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Belgian Journal of Entomology

Lasioglossum dorchini (Hymenoptera: Apoidea: Halictidae) a new species of bee from Israel

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Front cover: Head of a female of *Lasioglossum dorchini* sp. nov., paratype, Israel: Nahal Alexander. © A. Pauly.

Lasioglossum dorchini (Hymenoptera: Apoidea: Halictidae) a new species of bee from Israel

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Abstract

This paper describes a new species, *Lasioglossum dorchini*, occurring in sand dunes in Israel. It is close to *Lasioglossum leptcephalum*. Its phylogenetic relationships with the other species of the *virens/littorale* group are analyzed.

Keywords: bees, Israel, *Lasioglossum*, new species, sand dunes

Résumé

Cette publication donne la description d'une nouvelle espèce, *Lasioglossum dorchini*, découverte dans les dunes sableuses en Israël. Elle est proche de *Lasioglossum leptcephalum*. Ses relations phylogénétiques avec les autres espèces du groupe *virens/littorale* sont analysées.

Introduction

Israel and Palestine alone are home to approximately 1100 known bee species (O'TOOLE & RAW, 1991). Extensive collecting throughout Israel in recent years has led to the discovery of new species of wild bees (PISANTY *et al.*, 2016). In this paper we describe an additional new species from Israel, *Lasioglossum dorchini* Pauly sp. nov., which is very close and sympatric to the known species *Lasioglossum leptcephalum* (Blüthgen, 1923). The new species has been recently discovered in bee surveys in Nahal Alexander National Park in the central coastal Plain of Israel where it is the most common Halictid species collected in pan traps (i.e. colored bowls containing soapy water).

The genus *Lasioglossum* has a complex and unstable subgeneric classification and, although recent phylogenetic and molecular studies have been published (GIBBS *et al.*, 2013; GIBBS, 2018), these do not yet fully cover groups of Palaearctic species. It was therefore premature to adopt this new classification here because it would have forced us to make many extrapolations for species of ambiguous position and not yet sequenced. BYTISNKY-SALZ & EBMER (1974) placed *L. leptcephalum* in the paraphyletic subgenus "*Evyllaes* Robertson, 1902". The species belongs to the *Halictus virens* species-group distinguished by BLÜTHGEN (1931: 393) and to the *Lasioglossum littorale* group of EBMER (1974: 140; 1982: 218) (= *L. virens* group of EBMER 1976: 244; 1993: 780). All these species are classified by PESENKO (2007: 26) in his new subgenus "*Virensalictus*", including ten species. Preliminary molecular studies suggest that this group of species should be included in the subgenus *Hemihalictus* Cockerell, 1897 as delimited by GIBBS *et al.* (2013) and not in the subgenus *Dialictus* Robertson, 1902 that is largely comprised of species with metallic green reflections but with carinate propodeum.

Here, we aim to (i) understand if *L. dorchini* is one a well-delineated species on the basis of morphological and molecular analyses; and (ii) consider the phylogenetic relationships among different known species of the *virens/littorale* group of species.

Material and methods

REPOSITORIES AND EXAMINED SPECIMENS

Revision of types and identification of non-type specimens was based on material from the following institutions (with their acronyms): The Steinhardt Museum of Natural History, Tel Aviv University (SMNH-TAU); Museum für Naturkunde an der Humboldt Universität zu Berlin, Germany (MNHUB); Natural History Museum, London, UK (NHML); Royal Belgian Institute of Natural Sciences, Brussels, Belgium (RBINS). A total of 475 specimens were examined. In addition, a DNA fragment of the cytochrome c oxidase subunit I (COI) gene was sequenced for recently collected specimens of the following species of the *virens/littorale* group: *Lasioglossum aureolum* (Pérez, 1903), *L. dorchini* Pauly sp. nov., *L. leptocephalum* (Blüthgen, 1923), *L. littorale* (Blüthgen, 1923) and *L. aff. littorale*, *L. musculooides* (Ebmer, 1974), *L. pseudoleptocephalum* (Blüthgen, 1923), *L. pseudolittorale* (Blüthgen, 1923), *L. virens* (Erichson, 1835) (see acknowledgments for the collectors).

PROTOCOL FOR DNA ANALYSIS

For molecular analyses, we followed the protocol from PAULY *et al.* (2015) and PAULY *et al.* (2019) for specimen samples AP221, AP303, AP304, AP699, AP700, AP701, AP702, AP703, AP704 and AP705 (Table 1). Briefly, one middle leg per specimen was used to extract DNA with the NucleoSpin® Tissue Kit (Macherey-Nagel, Germany) following instructions of the manufacturer. One pair of primers (LCO1490 and HCO2198) was used to amplify the cytochrome c oxidase subunit I (COI) mitochondrial gene, referred to as the DNA barcode for animals (FOLMER *et al.*, 1994). The contigs resulting from the amplification of both primers were aligned and edited in CodonCode Aligner® ver. 5.0.1 (CodonCode Corp., Centerville, Massachusetts). In addition, barcode sequences of specimen samples AP404, AP409, AP410, AP454, AP463, AP499, AP500, AP501, AP502 and AP503 (Table 1), were produced and analysed at the Canadian Centre for DNA Barcoding (CCBD) using the protocols described in IVANOVA *et al.* (2006) and DEWAARD *et al.* (2008). The resulting consensus sequences (n = 20 species) with range of 482 – 676 bp were subject to BLAST search to check for possible contaminations. To complete the dataset, we added the barcodes KJ839379 and KJ836462 of *L. virens* from the work of SCHMIDT *et al.* (2015).

PHYLOGENETIC ANALYSIS

We selected four unique barcode sequences, KJ839608 and KJ839285 for *Lasioglossum nitidulum* (Fabricius 1804), and KJ839826 and GU706057 for *Lasioglossum morio* (Fabricius, 1793) (SCHMIDT *et al.*, 2015), retrieved from GenBank to constitute the outgroup rooting the generated phylogenetic trees. These two species belong to the subgenus *Dialictus*, a group with metallic reflections close to our species. We aligned all the DNA sequences using ClustalW (LARKIN *et al.*, 2007) with the default parameters in MEGA ver. 7.0.21 (KUMAR *et al.*, 2016). On the basis of the global similarity of the nucleotide sequences, we reconstructed a Neighbour-Joining (NJ) tree using MEGA ver. 7.0.21 with bootstrap pseudo-replicates (n = 1000).

