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Integrative taxonomy identifies *Lasioglossum fertoni* (Vachal, 1895) and *Lasioglossum discus* (Smith, 1853) (Hymenoptera: Anthophila: Halictidae) as distinct species

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Abstract. The genus *Lasioglossum* Curtis, 1833, is one of the most diverse bee genera in Europe, with 183 described species. Recent advances in integrative taxonomy, combining morphological, molecular, and ecological data, have enhanced our understanding of cryptic and semi-cryptic species complexes within the genus. This study provides a comprehensive reassessment of the taxonomic status of *L. fertoni* (Vachal, 1895) stat. rev., integrating genetic, morphological, and biogeographic data. Our findings reveal clear differentiation between *L. fertoni* and the closely related species *L. discus* (Smith, 1853), supported by genetic distances and diagnostic morphological traits. The two taxa show partially overlapping ranges, although confirmed cases of syntopy remain to be demonstrated. *Lasioglossum fertoni* is confirmed to have a distribution across the Western Mediterranean. The study highlights the importance of integrative approaches in resolving taxonomic ambiguities and underscores the relevance of accurate species delineation for conservation efforts, particularly in light of the growing threats to European pollinators.

Keywords. Distribution, restating, sweat bees, subspecies, conservation.

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Introduction

The diversity of wild bees in Europe is high, with more than 2100 documented species (Ghisbain *et al*. 2023a), representing around 10% of global diversity, and inhabiting a wide variety of ecosystems. This richness is a result of the ecological range and adaptability of bees, which occupy niches from alpine meadows to Mediterranean shrublands and deserts (Michez *et al*. 2019, 2025). Among bees, the genus *Lasioglossum* Curtis, 1833, stands out as the third most species-rich European genus, encompassing 183 described species in Europe (Ghisbain *et al.* 2023a; Flaminio *et al*. 2024).

Over the past decade, significant advances have been made in the taxonomy of *Lasioglossum* and Halictini Thomson, 1869 more broadly through integrative approaches, combining morphological, molecular, and ecological data to resolve taxonomic ambiguities. These studies have shed light on cryptic and semi-cryptic species complexes, revealing hidden diversity and clarifying species boundaries (Pauly *et al*. 2015, 2019, 2020; Gardner & Gibbs 2020; Gueuning *et al*. 2020). Notably, certain species within this genus exhibit broad geographic distributions associated with considerable morphological variability, often leading to the recognition of subspecies. However, the validity of these subspecies classifications has been the subject of ongoing debate, with individual interpretations (Ebmer 1988, 1997, 2000; Pauly 2016a, 2016b).

One such example is *Lasioglossum discus* (Smith, 1853), a species widespread across the Palearctic region (Ebmer 1988; Pauly 2016a). The name is often misspelled *L. discum* (e.g., Louadi 1999; Rust *et al*. 2003; Pauly 2016a), but '*discus'* is a Latin noun, so following Article 31.2.1 (ICZN 1999) of the Code, the original spelling is maintained (Lhomme *et al*. 2020: 75). Two subspecies of *L. discus* are currently recognised. The nominal subspecies, *Lasioglossum discus discus*, ranges from the northern Mediterranean basin to Central Asia and extends northward into eastern Austria (Ebmer 1988; Pauly 2016). In contrast, the subspecies *Lasioglossum discus fertoni* Vachal, 1895, inhabits a range that spans from north-west Africa to Sicily and southern France. Overlap zones of the two taxa were reported in the Var region (Pauly 2016), the Cottian Alps, and southern Italy (Ebmer 1988).

Recent morphological and genetic evidence suggests that *Lasioglossum discus fertoni* represents a distinct evolutionary lineage, warranting species status (Wood *et al*. 2024). In this study, we formally reassess the taxonomic status of *Lasioglossum discus fertoni* in a methodological framework of integrative taxonomy, considering multiple lines of evidence, including morphological characteristics, molecular data, and ecological traits. This work contributes to the broader effort to document and preserve Europe's rich wild bee fauna, which faces mounting threats from habitat loss, climate change, and other anthropogenic pressures.

Material and methods

Specimens examined

We examined the type material of *Lasioglossum discus*. The holotype of *L. fertoni* could not be located. Ebmer (1988) listed it as deposited in Sevilla, while Rasmussen (2012) reported it was not at EBDS (Estación Biológica de Doñana–CSIC, Sevilla, Spain) and noted that Medina's collection was split among his personal collection, Sevilla, MNCN (Museo Nacional de Ciencias Naturales–CSIC, Madrid, Spain), and MNHN (Muséum national d'Histoire Naturelle, Paris, France). Recent confirmation (Curro Molina pers. com. 2024) indicates it is not present at EBDS, and despite extensive searches, we were unable to locate it at MNHN. Since Ebmer (1988) examined the remaining types of this group, we follow his treatment for synonymy of the types we did not examine. Regarding non-type material, 979 specimens were examined. For each species in the catalogue, we provide the valid name, synonymy, type material examined (with depository information and images when available), additional material examined, diagnostic figures, distribution, and relevant remarks from the literature. This structure allows readers to easily access morphological, taxonomic, and biogeographic information for each taxon.

Genetic analysis

DNA extraction, PCR amplification, and sequencing were conducted by the Canadian Centre for DNA Barcoding, Guelph, using standardised high-throughput protocols (Ivanova *et al*. 2006; deWaard *et al*. 2008; http://ccdb.ca/resource). The results were submitted to the Barcode of Life Data System (BOLD), a cloud-based data storage and analysis platform developed by the Canadian Centre for DNA barcoding (https://boldsystems.org; Ratnasingham *et al*. 2024).

For DNA analysis, we barcoded 11 specimens of *L. fertoni*, four specimens of *L. discus* and two specimens of *L. aegyptiellum* (Strand, 1909). Specimens of *L. fertoni* from areas of sympatry with *L. discus* were included, but *L. discus* individuals from these same areas were not sequenced; therefore, potential introgression between the two taxa was not assessed. The ingroup sampling represents the widest possible distribution of *Lasioglossum discus* and *L. fertoni* (Table 1). *Lasioglossum aegyptiellum* was chosen as a comparative taxon due to its well-defined taxon concept, which is supported by both morphological and molecular evidence, and it is closely related to *L. discus* and *L. fertoni*. *Halictus consobrinus* Pérez, 1895, was chosen as an outgroup to root the tree. The tree was supplemented with additional sequences that were downloaded from the Barcode of Life Data System or taken from literature (e.g., Wood *et al*. 2024).

DNA sequences were aligned using the MUSCLE algorithm implemented in MEGA11 software (Tamura *et al*. 2021). Phylogenetic analysis was conducted using the Maximum Likelihood method in MEGA (Kumar *et al*. 2018). Bootstrap values were calculated based on 1000 replicates, employing the Tamura 3-parameter model, which was selected due to its lowest Bayesian Information Criterion scores, indicating it best represents the substitution pattern. *Halictus consobrinus* Pérez, 1895 was designated as the outgroup.

Intra- and interspecific distances were also calculated using MEGA11 software, with the maximum intraspecific and minimum interspecific values used for comparison.

Distribution

All analysed specimens' label information was recorded, and Google Earth™ (http://earth.google.com) was used to georeference their locations when original coordinates were not stated on the labels. The map was prepared with QGIS ver. 3.40.2 (QGIS.org 2024).

Photography

Photographs of habitus were taken using an Olympus E-M1 Mark I with a 60 mm Zuiko macro lens, and details were taken using Keyence VHX-970F. Habitus pictures were stacked with Helicon ver. 8.2.2 (HeliconSoft, Kharkiv, Ukraine). Plates were assembled using GIMP (GNU Image Manipulation Program).

Abbreviations

Morphological terminology follows Michener (2007). The abbreviations T and S are used for metasomal terga and metasomal sterna, respectively.

The examination and identification of type and non-type specimens were achieved in the following institutions and private collections (acronyms included):

AEC = Andreas Ebmer Private Collection, Linz, Austria
CBC = CREA Bologna Collection, Bologna, Italy
FSEC = Entomological Collection "Filippo Silvestri", Naples, Italy
IEGG = Istituto di Entomologia "Guido Grandi", Bologna, Italy

Table 1. Specimens included in the phylogenetic analysis. The scientific names are provided in the first column. Each specimen is marked with a label displaying a voucher code. Data are accessible on BOLD.

