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A review of the *Sphex flavipennis* species group (Hymenoptera, Sphecidae) in northwest Africa with description of two new species and a discussion of a species from Sardinia

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A b s t r a c t : The *Sphex flavipennis* species group from northwest Africa is revised and a key to species is given. *Sphex schlaeflei* nov.sp. and *Sphex maroccanus* nov.sp. are described from southern Morocco based on results from DNA barcoding and morphology. *Sphex afer* stat.nov. is restored from synonymy with *S. leuconotus* and given a new status as valid species. The form of male sternite VIII is introduced as new recognition character.

K e y w o r d s : Hymenoptera, Sphecidae, *Sphex*, new species, Morocco, Sardinia, DNA barcoding.

Introduction

The present contribution treats all species of *Sphex flavipennis* species group known from Libya, Tunisa, Algeria and Morocco. The group was recently revised by MENKE & PULAWSKI (2000), and additionally includes *S. atropilosus*, KOHL, 1885, *S. melas* GUSSAKOVSKIJ, 1930, and *S. oxianus* GUSSAKOVSKIJ, 1928 from Europe or Palearctic Asia, not regarded here. Species recognition is difficult and mainly based on colour of abdomen and pilosity. Males can also recognized by the shape and number of antennal placoids (MENKE & PULAWSKI 2000) and by the shape of sternite VIII (S8). The latter character is described here for the first time.

The genus *Sphex* is considered taxonomically mostly resolved in the Mediterranean area since MENKE & PULAWSKI (2000). However, new material from Morocco, mostly collected by the author during several trips to this country, resulted in an undescribed species that is recognized by its distinctive morphology, and that was first collected in the Ouarzazate region in 1990. Later, several *Sphex* specimens from this region were analysed by DNA barcoding as part of the survey of Apoid wasps from the western Paleartic region (SCHMID-EGGER et al. 2018). The genetic results confirmed the validity of the undescribed species from Ouarzazate. DNA barcoding provided another unexpected result. Other specimens from southwest Morocco, identified as *Sphex funerarius* with the keys by MENKE & PULAWSKI (2000) clearly form a distinct genetic cluster different from European specimens. In a detailed examination, diagnostic characters in male morphology and a unique colour combination in females were found and the species is described here as new. Another result is the re-evaluation of *Sphex leuconotus.* African specimens differ from Asian specimens, and the status of the African population was raised to species level.

Material and methods

The following abbreviations and terms are used:

AS.....Antennal segments

S.....sternites

T .....tergites, e.g. S8 = (male) sternit VIII

Placoids of male antennomeres (AS): There are various structures on the underside of male AS, and it is not always easy to recognize them properly. The basic structure of not modified AS consists in three medial longitudinal keels below, and a rectangular field each between the keels. The medial keel is more prominent than the lateral keels, and sometimes forms a bulge. The surface of the two inner fields is smoother than the back-side of AS. Some AS are modified. There are four keels, and the inner keels define a large area with a smooth and finely granulate surface, shinier and more different from the lateral fields or the remaining surface of AS. MENKE & PULAWSKI (2000) name this area placoid, and I follow them in using placoids for species recognition. The placoids can be confused with the lateral fields, especially in AS4, and therefore a detailed study of morphology of AS is necessary. AS with placoids always forms three defined areas, the placoid and laterally each a less distinct area. Placoid of AS 10 is sometimes reduced apically.

Length of the **petiole** is measured between apical beginning of muscle, connecting petiole with propodeum, and base of large part of tergite I.

Neighbour-joining DNA barcoding tree (NJ)

The NJ-tree (fig. 1) was taken from Schmid-EGGER et al. (2018) and shows analysis of the DNA barcode region of the animal kingdom (HEBERT et al., 2003). See also Schmid-Egger et al. (2018) for further details and methods. For the present study only three sequences per species are selected, and some new sequences (specimens from Sardinia) are supplemented. Two species, *Sphex fumicatus* CHRIST, 1791 and *S. pruinosus* GERMAR, 1817 were chosen as outgroup. For the full tree see SCHMID-EGGER et al. (2018), were *Sphex maroccanus* is still given as *Sphex funerarius* with the BIN BOLD: ACR4460, and *S. schlaeflei* as *Sphex* spCSE1701 with the BIN BOLD: ACR4300 in this paper. The names were recently updated in the Bold system (www.boldsystems.org).