For phylogenetic reconstruction based on bayesian inference (BI) method, we used PartitionFinder2 ver2.1.1 (LANFEAR *et al.*, 2017) to explore best nucleotide substitution model for our aligned DNA dataset by their nucleotide positions. The TIM gamma model of rate heterogeneity (TIM + G), the TrN (TRN + I) and the F81 (F81 + I) with invariables sites substitution models were selected as best nucleotide substitution models for nucleotide position

1, 2 and 3 respectively. We set-up Markov chain Monte Carlo (MCMC) length to five million generations in two parallel runs. After the run, we checked the posterior probabilities as well as the effective sample size (> 300) with Tracer ver. 1.7.1 program (RAMBAUT *et al.*, 2018). Finally, we summarized BI into phylogenetic tree via TreeAnnotator ver. 2.5.2. (included in BEAST environment) program with a burn-in of 25%. All phylogenetic trees were compiled using FigTree ver. 1.4.3 (RAMBAUT, 2017) and the document (.svg) was illustrated with Inkscape ver. 0.92.2.

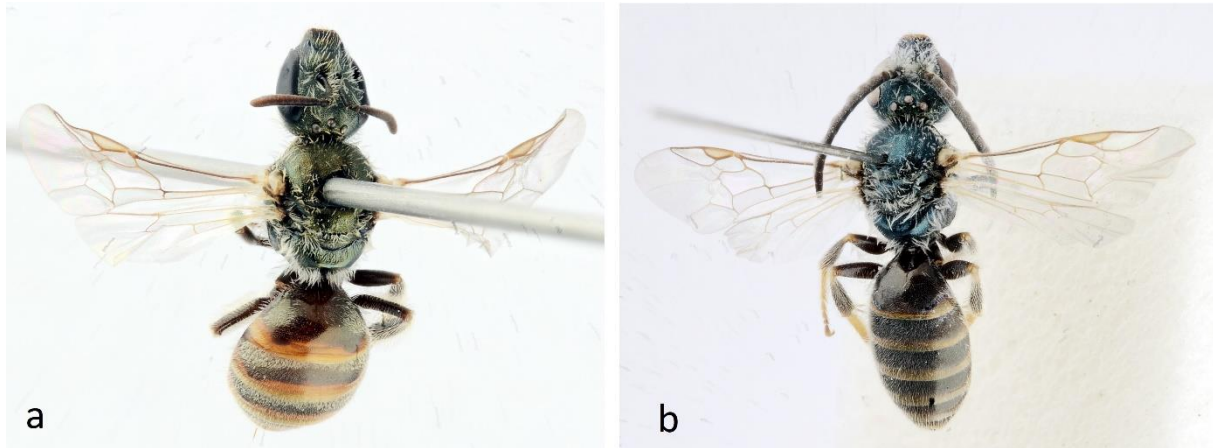


Fig. 1. *Lasioglossum dorchini*, Israel: Nahal Alexander. a, female; b, male.

Results

Lasioglossum dorchini Pauly sp. nov.

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DIAGNOSIS. Close to *L. leptcephalum*. The female differs by the less slender head (Fig. 2), the larger clypeus, the first tergum more densely punctuated in the middle (sparsely punctuated in the middle in *L. leptcephalum*) (Fig. 3), the third tergum pubescent only on its base, with very fine setae on the apical half (nearly completely covered with plumose setae in *L. leptcephalum*) (Figs 4, 5), the legs dark brown (pale brown in *L. leptcephalum*) (Fig. 6), the less long propodeum (Fig. 7d versus Fig. 11d). The male differs from *L. leptcephalum* (which is known only by the type series of *L. krugeri* Blüthgen, 1930) by the less abundant tomentum and the shorter erect setae on the terga (Fig. 8e compared to Fig. 12d) and the shorter propodeum (Fig. 8c compared to Fig. 12c).

DESCRIPTION. FEMALE. Length 6 mm.

Colouration. Body with metallic bronze-green reflections, apical margins of terga largely amber (Figs 1a, 4b), sometimes almost entirely amber; sterna completely amber (Fig. 6b). Legs black, end of the femurs and basal half of the basitarsi of the hind legs brown (Fig. 6b). Flagellum brown below. Mandibles dark brown. Tegulae pale yellow translucent (Fig. 7b, c).

Structure, punctation and pubescence. Head very elongate (length/width = 1.19) (Figs 2b, 7a). Clypeus and supraclypeal area long (Fig. 2b); vertex narrow (vertex width/ intertegular distance = 0.68), finely striated (Fig. 7b); frons densely and finely punctuated (Fig. 2b); apical half of the clypeus and lower adjacent part of the eyes black and smooth, with sparse punctures (Fig. 2b); genae densely striate. Mesosoma. Pronotum angles obtuse. Scutum and scutellum densely and finely punctuated, puncture interspaces equal a point diameter, the surface dull and completely striated (Fig. 7c). Propodeum not carinate, short (propodeal/metanotal length = 1.4), wrinkled on the basal half, micro-tessellated on the apical half (Fig. 7d). Metasoma. First

Table 1. Female specimen information from the *virens* / *littorale* group with their GenBank accession or BOLD process ID.

Code	Species	Locality	Date	Leg.	BOLD/GenBank
AP221	<i>Lasioglossum aureolum</i>	France	2014	D. Genoud	MT221619
AP303	<i>Lasioglossum pseudolittorale</i>	Israel, Nahal Alexander	2016	K. Levy	MT221618
AP304	<i>Lasioglossum dorchini</i>	Israel, Nahal Alexander	2016	K. Levy	MT221620
AP404	<i>Lasioglossum aureolum</i>	Portugal, Tavira, Cabanas	2016	A. Livory & R. Coulomb	HALAE002-19
AP409	<i>Lasioglossum aff littorale</i>	Portugal, Barra	2016	A. Livory & R. Coulomb	HALAE007-19
AP410	<i>Lasioglossum littorale littorale</i>	Italy, Toscana, Parco regional MSRM (Migliarino san Rossore Massaciucolli)	2016	M. Boschetti	HALAE008-19
AP454	<i>Lasioglossum pseudoleptocephalum</i>	Portugal, Algarve, Praia do Barril, Tavira	2016	T. Wood	HALAE052-19
AP463	<i>Lasioglossum aff littorale</i>	Italy, Sardarnia, Cagliari, Castiadas, San Giusta	2015	E. Dufrêne	HALAE061-19
AP499	<i>Lasioglossum leptocephalum</i>	Israel, Park Britannia	2016	T. Chaprazaro	HALAE097-19
AP500	<i>Lasioglossum dorchini</i>	Israel, Nahal Alexander	2016	K. Levy	HALAE098-19
AP501	<i>Lasioglossum dorchini</i>	Israel, Nahal Alexander	2016	K. Levy	HALAE099-19
AP502	<i>Lasioglossum dorchini</i>	Israel, Nahal Alexander	2017	K. Levy	HALAE100-19
AP503	<i>Lasioglossum dorchini</i>	Israel, Nahal Alexander	2018	K. Levy	HALAE101-19
AP699	<i>Lasioglossum leptocephalum</i>	Israel, Holot Shunera	2015	G. Pisanty	MT221611
AP700	<i>Lasioglossum leptocephalum</i>	Israel, Holot Shunera	2015	G. Pisanty	MT221612
AP701	<i>Lasioglossum musculoides</i>	Morocco, Haddada	2018	I. El Abdouni	MT221613
AP702	<i>Lasioglossum aff littorale</i>	Morocco, Bouknadel	2018	I. El Abdouni & P. Lhomme	MT221614
AP703	<i>Lasioglossum aff littorale</i>	Morocco, Haddada	2018	I. El Abdouni & P. Lhomme	MT221615
AP704	<i>Lasioglossum aff littorale</i>	Morocco, Bouknadel	2018	I. El Abdouni & L. Harroud	MT221616
AP705	<i>Lasioglossum aff littorale</i>	Morocco, Haddada	2018	I. El Abdouni & A. Sentil	MT221617

