1965; J. Doyen leg.; UCRC • 1 ♀; San Bernardino Co., Kramer Hills; [34.8967° N, 117.5086° W]; elev. 920 m.; 16 Apr 1957; P.H. Timberlake leg.; ex *Malacothrix californica*; UCRC • 1 ♀; ibid.; 25 Apr 1957; G.I. Stage leg.; UCRC • 1 ♀; ibid.; 25 Apr 1957; P.D. Hurd leg.; ex *Amsinckia tessellata*; UCRC • 1 ♀; ibid.; 25 Apr 1957; P.D. Hurd leg.; ex *Camissonia campestris* subsp. *campestris;* UCRC • 1 ♀; ibid.; 25 Apr 1957; P.D. Hurd leg.; ex *Mentzelia micrantha*; UCRC • 1 ♀; ibid.; 25 Apr 1957; P.D. Hurd leg.; ex *Gilia latiflora* subsp. *davyi ;* UCRC • 1 ♀; ibid.; 26 Apr 1957; P.H. Timberlake leg.; ex either *Calylophus* sp. or *Camissonia* sp. (verbatim: *Oenothera* sp.)*;* UCRC • 1 ♀; ibid.; 26 Apr 1957; P.H. Timberlake leg.; ex *Coreopsis;* UCRC • 1 ♀; San Bernardino Co., Lytle Creek; [34.2611° N, 117.4992° W]; elev. 1050 m.; 04 Jul 1925; P.H. Timberlake leg.; ex *Eriogonum fasciculatum;* UCRC • 13 ♀♀; Tulare Co., 2 mi. E of Johnsondale ; [35.9699° N, 118.4984° W]; 27 Apr 1964; J. Powell leg.; ex *Prunus subcordata;* UCRC • 33 ♀♀; ibid.; 27 Apr 1964; C. A. Toschi leg.; UCRC • 18 ♀♀; ibid.; 27 Apr 1964; C. A. Toschi leg.; ex *Prunus subcordata;* UCRC • 1 ♀; ibid.; 27 Apr 1964; J. Powell leg.; ex *Arctostaphylos;* UCRC • 2 ♀♀; ibid.; 27 Apr 1964; C. A. Toschi leg.; ex *Salix;* UCRC • 5 ♀♀; ibid.; 27 Apr 1964; P. Rude leg.; ex *Prunus subcordata;* UCRC • 5 ♀♀; ibid.; 27 Apr 1964; P. Rude leg.; ex *Salix;* UCRC

Description

Female. Length 5.64 (± 0.40 SD) mm. Head length 1.56 (± 0.06 SD) mm. Head width 1.67 (± 0.06 SD) mm. Wing length 4.28 (± 0.21 SD) mm. (n=16)

Colouration. Head and mesosoma dark brown to black, mesoscutum and mesoscutellum with an oily metallic sheen mostly with a green reflection and some with a green-purple mixture. Clypeus apex reddish brown. Labrum reddish brown. Mandible brown basally, light brown apically with reddish brown apex. Flagellum brown dorsally, light brown ventrally. Pronotal lobe brown to reddish brown. Tegula yellowish brown. Wing membrane hyaline, faintly dusky,veins with subcosta brown, otherwise honey-coloured. Legs brown. Metasoma brown to black, apical margins reddish brown to narrowly testaceous.

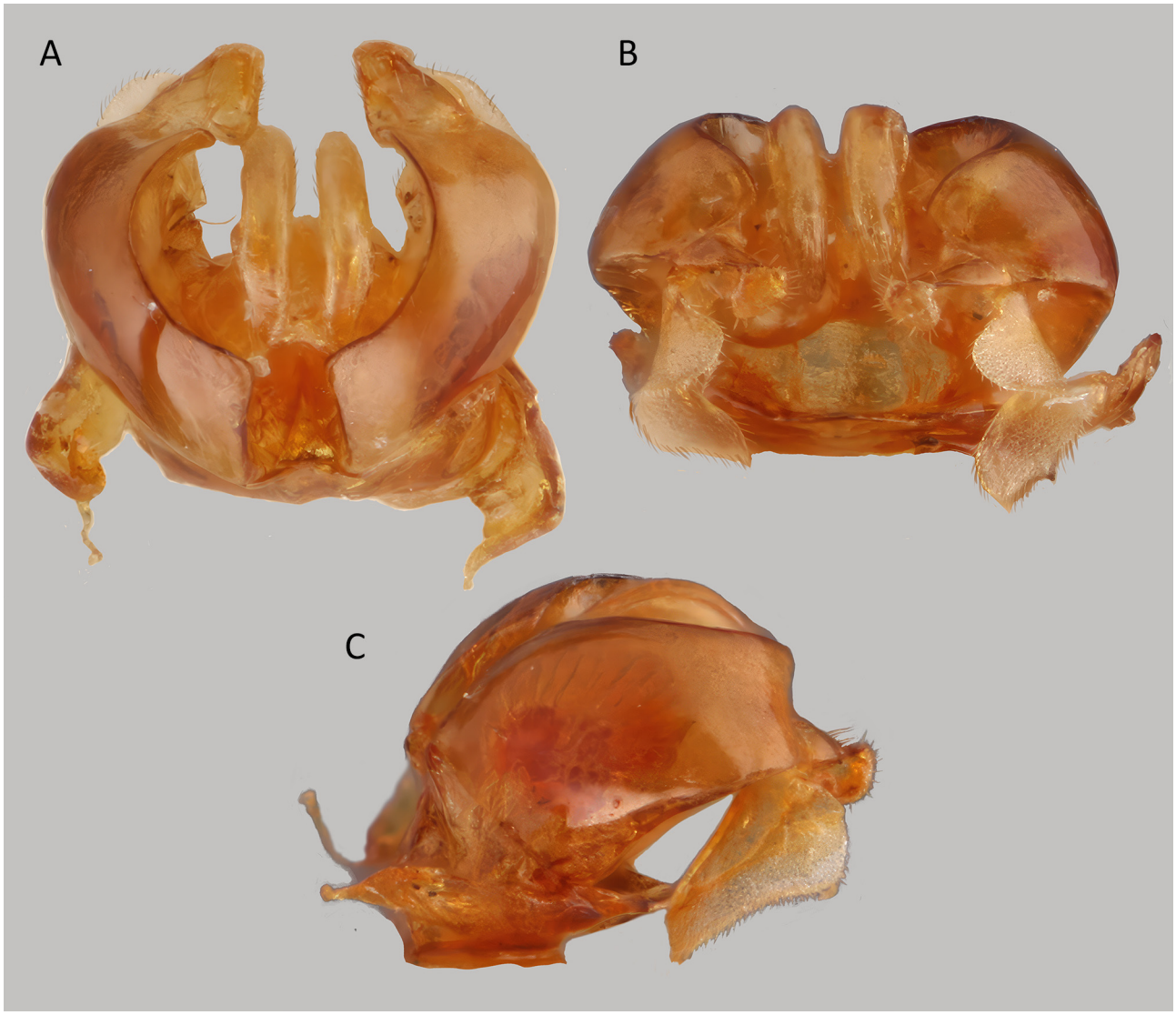

FIGURE 5. Genitalia of *Lasioglossum* (*Sphecodogastra*) *iridescens*, ♂, paratype. **A.** Dorsal view. **B.** Posterior view. **C.** Lateral view.

Pubescence. Setae off-white. Tomentum dense on pronotal angle and lobe, space between pronotal lobe and tegula, T2–T3 basolaterally; moderately dense on metanotum anterior margin; scattered on T4–T5; partially obscuring metepisternum. Head and mesosoma with mostly sparse pilosity, composed of highly plumose setae with very short fine setae intermixed. Lateral surface of propodeum with sparse erect setae; plumose patch on anterior dorsal area; very short fine hairs intermixed. Metafemoral scopa with dense plumose hairs. Wing hairs pale. T1 with sparse erect setae.

Surface sculpture. Clypeus shiny, becoming imbricate basally; punctures large, irregularly spaced (IS < PD) on apical third, smaller and denser on near basal margin (IS < 1 PD). Supraclypeal area mostly imbricate; punctures dense mostly throughout (IS ≤ 1 PD). Paraocular area reticulate; punctures dense (IS ≤ 1 PD) to crowded (IS = 0 PD). Frons punctate-reticulate; punctures crowded (IS = 0 PD) or dense (IS < 1 PD). Vertex imbricate laterally, strongly so medially; punctures absent or obscure. Gena shiny dorsally, becoming finely lineate ventrally; punctures fine, sparse (IS = 2–4 PD). Postgena shiny, becoming tessellate posteriorly. Tegula mostly shiny and impunctate except the base. Tegula base imbricate and diversopunctate with sparse punctures (IS = 1–3 PD). Mesoscutum shiny, becoming tessellate to imbricate anteromedially; punctures large and small intermixed, mostly dense on marginally and on median line (IS < 1 PD), little sparser submedially, becoming shallow and indistinct anteromedially. Punctures mesad of parapsidal line sparser (IS = 1–3 PD) than laterad of parapsidal line (IS = 1–2 PD), and becoming closer

near medial line (IS ≤ 1 PD). Mesoscutellum shiny; punctures dense marginally and on median line (IS ≤ 1 PD), sparser submedially (IS = 2–4 PD), diversopunctate. Metanotum shiny and becoming weakly rugulose laterally, crowdedly punctate medially (IS ≤ 1 PD). Metapostnotum rugae strong, anastomosing, reaching at the middle of posterior margin; sculpture shiny to imbricate. Preëpisternum reticulate-rugose to rugose. Hypoepimeron shiny, becoming weakly rugulose ventrally; punctures sparse (IS = 1–3 PD) anteriorly, becoming dense (IS < 1 PD) or obscure posteriorly, and there are scattered very minute punctures. Mesepisternum weakly rugose ventrally and reticulate-rugose to punctate dorsally; punctures dense (IS < 1 PD) in dorsal punctate area. Metepisternum rugulosо-lineate dorsally, imbricate ventrally. Propodeum lateral face imbricate anteriorly and dorsally, otherwise tessellate; posterior face tessellate. T1 anterior face shiny, punctures small and very sparse; T1 dorsal surface shiny, becoming weakly coriarious on rim, punctures small, sparse (IS = 1–4 PD), very sparse in large subapicolateral boss, and absent on rim. Usually, punctures appear deeper in this species compared to others. T2 disc imbricate to coriarious; punctures moderately dense basally (IS = 1–2 PD), becoming sparse apically (IS = 1–3 PD); rim coriarious; rim punctures absent (short hairs present but these not arising from distinct punctures).

Structure. Face length/width ratio 0.80 (± 0.02 SD). Eyes convergent below [UOD/LOD ratio 1.07 (± 0.02 SD)]. Clypeus projecting ~63% below suborbital tangent; clypeal area length/width ratio 0.83 (± 0.08 SD). Gena narrower than eye. Protibial spur with apical serrations quite longer than length to width of malus. Inner metatibial spur pectinate, teeth 3–4, basal teeth longer than width of rachis (Figs. 11A, 11B). Intertegular span 1.18 (± 0.06 SD) mm. Distance between parapsidal line (at the starting point) 0.90 (± 0.06 SD) mm. Pronotal angle obtuse. Mesoscutum length/width ratio 0.87 (± 0.05 SD); mesoscutum/mesoscutellum length ratio 3.01 (± 0.18 SD); mesoscutellum/metanotum length ratio 1.59 (± 0.11 SD). Propodeum lateral carinae reaching dorsal margin; oblique carina very strong. (n=18)

Male. Length 5.64 (± 0. 47 SD) mm. Head length 1.60 (± 0.03 SD) mm. Head width 1.53 (± 0.01 SD) mm. Wing length 4.10 (± 0.18 SD) mm. (n=3)

Colouration. Head and mesosoma dark brown to black, no metallic sheen. Clypeus apex yellow. Labrum yellow. Mandible yellow with brown basomedially and light reddish-brown apex. Flagellum brown dorsally, testaceous ventrally. Pronotal lobe testaceous to yellow. Metasoma brown, apical margins reddish brown to narrowly testaceous. Legs black to brown with femur-tibia joints, base and apex of tibiae, and tarsi yellow. Tegula pale amber. Wing membrane hyaline, veins with subcosta brown, otherwise light brown to pale amber. Metasoma brown to black, apical margins reddish brown to narrowly testaceous.

Pubescence. Body hair colour white. Tomentum dense on face below eye emargination, near posterior margin of pronotal angle and lobe, space between pronotal lobe and tegula; sparse on gena, mesoscutum margins, preëpisternum, mesepisternum, T2–T3 basolaterally, and T4 basally. Head and mesosoma with quite dense plumose and simple setae. Gena with quite dense plumose long setae. Metasomal sterna with short hairs, moderately plumose to simple, nearly bare in S1–S2. Wing hairs pale.