Acronyms of depositories and other institutions

CSE.....Personal collection, Christian Schmid-Egger, Berlin, Germany

MNHN.....Muséum National d'Histoire Naturelle, Paris, France

NRS .....Naturhistoriska Riksmuseet Stockholm, Sweden.

ZMK .....Zoologisk Museum Copenhagen, Denmark.

ZSM.....SNSB - Zoologische Staatsammlung München, Germany.

Zürich .....Zoologisches Museum, ETH Zuerich, Switzerland

Key to *Sphex flavipennis* group in northwest Africa

For definition of *S. flavipennis* group, see MENKE & PULAWSKI (2000). Distribution and characters only refer to North Africa.

Key to females

1 Petiole wider than long, 2/3 as long as hindtarsomere III. [Abdomen black or first tergites red. Wings dark brownish with yellowish shimmer. Mesonotum with erect dense brownish setae. A very large and broad species]. 25-35 mm. Morocco to Libya ..... *S. afer* LEPELETIER

\- Petiole at least 1.5x as long as wide.. 2

2 Abdomen black. Wings darkly infumate, apex as dark as remaining wing. Egypt, Libya, Tunisia .....*S. libycus* de BEAUMONT

\- First abdominal segments red (in *S. flavipennis* also black). Wings greyish or with yellow shimmer, apex of forewing darker than remaining wing. 3

3 Legs all black, foretibia may be dark red. Erect setae of face yellowish-brown. Ouarzazate region in southern Morocco. .....*S. schlaeflei* SCHMID-EGGER, nov.sp.

\- All legs with red parts. Erect setae of face white.....4

4 Pronotal collar and mesoscutum with adpressed white and golden setae (fig. 19). Wings yellowish with grey apical band. [First tergites red, abdomen may be all black in specimens from western Morocco]. 24-32 mm. Whole area. .....*S. flavipennis* FABRICIUS

\- Pronotal collar and mesoscutum without adpressed setae. Wings greyish darkened. Smaller species [T 1-3 red, T4 partly red or black]. 16-26 mm.....5

5 Hindtibia all red. Colour of leg and abdomen orange reddish. Tunisia (can also be expected from other regions).....*S. funerarius* GUSSAKOVSKIJ

\- Hindtibia black, or with some dark red on underside. Colour of leg and abdomen darker red than in previous species. Southern Morocco. ... *S. maroccanus* SCHMID-EGGER, nov.sp.

Key to males

1 Abdomen black. 2

\- First abdominal segments red.....3

2 AS 7-8 with placoids (fig. 6). S7 with short erect pilosity, setae 0,5x-0.8 as long as hindocellar diameter. Petiole 1.7x as long as wide. 20-22 mm. Egypt, Libya, Tunisia. ..... *S. libycus* de BEAUMONT

\- AS 6-8 with placoids (placoids in direct comparison narrower than in *S. libycus*, fig. 5). S7 with long erect pilosity, setae 1.5-2x as long as hindocellar diameter. Petiole 1.0x as long as wide. [Petiole laterally with dense pilosity, longest setae longer than diameter of petiole, fig. 20]. 20-26 mm. Morocco to Libya .....*S. afer* LEPELETIER

3 AS without large placoids. AS 7-8 with narrow placoids, which are 0,3x as large as width of AS (fig. 2). [Wings yellowish apart from grey apex.]. 18-26 mm. Whole area..... *S. flavipennis* FABRICIUS

\- At least AS 6-8 with large placoids, nearly as large as width of AS 4

4 AS 6-8 with placoids (fig. 8). T 1-4 red, apex of T4 sometimes black. Apex of S8 rounded, with medial point. Ouarzazate region in Southern Morocco ..... *S. schlaeflei* SCHMID-EGGER, nov.sp.

