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Seven new species of *Lasioglossum* (*Dialictus*) Robertson, 1902 (Hymenoptera: Halictidae: Halictini) from the Yucatán Peninsula, Mexico

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Abstract. *Lasioglossum* is a large genus of halictid bees with high species diversity in morphologically rather cryptic species groups. With more than 1900 described species, the taxonomy of the genus is complex and largely unresolved in many regions. For practical reasons, systematic reviews are restricted in scope either geographically or to particular species groups. In this study we focus on the subgenus *Dialictus* of the genus *Lasioglossum* from the Yucatán Peninsula in Mexico. In previous studies we identified members of the genus as important pollinators of cash crops in the region, and genetic analyses suggested the existence of seven molecular taxonomic units (mOTU). Based on additional morphological differences, we here describe these mOTUs as novel species, *Lasioglossum* (*Dialictus*) *yucatanense* Landaverde-González sp. nov., *L.* (*D.*) *paxtoni* Landaverde-González sp. nov., *L.* (*D.*) *ameshoferi* Landaverde-González sp. nov., *L.* (*D.*) *aureoviride* Landaverde-González & Husemann sp. nov.,

L. (*D.*) *paralepidii* Gardner sp. nov., *L.* (*D.*) *milpa* Landaverde-González sp. nov. and *L.* (*D.*) *nanotegula* Landaverde-González & Husemann sp. nov., and provide keys and images to assist in their identification.

Keywords. Apoidea, Neotropics, sensilla, sweat bee, wing morphometry.

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Introduction

The Yucatán Peninsula, with an area of 181 000 km^2, is located in the southeast of Mexico and separates the Caribbean Sea from the Gulf of Mexico. Its geological and cultural characteristics make the area unique (McColl 2005). The entire Yucatán Peninsula is an unconfined flat karst landscape with tropical lowlands bordered by the Sierra Madre de Chiapas that lies east of the Isthmus of Tehuantepec and the Montagua-Polochic-Jocotán fault system to the south, comprising the tectonic block Maya (Ferrusquía-Villafranca 1993; Morrone 2006). These features are known to be barriers to gene flow creating divergence and formation of cryptic species for various taxa principally for the Yucatán peninsula region (Morrone 2006; Mulcahy *et al*. 2006; Barber & Klicka 2010; Gutiérrez-García & Vázquez-Domínguez 2013; Landaverde-González *et al*. 2020) including bees (Duennes *et al*. 2017). This has undoubtedly contributed to the region's status as a biodiversity 'hotspot' (Myers *et al*. 2000; Mittermeier *et al*. 2004).

A study of pollinators of habanero cash crops in Yucatán showed the existence of a large number of sweat bees of *Lasioglossum* (*Dialictus*) Robertson, 1902 that were later delimited into seven molecular Operative Taxonomic Units (mOTU) (Landaverde-González *et al*. 2017a). *Lasioglossum* Curtis, 1833 is the most speciose bee genus worldwide with nearly 1900 described species, and *Dialictus* (sensu Gibbs *et al*. 2013) is its most speciose subgenus with nearly 400 described species (Ascher & Pickering 2021). Although only up to 45 species of *L.* (*Dialictus*) are known from Mexico and Guatemala (Engel *et al*. 2007; Gardner & Gibbs 2020), the late melittologist George C. Eickwort (Cornell University) considered it one of the most diverse halictid taxa in Mexico (Ayala *et al*. 1993). Of these 45 Mexican *L.* (*Dialictus*), only one was described from the lowlands of the Yucatán Peninsula, an additional six were described from the bordering mountain regions, and at least one more was later identified from the lowlands by Eickwort. Much of the total diversity remains undescribed, as there has been no comprehensive revision of the *L.* (*Dialictus*) of Mexico and Central America, and taxonomic work in the western United States (which shares many species with Mexico) is only just beginning (Gardner & Gibbs 2020). Some important studies have described the diversity of *L.* (*Dialictus*) in North America (Canada and the United States) (Gibbs 2009a, 2009b, 2010, 2011), the Caribbean (Puerto Rico and Dominica) (Engel 2001, 2006, 2011; Genaro & Franz 2008), and the western Nearctic of the United States and Mexico, including one species from Yucatán (Gardner & Gibbs 2020). Other studies investigated the subgenus *L.* (*Dialictus*) in Costa Rica (Wcislo 1990), and Mexico and Guatemala (Engel *et al*. 2007). Combining known biogeographic barriers, high diversity, and a lack of taxonomic work, it is unsurprising that *L.* (*Dialictus*) collections from the Yucatán Peninsula should turn up many new species.

A comprehensive revision is still beyond the scope and ability of this study, but we use information from Landaverde-González *et al*. (2017a) to formally describe the seven mOTUs delimited in that study as new species using an integrative taxonomic approach (DeSalle *et al*. 2005) and evolutionary species concept (Wiley & Mayden 2000). Because bees in *L.* (*Dialictus*) are known to be difficult to identify both morphologically (Gibbs 2010) and genetically (Gibbs 2018a), we use two additional morphological character sets which are known to be useful in species delimitation of other bees, but have not earlier

been applied to *L*. (*Dialictus*). These are wing shape morphometrics (Francoy *et al*. 2006, 2011, 2012, 2016; Ferreira *et al*. 2011) and antennal sensilla (González-Vaquero & Galvani 2016). The utility of these characters and associated techniques as delimitation tools in *L*. (*Dialictus*) is investigated for the first time. We also provide an identification key to the known species of *L*. (*Dialictus*) from the Yucatán Peninsula.

Material and methods

In this work, we follow the definition of *L*. (*Dialictus*) proposed by Gibbs *et al*. (2013) with modifications in Gibbs (2016, 2018b).

Specimens

A total of 855 specimens of *L*. (*Dialictus*) from Yucatán State were sampled as described in Landaverde-González *et al.* (2017a; further detail in Supp. file 1: Table S1 for the specimens sequenced). An additional 186 specimens from the Yucatán Peninsula and 323 specimens and type material from other areas of Mexico were examined or will be deposited in the following institutions:

BBSL = USDA Agricultural Research Service Pollinating Insect Research Unit, Utah State University, Logan, UT, USA (H. Ikerd, Terry Griswold)
CANG = Colección de Abejas Nativas de Guatemala, Guatemala City, Guatemala (Eunice Enríquez)
CAS = California Academy of Sciences, San Francisco, CA, USA (Chris Grinter)
ECOAB = El Colegio de Frontera Sur, Equipo Abejas collection, San Cristóbal de las Casas, Mexico (Philippe Sagot, Jorge Mérida, Rémy Vandame)
LACM = Natural History Museum of Los Angeles County, Los Angeles, CA, USA (Lisa Gonzalez, Weiping Xie)
MNHN = Muséum national d'histoire naturelle, Paris, France (Claire Villemant, now Bernardo Santos)
NHMUK = The Natural History Museum, London, United Kingdom (David Notton, now Joseph Monks)
PCYU = Packer collection at York University, Toronto, Ontario, Canada (Laurence Packer)
SEMC = University of Kansas Biodiversity Institute and Natural History Museum, Lawrence, KS, USA (Jennifer Thomas, Michael Engel)
TAMU = Texas A&M University Insect Collection, College Station, TX, USA (Karen Wright)
UADY = Universidad Autonoma de Yucatán, Mexico (Humberto Moo-Valle)
UCDC = University of California-Davis, R.M. Bohart Museum of Entomology, Davis, CA, USA (Lynn Kimsey, Tom Zavortink)
UCMC = University of Colorado Museum of Natural History, Boulder, CO, USA (Virginia Scott)
UCRC = University of California-Riverside Entomology Research Museum, Riverside, CA, USA (Doug Yanega)
UNAM = National Insect Collection at the Institute of Biology of Universidad Nacional Autónoma de México (Ricardo Ayala)
USNM = National Museum of Natural History, Smithsonian Institution, Washington D.C., United States (Seán Brady)
WRME = J.B. Wallis/R.E. Roughley Museum of Entomology, Winnipeg, Manitoba, Canada (Jason Gibbs)
ZMH = Zoological Museum Hamburg, University of Hamburg, Germany (Martin Husemann)
ZMHB = Museum für Naturkunde der Humboldt-Universität, Berlin, Germany (Michael Ohl)

The types of the following species were examined by PLG: *L.* (*D.*) *figueresi* Wcislo, 1990, *L.* (*D.*) *kraussi* Michener, 1954, *L.* (*D.*) *strigosigena* Michener, 1954, *L.* (*D.*) *verapaz* Engel, Hinojosa-Díaz & Yáñez-

Ordóñez, 2007, deposited at SEMC; *L.* (*D.*) *cyanorugosum* Engel, Hinojosa-Díaz & Yáñez-Ordóñez, 2007, *L.* (*D.*) *chryseis* (Smith, 1879), *L.* (*D.*) *exiguum* (Smith, 1879), *L.* (*D.*) *aspasia* (Smith, 1879), *L.* (*D.*) *aurora* (Smith, 1879) deposited at NHMUK; *L.* (*D.*) *oaxacacola* Engel, Hinojosa-Díaz & Yáñez-Ordóñez, 2007, deposited at LACM; *L.* (*D.*) *obscuripes* (Friese, 1917), *L.* (*D.*) *aeneiventre* (Friese, 1917), *L.* (*D.*) *aeneum* (Friese, 1917), *L.* (*D.*) *atrazureum* (Moure & Hurd, 1987) (nom. nov. for *Halictus cyanicollis* Friese, 1916), *L.* (*D.*) *chalybaeum* (Friese, 1917), *L.* (*D.*) *nigroaeneum* (Friese, 1917), *L.* (*D.*) *obscurior* (Friese, 1925), deposited at ZMHB; *L.* (*D.*) *biseptum* (Vachal, 1904), *L.* (*D.*) *cubitale* (Vachal, 1904), *L.* (*D.*) *sudum* (Vachal, 1904), and *L.* (*D.*) *terginum* (Vachal, 1904), deposited at MNHN.

The types of the following species which occur in the Neotropics or are closely related to known Yucatán species were examined by JG: *L.* (*D.*) *albuquerquense* (Michener, 1937) (= *L.* (*D.*) *stictaspis* (Sandhouse, 1923)), deposited in CAS; *L.* (*D.*) *umbripenne* (Ellis, 1913) deposited in UCMC; *L.* (*D.*) *perparvum* (Ellis, 1914), *L.* (*D.*) *pseudotegulare* (Cockerell, 1896), and *L.* (*D.*) *stictaspis* (Sandhouse, 1923), deposited in USNM.

Images of additional important type material, including *L.* (*D.*) *deceptor* (Ellis, 1914), *L.* (*D.*) *exiguum* (Smith, 1879), and *L.* (*D.*) *tropicior* (Ellis, 1914), were available from the USNM online database (https://collections.nmnh.si.edu/search/ento/) or the NHMUK online database (https://www.nhm.ac.uk/our-science/collections/entomology-collections.html).

Identification

Species were delimited using a procedure combining morphology and DNA barcoding, as described in Landaverde-González *et al.* (2017a). For morphology and analyses of wings and antennae, we used 9–16 (13.28 ± 2.71 SD) individuals per taxon, obtaining 42 morphological characters. The key to species and descriptions in Ellis (1914) were used in combination with images of holotypes to identify *L. deceptor*, *L. exiguum*, and *L. tropicior*.

Species descriptions follow the format used in recent papers by Gibbs (2010, 2011). Terminology for structures and surface sculpturing follows Engel (2001) and Michener (2007), for metapostnotum Gibbs (2010), for mesepisternum and mesonotum sculpturing Harris (1979), and that for the genital structures of the males we follow Eickwort (1969). The following abbreviations are used throughout (Michener 2007): interantennal (or interalveolar) distance (IAD), antennocular (or alveolocular) distance (AOD), median ocellar diameter (OD, used to give a relative measure of setal length), upper ocular distance (UOD), lower ocular distance (LOD), interocellar distance (IOD), the frontal line (FL), ratio of mesoscutellum and metapostnotum lengths (MMR), flagellomere length (F), metasomal sterna (S), metasomal terga (T), followed by the respective number. Puncture density is given in terms of the interspace (i) relative to puncture diameter (pd). Morphological examinations were made using an Olympus SZX7 microscope. Measurements were done using the program CellSens ver. 2.2, with the images taken with an Olympus DP21 camera and using a Leica SZX7 microscope ocular micrometre (Wetzlar, Germany). Length measurements of most body parts were taken along the medial axis. The length of the fore wing was measured from the distal-most point to the base and also from the distal landmark within the wing, including the humeral convexity as done by Gibbs (2009a). Comparisons between eye and gena were made using the maximum width in lateral view. Body length was taken between the front of the head to the end of the metasoma. As the metasoma was generally curved, we measured it separately from the beginning of the first tergite to the end of the 6th tergite and added this to the head (measured from the antennal base regardless of orientation) + mesosoma length.

Head morphology

We analysed 35 female specimens belonging to six of the new species and one morphospecies in the *L. stictaspis* species complex (5 individuals per species) with scanning electron microscopy (SEM).

Males were not analyzed due to the more limited number of specimens and *L. paralepidii* Gardner sp. nov. was not analyzed because it was discovered late in the writing of the manuscript. Measurements of the head were made for the length of the frontal line (FL) and the width (w) and length (l) of the head (Fig. 1). Antennae were detached from the head and rinsed overnight in a commercial detergent; after dehydration in an ethanol and distilled water series of 50, 70, and 96% (v/v) to absolute ethanol for 30 min each, antennae were air-dried in a desiccator and mounted on stubs. Finally, the prepared antennae were stored in a desiccator overnight (modified from González-Vaquero & Galvani 2016). Antennae and diagnostic structures were coated with gold palladium and examined in a Hitachi tabletop-value scanning electron microscope (TM4000Plus) operated with the Hitachi TM4000 software (Ominami *et al.* 2018). We analysed the flagellum sensilla of the right antenna. To assess differences among females,

Fig. 1. Frontal view of the head of *Lasioglossum* (*Dialictus*) *yucatanense* Landaverde-González sp. nov., holotype, ♀ (UNAM). The measurements taken for the head were length (l), excluding labrum, and mandible and width (w) of the face, as well as the length of the frontal line (FL) as the distance from the end of the supraclypeal area to below the median ocellus.

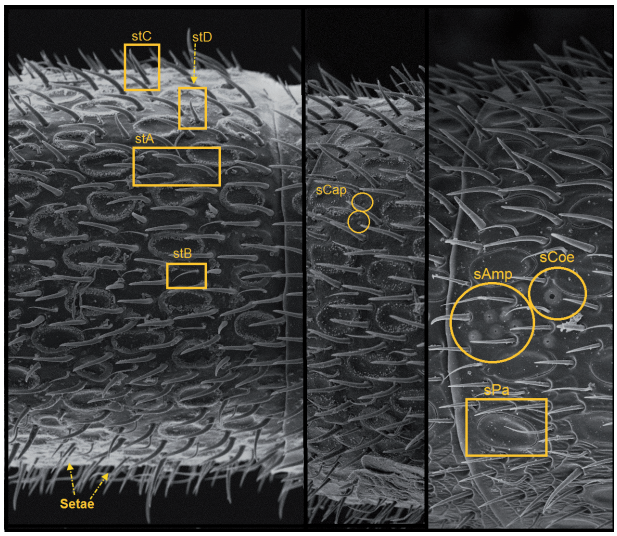

Fig. 2. Antennal sensilla in dorsal view of F10 of a female of *Lasioglossum* (*Dialictus*) Robertson, 1902. Abreviations: sAmp = sensilla ampullacea; sCap = sensilla coelocapitular; sCoe = sensilla coeloconica; sPa = sensila placoidea; stA = sensilla trichodea type A; stB = sensilla trichodea type B; stC = sensilla trichodea type C; stD = sensilla trichodea type D. Magnification is 875 ×.

we calculated the density of sensilla and setae on the ventral side of the distal F9, counting the units inside an area as defined in Galvani *et al.* (2008). Measurements were taken for the density of different sensilla: sensilla trichodea type A (*stA*), sensilla trichodea type B (*stB*), sensilla trichodea type C (*stC*), sensilla trichodea type D (*stD*), sensila placoidea (*sPa*), sensilla coeloconica (*sCoe*), sensilla ampullacea (*sAmp*), sensilla basiconica (sBa), sensilla coelocapitular (sCap) and setae (Fig. 2). The shape of the sPa was also analyzed using tpsDig2 ver. 2.17 (Rohlf 2013); comparisons were performed after Procrustes transformation (Bookstein 1991) and the mean configuration of the antennae from each taxon was used as a comparative parameter.

Genitalia

The male genital capsule and hidden sterna were dissected and cleared by immersion in a solution of 10% potassium hydroxide for 20 min before observation (González-Vaquero & Galvani 2016). Genital dissections were done for ten male specimens, for only four of the species (for the others no males were available or the genitalia could not be seen). For clarity, drawings of the images were made in collaboration with Natalia Escobedo-Kenefic from CANG, Guatemala, in which the penis valve, retrorse lobe of the genital capsule, gonostylus and gonobase are highlighted.

Geometric morphometric analysis of wings

The right fore wings of 155 female bees with a mean of 22 ± 3 SD (range = 17–26) individuals for six of the seven species plus specimens in the *L. stictaspis* complex, were mounted between microscope slides and photographed with an Olympus DP21 digital camera, attached to an Olympus SZX7 microscope, using the software CellSens Standard ver. 1.6 (Olympus 2011). *Lasioglossum paralepidii* sp. nov. was again not included due to its late discovery. We placed 20 homologous landmarks in the wing vein intersections (Fig. 3) using the software tpsDig2 ver. 2.17 (Rohlf 2013). The images were Procrustes aligned (Bookstein 1991) and the mean landmark coordinates averaged across all specimens from each taxon were used as a comparative parameter; the analysis was performed at the species level. A principal component analysis (PCA) was carried out using the relative Cartesian coordinates of each landmark after alignment (Dardón *et al.* 2020). A forward stepwise analysis (tolerance 0.01; F to enter 1.00) using the same measurements was carried out to determine discriminant functions, followed by a canonical analysis and a cross-validation test to check the accuracy of the equations in identifying species. The analyses were performed with MorphoJ ver. 1.06b (Klingenberg 2011). We delimited the taxa according to the previous results of COI analysis (see Landaverde-González *et al.* 2017a). Additionally, to evaluate the previous delimitation of the species, a partitioning around medioids (PAM) algorithm was used, which searches for k representative objects in a data set (k medoids) and then assigns each object to the

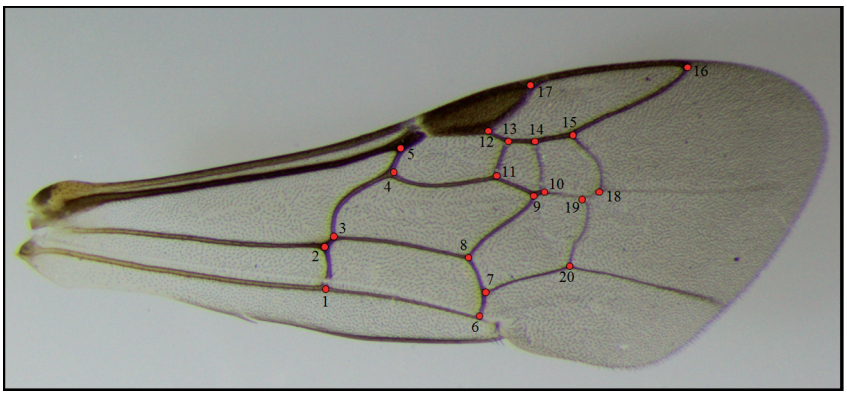

Fig. 3. Wing of *L.* (*Dialictus*) *milpa* Landaverde-González sp. nov. with 20 landmarks in the wing vein intersections that were used for morphometric analysis of the wings of seven species.

closest medoid to create clusters. For this we use Euclidean distances and the cluster package ver. 2.1.3 (Maechler *et al*. 2022) in R ver. 4.1.2. (R Core Team 2021).

Image capture

Some images of the different species of bees, as well as the wings and genitalia were captured using a Canon EOS 5D Mark III camera, edited and saved in TIFF format with the software Capture One© (Phase One, Copenhagen) and stacked with the algorithm PMax with Zerene Systems (Zerene Systems, Richland, WA); a scale bar was added with Photoshop ver. 6.0 (Adobe, San Jose, CA). The remaining images were generated with a Canon EOS 7D camera with an MPE-65 lens (Canon, Ōta, Tokyo, Japan) and StackShot system (Cognisys Inc., Traverse City, MI), and stacked in Helicon Focus software (Helicon Soft Ltd., Kharkiv, Ukraine).

Results

In this study, we describe seven new species of *Lasioglossum* (*Dialictus*) from the Yucatán Peninsula, which were previously delimited by Landaverde-González *et al.* (2017a). In addition to previous data, we include additional morphological characters for a better definition of the new species. We also confirm three previously described species from the Yucatán Peninsula: *L. deceptor* (Ellis, 1914), *L. exiguum* (Smith, 1879), and *L. tropicior* (Ellis, 1914). Added to *L. meteorum* Gardner & Gibbs, 2020, described from Yucatán State, a total of 11 species of *L.* (*Dialictus*) are now known from the Yucatán Peninsula. Five of these species are only known from the Yucatán Peninsula and may be endemic to the region.

Relationship with other species of Lasioglossum

Morphological and molecular results both indicate that all seven new species either belong to the *Lasioglossum gemmatum* species complex (which includes the *L. tegulare* group revised by Gibbs (2009a)) or the informal *L. comulum* species group, which is closely related. A revision of the *L. gemmatum* complex in the western Nearctic region by JG is currently in press. This is a large and diverse species complex including some difficult sub-complexes that continue to present major taxonomic barriers. One morphospecies from Yucatán belongs to such a sub-complex (the *L. stictaspis* species complex) and could not be confidently delimited at this time, although it is distinct from other Yucatán species and is included in the keys to species. Further revision may enable its description.

Damaged and excluded specimens

Unfortunately, the specimens from Landaverde-González *et al*. (2017a) were very damaged. Additional damage was accrued during a shipment of holotype candidates from PLG to JG (necessitating new specimens to be chosen as holotypes for all but two species).

Specimens that were sufficiently damaged to cast doubt on their identifications are included as ‘other material’ examined and explicitly excluded from paratype status. Furthermore, when examining other material from the region, in a few cases there were specimens that appeared to match our new species morphologically, but were collected from improbably distant locations. These geographic outliers are also excluded from paratype status on the grounds that further research might determine them to be separate, cryptic species.

High genetic variation was also observed in the Yucatán specimens. One reason may be due to poor sequencing quality, and not numts, because in several cases the Yucatán barcodes were placed in the same barcode index numbers (BINs; Ratnasingham & Hebert 2013) as independently barcoded, morphologically similar specimens which matched our expectations of where DNA barcodes of these species would likely cluster. Additionally, the translation of the genetic sequence was checked and they were correctly translated. The number of mOTUs also matched the number of morphospecies. Numts, in

contrast, are expected to artificially inflate the number of mOTUs with unexpected clustering (Françoso *et al*. 2019).

Morphometric analysis of wing shape

Analyses of morphometric landmarks placed on the wings did not reveal a clear pattern of differentiation between the shapes of cells for the different taxa. The canonical variate analysis (CVA) grouped all mOTUs together (Fig. 4A), a pattern also supported by ANOVA, which detected no significant differences between the taxa (F = 0.0054, $P < 0.997$). Hence, landmark data of the wings did not provide any resolution to distinguish among the mOTUs of *Lasioglossum* (*Dialictus*) (Fig. 4A). In addition, the partitioning around medioids (PAM) analysis showed that the number of clusters with the greatest support was four with an average silhouette width of 0.56 which was the highest among the different numbers of clusters analysed. However, it was not observed that the taxa could be grouped into clusters containing defined groups using wing landmarks, supporting that these characters are not useful to distinguish close species of *L*. (*Dialictus*) in Yucatán (Fig. 4B).

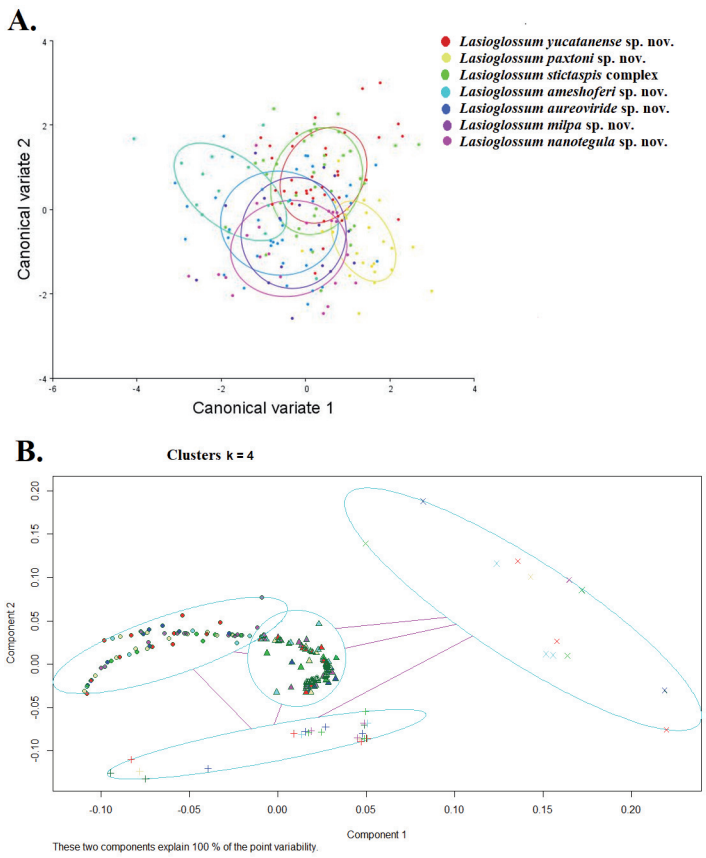

Fig. 4. We used 20 landmarks on the wings of 155 female bees (mean per species = 22.14 ± 3.27 SD). These measurements were used for the two following analysis: **A**. Scatter plots of the canonical variate analysis (CVA) of the wing landmarks of seven *Lasioglossum* (*Dialictus*) Robertson, 1902 bee species. No differentiation between the seven species was observed (P < 0.997). The scores of the first canonical variable (CV1 = 37.87%) are on the x–axis and the scores for the second canonical variable (CV2 = 22.56%) are on the y–axis. The ellipses with 85% confidence region represent the limits of each taxon. **B**. Cluster centroids using K-Medoids with the PAM algorithm of the wing landmark of seven *Lasioglossum* (*Dialictus*) bee species. The cluster with the highest silhouette width (0.56) was of four.

Antenna sensilla

With the goal of finding characters that allow differentiation of the new species of *Lasioglossum* (*Dialictus*), the different sensilla on the antenna of females from these taxa were examined. Sensilla variation has been found to be useful for discrimination of parasitic bees (Wcislo 1995; Galvani *et al.* 2016). The following types of sensilla are recognized in species of *Lasioglosum* (*Dialictus*): *stA*, *stB*, *stC*, *stD*, *sPa*, *sCoe*, *sAmp*, *Scap value* and setae (Fig. 2). The only type of sensilla not found in the subgenus *Dialictus* was the sensilla basiconica (*sBa*). In our analyses we did not find any significant differences among the species according to the density in six of the nine different sensilla types on the ventral surface of F9 (*stA*, *stB*, *stC*, *sPa*, *sAmp value* and setae; Mann-Whitney test with Benjamini and Hochberg's false discovery rate correction P > 0.1; Supp. file 1: Table S2). However, we found differences in the density of three sensilla types: Mann-Whitney test after Benjamini and Hochberg's false discovery rate correction for *stD* between *L.* (*D.*) *yucatanense* Landaverde-González sp. nov. and *L.* (*D.*) *nanotegula* Landaverde-González & Husemann sp. nov. (P < 0.01), for *sCoe* between *L.* (*D.*) *yucatanense* and *L.* (*D.*) *aureoviride* Landaverde-González & Husemann sp. nov. (P < 0.01) and between *L.* (*D.*) *yucatanense* and *L.* (*D.*) *nanotegula* (P < 0.01), for *sCap* between *L.* (*D.*) *ameshoferi* Landaverde-González sp. nov. and *L.* (*D.*) *milpa* Landaverde-González sp. nov. (P < 0.01) and *L.* (*D.*) *nanotegula* **(**P < 0.02), between *L.* (*D.*) *ameshoferi* and *L.* (*D.*) *milpa* (P < 0.01), and between *L.* (*D.*) *ameshoferi* and *L.* (*D.*) *nanotegula* **(**P < 0.01). Additionally, we did not find significant differences between the shapes of the *sPa* between the species (F= 1.12, –P = 0.30).

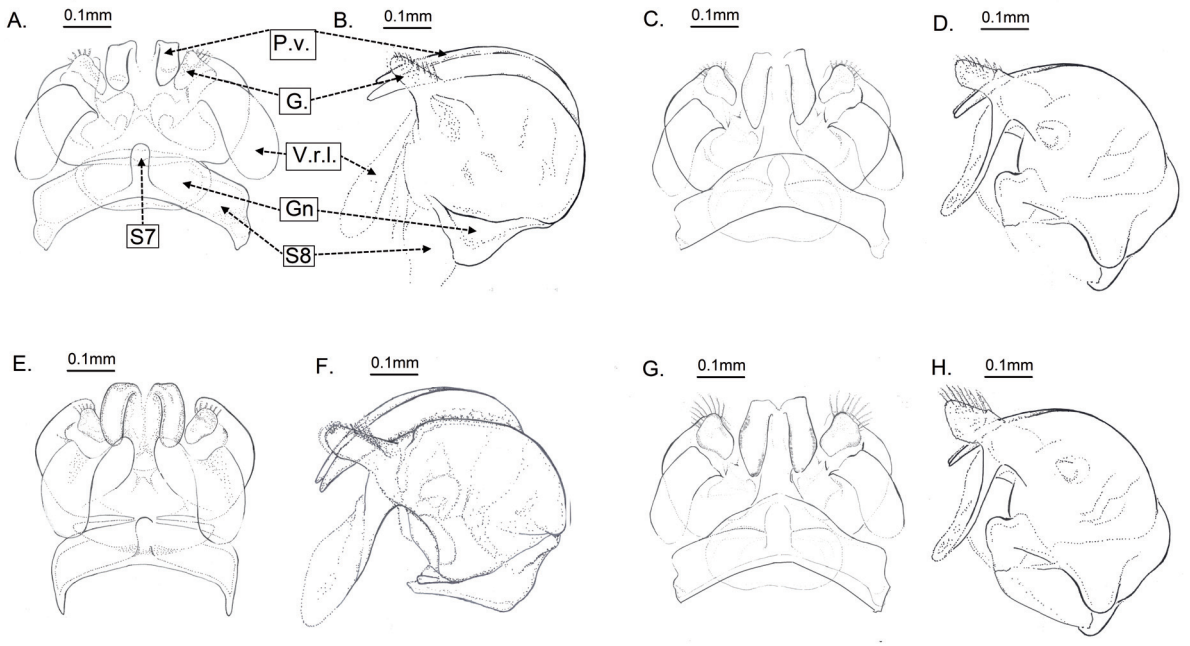

Fig. 5. Line drawings of male genitalia of species of *Lasioglossum* (*Dialictus*) Robertson, 1902. **A, C, E, G**. Ventral view. **B, D, F, H**. Lateral view. **A–B**. *L.* (*Dialictus*) *yucatanense* Landaverde-González sp. nov. **C–D**. *L.* (*Dialictus*) *paxtoni* Landaverde-González sp. nov. **E–F**. *L.* (*Dialictus*) *aureoviride* Landaverde-González & Husemann sp. nov. **G–H**. *L.* (*Dialictus*) *ameshoferi* Landaverde-González sp. nov. Abreviations: G. = gonostylus; P.v. = penis valve; Gn. = gonobase; V.r.l. = ventral retrorse lobe. Drawings made by Natalia Escobedo-Kenefic.