Surface sculpture. Clypeus shiny; punctures moderately dense (IS = 1–2 PD), diversopunctate. Supraclypeal area shiny, becoming imbricate medially; punctures dense to moderately dense (IS ≤ 2 PD). Paraocular area shiny reticulate; punctures crowded (IS = 0 PD). Frons punctulate-reticulate; punctures crowded (IS = 0 PD) or dense (IS <1 PD). Vertex reticulate-rugulose medially, becoming shiny to imbricate laterally; punctures dense (IS ≤ 1 PD) and obscure medially. Gena shiny and weakly rugulose-lineate posteriorly; punctures sparse (IS = 1–3 PD). Postgena sculpture imbricate-lineate, becoming shiny and weakly tessellate anteriorly. Tegula punctures absent. Mesoscutum imbricate, becoming shiny laterally; punctures dense (IS < 1 PD), interspersed with scattered minute punctures in some areas, becoming slightly sparser submedially (IS = 1–1.5 PD). Mesoscutellum shiny; punctures dense marginally and on median line (IS < 1 PD), moderately sparse submedially (IS = 1–2 PD), interspersed with scattered minute punctures in some areas. Metanotum shiny and becoming rugulose laterally, densely punctate medially (IS ≤ 1 PD). Metapostnotum rugae strong, anastomosing, reaching posterior margin and even go beyond posterior lateral margin; sculpture shiny to weakly imbricate. Preëpisternum sculpture rugose. Hypoepimeron rugulose; punctures crowded (IS = 0 PD), or obscure sometime. Mesepisternum reticulate-rugose to rugulose. Metepisternum rugulose. Propodeum lateral face imbricate to rugulose; posterior face rugose-imbricate, tessellate on propodeal triangle. T1 anterior face shiny; dorsal surface shiny, becoming weakly coriarious on rim; punctures moderately sparse (IS = 1–3 PD), becoming sparse in small subapicolateral boss (IS = 2–4 PD) and absent on apical rim. T2 disc weakly imbricate, becoming shiny apically; punctures small and moderately dense (IS = 1–2 PD) basally, becoming larger and denser (IS ≤ 1 PD), and again getting smaller and moderately dense (IS = 1–2 PD) near apical impressed area; rim coriarious; punctures minute, sparse (IS = 1–3 PD), absent apically.

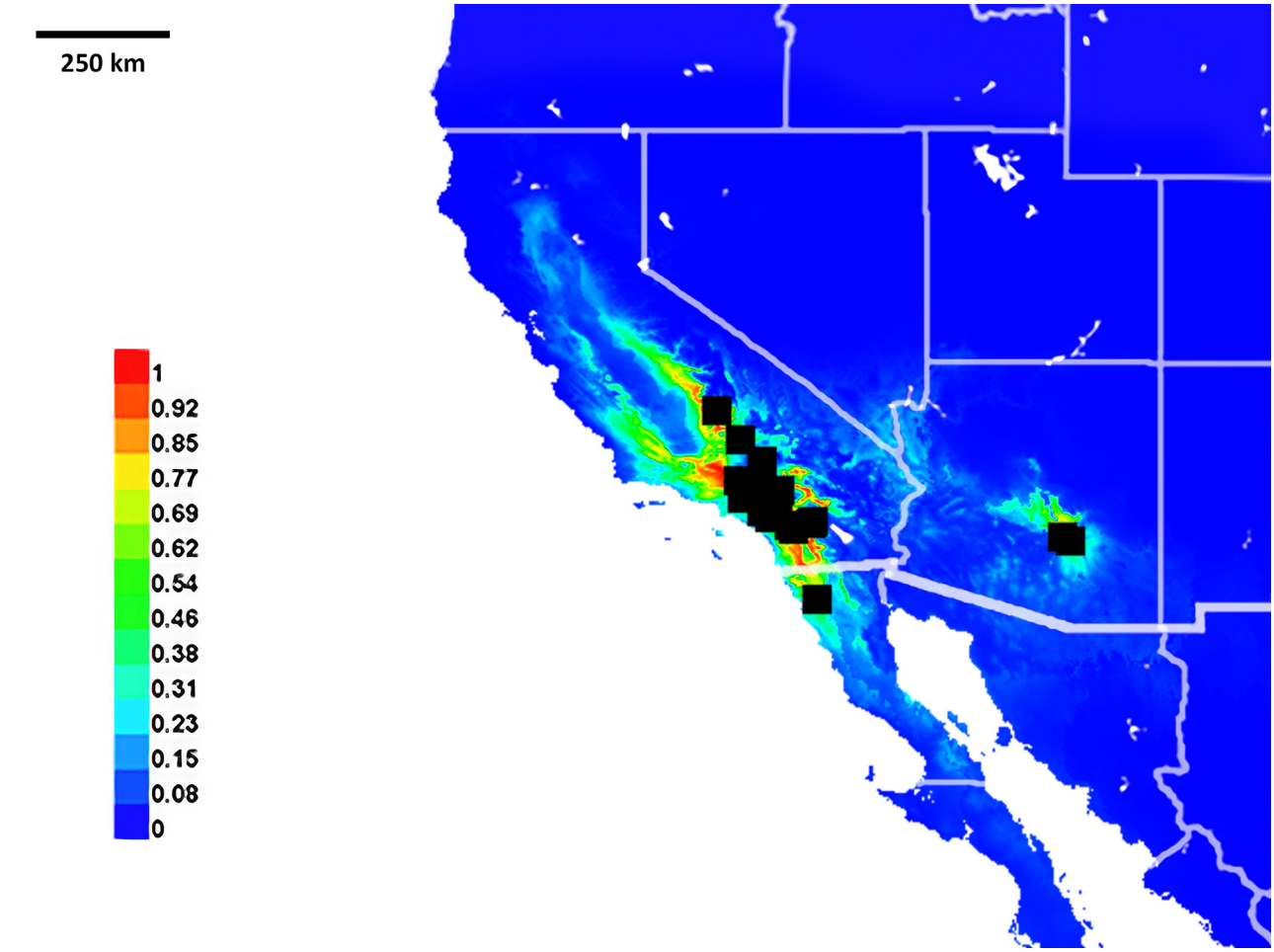

FIGURE 6. Georeferenced collection records of *Lasioglossum iridescens*. (black squares) and predicted distribution by maximum entropy ecological niche modeling in Maxent (colour shading). Warmer colours indicate higher cloglog probability of occurrence.

Structure. Face length/width ratio 0.89 (± 0.03 SD). Clypeus projecting ~60% below suborbital tangent; clypeal area length/width ratio 1.15 (± 0.09 SD). Mandible short, reaching near opposing clypeal angle. Flagellomeres, except F1, elongate, F2 longer than F1 and pedicel combined. F1:pedicel length ratio 1.22 (± 0.09 SD); F2:F1 length ratio 0.28 (± 0.04 SD); F2 length/width ratio 1.95 (± 0.08 SD); F9 length/width ratio 1.73 (± 0.11 SD). Eyes strongly convergent below (UOD/LOD ratio 1.42 (± 0.01 SD). Gena clearly narrower than eye. Pronotal angle obtuse. Intertegular span 1.14 (± 0.04 SD) mm. Mesoscutum length/width ratio 0.92 (± 0.03 SD); mesoscutum/mesoscutellum length ratio 2.40 (± 0.07 SD); mesoscutellum/metanotum length ratio 1.65 (± 0.08 SD). Propodeum lateral carinae not reaching dorsal margin; oblique carina absent. (n=3)

Genitalia. As shown in Fig. 5, gonostylus small, with short setae. Retrorse lobe long and broad, covered in short hairs, curved medially.

Range. Southern California through to Arizona, south to Baja California (Figs. 6, 7).

Floral hosts. ANACARDIACEAE: *Rhus trilobata* Nutt. • ASTERACEAE: *Chaenactis glabriuscula* DC., *Coreopsis* sp., *Encelia farinosa* Torr. & A.Gray, *Lasthenia coronaria* (Nutt.), Ornduff, *Lasthenia gracilis* (DC.) Greene, *Malacothrix californica* DC., *Senecio californicus* DC., Thistle • BORAGINACEAE: *Amsinckia tessellate* A. Gray, *Cryptantha intermedia* (Gray) Greene, *Phacelia distans* Benth., *Phacelia minor* (Harv.) Thell., *Plagiobothrys collinus* (Phil.) I.M.Johnst. • BRASSICACEAE: *Erysimum cheiranthoides* L., *Hirschfeldia incana* (L.) Lagr.-Foss. • CACTACEAE: *Cylindropuntia californica* (Torr. & A.Gray) F.M.Knuth, *Opuntia* sp. • CARYOPHYLLACEAE: *Minuartia douglasii* (Torr. & A.Gray) Mattf. • ERICACEAE: *Arctostaphylos* sp. • FABACEAE: *Prosopis* sp. • LAMIACEAE: *Salvia columbariae* Benth., *Salvia mellifera* Greene • LOASACEAE: *Mentzelia micrantha* (Hook.

& Arn.) Torr. & A.Gray • ONAGRACEAE: *Camissonia campestris* subsp. *campestris* (Greene) P.H. Raven, *Camissonia contorta* (Dougl. ex Lehm.) Kearney, either *Calylophus* sp. or *Camissonia* sp. • PAPAVERACEAE: *Eschscholzia californica* Cham., *Platystemon californicus* Benth., Poppy • PLANTAGINACEAE: *Keckiella antirrhinoides* (Benth.) Straw • POLEMONIACEAE: *Eriastrum virgatum* (Benth.) H.Mason, *Gilia achilleifolia* subsp. *multicaulis* (Benth.) V.E. Grant & A.D. Grant, *Gilia latiflora* subsp. *davyi* (Milliken) A.D. Grant & V.E. Grant • POLYGONACEAE: *Eriogonum fasciculatum* Benth. • RHAMNACEAE: *Ceanothus crassifolius* Torr. • ROSACEAE: *Adenostoma fasciculatum* Hook. & Arn., *Prunus subcordata* Benth. • SALICACEAE: *Salix laevigata* Bebb, *Salix* sp. • TAMARICACEAE: *Tamarix gallica* L.

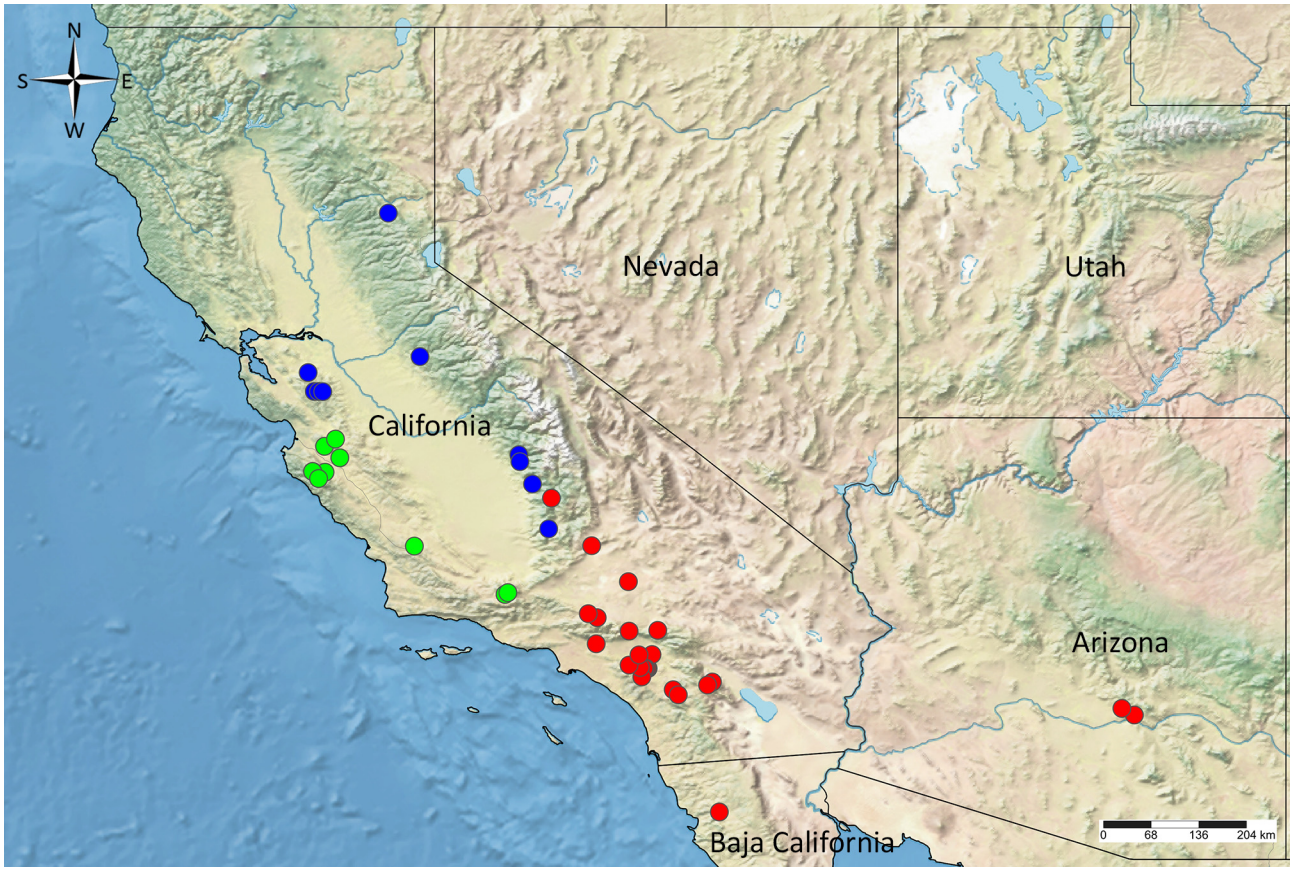

FIGURE 7. Distribution map of *Lasioglossum iridescens* (red dots), *Lasioglossum dilisena* (blue dots) and *Lasioglossum silveirai* (green dots).

***Lasioglossum* (*Sphecodogastra*) *dilisena* sp. nov.**
Figs. 7, 8B, 9B, 10B, 11C, 11D, 12, 13

Etymology. The specific epithet 'dilisena' is derived from the Sinhala word 'dilisena' දිලිසෙන, which means 'shining', but is used here as a noun in apposition. This name was chosen because all three species described in this paper have an unusual metallic reflection on the mesosoma that is not seen in other known North American species in the subgenus *Sphecodogastra*. The first author is also a native speaker of Sinhala from Sri Lanka. Sinhala language is one of the official and national languages of Sri Lanka and the mother tongue of the majority people of Sri Lanka. Through this naming choice, we hope to honour all the linguistic and cultural diversity of the world.