\- At least AS 5-8 with placoids. T 1-3 red, T4 at least laterally red. Apex of S8 with clear angle.....5

5 S8 with right angle apically (fig. 17). AS 5-10 with placoids (fig. 7). Southern Morocco. ..... *S. maroccanus* SCHMID-EGGER, nov.sp.

\- S8 with acute angle apically (fig. 13). AS 5-8 or 5-9 with placoids (fig. 4). Tunisia (can also be expected from other regions).....*S. funerarius* GUSSAKOVSKIJ

Taxonomy

Sphex afer LEPELETIER de SAINT FARGEAU, 1845, stat.rest. (figs 5, 15, 20)

Sphex afer LEPELETIER DE SAINT FARGEAU, 1845: 350, ♀ (as *afra*, incorrect original termination). Lectotype: female, Algeria: Oran (MNHN). Restored from synonymy of *Sphex leuconotus* BRULLÉ, 1833.

M a t e r i a l e x a m i n e d : *S. afer*: Morocco 1 male, 1 female 3.vi.2013. S Ait Mzizoui 34,47N 13,35W (leg. et coll. T. Ljubomirov). *S. leuconotus* was examined from Greece, Kazsachstan, Kyrgyzstan and Turkey (2 females, 4 males, in coll CSE).

R e m a r k : MENKE & PULAWSKI (2000) synonymised *S. afer* with *S. leuconotus* BRULLÉ, 1833, described from Greece. However, the present investigation revealed distinct morphological differences in a male from Morocco compared with males from Greece and Central Asia. Apex of S8 is clearly different in these males. For that reason, I consider the male from Morocco as belonging to a different species. *Sphex afer* is the next available name for it, and the taxon has to be restored from synonymy of *S. leuconotus*.

The results are also seen against the background that form of S8 is an important character for species recognition in the *S. flavipennis* species group, clearly different in all species. Another important hint for valuation of the taxonomic rank of these taxa is the large genetic gap between specimens from Europe and from Africa in many Crabronidae and Sphecidae species which makes a state as valid species of the African populations in most of these taxa probable (see discussion under SCHMID-EGGER et. al. 2018).

R e c o g n i t i o n : The male of *S. afer* has S8 with an obtuse apical angle (fig. 15), whereas the apical angle is acute in *S. leuconotus* (fig. 14, 4 males examined). Wings are dark in *S. afer*, and are somewhat yellowish in the *S. leuconotus* males. The female of *S. afer* is larger (body length 30 mm) than both examined *S. leuconotus* females (24-25 mm) from Central Asia, wings are dark and only slightly yellow in colour, whereas they are distinctly yellow in *S. leuconotus*. Propodeal setae are clearly white and gaster all black in *S. leuconotus*, and greyish in *S. afer* with a red gaster base in *S. afer*. These characters has to be verified with a larger sample, and especially the tergal colour is variable in both species (MENKE & PULAWSKI 2000).

G e o g r a f i c d i s t r i b u t i o n : The general distribution of *S. afer* is unclear, because I could only examine a single male and female from Morocco. However, information from literature suggests that *S. afer* occurs in whole North Africa apart from Egypt (MENKE & PULAWSKI 2000), and the European and Asian populations belong to *S. leuconotus*. The distribution area of the latter reaches Spain in the West, Israel in the South and Kazsachstan in the East.

Sphex flavipennis FABRICIUS, 1793 (figs 2, 9, 19)

Sphex flavipennis FABRICIUS, 1793: 201, sex not indicated. Lectotype: ♀, Italy: no specific locality (ZMK).

D i s t r i b u t i o n : *S. flavipennis* is widespread in the whole western and central Palearctic region, northwards to the southern Alps. In North Africa is it rarely collected but widespread. No specimens from North Africa were examined.

***Sphex funerarius* GUSSAKOVSKIJ, 1934, figs 3 (4, 10-13)**

Sphex funerarius GUSSAKOVSKIJ, 1934: 3, male, female. Lectotype: male, China: Gansu: Bei-lung-shui (NRS).