Genitalia

Genitalia were only available for four of the seven taxa (*L.* (*D.*) *yucatanense* sp. nov., *L.* (*D.*) *paxtoni* Landaverde-González sp. nov., *L.* (*D.*) *aureoviride* sp. nov., and *L.* (*D.*) *ameshoferi* sp. nov.). In these taxa, we detected some differences: *L.* (*D.*) *yucatanense* had the retrorse lobe of the genital capsule larger and wider (47.92 µm; Fig. 5A–B) compared to *L.* (*D.*) *paxtoni* (21.7 µm; Fig. 5C–D) and *L.* (*D.*) *ameshoferi* (28.21 µm; Fig. 5G–H), which had a small ventral retrorse lobe; *L.* (*D.*) *aureoviride* (68.40 µm; Fig. 5E–F) had an enlarged and wider ventral retorse lobe. The S7 median process is narrower in *L.* (*D.*) *paxtoni* and *L.* (*D.*) *aureoviride* compared to *L.* (*D.*) *yucatanense*, but the same is wide in *L.* (*D.*) *ameshoferi*. The S8 median process is wide in *L.* (*D.*) *paxtoni* and *L.* (*D.*) *ameshoferi*, while in *L.* (*D.*) *yucatanense* and *L.* (*D.*) *aureoviride* it is narrow and not larger than the S7 median process. In lateral view, the genital capsules of *L.* (*D.*) *yucatanense*, *L.* (*D.*) *paxtoni* and *L.* (*D.*) *ameshoferi* have a rather small and delicate penis valve, while *L.* (*D.*) *aureoviride* has a long and wide penis valve. *Lasioglossum* (*D.*) *yucatanense* has a narrow gonostylus with a few short and simple setae near the apex, while *L.* (*D.*) *ameshoferi* has a wider and rounded gonostylus and numerous simple setae near the apex.

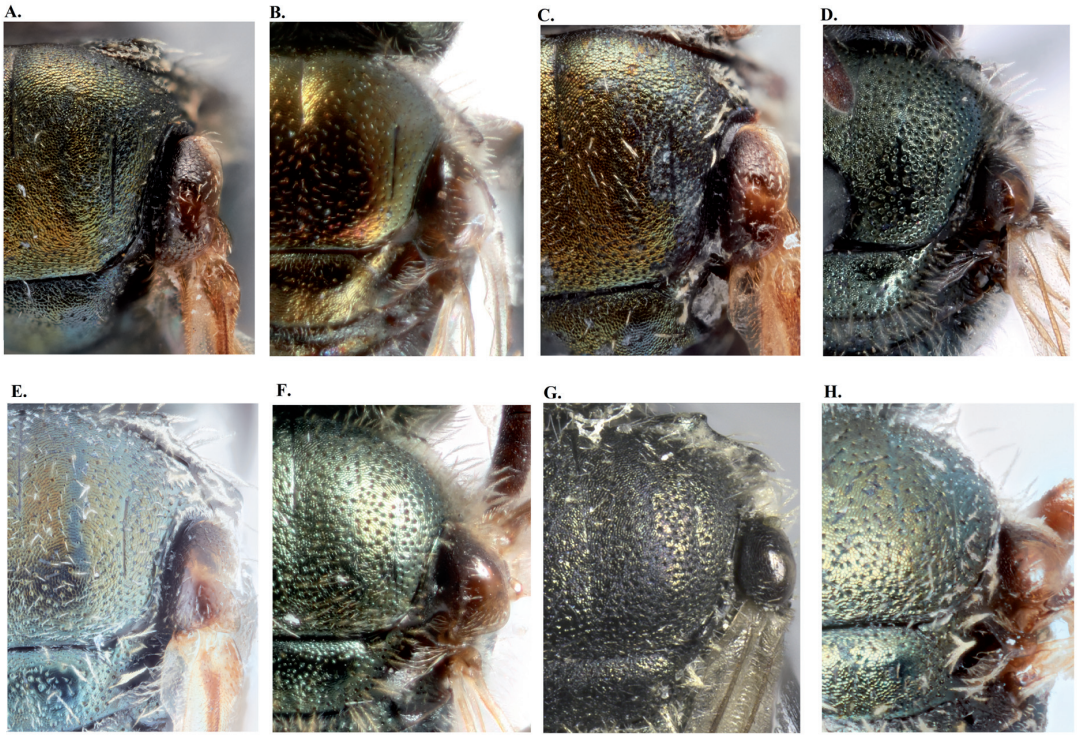

Fig. 6. Images of tegula form and punctation in species of *Lasioglossum* (*Dialictus*) Robertson, 1902. **A**. *L.* (*Dialictus*) *yucatanense* Landaverde-González sp. nov. **B**. *L.* (*Dialictus*) *paxtoni* Landaverde-González sp. nov. **C**. Specimen of the *Lasioglossum stictaspis* species complex. **D**. *L.* (*Dialictus*) *ameshoferi* Landaverde-González sp. nov. **E**. *L.* (*Dialictus*) *aureoviride* Landaverde-González & Husemann sp. nov. **F**. *L.* (*Dialictus*) *paralepidii* Gardner sp. nov. **G**. *L.* (*Dialictus*) *milpa* Landaverde-González sp. nov. **H**. *L.* (*Dialictus*) *nanotegula* Landaverde-González & Husemann sp. nov.

Taxonomy

Class Insecta Linnaeus, 1758
Order Hymenoptera Linnaeus, 1758
Family Halictidae Thomson, 1869
Tribe Halictini Thomson, 1869
Genus *Lasioglossum* Curtis, 1833

Subgenus ***Dialictus*** Robertson, 1902

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

Lasioglossum (*Dialictus*) – sensu Gibbs (2018b).

Diagnosis

Lasioglossum (*Dialictus*) are small bees (body length 3.1–8.1 mm) whose diagnosis on a global scale is somewhat problematic due to known exceptions to diagnostic characters. But on a regional scale, *L.* (*Dialictus*) can be reliably diagnosed from other Halictidae occurring on the Yucatán Peninsula by the combination of head and mesosoma dark (not brilliant) metallic blue, green, or golden, sometimes with red-brassy reflections; metasoma black, brown, or red; second and third fore wing submarginal cross-veins weakened in the female; T1 with well-developed setose fan in the female; inner metatibial spur of the female pectinate; and male clypeus apical margin black (not yellow).

Lasioglossum* (*Dialictus*) *yucatanense Landaverde-González sp. nov.
urn:lsid:zoobank.org:act: F9897B79-0567-4EAB-802A-1E0C1B4D65E1
Figs 1, 5A–B, 6A, 7–8, 30B, 36A

Diagnosis

Females of *L. yucatanense* sp. nov. can be recognized by the vertex and mesoscutum having very short, sparse pubescence, as if shaved (most noticeable in lateral view where most setae are separated by half or more their length); mesosoma entirely dulled by strong microsculpture; mesoscutum usually densely punctate laterad of parapsidal lines (i < 1 pd) and sometimes partially shiny (especially posteromedially); mesepisternum strongly imbricate to finely rugulose with indistinct punctures at least in dorsal portion; tegula enlarged (reaching posterior margin of mesoscutum in dorsal view; tegula width/ITS > 0.23) and distinctly, densely punctate on lateral margins (i < 1 pd), becoming more sparsely punctate medially (i ≥ 1 pd), sometimes densely punctate medially (i < 1 pd); metapostnotum with fine rugae extending onto propodeum dorsolateral slope; discs of T1–T2 with very fine, minute punctures, often hardly visible; and T2 and usually T3 apical impressed areas glabrous and impunctate. Males can be recognized by the same characters as females, except that the mesepisternum is shiny and distinctly and densely punctate (i < 1 pd).

Differential diagnosis

Both sexes of *L. yucatanense* sp. nov. are most similar to *Lasioglossum paxtoni* sp. nov. and *L. aureoviride* sp. nov. and some members of the *L. stictaspis* species complex in the Yucatán Peninsula. They are also similar to the Nearctic species *L. perparvum*, which does not co-occur with *L. yucatanense*, and some undescribed species related to *L. perparvum* which may co-occur with *L. yucatanense* at the limits of its range. Both sexes of *L. paxtoni* have the tegula more finely and sparsely, sometimes inconspicuously punctate (i = 1–2 pd on lateral margins), mesonotum and mesoscutum shiny, mesoscutum finely and sparsely punctate (i = 1–3 pd) becoming slightly denser laterad of parapsidal lines (i = 1–2 pd); females

also have the mesepisternum shiny, granular and finely, moderately densely punctate. *Lasioglossum aureoviride* females have the mesoscutum weakly tessellate and sparsely punctate between parapsidal lines (i = 1–3 pd), T2–T3 apical impressed areas evenly covered with minute punctures and fine setae, head and mesosoma metallic dark turquoise-green with golden reflections on mesoscutum, and mesepisternum very densely punctate (i < 0.5 pd). Both sexes of the *L. stictaspis* species complex have the mesoscutum with longer and denser pubescence (in lateral view all setae separated by less than half their length); females also have the mesepisternum usually imbricate and deeply, moderately densely punctate (i ≤ 1.5 pd) with distinct interspaces and T2–T3 apical impressed areas usually with minute punctures or setae; males also usually have the mesepisternum more sparsely punctate (i = 1–2 pd). Females of *L. perparvum* have the mesepisternum distinctly punctate and T2–T3 apical impressed areas with minute punctures; males have T1–T2 with deep and distinct punctures often extending across premarginal line onto apical rim. Other undescribed species may have the tegula much larger (exceeding posterior margin of mesoscutum in dorsal view) and/or entirely densely punctate (i < 1 pd); propodeum dorsolateral slope smooth without metapostnotal rugae; and/or mesepisternum shiny and distinctly punctate.

Etymology

The specific epithet refers to the Yucatán Peninsula region, Mexico where the species was discovered. The name was proposed by Manfred Stark who won a photo competition to name a species of bee at an event at the ZMH.

Type material

Holotype

MEXICO – **Yucatán** • ♀; Nenela; [20.3364° N, 89.022° W]; 25 Oct. 2011; Quezada-Euán and Moo-Valle leg.; original label 435.2; UNAM.

Paratypes

GUATEMALA – **Huehuetenango** • 1 ♀; Jacaltenango; 15.7167° N, 91.7455° W; elev. 1027 m; 28 Feb. 2010; César López leg.; ECOAB.43352 • 1 ♀; La Democracia, Calauté; 15.571° N, 91.8496° W; elev. 915 m; 27 Apr. 2010; Jorge Mérida leg.; ECOAB.43257 • 1 ♀; La Democracia, Camojaíto; 15.616° N, 91.8727° W; elev. 940 m; 1 Mar. 2010; Philippe Sagot leg.; ECOAB.43199.

MEXICO – **Campeche** • 1 ♂; Hopelchén; 19.58° N, 89.77° W; elev. 110 m; 25 Jan. 2016; Jesús López leg.; ECOAB.82805. – **Chiapas** • 1 ♀; 3 km N of San Francisco Pujiltic, SW of Soyatitán; [16.3° N, 92.44° W]; elev. 710 m; 21 Apr. 1993; R.W. Brooks leg.; ex *Bidens bipontina*; SEMC SM0341500 • 2 ♀♀; 3 km S of Palenque, Nututún; [17.485° N, 91.975° W]; elev. 40 m; 25 Apr. 1993; R.W. Brooks leg.; ex *Bidens pilosa*; SEMC SM0341501, SM0341502 • 5 ♂♂; same collection data as for preceding; SEMC SM0341706 to SM0341710 • 2 ♀♀; 5 mi S of Pichucalco; 17.4369° N, 93.1019° W; elev. 2137–2286 m; 13 Sep. 1974; George E. Bohart and W.J. Hanson leg.; BBSL 1101064, 1101065 • 2 ♂♂; same collection data as for preceding; BBSL 1101060, 1101061 • 51 ♀♀; 52.9 km N of Ocosingo Shanil; [17.2167° N, 92.1° W]; elev. 320 m; 23 Apr. 1993; R.W. Brooks leg.; ex *Bidens*; SEMC • 43 ♂♂; same collection data as for preceding; SEMC • 4 ♀♀; 52.9 km N of Ocosingo Shanil, near Agua Azul; 17.2167° N, 92.1° W; elev. 320 m; 23 Apr. 1993; E. Tovar leg.; ex *Bidens pilosa*; SEMC SM0341611 to SM0341614 • 4 ♀♀; Bonampak; [16.71° N, 91.06° W]; 23–26 Sep. 1977; W.D. Edmonds leg.; SEMC • 2 ♀♀; Estación Biológica Chajul, near Chajul; [16.113° N, 90.941° W]; elev. 200 m; 15 Apr. 1993; R.W. Brooks leg.; ex *Oenothera* sp.; SEMC SM0341481, SM0341482 • 1 ♂; same collection data as for preceding; SEMC SM0341819 • 1 ♂; Ocosingo, El Rosario; 16.8859° N, 92.2742° W; elev. 1118 m; 15 Apr. 2010; Miguel Guzmán leg.; ECOAB.43132 • 1 ♂; Ocosingo, San Francisco; 16.9156° N, 92.0483° W; elev. 922 m; 11 Feb. 2010; Miguel Cigarroa leg.; ECOAB.43016 • 1 ♂; Ocozocoautla; 16.98° N, 93.54° W; elev. 985 m; 8 May 2016; Philippe Sagot leg.; ECOAB.66283 • 2 ♂♂; Palenque;

17.5083° N, 91.9815° W; 10 Sep. 1974; George E. Bohart and W.J. Hanson leg.; BBSL 1101051 (photographed), 1101057 • 1 ♀; San Juan Cancuc, Chijil; 16.947° N, 92.4087° W; elev. 1095 m; 8 Apr. 2010; Carlos Balboa leg.; ECOAB.43222 • 3 ♀♀; San Juan Cancuc, Tzuluwitz; 16.894° N, 92.4019° W; elev. 1270 m; 5 May 2009; Jorge Mérida, César López and T. López leg.; ECOAB.42642, ECOAB.42651, ECOAB.42655 • 1 ♂; San Juan Cancuc, Tzumbal; 16.9394° N, 92.4434° W; elev. 1080 m; 6 Apr. 2010; Carlos Balboa leg.; ECOAB.42996 • 1 ♂; Socoltenango; 16.17° N, 92.37° W; elev. 609 m; 14 Jan. 2017; Philippe Sagot leg.; ECOAB.67384 • 1 ♂; Tzimol; 16.15° N, 92.32° W; elev. 617 m; 15 Jan. 2017; Philippe Sagot leg.; ECOAB.67480. – **Puebla** • 8 ♂♂; 3 km S of Venustiano Carranza; [20.48° N, 97.67° W]; 30 Apr. 1984; J.C. Schaffner leg.; TAMU-ENTO X1387389, X1395191, X1395942, X1395974, X1396008, X1396057, X1397280, X1397583 • 1 ♀; 3 mi SW of Cuetzalán (N of Zacapoaxtla); [19.99° N, 97.56° W]; elev. 1250 m; 19 Jun. 1961; University of Kansas Mexico Expedition leg.; SEMC • 1 ♀; 5 mi E of Huauchinango; [20.18° N, 97.98° W]; elev. 1250 m; 25 Jun. 1953; University of Kansas Mexico Expedition leg.; SEMC • 3 ♂♂; same collection data as for preceding; SEMC • 2 ♀♀; N of Cuetzalan; 20.1042° N, 97.489° W; elev. 160 m; 4 Jul. 2011; Jason J. Gibbs leg.; WRME. – **Quintana Roo** • 1 ♀; 12 km NW of Reforma; [18.89° N, 88.65° W]; 14 Oct. 1986; Charles D. Michener leg.; SEMC • 2 ♀♀; 49 km NE of Felipe Carrillo Puerto; [19.89° N, 87.71° W]; 11 Oct. 1986; Charles D. Michener leg.; SEMC • 3 ♂♂; Felipe Carrillo Puerto; 19.35° N, 88.03° W; 10–14 Oct. 1986; F.D. Parker leg.; BBSL 1100926, 1100927, 1100931 • 2 ♀♀; same collection data as for preceding; 10–14 Oct. 1986; BBSL 1100919, 1100932 • 4 ♀♀; Reforma; [18.81° N, 88.57° W]; 14 Oct. 1986; Charles D. Michener leg.; SEMC • 14 ♂♂; Xcan; [20.87° N, 87.6° W]; 31 Jul. 1962; A.B. Amerson Jr. leg.; SEMC. – **San Luis Potosi** • 1 ♀; 12 km NW of El Naranjo; [22.59° N, 99.38° W]; elev. 400 m; 5 Jul. 1990; Robert L. Minckley leg.; SEMC • 1 ♀; 2 mi NE of El Salto falls; [22.61° N, 99.36° W]; 21 Jul. 1962; Ellen Ordway Roberts leg.; ex *Helenium* sp.; SEMC • 8 ♀♀; 20 mi NE of Ciudad del Maíz; [22.61° N, 99.38° W]; elev. 914 m; 19 Jun. 1953; University of Kansas Mexico Expedition leg.; SEMC • 8 ♀♀; 3.4 mi NE of El Naranjo; [22.56° N, 99.3° W]; elev. 244 m; 5 Sep. 1962; University of Kansas Mexico Expedition leg.; SEMC • 6 ♂♂; same collection data as for preceding; SEMC • 2 ♀♀; 30 mi NE of Ciudad del Maíz; [22.7° N, 99.27° W]; elev. 396 m; 19 Jun. 1953; University of Kansas Mexico Expedition leg.; SEMC • 1 ♀; 9 mi S of Ciudad Valles; [21.9° N, 98.92° W]; elev. 183 m; 2 Sep. 1962; University of Kansas Mexico Expedition leg.; SEMC • 2 ♀♀; El Meco (near El Salto Falls); [22.57° N, 99.35° W]; elev. 350 m; 5 Jul. 1990; Ilan Yarom leg.; SEMC • 25 ♀♀; El Salto; [22.59° N, 99.38° W]; elev. 549 m; 8 Jun. 1961; University of Kansas Mexico Expedition leg.; ex *Kallstroemia hirsutissima*; SEMC • 13 ♀♀; same collection data as for preceding; SEMC • 1 ♂; same collection data as for preceding; SEMC • 3 ♂♂; same collection data as for preceding; SEMC • 1 ♀; El Salto Falls; [22.59° N, 99.38° W]; elev. 400 m; 4 Jul. 1990; Ilan Yarom leg.; SEMC • 1 ♂; same collection data as for preceding; 5 Jul. 1990; SEMC • 1 ♀; Pujal; [21.85° N, 98.94° W]; 20 Jun. 1953; University of Kansas Mexico Expedition leg.; SEMC • 1 ♀; Tamazunchale; [21.26° N, 98.79° W]; 18 Jun. 1937; SEMC • 2 ♀♀; Xilitla; [21.385° N, 98.975° W]; elev. 442 m; 23 Jul. 1954; University of Kansas Mexico Expedition leg.; SEMC • 4 ♂♂; same collection data as for preceding; SEMC. – **Tabasco** • 1 ♀; 2 mi SW of Frontera; [18.51° N, 92.67° W]; 7 Sep. 1968; Veryl V. Board leg.; TAMU-ENTO X1313226 • 1 ♂; same collection data as for preceding; TAMU-ENTO X1313330 • 1 ♂; Villahermosa; [17.99° N, 92.95° W]; Oct. 1954; N.L.H. Krauss leg.; SEMC. – **Tamaulipas** • 1 ♀; 10 km W of Antiguo Morelos, Highway 80; [22.555° N, 99.167° W]; elev. 470 m; 6 Jul. 1990; Ilan Yarom leg.; SEMC • 1 ♂; 6 mi W of Gómez Farías; [22.89° N, 99.12° W]; 5 Jul. 1986; J.C. Schaffner and Kovarik leg.; TAMU-ENTO X1413144 • 1 ♀; El Limón; [22.82° N, 99.01° W]; 17 Jun. 1953; University of Kansas Mexico Expedition leg.; SEMC • 2 ♂♂; same collection data as for preceding; SEMC • 3 ♀♀; Gómez Farías; 23.0475° N, 99.1556° W; 14 Feb. 2001; Douglas Yanega leg.; UCRC ENT 49797 to ENT 49799 • 5 ♀♀; Padilla; [24.05° N, 98.9° W]; 15 Jun. 1953; University of Kansas Mexico Expedition leg.; SEMC • 1 ♂; same collection data as for preceding; SEMC • 1 ♀; W of Gómez Farías; [23.03° N, 99.16° W]; 15 Nov. 1985; P.W. Kovarik, Jones and Haack leg.; TAMU-ENTO X1414798. – **Veracruz** • 5 ♀♀; 12 mi NW of San Andrés Tuxtla; [18.56° N, 95.32° W]; elev. 335 m; 24 Jun. 1961; University of Kansas Mexico Expedition

leg.; SEMC • 1 ♀; 15 mi W of Tlapacoyan; 19.8232° N, 97.2246° W; 28 Feb. 1972; F.D. Parker and D. Miller leg.; BBSL 1101047 • 1 ♀; 15 mi W of Veracruz; [19.17° N, 96.36° W]; elev. 15 m; 30 Jun. 1953; University of Kansas Mexico Expedition leg.; SEMC • 4 ♀♀; 17 mi NW of San Andrés Tuxtla; [18.545° N, 95.39° W]; elev. 274 m; 24 Jun. 1961; University of Kansas Mexico Expedition leg.; SEMC • 1 ♂; same collection data as for preceding; SEMC • 2 ♀♀; 2 mi N of Jesús Carranza (Isthmus of Tehuantepec); [17.47° N, 95.03° W]; elev. 46 m; 25 Jun. 1961; University of Kansas Mexico Expedition leg.; SEMC • 2 ♀♀; 3 mi SW of Paso del Toro; [19° N, 96.17° W]; elev. 15 m; 23 Jun. 1961; University of Kansas Mexico Expedition leg.; ex *Porophyllum*; SEMC • 2 ♀♀; same collection data as for preceding; SEMC • 1 ♀; 32 km N of Catemaco, UNAM Preserve; [18.58° N, 95.07° W]; 4 Jan. 1982; John W. Wenzel leg.; SEMC • 1 ♀; same collection data as for preceding; 9 Jan. 1982; E.M. May leg.; SEMC • 4 ♀♀; 34 km SE of Catemaco, 1 km along road to Montepio; [18.21° N, 94.88° W]; 3 Jan. 1982; B.H. Smith leg.; SEMC • 4 ♀♀; 4 mi W of Puente Nacional; [19.32° N, 96.55° W]; elev. 274 m; 22 Jun. 1961; University of Kansas Mexico Expedition leg.; ex *Kallstroemia hirsutissima*; SEMC • 1 ♂; 5 mi SW of Tlapacoyan; [19.91° N, 97.27° W]; elev. 853 m; 26 Jun. 1953; University of Kansas Mexico Expedition leg.; SEMC • 3 ♂♂; 7 mi NW of Alazán, near Tuxpan; [21.16° N, 97.81° W]; 11 Jun. 1961; University of Kansas Mexico Expedition leg.; ex *Lippia* sp.; SEMC • 2 ♂♂; Alazán; 21.0917° N, 97.7255° W; 27 Feb. 1972; F.D. Parker and D. Miller leg.; BBSL 1101044, 1101045 • 1 ♀; Balzapote, NE of Estación Los Tuxtlas; [18.62° N, 95.07° W]; 17 Sep. 1987; A.L. Norrbom leg.; USNM • 1 ♀; Boca del Río; [19.11° N, 96.11° W]; elev. 8 m; 23 Jun. 1961; University of Kansas Mexico Expedition leg.; ex *Acacia*; SEMC • 1 ♀; Huatusco; 19.1734° N, 96.9724° W; 11 Jan. 2007; Sam W. Droege leg.; PCYU USGS-DRO 074912 • 1 ♂; Veracruz; [19° N, 96° W]; 1959; N.L.H. Krauss leg.; USNM. – **Yucatán** • 1 ♀; 6 km E of Uxmal; [20.36° N, 89.71° W]; 6 Apr. 1997; R.W. Brooks leg.; ex *Vitex gaumeri*; SEMC SM0105999 • 1 ♂; Xmatkuil, 15 km S of Mérida; [20.86° N, 89.62° W]; 13 Feb. 1987; Charles D. Michener leg.; SEMC • 1 ♀; Chichén-Itzá; [20.68° N, 88.57° W]; 11 Jan. 1976; L. Greenberg leg.; SEMC • 1 ♂; same collection data as for preceding; SEMC • 2 ♂♂; Chichén-Itzá ruins (near Piste); [20.68° N, 88.57° W]; 15 Feb. 1987; Charles D. Michener leg.; SEMC • 2 ♀♀; Kabah, 25 km SW of Ticul; [20.25° N, 89.65° W]; 14 Feb. 1987; Charles D. Michener leg.; SEMC • 4 ♂♂; same collection data as for preceding; SEMC • 2 ♂♂; San Simón Pueblo; 20.2159° N, 89.8098° W; 22 Jan. 1981; George E. Bohart leg.; BBSL 1101107, 1101108 • 1 ♀; Timul; 20.3156° N, 88.9322° W; 9 Jun. 2011; José J.G. Quezada-Euán and Humberto Moo-Valle leg.; original label 300C2; ZMH 842012 • 1 ♀; same collection data as for preceding; original label 300d; ZMH 842013.

Other material examined

MEXICO – **Guerrero** • 1 ♀; Acapulco; [16.9° N, 99.9° W]; Baker leg.; USNM. – **Jalisco** • 1 ♀; Careyes; 19.4289° N, 105.0274° W; 12 Feb.–19 Mar. 1997; F.D. Parker leg.; BBSL 1100768. – **Yucatán** • 1 ♀; Nenela; [20°20′10.90″ N, 89°1′19.20″ W]; 25 Oct. 2011; Quezada-Euán and Moo-Valle leg.; original label 344a; ZMH 842014 • 1 ♀; Yaxcopil; [20°4′4.10″ N, 88°54′23.80″ W]; 25 Oct. 2011; Quezada-Euán and Moo-Valle leg.; original label 602C; ZMH 81028 • 1 ♂; Nenela; [20°20′10.90″ N, 89°01′19.20″ W]; 25 Oct. 2011; Quezada-Euán and Moo-Valle leg.; original label 68a; ZMH 81027 • 1 ♀; Timul; [20°18′56.1″ N, 88°55′55.9″ W]; 9 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 300a; ZMH 839500 • 1 ♀; Nenela; [20°15′10.0″ N, 89°05′24.5″ W]; 25 Oct. 2011; Quezada-Euán and Moo-Valle leg.; original label 65a1; ZMH 842000 • 1 ♀; Nenela; [20°15′10.0″ N, 89°05′24.5″ W]; 25 Oct. 2011; Quezada-Euán and Moo-Valle leg.; original label 65a2; ZMH 842001 • 1 ♀; Nenela; [20°15′10.0″ N, 89°05′24.5″ W]; 25 Oct. 2011; Quezada-Euán and Moo-Valle leg.; original label 68c; ZMH 842002 • 1 ♀; Alfonso Caso; [20°05′02.5″ N, 89°09′39.3″ W]; 25 Oct. 2011; Quezada-Euán and Moo-Valle leg.; original label 77; ZMH 842003 • 1 ♀; Moctezuma; [21°24′46.2″ N, 87°42′05.7″ W]; 30 May 2011; Quezada-Euán and Moo-Valle leg.; original label 148; ZMH 842004 • 1 ♀; Moctezuma; [21°24′46.2″ N, 87°42′05.7″ W]; 30 May 2011; Quezada-Euán and Moo-Valle leg.; original label 153; ZMH 842005 • 1 ♀; San Pedro Bacab; [21°18′04.9″ N, 087°38′24.8″ W]; 31 May 2011; Quezada-Euán and Moo-Valle leg.; original label 169; ZMH 842006 • 1 ♀; San Pedro Bacab; [21°18′04.9″ N,

087°38′24.8″ W]; 31 May 2011; Quezada-Euán and Moo-Valle leg.; original label 173; ZMH 842007 • 1 ♀; Rancho Alegre; [21°18′26.7″ N, 87°46′29.6″ W]; 13 Aug. 2011; Quezada-Euán and Moo-Valle leg.; original label 213; ZMH 842008 • 1 ♀; same collection data as for preceding; original label 216; ZMH 842009 • 1 ♀; Tah Dziú; [20°10′06.9″ N, 88°55′36.2″ W]; 6 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 240a; ZMH 842010 • 1 ♀; Timul; [20°18′56.1″ N, 88°55′55.9″ W]; 9 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 299e; ZMH 842011 • 1 ♀; Tixcuytun; [20°12′21.80″ N, 89°09′17.50″ W]; 7 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 432.1; ZMH 842015 • 1 ♀; Tixcuytun; [20°12′21.80″ N, 89°09′17.50″ W]; 7 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 433a; ZMH 842016 • 1 ♀; Tixcuytun; [20°12′21.80″ N, 89°09′17.50″ W]; 7 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 433b; ZMH 842017 • 1 ♀; Tixcuytun; [20°12′21.80″ N, 89°09′17.50″ W]; 7 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 435; ZMH 842018 • 1 ♀; Tah Dziú; [20°10′06.9″ N, 88°55′36.2″ W]; 6 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 473; ZMH 842019 • 1 ♀; Tixcuytun; [20°12′21.80″ N, 89°09′17.50″ W]; 7 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 488a2; ZMH 842020 • 1 ♀; Muna; [20°28′15.7″ N, 89°46′53.5″ W]; 22 Jul. 2011; Quezada-Euán and Moo-Valle leg.; original label 569d; ZMH 842021 • 1 ♀; Santa María; [20°23′32.5″ N, 88°55′14.6″ W]; 26 Jul. 2011; Quezada-Euán and Moo-Valle leg.; original label 587f; ZMH 842022 • 1 ♀; same collection data as for preceding; original label 590a; ZMH 842023 • 1 ♀; Yaxcopil; [20°4′4.10″ N, 88°54′23.80″ W]; 1 Aug. 2011; Quezada-Euán and Moo-Valle leg.; original label 603a; ZMH 842024 • 1 ♀; Timul; [20°18′56.1″ N, 88°55′55.9″ W]; 9 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 300d; ZMH 842013.