tergum finely and rather densely punctuated, puncture interspaces equal two puncture diameters, the inclined base finely striate (Fig. 3b). Sides of inclined base of tergum 1 and on the bases of terga 2 to 4 with grey plumose tomentum (Fig. 4b). Middle of the tergum 3 with short weakly branched setae, without plumose hairs (Fig. 5b). Legs. Hind tibial spur with 3 long oblique teeth (Fig. 7e).

MALE. Length 6 mm.

Colouration. Head and mesosoma with blue-green metallic reflections, metasoma black without or with very weak metallic reflections (Fig. 1b). Apical margins of terga hyaline fulvous (Fig. 8e). All tarsi, basal and apical parts of hind tibiae pale yellow (Fig. 8f). Apical third of the clypeus pale yellow (Fig. 8a). Underside of flagellum ocraceous (Fig. 8g). Tegulae pale yellow translucent (Fig. 8b).

Structure, punctation and pubescence. Head long (length/width=1.12). Flagellomeres 1,5 time longer than wide (Fig. 8g). Mesosoma. Scutum and scutellum densely and finely punctate, puncture interspaces dull and equal to a puncture diameter (Fig. 8b). Propodeum not carinate, the propodeal area relatively short (propodeal/metanotal length=1.25), with some wrinkles reaching posterior margin (Fig. 8c). Metasoma. Surface of the terga shiny, with punctures fine and comparatively dense (puncture interspaces equal 1.5–2 puncture diameter) (Fig. 8d, e).



Fig. 2. Comparison of the heads; a, *Lasioglossum leptcephalum*, Israel: Araba; b, *Lasioglossum dorchini*, Israel: Nahal Alexander.



Fig. 3. Comparison of the punctuation in the middle of the first tergum; a, *Lasioglossum leptocephalum*, Israel: Park Britania; b, *Lasioglossum dorchini*, female, Israel: Nahal Alexander.



Fig. 4. Comparison of the pilosity on the metasoma; a, *Lasioglossum leptocephalum*, Israel: Park Britannia; b, *Lasioglossum dorchini*, female, Israel: Nahal Alexander.



Fig. 5. Comparison of the pilosity on the third tergum; a, *Lasioglossum leptocephalum*, Israel: Park Britannia; b, *Lasioglossum dorchini*, female, Israel: Nahal Alexander).



Fig. 6. Comparison of the colour of the hind leg; a, *Lasioglossum leptcephalum*, Israel: BatYam; b, *Lasioglossum dorchini*, Israel: Nahal Alexander.

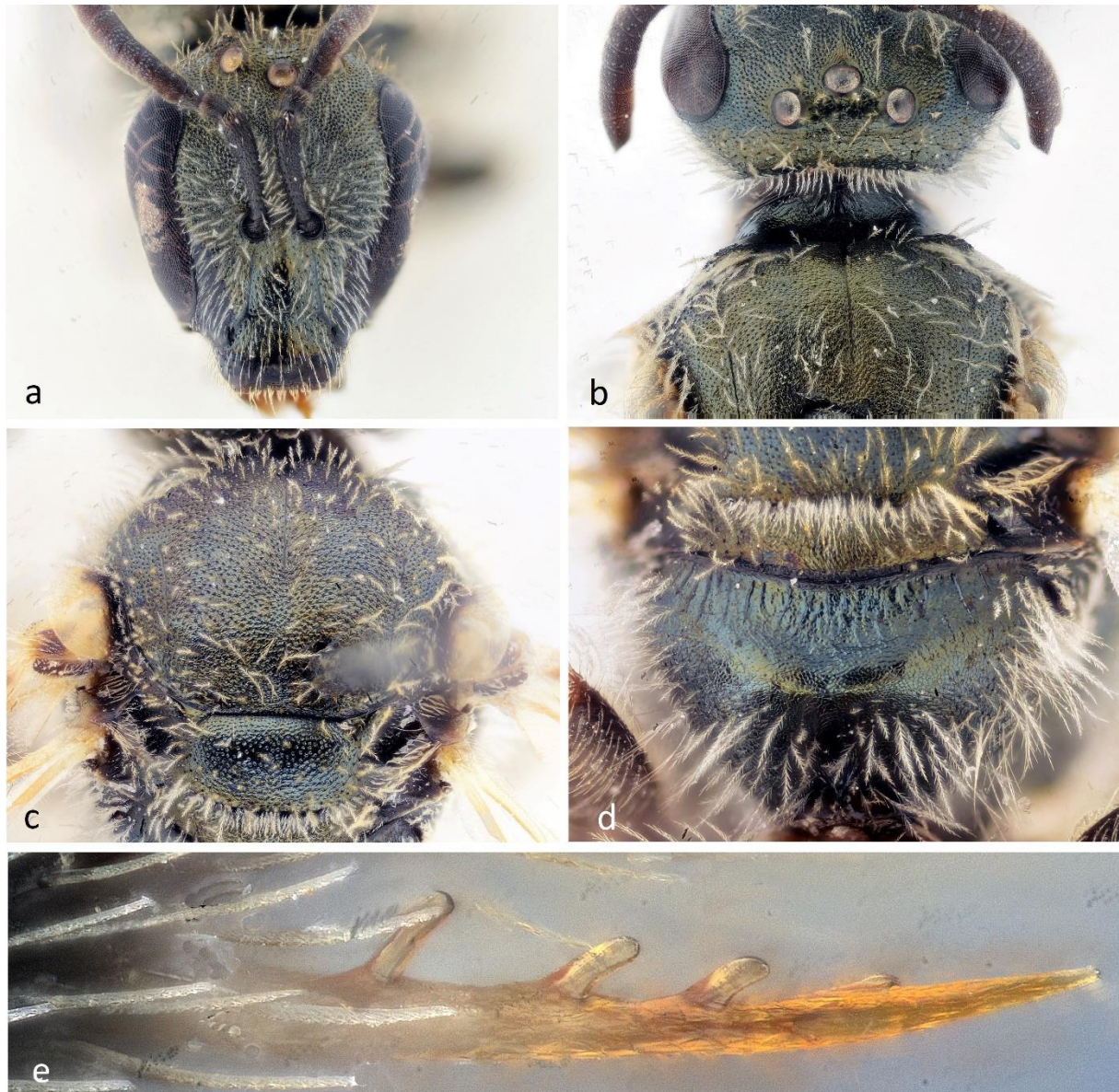


Fig. 7. *Lasioglossum dorchini*, Nahal Alexander; a, head; b, vertex; c, scutum and scutellum; d, propodeum; e, calcar.