M a t e r i a l e x a m i n e d : 5 females 8 males from Tunisia, 7 females 15 males from Sardinia, around 100 specimens from remaining Europe and palearctic Asia (all coll. CSE).

R e m a r k : The species occurs in the western palearctic region in three morpho- and colour types (for additional variation in central and eastern Palearctic region see MENKE & PULAWSKI 2000).

Females from Europe and western Asia (except Sardinia) have hindfemur black, red spots on femora are small, and red body colour is not orange but dark red. The females therefore resemble *S. maroccanus*. Males from this origin have apex of S8 with acute angle (figs. 10, 12, ca. 70 degree), the apex is somewhat pointed. Most specimens have AS 5-10 with placoids, other have also a placoid on AS 4. Number of placoids vary, see MENKE & PULAWSKI (2000) for details.

Females from Sardinia differ from the European mainland specimens as follows: apex of femora, tibiae and tarsi all red; red body colour is more orange red than dark red. These specimens are similar to the females from Tunisia. The apex of S8 of Sardinian males is larger than in other European males, and nearly right angled (fig. 11, 80-85 degree). Apical angle of S8 stands between *S. funerarius* males from European mainland and males of *S. maroccanus*. Males have placoids on AS 5-9 (9 specimens) or on AS 5-10 (2 specimens). Specimens from Corsica were not examined but probably also refer to this form, see MENKE & PULAWSKI (2000).

Females from Tunisia are similar in colour pattern to females from Sardinia (legs red apart most part of femora). S8 of these males looks similar to males from European mainland and palearctic Asian (fig. 13). Males have placoids on AS 5-8 (5 specimens) or on AS 5-9 (2 specimens).

Specimens from Sardinia and from European Mainland differ distinctly genetically by appr. 4.5% (fig. 1). This genetic gap in combination with the different form of male S8 gives a hint to a beginning species diversification of the Sardinian population. Because of this large genetic distance is a treatment as valid species of the Sardinian population also possible. However, the subject needs further examination in a larger geographic area, and especially the population from Tunisia has to be examined genetically, because they also may represent a different clade. The form from Cyprus is also distinctive and was described as *Sphex maxillosus mavromoustakisi*de BEAUMONT, 1947. See MENKE & PULAWSKI (2000) for details.

D i s t r i b u t i o n : *S. funerarius* s.lat is widespread in the whole western and central Palearctic region and reaches Sweden in the North. Recently the species is expansive in Germany, the northernmost location was Berlin in 2017 (pers. observation). Its distribution in North Africa is not clear. I could only examine *S. funerarius* from Tunisia, whereas all specimens from southern Morocco, formerly identified as *S. funerarius*, belong to *S. maroccanus*. It can be expected that *S. funerarius* is more widespread in northern Africa.

Sphex libycus BEAUMONT, 1956 (figs 6, 16)

Sphex libycus de BEAUMONT, 1956:182, male, female. Holotype: female, Libya: Cyrenaica: Porto Bardia (Zürich).

M a t e r i a l e x a m i n e d : 1 male 20.vi.2007 Tunisia, Chenini (CSE).

D i s t r i b u t i o n : *Sphex libycus* is recorded from Egypt and Libya (MENKE & PULAWSKI 2000), and new to the fauna of Tunisia.

Sphex maroccanus SCHMID-EGGER nov.sp. (figs 7, 17)

Holotype: Morocco male 11.vi.2014 15 km SE Ait Baha, Seisid 30.04N 9.08W (barcoding voucher number BC ZSM HYM 22118, coll. ZSM). Paratypes: Morocco: 1 male 1 female 16.vi.2014 20 km E Tiznit, Assaka 29.690N 9.530W; male 12.iv.2015 Tata 29.778N 7.978W (barcoding voucher number BC ZSM HYM 24541), 1 female 15.vi.2014 Morocco, 30 km NNW Tazenakht, on route N10, 30.830N 7.288W; male 12.iv.2015 Tata 29.778N 7.978W (barcoding voucher number BC ZSM HYM 24540); 5 females 30.iv.2018 18 km NE Sidi Ifni, Beach 29.516N 10.070W (barcoding voucher number of two females: BC-ZSM-HYM-29771-C09, BC-ZSM-HYM-29771-C10) (all leg. CSE, coll. CSE and ZSM).