Floral records

ASTERACEAE Giseke: *Bidens* L.: *B. bipontina* Sherff • *B. pilosa* L. • *Helenium* L.• *Porophyllum* Guett. • FABACEAE Juss.: *Acacia* Mill.• LAMIACEAE Martinov: *Vitex* L.: *V. gaumeri* Greenm. • ONAGRACEAE Juss.: *Oenothera* L. • SOLANACEAE Adans.: *Capsicum* L.: *C. chinense* Jacq. • VERBENACEAE J. St.-Hil.: *Lippia* L. • ZYGOPHYLLACEAE R. Br.: *Kallstroemia* Scop.: *K. hirsutissima* Vail.

DNA barcodes

Thirty sequences available, two haplotypes (BOLD process IDs: LDSPS002-15 to LDSPS008-15, LDSPS010-15 to LDSPS028-15 (haplotype 1); DLII504-07, DLIII127-18, DLIII137-19, DLIII138-19 (haplotype 2). The holotype GenBank accession number: KU574888. BOLD process ID: LDSPS009-15. Haplotype 1 is morphologically and genetically similar to haplotype 2 with a large number of sequences available (consistent with the relative abundance of specimens of *L. yucatanense* sp. nov.). The sequences are highly variable (maximum intraspecific p-distance between haplotypes 3.53%; within haplotype 1 intraspecific p-distance 0.54%; minimum interspecific p-distance (to *L. paxtoni* sp. nov.) 2.89%). Two reasons that may influence the high intraspecific variation are the existence of cryptic species throughout the distribution of these taxa and problems in the quality of the sequence data for the Yucatán specimens.

Description

Female (holotype)

Measurements. Length 3.88 mm; head length 1.08 mm; head width 1.14 mm; forewing length 3.1 mm; 14 female paratypes measured: length 3.88–4.91 mm; head length 1.08–1.18 mm; head width 1.14–1.24 mm; fore wing length 2.85–4.96 mm.

Colour. Head and mesosoma dark metallic green with copper-red reflections on mesoscutum; clypeus basally metallic green and apically black; scape and pedicel dark brown; F1–F10 dark brown dorsally, light brown ventrally; tegula dark reddish brown; wing membrane subhyaline, venation and pterostigma

reddish brown; legs black with tarsal segments light brown; metasoma black with apical rims of terga and sterna dark brown.

Pubescence. Light yellow. Head and mesosoma with abundant setae (1–2 OD), very short and sparse on vertex and mesoscutum (i≤1 OD), most setae on mesoscutum separated by half their length or more in lateral view and subappressed setae little more than stubble, appearing shaved; lower paraocular area with sparse subappressed tomentum and gena with sparse erect setae; propodeum with plumose setae on lateral and posterior surfaces, more scattered on the latter (2–2.5 OD); T1 with dense complete setose fan; T2–T3 with small and short basolateral patches of appressed tomentum covering less than half length of segment and usually apical rims glabrous and impunctate; discs of T2–T6 with sparse, short, simple setae; apical impressed areas glabrous except T3–T4 with sparse apicolateral setae.

Surface sculpture. Clypeus and supraclypeal area shiny and moderately densely punctate (i = 1–2 pd); lower paraocular area shiny and densely punctate (i ≤ 1d); antennocular area imbricate and densely punctate (i ≤ 1pd); upper paraocular area, frons, and ocellocular area shiny and densely punctate (i < 1d); gena and postgena lineate; tegula larteral margin with deep, distinct, and dense punctures (i < 1d) slightly larger than mesoscutum punctures, sparse medially (i = 1–3 pd); mesoscutum tessellate and finely and densely punctate laterad of parapsidal lines (i ≤ 1pd), becoming sparse and obscure anteromedially (i = 1–3 pd); mesoscutellum tessellate and coarsely, irregularly, sparsely punctate (i = 1–5 pd); axilla similar to mesoscutellum; metanotum finely rugulose-punctate; mesepisternum strongly imbricate to finely rugulose and densely punctate (i ≤ 1 pd), punctures shallow and indistinct on ventral half and dorsal margin; metepisternum finely rugulose; metapostnotum dull, finely reticulate with fine subparallel rugae reaching posterior margin; propodeum dorsolateral slope strigate; discs of metasomal terga shiny to finely coriarious with minute, shallow, sparse punctures (i = 1–4 pd); apical impressed areas impunctate; T2 and usually T3 apical rims impunctate; metasomal terga polished from T4–T6 with irregularly distributed punctures.

Structure. Head wide (length/width ratio = 0.95–0.98; holotype = 0.95); eyes weakly convergent below (UOD/LOD ratio = 1.25–1.35; holotype = 1.35); apicolateral margins of clypeus strongly convergent; antennal sockets close (IAD/AOD = 0.57–0.7); frontal line ending 2.5 OD below median ocellus; gena narrower than eye; inner metatibial spur pectinate with four teeth; tegula relatively large, reaching posterior margin of mesoscutum in dorsal view, with inner posterior margin straight, more bean-shaped; scutellum length 0.23; metapostnotum length 0.2, metapostnotum moderately elongate (MMR ratio = 1.15), posterior margin sharply angled onto posterior surface; propodeum with oblique carina, lateral carina nearly reaching margin of dorsal surface.

Male

Measurements. Length 3.60–3.80 mm; head length 1.05– 1.18 mm; head width 1.11–1.48 mm; fore wing length 2.57–3.03 mm.

Colour. Head and mesosoma dark metallic blue-green with copper-red reflections on mesoscutum; antenna dorsal side dark brown and ventral side light brown; tegula dark brown; wing membrane light brownish, venation and pterostigma brown; legs dark brown; metasoma black with apical rims of terga and sterna dark brown.

Pubescence. Light brown. Head with abundant setae (0.5–1 OD), more abundant, forming dense tomentum in paraocular and supraclypeal areas; gena with sparse setae; mesoscutum with sparse plumose setae 0.5–1 OD long (most setae separated by half their length or more in lateral view, especially in posterior half); propodeum with plumose setae on lateral and posterior surfaces, sparser on the latter (0.5–1 OD); discs of metasomal terga with sparse short setae; apical impressed areas impunctate; T2–T3 basolateral margins with a few sparse tomentose setae.

Surface sculpture. Clypeus, supraclypeal area, paraocular area, and ocellocular area shiny and densely punctate (i < 1 pd); frons dull with crowded punctures (i = 0 pd); gena and postgena lineolate; tegula lateral margin with deep, distinct, and dense punctures (i < 1d) slightly larger than mesoscutal punctures, moderately dense medially (i = 1–2 pd); mesoscutum shiny to weakly tessellate and densely punctate (i ≤ 1 pd), becoming more strongly tessellate and slightly sparser anteromedially (i = 1–2 pd); mesoscutellum shiny to weakly tessellate and densely punctate (i ≤ 1pd); metanotum rugulose; mesepisternum shiny and densely punctate (i < 1 pd); metepisternum rugulose; propodeum with dorsolateral slope strigate, metapostnotum somewhat shiny, finely and weakly reticulate with strong subparallel rugae; metasomal terga shiny with minute, shallow, sparse punctures (i = 1–4 pd).

Structure. Head wide (length/width ratio = 0.94–0.98). Eyes weakly convergent below (UOD/LOD ratio = 1.65–1.69); antennal sockets slightly separated (IAD/AOD < 1.07); frontal line ending 2.5 OD below median ocellus; tegula relatively large, reaching posterior margin of mesoscutum in dorsal view, with inner posterior margin straight or concave; scutellum length 0.22; metapostnotum length 0.19, metapostnotum elongate (MMR ratio = 1.16), posterior margin sharply angled onto posterior surface; genitalia with penis valve short, delicate and thin; retrorse lobe of genital capsule of median size and width, gonostylus small, fine and rounded, with a few short, simple setae near apex; S7–S8 median processes narrow.

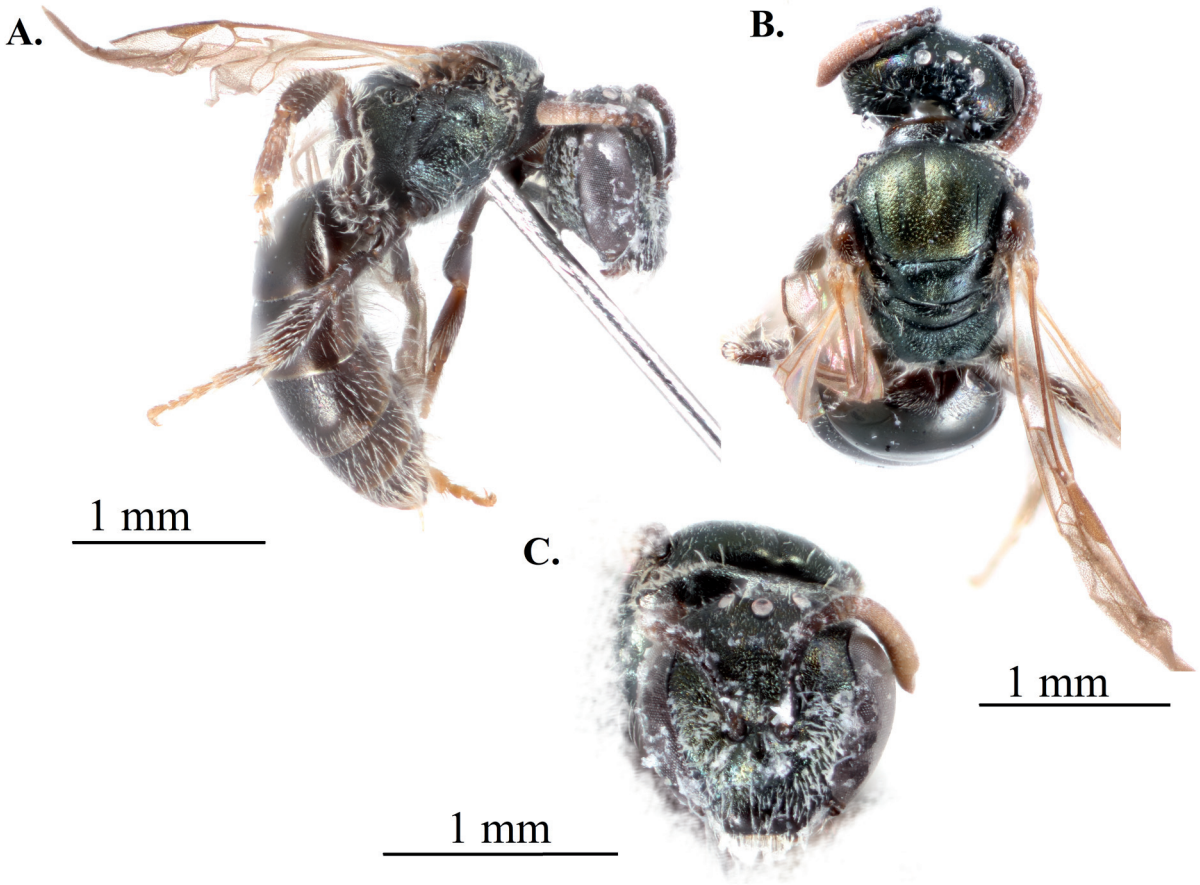

Fig. 7. *Lasioglossum* (*Dialictus*) *yucatanense* Landaverde-González sp. nov., holotype, ♀ (435.2 UNAM). **A**. Lateral habitus. **B**. Dorsal habitus. **C**. Face.

Distribution

Widely dispersed throughout the eastern lowlands of Mexico from Tamaulipas to Yucatán and Chiapas and in northwestern Guatemala. Two outliers from Jalisco and Guerrero are morphologically

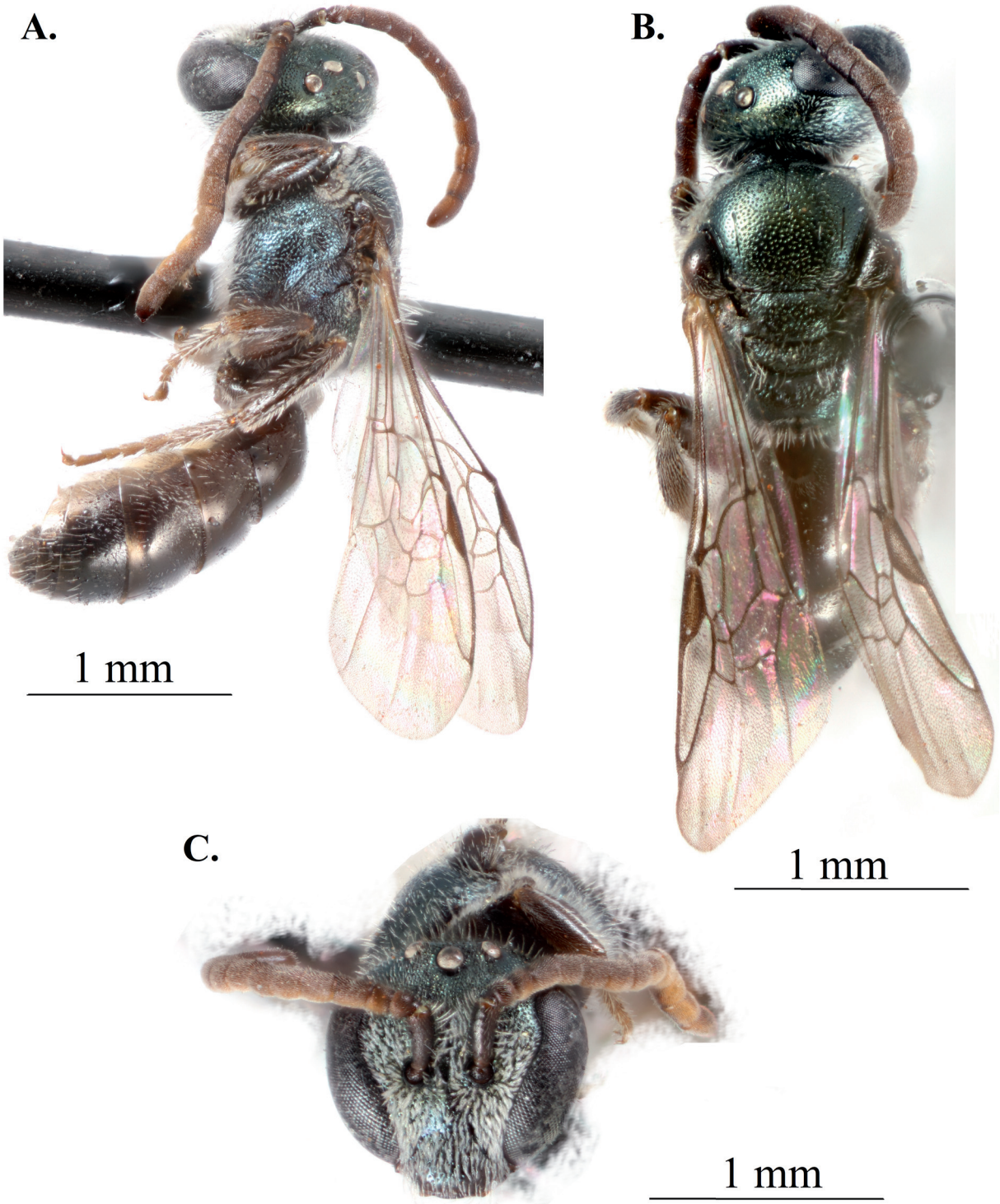

Fig. 8. *Lasioglossum* (*Dialictus*) *yucatanense* Landaverde-González sp. nov., ♂ (BBSL 1101051). **A**. Lateral habitus. **B**. Dorsal habitus. **C**. Face.

indistinguishable from the eastern specimens; it is unclear whether these represent long-range dispersal events, a natural range extension, or a cryptic species.

Remarks

Very common. Specimens of both DNA barcode haplotypes are morphologically indistinguishable, but geographically separate. All haplotype 1 sequences are from Yucatán while haplotype 2 is from Puebla, Veracruz, and Chiapas. It is possible that these represent cryptic species; however, the geographic separation disappears when considering all available specimens (with barcodes or not). Yet, the variation between haplotypes could be reinforced, mainly when considering genetic variation, following the findings from other species of bees and insects in the region (Landaverde-González *et al*. 2020; Urueña *et al*. 2022). Thus, in order to be conservative, it is inadvisable to consider a two-species hypothesis at this time. This species is a member of the *L. gemmatum* species complex and corresponds to mOTU1 in Landaverde-González *et al*. (2017a).

Lasioglossum* (*Dialictus*) *paxtoni Landaverde-González sp. nov.
urn:lsid:zoobank.org:act: 8AB32A78-9274-49AE-B9CA-3D2BF1A925BE
Figs 5C–D, 6B, 9–10, 28A, 29A, 30A

Diagnosis

Females of *L. paxtoni* sp. nov. can be recognised by having the vertex and mesoscutum with very short, sparse pubescence as if shaved (most noticeable in lateral view where most setae are separated by half or more their length); tegula enlarged (reaching posterior margin of mesoscutum in dorsal view; tegula width/ITS 0.21–0.22) and lateral margin with shallow, minute, and sparse punctures (i = 1–2d) no larger than mesoscutum punctures (sometimes inconspicuous and tegula nearly impunctate); mesoscutum shiny, finely and sparsely punctate (i = 1–3 pd), becoming slightly denser laterad of parapsidal lines (i = 1–2 pd), and with distinct red–brassy reflections medially; mesepisternum shiny, granular and finely, moderately densely punctate (i = 1–1.5 pd); metapostnotum with fine rugae extending onto propodeum dorsolateral slope; discs of T1–T2 with very fine, minute punctures, often hardly visible; and T2 and usually T3 apical impressed areas glabrous and impunctate. Males can be recognized by the same characters, except that the mesoscutum color is less red and more brassy, and the mesepisternum is more densely punctate (i < 1 pd), the mesoscutum has sparse plumose setae 0.5–1 OD long (most setae separated by half their length or more in lateral view, especially in posterior half).

Differential diagnosis

Both sexes of *L. paxtoni* sp. nov. are most similar to *L. yucatanense* sp. nov., *L.* (*D.*) *aureoviride* sp. nov., specimens of the *Lasioglossum stictaspis* species complex, the Nearctic species *L. perparvum*, and some undescribed species related to *L. perparvum* which are not known to co-occur with *L. paxtoni*. See the differential diagnosis for *L. yucatanense* for characters separating these species. *Lasioglossum* (*D.*) *aureoviride* has the mesoscutum weakly tessellate and sparsely punctate between the parapsidal lines (i = 1–3 pd) and with dense erect setae ~1 OD long (all setae separated by less than half their length in lateral view); T2–T3 apical rims evenly covered with fine setae and/or punctures; mesoscutum with dense erect setae ~1 OD long and subappressed setae 0.25–0.5 OD long; mesepisternum imbricate and very densely punctate (i < 0.5 pd).

Specimens of *Lasioglossum stictaspis* species complex have the mesepisternum imbricate and deeply, moderately densely punctate (i ≤ 1.5 pd) with distinct interspaces, T2–T3 apical rims evenly covered with fine setae and/or punctures. Females of *L. perparvum* have the scutum olive green with no red reflections, tarsi dark brown, scutum tessellate, mesepisternum tessellate with indistinct punctures, and

T2–T3 with extensive basolateral fine tomentum covering about half length of segment laterally and apical impressed areas minutely punctate with fine setae associated with punctation.

One undescribed species from western Veracruz labeled as *L.* sp. mex9 on BOLD is especially similar to *L. paxtoni* sp. nov., but lacks copper-red reflections on the mesoscutum and the tegula is more deeply and distinctly (but still sparsely) punctate. This species is apparently restricted to high elevations in the Sierra Madre Oriental mountains, in contrast to *L. paxtoni* which is restricted to the Yucatán Peninsula and northern Chiapas.

Etymology

The specific epithet is in dedication to Prof Robert Paxton, the PhD advisor of PLG and JQE.

Type material

Holotype

MEXICO – **Yucatán** • ♀; Yaxnic; [20.79° N, 89.62° W]; 8 Apr. 1997; R.W. Brooks, H. Delphin, H. Contreras and U. Mao leg.; ex *Momordica charantia*; SEMC SM0106374.

Paratypes

MEXICO – **Campeche** • 1 ♂; 10 mi N of Hopelchén; [19.89° N, 89.84° W]; 17 Apr. 1962; L.A. Stange leg.; UCDC. – **Chiapas** • 1 ♀; San Juan Cancuc, Tzajalchén; 16.9474° N, 92.3578° W; elev. 1020 m; 4 Feb. 2010; Philippe Sagot leg.; ECOAB.43220 • 1 ♂; same collection data as for preceding; ECOAB.43235 • 1 ♀; San Juan Cancuc, Tzuluwitz; 16.894° N, 92.4019° W; elev. 1270 m; 5 May 2009; Jorge Mérida, César López and T. López leg.; ECOAB.42654. – **Quintana Roo** • 2 ♂♂; Xcan; [20.87° N, 87.6° W]; 31 Jul. 1962; A.B. Amerson Jr. leg.; SEMC. – **Yucatán** • 1 ♂; Xmatkuil, 15 km S of Mérida; [20.86° N, 89.62° W]; 13 Feb. 1987; Charles D. Michener leg.; SEMC • 2 ♀♀; Mérida; [20.97° N, 89.59° W]; Nov. 1961; N.L.H. Krauss leg.; SEMC • 1 ♀; Mérida, 15 km S of University of Yucatán; [20.83° N, 89.62° W]; 7 Apr. 1997; R.W. Brooks leg.; ex *Piscidia piscipula*; SEMC SM0105915 • 1 ♂; Yaxnic; [20.79° N, 89.62° W]; 8 Apr. 1997; R.W. Brooks, H. Delphin, H. Contreras and U. Mao leg.; ex *Momordica charantia*; SEMC SM0106372 (photographed).

Other material examined

MEXICO – **Yucatán** • 1 ♀; Alfonso Caso; 20.084° N, 89.1609° W; 25 Oct. 2011; Quezada-Euán and Moo-Valle leg.; ZMH 842027 • 1 ♂; Yaxcopil; [20°4′4.10″ N, 88°54′23.80″ W]; 25 Oct. 2011; Quezada-Euán and Moo-Valle leg.; original label 38b; ZMH 81029 • 1 ♀; Santa María; [20°23′32.5″ N, 88°55′14.6″ W]; 26 Jul. 2011; Quezada-Euán and Moo-Valle leg.; original label 587e; ZMH 81040 • 1 ♀; Alfonso Caso; [20°05′02.5″ N, 89°09′39.3″ W]; 25 Oct. 2011; Quezada-Euán and Moo-Valle leg.; original label 81; ZMH 842025 • 1 ♀; same collection data as for preceding; original label 87; ZMH 842026 • 1 ♀; same collection data as for preceding; original label 91; ZMH 842027 1 ♀; Yaxcopil; [20°4′4.10″ N, 88°54′23.80″ W]; 1 Aug. 2011; Quezada-Euán and Moo-Valle leg.; original label 602c; ZMH 842029 • 1 ♀; same collection data as for preceding; original label 86; UADY.

Floral records

CUCURBITACEAE Juss.: *Momordica* L.: *M. charantia* L. • FABACEAE Juss.: *Piscidia*: *P. piscipula* (L.) Sarg. • SOLANACEAE Adans.: *Capsicum* L.: *C. chinense* Jacq.

DNA barcodes

Five sequences available (BOLD process IDs: LDSPS029-15 to LDSPS033-15). The attribution of these sequences to *L. paxtoni* sp. nov. is based on their genetic similarity to the undescribed *L.* sp. mex9, which is morphologically similar to the description of *L. paxtoni* (unfortunately the specimen originally

designated as a holotype was destroyed), and the small number of available sequences (consistent with the low relative abundance of *L. paxtoni*). The sequences are variable and distinguished from those of other species (maximum intraspecific p-distance 0.82%; minimum interspecific p-distance (to *L. yucatanense* sp. nov.) 2.89%).

Description

Female (holotype)

Measurements. Length 3.75 mm; head length 1.05 mm; head width 1.08 mm; fore wing length 2.43 mm. Five female paratypes measured: length 3.75–4.4 mm; head length 1.05–1.11 mm; head width 1.08–1.17 mm; forewing length 2.43–3.21 mm.

Colour. Head and mesosoma metallic blue-green with red-brassy reflections dorsally; scape and pedicel dark brown; F1–F10 dark brown dorsally, orange-brown ventrally; tegula orange-brown; wing membrane subhyaline, venation and pterostigma dark brown; legs dark brown with tarsi lighter orange-brown; metasoma dark brown.

Pubescence. Light yellow; head and mesosoma with moderately abundant setae (1–2 OD), very short and sparse on vertex, gena, and mesoscutum (<1 OD); lower paraocular area with sparse subappressed tomentum; propodeum with plumose long setae (2–2.5 OD) on lateral and posterior surfaces, in the latter sparser; T1 with sparse complete setose fan; T1–T6 evenly covered with very short, sparse, simple setae, except T1–T2 apical impressed areas glabrous, tarsal segments with plumose, light-yellow setae.

Surface sculpture. Clypeus shiny and moderately densely punctate (i = 1–2 pd); supraclypeal area shiny and sparsely punctate (i = 1–3d); paraocular area shiny and densely punctate (i ≤ 1 pd); frons dull with very fine crowded punctures (i = 0 pd); ocellocular area shiny and moderately sparsely punctate (i = 1–2 pd); gena and postgena lineate; tegula lateral margin with a few shallow, minute, and sparse punctures (i = 1–2d) , otherwise impunctate; mesoscutum shiny and sparsely punctate medially (i = 1–3 pd), becoming moderately dense laterad of parapsidal lines and posteromedially (i = 1–1.5 pd); mesoscutellum weakly tessellate and moderately sparsely punctate (i = 1–2 pd); axilla similar to mesoscutellum; metanotum very finely rugulose; mesepisternum granular, shiny and moderately fine and densely punctate (i = 1–1.5d); metepisternum very finely rugulose; metapostnotum reticulate with fine subparallel rugae reaching posterior margin; propodeum lateral and posterior surface finely reticulate; discs of metasomal terga weakly coriarious and very minutely, sparsely, obscurely punctate (i = 2–4 pd); apical impressed areas impunctate; T2 and usually T3 apical rims impunctate.

Structure. Head square (length/width ratio = 0.99–1.01; holotype:1.0); eyes weakly convergent below (UOD/LOD ratio = 1.29–1.31; holotype = 1.33); clypeus ½ below suborbital tangent; antennal sockets close (IAD/AOD = 0.53-0.65), frontal line ending 2.5 OD below median ocellus; gena wider than eye; inner metatibial spur pectinate with 2–3 teeth; tegula relatively large, reaching posterior margin of mesoscutum in dorsal view, with inner posterior margin straight, more bean-shaped; scutellum length 0.22; metapostnotum length 0.15, metapostnotum moderately elongate (MMR ratio = 1.47), weakly rounded posteriorly; propodeum with oblique carina, lateral carina nearly reaching margin of dorsal surface.

Male

Measurements. Length 3.53–3.85 mm; head length 0.86–1.01 mm; head width 0.95–1.18 mm; fore wing length 2.02–2.58 mm.

Colouration. Head and mesosoma dark turquoise-green to olive green with brassy-gold reflections dorsally; antenna dark brown dorsally, orange-brown ventrally; wing membrane subhyaline, venation and pterostigma dark brown; legs dark brown with tarsi lighter orange-brown; metasoma dark brown.

Pubescence. Light yellowish; head and mesosoma with moderately abundant setae (1–2 OD), very short and sparse on vertex and mesoscutum (<1 OD); lower paraocular area with dense subappressed tomentum; mesoscutum with sparse plumose setae 0.5–1 OD long (most setae separated by half their length or more in lateral view, especially in posterior half); propodeum with short plumose setae on lateral and posterior surfaces (0.5–1 OD); discs of metasomal terga covered with sparse, short, simple setae.

Surface sculpture. Clypeus, supraclypeal area, and lower paraocular area shiny and densely punctate (i ≤ 1 pd), upper paraocular area and frons shiny with crowded punctures (i = 0 pd), ocellocular area shiny and densely punctate (i ≤ 1 pd); gena and postgena lineate; mesoscutum shiny and sparsely punctate (i = 1–3 pd), becoming slightly denser laterad of parapsidal lines (i = 1–2 pd); mesoscutellum shiny and

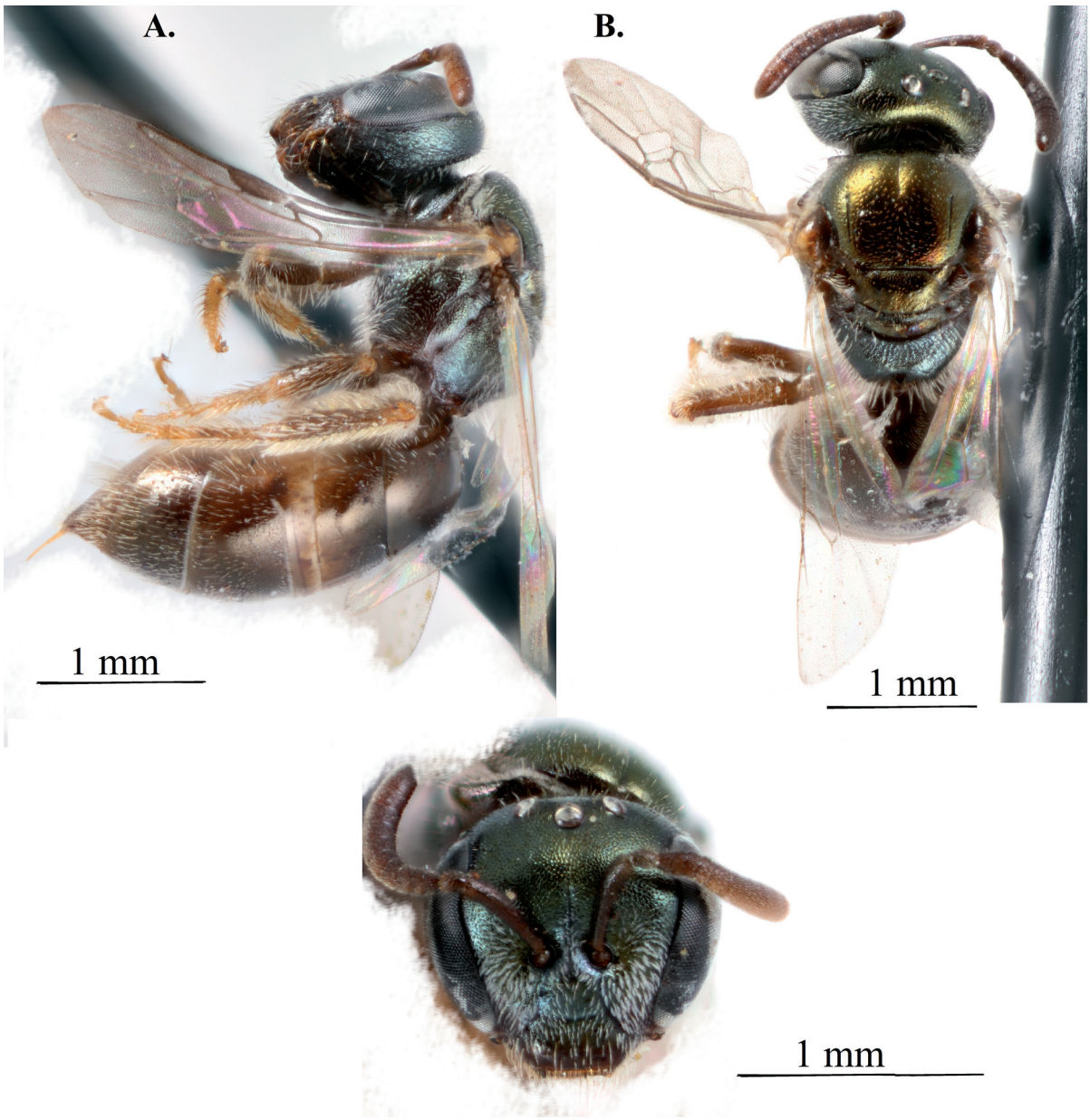

Fig. 9. *Lasioglossum* (*Dialictus*) *paxtoni* Landaverde-González sp. nov., holotype, ♀ (SEMC SM0106374). **A**. Lateral habitus. **B**. Dorsal habitus. **C**. Face.

moderately densely punctate (i = 1–2 pd); tegula sparsely punctate (i = 2–4 pd), more sparse medially (i > 1.5 dp), sometimes inconspicuous and tegula nearly impunctate; mesepisternum granular, shiny and densely punctate (i < 1–1.5 pd); propodeum lateral surface finely reticulate, posterior surface shiny and moderately densely punctate (i = 1–2 pd); discs of T1–T3 shiny and moderately sparsely punctate (i = 1–3 pd) sometimes impuctate; apical impressed areas and discs of T4–T6 impunctate.