Holotype. USA—**California** • ♀; Santa Clara Co., 8 mi. E of Mount Hamilton [37.3416° N, 121.4964° W]; 16 April 1955; D.J. Burdick leg.; UCRC GIBBS-11531. [Verbatim label: Calif: Sta. Clara Co., Mt. Hamilton, 8mi. E. VI-16-55 / D.J. Burdick Collector // Lasioglossum GIBBS-11531 // Holotype/ *Lasioglossum* (*Sphecodogastra*) *dilisena* Hettiarachchi and Gibbs]

Paratypes. USA—**California** • 1 ♀; Alameda Co., Arroyo Mocho; 37.5839° N, 121.6297° W; 09 Apr 1957; D.J. Burdick leg.; EMEC • 3 ♀♀; Santa Clara Co., 5 mi. E of Mount Hamilton; [37.3414° N, 121.5505° W]; 16 Apr 1955; D.J. Burdick leg.; UCRC • 1 ♀; Santa Clara Co., 8 mi. E of Mount Hamilton; [37.3416° N, 121.4964° W]; 16 Apr 1955; D.J. Burdick leg.; EMEC • 21 ♀♀; Santa Clara Co., 8 mi. E of Mount Hamilton; [37.3416° N, 121.4964° W]; 16 Apr 1955; D.J. Burdick leg.; UCRC • 1 ♀; Santa Clara Co., 11 mi. E of Mount Hamilton; [37.3386° N, 121.4419° W]; 19 Apr 1956; D.J. Burdick leg.; UCRC • 1 ♀; Sierra Co., 5 mi. NNE Sierra City; [39.6332° N, 120.5981° W]; 07 Sep 1964; J. Bedea leg.; OSAC • 6 ♀♀; Mariposa Co., 5.5 mi. N of Coulterville; [37.7892° N, 120.1902° W]; 18 July 1963; R.W. Thorp leg.; ex *Clarkia dudleyana*; EMEC • 1 ♀; Tulare Co., 4 mi. N of Kaweah; [36.5278° N, 118.9182° W]; 13 May 1963; C. A. Toschi leg.; UCRC • 1 ♀; Tulare Co., Three Rivers; [36.4386° N, 118.9044° W]; elev. 265 m.; 10 June 1925; P.H. Timberlake leg.; ex *Penstemon* sp.; UCRC • 2 ♀♀; Tulare Co., Coffee Camp; [36.1519° N, 118.7425° W]; elev. 620 m.; 17 June 1953; P.H. Timberlake leg.; ex *Clarkia purpurea* subsp. *viminea* (verbatim: *Godetia viminea*); UCRC • 3 ♀♀; Kern Co., Miracle Hot Springs; [35.5756° N, 118.5344° W]; elev. 725 m.; 29 April 1964; J. Powell leg; UCRC.

FIGURE 8. Mesoscutum and mesoscutellum of female **A.** *Lasioglossum iridescens*, holotype. **B.** *Lasioglossum dilisena*, paratype. **C.** *Lasioglossum silveirai*, holotype. **D.** *Lasioglossum silveirai*, paratype with lacking metallic sheen.

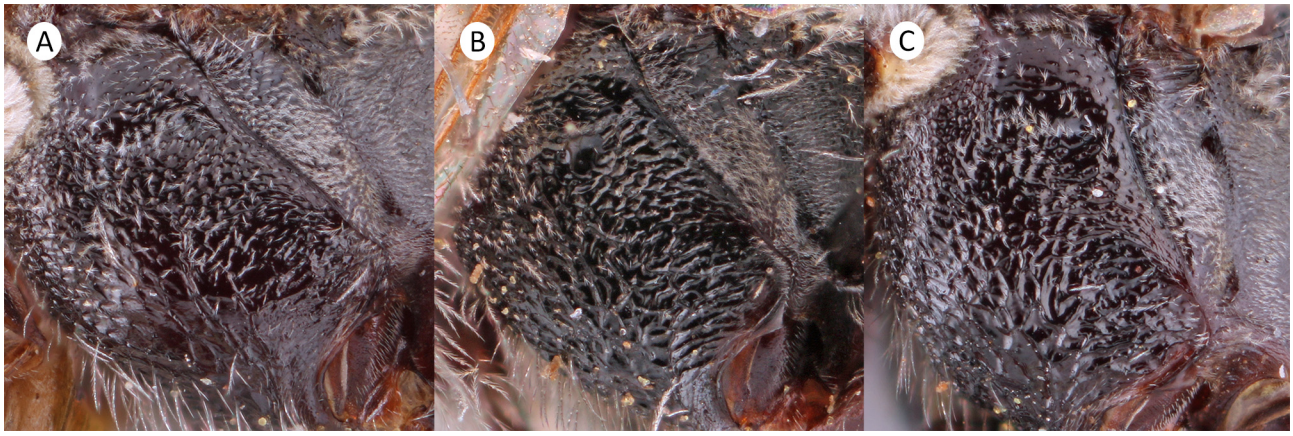

FIGURE 9. Mesepisternum of female paratypes **A.** *Lasioglossum iridescens.* **B.** *Lasioglossum dilisena*. **C.** *Lasioglossum silveirai*.

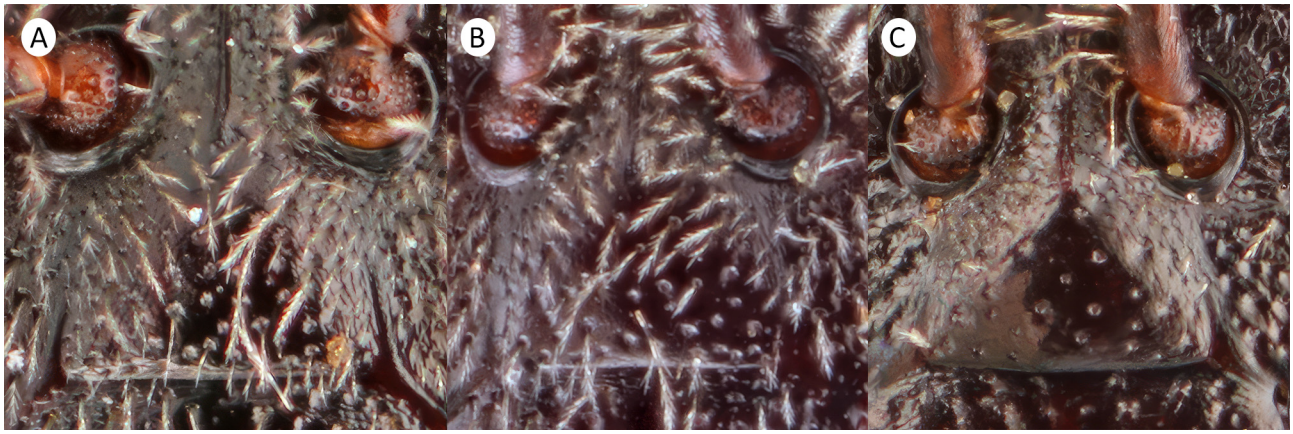

FIGURE 10. Supraclypeal area of female **A.** *L. iridescens*, holotype. **B.** *L. dilisena*, paratype. **C.** *L. silveirai*, paratype.

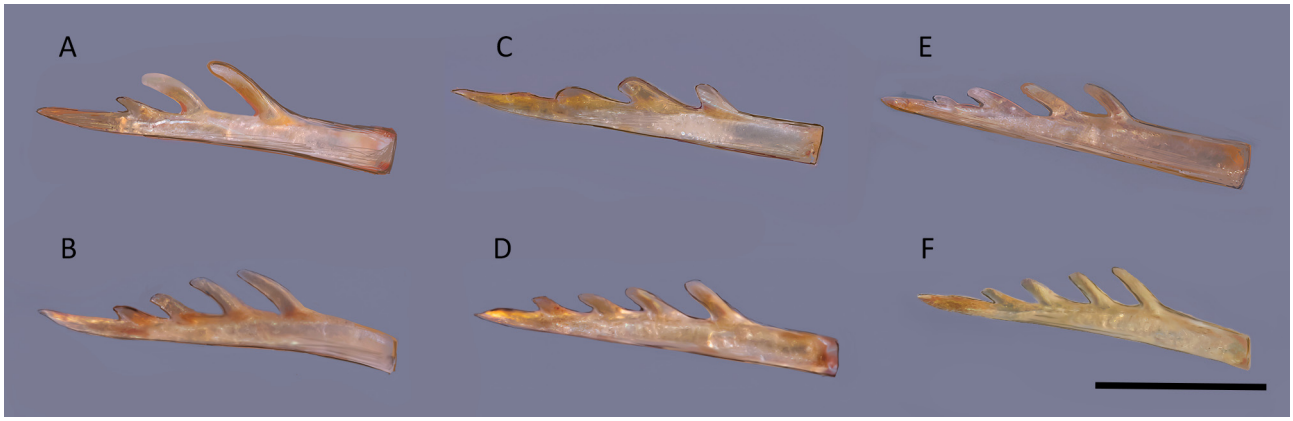

FIGURE 11. Metatibial spur of female paratypes **A&B**. *L. iridescens.* **C&D**. *L. dilisena* **E&F**. *L. silveirai*. Scale bars = 0.25 mm.

Description

Female. Length 5.66 (± 0.42 SD) mm (n=6). Head length 1.57 (± 0.04 SD) mm (n=16). Head width 1.65 (± 0.06 SD) mm (n=6). Wing length 4.20 (± 0.19 SD) mm (n=16).

Colouration. Head and mesosoma dark brown to black, mesoscutum and mesoscutellum with an oily metallic sheen with variable reflections; most specimens with a green reflection, while some display a green-purple mixture and others with a greater prominence of purple reflection around the parapsidal line and its vicinity. Clypeus apex

dark brown. Labrum dark brown. Mandible brown basally, light brown apically with reddish brown apex. Flagellum brown dorsally, light brown ventrally. Pronotal lobe brown to reddish brown. Tegula yellowish brown. Wing membrane hyaline, faintly dusky, veins with subcosta brown, otherwise honey-coloured. Legs brown. Metasoma dark brown, apical margins reddish brown to narrowly testaceous.

Pubescence. Setae off-white. Tomentum dense on pronotal angle and lobe, space between pronotal lobe and tegula, T2–T3 basolaterally; moderately dense on metanotum; scattered on T4–T5; partially obscuring metepisternum. Head and mesosoma with mostly sparse pilosity, composed of highly plumose setae with very short fine setae intermixed. Lateral surface of propodeum with sparse erect setae; plumose patch on dorsal area; very short fine hairs intermixed. Metafemoral scopa with dense plumose hairs. Wing hairs pale. T1 with sparse erect setae.

FIGURE 12. *Lasioglossum* (*Sphecodogastra*) *dilisena* **sp. nov.**, ♀, holotype. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars = 1 mm.

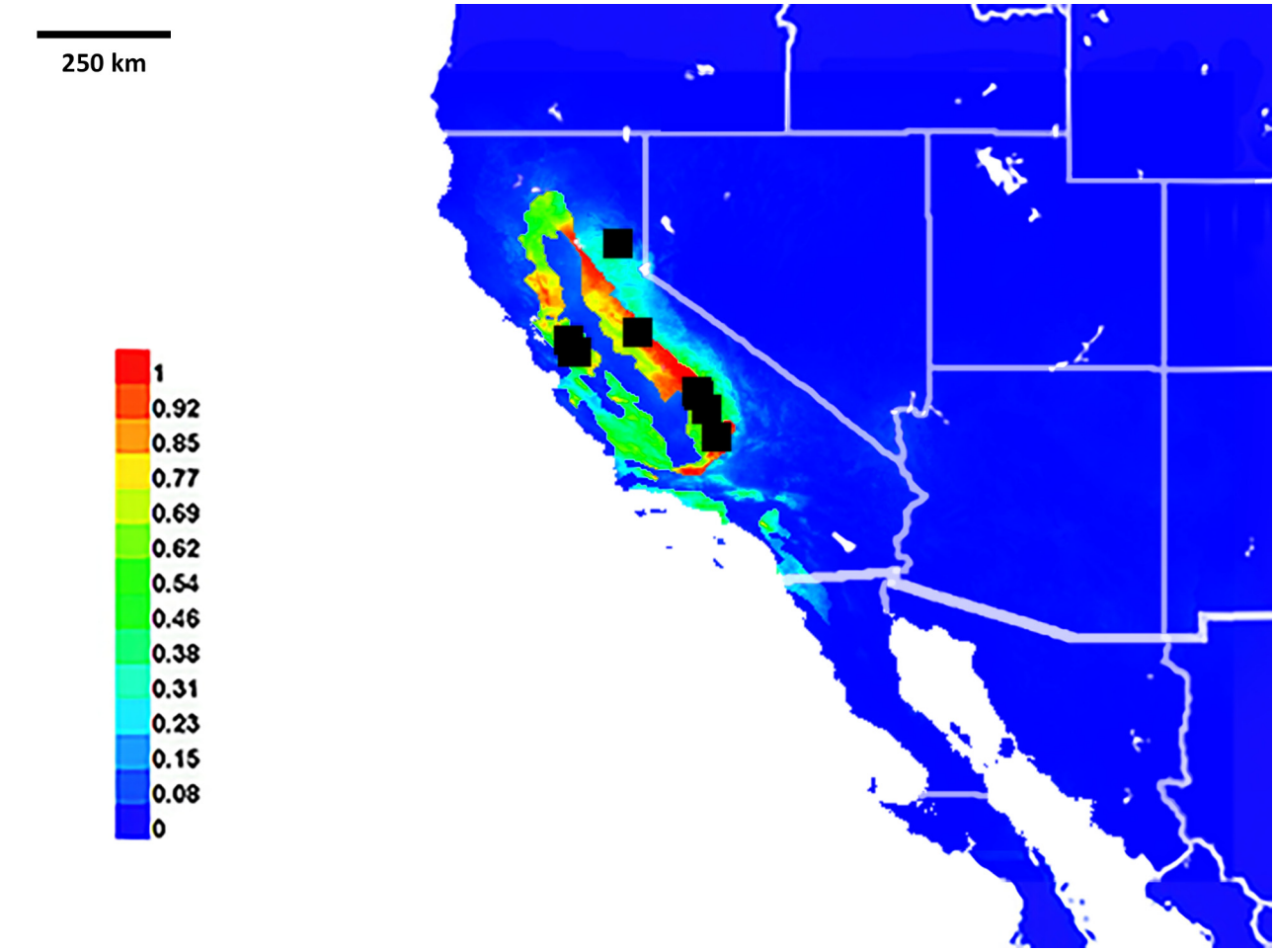

FIGURE 13. Georeferenced collection records of *Lasioglossum dilisena* (black squares) and predicted distribution by maximum entropy ecological niche modeling in Maxent (colour shading). Warmer colours indicate higher cloglog probability of occurrence.