Taxon	**Locality**	**Collector/Identifier**	**Voucher Code**	**BOLD**
Lasioglossum aegyptiellum	Cyprus: Alassa, Kauris Dom	Rosa P./Faminio S.	HASARD-001	HASARD-001-24
Lasioglossum aegyptiellum	Lebanon: Hrar, Al Ared, Al Wosta	Boustani M./Faminio S.	HASARD-023	HASARD-023-24
Lasioglossum discus	Italy: Campania, Agropoli	Faminio S./Faminio S.	HASARD-003	HASARD-003-24
Lasioglossum discus	Kyrgyzstan: Tolmok	Faminio S./Faminio S.	HASARD-042	HASARD-042-24
Lasioglossum discus	Uzbekistan: Kutanbay, Kashkadarya	D. Benda/Faminio S.	HASARD-013	HASARD-013-24
Lasioglossum discus	Greece: Eastern Macedonia and Thrace, Kavala	Wood T./Faminio S.	TJW_1643	WPATW1475-23
Lasioglossum fertoni	Spain: Alicante, Les Salades	Queros C./Faminio S.	HASARD-004	HASARD-004-24
Lasioglossum fertoni	Italy: Apulia, Lecce	Bollino M./Faminio S.	HASARD-005	HASARD-005-24
Lasioglossum fertoni	Morocco: Rabat	Lhomme P./Faminio S.	HASARD-006	HASARD-006-24
Lasioglossum fertoni	France: Provence-Alpes-Côte d'Azur, Chemin Istres	Le Divelec R./Faminio S.	HASARD-007	HASARD-007-24
Lasioglossum fertoni	Spain: Teruel, Tramacastilla	Le Divelec R./Faminio S.	HASARD-008	HASARD-008-24
Lasioglossum fertoni	Italy: Sardinia, Alghero	Niolu P./Faminio S.	HASARD-009	HASARD-009-24
Lasioglossum fertoni	Spain: Andalusia, Parque del Guadalhorce	Ghisbain G./Faminio S.	HASARD-010	HASARD-010-24
Lasioglossum fertoni	France: Occitanie, N.D. De Londres, Fontanilles	Aubert M./Faminio S.	HASARD-011	HASARD-011-24
Lasioglossum fertoni	France: Provence-Alpes-Côte d'Azur, Peg. De Buèges	Aubert M./Faminio S.	HASARD-056	HASARD-056-24
Lasioglossum fertoni	Morocco: Fès-Meknès, Midelt	Wood T./Faminio S.	TJW_1645	WPATW1477-23
Lasioglossum fertoni	Morocco: Drâa-Tafilalet, Ouarzazate	Wood T./Faminio S.	TJW_1644	WPATW1476-23
Halictus consobrinus	Morocco: Amroud, route to Sidi Chamarouch	Wood T./Faminio S.	ORBIT280-23	AFP1176

MAPC = Mathieu Aubert Private Collection, France
MNHN = Muséum national d'Histoire naturelle, Paris, France
MSNG = Museo Civico di Storia Naturale "Giacomo Doria", Genova, Italy
NHMUK = Natural History Museum, London, UK
NMPC = National Museum, Prague, Czech Republic
NMW = Wien Natural History Museum, Vienna, Austria
OOLM = Oberösterreichisches Landesmuseum, Linz, Austria
RBINS = Royal Belgian Institute of Natural Sciences, Brussels, Belgium
RLDC = Romain Le Divelec Private Collection, Mons, Belgium
SFC = Simone Flaminio Private Collection, Mons, Belgium
TJWC = Thomas J. Wood Private Collection, Leiden, Netherlands
UMONS = University of Mons Collection, Mons, Belgium
ZIN = Zoological Institute, St Petersburg, Russia
ZSM = Zoologische Staatssammlung Germany, Munich, Germany

Results

Genetic analysis

Clades with specimens of *Lasioglossum discus* and *L. aegyptiellum* were well resolved, with a bootstrap value of 100. In contrast, the clade with *L. fertoni* showed strong support with a bootstrap value of 99 (Fig. 1). Interspecific distances between *Lasioglossum discus* and *L. fertoni* ranged from 7.02% to 7.92%, with an average of 7.47%. Results suggest that the two putative subspecies of *L. discus* are not monophyletic. These molecular differences are also consistent with morphological distinctions previously noted between *L. discus* and *L. fertoni* (e.g., Ebmer 1976), as well as their distributions: *L. fertoni* occurs mainly in the western Mediterranean (Iberian Peninsula, North Africa, southern France), whereas *L. discus* is found from Italy eastwards through the Balkans, Greece and into western Asia, with areas of contact in the central Mediterranean.

Morphology

Diagnostic characters

Lasioglossum fertoni can be distinguished from *L. discus* in both sexes by several morphological traits, as summarised in Table 2. The most striking difference lies in the punctation of the scutum, which is extremely sparse in *L. discus* (Fig. 6A), with the distance between punctures equivalent to several (>4) puncture diameters, but significantly denser in *L. fertoni* (Fig. 6B), where the distance, especially in the upper third and on the disc, does not exceed 2–3 puncture diameters. Similarly, the T1 of *L. fertoni* is more densely punctate (Fig. 8B), both on the disc and the margin, compared to *L. discus* (Fig. 8A). While the punctation on the margin is somewhat variable in *L. discus*, being sometimes denser, almost as in *L. fertoni*, the punctation on the disc is always denser in *L. fertoni*.

The propodeal sculpture also differs between the two species. In *L. discus*, the basal and lateral portions of the propodeum bear long, parallel longitudinal carinae that are only slightly irregular in the middle (Fig. 7A–C). These carinae transition smoothly into the lateral fields with only a subtle angular shift, making the boundary between the basal and lateral fields barely perceptible. While *L. fertoni* exhibits a propodeal sculpture reminiscent of *L. discus*, the angular ridges at the transition from the basal to the lateral fields are more pronounced, rendering the boundary more distinct (Fig. 7B–D).

Further differences are obvious in female specimens, as noted by Ebmer (1970). In *L. fertoni*, the genae exhibit longitudinal grooves extending almost to the eyes, with obliquely impressed punctures (Fig. 5D). In *L. discus*, these punctures are narrower, the punctate area is more extensive, and the surface appears glossier (Fig. 5C). Additionally, the pubescence near the sulcus is light reddish-yellow in *L. fertoni* (Fig. 9B), whereas in *L. discus*, it is whitish (Fig. 9A).

Males of *L. fertoni* can also be differentiated from those of *L. discus* by the distinctive shape of S7 (Fig. 14B–D) (Ebmer 1970), in addition to the traits listed for females that are also valid for males, as indicated in Table 2. Moreover, some *L. fertoni* males display larger body sizes and a macrocephalic