Structure. Head slightly long (length/width ratio = 1.01–1.04); eyes weakly convergent below (UOD/LOD ratio = 1.29–1.62); clypeus ½ below suborbital tangent; antennal sockets slightly close (IAD/AOD < 1.42); frontal line ending 2.5 OD below median ocellus; gena narrower than eye; tegula relatively large, reaching posterior margin of mesoscutum in dorsal view, with inner posterior margin straight or

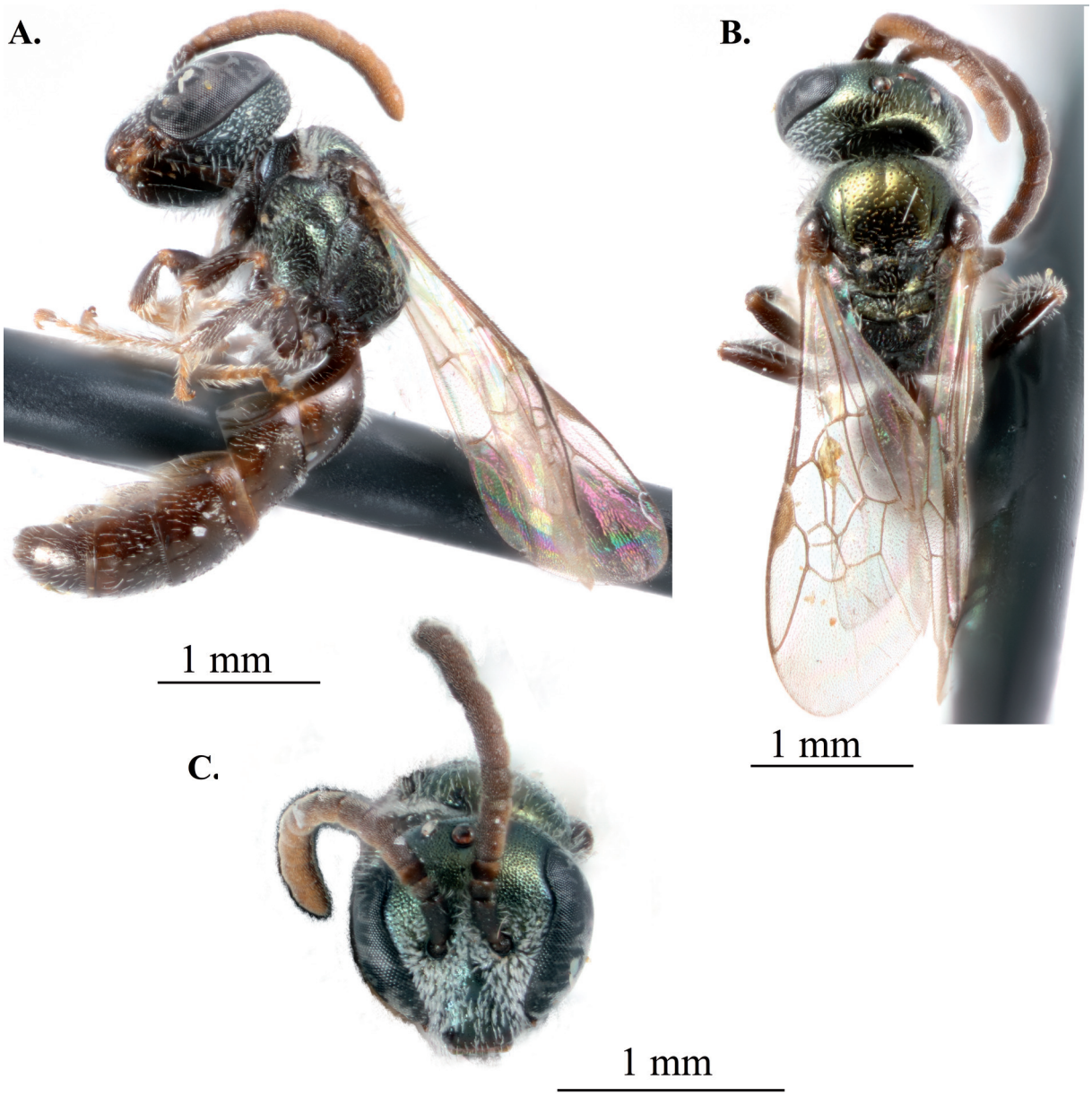

Fig. 10. *Lasioglossum* (*Dialictus*) *paxtoni* Landaverde-González sp. nov., ♂ (SM0106372). **A**. Lateral habitus. **B**. Dorsal habitus. **C**. Face.

concave; scutellum length 0.19; metapostnotum length 0.15, metapostnotum elongate (MMR ratio = 1.27), weakly rounded onto posterior surface; propodeum with lateral carina not reaching margin of dorsal surface; genitalia with penis valve small and delicate, retrorse lobe small, gonostylus of medium size and with a few short, simple setae near apex; S7 median process narrow; S8 median process wide.

Distribution

Only known from the Yucatán Peninsula and northern Chiapas.

Remarks

Rare and apparently geographically restricted to the Yucatán Peninsula. This species is a member of the *L. gemmatum* species complex and corresponds to mOTU2 in Landaverde-González *et al*. (2017a).

Lasioglossum stictaspis species complex
Figs 6C, 11–12, 22C, 31A

Ten specimens and six DNA barcode sequences were examined from the Yucatán Peninsula which belong to a complex of species related to *L. stictaspis* (Sandhouse, 1923). Morphological variation suggests

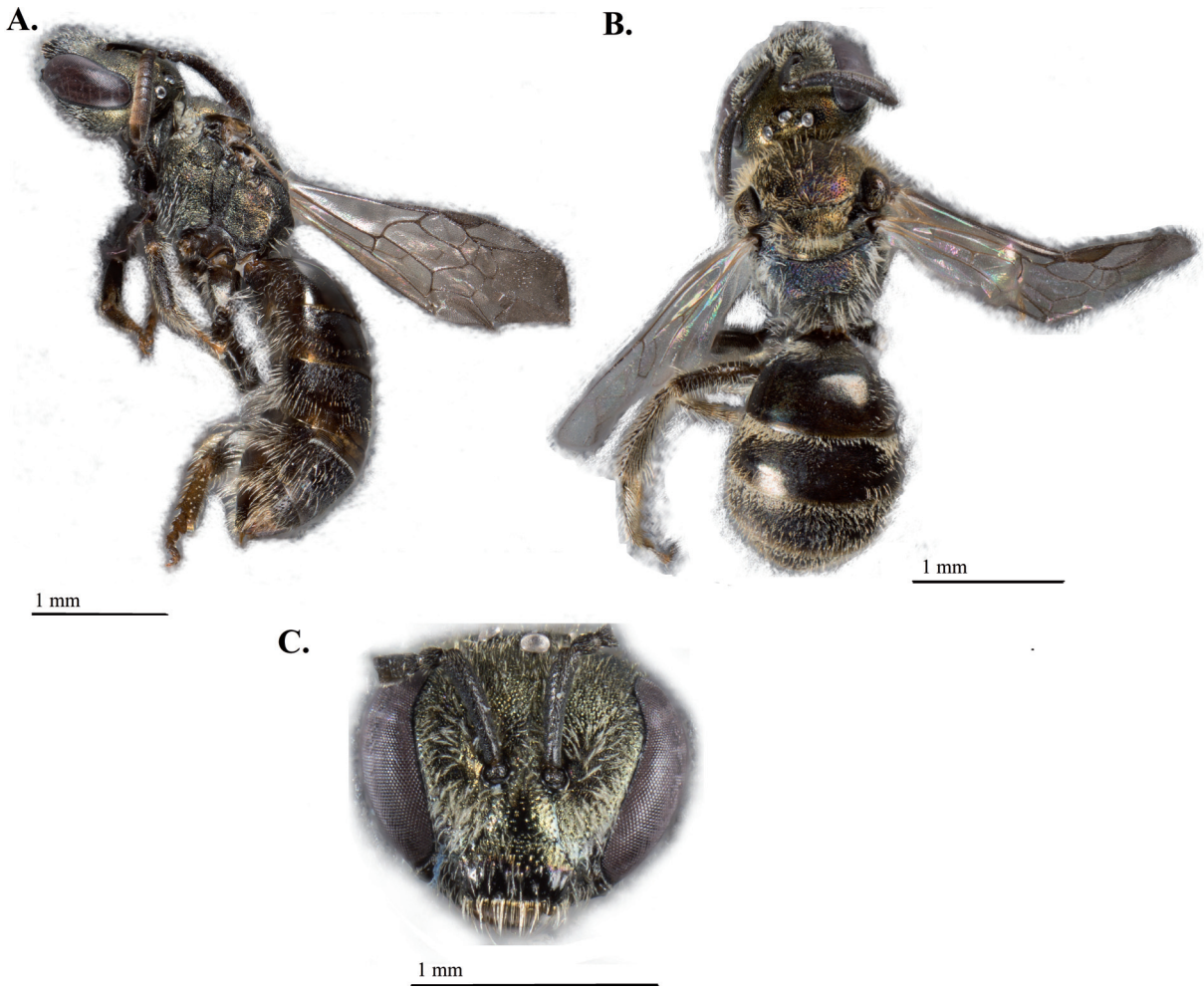

Fig. 11. Female of *L. stictaspis* species complex (ZMH 81030). **A**. Lateral habitus. **B**. Dorsal habitus. **C**. Face.

that this complex may include up to 5–6 cryptic species, but overlapping geographic ranges and COI haplotypes preclude delimitation of these species. Further revision, including more robust genetic data beyond DNA barcodes and across a large geographic area, is needed. The Yucatán specimens appear to be distinct from the nominal *L. stictaspis*, but separating them from *L. cupreicollis* (Friese, 1917) and other undescribed morphospecies is difficult and beyond the scope of this study. Here we diagnose briefly the Yucatán morphospecies in the *L. stictaspis* species complex from other species on the Yucatán Peninsula.

Diagnosis

Females of the *L. stictaspis* species complex in the Yucatán Peninsula can be recognised by the diagnostic combination of tegula greatly enlarged (reaching posterior margin of mesoscutum in dorsal view and

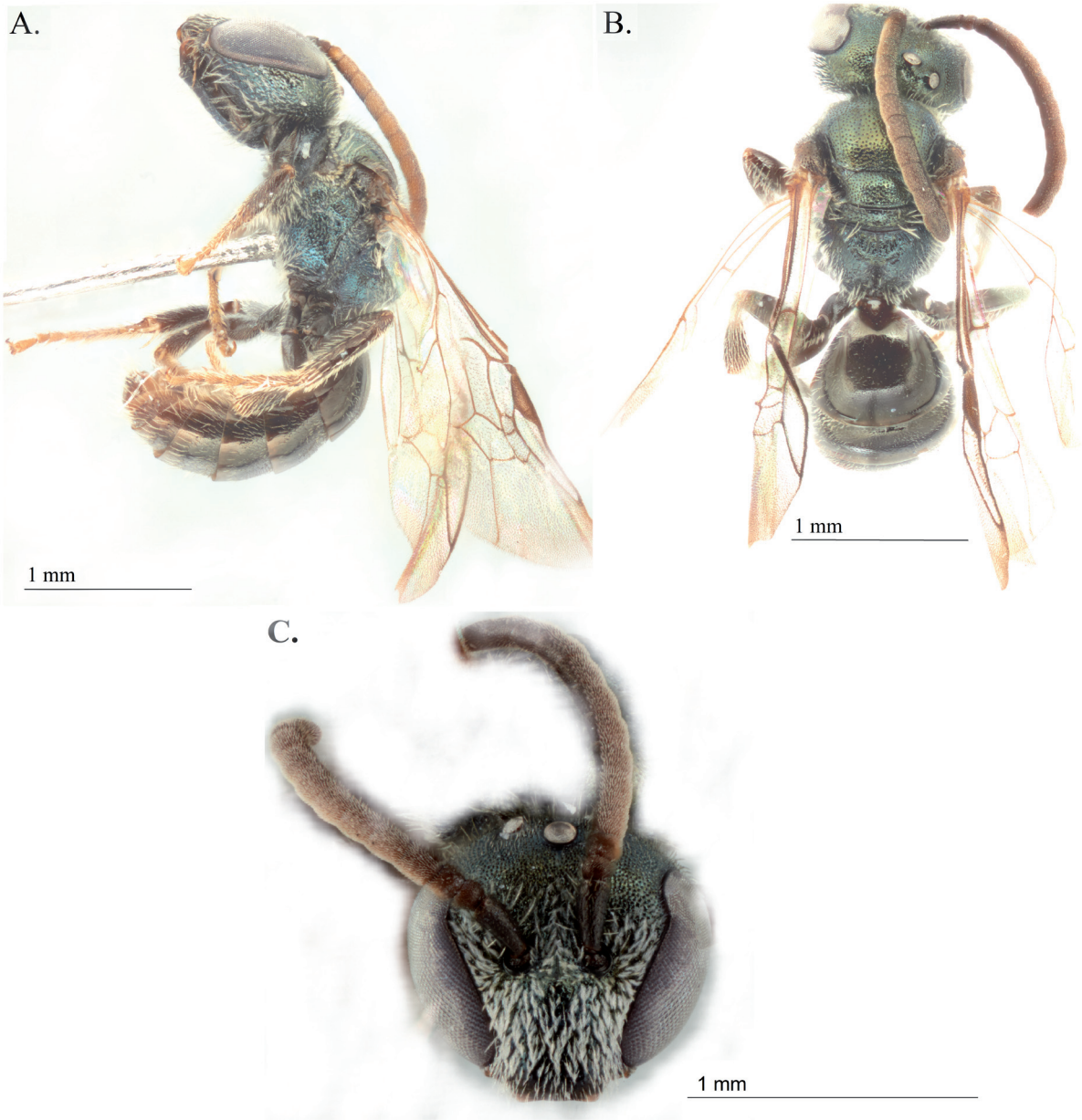

Fig. 12. Male of *L. stictaspis* species complex (ZMH 839507). **A**. Lateral habitus. **B**. Dorsal habitus. **C**. Face.

tegula width/ITS > 0.23) and densely, distinctly punctate (i < 1 pd), sometimes becoming more sparsely punctate medially (i ≤ 1.5 pd); mesepisternum usually imbricate and moderately densely punctate (i ≤ 1.5 pd) with distinct interspaces; mesoscutum with dense plumose setae 1 OD long or slightly more (all setae separated by less than half their length in lateral view); T2–T3 with extensive basolateral fine tomentum covering about half length of segment laterally and apical impressed areas minutely punctate with fine setae associated with punctation.

Males have the tegula large and densely punctate (as in the female, but punctures not becoming sparser medially); mesepisternum shiny and moderatly sparsely punctate at least in ventral half (i = 1–2 pd); and mesoscutum with dense plumose setae about 1 OD long (as in the female).

Differential diagnosis

Both sexes of the *L. stictaspis* species complex are most similar to *L. yucatanense* sp. nov., *L. paralepidii* sp. nov., and *L. aureoviride* sp. nov. Both sexes of *L. yucatanense* have the mesoscutum with sparser, shorter setae (most setae separated by half or more their length in lateral view); females of *L. yucatanense* also have the mesepisternum strongly imbricate to finely rugulose with indistinct punctures at least in dorsal portion and T2–T3 apical impressed areas largely glabrous; males of *L. yucatanense* have the mesepisternum shiny and densely and distinctly punctate (i < 1 pd). Both sexes of *L. paralepidii* and *L. aureoviride* have the mesepisternum much more densely punctate (i < 1 pd).

DNA barcodes

Six sequences available (BOLD process IDs: LDSPS034-15 to LDSPS039-15). These sequences are distinct from those of other Yucatán species (maximum intraspecific p-distance 0.6%; minimum interspecific distance (to *L. aureoviride* sp. nov.) 3.77%) but poorly distinguished from other members of the *L. stictaspis* species complex (minimum p-distance 0.15%).

Remarks

Common. The *L. stictaspis* species complex is a subset of the *L. gemmatum* species complex. The Yucatán morphospecies corresponds to mOTU3 in Landaverde-González *et al.* (2017a).

Lasioglossum* (*Dialictus*) *ameshoferi Landaverde-González sp. nov.
urn:lsid:zoobank.org: act:56635D12-86E3-4758-B5A1-BFE003DBAF00
Figs 5G–H, 6D, 13–14, 25A, 26A, 34C

Diagnosis

Females of *L.* (*D.*) *ameshoferi* sp. nov. can be recognised by the combination of tegula small and ovoid with inner posterior angle not produced mesally (tegula width/ITS 0.21–0.22), clearly not reaching posterior margin of mesoscutum in dorsal view, and impunctate except for scattered minute punctures in anterior half; frons punctures as large and dense as those of lower paraocular area; mesoscutum with large, coarse and dense punctures (i < 1 pd), crowded laterad of parapsidal lines (i = 0 pd) except on anteromedian margin (i > 1.5 pd); mesepisternum strongly rugose with the upper part areolate; metapostnotum shiny with strong subparallel rugae usually reaching posterior margin; and propodeum with strong U-shaped oblique carina sharply delineating metapostnotum. Males have the tegula small and ovoid (as in the female); frons punctures as large and dense as those of lower paraocular area, which is clearly visible beneath sparse appressed tomentum; metapostnotum with strong subparallel rugae reaching or nearly reaching posterior margin; and propodeum with trace of oblique carina present (this is unusual for males which almost always lack an oblique carina even when it is well-developed in the female).

Differential diagnosis

Both sexes of *Lasioglossum* (*Dialictus*) *ameshoferi* sp. nov. are most similar to *L.* (*D.*) *nanotegula* sp. nov. and females of *L.* (*D.*) *milpa* sp. nov. (the male is unknown). Females of *L. ameshoferi* are also similar to an undescribed species known from higher elevations in the mountains of Chiapas. Both sexes of *L.* (*D.*) *nanotegula* have the frons punctures much smaller and denser than those of the lower paraocular area, which in the male is partially obscured by dense appressed tomentum; females also have the propodeum with an oblique carina straight; and males have the propodeum without a trace of an oblique carina. Females of *L. milpa* also have the metapostnotum dull, imbricate, with shallow anastomosing rugae reaching posterior margin or nearly so and mesepisternum slightly sparsely punctate (i ≤ 1–1.5d), while females of *L. nanotegula* have the mesoscutum punctures laterad of the parapsidal lines moderately dense but not crowded (i ≤ 1 pd). Females of the undescribed Chiapas species have the frons punctures much smaller and denser than those of the lower paraocular area.

Lasioglossum ameshoferi sp. nov. is very similar to the Panama species *L. strigosigena* Michener, 1954, and diagnostic characters separating the two are not well known. It seems that the postgena of *L. ameshoferi* is mostly smooth, while in *L. strigosigena* it is entirely and strongly lineate, but a few specimens of *L. ameshoferi* approach the condition found in *L. strigosigena*. Geography is probably the most reliable way to separate these species.

Etymology

The specific epithet is dedicated to Andreas Ameshofer for his great support to PLG and his love and patience during the development of the entire study.

Type material

Holotype

MEXICO – **Campeche** • ♀; Hopelchén; 19.66° N, 89.66° W; elev. 77 m; 24 Jan. 2016; Misael Hdz leg.; ECOAB.82784.

Paratypes

GUATEMALA – **Huehuetenango** • 1 ♀; Jacaltenango, San Andrés; 15.7167° N, 91.7455° W; elev. 1027 m; 28 Feb. 2010; Miguel Cigarroa leg.; ECOAB.44665 • 1 ♀; La Democracia, Unión; 15.574° N, 91.8141° W; elev. 1038 m; 26 Feb. 2010; Jorge Mérida leg.; ECOAB.44666 • 1 ♀; San Antonio Huista, Pinalito; 15.6653° N, 91.8618° W; elev. 963 m; 1 May 2010; Philippe Sagot leg.; ECOAB.44660.

MEXICO – **Campeche** • 1 ♀; Hopelchén; 19.71° N, 89.8° W; elev. 70 m; 2 Oct. 2015; Roberto May leg.; ECOAB.82345 • 1 ♀; Hopelchén; 19.39° N, 89.71° W; elev. 147 m; 4 Nov. 2015; Misael Hdz leg.; ECOAB.82585 • 1 ♀; Hopelchén; 20.04° N, 89.74° W; elev. 105 m; 22 Jan. 2016; Eric Vides leg.; ECOAB.82685. – **Chiapas** • 1 ♀; 37 km E of Tuxtla Gutiérrez; 16.75° N, 92.9167° W; elev. 1240 m; 12 Apr. 1993; George C. Eickwort leg.; ex *Senecio deppeanus*; SEMC SM0341238 • 1 ♀; Arriaga, Ej. Adolfo López Mateos; 16.3463° N, 93.9741° W; elev. 367.5 m; 15 Sep. 2009; Carlos Balboa, Miguel Guzmán and Miguel Cigarroa leg.; ECOAB.54267 • 1 ♀; Nicolás Ruiz and Carr. N. Ruiz-V. Guerrero; 16.4238° N, 92.6326° W; elev. 685 m; 29 Oct. 2011; Philippe Sagot leg.; ECOAB.53509 • 2 ♀♀; Ocozocoautla; 16.84° N, 93.45° W; elev. 836 m; 30 Dec. 2015; Philippe Sagot leg.; ECOAB.79338, 79346 • 1 ♀; Suchiapa; 16.6294° N, 93.0916° W; elev. 465 m; 8 Sep. 1987; L. Mendoza leg.; ECOAB.43998 • 1 ♀; Venustiano Carr.; 16.49° N, 92.5° W; elev. 1073 m; 31 Dec. 2016; Philippe Sagot leg.; ECOAB.67208. – **Colima** • 1 ♀; San Antonio; 19.4515° N, 103.7184° W; elev. 1200 m; 10 Oct. 2008; Laurence Packer leg.; PCYU. – **Guerrero** • 2 ♀♀; 23 mi W of Acapulco; [17° N, 100.2° W]; 10 Aug. 1962; Ellen Ordway leg.; SEMC. – **Jalisco** • 1 ♀; Chamela; [19.5° N, 105.04° W]; 6 Jul. 1985; Ricardo Ayala Barajas leg.; ex *Prockia crucis*; SEMC • 1 ♀; same collection data as for preceding; 17 Aug. 1985; SEMC. – **Oaxaca** • 1 ♀; Puerto Escondido; [15.87° N, 97.08° W]; elev. 10 m; 1 Sep. 1990; Luis M. Gódinez leg.; SEMC

• 1 ♀; same collection data as for preceding; 30 Sep. 1990; SEMC. – **Quintana Roo** • 2 ♀♀; Tulum; [20.21° N, 87.47° W]; 22 Jan. 1976; L. Greenberg leg.; SEMC • 1 ♂; same collection data as for preceding; SEMC. – **Yucatán** • 1 ♂; Yucatán, Tixcuytun; [20°12′21.80″ N, 89°09′17.50″ W]; 7 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 293; UNAM (photographed) • 3 ♀♀; 30 mi S of Mérida; [20.53° N, 89.61° W]; 31 Jul. 1964; Paul J. Spangler leg.; USNM • 2 ♂♂; Chichén-Itzá; [20.68° N, 88.57° W]; 11 Jan. 1976; L. Greenberg leg.; SEMC • 1 ♂; Kabah, 25 km SW of Ticul; [20.25° N, 89.65° W]; 14 Feb. 1987; Charles D. Michener leg.; SEMC • 1 ♀; Mérida; [20.97° N, 89.59° W]; Nov. 1961; N.L.H. Krauss leg.; SEMC • 2 ♀♀; Uxmal Ruins, 16 km SW of Muna; [20.36° N, 89.77° W]; 14 Feb. 1987; Charles D. Michener leg.; SEMC • 1 ♀; Yaxnic; [20.79° N, 89.62° W]; 8 Apr. 1997; R.W. Brooks, H. Delphin, H. Contreras and U. Mao leg.; ex *Acacia pennatula*; SEMC SM0106223.

Other material examined

MEXICO - **Yucatán** • 1 ♀; Alfonso Caso; [20° 05′02.5″ N, 89°09′39.3″ W]; 25 Oct. 2011; Quezada-Euán and Moo-Valle leg.; original label 113; ZMH 842030 • 1 ♀; Tah Dziú; [20°10′06.9″ N, 88°55′36.2″ W]; 7 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 241a1; ZMH 842033 • 1 ♂; Tixcacaltuyub; [20°25′03.1″ N, 88°55′51.5″ W]; 22 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 502a; ZMH 839502 • 1 ♀; Tixcuytun; [20°11′25.30″ N, 89°10′29.30″ W]; 22 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 493d; ZMH 63081 • 1 ♀; Alfonso Caso; [20°05′02.5″ N, 89°09′39.3″ W]; 25 Oct. 2011; Quezada-Euán and Moo-Valle leg.; original label 89; ZMH 842065 • 1 ♀; Tixmehuac; [20°15′52.4″ N, 89°08′58.1″ W]; 22 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 411; ZMH 842067 • 1 ♀; Yucatán, Nenela; [20°14.44′0.0″ N, 89°05′24.5″ W]; 9 May 2011; Quezada-Euán and Moo-Valle leg.; original label 2; UADY.

Floral records

ASTERACEAE Giseke: *Senecio* L.: *S. deppeanus* Hemsl. • FABACEAE Juss.: *Acacia* Mill.: *A. pennatula* (Schltdl. & Cham.) Benth. • SALICACEAE Mirb.: *Prockia* P. Browne ex L.: *P. crucis* P. Browne ex L. • SOLANACEAE Adans.: *Capsicum* L.: *C. chinense* Jacq.

DNA barcodes

Fourteen sequences are available (BOLD process IDs: BBLEG181-17, DIAL1304-08, GMMCK090-14, GMMCK130-14, GMMCK932-14, LDSPS110-15 to LDSPS118-15). These sequences are attributed to *L. ameshoferi* sp. nov. based on two specimens (BBLEG181-17, DIAL1304-08) that were examined and barcoded independently of the sequences from Yucatán; the specimen corresponding to BBLEG181-17 is the holotype. Including the Yucatán sequences, there is a large amount of divergence (maximum intraspecific p-distance 4.21%; minimum interspecific p-distance (to *L. aureoviride* sp. nov.) 5.92%). Within the Yucatán sequence there is also variation (maximun intraspecific p-distance 1.44%; minimum interspecific p-distance (to *L. aureoviride*) 5.53%).

Description

Female (holotype)

Measurements. Length 5.47 mm; head length 1.48 mm; head width 1.6 mm; fore wing length 3.7 mm. 15 female paratypes measured: length 5.01–5.47 mm; head length 1.17–1.48 mm; head width 1.22–1.6 mm; fore wing length 3.22–3.7 mm.

Colour. Head and mesosoma metallic dark blue-green; clypeus apical half black; scape black, F1–F10 black dorsally, dark brown ventrally; tegula reddish brown; wing membrane subhyaline, subcosta black, venation and pterostigma otherwise brown; legs dark brown; metasoma black with apical margins of terga and sterna dark brown.

Pubescence. Whitish; head and mesosoma with abundant long pubescence (1–2.5 OD); gena with sparse appressed tomentum; propodeum with abundant plumose setae on lateral and posterior surfaces (1.5–2.5 OD); T1 with dense complete setose fan; T2–T3 with small basolateral patches of appressed tomentum covering less than half length of segment; T1–T2 evenly and densely covered by short simple setae, T3–T4 with similar setae but about twice as long; tarsal segments with plumose light-yellow setae.

Surface sculpture. Face with strong uniform large and dense punctation; clypeus shiny and densely punctate (i ≤ 1 pd); supraclypeal area tessellate and sparsely punctate (i = 1–4 pd); upper paraocular area, frons, and ocellocular area shiny, with crowded punctures (i = 0 pd); lower paraocular area shiny and very

Fig. 13. *Lasioglossum* (*Dialictus*) *ameshoferi* Landaverde-González sp. nov., holotype, ♀ (ECOAB.82784). **A**. Lateral habitus. **B**. Dorsal habitus. **C**. Face.

densely punctate (i < 0.5 pd); antennocular area imbricate and slightly less densely punctate (i ≤ 1 pd); gena and postgena finely lineate, becoming smooth and shiny on postgena anteriorly; mesoscutum tessellate, and large, coarsely and densely punctate (i < 1 pd), becoming crowded laterad of parapsidal line (i = 0 pd) and slightly sparse on anteromedian margin (i > 1.5 pd); tegula impunctate except a few scattered minute punctures on anterior half; mesoscutellum coarsely and moderately sparsely punctate (i = 1–2 pd), becoming fine and dense (i < 1 pd) on margins and median line; axilla shiny and densely punctate (i < 1 pd); metanotum rugulose with abundant plumose setae; mesepisternum rugose with the upper part areolate; metepisternum rugose dorsally, weakly rugulose ventrally; metapostnotum shiny with coarse subparallel rugae reaching posterior margin; propodeum posterior surface smooth and tessellate; T1 anterior surface coriarious; T1–T2 shiny to weakly coriarious, and finely and sparsely punctate (i = 2–4 pd).

Structure. Head wide (length/width ratio = 0.91–0.98; holotype = 0.93); eyes weakly convergent below (UOD/LOD ratio = 1.19–1.46; holotype = 1.46); clypeus ¾ below suborbital tangent; antennal sockets close (IAD/AOD < 1.18); frontal line ending 2.5 OD below median ocellus; gena wider than eye; tegula ovoid and relatively small, not produced mesally; inner metatibial spur pectinate, with three teeth; scutellum length 0.36; metapostnotum length 0.35, metapostnotum moderately long (MMR ratio = 1.03), posterior margin sharply angled onto posterior surface; propodeum with strong U-shaped oblique carina extending onto dorsolateral slope.

Male

Measurements. Length 5.37–3.85 mm; head length 1.25–1.48 mm; head width 1.43–1.58 mm; fore wing length 2.59–3.5 mm.