Surface sculpture. Clypeus shiny, becoming imbricate basally; punctures large, irregularly spaced (IS < PD) on apical third, smaller and denser on near basal margin (IS ≤ 1 PD). Supraclypeal area imbricate basolaterally, mostly becoming weakly or moderately imbricate medially; punctures dense laterally (IS ≤ 1 PD) and moderately dense to moderately sparse (IS = 1–2 PD) medially. Paraocular area imbricate to reticulate; punctures dense (IS ≤ 1 PD) to crowded (IS = 0 PD). Frons punctate-reticulate; punctures crowded (IS = 0 PD) or dense (IS < 1 PD). Vertex imbricate laterally, strongly so medially; punctures absent or obscure. Gena shiny dorsally, becoming finely lineate ventrally; punctures fine, sparse (IS = 1–3 PD). Postgena shiny, becoming tessellate posteriorly. Tegula mostly shiny and impunctate except the base. Tegula base imbricate with punctures absent or obscure. Mesoscutum shiny, becoming tessellate to imbricate anteromedially; punctures large and small intermixed, mostly dense on marginally and on median line (IS < 1 PD), sparser submedially, becoming shallow and indistinct anteromedially. Punctures mesad of parapsidal line (IS = 1–3 PD) slightly sparser than laterad of parapsidal line (IS = 1–2 PD), becoming closer submedially and adjacent to medial line (IS ≤ 1 PD). Mesoscutellum shiny; punctures dense marginally and on median line (IS ≤ 1 PD), sparser submedially (IS = 2–4 PD), diversopunctate. Metanotum shiny and becoming weakly rugulose laterally, densely punctate medially (IS ≤ 1 PD). Metapostnotum rugae strong, anastomosing, reaching at the middle of posterior margin; sculpture shiny to imbricate. Preëpisternum rugose. Hypoepimeron weakly rugulose; punctures dense (IS < 1 PD), or sometime obscure, and sometime there are few scattered minute punctures anteriorly. Mesepisternum rugose mostly throughout; punctures obscure dorsally, absent ventrally. Metepisternum ruguloso-lineate dorsally, imbricate ventrally. Propodeum lateral face imbricate anteriorly and dorsally, otherwise tessellate; posterior face tessellate. T1 anterior face shiny, punctures small and very sparse;

T1 dorsal surface shiny, becoming weakly coriarious on rim, punctures small, sparse (IS = 1–4 PD), very sparse in large subapicolateral boss, and absent on rim. T2 disc imbricate to coriarious; punctures moderately dense basally (IS = 1–2 PD), becoming abruptly sparse apically (IS = 1–3 PD); rim coriarious; rim punctures absent (short hairs present but these not arising from distinct punctures).

Structure. Face length/width ratio 0.81 (± 0.02 SD). Eyes convergent below [UOD/LOD ratio 1.03 (± 0.03 SD)]. Clypeus projecting ~66% below suborbital tangent; clypeal area length/width ratio 0.83 (± 0.05 SD). Gena narrower than eye. Protibial spur with apical serrations as long as width of malus. Inner metatibial spur pectinate, branches mostly shorter than width of rachis (Figs. 11C, 11D). Intertegular span 1.14 (± 0.08 SD) mm. Distance between parapsidal line (at the starting point) 0.87 (± 0.08 SD) mm. Pronotal angle obtuse. Mesoscutum length/width ratio 0.88 (± 0.03 SD); mesoscutum/mesoscutellum length ratio 2.84 (± 0.16 SD); mesoscutellum/metanotum length ratio 1.54 (± 0.19 SD). Propodeum lateral carinae reaching dorsal margin; oblique carina very strong. (n=18)

Male. Unknown

Range. Diablo and Sierra Nevada mountain ranges of California (Figs. 7, 13).

Floral hosts. ONAGRACEAE: *Clarkia dudleyana* (Abrams) J.F.Macbr., *Clarkia purpurea* subsp. *viminea* (Douglas ex Hook.) H. Lewis & M. Lewis • PLANTAGINACEAE: *Penstemon* sp.

Lasioglossum (*Sphecodogastra*) *silveirai* sp. nov.

Figs. 7, 8C, 8D, 9C, 10C, 11E, 11F, 14, 15

Etymology. This species is named in honour of the late Fernando Silveira (Universidade Federal de Minas Gerais) for his contributions to bee taxonomy and his warm, jovial spirit, which made it a delight to attend international conferences on pollinators.

Holotype. USA—**California** • ♀; San Luis Obispo Co., La Panza Camp.; [35.3539° N, 120.2625° W]; elev. 660 m.; 25 April 1968; J. Powell leg.; UCRC GIBBS-11595. [Verbatim label: La Panza Camp., S.L.O. Co., Calif IV-25-68 // J. Powell Collector // Lasioglossum GIBBS-11595 // Holotype/ *Lasioglossum* (*Sphecodogastra*) *silveirai* Hettiarachchi and Gibbs]

Paratypes. USA—**California** • 1 ♀; Monterey Co., 3 air mi. NE of Paloma Creek; [36.3036° N, 121.4118° W]; elev. 274 m.; 06 May 1975; J. Powell leg.; ex *Ranunculus*; EMEC • 1 ♀; Monterey Co., Chew's Ridge; [36.3117° N, 121.5682° W]; elev. 1524 m.; 09 May 1975; J. Powell leg.; EMEC • 3 ♀♀; Monterey Co., Chew's Ridge nr. White Oak camp; [36.3128° N, 121.5721° W]; elev. 1219.2m.; 08 May 1975; J. Powell leg.; ex *Ranunculus*; EMEC •1 ♀; ibid.; 08 May 1975; R. Wharton leg.; ex *Ranunculus*; EMEC • 1 ♀; ibid.; 08 May 1975; R. Wharton leg.; EMEC • 2 ♀♀; Monterey Co., Chew's Ridge, Santa Lucia Mts.; [36.3117° N, 121.5682° W]; elev. 1524 m.; 08 May 1975; R. Wharton leg.; ex *Pinus* ;EMEC • 2 ♀♀; Monterey Co., Horse Bridge, 1.5 air mi SW of Arroyo Seco Grd. Sta.; [36.2219° N, 121.4950° W]; elev. 330 m.; 07 May 1975; R. Wharton leg.; EMEC • 1♀; San Benito Co., W side of Pinnacles National Monument; [36.4886° N, 121.2217° W]]; elev. 485 m; 02 Jul 1956; E.G. Linsley leg.; ex *Hemizonia lobbii*; EMEC • 1 ♀; San Benito Co., 5 mi. SW of Paicines, Limeklin Rd.; [36.6362° N, 121.4186° W]; 24 Mar 1966; R.L. Langston leg.; UCRC • 10 ♀♀; San Benito Co., SW. of Paicines; [36.7286° N, 121.2775° W]; 24 Apr 1968; J. Powell leg.; UCRC • 1 ♀; San Luis Obispo Co., La Panza Camp.; [35.3539° N, 120.2625° W]; elev. 660 m.; 25 Apr 1968; P.A. Opler leg.; ex *Rhamnus crocea*; UCRC • 1 ♀; ibid.; 25 Apr 1968; J. Powell leg.; UCRC • 3 ♀♀; ibid.; 25 Apr 1968; J. Doyen leg.; ex *Rhamnus crocea*; UCRC • 2 ♀♀; Ventura Co., Lockwood Valley; [34.7331° N, 119.0958° W]; elev. 1555 m.; 05 May 1959; P.H. Timberlake leg.; ex *Phacelia ciliata*; UCRC • 2 ♀♀; Ventura Co., Lockwood Valley, nr. Stauffer P.O.; [34.7556° N, 119.0592° W]; elev. 1540 m.; 05 May 1959; P.D. Hurd leg.; ex *Euphorbia albomarginata*; EMEC.

Description

Female. Length 5.57 (± 0.34 SD) mm (n=7). Head length 1.51 (± 0.07 SD) mm (n=16). Head width 1.67 (± 0.08 SD) mm (n=16). Wing length 4.11 (± 0.27 SD) mm (n=6).

Colouration. Head and mesosoma dark brown to black, mesoscutum and mesoscutellum with or without an oily metallic sheen. If they have a metallic sheen, it can be metallic green either with or without a purple tint. Metallic sheen not as prominent compared to the other two species, with nearly 30% of specimens (n=30) lacking the sheen or having a sheen that is not notable (Fig. D). Clypeus apex dark brown. Labrum dark brown. Mandible brown basally, light brown apically with reddish brown apex. Flagellum light brown dorsally, brown ventrally. Pronotal

lobe brown to dark brown. Tegula brown. Wing membrane hyaline, faintly dusky, veins with subcosta brown, otherwise honey-coloured. Legs dark brown. Metasoma brown to black, apical margins reddish brown to narrowly testaceous.

Pubescence. Setae off-white. Tomentum dense on pronotal angle and lobe, space between pronotal lobe and tegula, T2–T3 basolaterally; moderately dense on metanotum anterior margin; scattered on T4–T5; partially obscuring metepisternum. Head and mesosoma with mostly sparse pilosity, composed of highly plumose setae with very short fine setae intermixed. Lateral surface of propodeum with sparse erect setae; plumose patch on anterior dorsal area; very short fine hairs intermixed. Metafemoral scopa with dense plumose hairs. Wing hairs pale. T1 with sparse erect setae.

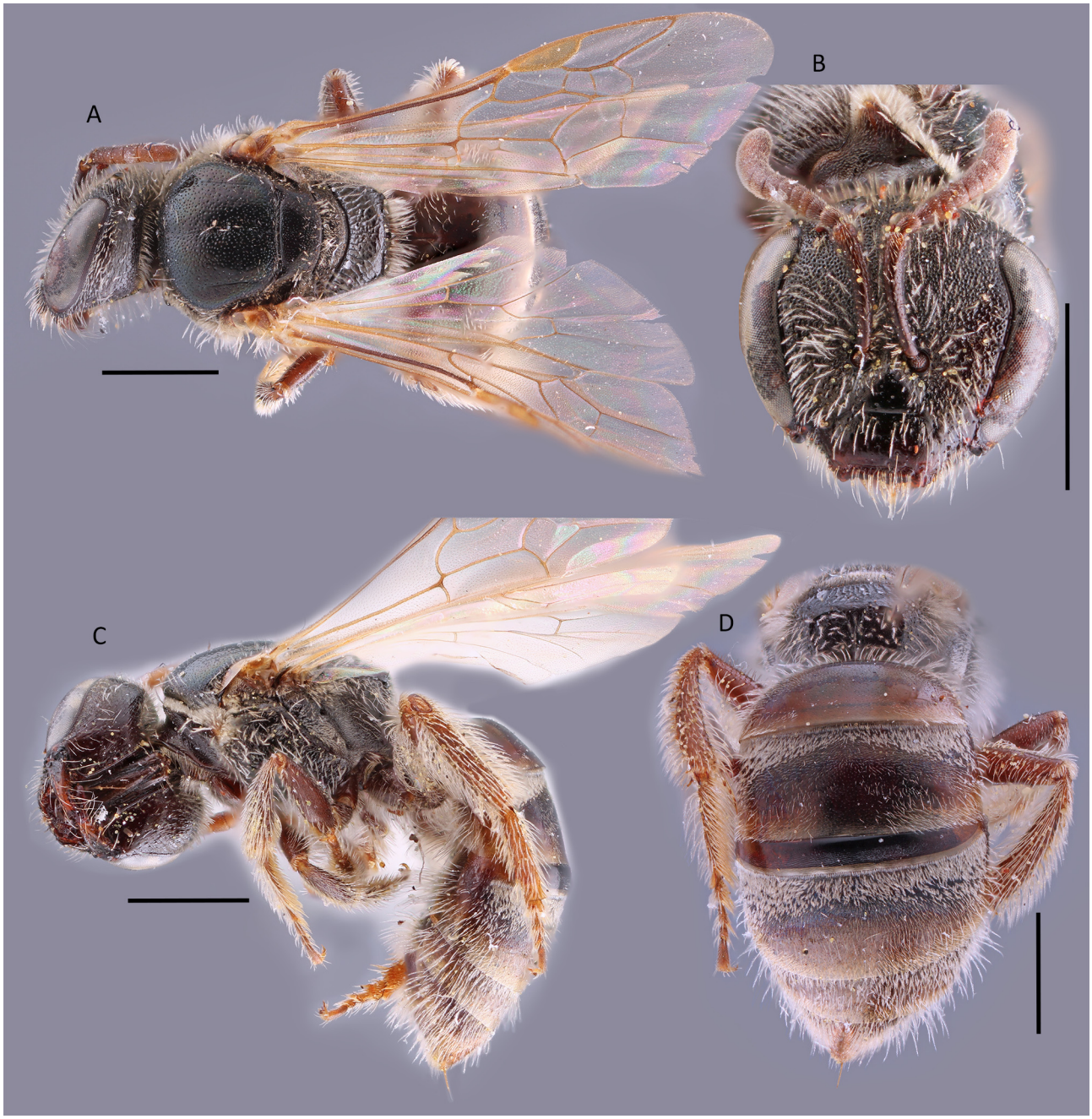

FIGURE 14. *Lasioglossum* (*Sphecodogastra*) *silveirai* **sp. nov.**, ♀, holotype. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars = 1 mm.