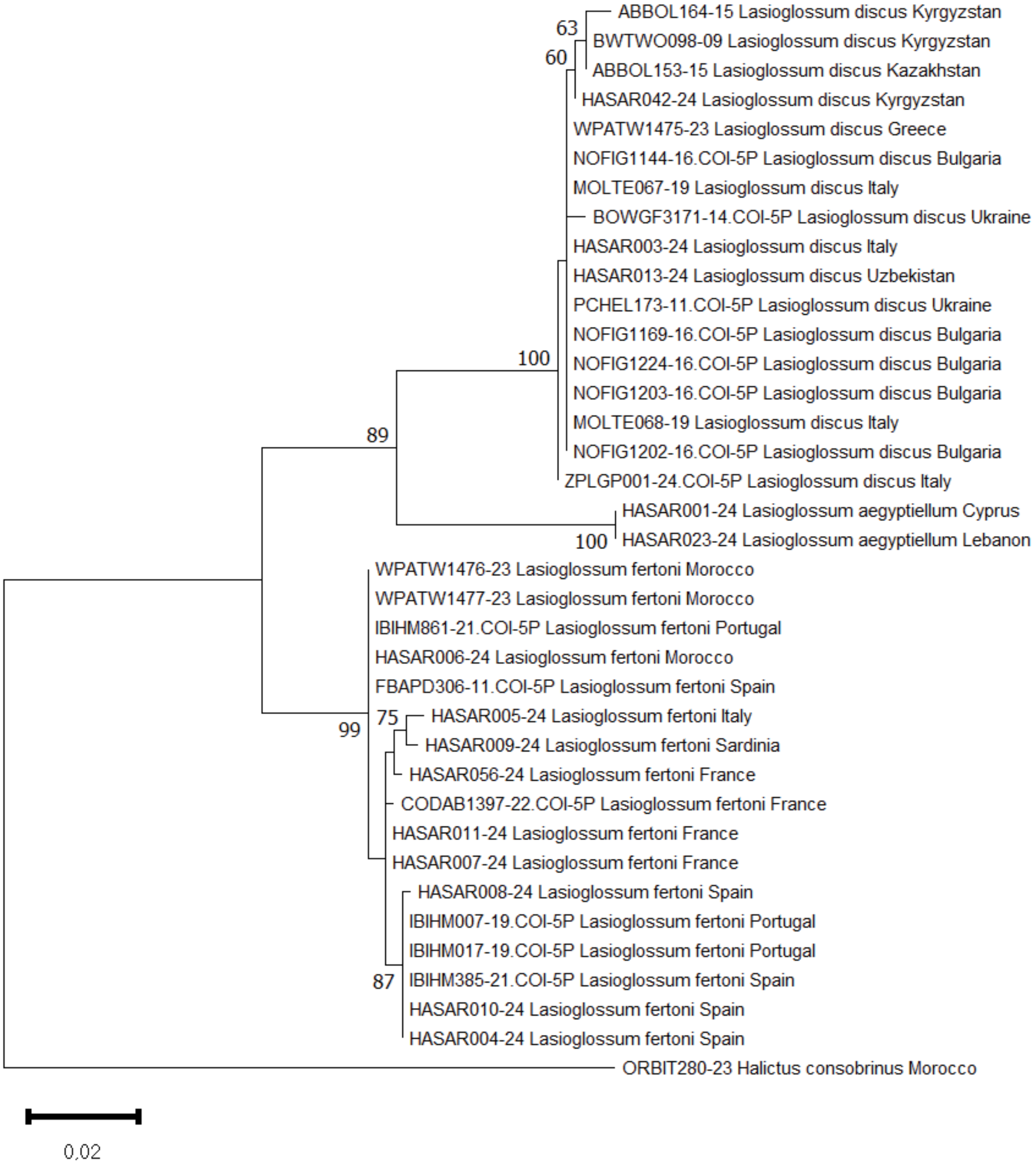

Fig. 1. Maximum Likelihood tree, showing the relationships between *Lasioglossum discus* (Smith, 1853), *L. fertoni* (Vachal, 1895) stat. rev. and *L. aegyptiellum* (Strand, 1909). The percentage of replicate trees where the associated taxa clustered together in the bootstrap test (1000 replicates) is shown above the branches. The evolutionary distances were computed using the Maximum Composite Likelihood method. This analysis involved six OTUs, each represented by a single nucleotide sequence. Values <0.5 are omitted.

Table 2. Determination table to morphologically separate specimens of *Lasioglossum discus* (Smith, 1853) and *L. fertoni* (Vachal, 1895).

Character	***Lasioglossum discus***	***Lasioglossum fertoni***
Scutum punctation (♂ & ♀)	Extremely sparse (interspace > 4–5 puncture diameters)	Significantly denser (interspace < 3 puncture diameter)
T1 punctation (♂ & ♀)	Variable on the margin, always sparse on the disc	Dense on both the disc and the margin
Propodeal sculpture (♂ & ♀)	Long, parallel longitudinal carinae, smooth transition between basal and lateral fields	More angular ridges, distinct boundary between basal and lateral fields
Genae (♀)	Narrow, extensive punctation, glossier surface	Longitudinal grooves with obliquely impressed punctures
Pubescence near the sulcus (♀)	Whitish-yellow	Light reddish-yellow
S7 shape (♂)	Distinct from *L. fertoni* (Fig. 14A)	Distinct from *L. discus* (Fig. 14B)

morphology (Fig. 10C), with distinctly pointed genae (Fig. 10F), a trait never observed in the European population of *L. discus*. In areas where *L. discus* and *L. fertoni* coexist, some *L. fertoni* individuals may show less pronounced diagnostic traits. We have barcoded *L. fertoni* from these sympatric sites, confirming their species identity. However, specimens of *L. discus* from the same areas were not sequenced, so we did not assess potential introgression. Despite this, careful morphological examination across all diagnostic characters reliably distinguishes the two species, supporting our conclusions.

Distribution

Morocco, Tunisia, Algeria, Spain, Portugal, France, Italy (including Sardinia and Sicily), and Malta (Fig. 2).

Ecology

Sphecodes schenckii Hagens, 1882 has been reported as a brood parasite of *Lasioglossum discus* s. lat. (Blüthgen 1934; Grozdanić 1971; Bogusch & Straka 2012). The species is known to use multiple hosts, including *Halictus simplex* Blüthgen, 1923, and *H. maculatus* Smith, 1848, which are broadly distributed across Europe. To date, there is no evidence that *S. schenckii* parasitises *L. fertoni*.

Taxonomy

Class Insecta Linnaeus, 1758
Order Hymenoptera Linnaeus, 1758
Family Halictidae Thomson, 1869
Subfamily Halictinae Thomson, 1869
Genus *Lasioglossum* Curtis, 1833
Subgenus *Leuchalictus* Warncke, 1975

Lasioglossum* (*Leuchalictus*) *discus (Smith, 1853)

Figs 1–3, 5A, C, 6A, 7A, C, 8A, C, 9A, 10A, D, 11A, 12A, C, 13A, C, 14A, C

Halictus discus Smith, 1853: 70.
Halictus morbillosus Kriechbaumer, 1873: 61–62.
Halictus morbillosus glasunovi Cockerell, 1924: 582–583.

Lasioglossum discus fertoni ♂ – Blüthgen 1931: 211 (comb. non auct.).
Halictus morbillosus glasunovi ♂ – Blüthgen 1931: 211 (synonymy with *Lasioglossum discus fertoni,* non auct.) [included within *Lasioglossum discus* based on geographic evidence].
Halictus morbillosus ♀ – Ebmer 1976: 5 (synonymy with *Lasioglossum discus*).

Type material examined

Lectotype of *Halictus discus* Smith, 1853 (designated by Ebmer 1976)
GREECE? • ♀ (Fig. 1); "Type H.T // B.M. Type Hym. 17.a.997 // B.M. Type Hym. *Halictus discus* Smith 1853 // discus Typus Sm. // Rhea #f // Hololectotypus // *LASIOGLOSSUM Lasioglossum discum* (SM.) #F det A.W. Ebmer 1975 // NHMUK 014024745"; NHMUK 014024745.

Lectotype of *Halictus morbillosus* Kriechbaumer, 1873 (designated by Ebmer 1976)
ITALY • ♀ (Fig. 2); South Tyrol, surroundings of Bolzano; "Cotype // 485. // Bozen A. Kriechbaumer // Sudtirol Haslach bei Bozen 24.8.1868 Kriechbaumer % // *Halictus morbillosus* Kriechbau P. Blüthgen det. #f // Lectotypus *Halictus morbillosus* #f Kr. Zool. Staatssammlg. Münich // *LASIOGLOSSUM Lasioglossum discum* (Sm.) #f, det A.W. Ebmer 1975"; WNHM.

Type material not examined

Holotype of *Halictus morbillosus glasunovi* Cockerell, 1924
TAJIKISTAN • ♂; Varsaminor; ZIN.

Other material examined

See Supp. file 1.

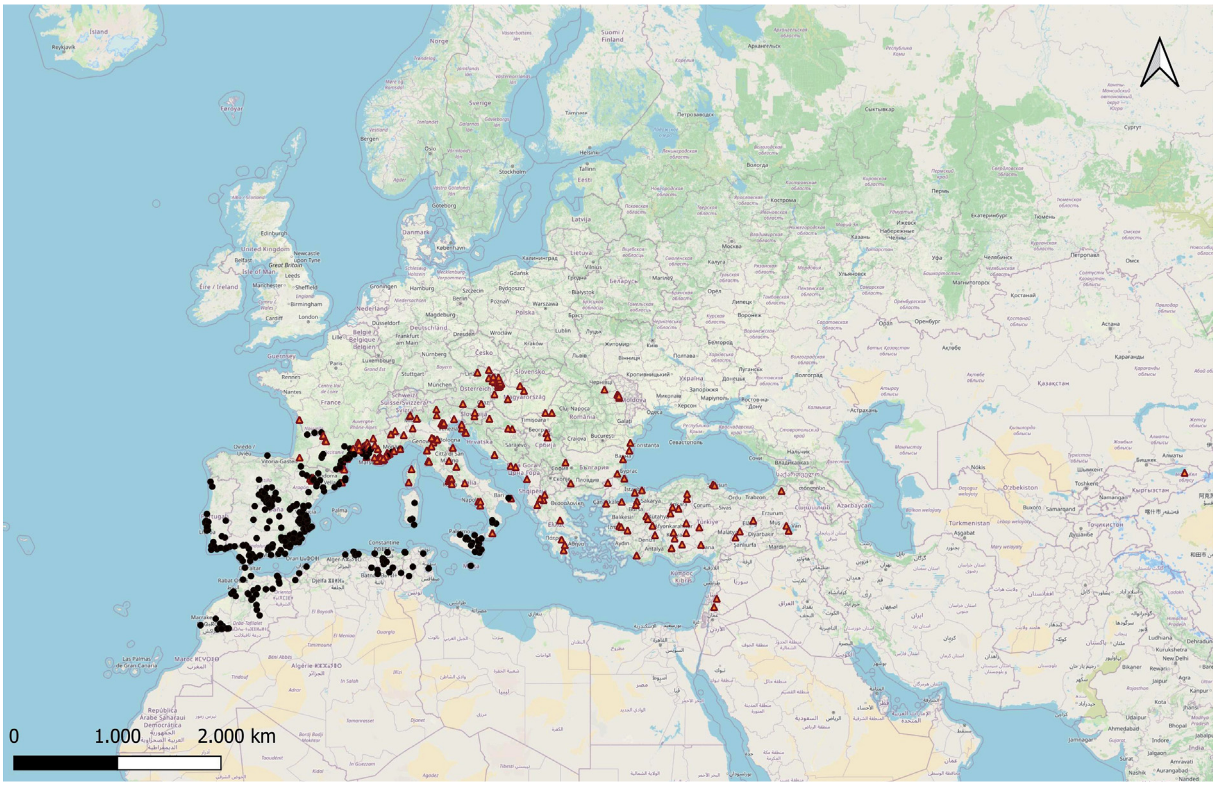

Fig. 2. Distributions of *Lasioglossum discus* (Smith, 1853) (red triangle) and *Lasioglossum fertoni* (Vachal, 1895) (black dots) across the West Palearctic region based on examined material.