Colour. Head and mesosoma metallic dark turquoise-green to golden-green; clypeus apical half black; scape black, F1–F10 black dorsally, dark brown ventrally; tegula dark reddish brown; legs black with tarsi becoming dark reddish brown; metasoma black with apical rims of terga and sterna dark reddish brown.

Pubescence. Dull white; head and mesosoma with abundant long setae (1–2.5 OD); S3–S5 pubescence short (1–2 OD), suberect, and weakly plumose, appearing simple at <40× magnification; face with sparse appressed tomentum below eye emargination; propodeum with abundant long plumose setae on lateral and posterior surfaces (1.5–2.5 OD); discs of metasomal terga with sparse, short, simple setae medially and longer plumose setae laterally (1–3 OD).

Surface sculpture. Clypeus shiny and densely punctate (i ≤ 1 pd); supraclypeal area tessellate and sparsely punctate (i = 1–3 pd); paraocular area, frons, and ocellocular area shiny with crowded punctures (i = 0 pd); gena and postgena finely lineate to imbricate; mesoscutum shiny and coarsely, moderately sparsely punctate (i = 1–2 pd); tegula impunctate; mesoscutellum coarsely and sparsely punctate (i = 2–4 pd), becoming dense on margins and median line (i < 1 pd); metanotum areolate-rugulose; mesepisternum rugose and obscurely punctate; metapostnotum shiny with coarse and strong subparallel rugae reaching posterior margin; propodeum posterior surface shiny and finely, sparsely punctate (i = 1–3 pd), dorsolateral slope sometimes roughened by rugae reaching posterior margin, and with trace of oblique carina present (this is unusual for males which almost always lack an oblique carina even when it is well-developed in the female); discs of T1–T3 shiny and sparsely punctate in basal half (i = 1–3 pd), becoming very sparse in apical half (i = 2–4 pd); apical impressed areas impunctate.

Structure. Head wide (length/width ratio = 0.80–0.81); eyes weakly convergent below (UOD/LOD ratio = 1.13–1.29); clypeus ¾ below suborbital tangent; antennal sockets close (IAD/AOD < 0.48); frontal line ending 2.5 OD below median ocellus; gena wider than eye; tegula small and ovoid, not produced mesally and clearly not reaching posterior margin of mesoscutum in dorsal view; scutellum

length 0.32; metapostnotum length 0.29, metapostnotum long (MMR ratio = 1.1), posterior margin gently angled onto posterior surface; genitalia with penis valve small and delicate, retrorse lobe small, gonostylus wider and rounded with a few short, simple setae near apex.

Distribution

Yucatán Peninsula and Pacific coast from Oaxaca to Jalisco.

Remarks

Uncommon. *Lasioglossum ameshoferi* sp. nov. has an unusual distribution which seems to cross from the Atlantic coast to the Pacific coast at the Isthmus of Tehuantepec. It is not known from the Atlantic coast west of the isthmus or the Pacific coast east of the isthmus. Specimens from both sides are nearly identical both morphologically and in their DNA barcodes, precluding any consideration of splitting the populations into separate species. It is possible that additional sampling will reveal a more extensive

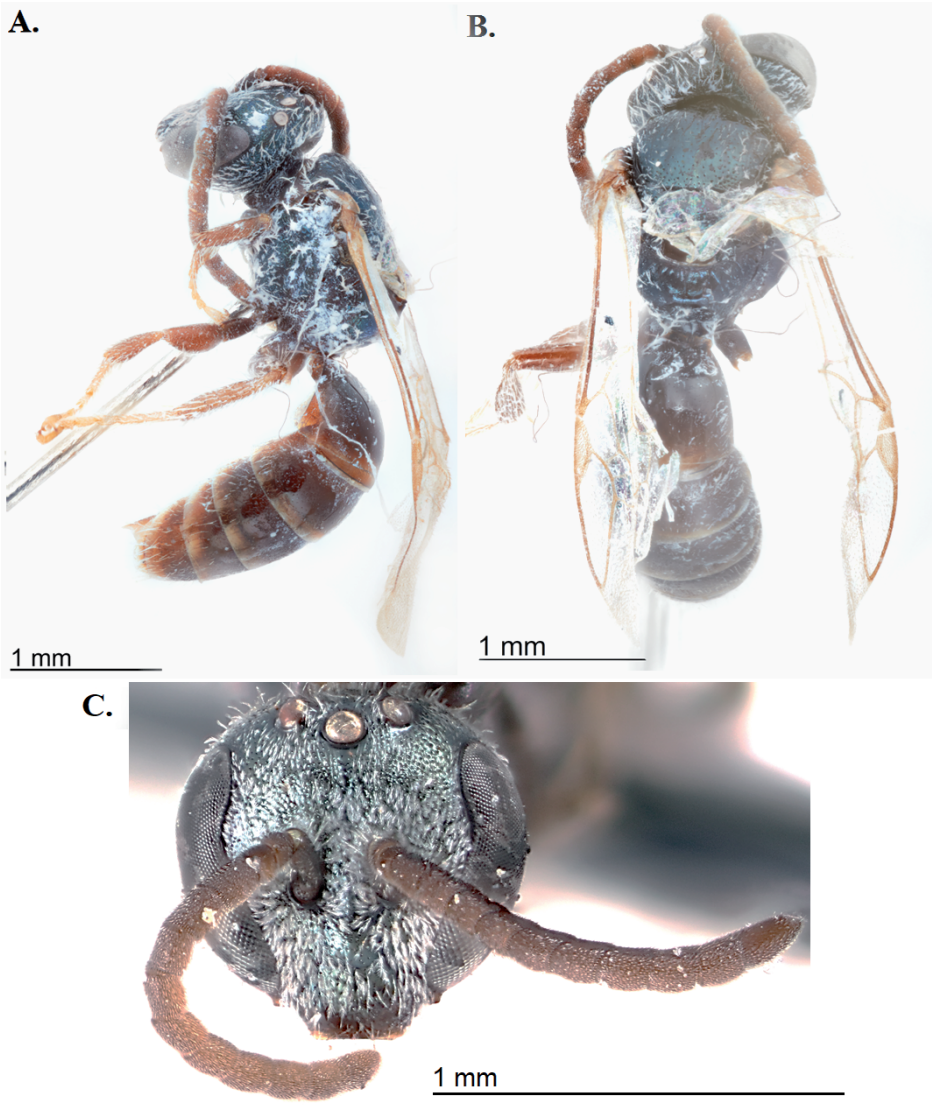

Fig. 14. *Lasioglossum* (*Dialictus*) *ameshoferi* Landaverde-González sp. nov., ♂ (293 UNAM). **A**. Lateral habitus. **B**. Dorsal habitus. **C**. Face.

distribution. This species is a member of the informal *L. comulum* species group and corresponds to mOTU7 in Landaverde-González *et al*. (2017a).

Lasioglossum* (*Dialictus*) *aureoviride Landaverde-González & Husemann sp. nov.
urn:lsid:zoobank.org: act: C0BCD1CE-12B0-4363-AD44-D4B628683ACC
Figs 5E–F, 6E, 15–16, 28B, 32A, 35A

Diagnosis

Females of *L.* (*Dialictus*) *aureoviride* sp. nov. can be recognised by the diagnostic combination of tegula enlarged (reaching posterior margin of mesoscutum in dorsal view or nearly so and tegula width/ITS 0.21–0.24), with inner posterior margin straight, and scattered minute punctures (i ≥ 1.5 pd), becoming moderately dense on posterior margin (i = 1–2 pd) but still inconspicuous, smaller than those of mesoscutum; mesepisternum very densely punctate (i < 0.5 pd); mesoscutum weakly tessellate and sparsely punctate between parapsidal lines (i = 1–3 pd) and with dense plumose setae about 1 OD long (all setae less than half their length from each other in lateral view); supraclypeal area sparsely punctate (i = 1–3 pd); metapostnotum dull with shallow rugae blending into finely reticulate background microsculpture; T2–T3 apical impressed areas evenly covered with minute punctures and fine setae. Males may be recognised by the same characters, except the tegula is often more distinctly, but still sparsely punctate (i = 1–3 pd) and the T2–T3 apical impressed areas are impunctate.

Differential diagnosis

Both sexes of *Lasioglossum* (*Dialictus*) *aureoviride* sp. nov. are most similar to *Lasioglossum* (*Dialictus*) *paxtoni* sp. nov., *Lasioglossum* (*Dialictus*) *yucatanense* sp. nov., to species within the *L. stictaspis* species complex and *L. paralepidii* sp. nov., all found on the Yucatán Peninsular, the subtropical Florida species *L. lepidii* (Graenicher, 1927), and some possible undescribed species occurring in other parts of Mexico. Both sexes of all of these undescribed Mexican species have the tegula more distinctly and densely punctate (i = 1–3 pd in females, i ≤ 1 pd in males) and the metapostnotum shiny with strong, coarse rugae. Both sexes of *L. paralepidii* and *L. lepidii* also have the mesoscutum densely punctate (i ≤ 0.5–1 pd), becoming moderately sparse submedially and anteromedially (i = 1–2 pd), and both sexes of *L. paralepidii* have the supraclypeal area shiny and very densely punctate (i ≤ 0.5–1 pd). For differences between *L.* (*D.*) *aureoviride* and *L.* (*D.*) *paxtoni* see above in the diagnosis for the latter. For differences between *L.* (*D.*) *aureoviride* and *L.* (*D.*) *yucatanense* see above in the diagnosis for the latter. For differences between *L.* (*D.*) *aureoviride* and the species of the *L. stictaspis* species complex see above in the diagnosis for that complex.

Etymology

The specific epithet '*aureoviride*' is a combination of the Latin adjectives '*aureum*' ('golden') and '*viride*' ('green'), referring to the presence of both colours on the thorax.

Type material

Holotype

MEXICO - **Yucatán** • ♀; Tixcuytún; [20.2061° N, 89.1549° W]; 7 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 490d; UNAM.

Paratypes

MEXICO – **Quintana Roo** • 1 ♀; 12 km NW of Reforma; [18.89° N, 88.65° W]; 14 Oct. 1986; Charles D. Michener leg.; SEMC SM0753056 • 1 ♀; 49 km NE of Felipe Carrillo Puerto; [19.89° N, 87.71° W]; 11 Oct. 1986; Charles D. Michener leg.; SEMC • 6 ♂♂; Xcan; [20.87° N, 87.6° W]; 31 Jul. 1962; A.B. Amerson Jr. leg.; SEMC. – **Yucatán** • 1 ♂; 6 km E of Uxmal; [20.36° N, 89.71° W]; 6 Apr. 1997;

R.W. Brooks leg.; ex *Vitex gaumeri*; SEMC SM0106177 (photographed) • 1 ♀; Alfonso Caso; 20.084° N, 89.1609° W; 25 Oct. 2011; Quezada-Euán and Moo-Valle leg.; ZMH 842058 • 1 ♂; Xmatkuil, 15 km S of Mérida; [20.86° N, 89.62° W]; 13 Feb. 1987; Charles D. Michener leg.; SEMC • 2 ♀♀; Chichén-Itzá Ruins (near Piste); [20.68° N, 88.57° W]; 15 Feb. 1987; Charles D. Michener leg.; SEMC • 1 ♂; same collection data as for preceding; SEMC • 1 ♀; Dzibichaltún; [21.1° N, 89.6° W]; 13 Jan. 1976; L. Greenberg leg.; SEMC • 4 ♀♀; Kabah, 25 km SW of Ticul; [20.25° N, 89.65° W]; 14 Feb. 1987; Charles D. Michener leg.; SEMC • 3 ♂♂; same collection data as for preceding; 14 Feb. 1987; Charles D. Michener leg.; SEMC • 1 ♀; Mérida; [20.97° N, 89.59° W]; Nov. 1961; N.L.H. Krauss leg.; SEMC • 1 ♀; Mérida; 20.9678° N, 89.5928° W; 19 Oct. 2011; Quezada-Euán and Moo-Valle leg.; ZMH 839501 • 5 ♀♀; Mérida, 15 km S of University of Yucatán; [20.83° N, 89.62° W]; 7 Apr. 1997; R.W. Brooks leg.; ex *Piscidia piscipula*; SEMC SM0105911, SM0105919, SM0105921, SM0105923, SM0105927 • 3 ♂♂; same collection data as for preceding; SEMC SM0105912, SM0105913, SM0105920 • 2 ♀♀; Yaxnic; [20.79° N, 89.62° W]; 8 Apr. 1997; R.W. Brooks, H. Delphin, H. Contreras and U. Mao leg.; ex *Acacia pennatula*; SEMC SM0105951, SM0106219 • 4 ♂♂; same collection data as for preceding; SEMC SM0106222, SM0106227, SM0106247, SM0106248 • 1 ♂; same collection data as for preceding; ex *Porophyllum punctatum*; SEMC SM0106360.

Other material examined

MEXICO - **Yucatán** • 1 ♀; Mérida; [20°58′04.05″ N, 89°35′33.93″ W]: 19 Oct. 2011; Quezada-Euán and Moo-Valle leg.; original label 622d1; ZMH 839506 • 1 ♀; Moctezuma; [21°24′46.2″ N, 87°42′05.7″ W]; 30 May 2011; Quezada-Euán and Moo-Valle leg.; original label 149; ZMH 842038 • 1 ♀; same collection data as for preceding; original label 157; ZMH 842039 • 1 ♀; San Pedro Bacab; [21°18′04.9″ N, 87°38′24.8″ W]; 31 May 2011; Quezada-Euán and Moo-Valle leg.; original label 175; ZMH 842041 • 1 ♀; San Pedro Bacab; [21°18′04.9″ N, 87°38′24.8″ W]; 31 May 2011; Quezada-Euán and Moo-Valle leg.; original label 176; ZMH 842042 • 1 ♀; same collection data as for preceding; original label 181; ZMH 842043 • 1 ♀; same collection data as for preceding; original label 188; ZMH 842044 • 1 ♀; Rancho Alegre; [21°18′26.7″ N , 87°46′29.6″ W]; 13 Aug. 2011; Quezada-Euán and Moo-Valle leg.; original label 219; ZMH 842045 • 1 ♀; Nenela; [20°20′10.90″ N, 89°1′19.20″ W]; 25 Oct. 2011; Quezada-Euán and Moo-Valle leg.; original label 342b; ZMH 842047 • 1 ♀; Tixcuytun; [20°12′21.80″ N, 89°09′17.50″ W]; 7 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 489e; ZMH 842048 • 1 ♀; same collection data as for preceding; original label 490; ZMH 842049 • 1 ♀; same collection data as for preceding; original label 491c; ZMH 842050 • 1 ♀; Muna; [20°28′15.7″ N, 89°46′53.5″ W]; 22 Jul. 2011; Quezada-Euán and Moo-Valle leg.; original label 546; ZMH 842051 • 1 ♀; same collection data as for preceding; original label 564; ZMH 842053 • 1 ♀; same collection data as for preceding; original label 570d; ZMH 842054 • 1 ♀; Yaxcopil; [20°4′4.10″ N, 88°54′23.80″ W]; 1 Aug. 2011; Quezada-Euán and Moo-Valle leg.; original label 603c; ZMH 842055 • 1 ♀; Mérida; [20°58′04.05″ N, 89°35′33.93″ W]; 19 Oct. 2011; Quezada-Euán and Moo-Valle leg.; original label 622a; ZMH 842057 • 1 ♀; San Pedro Bacab; [21°18′04.9″ N, 87°38′24.8″ W]; 31 May 2011; Quezada-Euán and Moo-Valle leg.; original label 172; ZMH 842040 • 1 ♀; Xaya, [20°16′51.70″ N, 89°11′28.70″ W]; 5 Aug. 2011; Quezada-Euán and Moo-Valle leg.; original label 621; ZMH 842056 • 1 ♀; Nenela; [20°20′10.90″ N, 89°1′19.20″ W]; 25 Oct. 2011; Quezada-Euán and Moo-Valle leg.; original label 342e; ZMH 842046 •1 ♀; Muna; [20°28′15.7″ N, 89°46′53.5″ W]; 22 Jul. 2011; Quezada-Euán and Moo-Valle leg.; original label 553; ZMH 842052 • 1 ♀; Yucatán, Tekal de Venegas; [21º01′40.5″ N, 88°58′46.3″ W]; 21 May 2011; Quezada-Euán and Moo-Valle leg.; original label 115; UADY.

Floral records

ASTERACEAE Giseke: *Porophyllum* Guett.: *P. punctatum* (Mill.) S.F. Blake • FABACEAE Juss.: *Acacia* Mill.: *A. pennatula* (Schltdl. & Cham.) Benth. • *Piscidia* L.: *P. piscipula* (L.) Sarg. • LAMIACEAE Martinov: *Vitex* L.: *V. gaumeri* Greenm. • SOLANACEAE Adans.: *Capsicum* L.: *C. chinense* Jacq.

DNA barcodes

Twenty-five sequences available (BOLD process IDs: LDSPS052-15 to LDSPS076-15). The holotype and male paratype are GenBank accession: KU574945. BOLD process ID: LDSPS065-15, paratype male GenBank accession: KU574946. BOLD process ID: LDSPS064-15. These sequences are very variable (maximum intraspecific p-distance 1.63%; minimum interspecific p-distance (to *L. lepidii*) 2.15%). This group of sequences is tentatively attributed to *L. aureoviride* sp. nov., although they share similarity with *L. lepidii* sequences. Some sequences are likely attributable to *L paralepidii* sp. nov. as well, but the intraspecific variation is too great to distinguish species within the broader *L. lepidii* species complex.

Description

Female (holotype)

Measurements. Length 4.3 mm; head length 1.26 mm; head width 1.33 mm; fore wing length 2.77 mm. Ten female paratypes measured: length 4.1–4.3 mm; head length 1.17–1.26 mm; head width 1.22–1.33 mm; fore wing length 2.77–2.78 mm.

Colour. Head and mesosoma metallic dark turquoise-green with golden reflections on mesoscutum; clypeus apical half black; scape dark reddish brown, F1–F10 dark reddish brown dorsally, light brown ventrally; tegula reddish-brown; wing membrane subhyaline, venation and pterostigma brown; legs dark brown; metasoma black with rims of terga and sterna dark brown.

Pubescence. Dull white; head and mesosoma with abundant long setae (1–2.5 OD); lower paraocular area and gena with sparse subappressed tomentum; mesoscutum with dense erect setae ~1 OD long interspersed with subappressed setae 0.25–0.5 OD long; propodeum with abundant plumose setae on lateral and posterior surfaces (1.5–2.5 OD); T1 with dense and complete setose fan, T2–T3 basal margins with dense appressed tomentum and disc of T4 with sparse tomentum throughout; T2–T4 evenly covered with dense, short, simple setae becoming long and plumose laterally (1–3 OD); tarsal segments with plumose, light-yellow setae.

Surface sculpture. Clypeus shiny and moderately sparsely punctate (i = 1–2 pd); supraclypeal area shiny and sparsely punctate (i = 1–3 pd); lower paraocular area shiny and densely punctate (i < 1 pd); antennocular area imbricate and densely punctate (i ≤ 1 pd); upper paraocular area and frons shiny and finely, densely punctate (i < 1 pd); ocellocular area shiny and densely punctate (i ≤ 1 pd); gena and postgena lineolate; tegula with a few fine and scattered minute punctures (i ≥ 1.5 pd), hardly visible at 40× magnification; mesoscutum weakly tessellate and sparsely punctate (i = 1–3 pd), becoming dense laterad of parapsidal lines (i < 1 pd); mesoscutellum shiny and moderately densely punctate (i = 1–1.5 pd); axilla shiny and densely punctate (i < 1 pd); metanotum finely rugulose; mesepisternum very densely punctate (i < 0.5 pd); metapostnotum dull with shallow subparallel rugae blending into finely reticulate background microsculpture; propodeum with posterior surface tessellate; T1–T2 weakly coriarious and minutely, moderatey sparsely punctate (i = 1–2 pd); T2–T3 apical impressed areas weakly coriarious and minutely, sparsely punctate (i = 1–4 pd).

Structure. Head wide (length/width ratio = 0.95–0.99; holotype = 0.95); eyes weakly convergent below (UOD/LOD ratio = 1.16–1.24; holotype = 1.21); clypeus $^{4}/_{5}$ below suborbital tangent; antennal sockets close (IAD/AOD < 0.54); frontal line ending 2.5–3 OD below median ocellus; gena narrower than eye; tegula inner posterior margin straight; inner metatibial spur pectinate with three teeth; scutellum length 0.27; metapostnotum length 0.22, metapostnotum elongate (MMR ratio = 1.23), posterior margin sharply angled onto posterior surface, propodeum with oblique carina present and lateral carina not reaching margin of dorsal surface.

Male

Measurements. Length: 4.5–4.52 mm; head length 1.01–1.3 mm; head width 1.07–1.33 mm; fore wing length 3.13–3.33 mm.

Colour. Head and mesosoma dark turquoise-green to olive green; clypeus apical half black; scape black; F1–F11 dark brown dorsally, light brown ventrally; tegula reddish-brown; legs dark brown with tarsi light brown; wing membrane subhyaline; venation and pterostigman brown; metasoma black with rims of terga and sterna dark brown.

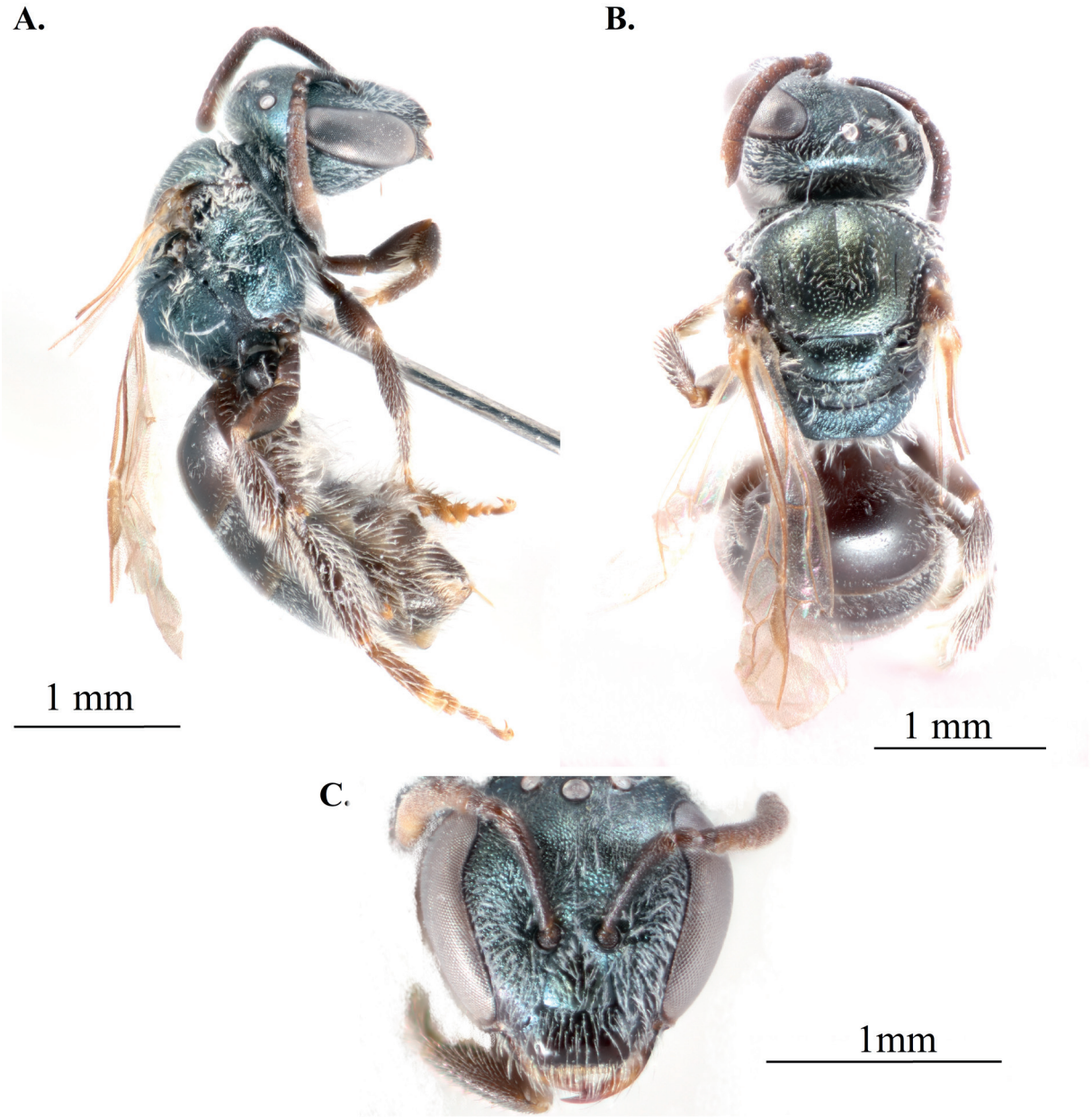

Fig. 15. *Lasioglossum* (*Dialictus*) *aureoviride* Landaverde-González & Husemann sp. nov., holotype, ♀ (490d UNAM). **A**. Lateral habitus. **B**. Dorsal habitus. **C**. Face.

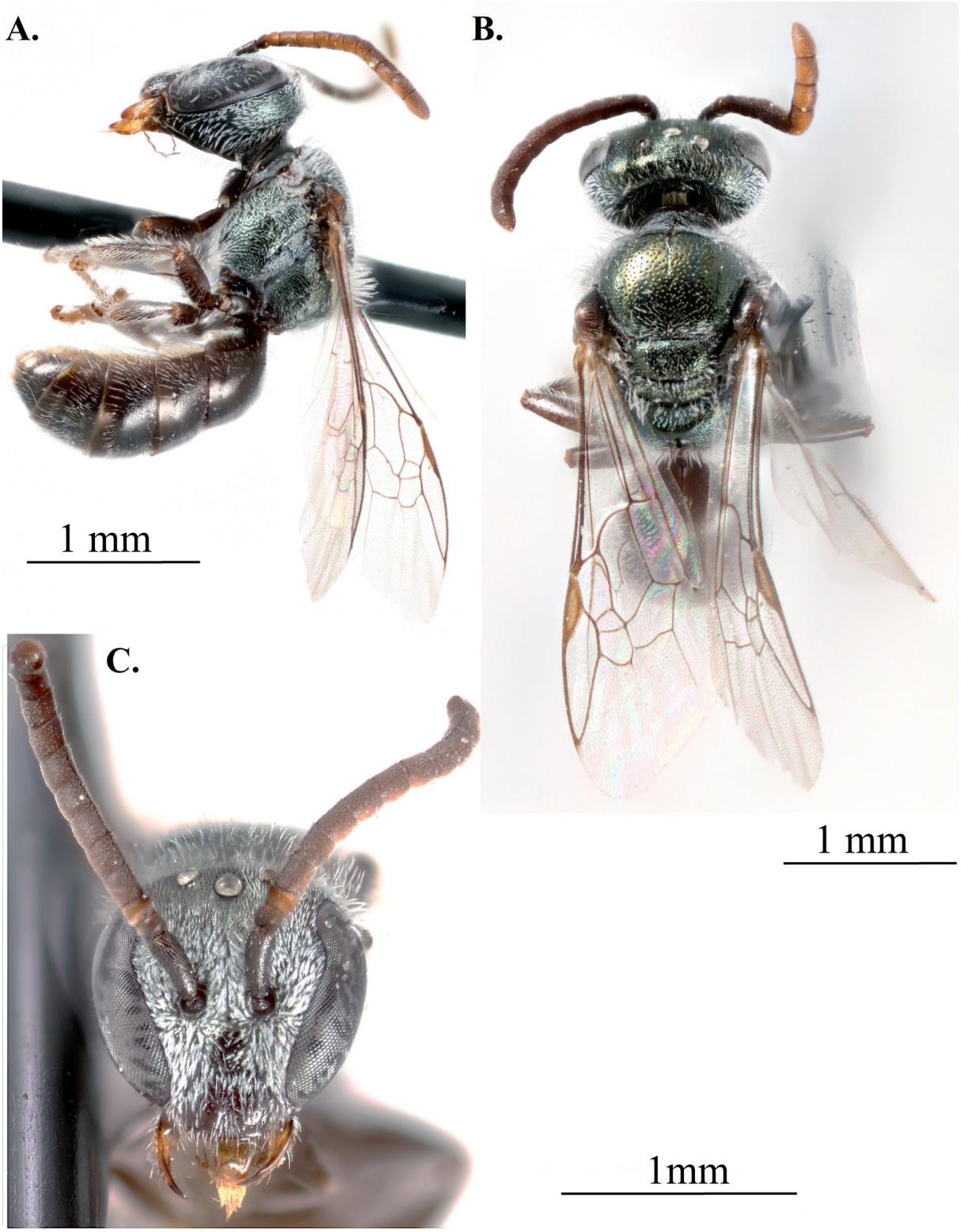

Fig. 16. *Lasioglossum* (*Dialictus*) *aureoviride* Landaverde-González & Husemann sp. nov., ♂ (SM0106177). **A**. Lateral habitus. **B**. Dorsal habitus. **C**. Face.

Pubescence. Dull white. Head and mesosoma with abundant long setae (1–2 OD); paraocular area and lower frons with dense appressed tomentum; clypeus, supraclypeal area, gena, and preëpisternum with sparse appressed tomentum; mesoscutum with dense plumose setae 0.5–1 OD long (all setae separated by less than half their length in lateral view); propodeum with abundant plumose setae on lateral and posterior surfaces (1–2 OD); tarsal segments with plumose light-yellow setae; discs of T1–T6 evenly covered with dense, short, simple setae, becoming long and plumose laterally (1–3 OD).

Surface sculpture. Clypeus shiny and densely punctate (i ≤ 1 pd); supraclypeal area shiny and moderately sparsely punctate (i = 1–2 pd); paraocular area and ocellocular area shiny and densely punctate (i < 1 pd); frons shiny with fine, crowded punctures (i = 0 pd); gena and postgena shiny; tegula finely, sparsely punctate (i = 1–3 pd); tegula with sparse punctures medially (i > 1.5 dp) (sometimes inconspicuous and tegula nearly impunctate); mesoscutum shiny and sparsely punctate (i = 1–3 pd), becoming dense laterad of parapsidal lines and on posterior margin (i ≤ 1 pd); mesoscutellum shiny and densely punctate (i ≤ 1 pd); mesepisternum rugulose with distinct dense punctures (i < 1 pd); propodeum with posterior surface shiny and densely punctate (i < 1 pd); discs of T1–T3 shiny and moderately densely punctate (i = 1–2 pd), apical impressed areas impunctate.

Structure. Head wide (length/width ratio = 0.94–0.96); eyes weakly convergent below (UOD/LOD ratio = 1.16–1.24; holotype = 1.19); clypeus $^{4}/_{5}$ below suborbital tangent; antennal sockets separated (IAD/AOD > 1.19); frontal line ending 2.5–3 OD below median ocellus; tegula enlarged, reaching posterior margin of mesoscutum in dorsal view, with inner posterior margin straight; scutellum length 0.28; metapostnotum length 0.22, metapostnotum elongate (MMR ratio = 1.27), posterior margin rounded onto posterior surface; genitalia with penis valve long and wide, retrorse lobe enlarged and wide, gonostylus medium and rounded, with a few short, simple setae near apex; S7–S8 median processes narrow.