D i a g n o s i s : *Sphex maroccanus* is similar to *S. funerarius* and differs clearly genetically (fig. 1). The male has S8 right angled apically, whereas the angle is always acute in *S. funerarius*, and the apex is slightly pointed. AS 5-10 have placoids, whereas all examind males of *S. funerarius* from Tunisia lack placoid on AS 10. Females differ from Tunisian females by less extended red colour on leg. Mid- and hindtibia and tarsi are completely red in *S. funerarius*, whereas midtibia is partly and hindtibia all black in *S. maroccanus*. The red body colour (legs and abdomen) is orange red in *S. funerarius*, and dark red in *S. maroccanus*. So, both females are different in North Africa, but *S. maroccanus* resembles females from Europe in colour pattern. See also remark at *S. funerarius.*

D e s c r i p t i o n o f m a l e h o l o t y p e : Body length: 19.0 mm. Colour: Black, with the following parts red: Mandible medially, T 1-3 and S 1-3 (apart from black petiole), basal half of S4, T4 laterally. Long erect pilosity of head, mesosoma and petiole white. Wings greyish transparent, apex darker than remaining wing. Morphology: AS 5-10 with large placoids. Petiole 1,8x as long as maximum width. S8 with right angle apically. Similar to *S. funerarius* in all remaining characters. Male paratypes agree with holotype.

D e s c r i p t i o n o f f e m a l e : Body length 19.5-23.0 mm. Colour: Black, red are: basal half of mandible, tegula, T 1-3 and S 1-3 (apart from black petiole), basal half of S4, T4 laterally, underside and apex of forefemur, large apical spot on underside and apex of midfemur, apex of hindfemur, fore- and midtibia, tarsi. Hindtibia black with some red on underside. Wings greyish transparent with darker apex, with some yellow shimmer. Erect pubescence of head and mesosoma white. Petiole 1,8x as long as maximum width. Agree otherwise with *S. funerarius*.

G e o g r a p h i c d i s t r i b u t i o n : Southern Morocco.

H a b i t a t : The species was found in semi-arid and steppe like habitats in southern Morocco. It was collected together with *S. schlaeflei*.

E t y m o l o g y : The species is named after the country of origin, Morocco.

***Sphex schlaeflei* SCHMID-EGGER nov.sp. (figs. 8, 18, 21)**

Holotype: male 15.vi.2014 Morocco, 30 km NNW Tazenakht, on route N10, 30.830N 7.288W leg CSE (coll ZSM, barcoding voucher number BC ZSM HYM 22120). Paratypes: 3 males, 2 females, same date as holotype, coll. CSE (1 male: barcoding voucher number BC ZSM HYM 22129, 1 female barcoding voucher number BC ZSM HYM 22121); male 30.v.1995 Morocco, Anti-Atlas, 40 km SW Quarzazate, Steppe 10 km SW Tazenakht 30.515N 7.283W (leg. et. coll CSE); 2 females 7 males 30.v.1990 Ait Saoun near Agdz 30.733N 6.632W (leg. et coll. Schlaefle); male 11.vi.2007 Tizi'n-Tinififft 30.710N 6.588W (leg. et coll. Schlaefle); male 19.vi.2007 Ouarzazate 30.911N 6.923W (leg. et coll. Schlaefle).

D i a g n o s i s : *Sphex schlaeflei* is similar to *S. funerarius* and differs genetically from the remaining species of this lineage (fig. 1). The female is characterized by the following character combination: T 1-3 and S1-3 red, apart from black petiole, legs black (at most foretibia red), wings transparent with grey apical margin, erect setae of face yellowish-brown, petiole 1,3x as long as medial width. *S. flavipennis*, *S. maroccanus* and *S. funerarius* differ by having legs predominantly red and setae of face white.