Surface sculpture. Clypeus shiny, becoming weakly imbricate basolaterally; punctures large, irregularly spaced (IS ≤ PD) on apical third, smaller and denser on near basal margin (IS ≤1 PD). Supraclypeal area mostly shiny; punctures sparse medially (IS = 2–4 PD). Paraocular area imbricate to reticulate, becoming shiny laterally; punctures mostly dense (IS ≤ 1 PD) to crowded (IS = 0 PD). Frons punctate-reticulate; punctures crowded (IS = 0 PD) or dense (IS < 1 PD). Vertex imbricate laterally, strongly so medially; punctures absent or obscure. Gena shiny dorsally, becoming finely lineate ventrally; punctures fine, sparse (IS = 1–3 PD). Postgena shiny, becoming weakly tessellate posteriorly. Tegula mostly shiny and impunctate except the base. Tegula base imbricate with punctures absent or obscure. Mesoscutum shiny, becoming tessellate to imbricate anteromedially; punctures large and small intermixed, mostly dense on marginally and on median line (IS < 1 PD), sparser submedially, becoming shallow and indistinct anteromedially. Punctures mesad of parapsidal line (IS = 2–4 PD) slightly sparser than laterad of parapsidal line (IS = 2–3 PD) and becoming closer near medial line (IS ≤ 1 PD). Mesoscutellum shiny; punctures comparatively smaller than the other two species, dense marginally and on median line (IS ≤ 1 PD), sparser submedially (IS = 1–5 PD), diversopunctate, Metanotum shiny and becoming weakly rugulose laterally, densely punctate medially (IS ≤ 1 PD). Metapostnotum rugae strong, anastomosing, reaching posterior margin; sculpture shiny to imbricate. Preëpisternum rugose. Hypoepimeron shiny, becoming weakly rugulose posteriorly; punctures moderately dense (IS = 1–2 PD), and sometime there are few scattered minute punctures anteriorly. Mesepisternum rugose dorsally and becoming strongly so ventrally; punctures obscure or indistinct dorsally, absent ventrally. Metepisternum rugulosolineate dorsally, imbricate ventrally. Propodeum lateral face imbricate anteriorly and dorsally, otherwise tessellate; posterior face tessellate. T1 anterior face shiny, punctures small and very sparse; T1 dorsal surface shiny, becoming weakly coriarious on rim, punctures small, sparse (IS = 1–4 PD), very sparse in large subapicolateral boss, and absent on rim. T2 disc imbricate to coriarious; punctures moderately dense basally (IS = 1–2 PD), becoming sparse apically (IS = 1–3 PD); rim coriarious; rim punctures absent (short hairs present but these not arising from distinct punctures).

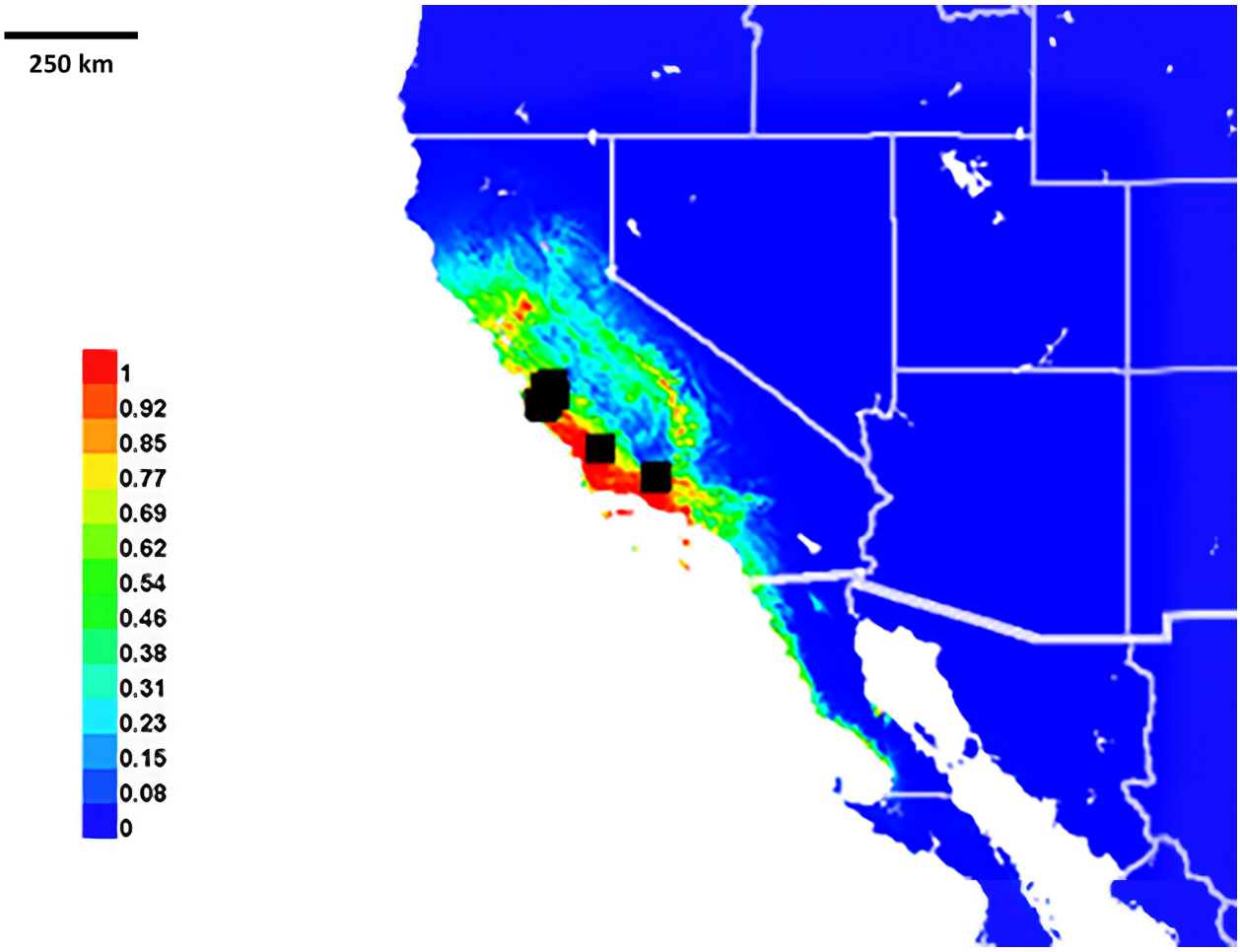

FIGURE 15. Georeferenced collection records of *Lasioglossum silveirai* (black squares) and predicted distribution by maximum entropy ecological niche modeling in Maxent (colour shading). Warmer colours indicate higher cloglog probability of occurrence.

Structure. Face length/width ratio 0.78 (± 0.01 SD). Eyes convergent below [UOD/LOD ratio 1.06 (± 0.03 SD)]. Clypeus projecting ~60% below suborbital tangent; clypeal area length/width ratio 0.86 (± 0.07 SD). Gena narrower than eye. Protibial spur with apical serrations quite longer than length to width of malus. Inner metatibial spur pectinate, basal branches shorter or subequal to width of rachis (Figs. 11E, 11F). Intertegular span 1.11 (± 0.10 SD) mm. Distance between parapsidal line 0.85 (± 0.08 SD) mm. Pronotal angle obtuse. Mesoscutum length/width ratio 0.87 (± 0.04 SD); mesoscutum/mesoscutellum length ratio 2.83 (± 0.21 SD); mesoscutellum/metanotum length ratio 1.59 (± 0.11 SD). Propodeum lateral carinae reaching dorsal margin; oblique carina very strong. (n=18)

Male. Unknown.

Range. Coastal Mountains of central California (Figs. 7, 15).

Floral hosts. ASTERACEAE: *Hemizonia lobbii* Greene • BORAGINACEAE: *Phacelia ciliata* Benth. • EUPHORBIACEAE: *Euphorbia albomarginata* Torr. & A.Gray • RANUNCULACEAE: *Ranunculus* sp. • PINACEAE: *Pinus* sp. • RHAMNACEAE: *Rhamnus crocea* Nutt.

Key to *Lasioglossum* subgenera in North America

Modified from McGinley (1986), Michener (2007), and Gibbs *et al*. (2013).

1. Second submarginal crossvein (1rs-m) as strong as first (second abscissa of Rs) (Fig. 16A), difficult to see in male; head and mesosoma black, except *L. pavonotus* (Cockerell); male clypeus often flat or depressed ventrally; flagellomere 2 subequal to pedicel and flagellomere 1 combined (Fig. 17A); body length usually greater (approx. 7–12 mm) 2
- Second submarginal crossvein (1rs-m) weaker than first (second abscissa of Rs) (Fig. 16B), at least in female; head and mesosoma variable in colour; male clypeus often rounded; flagellomere variable, if black and moderately large (> 6 mm), then flagellomere 2 longer than pedicel and flagellomere 1 combined (Fig. 17B) 3
2. Propodeum with lateral carina well developed, reaching dorsal surface (Fig. 18A); dorsal surface coarsely sculptured, shorter than scutellum (Fig. 18A); T1 without basal hair band (Fig. 18A); head long (length/width ratio = 0.88–1.0) (Fig. 19A); male gonostylus without retrorse lobe (Fig. 20A) . . . . . *L.* (*Leuchalictus*)
- Propodeum with lateral carina usually poorly developed, not reaching dorsal surface (Fig. 18B), but if strong (Figs. 18C, 18D) then dorsal surface longer than scutellum (Fig. 18C) or weakly sculptured (Fig. 18C) or T1 with basal hair band or head short (Fig. 18D) (length/width ratio = 0.77–0.89) (Fig. 19B); male gonostylus with retrorse lobe (Fig. 20B) . . . . *L.* (*Lasioglossum*)
3(1). Head and mesosoma distinctly metallic (green, blue, or golden) 4
- Head and mesosoma black-brown, at most with weak reflections 6
4. Head and mesosoma brilliant metallic (Antillean, southern Florida); male inner metatibial spur typically pectinate; male gonostylus without retrorse lobe . . . . . *L.* (*Habralictellus*)
- Head and mesosoma dull metallic; male inner metatibial spur ciliate; male gonostylus with retrorse lobe 5
5. Body size usually small (3.5–6 mm); female T1 usually with appressed hairs at least laterally (Fig. 21A) in North American species (except *L. ruidosense* and *L. petrellum* (Cockerell) species complexes, *L. microlepoides* (Ellis), *L. pavoninum* (Ellis)), typically lacking erect hairs medially; female mandible almost always with small preapical tooth (Fig. 21B), except in the wood-nesting *L. coeruleum* (Robertson)) (cosmopolitan) . . . . . *L.* (*Dialictus*)
- Body size usually larger (6–8 mm); female T1 without appressed hairs, medially with distinct erect hairs (Fig. 22A); female mandible often strongly bidentate (Fig. 22B), if preapical tooth small, then propodeum with distinct lateral carina reaching dorsal margin (primarily from Panama to Mexico, except *L. aquilae*, which reaches to high elevation areas in the southwestern USA) . . . . . *L.* (*Eickwortia s.l.*)
6 (3). Head wide (Fig. 23A); female inner metatibial spur with fine oblique teeth, not as tall as width of main rachis (Fig. 23A); male gonostylus without retrorse lobe; metasomal sterna with erect pubescence . . . . . *L.* (*Evylaeus*)
- Head usually longer (Fig. 23B); female inner metatibial spur usually with longer, narrow or fat teeth, often taller than width of main rachis basally (Fig. 24B); male gonostylus with retrorse lobe; metasomal sterna with variable pubescence 7
7. Foretibia of female with long projection (Fig. 25A); metapostnotum enclosed by carina, with distinct parallel carinulae (Fig. 26A); frons with two bulbous protuberances (Fig. 26B); retrorse lobe absent (Neotropical) . . . . . *L. gattaca* complex (*L. gattaca* and *L. hartmanni* Danforth and Wcislo)
- Foretibia of female without long projection (Fig. 25B); metapostnotum not as above; retrorse lobe present (widespread) . . . 8
8. Female mandible strongly bidentate (Fig. 27), subapical tooth nearly equal to apical one; male metasoma with entirely pale-orange sterna; gonobase at middorsum less than one-fourth length of gonocoxite; T1 narrow or apex of clypeus distinctly thick (Mexico and Central America) . . . . . *L.* (*Eickwortia s.s.*)
- Female mandible with small preapical tooth dorsally; male gonobase at middorsum usually more than one-third length of gonocoxite 9
9. Either propodeum with weak lateral carina and fully developed scopa (Figs. 28A, 28B) or mesosoma coarsely sculptured on pleuron and carina appearing to reach dorsal surface (Figs. 28C, 28D); male metasomal sterna with erect pubescence; male antennae usually relatively short; male heads sometimes enlarged with long mandibles (Fig. 28E) . . . . . *L.* (*Hemihalictus*)
- Either propodeum with weak lateral carina and highly modified reduced scopa (Figs. 29A, 29B) or mesosoma weakly rugose at most and propodeum with complete carina (Figs. 29C, 29D); male metasomal sterna nearly bare, except in Onagraceae specialists; male antennae relatively long (Fig. 4C); male heads not enlarged (Fig. 4B) . . . . . *L.* (*Sphecodogastra*)

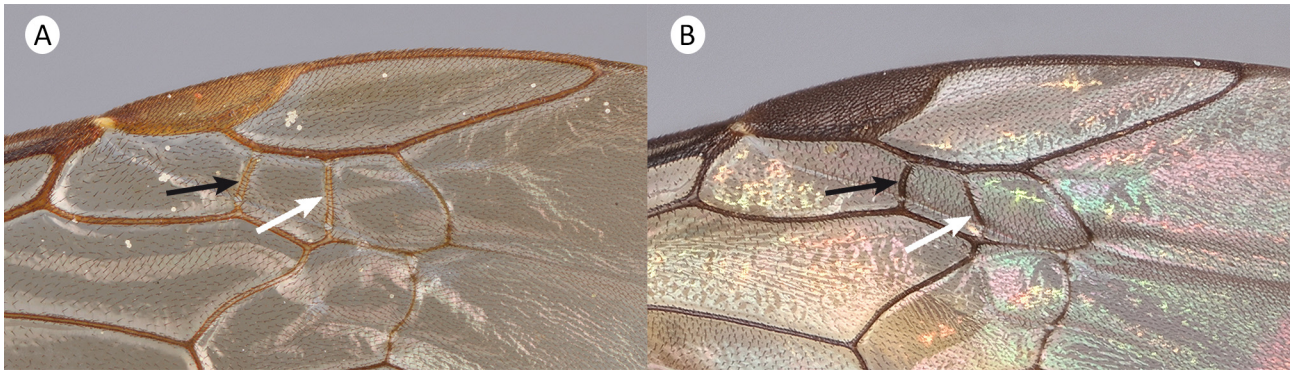

FIGURE 16. Forewings of female with black arrows indicating first submarginal crossvein and white arrows indicating second submarginal crossvein. **A.** *Lasioglossum* (*Lasioglossum*) *coriaceum* (Smith). **B.** *Lasioglossum* (*Hemihalictus*) *inconditum* (Cockerell).