Sterna with oblique setae apically (Fig. 8f). Genitalia. Gonocoxites with gonostyli and ventral membranes illustrated in Fig. 8h.

DISTRIBUTION AND ECOLOGY. *Lasioglossum dorchini* is known only from the central coastal plain of Israel (one specimen from Acre in the northern coastal plain). The type locality in Nahal Alexander National Park is characterized by semi-stabilized sand dunes typical of Israel's central coastal plain (KUTIEL, 2001) (Figs 15–18). The park was planted in part with non-native *Eucalyptus* trees in the mid 1960s, mainly *E. camaldulensis* Dehnh. The natural shrubland flora is dominated by *Artemisia monosperma* Delile, *Retama raetam* (Forssk.) Webb and *Ephedra aphylla* Forssk. Bees were collected in the north western part of the park, during spring (February–April). Most specimens were captured with pan traps and some others were collected with nets while visiting flowers of Asteraceae (*Crepis aculeata* (DC.) Boiss., *Senecio glaucus* L., and *S. leucanthemifolius* subsp. *vernalis* (Waldst. & Kit.) Greuter).

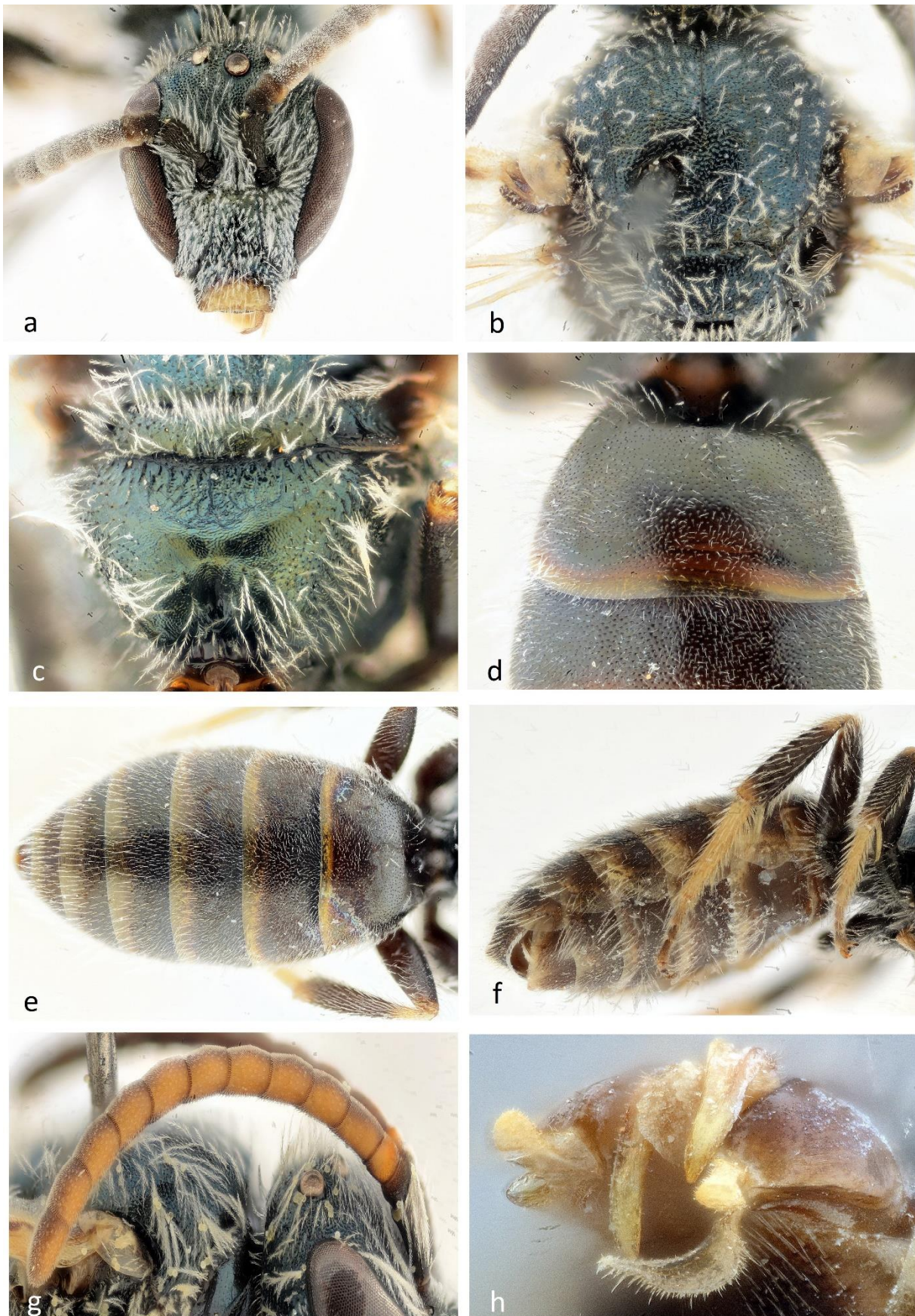


Fig. 8. *Lasioglossum dorchini*, male, Nahal Alexander; a, head; b, scutum and scutellum; c, propodeum; d, first tergum; e, metasoma; f, hind leg and pilosity of the sternum; g, antenna; h, genitalia.

TYPE MATERIAL (456 specimens; SMNHTAU, RBINS). **Holotype** ♀: ISRAEL, Nahal Alexander, 32.401 34.882, 1.V.2016, leg. K. Levy (AP 304) (GenBank MT221620) (SMNHTAU).