Distribution

Only known from the Yucatán Peninsula.

Remarks

Common. Morphologically similar specimens were examined from the Atlantic coast from Veracruz to Tamaulipas. These specimens have the metapostnotum with strong anastomosing rugae, tegula more distinctly punctate, and the face noticeably shorter, and are thought to be an undescribed species. *Lasioglossum aureoviride* sp. nov. is a member of the *L. gemmatum* species complex and partially corresponds to mOTU5 in Landaverde-González *et al*. (2017a).

Lasioglossum* (*Dialictus*) *paralepidii Gardner sp. nov.
urn:lsid:zoobank.org:act:D68E4E0E-879C-4944-9AFE-025ADC3580AE
Figs 6F, 17–18. 29B, 31B, 32B, 35B, 36B

Diagnosis

Females of *L. paralepidii* sp. nov. can be recognised by the diagnostic combination of tegula enlarged (reaching posterior margin of mesoscutum in dorsal view), sparsely punctate (i = 1–3 pd), becoming dense on lateral and posterior margins (i ≤ 1 pd), and with inner posterior margin weakly concave; mesoscutum densely punctate (i ≤ 0.5–1 pd), becoming moderately sparse submedially and anteromedially (i = 1–2 pd); supraclypeal area very densely punctate (i ≤ 0.5–1 pd); mesepisternum very densely punctate (i < 0.5 pd); metapostnotum mostly shiny with weak microsculpture and strong anastomosing rugae reaching posterior margin; and T2–T3 apical impressed areas evenly covered with dense, short, simple setae. Males can be recognised by the same characters, except the tegula is more densely punctate (i ≤ 1 pd), the metapostnotum shiny with strong anastomosing rugae, and the metasomal terga apical

impressed areas are glabrous. In addition, the paraocular area is covered with dense appressed tomentum contrasting with the clypeus and supraclypeal area, which are mostly bare.

Differential diagnosis

Both sexes of *L. paralepidii* sp. nov. are most similar to *L. aureoviride* sp. nov. and some members of the *L. stictaspis* species complex. They are also very similar to the subtropical Florida species *L. lepidii*. See the differential diagnoses for *L. aureoviride* and the *L. stictaspis* species complex for comparison. Males of *L. lepidii* have the face below the eye emargination, including the clypeus and supraclypeal area, completely covered with dense appressed tomentum. Females of *L. lepidii* are morphologically nearly identical to *L. paralepidii* sp. nov., and reliable diagnostic characters separating the two are not known; it is best to identify females by geography and/or in association with males.

Etymology

The specific epithet '*paralepidii*' sp. nov. is formed from the Greek prefix '*para*-' ('near') and the specific epithet '*lepidii*', referring to its close relationship to *L. lepidii*.

Type material

Holotype

MEXICO – **Quintana Roo** • ♂; Felipe Carrillo Puerto; 19.35° N, 88.03° W; 10–14 Oct. 1986; USDA-ARS staff leg.; BBSL 1100921.

Paratypes

MEXICO – **Quintana Roo** • ♀; Isla Mujeres; 21.2412° N, 86.7397° W; 25 Jan. 1981; George E. Bohart leg.; BBSL 1100936 • 1 ♀; 12 km NW of Reforma; [18.89° N, 88.65° W]; 14 Oct. 1986; Charles D. Michener leg.; SEMC SM0753055 • 1 ♀; 8 km W of Puerto Morelos; [20.85° N, 86.95° W]; 16 Oct. 1986; Charles D. Michener leg.; SEMC • 2 ♂♂; Felipe Carrillo Puerto; 19.35° N, 88.03° W; 10–14 Oct. 1986; F.D. Parker leg.; BBSL 1100928, 1100930 • 4 ♂♂; same collection data as for holotype; BBSL 1100922 to 1100925 • 1 ♂; same collection data as for preceding; 13 Oct. 1986; F.D. Parker and Terry L. Griswold leg.; ex *Mentha* sp.; BBSL 1100934 • 1 ♂; Vallarta, 17 km W of Puerto Morelos; 20.8619° N, 87.0304° W; 6–8 Oct. 1986; Terry L. Griswold leg.; BBSL 1100937. – **Yucatán** • 1 ♀; Progreso Beach, N of Mérida; [21.28° N, 89.66° W]; 29 Jun. 1966; University of Kansas Mexico Expedition leg.; SEMC • 1 ♂; same collection data as for preceding; SEMC • 1 ♀; Tixcuytún; 20.2061° N, 89.1549° W; 7 Jun. 2011; Quezada-Euán and Moo-Valle leg.; ZMH 842060.

Other material examined

MEXICO – **Tabasco** • 1 ♀; 38 mi SE of Villahermosa; 17.6872° N, 92.5216° W; 9 Sep. 1974; George E. Bohart and W.J. Hanson leg.; BBSL 1101072 • 1 ♂; same collection data as for preceding; BBSL 1101071.

Floral records

LAMIACEAE Martinov: *Mentha* L. • SOLANACEAE Adans.: *Capsicum* L.: *C. chinense* Jacq.

DNA barcodes

None confirmed, but it is reasonably likely that some of the sequences listed for *L. aureoviride* sp. nov. actually correspond to *L. paralepidii* sp. nov. (see the discussion of DNA barcodes for *L. aureoviride*).

Description

Female

Measurements. Length 4.02 mm; head length 1.18 mm; head width 1.27 mm; fore wing length 2.57 mm.

Colour. Head and mesosoma metallic blue-green with golden reflections on mesoscutum, clypeus, and supraclypeal area; clypeus apical half black; scape and pedicel dark reddish brown, F1–F10 dark reddish brown, F8–F10 becoming light brown ventrally; tegula dark reddish-brown; wing membrane subhyaline, venation and pterostigma brown; legs dark brown; metasoma black with rims of terga and sterna reddish brown.

Pubescence. Dull white; head and mesosoma with abundant long setae (1–2.5 OD); lower paraocular area, gena, and preëpisternum with sparse subappressed tomentum; mesoscutum with dense erect setae ~1 OD long interspersed with subappressed setae 0.25–0.5 OD long; propodeum with abundant plumose setae on lateral and posterior surfaces (1.5–2.5 OD); T1 with dense and complete setose fan, T2–T3 basal margins with dense appressed tomentum and disc of T4 with sparse tomentum throughout; T2–T4 evenly covered with dense, short, simple setae becoming long and plumose laterally (1–3 OD); tarsal segments with plumose, light-yellow setae.

Surface sculpture. Clypeus shiny and densely punctate (i ≤ 1 pd); supraclypeal area shiny and very densely punctate (i ≤ 0.5-1 pd); lower paraocular area shiny and densely punctate (I ≤ 1 pd); antennocular area imbricate and densely punctate (i ≤ 1 pd); upper paraocular area and frons shiny and finely, densely punctate (i < 1 pd); ocellocular area shiny and densely punctate (i ≤ 1 pd); gena and postgena lineate; tegula finely and sparsely punctate (i = 1–3 pd), becoming dense on lateral and posterior margins (i ≤ 1 pd); mesoscutum weakly tessellate and densely punctate (i ≤ 0.5-1 pd), becoming moderately sparse submedially and anteromedially (i = 1–2 pd); mesoscutellum weakly tessellate and densely punctate (i < 1 pd), becoming moderately sparse submedially (i = 1–2 pd); axilla shiny and densely punctate (i < 1 pd); metanotum finely rugulose; mesepisternum imbricate and very densely punctate (i < 0.5 pd); metapostnotum shiny laterally, becoming dull with finely reticulate microsculpture medially, covered with strong anastomosing rugae reaching posterior margin; propodeum with posterior surface weakly tessellate; T1–T2 weakly coriarious and minutely, moderatey sparsely punctate (i = 1–2 pd); T2–T3 apical impressed areas weakly coriarious and minutely, sparsely punctate (i = 1–4 pd).

Structure. Head wide (length/width ratio = 0.93); eyes weakly convergent below (UOD/LOD ratio = 1.20); clypeus $^{3}/_{5}$ below suborbital tangent; antennal sockets close (IAD/AOD = 0.52); frontal line ending 1–2 OD below median ocellus; gena narrower than eye; tegula inner posterior margin straight; inner metatibial spur pectinate, with three teeth; metapostnotum elongate (MMR ratio = 1.09), posterior margin sharply angled onto posterior surface, propodeum with oblique carina straight and lateral carina not reaching margin of dorsal surface.

Male (holotype)

Measurements. Length: 4.16 mm; head length 1.05 mm; head width 1.05 mm; fore wing length 2.53 mm.

Colour. Head and mesosoma metallic blue-green to golden green; clypeus apical half black; scape and pedicel brown; F1–F11 dark brown dorsally, light brown ventrally; tegula dark reddish brown; legs dark brown with tarsi light brown; wing membrane hyaline; venation and pterostigma brown; metasoma dark brown with rims of terga and sterna reddish brown.

Pubescence. Dull white. Head and mesosoma with abundant long setae (1–2 OD); paraocular area and lower frons with dense appressed tomentum; gena, preepisternum, and sometimes clypeus and supraclypeal area with sparse appressed tomentum; mesoscutum with dense plumose setae 0.5–1 OD long; propodeum with abundant plumose setae on lateral and posterior surfaces (1–2 OD); tarsal segments with plumose light-yellow setae; discs of T1–T6 evenly covered with dense, short, simple setae, becoming long and plumose laterally (1–3 OD).

Surface sculpture. Clypeus shiny and densely punctate (i < 1 pd); supraclypeal area shiny and densely punctate (i ≤ 1 pd); paraocular area and ocellocular area shiny and densely punctate (i < 1 pd); frons shiny with fine, crowded punctures (i = 0 pd); gena shiny; postgena lineolate; tegula densely punctate medially (i ≤ 1 pd); mesoscutum shiny or tessellate and moderately densely punctate (i = 1–2 pd), becoming denser laterad of parapsidal lines and on posterior margin (i < 1 pd); mesoscutellum shiny and densely to moderately densely punctate (i = 0.5–2 pd); mesepisternum shiny and densely punctate (i < 1 pd); metapostnotum shiny with weak microsculpture and strong rugae; propodeum with posterior

Fig. 17. *Lasioglossum* (*Dialictus*) *paralepidii* Gardner sp. nov., ♀ (BBSL1100936). **A**. Lateral habitus. **B**. Dorsal habitus. **C**. Face.

surface shiny and moderately sparsely punctate (i = 1–2 pd); discs of T1–T3 shiny and finely, moderately densely punctate (i = 1–2 pd), apical impressed areas impunctate.

Structure. Head round (length/width ratio = 1.00); antennal sockets separated (IAD/AOD = 1.35); frontal line ending 1–2 OD below median ocellus; tegula enlarged, reaching posterior margin of

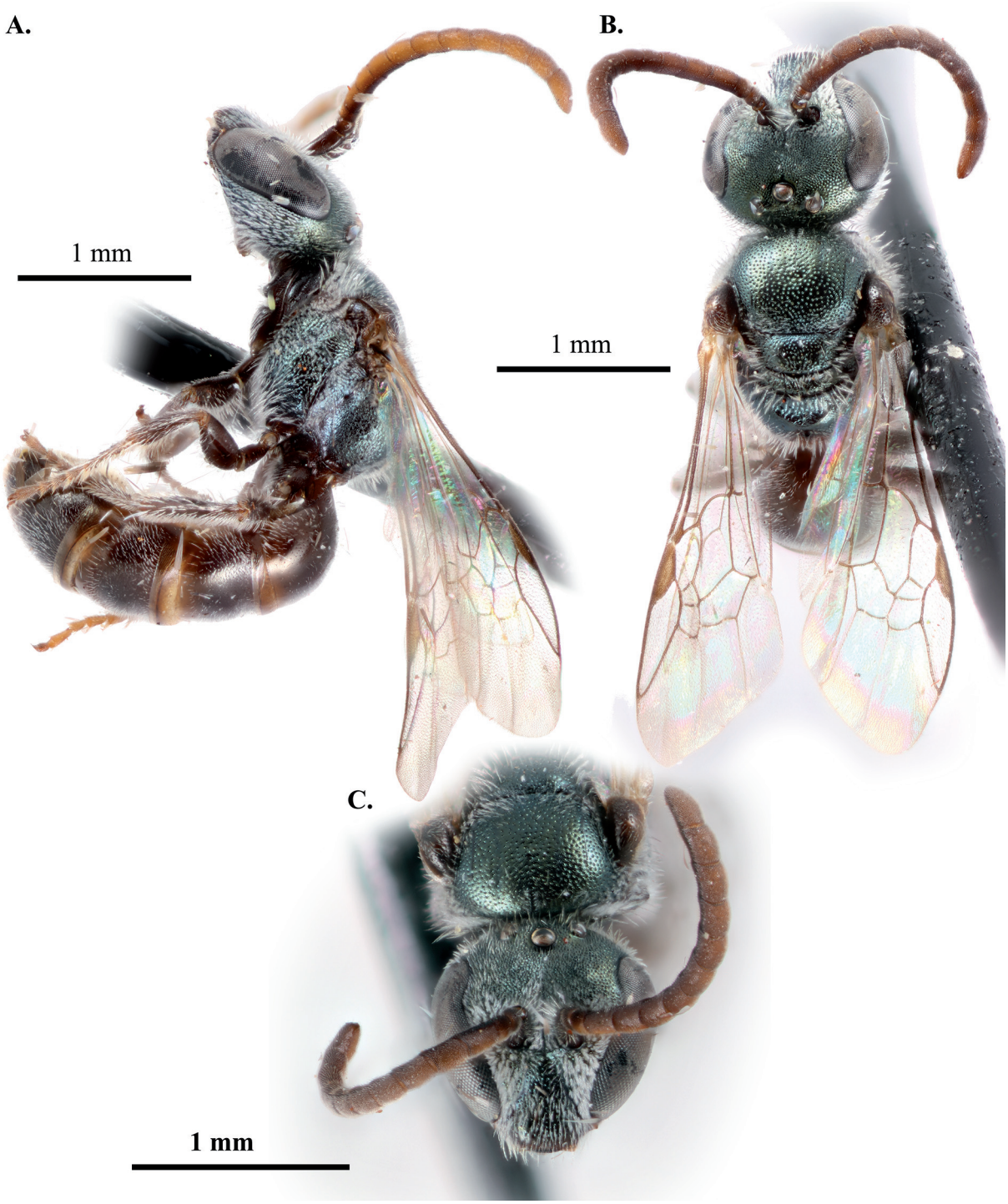

Fig. 18. *Lasioglossum* (*Dialictus*) *paralepidii* Gardner sp. nov., holotype, ♂ (BBSL 1100921). **A**. Lateral habitus. **B**. Dorsal habitus. **C**. Face.

mesoscutum in dorsal view, with inner posterior margin straight or weakly concave; metapostnotum elongate (MMR ratio = 1.34), posterior margin rounded onto posterior surface; genitalia not examined.

Distribution

Only known from the Yucatán Peninsula.

Remarks

Uncommon. Some morphologically similar specimens were examined from María Cleofas, Isla Tres Marías, Nayarit. These specimens have the metapostnotum rugae not reaching the posterior margin and are believed to be an undescribed species. It seems likely that there is a large complex including many undescribed species related to *L. lepidii*, *L. aureoviride* sp. nov., and *L. paralepidii* sp. nov. occurring throughout the Neotropics. Further revisionary work is needed to elucidate this complex. *Lasioglossum paralepidii* is a member of the *L. gemmatum* species complex and partially corresponds to mOTU5 in Landaverde-González *et al*. (2017a).

Lasioglossum* (*Dialictus*) *milpa Landaverde-González sp. nov.
urn:lsid:zoobank.org: act:6D61F2D7-BF99-4B3E-8560-01405B0F3977
Figs 6G, 19, 25C, 27A

Diagnosis

Females of *L.* (*D.*) *milpa* sp. nov. can be recognised by the diagnostic combination of tegula small, ovoid, not produced mesally (tegula width/ITS < 0.20), and impunctate; frons punctures much smaller and denser than those of lower paraocular area; mesoscutum sparsely punctate between parapsidal lines (i = 1.5–3 pd), becoming moderately dense but not crowded laterad of parapsidal lines (i = 1 pd); metapostnotum dull, imbricate with shallow anastomosing rugae reaching posterior margin or nearly so; and head about as long as broad (length/width 0.95–0.99). The male is unknown.

Differential diagnosis

Females of *Lasioglossum* (*D.*) *milpa* sp. nov. are most similar to those of *L.* (*D.*) *ameshoferi* sp. nov., *L.* (*D.*) *nanotegula* sp. nov., and *L.* (*D.*) *aureoviride* sp. nov. Females of *L. ameshoferi* also have the frons punctures as large and dense as those in the lower paraocular area and the mesoscutum much more coarsely and densely punctate laterad of the parapsidal lines (i = 0 pd). Females of *L. ameshoferi* and *L. nanotegula* have the metapostnotum shiny with strong and coarse rugae and the propodeum with its oblique carina U-shaped and extending onto the dorsolateral slope. Females of *L. aureoviride* have the tegula enlarged (reaching posterior margin in dorsal view), with the inner posterior margin straight.

Etymology

The specific epithet '*milpa*' is a noun in apposition that refers to the traditional agriculture that is mainly found in the region and apparently beneficial for the different species of *Lasioglossum* (*Dialictus*) found there (Landaverde-González *et al*. 2017b).

Type material

Holotype

MEXICO – **Campeche** • ♀; Hopelchén; 19.41° N, 89.35° W; elev. 130 m; 27 Jan. 2016; Eric Vides leg.; ECOAB.82909.

Paratypes

MEXICO – **Chiapas** • 1 ♀; Ocosingo, El Rosario; 16.8859° N, 92.2742° W; elev. 1118 m; 11 Feb. 2010; Jorge Mérida leg.; ECOAB.43291. – **Yucatán** • 1 ♀; Tixcacaltuyub; [20.4175° N, 88.931° W]; 22 Jun.

2011; Quezada-Euán and Moo-Valle leg.; ZMH 839502 • 1 ♀; Uxmal Ruins, 16 km SW of Muna; [20.36° N, 89.77° W]; 14 Feb. 1987; Charles D. Michener leg.; SEMC.

Other material examined

MEXICO – **Yucatán** • 1 ♀; Tixcacaltuyub; [20.4175° N, 88.931° W]; 22 Jun. 2011; Quezada-Euán and Moo-Valle leg.; ZMH 839505 • 2 ♀♀; Yaxcopil; [20°4′4.10″ N, 88°54′23.80″ W]; 25 Oct. 2011; Quezada-Euán and Moo-Valle leg.; original labels 602a, 602b; ZMH 81035, 81036 • 2 ♀♀; same collection data as preceding; original labels 604a1, 604a2; ZMH 81037, 81038 • 1 ♀; Tah Dziú; [20°10′06.9″ N, 88°55′36.2″ W]; 6 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 240a2; ZMH 839504 • 1 ♀; Alfonso Caso; [20°05′02.5″ N, 89°09′39.3″ W]; 25 Oct. 2011; Quezada-Euán and Moo-Valle leg.; original label 84; ZMH 842058 • 1 ♀; Alfonso Caso; [20°05′02.5″ N, 89°09′39.3″ W]; 25 Oct. 2011; Quezada-Euán and Moo-Valle leg.; original label 85; ZMH 842059 • 1 ♀; Moctezuma; [21°24′46.2″ N, 87°42′05.7″ W]; 30 May 2011; Quezada-Euán and Moo-Valle leg.; original label 159; ZMH 842028 • 1 ♀; Tah Dziú; [20°10′06.9″ N, 88°55′36.2″ W]; 7 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 238; ZMH 842032 • 1 ♀; Tixcacaltuyub; 20°25′03.1″ N, 88°55′51.5″ W; 22 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 503d; ZMH 842061 • 1 ♀; Santa María; [20°23′32.5″ N, 88°55′14.6″ W]; 26 Jul. 2011; Quezada-Euán and Moo-Valle leg.; original label 587b; ZMH 842063 • 1 ♀; Santa María; 20°23′32.5″ N, 88°55′14.6″ W; 26 Jul. 2011; Quezada-Euán and Moo-Valle leg.; original label 588; ZMH 842064 • 1 ♀; Tixcuytun; [20°12′21.80″ N, 89°09′17.50″ W]; 7 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 493; ZMH 842060 • 1 ♀; Muna; 20°28′15.7″ N, 89°46′53.5″ W; 22 Jul. 2011; Quezada-Euán and Moo-Valle leg.; original label 570c; ZMH 842062 • 1 ♀; Nenela; [20°20′10.90″ N, 89°1′19.20″ W]; 10 May 2011; Quezada-Euán and Moo-Valle leg.; original label 40; UADY • 1 ♀; Timul; 20°18′56.1″ N, 88°55′55.9″ W; 9 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 301; UADY.

Floral records

SOLANACEAE Adans.: *Capsicum* L.: *C. chinense* Jacq.

DNA barcodes

Twenty-eight sequences available (BOLD process IDs: LDSPS077-15 to LDSPS095-15, LDSPS098-15, LDSPS099-15, LDSPS103-15 to LDSPS109-15). These sequences are extremely variable, and therefore poorly distinguished from those of other species (maximum intraspecific p-distance 2.45%; minimum interspecific p-distance (to *L. aureoviride* sp. nov.) 4.32%). This group of sequences is very tentatively attributed to *L. milpa* sp. nov. based on their similarity to the *L.* sp. mex8 sequence (unfortunately the original specimen to be designated as holotype was destroyed), an undescribed species which is most morphologically similar to *L. milpa*. However, it is possible that more cryptic species exists.

Description

Female (holotype)

Measurements. Length 4.13 mm; head length 1.24 mm; head width 1.3 mm; fore wing length 2.93 mm. Eight female paratypes measured: length 4.13–5.10 mm; head length 1.17–1.24 mm; head width 1.22–1.3 mm; fore wing length 2.78–2.93 mm.

Colour. Head and mesosoma blue-green to olive green; clypeus apical half black; scape and pedicel black; F1–F10 black dorsally, brown ventrally; tegula reddish brown; wing membrane subhyaline, venation and pterostigma brown; legs dark brown; metasoma black with rims of terga and sterna dark brown.

Pubescence. Dull white; head and mesosoma with abundant long setae (1–2.5 OD); lower paraocular area and gena with sparse subappressed tomentum; propodeum with abundant plumose setae on lateral and posterior surfaces (1.5–2.5 OD); mesepisternum with dense plumose setae (1–1.5 OD); T1 with dense complete setose fan; T1 shiny with sparse, short, simple setae medially; T2–T4 evenly covered with dense, short, simple setae, about half as long on T2 and absent on apical impressed area medially; T2–T3 with small basolateral patches of appressed tomentum covering less than half length of segment laterally; T4 with sparse tomentum in basal half, tibia and tarsal segments with plumose light-yellow setae.

Fig. 19. *Lasioglossum* (*Dialictus*) *milpa* Landaverde-González sp. nov., holotype, ♀ (ECOAB.82909). **A**. Lateral habitus. **B**. Dorsal habitus. **C**. Face.

Surface sculpture. Clypeus shiny and densely punctate (i ≤ 1 pd); supraclypeal area shiny and moderately sparsely punctate (i = 1–2 pd); lower paraocular area shiny and densely punctate (i < 1 pd); antennocular area imbricate and densely punctate (i ≤ 1 pd); upper paraocular area and frons shiny with crowded punctures (i = 0 pd); ocellocular area shiny and moderately densely punctate (i = 1–2 pd); punctures of upper half of face distinctly smaller and denser than punctures of lower half; gena and postgena lineate; mesoscutum between parapsidal lines sparsely punctate (i = 1.5–3 pd), becoming moderately dense laterad of parapsidal lines (i = 1 pd); metapostnotum dull, imbricate with shallow anastomosing rugae reaching posterior margin or nearly so; mesepisternum slightly sparsely punctate (i ≤ 1–1.5d); metepisternum finely rugulose; propodeum posterior surface tessellate; discs of T1–T2 very finely, minutely, sparsely punctate (i = 1–3 pd); T2 apical impressed area very minutely, sparsely punctate laterally (i = 2–4 pd).

Structure. Head wide (length/width ratio = 0.94–0.99; holotype = 0.95); eyes weakly convergent below (UOD/LOD ratio = 1.14–1.30; holotype = 1.27); clypeus $^{4}/_{5}$ below suborbital tangent; antennal sockets close (IAD/AOD < 0.55); frontal line ending < 2 OD below median ocellus; head about as long as broad (length/width 0.94–0.99); gena wider than eye; tegula small, ovoid, not produced mesally; inner metatibial spur pectinate, with 3–4 teeth; scutellum length 0.25; metapostnotum length 0.2, metapostnotum elongate (MMR ratio = 1.25), posterior margin sharply angled onto posterior surface; propodeum with lateral carina not reaching margin of dorsal surface.

Male

Unknown.

Distribution

Yucatán Peninsula and northern Chiapas.

Remarks

This species is a member of the informal *L. comulum* species group and corresponds to mOTU6 in Landaverde-González *et al*. (2017a).

Lasioglossum* (*Dialictus*) *nanotegula Landaverde-González & Husemann sp. nov.
urn:lsid:zoobank.org:act:907458CF-52CC-464C-A761-66B9373D5153
Figs 6H, 20–21, 25B, 26B, 27B, 34B

Diagnosis

Females of *L.* (*D.*) *nanotegula* sp. nov. can be recognised by the diagnostic combination of tegula small, ovoid (tegula width/ITS < 0.20), and impunctate; frons punctures much finer and denser than those of lower paraocular area; head broader than long (length/width 0.91–0.95); mesoscutum moderately sparsely punctate between parapsidal lines (i = 1–3 pd), becoming dense but not crowded laterad of parapsidal lines (i ≤ 1 pd); metapostnotum shiny to weakly tessellate with strong coarse rugae reaching posterior margin; and T1–T3 apical impressed areas evenly covered with fine sparse punctures (i = 1–3 pd) with short simple setae arising from them (except absent on T1 medially). Males can be recognised by the same characters (however, the single male available for study is missing the metasoma, so metasoma-based diagnostic characters are uncertain); in addition, males have the paraocular area and lower frons with dense appressed tomentum.

Differential diagnosis

Females of *L.* (*D.*) *nanotegula* sp. nov. are most similar to those of *L.* (*D.*) *milpa* sp. nov. and *L.* (*D.*) *ameshoferi* sp. nov. For comparison with *Lasioglossum* (*D.*) *ameshoferi* see above in *L.* (*D.*) *ameshoferi*

differential diagnosis; however, the male of that species is unknown. For comparison with *L.* (*D.*) *milpa* see above in *L.* (*D.*) *milpa* differential diagnosis.

Etymology

The specific epithet '*nanotegula*' is a combination of the Latin nouns '*nanus*' ('dwarf') and '*tegula*' ('roof tile', literally 'covering instrument', now applied to the sclerite covering the wing base). It refers to the small size of the tegula.

Type material

Holotype

MEXICO – **Yucatán** • ♀; Mérida, 15 km S of University of Yucatán; [20.83° N, 89.62° W]; 7 Apr. 1997; R.W. Brooks leg.; ex *Piscidia piscipula*; SEMC SM0105925.

Paratypes

GUATEMALA – **Huehuetenango** • 1 ♀; Jacaltenango, San Andrés; 15.7167° N, 91.7455° W; elev. 1027 m; 28 Feb. 2010; Miguel Cigarroa leg.; ECOAB.43341 • 1 ♀; La Democracia, Camojaíto; 15.616° N, 91.8727° W; elev. 940 m; 1 Mar. 2010; Daniel Sánchez leg.; ECOAB.43336 • 1 ♀; San Antonio Huista, Pinalito; 15.6653° N, 91.8618° W; elev. 963 m; 2 Mar. 2010; Jaime Florez leg.; ECOAB.43339.

MEXICO – **Chiapas** • 1 ♀; Arriaga, Ej. Adolfo López Mateos; 16.3463° N, 93.9741° W; elev. 367.5 m; 17 Jul. 2009; Carlos Balboa, Miguel Guzmán and Miguel Cigarroa leg.; ECOAB.53487 • 1 ♀; same collection data as for preceding; 17 Nov. 2009; ECOAB.53350 • 1 ♀; Arriaga, Paraje, Poza Verde; 16.3428° N, 93.952° W; elev. 465.5 m; 14 Mar. 2009; Carlos Balboa, Miguel Guzmán and Miguel Cigarroa leg.; ECOAB.53314 • 1 ♀; same collection data as for preceding; 15 Jul. 2009; ECOAB.53483 • 2 ♀♀; La Trinitaria, Carretera 190; 16.0424° N, 92.0179° W; elev. 1041 m; 15 Feb. 2014; Philippe Sagot leg.; ECOAB.53398, ECOAB.53399 • 1 ♀; Mapastepec, El Unión Los Olivos; 15.3083° N, 92.4738° W; elev. 315 m; 1 Apr. 2005; M. Rincón, Ricardo Ayala Barajas, R. Vandame and Miguel Guzmán leg.; ECOAB.43760 • 1 ♀; Ocosingo, El Rosario; 16.8859° N, 92.2742° W; elev. 1118 m; 11 Feb. 2010; Philippe Sagot leg.; ECOAB.43281 • 2 ♀♀; Ocosingo, Sibaca; 16.9447° N, 92.1839° W; elev. 1107 m; 12 Apr. 2010; Carlos Balboa leg.; ECOAB.43271, ECOAB.43331 • 1 ♀; San Juan Cancuc, Tzuluwitz; 16.894° N, 92.4019° W; elev. 1270 m; 6 Apr. 2010; Philippe Sagot leg.; ECOAB.43325. – **Quintana Roo** • 1 ♀; 12 km NW of Reforma; [18.89° N, 88.65° W]; 14 Oct. 1986; Charles D. Michener leg.; SEMC. – **Yucatán** • 1 ♂; same collection data as for holotype; SEMC SM0105924 (photographed) • 1 ♀; Tah Dziú; [20°10′06.9″ N, 88°55′36.2″ W]; 7 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 237; ZMH 842031 • 2 ♀♀; Uxmal Ruins, 16 km SW of Muna; [20.36° N, 89.77° W]; 14 Feb. 1987; Charles D. Michener leg.; SEMC.