Distribution

Lasioglossum discus is distributed across southern Europe and western Asia, from the Iberian Peninsula in the west, across southern Europe including France, the Balkans and Anatolia, to the Caucasus and Central Asia in the east (Fig. 2).

Remarks

Blüthgen (1931) synonymised *Lasioglossum morbillosum glasunovi* with *Lasioglossum discus fertoni* based on correspondence by Popov, who compared a specimen of *L. discus fertoni* with the *L. morbillosum glasunovi* specimen cited by Morawitz (1893) and housed at ZIN. Furthermore, Pesenko (2006) synonymised *L. discus fertoni* with *L. discus* based on several Transcaucasian and Central Asia specimens, whose T1 punctation matched that of *L. fertoni*. According to Pesenko (2006), the *L. discus* specimen collected in China and preserved at ZIN "undoubtedly belongs to '*L. discus fertoni*'." While some Central Asian specimens examined during this study do resemble the morphology described by Popov, a thorough assessment of both external and internal morphological characters confirms their

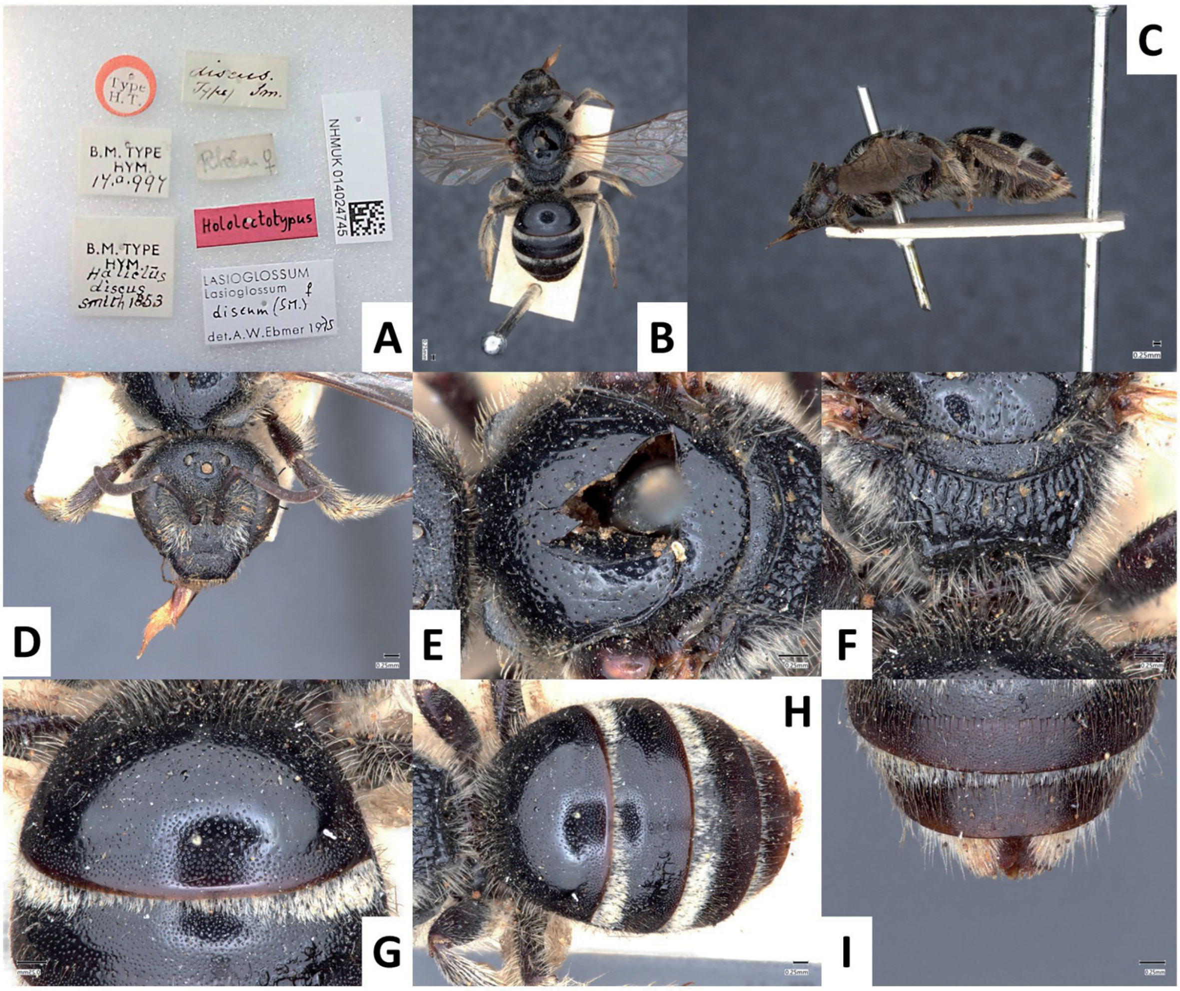

Fig. 3. *Lasioglossum discus* (Smith, 1854), lectotype, ♀ (NHMUK 014024745). **A**. Labels. **B**. Habitus, dorsal view. **C**. Habitus, lateral view **D**. Head, frontal view. **E**. Scutum, dorsal view. **F**. Propodeum, dorsal view. **G**. T1, dorsal view. **H**. Metasoma, dorsal view. **I**. Sulcus, dorsal view. Scale bars = 0.25 mm.

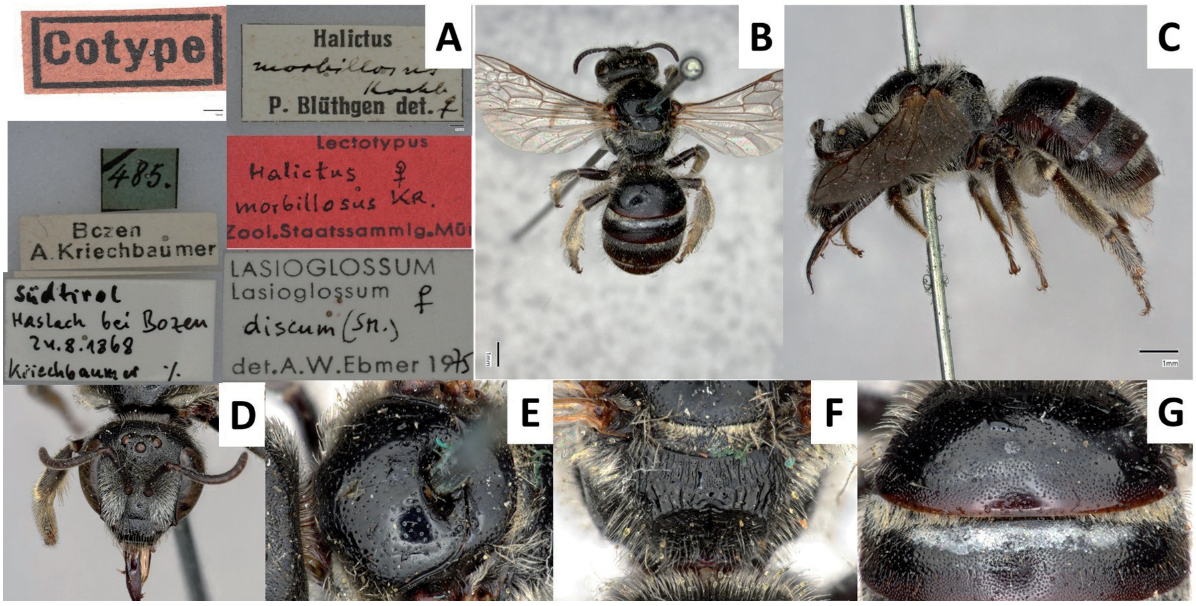

Fig. 4. *Lasioglossum morbillosus* Kriechbaumer, 1873, lectotype, ♀ (NMW). **A**. Labels. **B**. Habitus, dorsal view. **C**. Habitus, lateral view. **D**. Head, frontal view. **E**. Scutum, dorsal view. **F**. Propodeum, dorsal view. **G**. T1, dorsal view. Scale bars: B–C = 1 mm; D–G = not to scale.