The male of *S. schlaeflei* is characterized by black legs, T 1-4 and S 1-4 red (apart from black petiole), wings transparent with grey margin, AS 6-8 with placoids. Setae of underside of head and mesosoma yellowish or "dirty" white, darker than in *S. funearius*. The remaining *Sphex* males from northwest Africa with red abdominal base differ by number of placoids. They lack in *S. flavipennis* (resp. are reduced to very narrow placoids in AS 7-8). *S. funerarius* and *S. maroccanus* have large placoids on AS 7-9, at least in African populations. S8 of *S. schlaeflei* is unique by a rounded apex with small point.

D e s c r i p t i o n o f m a l e h o l o t y p e : Body length 20.0 mm. Colour: Black, apical third of mandible brown. Red are T 1-3 and S 1-3 except petiole, basal half of T4 and S4. Face below ocelli with dense adpressed silver pubescence and erect white setae. Pilosity of underside of head and mesosoma yellowish to brownish white. Wings greyish with some yellow shimmer, with infumate apical zone, wing venation black. Morphology: AS 6-8 with large placoids. Petiole 2,3x as long as its maximal width. S8 with rounded apex, apically with small point. Otherwise similar to *S. funerarius*.

V a r i a t i o n i n m a l e p a r a t y p e s : Body length. 19.0 - 25.0 mm. Adpressed setae of face yellow in some specimens, red colour of abdomen variable (T2 all black, or T4 all red).

D e s c r i p t i o n o f f e m a l e : Body length 20.0-30.0 mm. Colour: Black, basal half of mandible and tegula dark red; parts of foretibia and foretarsi dark red, T 1-3 and S 1-4 red, apart from petiole (red is somewhat darker than in *S. funerarius*). Wings greyish with an infumate apical zone. Wing venation reddish, media black. Erect setae of face dark brown-yellowish, adpressed setae of face silver. Remaining setae of thorax and mesosoma brownish. Morphology: Petiole 1,4-1.5x maximal width. Otherwise similar to *S. funerarius*.

G e o g r a p h i c d i s t r i b u t i o n : The species is only known from a small area around Ouarzazate in southern Morocco, south of the Atlas Mountains.

H a b i t a t : *S. schlaeflei* was found in a steppe-like habitat and in a small oasis with palm trees on flowering *Echinops* spp.

E t y m o l o g y : The species is named after Wolfgang Schlaefle from Switzerland, a friend and engaged hymenopterist. He collected the new species for the first time.

Discussion

The recognition of both new described species was enabled or confirmed by genetic data from DNA barcoding (fig. 1). Whereas *Sphex schlaeflei* had already been recognized as a distinct species by morphological characters, the recognition of *S. maroccanus* was completely surprising and unexpected. Diagnostic characters were found after DNA barcoding was used, confirming the value of DNA barcoding in Hymenoptera taxonomy (SCHMID-EGGER et al. 2017, 2018, SCHMIDT et al. 2015). Besides discovering new species, DNA barcoding also helps to evaluate the taxonomic status of different morphs and forms. It can be expected that further genetic examination will confirm the validity of *S. afer* and clarify the status of the different forms of *S. funerarius* from Tunisia, Sardinia and Cyprus.

Although the neighbour-joining tree (Fig. 1) is not a phylogenetic analysis, it gives some indication about phylogenetic relationship among species and species groups (see SCHMID-EGGER et al. 2017). It suggests that *S. maroccanus* is close to *S. funerarius* sensu lato (including the Sardinian populations), whereas *S. schlaeflei* forms a separate clade together with *S. flavipennis*, and is therefore closer to *S. flavipennis* than to *S. funerarius/S. maroccanus*. *Sphex fumicatus* and *S. pruinosus* form a distinct outgroup and confirm the assumption of the *S. flavipennis* species group sensu MENKE & PULAWSKI (2000), of course considering that not all species have been examined by DNA barcoding.

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Zusammenfassung

Die *Sphex flavipennis*-Artengruppe wird in Nordwest-Afrika revidiert, ein Schlüssel zu den Arten wird erstellt. *Sphex schlaeflei* nov.sp. und *Sphex maroccanus* nov.sp. werden aus Süd-Marokko beschrieben, auf Basis von Ergebnissen des DNA-Barcoding sowie morphologischer Befunde. *Sphex afer* stat.nov. wird aus der Synonymie in den Artrang erhoben (war ein Synonym von *S. leuconotus*). Die Form des Sternite VIII wird als neues Unterscheidungsmerkmal für die Männchen vorgestellt.