Other material examined

MEXICO – **Jalisco** • 1 ♀; Chamela; [19.5° N, 105.04° W]; 26 Sep. 1985; R.J. McGinley leg.; USNM • 1 ♀; same collection data as for preceding; 30 Sep. 1985; USNM • 2 ♀♀; Guadalajara; [20.65° N, 103.35° W]; J.C. Crawford leg.; USNM • 1 ♀; Mascota; [20.53° N, 104.79° W]; 17 Jul. 1989; R.J. McGinley leg.; USNM. – **Yucatán** • 1 ♂; Tah Dziú; 6 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 452b; ZMH 839503 • 1 ♀; Muna; [20°28′15.7″ N, 89°46′53.5″ W]; 22 Jul. 2011; Quezada-Euán and Moo-Valle leg.; original label 570; ZMH 842054 • 1 ♀; Tixmehuac; [20°15′52.4″ N, 89°08′58.1″ W]; 15 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 410; ZMH 842034 • 1 ♀; Tixcuytun; [20°12′21.80″ N, 89°09′17.50″ W]; 7 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 488b; ZMH 842036 • 1 ♂; Xaya, [20°16′51.70″ N, 89°11′28.70″ W], 5 Aug. 2011; Quezada-Euán and Moo-Valle leg.; original label 621c; ZMH 839508 • 1 ♀; Tixcuytun; [20°12′21.80″ N, 89°09′17.50″ W]; 7 Jun. 2011; Quezada-Euán and Moo-Valle leg.; original label 493; ZMH 842037 •

1 ♀; Muna; [20°28′15.7″ N, 89°46′53.5″ W]; 22 Jul. 2011; Quezada-Euán and Moo-Valle leg.; original label 569a; ZMH 842068 • 1 ♀; Yaxcopil; [20°4′4.10″ N, 88°54′23.80″ W]; 1 Aug. 2011; Quezada-Euán and Moo-Valle leg.; original label 605b; ZMH 842069 • 1 ♀; Alfonso Caso; [20°05′02.5″ N, 89°09′39.3″ W]; 25 Oct. 2011; Quezada-Euán and Moo-Valle leg.; original label 92; ZMH 842066.

Floral records

FABACEAE Juss.: *Piscidia* L.: *P. piscipula* (L.) Sarg. • SOLANACEAE Adans.: *Capsicum* L.: *C. chinense* Jacq.

DNA barcodes

Seventeen sequences available (BOLD process IDs: LDSPS040-15 to LDSPS051-15, LDSPS096-15, LDSPS097-15, LDSPS100-15 to LDSPS102-15). These sequences are highly variable (maximum intraspecific p-distance 1.3%; minimum interspecific distance, to *L. aureoviride* sp. nov., 3.96%). The other sequences not from Yucatán are much less variable, with a clear barcode gap (maximum intraspecific p-distance 0.2%; minimum interspecific distance, to *L. nanotegula* sp. nov., 4.4%). This species is a member of the informal *L. comulum* species group and corresponds to mOTU4 in Landaverde-González *et al*. (2017a).

Description

Female (holotype)

Measurements. Length 4.45 mm; head length 1.21 mm; head width 1.33 mm; fore wing length 2.93 mm. Six female paratypes measured: length 4.25–4.46 mm; head length 1.15–1.21 mm; head width 1.21–1.33 mm; fore wing length 2.91–2.94 mm.

Colour. Head and mesosoma metallic blue-green to olive green; clypeus apical half black; supraclypeal area with golden reflection; scape and pedicel black, F1–F10 black, F8–F10 becoming brown ventrally; wing membrane subhyaline, subcosta dark brown, venation and pterostigma otherwise light brown; legs dark brown with distitarsi light brown; metasoma dark brown with rims of terga and sterna lighter reddish brown.

Pubescence. Dull white. Head and mesosoma with abundant long setae (1–2.5 OD); lower paraocular area and gena with sparse subappressed tomentum; propodeum with abundant plumose setae on lateral and posterior surfaces (2 OD); T1 with with dense complete setose fan; T2–T3 with small basolateral patches of appressed tomentum covering less than half length of segment laterally; disc of T4 with sparse appressed tomentum throughout; T1–T5 evenly covered with dense, short, simple setae, about half as long on T1–T2, becoming long and plumose laterally (1–2.5 OD); tibia and tarsal segments with plumose light-yellow setae.

Surface sculpture. Clypeus shiny and densely punctate (i ≤ 1 pd); supraclypeal area shiny and moderately sparsely punctate (i = 1–2 pd); paraocular area and antennocular area shiny and very densely punctate (i < 0.5 pd); upper paraocular area and frons with fine crowded punctures (i = 0 pd); gena and postgena shiny; mesoscutum moderately sparsely punctate between parapsidal lines (i = 1–3 pd), becoming dense and crowded laterad of parapsidal lines (i ≤ 1 pd); mesepisternum imbricate and densely punctate (i ≤ 1 pd); metapostnotum shiny to weakly tessellate, with strong coarse rugae reaching posterior margin; propodeum with lateral surface and posterior surface weakly tessellate; T1–T3 minutely, sparsely punctate (i = 1–3 pd); T1 apical impressed area impunctate medially.

Structure. Head wide (length/width ratio = 0.91–0.95; holotype = 0.91); eyes weakly convergent below (UOD/LOD ratio = 1.23–1.28; holotype = 1.23); clypeus $^{4}/_{5}$ below suborbital tangent; antennal sockets close (IAD/AOD < 0.52); frontal line ending > 2.5 OD below median ocellus; head broader than

long (length/width 0.91–0.95); gena narrower than eye; inner metatibial spur with three teeth; tegula small, ovoid, not produced mesally (tegula width/ITS < 0.215); scutellum length 0.28; metapostnotum length 0.22, metapostnotum elongate (MMR ratio = 1.27), posterior margin rounded onto posterior surface; propodeum with oblique carina straight and lateral carina not reaching margin of dorsal surface.

Male

Measurements. Length 3.58 mm; head length 1.05 mm; head width 1.09 mm; fore wing length 2.57 mm.

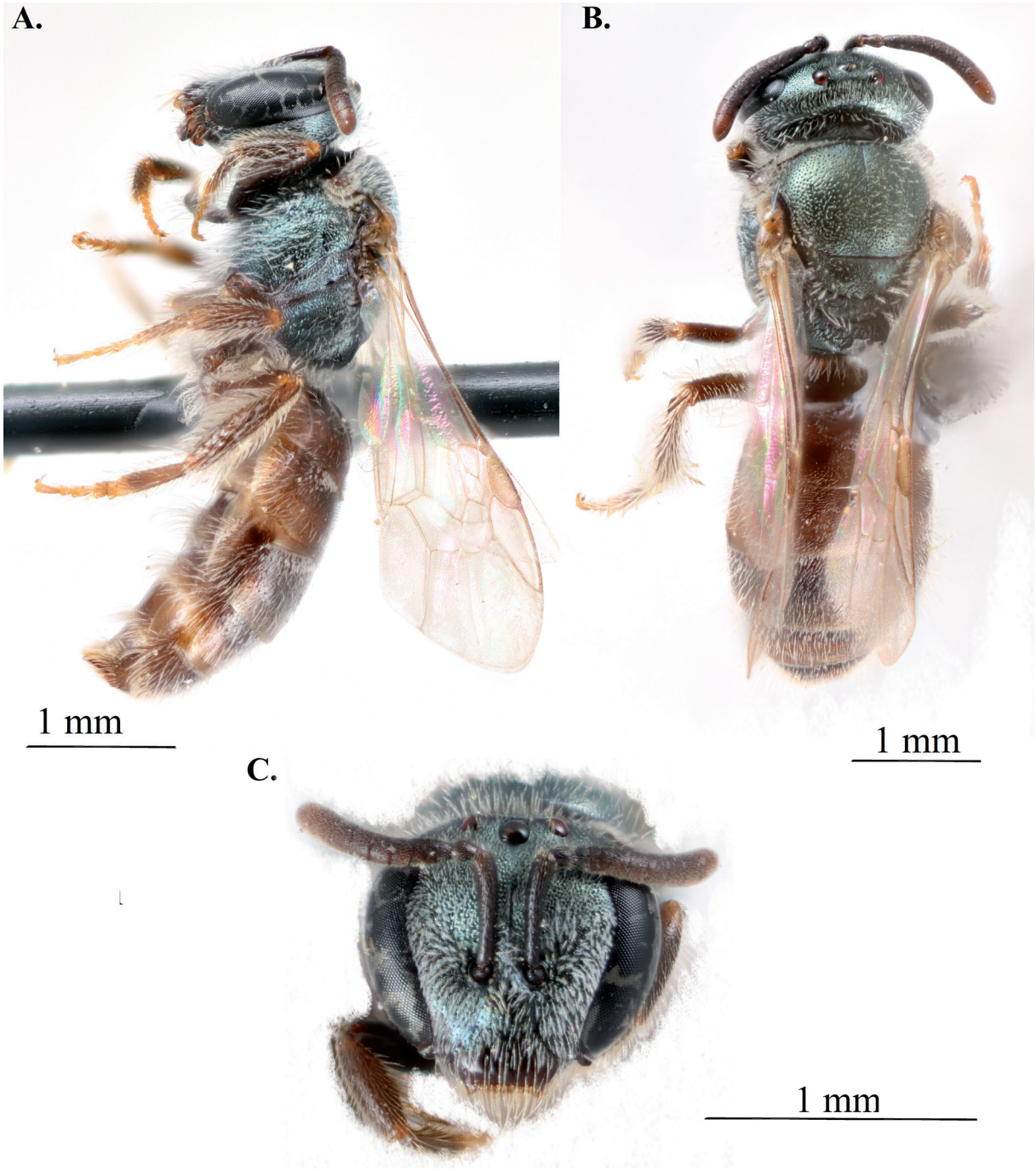

Fig. 20. *Lasioglossum* (*Dialictus*) *nanotegula* Landaverde-González & Husemann sp. nov., holotype, ♀ (SM0105925). **A**. Lateral habitus. **B**. Dorsal habitus. **C**. Face.

Colouration. Head and mesosoma metallic blue-green; scape and pedicel dark brown; F1–F10 dark brown dorsally, light brown ventrally; legs dark brown with tibial bases, apices, and tarsi light brown.

Pubescence. Dull white. Head and mesosoma with abundant plumose short setae (0.5–2 OD); paraocular area and lower frons with dense appressed tomentum; clypeus, supraclypeal area, and gena with sparse appressed tomentum; propodeum with abundant plumose setae on lateral and posterior surfaces (1–2 OD); S3–S5 pubescence short (1–2 OD), suberect, and weakly plumose, appearing simple at < 40 × magnification; tibia and tarsal segments with plumose light-yellow setae.

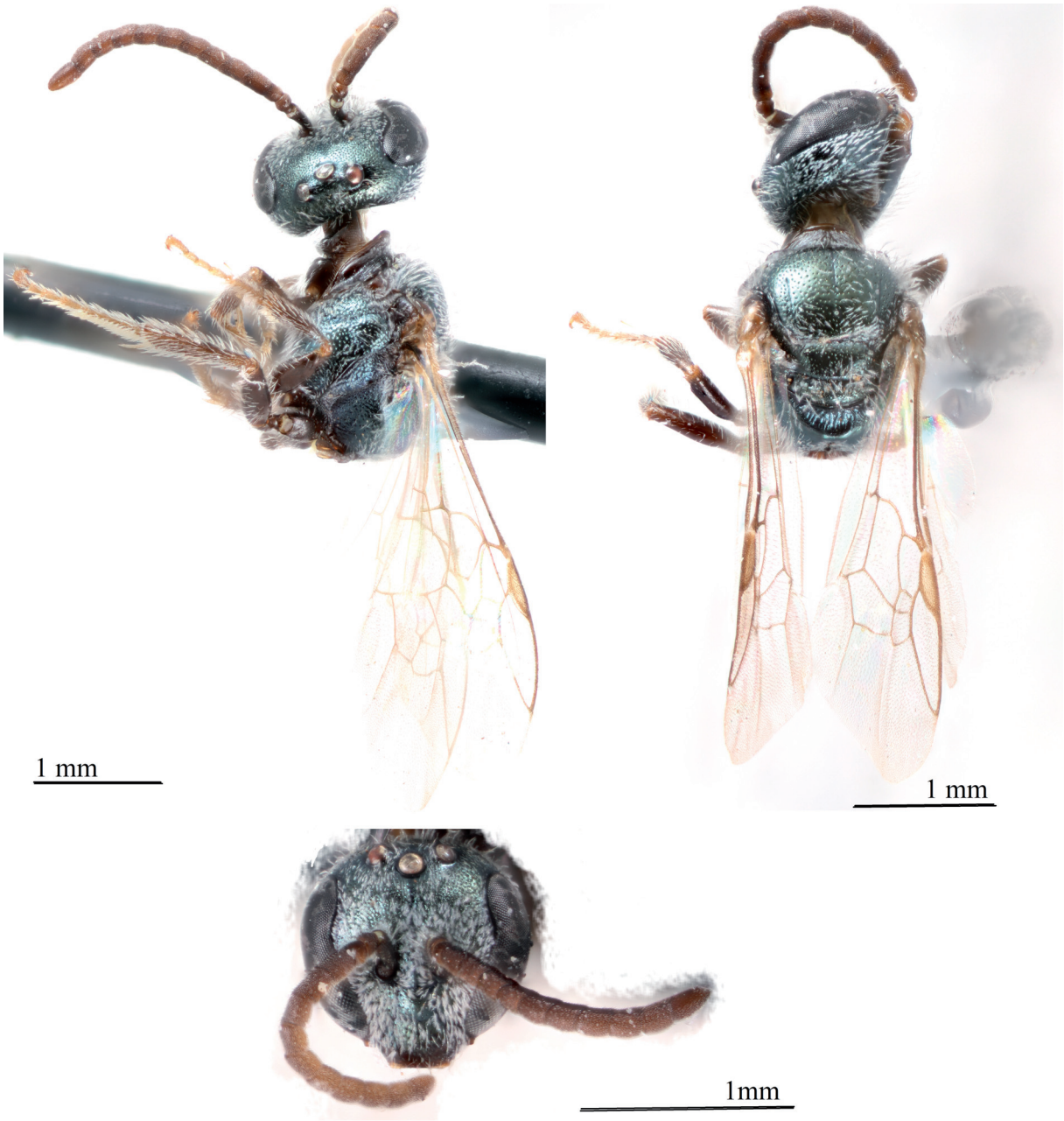

Fig. 21. *L.* (*Dialictus*) *nanotegula* Landaverde-González & Husemann sp. nov., ♂ (SM0105924). **A**. Lateral habitus. **B**. Dorsal habitus. **C**. Face.

Surface sculpture. Clypeus shiny and sparsely punctate (i = 1–3 pd); supraclypeal area shiny and moderately sparsely punctate (i = 1–2 pd); lower paraocular area and antennocular area shiny and densely punctate (i < 1 pd); upper paraocular area and frons shiny with crowded punctures (i = 0 pd); ocellocular area shiny and densely punctate (i ≤ 1 pd); gena and postgena weakly imbricate-rugulose, mostly shiny; mesoscutum shiny and sparsely punctate between parapsidal lines (i = 1–3 pd), becoming moderately denser laterad of parapsidal lines (i ≤ 1.5 pd); mesepisternum shiny and densely punctate (i < 1 pd); metapostnotum shiny with strong or somewhat finer rugae not reaching onto propodeum dorsolateral slope except at base; propodeum with lateral surface and posterior surface shiny and moderately densely punctate (i = 1–2 pd) and with oblique carina absent.

Structure. Head wide (length/width ratio = 0.97–0.99); eyes weakly convergent below (UOD/LOD ratio = 1.55); clypeus $^{4}/_{5}$ below suborbital tangent; antennal sockets close (IAD/AOD < 1.07); frontal line ending 2.5 OD below median ocellus; gena narrower than eye; scutellum length 0.22; metapostnotum length 0.17, metapostnotum elongate (MMR ratio = 1.29); genitalia not examined.

Distribution

Yucatán Peninsula, northern Chiapas, and northern Guatemala, possibly also the Pacific coast to Jalisco. The five outlier Jalisco specimens seem morphologically indistinguishable from this species, but until additional records are found to fill the distribution gap, the possibility that they are a cryptic species must be considered and they are therefore excluded from the paratype series.

Remarks

Uncommon. This species is a member of the informal *L. comulum* species group and corresponds to mOTU4 in Landaverde-González *et al*. (2017a).

Lasioglossum* (*Dialictus*) *deceptor (Ellis, 1914)
Fig. 33A

Halictus (*Chloralictus*) *deceptor* Ellis, 1914: 101 (holotype, ♀, USNM ENT00535076).

Dialictus deceptor – Moure & Hurd 1987: 99 (catalogue).

Type material

Holotype

GUATEMALA – **Izabal** • 1 ♀; Quirigua; [15.27° N, 89.04° W]; Feb.–Mar. 1912; W.P. Cockerell leg.; USNM ENT00535076.

Other material examined

MEXICO – **Yucatán** • 1 ♂; Alfonso Caso, 10 km W of Tzucacab; [20.08° N, 89.15° W]; 12 Feb. 1987; Charles D. Michener leg.; ex *Viguiera dentata*; SEMC.

Remarks

Rare on the Yucatán Peninsula. The identification of this species is somewhat uncertain because only a single male was discovered in the Yucatán Peninsula, while the holotype is a female. The specimen analysed is believed to be *L. deceptor* and not the male of *L. tropicior* based on the relatively long face and moderately dense mesoscutum punctures (i = 1–2 pd), which agree more closely with the holotype of *L. deceptor* than with *L. tropicior*. Furthermore, both these species were described from the same type locality, so it is assumed that if one occurs on the Yucatán Peninsula, the other is also likely to occur there.

Lasioglossum* (*Dialictus*) *exiguum (Smith, 1879)
Figs 22A, 23A, 24A, 34A

Halictus exiguus Smith, 1879: 37 (holotype, ♀, NHMUK 010265368).

Dialictus exiguus – Moure & Hurd 1987: 100 (catalogue).

Type material

Holotype
MEXICO – ♀; on/around Orizaba volcano; [19° N, 97.3° W]; "8.M.1856"; M. Salle leg.; NHMUK 010265368.

Other material examined

MEXICO – **Quintana Roo** • 1 ♀; 12 km NW of Reforma; [18.89° N, 88.65° W]; 14 Oct. 1986; Charles D. Michener leg.; SEMC SM0753053 • 2 ♂♂; same collection data as for preceding; 14 Oct. 1986; Charles D. Michener leg.; SEMC SM0730146, SM0753052 • 1 ♀; Reforma; [18.81° N, 88.57° W]; 14 Oct. 1986; Charles D. Michener leg.; SEMC.

Remarks

Uncommon on the Yucatán Peninsula (four specimens examined in the region); more common in Veracruz. The very large head and rectangular, strongly toothed clypeus apical margin are unmistakable diagnostic characters for this species. We consider the identifications highly reliable despite the distance between Orizaba and Quintana Roo.

Lasioglossum* (*Dialictus*) *tropicior (Ellis, 1914)
Fig. 24B

Halictus (*Chloralictus*) *tropicior* Ellis, 1914: 219 (holotype, ♀, USNM ENT00535200).

Dialictus tropicior – Moure & Hurd 1987: 135 (catalogue).

Type material

Holotype
GUATEMALA – **Izabal** • 1 ♀; Quirigua; [15.27° N, 89.04° W]; 20 Feb. 1912; W.P. Cockerell leg.; ex *Distimake quinquefolius*; USNM ENT00535200.

Other material examined

MEXICO – **Campeche** • 1 ♀; Ruinas Edzna; [19.597° N, 90.23° W]; 24 Jun. 1966; University of Kansas Mexico Expedition leg.; SEMC. – **Quintana Roo** • 1 ♀; 12 km NW of Reforma; [18.89° N, 88.65° W]; 14 Oct. 1986; Charles D. Michener leg.; SEMC • 1 ♀; 23 km W of Felipe Carrillo Puerto; [19.58° N, 88.27° W]; 12 Oct. 1986; Charles D. Michener leg.; SEMC.

Remarks

Uncommon on the Yucatán Peninsula (three specimens examined). The specimens closely match images of the holotype and agree with the original description (Ellis 1914), and the type locality in eastern Guatemala is on the southern edge of the Yucatán Peninsula, but we still consider the identifications somewhat uncertain because of the likelihood that this species (along with *L. deceptor*, *L. flaveriae* (Mitchell, 1960), *L. gundlachii* (Baker, 1906), *L. liguanense* (Sandhouse, 1924), and possibly *L. exiguum* and *L. umbripenne* (Ellis, 1913)) is part of a large and diverse complex including many undescribed

species. Morphologically similar specimens which cannot be confidently assigned to a described species are common in other areas of Mexico.

Key to known females of Lasioglossum (Dialictus) from the Yucatán Peninsula

1. Propodeum dorsolateral slope smooth, with no oblique carina (Fig. 22A–B) 2
– Propodeum dorsolateral slope with an oblique carina (Fig. 22C) 5

2. Metapostnotum smooth with weak rugae covering less than half its length (Fig. 22A); mesonotum and mesepisternum shiny due to weak or absent microsculpture (Fig. 23A); metasoma black to brown and without appressed tomentum 3
– Metapostnotum with strong rugae covering half or more its length (Fig. 22B); mesonotum and mesepisternum dull due to very strong microsculpture (Fig. 23B); metasoma orange to reddish brown and with some sparse appressed tomentum on T2–T4 .... ***L. meteorum*** Gardner & Gibbs, 2020

3. Clypeus apicolateral margins parallel with distinct, acute teeth (Fig. 24A); hind legs and tarsi of other legs light brown; abdomen dark brown, margin of segment testaceos; metanotum with abundant short plumose setae (Fig. 23A) ..... ***L. exiguum*** (Smith, 1879)
– Clypeus apicolateral margins strongly convergent with indistinct, rounded knobs (Fig. 24B); hind legs dark brown or black, tarsi sometimes lighter; abdomen piceous, margin of segment not testaceous; metanotum with short plumose setae very sparse or absent (as in Fig. 23B) 4

4. Mesoscutum between parapsidal lines and mesoscutellum sparsely punctate (i = 2–4 pd); face broader than long ..... ***L. tropicior*** (Ellis, 1914)
– Mesoscutum between parapsidal lines and mesoscutellum moderately densely punctate (i = 1–2 pd); face about as long as broad or slightly longer ..... ***L. deceptor*** (Ellis, 1914)

5. Tegula ovoid and relatively small, clearly not reaching posterior margin of mesoscutum in dorsal view (Fig. 6D, G–H) 6
– Tegula with inner posterior margin straight or concave, more bean-shaped, and relatively large, reaching posterior margin of mesoscutum in dorsal view or nearly so (Fig. 6A–C, E–F) 8

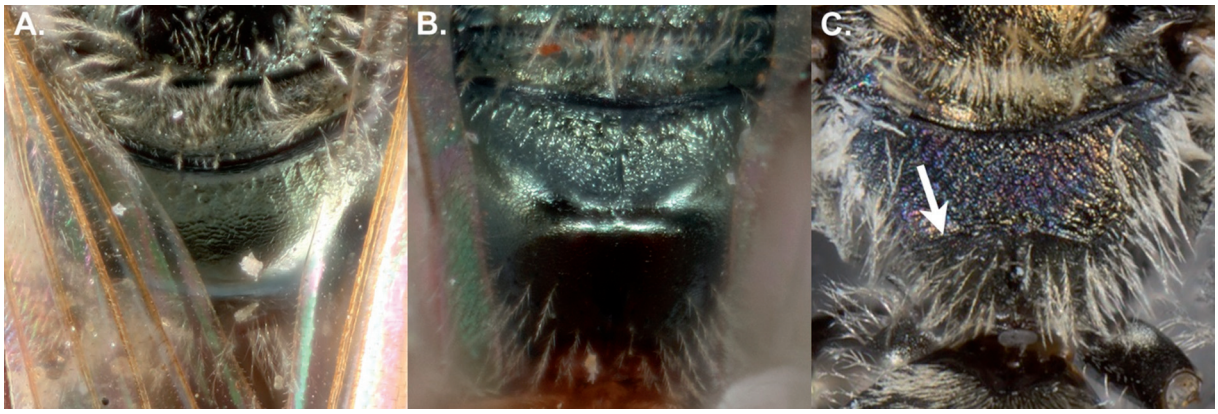

Fig. 22. Propodeum. **A**. *Lasioglossum* (*Dialictus*) *exiguum* (Smith, 1879), ♀, smooth with metapostnotum rugae covering less than half its length and oblique carina absent. **B**. *L.* (*D.*) *meteorum* Gardner & Gibbs, 2020, ♀, smooth with metapostnotum rugae covering about half its length and oblique carina absent. **C**. *L.* (*D.*) *stictaspis* species complex female, roughened by strong anastomosing rugae reaching posterior margin and oblique carina present (arrow).

6. Punctures of face uniformly large and dense (Fig. 25A); mesoscutum punctures large, coarse and dense (i < 1 pd) and very coarse, with many punctures touching laterad of parapsidal lines (i = 0 pd) except on anteromedian margin (i > 1.5 pd) (Fig. 26A); propodeum with oblique carina U-shaped and extending onto dorsolateral slope .....***L. ameshoferi*** Landaverde-González sp. nov.

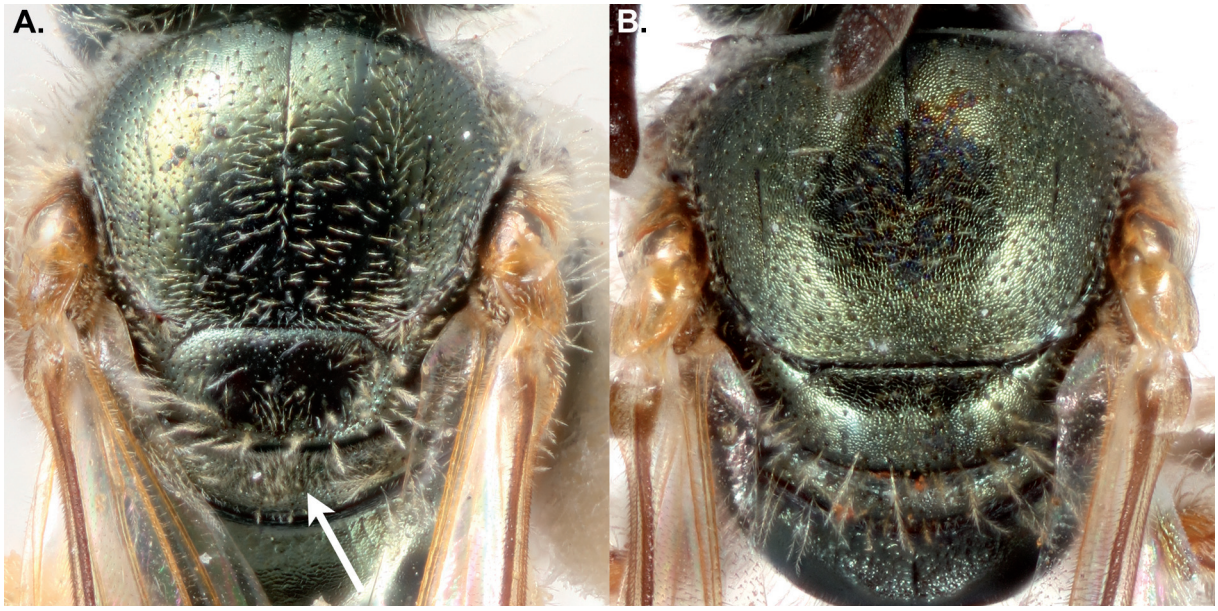

Fig. 23. Mesoscutum sculpture and metanotum pubescence. **A**. *Lasioglossum* (*Dialictus*) *exiguum* (Smith, 1879), ♀, mesoscutum shiny and metanotum with abundant short plumose setae (arrow). **B**. *L*. (*D*.) *meteorum* Gardner & Gibbs, 2020, ♀, mesoscutum dull and metanotum with very sparse short plumose setae.

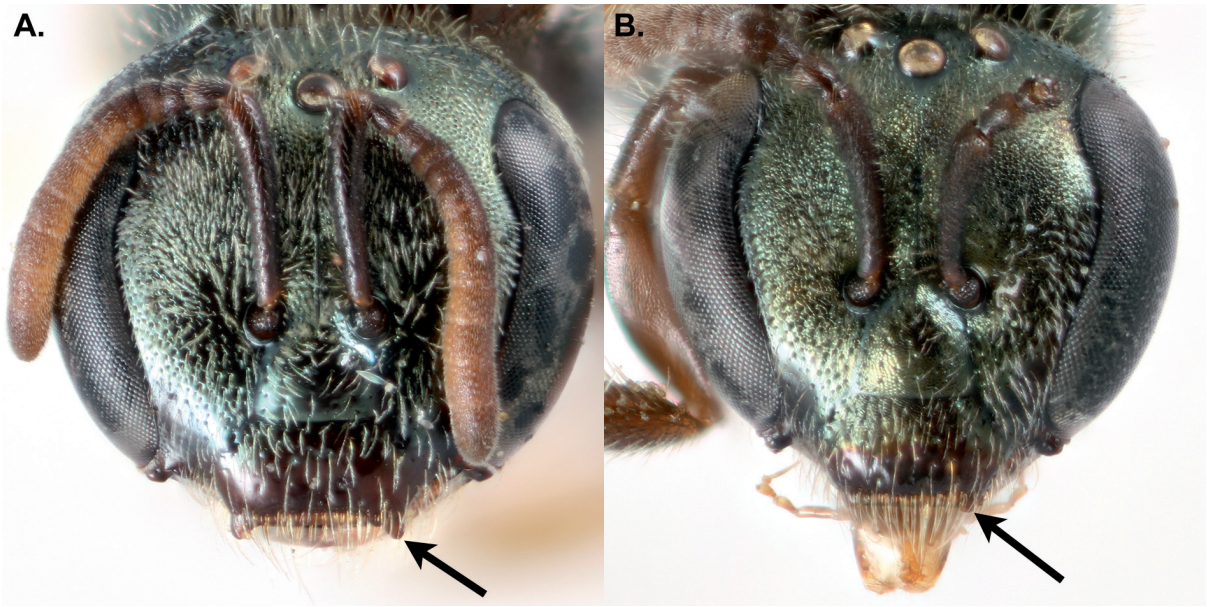

Fig. 24. Face and clypeus. **A**. *Lasioglossum* (*Dialictus*) *exiguum* (Smith, 1879), ♀, with clypeus apicolateral margins parallel and forming acute teeth (arrow). **B**. *L*. (*D*.) *tropicior* (Ellis, 1914), ♀, with clypeus apicolateral margins convergent and forming low rounded knobs (arrow).

– Punctures of upper half of face distinctly smaller and denser than punctures of lower half (Fig. 25B–C); mesoscutum punctures between parapsidal lines sparser (i = 1–3 pd) (Fig. 26B); propodeum with oblique carina straight, not extending onto dorsolateral slope 7

7. Mesepisternum slightly sparsely punctate (i ≤ 1–1.5 d) with dense plumose setae (1–1.5 OD); metapostnotum dull, imbricate, with shallow anastomosing rugae reaching posterior margin or nearly so; mesoscutal punctation between parapsidal lines sparse (i = 1.5–3 pd), becoming moderately dense but not crowded laterad of parapsidal lines (i = 1 pd; Fig. 27A); head about as long as broad (length/width 0.94–0.99) (Fig. 25B) ..... ***L. milpa*** Landaverde-González sp. nov.

– Mesepisternum imbricate and densely punctate (i ≤ 1 pd); metapostnotum shiny to weakly tessellate, with strong, coarse rugae reaching posterior margin; mesoscutal punctation moderately sparsely punctate between parapsidal lines (i = 1–3 pd), becoming dense and crowded laterad of parapsidal lines (i ≤ 1 pd; Fig. 27B); head broader than long (length/width 0.91–0.95) (Fig. 25C) .... ***L. nanotegula*** Landaverde-González & Husemann sp. nov.