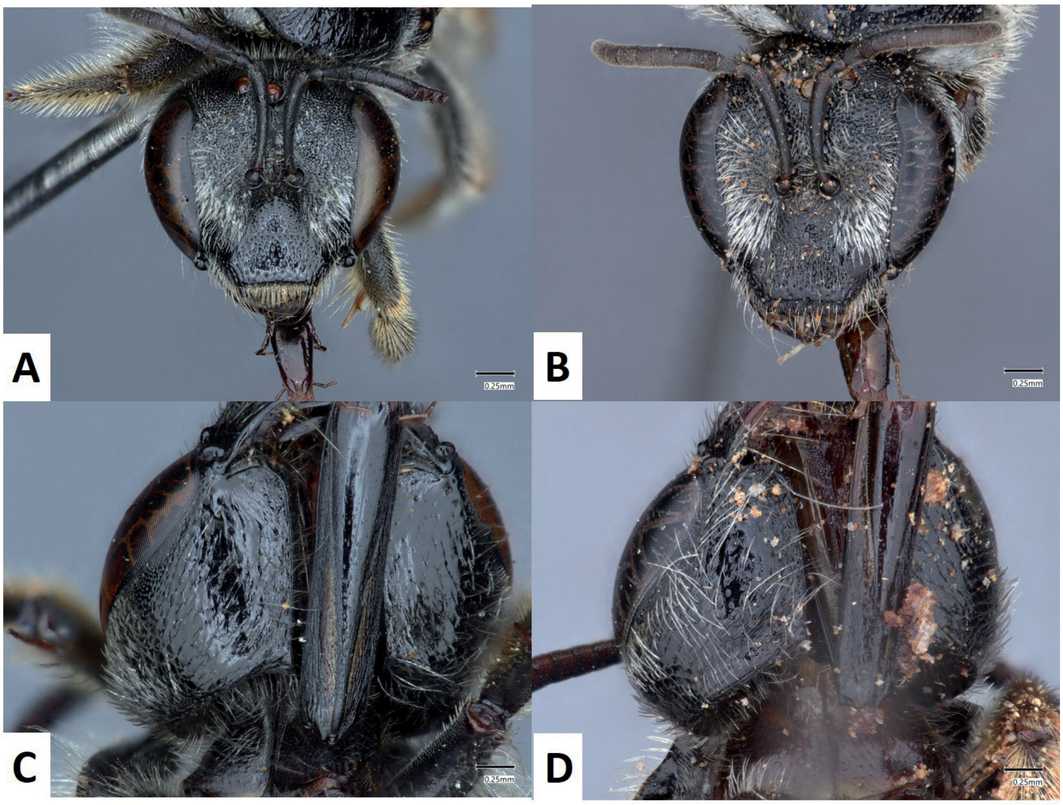

Fig. 5. A, C. *Lasioglossum discus* (Smith, 1854), ♀ (SFC). **B, D**. *L. fertoni* (Vachal, 1895), ♀ (SFC). **A-B**. Head, frontal view. **C-D**. Genae, ventral view. Scale bars = 0.25 mm.

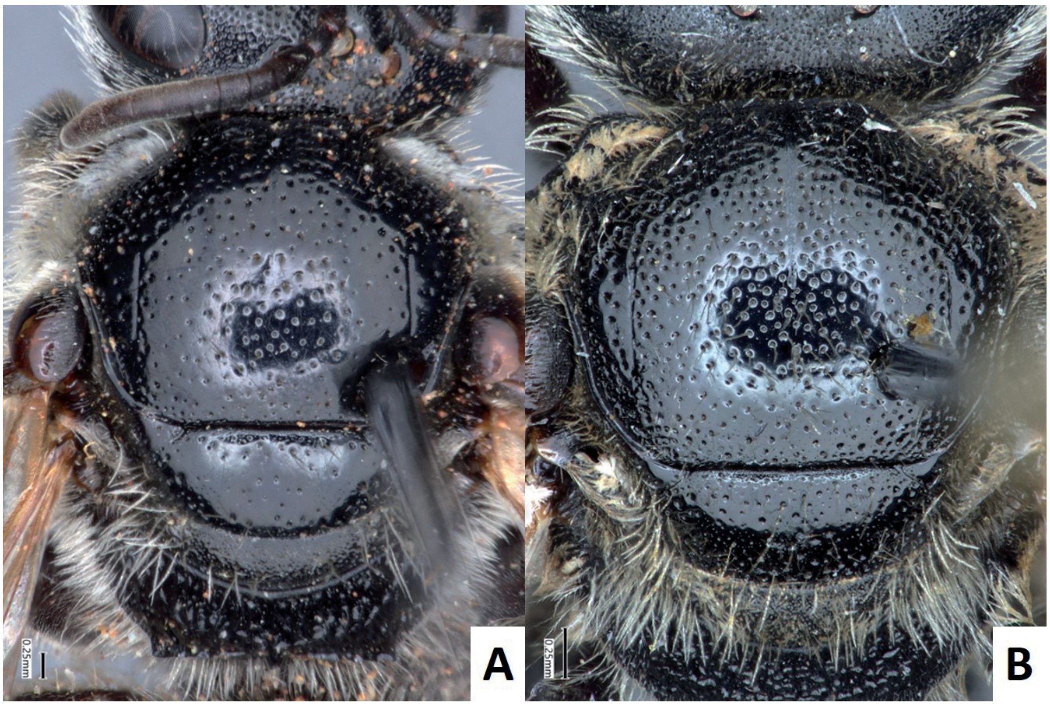

Fig. 6. A. *Lasioglossum discus* (Smith, 1854), ♀ (SFC), scutum, dorsal view. **B**. *L. fertoni* (Vachal, 1895). ♀ (SFC), scutum, dorsal view. Scale bars = 0.25 mm.

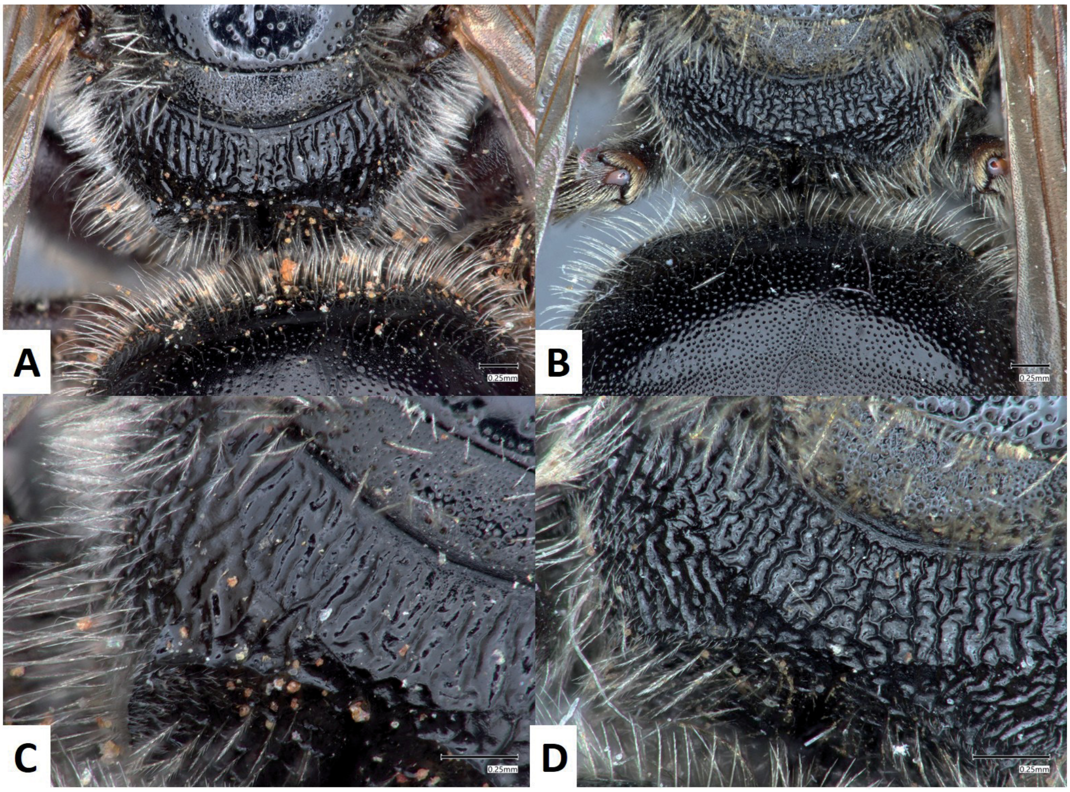

Fig. 7. A, C. *Lasioglossum discus* (Smith, 1854), ♀ (SFC), propodeum, dorsal view. **B, D**. *L. fertoni* (Vachal, 1895), ♀ (SFC), propodeum, dorsal view. Scale bars = 0.25 mm.