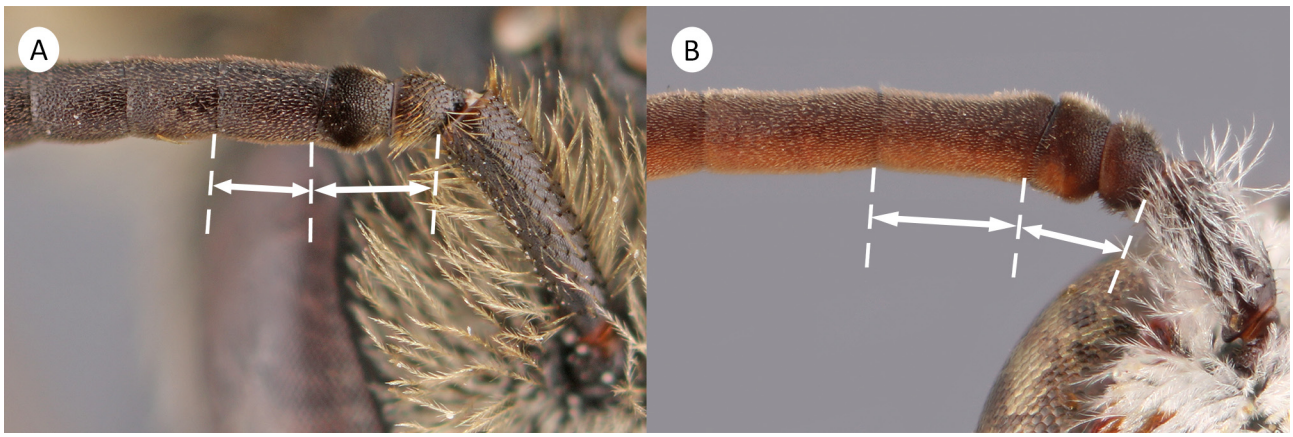

FIGURE 17. Antennae of male showing relative length of pedicel and flagellomere 1 to flagellomere 2 (arrows). **A.** *Lasioglossum* (*Leuchalictus*) *zonulus* (Smith). **B.** *Lasioglossum* (*Evylaeus*) *amicus* (Cockerell).

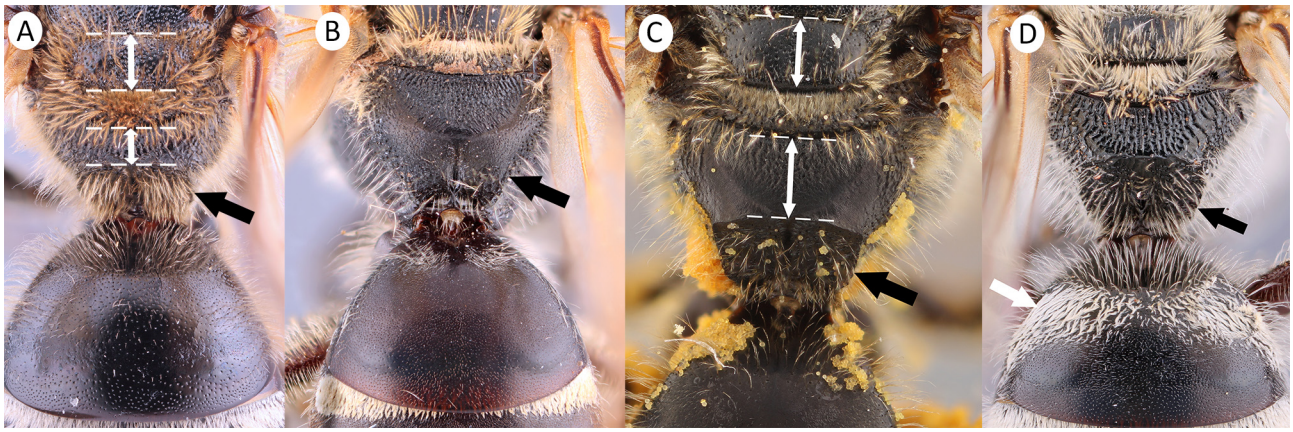

FIGURE 18. Mesoscutellum to tergum 1 of female with black arrows indicating lateral carina of female. Double arrows indicate relative lengths of mesoscutellum and metapostnotum. **A.** *Lasioglossum* (*Leuchalictus*) *zonulus*. **B.** *Lasioglossum* (*Lasioglossum*) *colatum* (Vachal). **C.** *Lasioglossum* (*Lasioglossum*) *fuscipenne* (Smith). **D.** *Lasioglossum* (*Lasioglossum*) *sisymbrii* (Cockerell) (white arrow showing basal hair band).

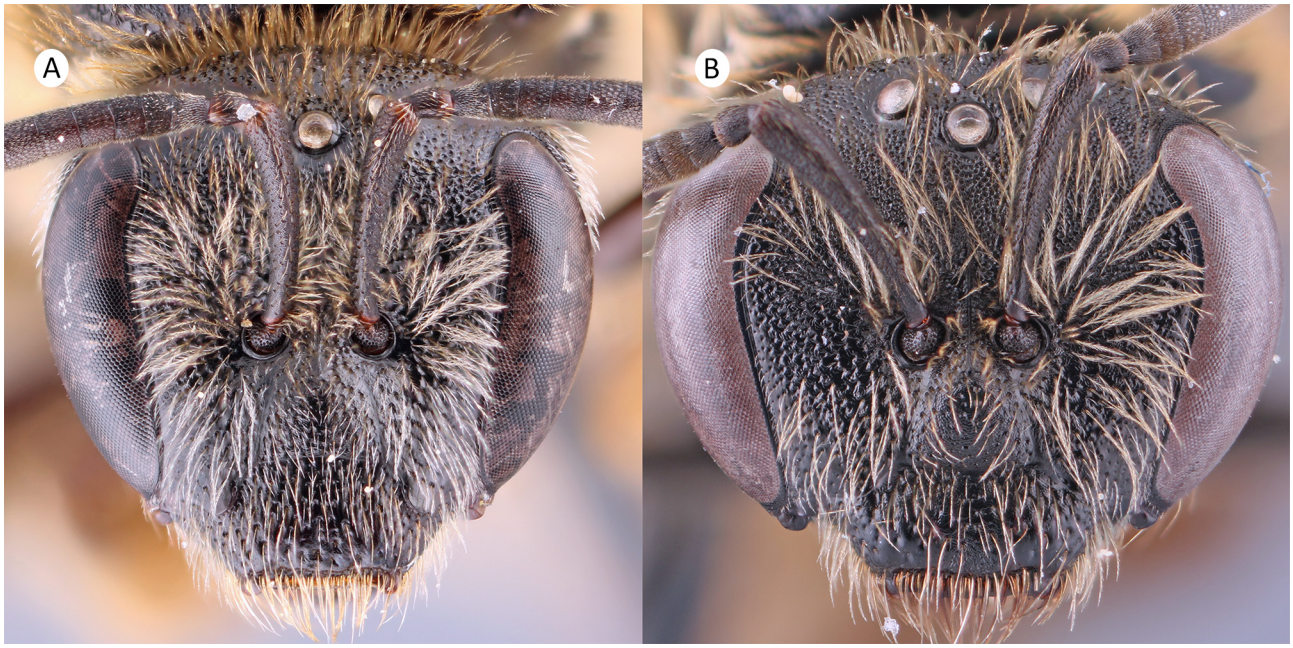

FIGURE 19. Face shape of females. **A.** *Lasioglossum* (*Leuchalictus*) *zonulus*. **B.** *Lasioglossum* (*Lasioglossum*) *olympiae* (Cockerell).

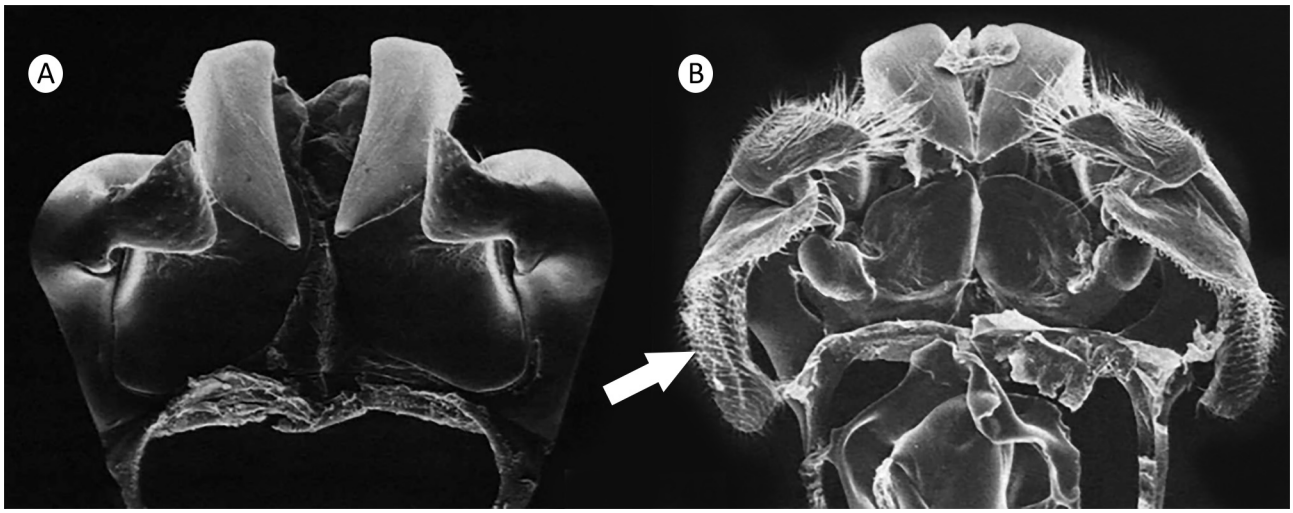

FIGURE 20. Male genitalia. **A.** *Lasioglossum* (*Leuchalictus*) *zonulus*. **B.** *Lasioglossum* (*Lasioglossum*) *colatum* (from McGinley 1986), with arrow indicating retrorse lobe.

Discussion

The genus *Lasioglossum* has an incredible number of species. Many areas have been poorly studied and the richness of the genus is likely to increase. There are valid reasons for wishing to subdivide *Lasioglossum s.l.* into multiple genera. However, at this time there have been too few taxa included in phylogenies to reliably place many species into clades. What we have learned from phylogenetics is that some earlier concepts of genus-groups were artificial and not based on evolutionary relationships (Danforth & Ji 2001; Gibbs *et al*. 2012a, b; Zhang *et al*. 2022). Thus, it will be necessary to refine genus-group concepts as phylogenetic inferences improve. Dividing *Lasioglossum s.l.* into multiple genera runs the risk of short-lived combinations that must be changed to better match future classifications. As an illustration, the name *Habralictellus* has been used at both the generic (Moure & Hurd 1982; Engel 2001) and subgeneric level (Genaro 2021; Gibbs *et al*. 2022) or treated as junior synonym of *Dialictus* (Michener 2000; Gibbs 2010). The monophyly of the group has been questioned (Gibbs 2018a) but if species are part of an inclusive *Lasioglossum* the combinations do not change.

FIGURE 21. *Lasioglossum* (*Dialictus*) *novascotiae* (Mitchell). **A.** Propodeum and T1 (white arrow showing appressed hairs on T1). **B.** Mandible with preapical tooth.