Paratypes. ISRAEL, Nahal Alexander, 31.III.2016, 1♂, 1♀; 3.IV.2016, 1♀; 5.IV.2016, 3♂, 27♀; 6.IV.2016, 1♂, 9♀; 7.IV.2016, 4♀; 20.IV.2016, 1♀; 21.IV.2016, 1♂, 22♀; 24.IV.2016, 6♂, 30♀; 25.IV.2016, 10♀; 1.V.2016, 1♀; 5.V.2016, 1♀; 4.III.2017, 5♀; 9.III.2017, 4♀; 10.III.2017, 35♀; 23.III.2017, 2♀; 31.III.2017, 1♀; 3.IV.2017, 4♀; 4.IV.2017, 23♀; 6.IV.2017, 10♀; 10.II.2018, 14♀; 11.II.2018, 46♀; 14.II.2018, 30♀; 15.II.2018, 12♀; 16.II.2018, 87♀; 7.III.2018, 10♀; 8.III.2018, 7♀; 9.III.2018, 1♀; 16.III.2018, 1♀; 17.III.2018, 2♀; 4.IV.2018, 1♂, 5♀; 5.IV.2018, 2♀; 6.IV.2018, 2♂, 14♀; 7.IV.2018, 1♂, 4♀; 8.IV.2018, 1♀, all. leg. K. Levy (SMNHTAU, RBINS). – Giv'at Homera Nature Reserve, 31.935 34.743, 6.II.2015, pan trap, 2♀, leg. G. Pisanty (202534, 202559) (SMNHTAU). – Palmahim, 31.927 34.730, 6.II.2015, pan trap, 2♀, leg. G. Pisanty (202520) (SMNHTAU). – 'En Sarid, 32.273 34.928, 5.IV.2012, leg. O. Afik (SMNHTAU). – Cesarea, 30.IV.1963, 1♀, leg. Kugler (SMNHTAU). – Holon, 1.III.1986, 1♀, leg. E. Shney-Dor (SMNHTAU). – Holon, 32.002 34.787, 4.V.1978, 1♀, leg. M. Kaplan (SMNHTAU). – Holon Dunes, 31.998 34.787, 1.III.1986, 1♀, leg. E. Shney-Dor (SMNHTAU). – Tel-Aviv Swamp, 31.935 34.743, 9.IV.1981, 1♀, leg. Freidberg (SMNHTAU). – Acre, 30.IV.1963, 1♂, leg. Kugler (SMNHTAU). – Berekhat Ya'ar, North, 32.412 34.898, 23.V.2003, 1♂, leg. A. Freidberg (SMNHTAU). – Nizzanim, 31.722 34.603, 13.V.2003, 1♂, leg. L. Freidman (SMNHTAU). – 17 km SSW Tel Aviv, Dünen W Kefar, N31.41 E35.28, 13.V.1996, 1♀, leg. O. Niehuis (col. Ebmer) (specimen examined and identified by Ebmer as *L. sinaiticum*). – Sharon Plain, Netanya shore, 32.286 34.841, 1♀, 27.IV.2009, at 9 am, leg. A. Dorchin.

ETYMOLOGY. This new species is dedicated to Achick Dorchin, bee specialist at the Tel Aviv University, who discovered the first specimen I examined of this species.

Lasioglossum leptocephalum (Blüthgen, 1923)

Halictus leptocephalus BLÜTHGEN, 1923: 245. Lectotype ♀: Tunisia, Nefta, 14.V.1913 (coll. Blüthgen, MNHUB).

= *Lasioglossum sinaiticum* BYTINSKI-SALZ & EBMER, 1974: 195. Holotype ♀: Sinai, Nahal Yam (lagoon of Bardawil), 1.II.1973, leg. A. Freidberg (coll. Ebmer, in Linz) (not examined).

Paratypes: 3♀, idem (Linz and col. Bytinsky-Salz) (2♀ examined in SMNHTAU), **syn. nov.**

= ?*Halictus krugeri* BLÜTHGEN, 1930: 222. Holotype ♂: Libya, Agedabia (SW Tripoli), 20.V.1925, leg. Krüger (MNHUB) (examined). Paratypes: 4♂, idem (MNHUB and R.U. Agrario Bengasi) (examined in MNHUB).

NOTE. WARNCKE (1982: 69) erroneously considered *L. leptocephalum* as a subspecies of *L. albovirens* (Pérez, 1895) with a more elongated head and *L. sinaiticum* as a simple form of *L. albovirens leptocephalum*. He also placed *L. krugeri* in synonymy with *L. albovirens leptocephalum*. The synonymy of *L. krugeri* remains doubtful and should be confirmed by the discovery of the two sexes in a same locality; it is mentioned here with a "?".

DISTRIBUTION AND ECOLOGY. *Lasioglossum leptocephalum* occurs in coastal dunes from Tunisia to Israel in the east. The locality in Holot Shunera is a partially stabilized sand dune ecosystem in the Western Negev (Gideon Pisanty, personal communication). In Libya, it has been collected in stabilised sands of the green belt.

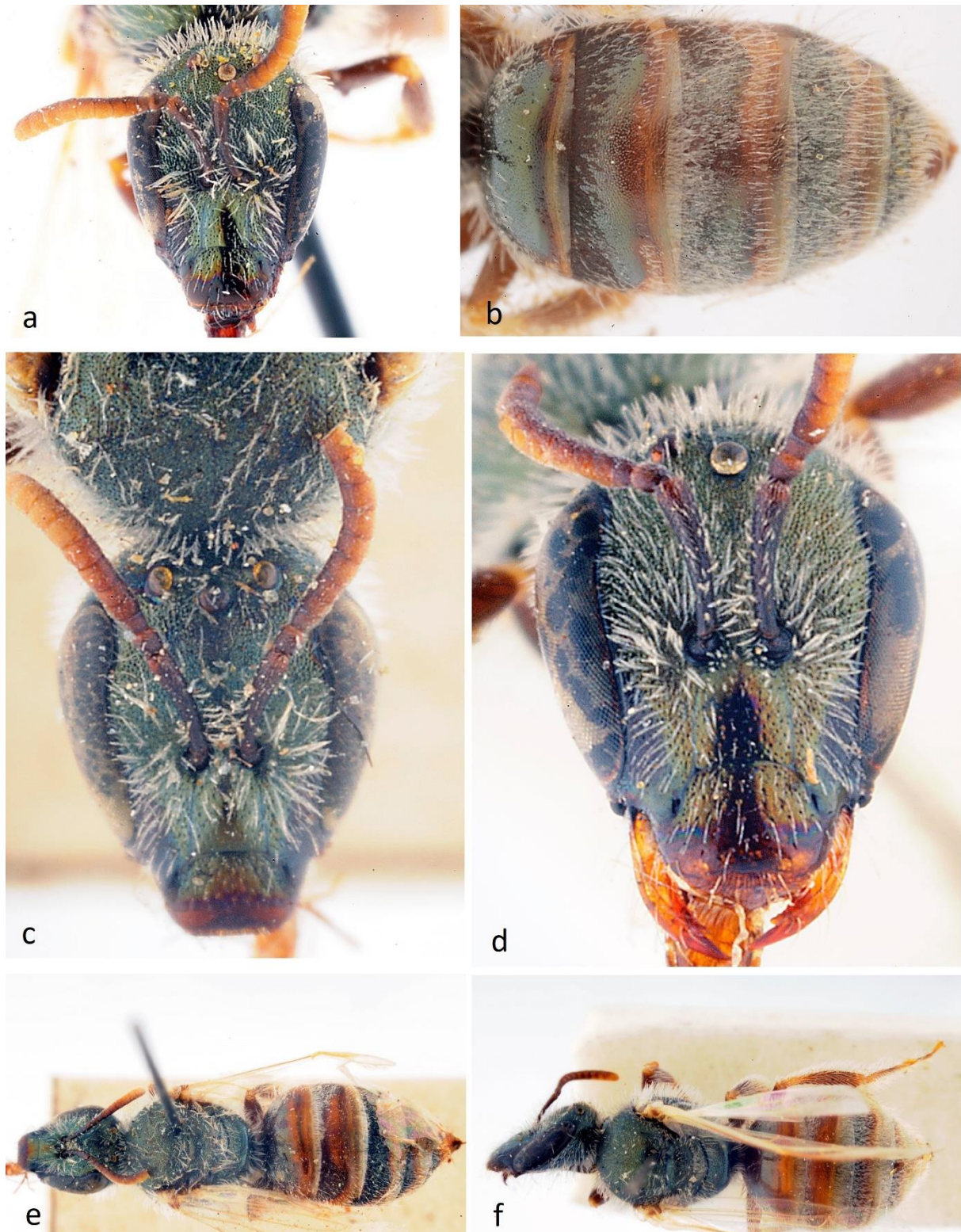


Fig. 9. *Lasioglossum leptocepalum*; a, b, female lectotype (Nefta); c, e, Djerba; d, Tripoli; f, Bat Yam.