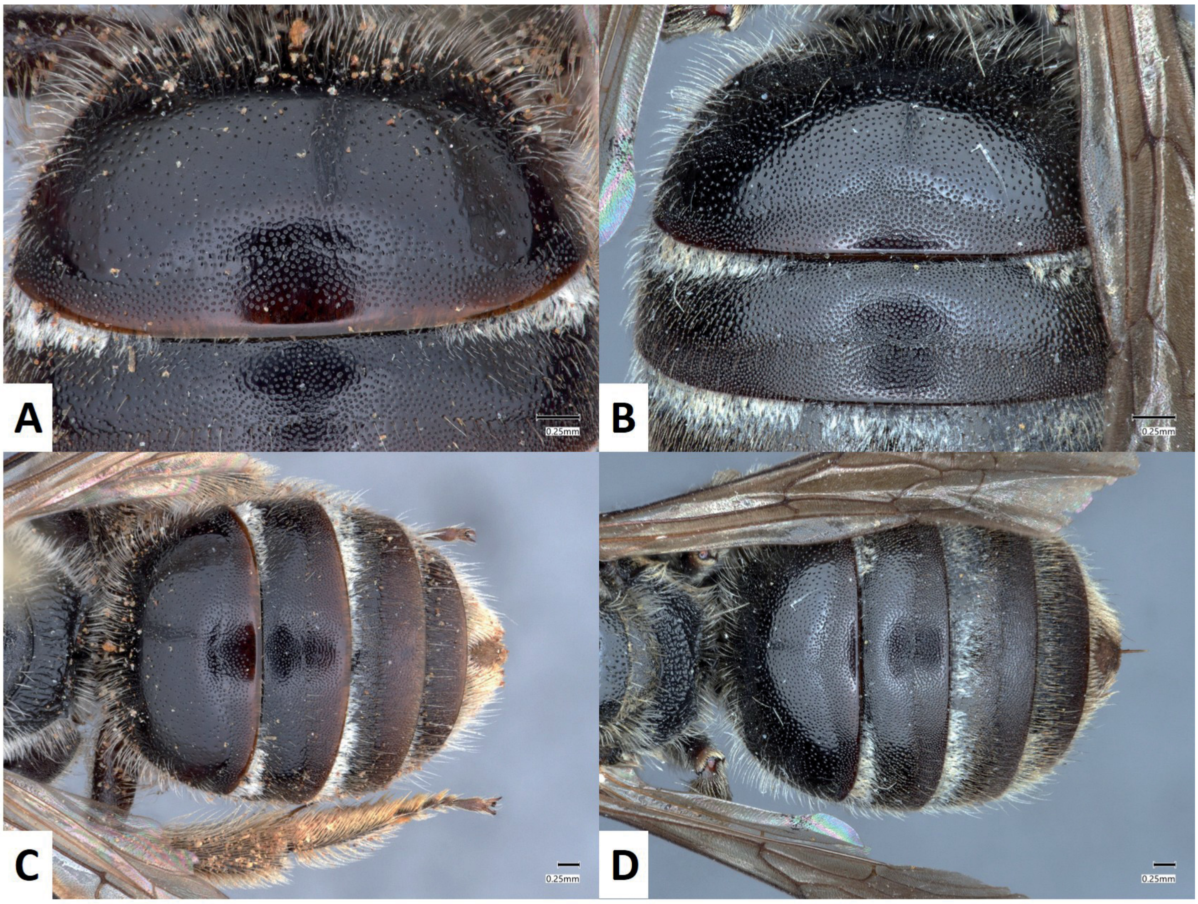

Fig. 8. A, C. *Lasioglossum discus* (Smith, 1854), ♀ (SFC). **B, D**. *L. fertoni* (Vachal, 1895), ♀ (SFC). **A–B**. T1, dorsal view. **C–D**. Metasoma, dorsal view. Scale bars = 0.25 mm.

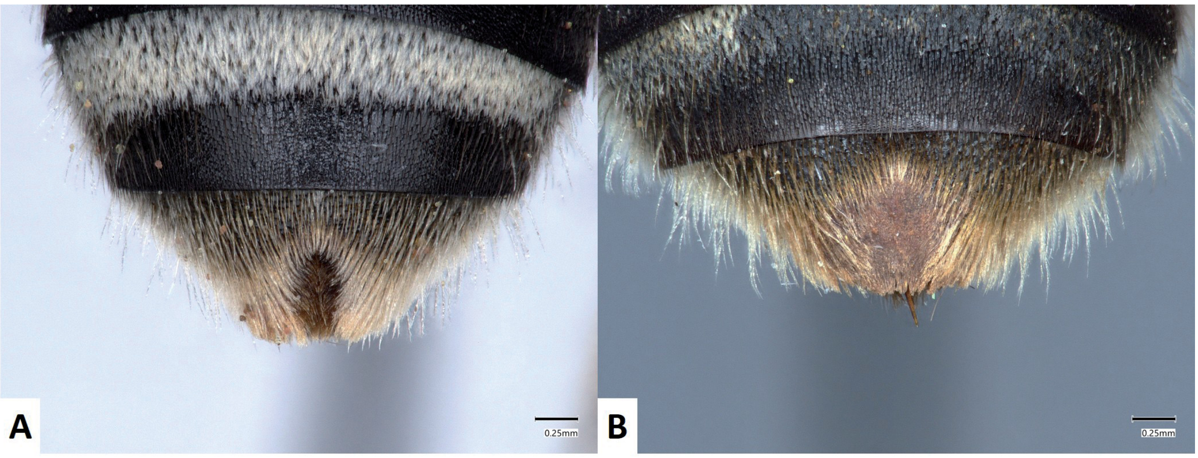

Fig. 9. A. *Lasioglossum discus* (Smith, 1854), ♀ (SFC), sulcus, dorsal view. **B**. *L. fertoni* (Vachal, 1895). ♀ (SFC), sulcus, dorsal view. Scale bars = 0.25 mm.

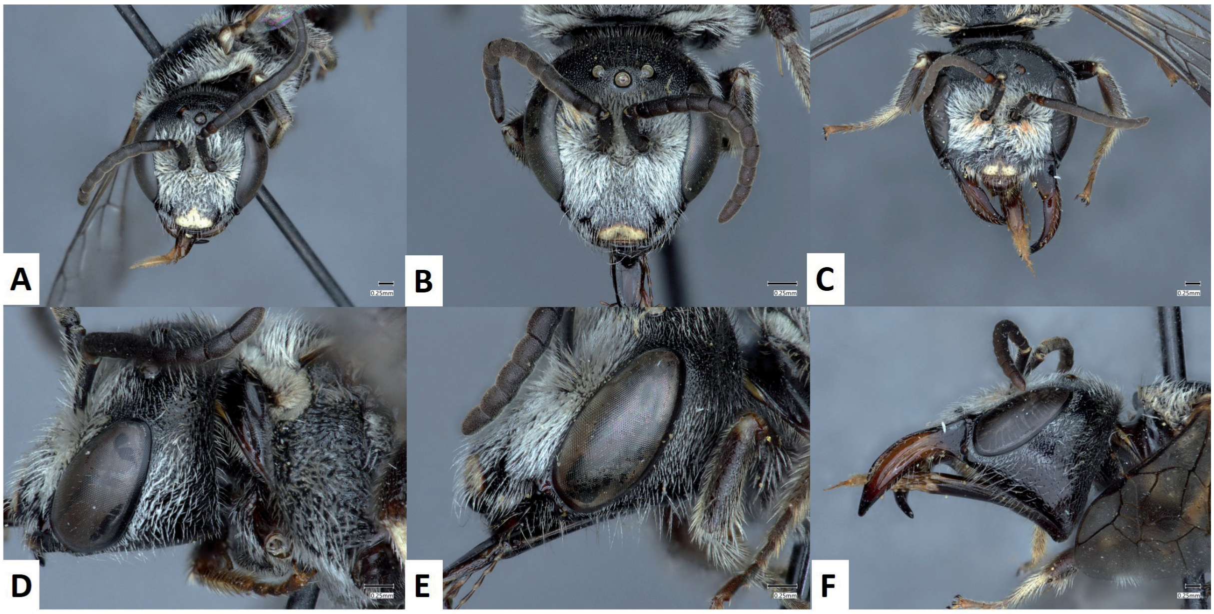

Fig. 10. A, D. *Lasioglossum discus* (Smith, 1854), ♂ (SFC), head, frontal view. **B, E**. *L. fertoni* (Vachal, 1895), ♂ (SFC). **C, F**. *L. fertoni*, macrocephalic specimen, ♂ (SFC). **A–C**. Head, frontal view. **D–F**. Genae, lateral view. Scale bars = 0.25 mm.