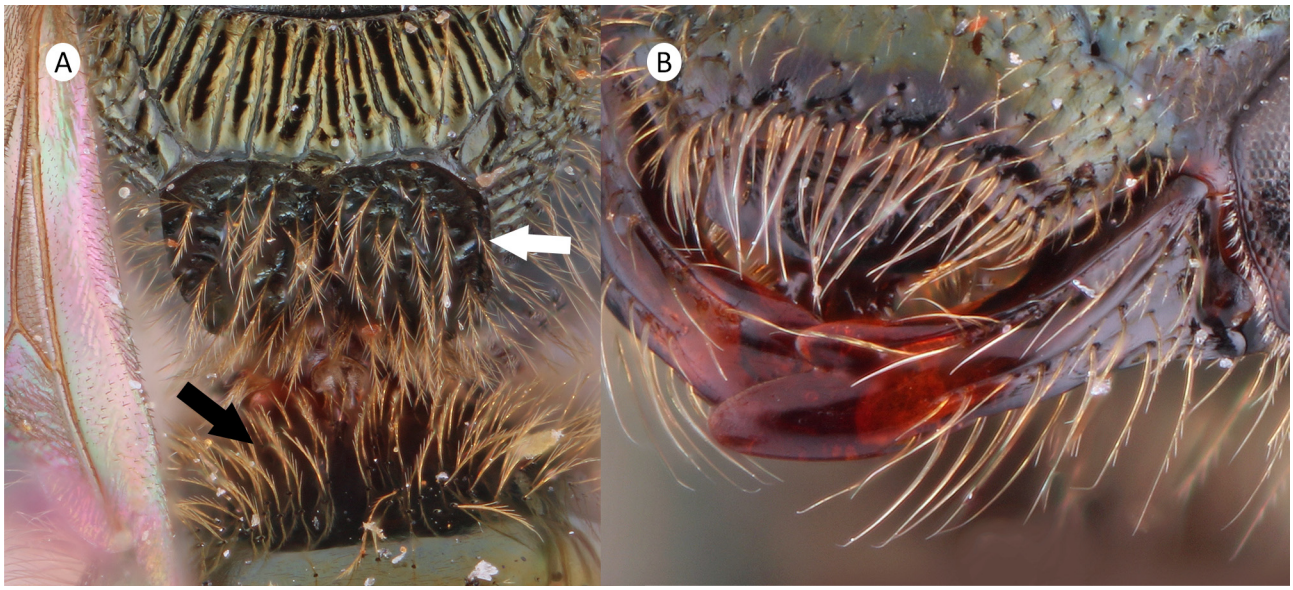

FIGURE 22. *Lasioglossum* (*Eickwortia*) *aurora* (Smith), ♀. **A.** Propodeum and T1 (white arrow showing lateral carina and black arrow showing erect hairs on T1). **B.** Mandible with preapical tooth**.**

Although it may be premature to subdivide *Lasioglossum* into multiple genera, there may be greater justification for creating more narrowly divided subgenera. Some authors, such as Pesenko (2007) and Pauly (1999) have named subgenera only to have these synonymized soon after into pre-existing subgenera (Michener 2007, Gibbs *et al*. 2013). However, in some cases subsequent molecular phylogenetic studies have supported the classifications proposed based on morphology (Gibbs *et al*. 2012b). For example, Pauly's (1999) taxa *Ipomalictus* and *Rubrihalictus* were treated as *Ctenonomia* Cameron by Michener (2007), but these are quite distinct in phylogenies (Gibbs *et al*. 2012b). Similarly, *Dialictus* and *Evylaeus* have been used very broadly in the past (Ebmer 2002; Gibbs 2010; Michener 1990, 2000), but over time their scope has been narrowed to reflect the phylogeny, while other taxa have increased in size (Gibbs *et al*. 2013). Some genus-group names that were synonymized within the more comprehensive *Hemihalictus*, *Sphecodogastra*, and *Dialictus*, may need to be resurrected to better match evolutionary relationships and improve the confusing state of diagnostics of the subgenera (e.g. *Rostrohalictus* Warncke; Zhang *et al*. 2022).

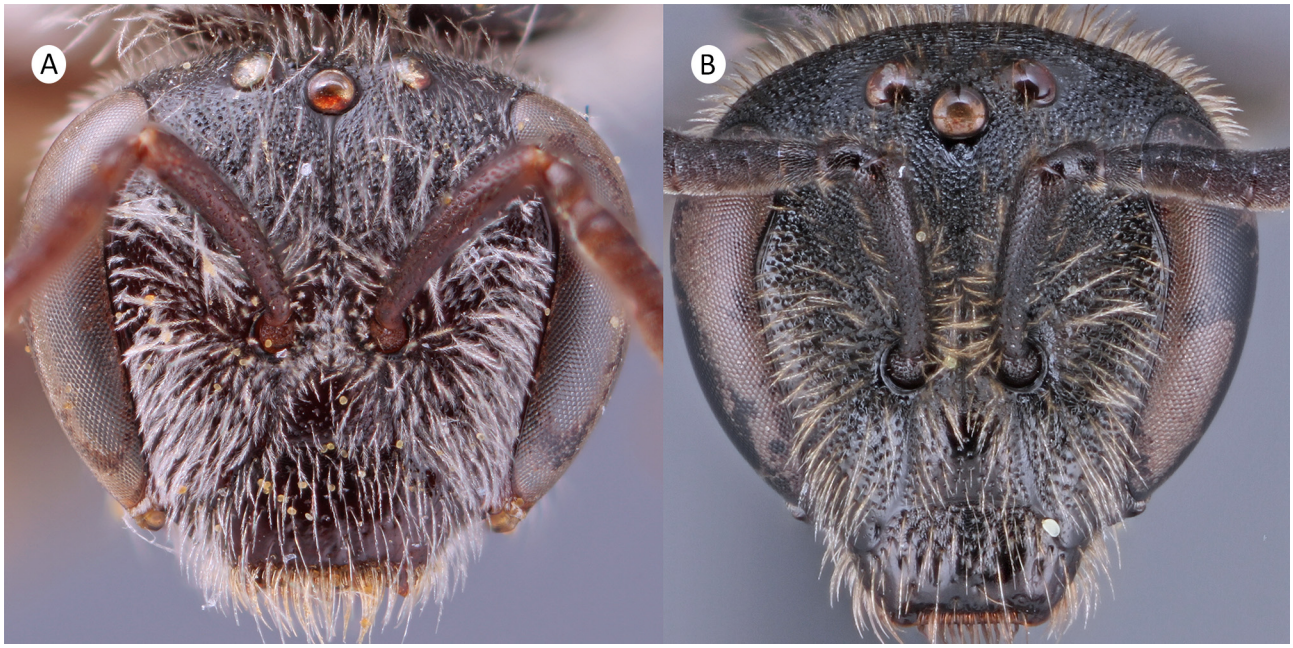

FIGURE 23. Head shape of females. **A.** *Lasioglossum* (*Evylaeus*) *amicus.* **B.** *Lasioglossum* (*Hemihalictus*) *inconditum* (Cockerell).

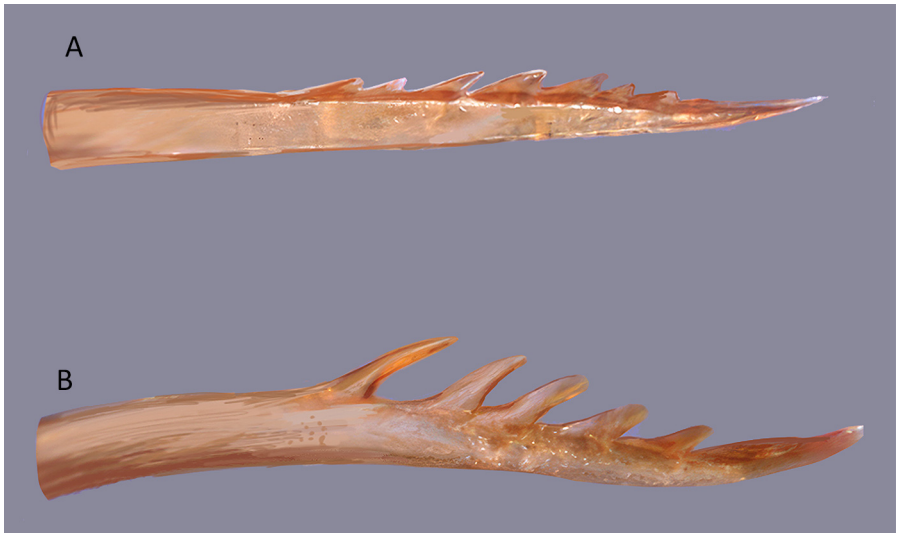

FIGURE 24. Female inner metatibial spurs. **A.** *Lasioglossum* (*Evylaeus*) *cinctipes* (Provancher). **B.** *Lasioglossum* (*Sphecodogastra*) *truncatum* (Robertson).

The new species described here are predominately from high elevation areas in California. The species are clearly closely related, and initially considered to be conspecific. However, the populations seem sufficiently distinct to warrant species status. More recent material is needed to further test species limits using additional tools (i.e. molecular data) and to describe the males of *L. dilisena* and *L. silveirai*.

Climate change poses a significant threat to high-elevation species and their habitats (Mountain Research Initiative EDW Working Group 2015), impacting them through changes in temperature and precipitation patterns, as well as shifts in vegetation distribution and abundance (Parmesan & Yohe 2003; Hodkinson 2005). To better understand the potential threats facing these bees in their changing environments, future research should focus on their ecology and distribution. By doing so, we can gain insights into how these species may respond to climate change and develop effective conservation strategies to mitigate its negative impacts.

FIGURE 25. Forelegs of female. **A.** *Lasioglossum* (*Dialictus*) *hartmanni* with arrow indicating the long projection on probasitarsus. **B.** *Lasioglossum* (*Hemihalictus*) *pectorale* (Smith)

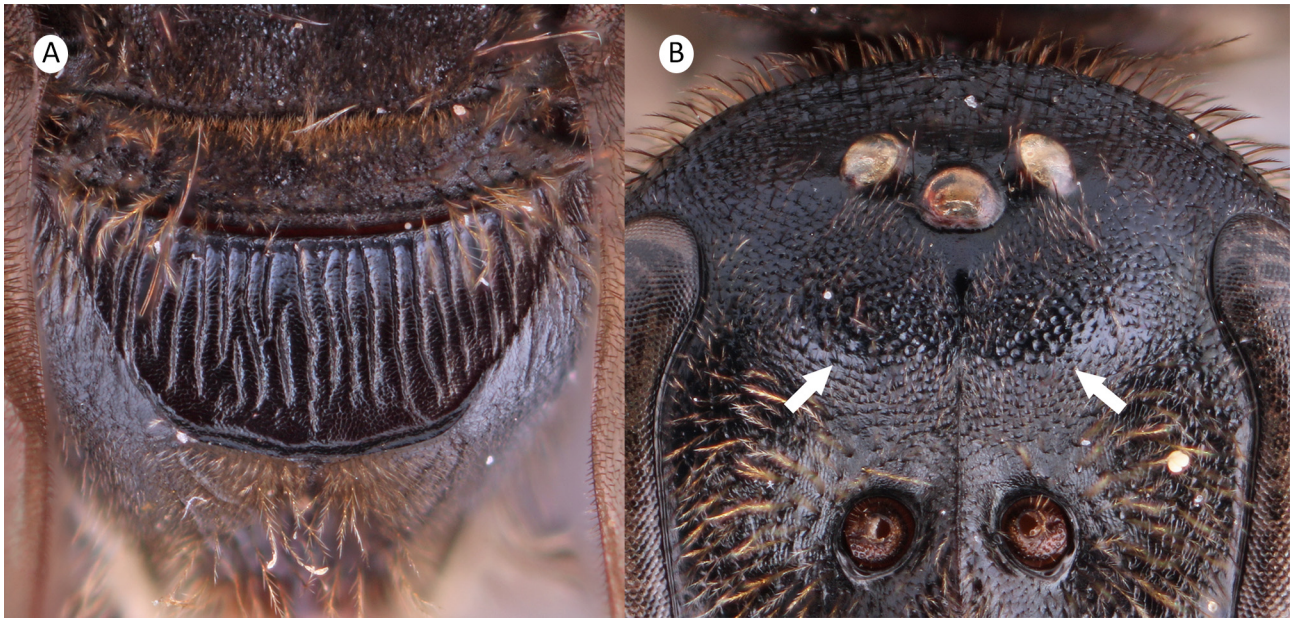

FIGURE 26. *Lasioglossum* (*Dialictus*) *hartmanni*, ♀. **A.** Enclosed metapostnotum. **B.** Bulbous protuberances on frons.

Acknowledgments

The authors would like to express their sincere gratitude to the museum curators who generously provided the specimens used in this study. The first author would like to express gratitude towards all the lab mates for their companionship and support in numerous ways. Special thanks are extended to Dr. Doug Yanega and an anonymous reviewer for their invaluable comments, which greatly enhanced our paper. We are particularly grateful to Dr. Doug Yanega for supplying us with locality coordinates for UCRC and EMEC specimens. Funding for this project comes from National Sciences and Engineering Research Council of Canada Discovery Grant RGPIN-2018-05353 (principal investigator: J.G.) and the University of Manitoba Graduate Enhancement of Tri-agency Stipends (GETS).

FIGURE 27. Strongly bidentate mandible of *Lasioglossum* (*Eickwortia*) *nyctere* (Vachal).