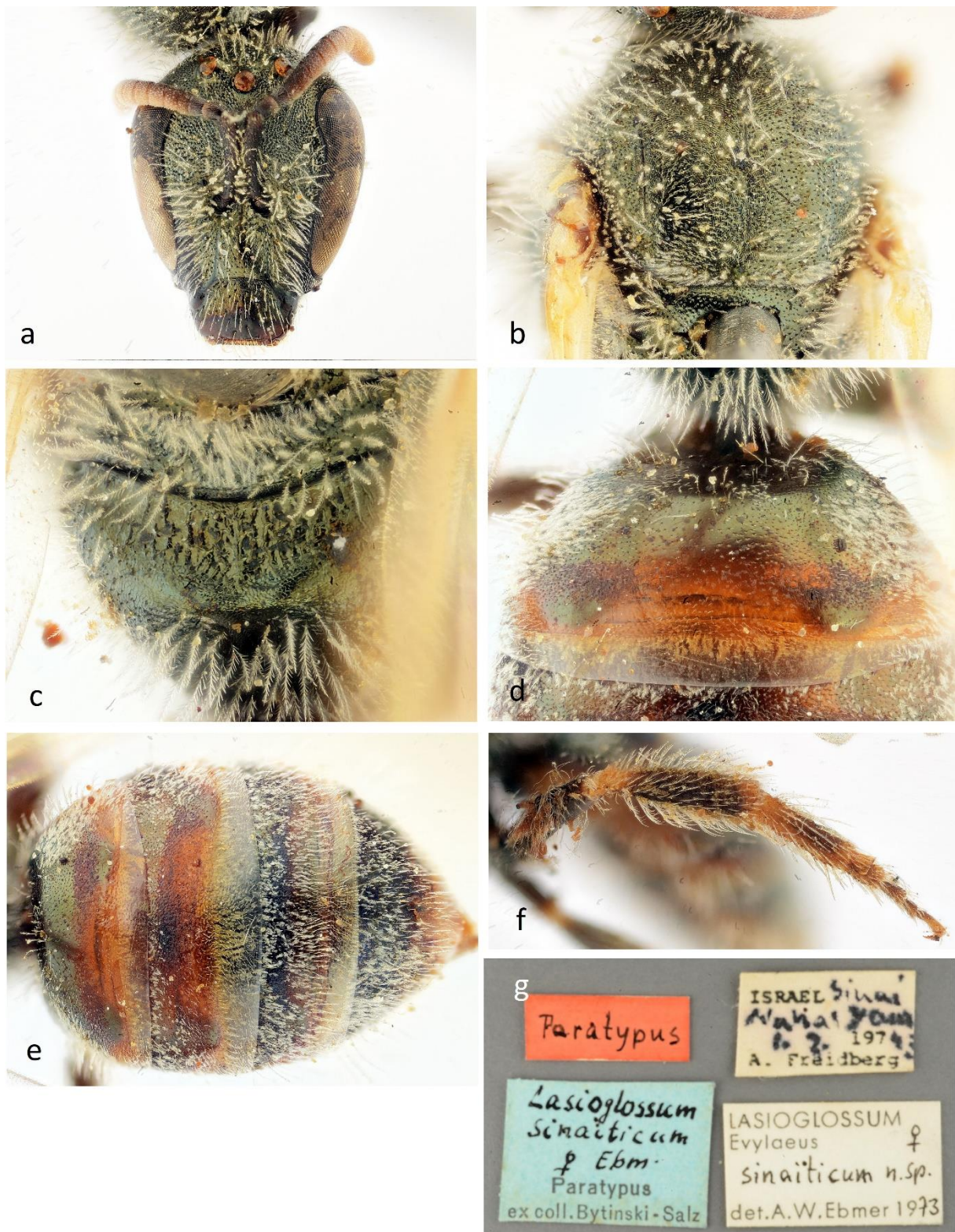


Fig. 10. *Lasioglossum sinaiticum*, female paratype, Nahal Yam, (syn. of *L. leptocepalum*); a, head; b, scutum; c, propodeum; d, first tergum; e, metasoma; f, hind leg; g, labels.



Fig. 11. *Lasioglossum krugeri*, male holotype; a, head; b, scutum and scutellum; c, propodeum; d, metasoma; e, antenna.

MATERIAL (19 specimens). TUNISIA. Tozeur, 10.V.1913, 1♀ (paratype) (col. Blüthgen, MNHUB) (BLÜTHGEN, 1923: 245; 1924: 307). – Tunis, "Ued Mda" (Oued Melah), 1♀, col. Alfken (? MNHUB) (BLÜTHGEN, 1923: 245; 1924: 307). – Nefta, 14.V.1913, 2♀ (BLÜTHGEN, 1924: 307). – Tunis, 1♀ (MNHUB). – Gabès, 1♀ (MNHUB) (BLÜTHGEN, 1934: 190).

LIBYA. Tripolitania, 9 km S. of Tripoli, 18.III.1951, fixed sandy ground in green belt, 1♀, leg. K.M. Guichard (NHML).

EGYPT. Mansuria, 30.XII.1926, 1♀ (BLÜTHGEN, 1934: 190). Araba, N. Sinai, 3.II.1973, 3♀, leg. D. Furth (= Wadi Araba) (29.574779, 34.979854) (SMNHTAU).

ISRAEL. Park Britannia, 31.707 34.921, 17.IV.2016, 1♀, leg. T. Chaprazaro (251704) (SMNHTAU). – Bat Yam, 32.008 34.898, 2.III.1919, 6♀, leg. Bytinsky Salz (MNHUB). – Holot Shunera, 30.942 34.597, 25.II.2015, 2♀, in stabilized sand dune, leg. G. Pisanty (205506) (SMNHTAU).