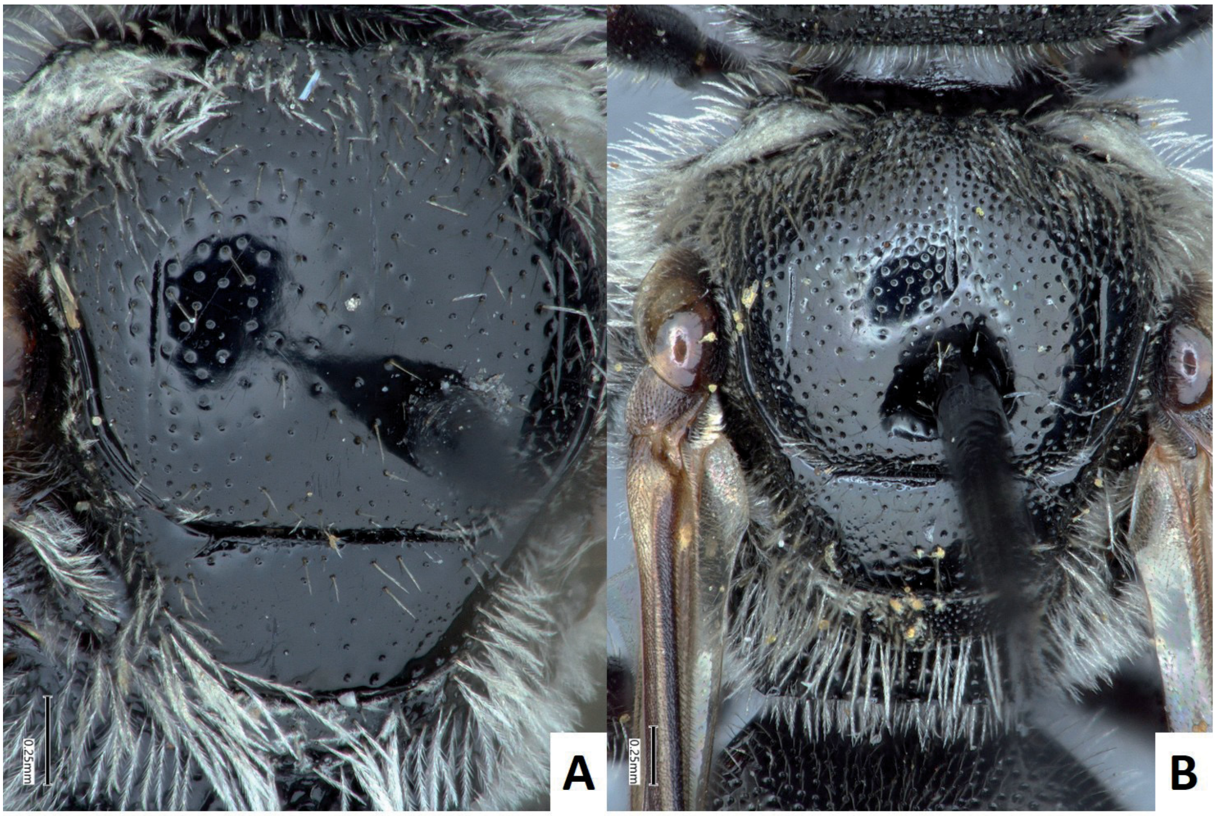

Fig. 11. A. *Lasioglossum discus* (Smith, 1854), ♂ (SFC), scutum, dorsal view. **B**. *L. fertoni* (Vachal, 1895), ♂ (SFC), propodeum, dorsal view. Scale bars = 0.25 mm.

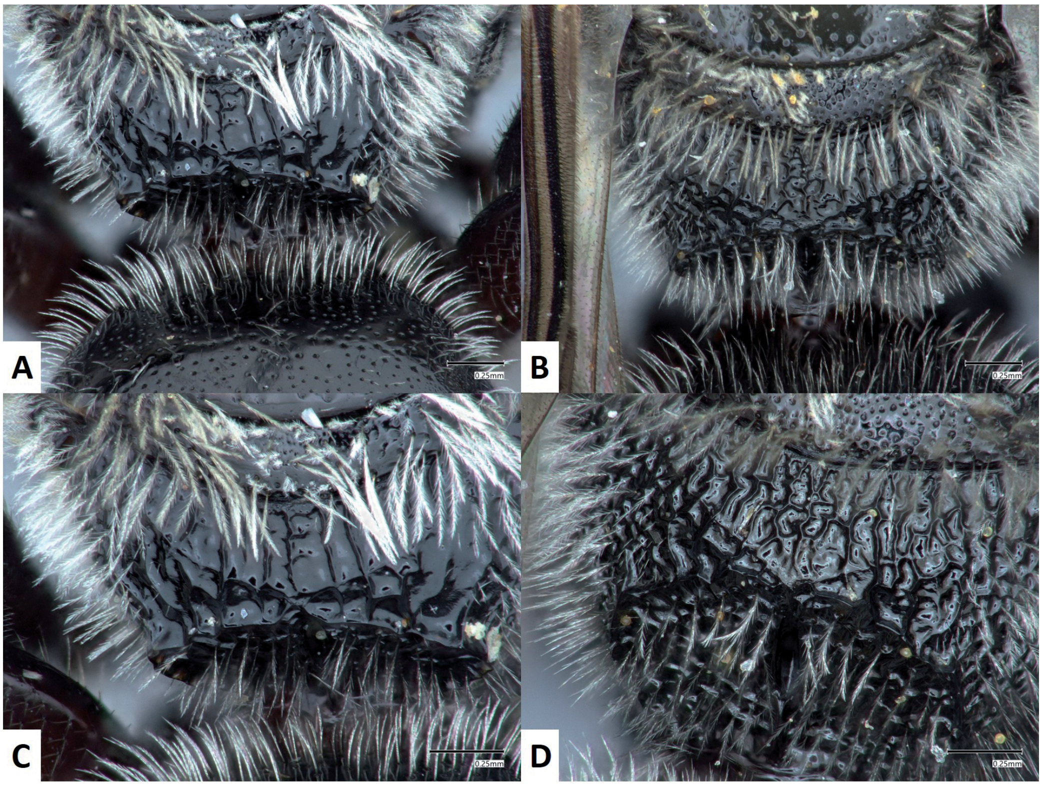

Fig. 12. A, C. *Lasioglossum discus* (Smith, 1854), ♂ (SFC), propodeum, dorsal view. **B, D**. *L. fertoni* (Vachal, 1895), ♂ (SFC), propodeum, dorsal view. Scale bars = 0.25 mm.

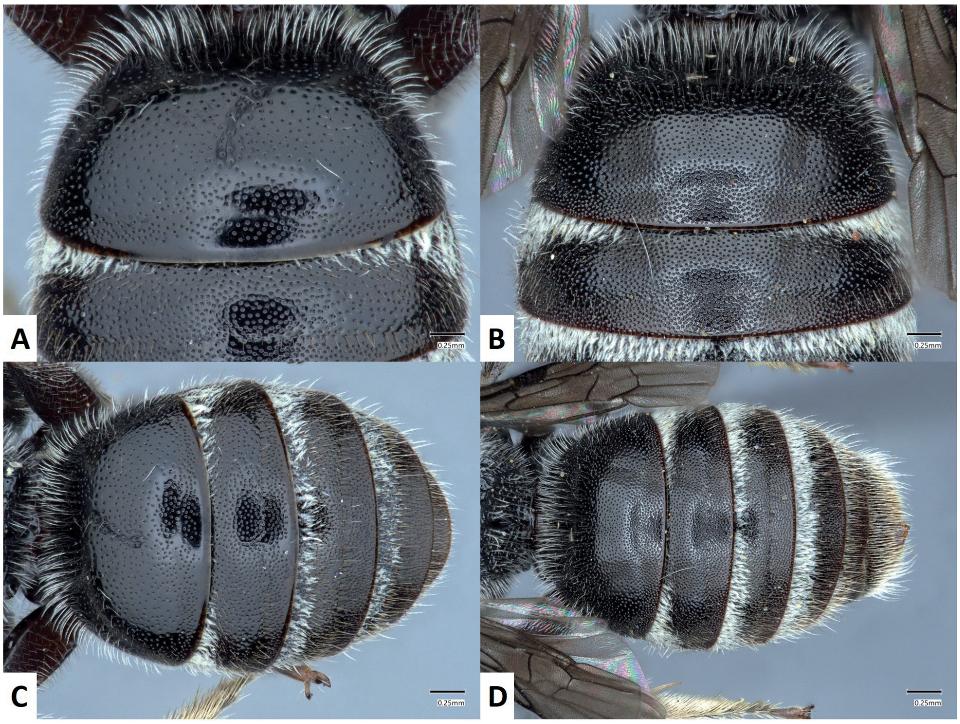

Fig. 13. A, C. *Lasioglossum discus* (Smith, 1854), ♂ (SFC). **B, D**. *L. fertoni* (Vachal, 1895), ♂ (SFC). **A–B**. T1, dorsal view. **C–D**. Metasoma, dorsal view. Scale bars = 0.25 mm.

placement within *L. discus* and not *L. fertoni*. Further research is necessary to determine the identity of the supposed *L. fertoni* specimens from China and Central Asia.