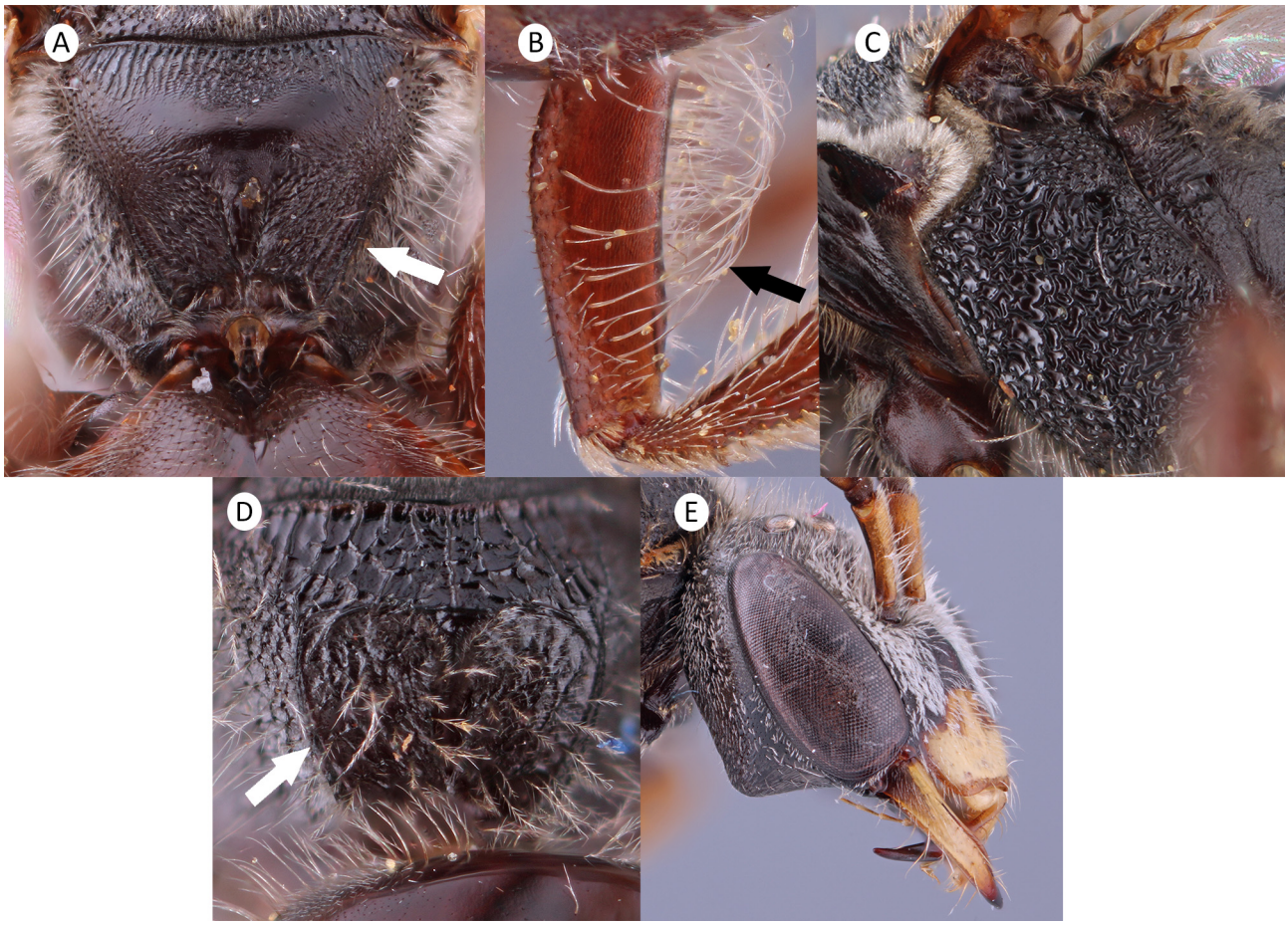

FIGURE 28. *Lasioglossum* (*Hemihalictus*) *ovaliceps* (Cockerell), ♀. **A.** Propodeum. **B**. Hind leg.; *Lasioglossum* (*Hemihalictus*) *kincaidii* (Cockerell), ♀. **C.** Mesosoma. **D.** Propodeum.; *Lasioglossum* (*Hemihalictus*) *sopinci* (Crawford), ♂. **E.** Enlarged head.

FIGURE 29. *Lasioglossum* (*Sphecodogastra*) *texanum*, ♀. **A.** Propodeum. **B.** Hind leg., *L.* (*Sphecodogastra*) *comagenense* (Knerer & Atwood).

References

Ascher, J.S. & Pickering, J. (2023) Discover Life bee species guide and world checklist (Hymenoptera: Apoidea: Anthophila). Available from: http://www.discoverlife.org/mp/20q?guide=Apoidea_species (accessed 10 March 2023)

Ashmead, W.H. (1899) Classification of the bees, or the superfamily Apoidea. *Transactions of the American Entomological Society*, 26, 49–100.

Bossert, S., Wood, T.J., Patiny, S., Michez, D., Almeida, E.A.B., Minckley, R.L., Packer, L., Neff, J.L., Copeland, R.S., Straka, J., Pauly, A., Griswold, T., Brady, S.G., Danforth, B.N. & Murray, E.A. (2021) Phylogeny, biogeography and diversification of the mining bee family Andrenidae. *Systematic Entomology*, 47 (2), 283–302. https://doi.org/10.1111/syen.12530

Cane, J.H. (1987) Estimation of bee size using intertegular span (Apoidea). *Journal of the Kansas Entomological Society*, 60

(10), 145–147.
Cardinal, S. (2018) Bee (Hymenoptera: Apoidea: Anthophila) diversity through time. *In*: Foottit, R.G. & Adler, P.H. (Eds.), *Insect Biodiversity*: Science and Society. John Wiley & Sons, Ltd, Chichester, pp. 851–867. https://doi.org/10.1002/9781118945582.ch28
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. https://doi.org/10.1080/10635150390132687
Danforth, B.N. & Ji, S. (2001) Australian *Lasioglossum* + *Homalictus* form a monophyletic group: resolving the "Australian enigma." *Systematic Biology*, 50, 268–83. https://doi.org/10.1093/sysbio/50.2.268
Ebmer, A.W. (1969) Die Bienen des Genus *Halictus* Latr. s. l. im Grossraum von Linz (Hymenoptera, Apidae). Systematik, Biogeographie, Ökologie und Biologie mit Berücksichtigung aller bisher aus Mitteleuropa bekannten Arten. Teil I. *Naturkundliches Jahrbuch der Stadt Linz*, 1969, 133–183. [in German]
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 (2), 819–934. [in German]
Ebmer, A.W. (2008) Neue taxa der Gattungen *Halictus* Latreille 1804 und *Lasioglossum* Curtis 1833 (Hymenoptera, Apoidea, Halictidae) aus den Vereinigten Arabischen Emiraten. *Linzer Biologische Beiträge*, 40 (1), 551–580. [in German]
Engel, M.S. (2001) Three new *Habralictellus* bee species from the Caribbean (Hymenoptera: Halictidae). *Solenodon*, 1, 33–37.
Gardner, J. & Gibbs, J. (2020) The "red-tailed" *Lasioglossum* (*Dialictus*) (Hymenoptera: Halictidae) of the western Nearctic. *European Journal of Taxonomy*, 725, 1–242. https://doi.org/10.5852/ejt.2020.725.1167
Genaro JA (2021) Especies nuevas de *Lasioglossum* Curtis de las altas montañas de las Antillas Mayores y estado actual del conocimiento del taxon *Habralictellus* Moure y Hurd (Hymenoptera: Apoidea: Halictidae). *Insecta Mundi*, 0853, 1–17.
Gibbs, J. (2010) Revision of the metallic species of *Lasioglossum* (*Dialictus*) in Canada (Hymenoptera, Halictidae, Halictini). *Zootaxa*, 3073 (1), 1–382. https://doi.org/10.11646/zootaxa.2591.1.1
Gibbs, J. (2018a) Bees of the genus *Lasioglossum* (Hymenoptera: Halictidae) from Greater Puerto Rico, West Indies. *European Journal of Taxonomy*, 400, 1–57. https://doi.org/10.5852/ejt.2018.400
Gibbs, J. (2018b) DNA barcoding a nightmare taxon: Assessing barcode index numbers and barcode gaps for sweat bees. *Genome*, 61, 21–31. https://doi.org/10.1139/gen-2017-0096
Gibbs, J., Albert, J. & Packer, L. (2012a) Dual origins of social parasitism in North American *Dialictus* (Hymenoptera: Halictidae) confirmed using a phylogenetic approach. *Cladistics*, 28, 195–207. https://doi.org/10.1111/j.1096-0031.2011.00373.x
Gibbs, J., Bass, A. & Morgan, K. (2022) *Habralictus* and *Lasioglossum* of Saint Lucia and Saint Vincent and the Grenadines, Lesser Antilles (Hymenoptera, Apoidea, Halictidae). *Zookeys*, 1089, 125–167. https://doi: 10.3897/zookeys.1089.72645
Gibbs, J., Brady, S.G., Kanda, K. & Danforth, B.N. (2012b) Phylogeny of halictine bees supports a shared origin of eusociality for *Halictus* and *Lasioglossum* (Apoidea: Anthophila: Halictidae). *Molecular Phylogenetics and Evolution*, 65, 926–939. https://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), 1–117. https://doi.org/10.11646/zootaxa.3672.1.1
Grab, H., Branstetter, M.G., Amon, N., Urban-Mead, K.R., Park, M.G., Gibbs, J., Blitzer, E.J., Poveda, K., Loeb, G. & Danforth, B.N. (2019) Agriculturally dominated landscapes reduce bee phylogenetic diversity and pollination services. *Science*, 363, 282–284. https://doi.org/10.1126/SCIENCE.AAT6016
Harris, R.A. (1979) A glossary of surface sculpturing. *Occasional Papers in Entomology*, 28, 1–31. Available from: https://zenodo.org/record/26215 (accessed 1 January 2023)
Krijthe, J.H. (2015) Rtsne: T-distributed stochastic neighbor embedding using Barnes-Hut implementation. R package version 0.16. Available from: https://github.com/jkrijthe /Rtsne (accessed 20 September 2022)
McGinley, R.J. (1986) Studies of Halictinae (Apoidea: Halictidae), I: Revision of New World *Lasioglossum* Curtis. *Smithsonian Contributions to Zoology*, 429, 1–294. https://doi.org/10.5479/si.00810282.429
McGinley, R.J. (2003) Studies of Halictinae (Apoidea: Halictidae), II: Revision of *Sphecodogastra* Ashmead, floral specialists of Onagraceae. *Smithsonian Contributions to Zoology*, 610, 1–55. https://doi.org/10.5479/si.00810282.610

Michener, C.D. (1944) Comparative external morphology, phylogeny, and a classification of the bees (Hymenoptera). *Bulletin of the American Museum of Natural History*, 82, 151–326.
Michener, C.D. (1990) Reproduction and castes in social halictine bees. *In*: Engels, W. (Ed), *Social Insects: An Evolutionary Approach to Castes and Reproduction*. Springer, New York, pp. 77–121. https://doi.org/10.1007/978-3-642-74490-7_6
Michener, C.D. (2000) *The bees of the world*. The Johns Hopkins University Press, Baltimore, 913 pp.
Michener, C.D. (2007) *The bees of the world*. *2nd ed*. The Johns Hopkins University Press, Baltimore, xvi + [i] + 953 pp.
Mitchell, T.B. (1960) Bees of the Eastern United States: volume I. *N. C. Agricultural Experimental Station Technical Bulletin*, 141, 1–538.
Mountain Research Initiative EDW Working Group (2015) Elevation-dependent warming in mountain regions of the world. *Nature Climate Change*, 5, 424–430. https://doi.org/10.1038/nclimate2563
Moure, J.S. (2007) Halictini Thomson, 1869. *In*: Moure, J.S., Urban, D. & Melo, G.A.R. (Eds), *Catalogue of bees (Hymenoptera, Apoidea) in the Neotropical region*. Sociedade Brasileira de Entomologia, Curitiba, pp. 823–870.
Moure, J.S. & Hurd, P.D. (1982) On two new groups of Neotropical halictine bees (Hymenoptera, Apoidea). *Dusenia,* 13 (2), 46.
Parmesan, C. & Yohe, G. (2003) A globally coherent fingerprint of climate change impacts across natural systems. *Nature*, 421 (6918), 37–42. https://doi.org/10.1038/nature01286
Pauly, A. (1999) Classification des Halictini de la Région Afrotropicale (Hymenoptera Apoidea Halictidae). *Bulletin de l'Institute Royal Des Sciences Naturelles de Belgique*, 69, 137–196.
Pesenko, Y.A. (2007) Subgeneric classification of the Palaearctic bees of the genus *Evylaeus* Robertson (Hymenoptera: Halictidae). *Zootaxa*, 1500 (1), 1–54. https://doi.org/10.11646/zootaxa.1500.1.1
Pesenko, Y.A., Banaszak, J., Radchenko, V.G. & Cierzniak, T. (2000) *Bees of the family Halictidae (excluding Sphecodes of Poland: taxonomy, ecology, bionomics*. Wyzszej Szkoly Pedagogicznej, Bydgszcz, ix + 348 pp.
R Core Team (2022) R: A Language and Environment for Statistical Computing. ver. 4.3.0. Available from: http://www.R-project.org (accessed 10 August 2022)
USDA, NRCS (2023) The PLANTS Database, National Plant Data Team, Greensboro, NC USA. [online]. Available from: http://plants.usda.gov (accessed 10 February 2023)
Venables, W.N. & Ripley, B.D. (2002) *Modern Applied Statistics with S. Fourth edition*. Springer, New York, xi + 495 pp. https://doi.org/10.1007/978-0-387-21706-2
World Flora Online Consortium (2020) World Flora Online [online]. Available from: http://www.worldfloraonline.org (accessed 10 February 2023)
Zhang, D., Niu, Z.Q., Luo, A.R., Orr, M.C., Ferrari, R.R., Jin, J.F., Wu, Q.T., Zhang, F. & Zhu, C.D. (2022) Testing the systematic status of *Homalictus* and *Rostrohalictus* with weakened cross-vein groups within Halictini (Hymenoptera: Halictidae) using low-coverage whole-genome sequencing. *Insect Science*, 29, 1819–1833. https://doi.org/10.1111/1744-7917.13034