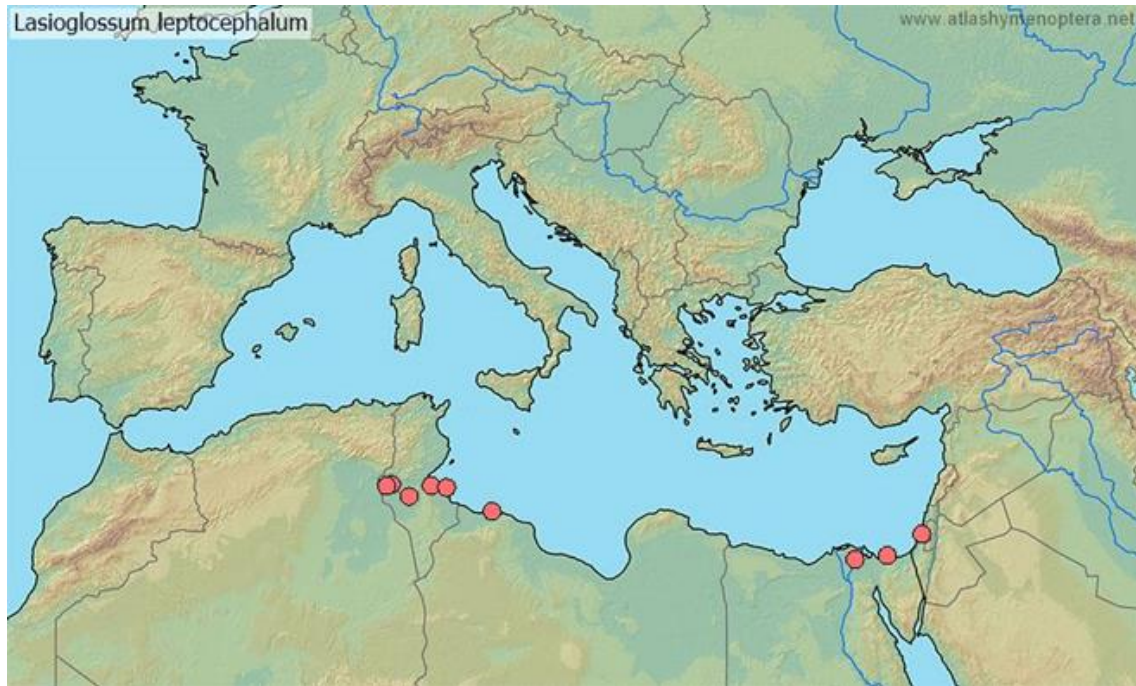


Fig. 12. Distribution map of *Lasioglossum leptocephalum*.

Table 2. Morphological comparison between *Lasioglossum leptocephalum* and *L. dorchini*

Characters and measurements	<i>Lasioglossum leptocephalum</i>	<i>Lasioglossum dorchini</i>
Female		
HL/HW= head length/ width	1.23 (Fig. 2a), narrower	1.14 (Fig. 2b), wider
CL/CW= clypeus length/ width	0.67 (Fig. 2a), narrower	0.61 (Fig. 2b), wider
UID/LID= upper interorbital distance/ lower interorbital distance	1.14, more convergent below (Fig. 2a)	1.11, less convergent below (Fig. 2a)
punctuation of middle of first tergum	sparse (Fig. 3a)	dense (Fig. 3b)
pubescence of third tergum	plumose setae covering 2/3 of the basal surface (Fig. 5a)	plumose setae delimited to the sides, short and unbranched in the middle (Fig. 5b)
length of the propodeal area/ length of the metanotum	1.5 (Fig. 10c)	1.4; (Fig. 7d)
colour of the hind leg	with more extended pale brown maculations (Fig. 6a)	nearly completely dark brown (Fig. 6b)
Male	(type of <i>Halictus krugeri</i> Blüthgen 1930)	(males from Nahal Alexander)
setae of the terga	long, white and plumose (Fig. 11d)	short, grey and weakly branched (Fig. 8e)
colour of the metasoma	with metallic blue reflections (Fig. 11d)	mostly black (Fig. 8e)
length of the propodeal area / length of the metanotum	1.66 (Fig. 11c)	1.25 (Fig. 8c)
wrinkles of the propodeal area	wrinkles limited to basal half of the propodeal area (Fig. 11c)	wrinkles reaching posterior margin of propodeal area (Fig. 8c).

Phylogenetic analysis

All specimens identified as *L. dorchini* based on morphological examination formed a monophyletic group with maximal posterior probability and bootstrap support values in all BI, NJ and ML phylogenetic analyses, respectively (Figs 13, 14). Similarly, specimens of *L. virens*, *L. leptocephalum* and *L. aureolum* were all reciprocally monophyletic (Figs 13, 14). Our results further show that specimens identified as *L. littorale* or *aff. littorale* (AP409, AP410, AP463, AP702, AP703, AP704 and AP705) were polyphyletic, comprising at least four different lineages across the *virens/littorale* group phylogeny (Figs 13, 14). Phylogenetic relationships among the different species of the *virens/littorale* group remain unsupported by our phylogeny (Figs 13, 14).