Although *Lasioglossum discus* was originally described by Smith (1853) with a type locality given as "North America", subsequent studies have cast doubt on this attribution. Ebmer (1976) re-examined Smith's material and concluded that the species is in fact West Palaearctic, not Nearctic, where representatives of the subgenus *Leuchalictus* are absent, and the only species recorded, *L. zonulus* (Smith, 1848) and *L. leucozonium* (Schrank, 1871), are introduced from the Palearctic (Ebmer 2011). In his revision, Ebmer (1976) examined three syntype specimens and interpreted the label "Rhea" as possibly referring to a locality in Greece, though he did not identify a specific site.

However, as noted by Baker (1993), the name "Rhea" is more likely an unpublished manuscript name rather than a geographical indication, possibly linked to classical references, as was common in 19th-century collections. Given the absence of a reliable type locality and following Baker's treatment, the species should be regarded as lacking a definitive terra typica.

Lasioglossum* (*Leuchalictus*) *fertoni (Vachal, 1895) stat. rev.

Figs 1–2, 5B, D, 6B, 7B, D, 8B, D, 9B, 10B–C, E–F, 11B, 12B, D, 13B, D, 14B, D

Halictus fertoni Vachal, 1895: 149.
Lasioglossum pseudomorbillosum Ebmer, 1970: 30
Lasioglossum pseudomorbillosum – Pagliano, 1988: 98 (synonymy with *Lasioglossum discus fertoni*).

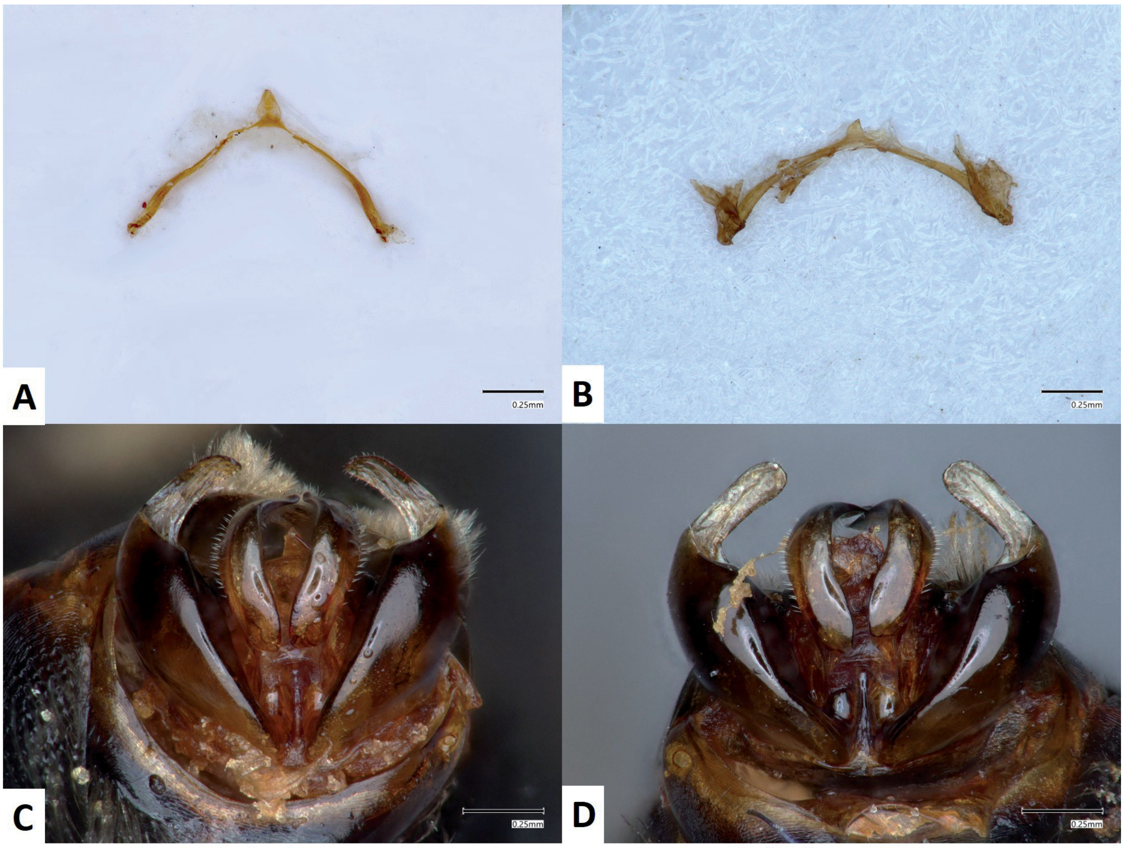

Fig. 14. A, C. *Lasioglossum discus* (Smith, 1854), ♂ (SFC). **B, D**. *L. fertoni* (Vachal, 1895), ♂ (SFC). **A–B**. S7, dorsal view. **C–D**. Genitalia, frontal view. Scale bars = 0.25 mm.

Type material not examined

Holotype of *Halictus fertoni* Vachal, 1894

FRANCE • ♂; Gallo province. The type has never been located.

Holotype of *Lasioglossum* (*Lasioglossum*) *pseudomorbillosum* Ebmer, 1970

ITALY • ♂; Sicily; AEC.

Other material examined

See Supp. file 1.

Discussion

This study identifies *Lasioglossum fertoni* as a distinct taxon, warranting its elevation to species rank. This conclusion is supported by a combination of morphological, biogeographical, ecological, and genetic evidence. Genetic analyses reveal a clear separation between *L. fertoni*, *L. discus*, and *L. aegyptiellum*, with significant interspecific distances and high bootstrap values for the different clades, underscoring their distinctiveness. Morphologically, *L. fertoni* is characterised by a denser punctation of the scutum and T1 and distinct features in the genae, propodeum structure and pubescence, consistent with common diagnostic characters used to define species-level distinctions in *Lasioglossum* (Ebmer 1970, 1971; Pesenko 2006).

The updated distribution patterns of *Lasioglossum discus* and *L. fertoni* profoundly alter our understanding of their biogeographic affinities. Historically, populations now attributed to *L. fertoni* were often included within a broadly defined *L. discus*, considered widespread across the western Mediterranean and central Europe (Blüthgen 1931; Ortiz-Sánchez & Pauly 2017; Lhomme 2020). This broader interpretation situated *L. discus* firmly within the thermophilic, Mediterranean bioclimatic zone.

However, the taxonomic revision separating *L. fertoni* as a distinct species has redefined the distributional range of *L. discus*. Without the western Mediterranean populations now assigned to *L. fertoni*, *L. discus* emerges as a species centred in southern and southeastern Europe and Anatolia, with a scattered presence in Central Europe. Its current range still includes parts of the Mediterranean region but extends more prominently into temperate and continental climatic zones. These two types of distribution, West-Mediterranean centred and East-Mediterranean centred, were described for many other bee species, like *Dasypoda crassicornis* for the West, and *Hoplitis manicata* for the East (Michez *et al*. 2025).

This shift implies that *L. discus* is less tied to classic Mediterranean ecosystems than previously interpreted. Instead, its distribution suggests adaptation to more mesic and cooler environments, possibly occupying ecological niches distinct from those traditionally associated with Mediterranean-specialist bee species. From a historical biogeography perspective, this revision suggests that the evolutionary history of *L. discus* and *L. fertoni* reflects survival in distinct glacial refugia during Quaternary climatic oscillations. *Lasioglossum discus* likely persisted in the Balkan Peninsula, a region characterised by more humid, temperate refugial environments, while *L. fertoni* survived in the Iberian Peninsula and southwestern Europe, where refugia were typically warmer and drier, consistent with Mediterranean climatic conditions (Hewitt 2004; Provan & Bennett 2008; Salvi *et al.* 2013). These contrasting environmental settings may have promoted allopatric divergence, with subsequent adaptation to different ecological niches. After the last glacial maximum, both taxa appear to have expanded their ranges northward, leading to present-day zones of contact in southeastern France (e.g., the Var). However, the occurrence of *L. fertoni* in southern Italy suggests the existence of a separate refugium in that region (possibly in Sicily), while *L. discus* may have persisted further north in central or southern Italy. The presence of both species on Sardinia and Corsica also points to a more complex biogeographic history than cannot be reconstructed with the available data. The findings from this study highlight the importance of integrative taxonomy in resolving taxonomic ambiguities within cryptic species complexes, as demonstrated in other bee clades (e.g., *Dasypoda* Latreille, 1802, Ghisbain *et al*. 2023b; *Bombus* Latreille, 1802, Martinet *et al*. 2019). Many European species of *Lasioglossum* have numerous described subspecies (Ebmer 1988), several of which may require reexamination; our study illustrates how integrative approaches can help resolve these taxonomic uncertainties. By combining molecular, morphological, and biogeographic data, we provide robust evidence to clarify the status of *L. fertoni* and contribute to a more comprehensive understanding of the genus *Lasioglossum*. This work also has broader implications for pollinator conservation and biodiversity research, as it emphasises the value of precise species delineation for effective conservation strategies.

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Supplementary file

Supp. file 1. List of examined material. https://doi.org/10.5852/ejt.2026.1034.3163.14073