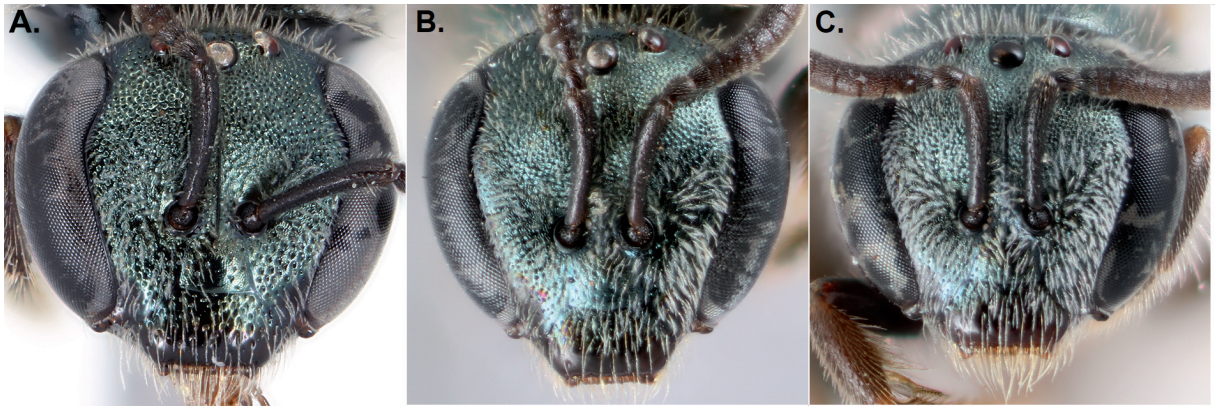

Fig. 25. Face. **A**. *Lasioglossum* (*Dialictus*) *ameshoferi* Landaverde-González sp. nov., ♀, punctures very coarse, with frons punctures about as large and dense as in lower paraocular area. **B**. *L.* (*D.*) *milpa* Landaverde-González sp. nov., ♀, punctures finer, with frons punctures smaller and denser than in lower paraocular area, head about as long as broad. **C**. *L.* (*D.*) *nanotegula* Landaverde-González & Husemann sp. nov., ♀, punctures finer, with frons punctures smaller and denser than in lower paraocular area, head broader than long.

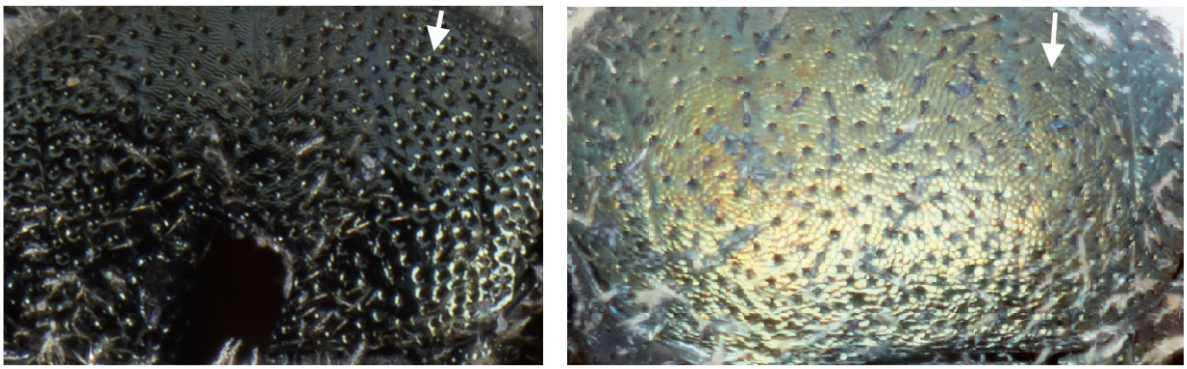

Fig. 26. Mesoscutum punctation. **A**. *Lasioglossum* (*Dialictus*) *ameshoferi* Landaverde-González sp. nov., ♀, dense (i < 1 pd). **B**. *L.* (*D.*) *nanotegula* Landaverde-González & Husemann sp. nov., ♀, sparse (i = 1–3 pd).

8. T2 and usually T3 apical rims glabrous and impunctate (Fig. 28A); mesoscutum with sparse erect setae ~1 OD long (most setae separated by half their length or more in lateral view) and subappressed setae little more than stubble, appearing shaved (Fig. 29A); mesoscutum often with copper-red reflections medially 9
– T2–T3 apical rims evenly covered with fine setae and/or punctures (Fig. 28B); mesoscutum with dense erect setae ~1 OD long (all setae separated by less than half their length in lateral view) and subappressed setae 0.25–0.5 OD long (Fig. 29B); mesoscutum dark turquoise-green with golden reflections 10

9. Tegula lateral margin with shallow, minute, and sparse punctures (i = 1–2 d) no larger than mesoscutum punctures (sometimes inconspicuous and tegula nearly impunctate) (Fig. 6B); mesonotum and mesepisternum shiny; mesepisternum granular with distinct fine and dense punctures (i = 1–1.5 pd) (Fig. 30A) ..... ***L. paxtoni*** Landaverde-González sp. nov.
– Tegula lateral margin with deep, distinct, and dense punctures (i < 1 d) slightly larger than mesoscutum punctures (Fig. 6A); mesonotum and mesepisternum dull with strong microsculpture; mesepisternum strongly imbricate to finely rugulose and indistinctly punctate at least dorsal half (Fig. 30B) ..... ***L. yucatanense*** Landaverde-González sp. nov.

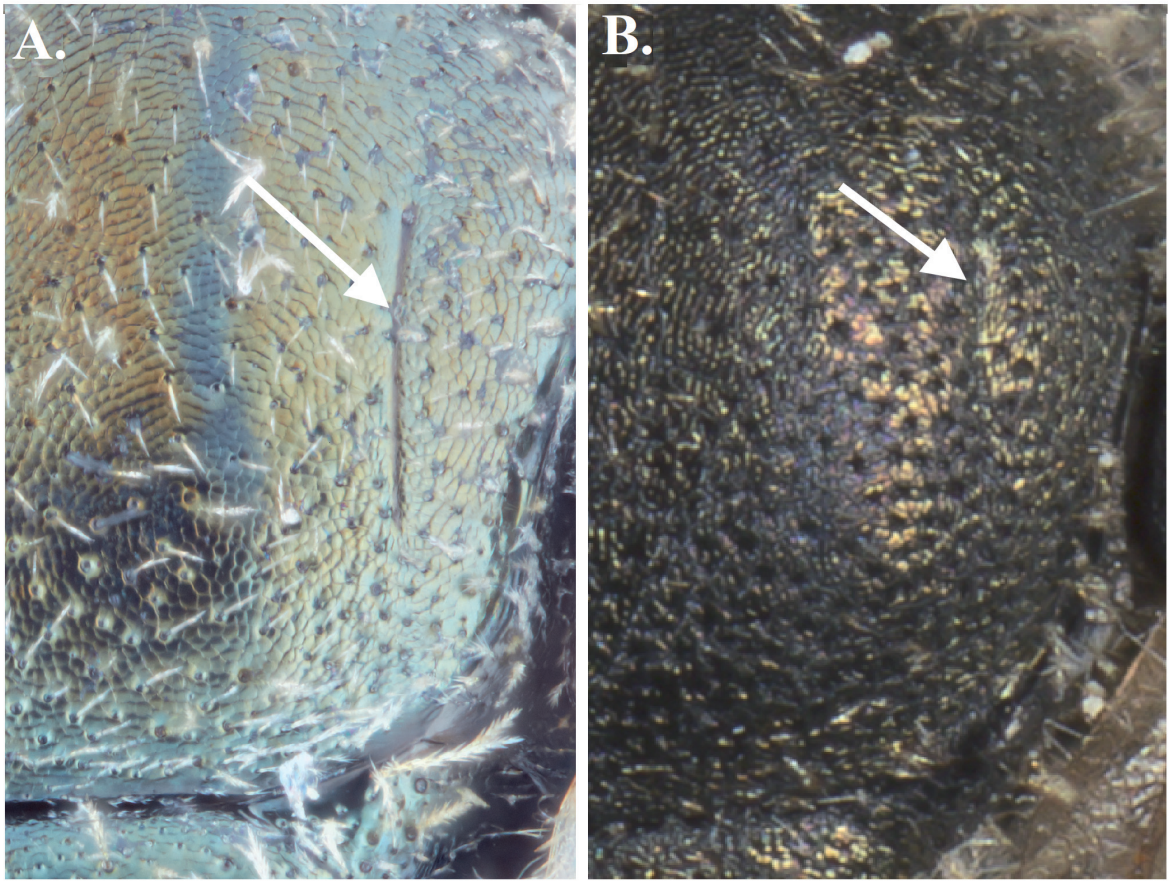

Fig. 27. Mesoscutum punctation lateral of parapsidal line. **A**. *Lasioglossum* (*Dialictus*) *milpa* Landaverde-González sp. nov.; sparse (i = 1 pd). **B**. *L.* (*D.*) *nanotegula* Landaverde-González & Husemann sp. nov.; dense (i < 1.0 pd).

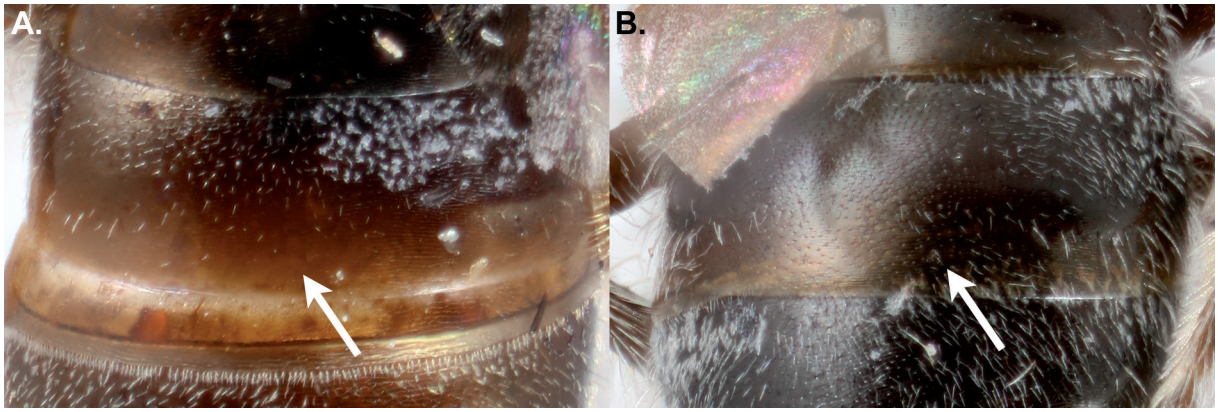

Fig. 28. T2. **A**. *Lasioglossum* (*Dialictus*) *paxtoni* Landaverde-González sp. nov., ♀, apical impressed area (arrow) glabrous and impunctate. **B**. *L*. (*D*.) *aureoviride* Landaverde-González & Husemann sp. nov., ♀, apical impressed area (arrow) with sparse punctures and short simple setae.

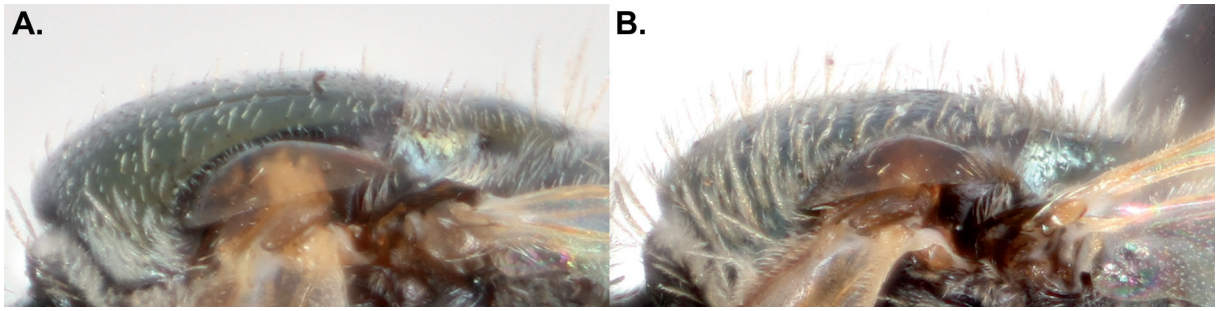

Fig. 29. Mesoscutum in lateral view. **A**. *Lasioglossum* (*Dialictus*) *paxtoni* Landaverde-González sp. nov., ♀, with very short, sparse pubescence, appearing shaved. **B**. *L*. (*D*.) *paralepidii* Gardner sp. nov., ♀, with long, dense pubescence.

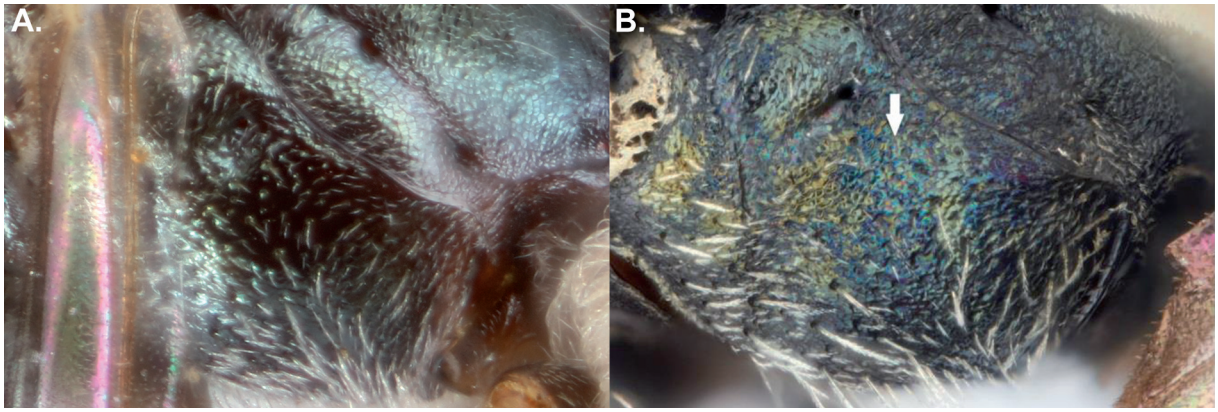

Fig. 30. Mesepisternum. **A**. *Lasioglossum* (*Dialictus*) *paxtoni* Landaverde-González sp. nov., ♀, shiny and distinctly punctate. **B**. *L*. (*D*.) *yucatanense* Landaverde-González sp. nov., ♀, imbricate-rugulose and indistinctly punctate in dorsal half (arrow).

10. Tegula deeply and distinctly punctate (similar to mesoscutum), usually densely (i < 1 pd) (Fig. 6C); mesepisternum usually imbricate and moderately sparsely punctate (i = 1–2 pd) (Fig. 31A) ....***L. stictaspis*** species complex
– Tegula finely punctate (punctures smaller than those of mesoscutum), usually sparsely (i ≥ 1.5 pd) (Fig. 6E–F); mesepisternum very densely punctate (i < 0.5 pd) (Fig. 31B) 11

11. Mesoscutum and supraclypeal area sparsely punctate (i = 1–3 pd); tegula with a few scattered minute punctures hardly visible at 40× magnification (Fig. 6E); metapostnotum dull with shallow rugae blending into finely reticulate background microsculpture (Fig. 32A) .... ***L. aureoviride*** Landaverde-González & Husemann sp. nov.
– Mesoscutum and supraclypeal area densely punctate (i = 0.5–1 pd); tegula distinctly punctate at 40× magnification at least on lateral margins, where it is dense (i ≤ 1 pd; Fig. 6F); metapostnotum shiny with strong anastomosing rugae (Fig. 32B) .....***L. paralepidii*** Gardner sp. nov.

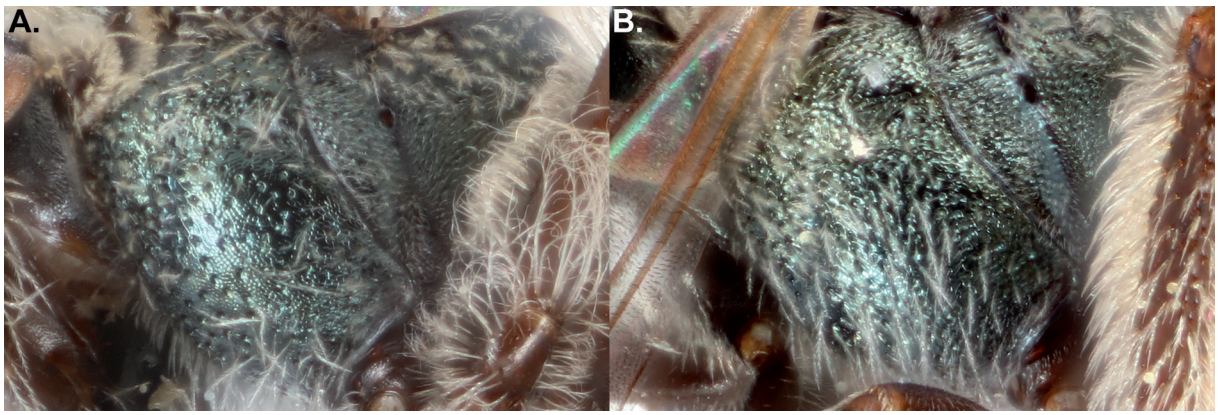

Fig. 31. Mesepisternum. **A**. *Lasioglossum* (*Dialictus*) *stictaspis* species complex, ♀, moderately sparsely punctate (i = 1–2 pd). **B**. *L.* (*D.*) *paralepidii* Gardner sp. nov., ♀, very densely puncate (i < 0.5 pd).

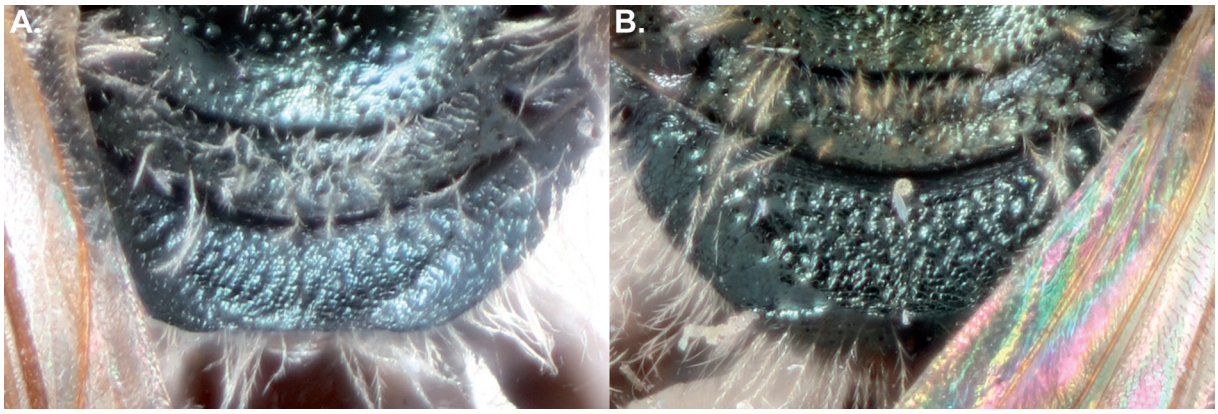

Fig. 32. Metapostnotum. **A**. *Lasioglossum* (*Dialictus*) *aureoviride* Landaverde-González & Husemann sp. nov., ♀, entirely dull with fine shallow rugae. **B**. *L.* (*D.*) *paralepidii* Gardner sp. nov., ♀, shiny basally and laterally with strong anastomosing rugae.

Key to known males of Lasioglossum (Dialictus) from the Yucatán Peninsula

1. Tegula ovoid and relatively small, clearly not reaching posterior margin of mesoscutum in dorsal view (as in Fig. 6D, G–H) 2
– Tegula with inner posterior margin straight or concave, more bean-shaped, and relatively large, reaching posterior margin of scutum in dorsal view or nearly so (as in Fig. 6A–C, E–F) 6

2. S3–S5 pubescence long (2–4 OD), erect, and densely plumose (Fig. 33A); propodeum dorsolateral slope smooth, with rugae not reaching posterior margin (Fig. 34A) 3
– S3–S5 pubescence short (1–2 OD), suberect, and weakly plumose, appearing simple at < 40× magnification (Fig. 33B); propodeum dorsolateral slope sometimes roughened by rugae reaching posterior margin (Fig. 34B–C) 4

3. S4–S5 with long setae limited to median portion, hidden in dorsal view; face broader than long .... ***L. exiguum*** (Smith, 1879)
– S4–S5 with long setae on extreme lateral margins visible in dorsal view; face about as long as broad ..... ***L. deceptor*** (Ellis, 1914)

4. Metapostnotum with strong and coarse subparallel rugae extending onto and fully covering propodeum dorsolateral slope (Fig. 34C), usually with trace oblique carina present; retrorse lobe small; penis valve small and delicate ..... ***L. ameshoferi*** Landaverde-González sp. nov.
– Metapostnotum with strong or somewhat finer rugae not extending onto propodeum dorsolateral slope except at base (Fig. 34B) and oblique carina absent 5

Fig. 33. Metasoma S3–S5 pubescence. **A**. *Lasioglossum* (*Dialictus*) *deceptor* (Ellis, 1914), ♂, very dense and thickly plumose (arrow). **B**. *L.* (*D.*) *meteorum* Gardner & Gibbs, 2020, ♂, sparse and weakly plumose.

Fig. 34. Propodeum. **A**. *Lasioglossum (Dialictus) exiguum* (Smith, 1879), ♂, with metapostnotum rugae not reaching posterior margin and dorsolateral slope smooth (arrow). **B**. *L.* (*D.*) *nanotegula* Landaverde-González & Husemann sp. nov., ♂, with metapostnotum rugae reaching posterior margin and extending onto dorsolateral slope at base (arrow). **C**. *L.* (*D.*) *ameshoferi* Landaverde-González sp. nov., ♂, with metapostnotum rugae reaching posterior margin and covering dorsolateral slope (arrow).

5. Mesepisternum densely punctate (i < 1 pd) ..... ***L. nanotegula*** Landaverde-González & Husemann sp. nov.
– Mesepisternum sparsely punctate (i = 1–3 pd) ..... ***L. meteorum*** Gardner & Gibbs, 2020

6. Tegula with sparse punctures medially (i > 1.5 dp) (sometimes inconspicuous and tegula nearly impunctate) (Fig. 35A) 7
– Tegula with dense punctures medially (i ≤ 1dp) (Fig. 35B) 8

7. Mesoscutum with dense plumose setae 0.5–1.0 OD long (all setae separated by less than half their length in lateral view) (as in Fig. 29B); mesoscutum dark turquoise-green to olive green; retrorse lobe enlarged and wide; S8 median processs narrow and long; penis valve wide observed in lateral view ..... ***L. aureoviride*** Landaverde-González & Husemann sp. nov.
– Mesoscutum with sparse plumose setae 0.5–1 OD long (most setae separated by half their length or more in lateral view, especially on posterior half) (as in Fig. 29A); mesoscutum golden-green to brassy; retrorse lobe small; S8 median process wide; penis valve small and delicate observed in lateral view ..... ***L. paxtoni*** Landaverde-González sp. nov.

8. Mesepisternum moderately sparsely punctate at least on ventral half (i = 1–2 pd) (as in Fig. 31A) . ..... ***L. stictaspis*** species complex
– Mesepisternum densely punctate (i < 1 pd) (as in Fig. 31B) 9

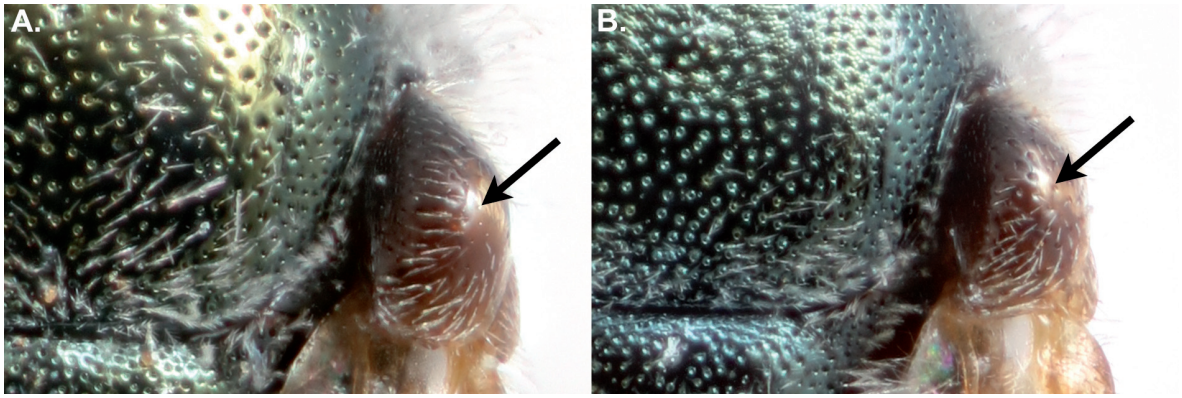

Fig. 35. Tegula. **A**. *L.* (*D.*) *aureoviride* sp. nov. male, finely and sparsely punctate medially (i > 1 pd) (arrow). **B**. *L.* (*D.*) *paralepidii* sp. nov. male, distinctly and densely punctate medially (i ≤ 1 pd) (arrow).

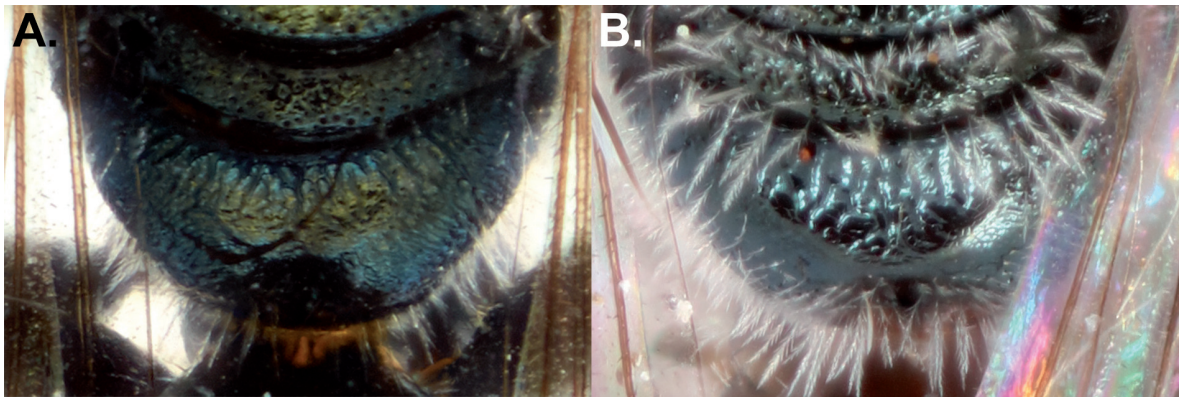

Fig. 36. Metapostnotum. **A**. *L.* (*D.*) *yucatanense* sp. nov. male, dull with fine rugae. **B**. *L.* (*D.*) *paralepidii* sp. nov. male, shiny with strong rugae.

9. Mesoscutum with sparse plumose setae 0.5–1 OD long (most setae separated by half their length or more in lateral view, especially on posterior half) (as in Fig. 29A); metapostnotum somewhat shiny, finely and weakly reticulate, with strong subparallel rugae (Fig. 36A) .... ***L. yucatanense*** Landaverde-González sp. nov.
– Mesoscutum with dense plumose setae 0.5–1 OD long (all setae separated by less than half their length in lateral view) (as in Fig. 29B); metapostnotum shiny, with weak microsculpture and strong rugae (Fig. 36B) ..... ***L. paralepidii*** Gardner sp. nov.

Discussion

The bee fauna of Mesoamerica in general and the Yucatán Peninsula in particular is highly diverse, but requires additional study. The halictid bees especially remain poorly known. In this paper we use molecular and morphological data to formally describe seven molecular Operational Taxonomic Units discovered in a previous study (Landaverde-González *et al*. 2017a) to contribute to the knowledge of *Lasioglossum* (*Dialictus*) in the Mesoamerican region.

We tested different morphological traits to delimit the species. Geometric morphometrics of wings was not informative. In contrast, wing morphometrics successfully separated subspecies of honey bee (*Apis mellifera* Linnaeus, 1758) (Francoy *et al*. 2006), geographic lineages of species of *Melipona* (Francoy *et al*. 2011; Bonatti *et al*. 2014), species of *Euglossa* (Francoy *et al*. 2012), and geographic and phenotypic lineages in the *Tetragonula iridipennis* complex (Francoy *et al*. 2016). Other combinations of landmarks, such as outline-based methods (Francoy *et al*. 2012) and the analysis of sensilla in male antennae may provide more resolution to differentiate species of *L.* (*Dialictus*).

Some types of antennal sensilla in females provided better discrimination. We observed nine types of sensilla on the proximal flagellomeres (F1–3) (Wcislo 1995; Galvani *et al.* 2008, 2012; González-Vaquero *et al.* 2016). An interesting result, similar to that of González-Vaquero *et al.* (2016) for *Corynura* Spinola, 1851, is the absence of sensilla basiconica on the antennae of females. These sensilla are known to be present on the distal part of the dorsal flagellomeres in different species of Apidae Latreille, 1802, Andrenidae Latreille, 1802, Colletidae Lepeletier, 1841, and Halictidae Thomson, 1869 nom. protect., including species of *L.* (*Dialictus*) from North America (Ågren & Svensson 1982; Wcislo 1995; Galvani *et al.* 2012). In contrast to previous studies (Galvani *et al.* 2016), we found significant differences in three types of sensilla present on the antennae of species of *L.* (*Dialictus*) from Yucatán (*stD*, sCoe and sCap), suggesting that these may be useful diagnostic traits in some cases. In addition, we did not find significant differences in the length of the frontal line below the ocellus ($F = 1.25$, $P < 0.35$).

Conclusion

The recent decline in pollinators has led to an increased interest in bees. Yet, our knowledge of bee taxonomy for many regions remains limited. With the description of these new species, we contribute to our knowledge about the difficult sweat bee subgenus *L.* (*Dialictus*) in Mesoamerica. We also provide information about characters that have been found to be efficient for species delimitation in other groups, but were uninformative for the species described here, i.e., the morphology of wings and the density of six of nine sensilla types. The sensilla stD, sCoe and sCap appear to be efficient to differentiate between species of *L.* (*Dialictus*) and may be useful for determination of other species of the group.

Our study also highlights the great diversity of undescribed *L.* (*Dialictus*) in Mesoamerica and, in some cases, the likelihood of cryptic species complexes. We stress that this study is not a comprehensive revision, but only a starting point for future taxonomic work. *Lasioglossum* (*D.*) *meteorum* was not found by Landaverde-González *et al*. (2017a) despite apparently being endemic to the Yucatán Peninsula (Gardner & Gibbs 2020), suggesting that other species are likely to occur in the region, but are not

recorded yet. Additional studies of other regions in Mesoamerica and the Caribbean are necessary for a more complete understanding of the regional bee fauna.

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Supplementary file

Supp. file 1. Additional information. https://doi.org/10.5852/ejt.2022.862.2079.8685

Table S1. Information on the specimens used for the phylogenetic analysis with collection sites, COI GenBank Accession numbers (Accession numbers are given for all unique haplotypes), BOLD process ID and sample ID.

Table S2. Density of different sensilla types on the ventral surface of F9 for female bees.