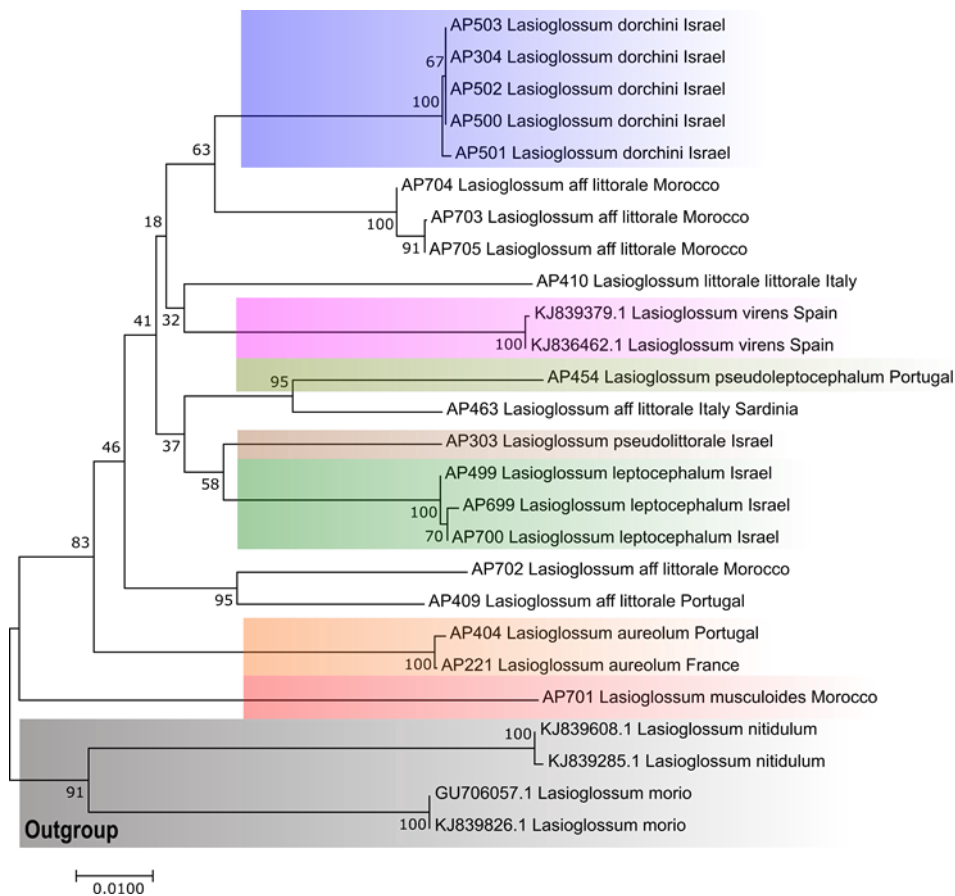


Fig. 13. Neighbour-joining tree reconstructed using 22 barcode sequences (658bp) of the cytochrome oxidase *c* subunit I gene for specimens currently identified into the *virens/littorale* group of species. The tree is drawn to scale, with branch lengths representing p-distances (*i.e.* proportions of variable sites). Four barcode sequences (shaded in grey) are used as outgroup for the phylogenetic tree: *Lasioglossum morio* and *L. nitidulum*. Each label corresponds to the study code (Table 1) or GenBank accession followed by the species name and the country of collection. The shaded colours on the tree correspond to morphological delineation except for the species identified as *Lasioglossum littorale* or *aff. littorale* which are left unshaded. Values at node correspond to bootstrap values (%).

Discussion and conclusions

Lasioglossum dorchini is a species so close to *L. leptocephalum* that it may be considered as a simple variation. Here however, integrative taxonomy combining barcodes and morphological features support its validity as a new species.

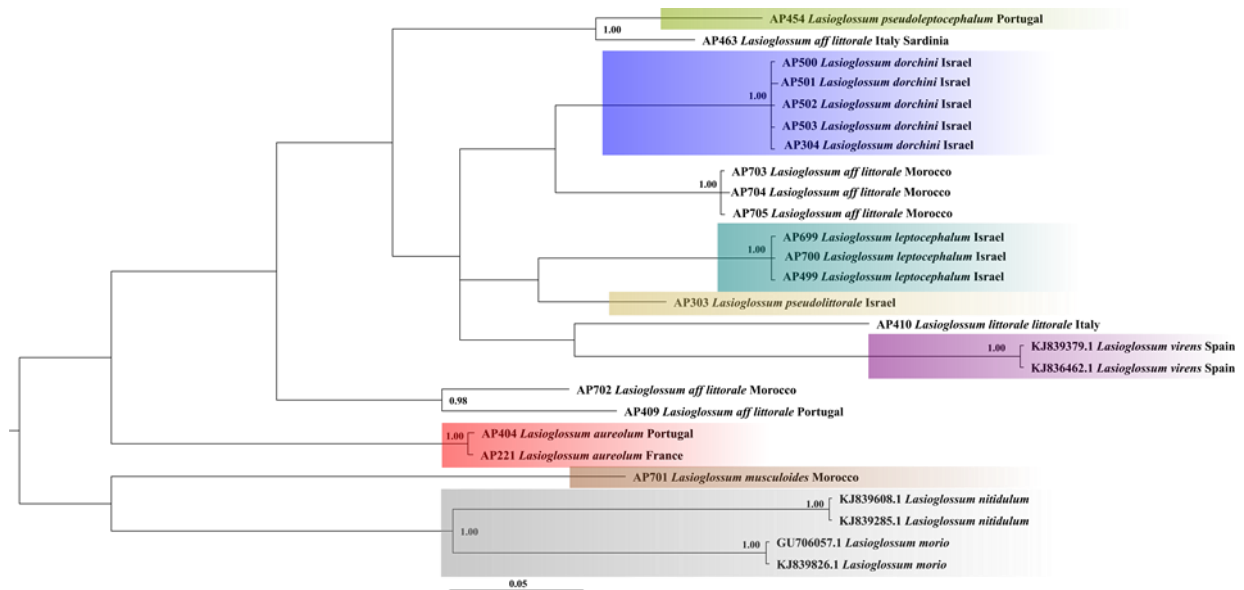


Fig. 14. Phylogenetic tree constructed using Bayesian inference. The tree is based on 22 barcode sequences (676 bp) of the cytochrome oxidase *c* subunit I gene for specimens currently identified into the *virens/littorale* group of species. Four barcode sequences (shaded in grey) are used as root for the phylogenetic tree: *Lasioglossum morio* and *Lasioglossum nitidulum*. Each label corresponds to the study code (Table 1) or GenBank accession followed by the species name and the country of collection. Posterior probabilities are given at nodes. The shaded colors on the tree correspond to morphological delineation except for the species identified as *Lasioglossum aff littorale* which was left as blank. Only posterior probabilities above 0.95 are shown in the figure.

Lasioglossum littorale has been considered as a widespread species occurring in coastal habitats of the Mediterranean Basin. It has been split by EBMER (1972, 1976) in different insular and geographic subspecies that are difficult to identify. The morphological heterogeneity of the different subspecies with respect to body size or length of the head complicates their classification. Our molecular analyses demonstrate that the species is composite. Additional freshly collected material, especially from Southern Spain and North Africa, is needed to clarify the systematics of all the species provisionally identified as "aff *littorale*". But our preliminary revision of the barcoded specimens already reveals some subtle morphological differences, for instance, in the density and size of the punctation of the scutum and terga.

All species of the *virens/littorale* group occur in sandy habitats, and particularly in coastal dunes, a type of habitat that is strongly threatened by infrastructure development for tourism and urbanisation. Consequently, the geographic distribution of these species is very limited, despite the fact that these specialized species are often counted among the most abundant bees collected with pan traps in these particular habitats (BOSCHETTI *et al.*, 2017).

The subgeneric classification of the *Lasioglossum Hemihalictus* series remains challenging, and is currently being revised based on molecular phylogenetic evidence. It would be premature to recognise the *virens/littorale* group as a valid subgenus before this group is proved monophyletic. To achieve this, additional non-metallic species (that lack metallic green reflections) outside the *virens/littorale* group need to be sequenced to obtain a more robust phylogeny and stabilize the classification. The name *Virenshalictus* Pesenko, 2007, is available if a subgeneric status is found appropriate for the group in future studies.



Fig. 15. Semi stabilized sand dunes, natural habitat of *Lasioglossum dorchini* in Alexander Stream National Park (March 2017).



Fig. 16. Semi stabilized sand dunes, natural habitat of *Lasioglossum dorchini* in Alexander Stream National Park (March 2017).



Fig. 17. Part of the Alexander Stream National Park planted with *Eucalyptus* trees (March 2017).



Fig. 18. Part of the Alexander Stream National Park planted with *Eucalyptus* trees (March 2018).

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