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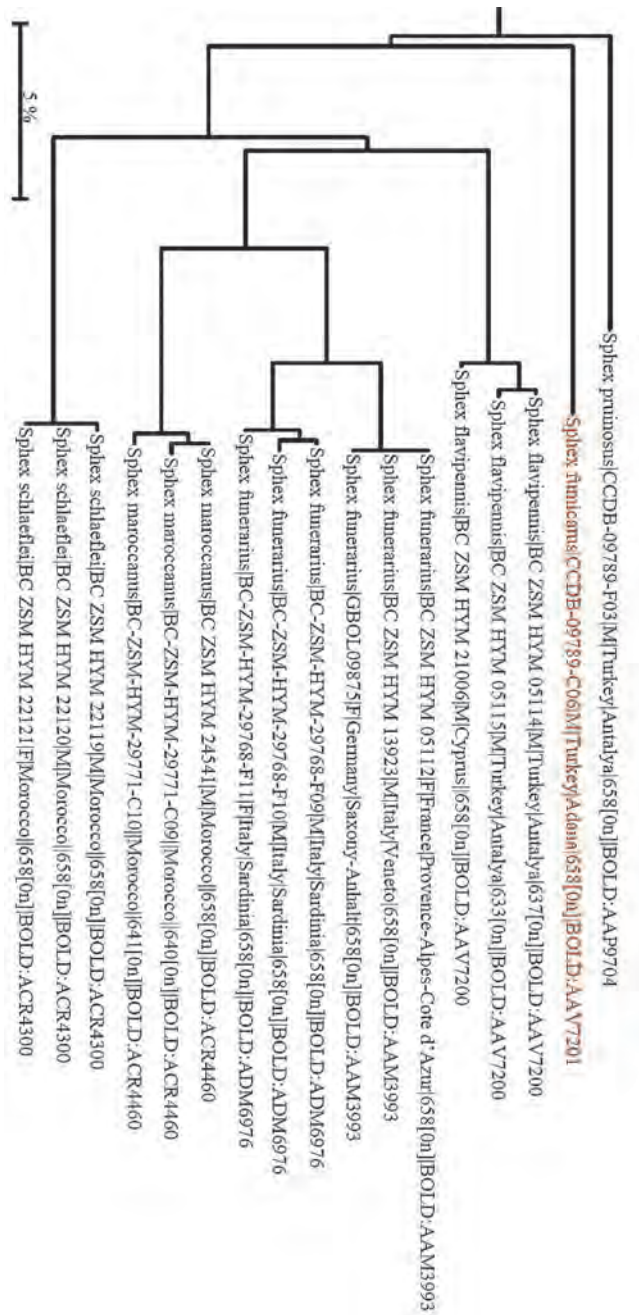
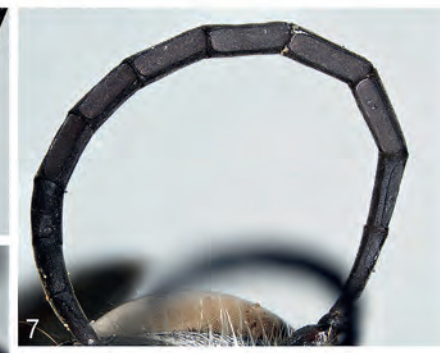
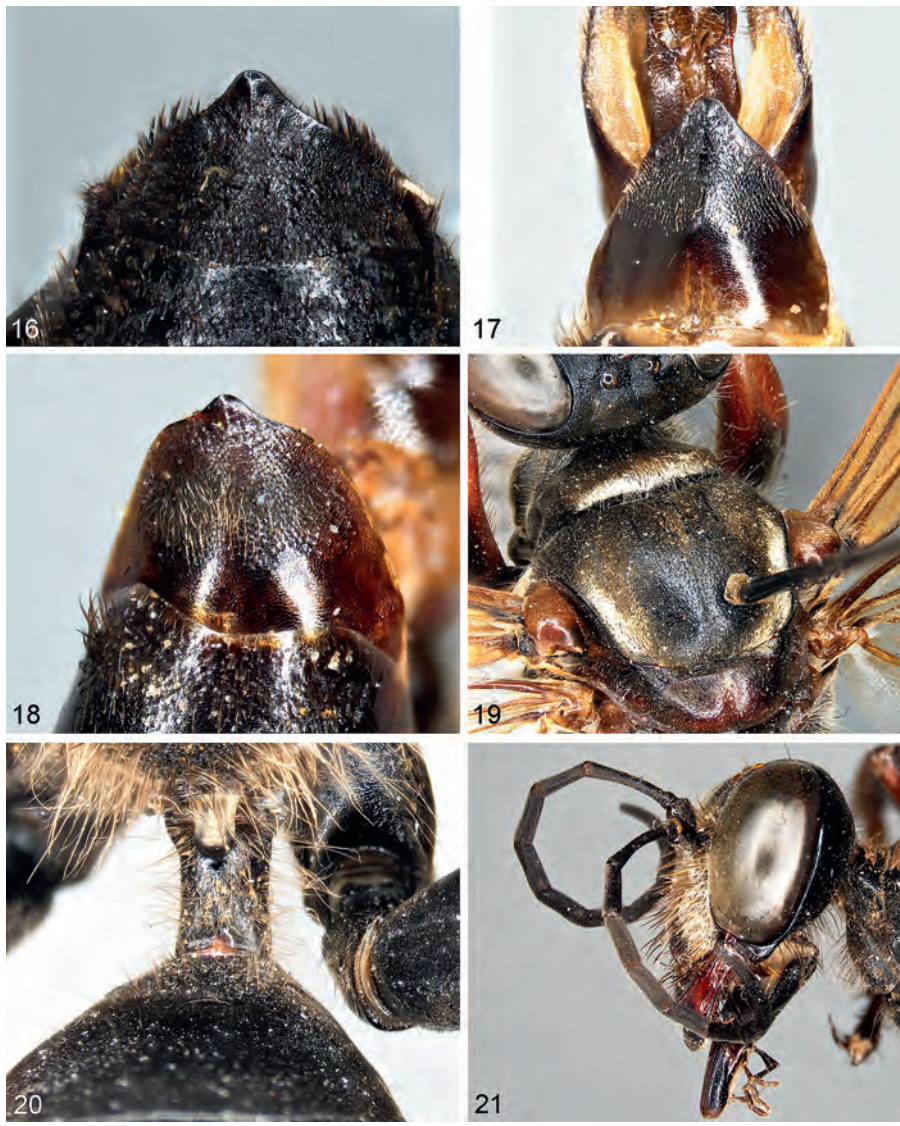


Fig. 1: Neighbour-joining tree of examined *Sphex* specimens, based on the barcode region of the cytochrome c oxidase I (COI) gene.



Figs 2-9: (**2**) Placoids of antennomeres, male of *Sphex flavipennis* from Turkey; (**3**) Placoids of antennomeres, male of *Sphex funerarius* from Sardinia; (**4**) Placoids of antennomeres, male of *Sphex funerarius* from Tunisia; (**5**) Placoids of antennomeres, male of *Sphex afer*; (**6**) Placoids of antennomeres, male of *Sphex libycus*; (**7**) Placoids of antennomeres, male holotype of *Sphex maroccanus*; (**8**) Placoids of antennomeres, male holotype of *Sphex schlaeflei*; (**9**) Sternite VIII, ventral view, male of *Sphex flavipennis* from Turkey.

Figs 10-15: (**10**) Sternite VIII, ventral view, male of *Sphex funerarius* from Germany; (**11**) Sternite VIII, ventral view, male of *Sphex funerarius* from Sardinia; (**12**) Sternite VIII, ventral view, male of *Sphex funerarius* from Kazsachsan; (**13**) Sternite VIII, ventral view, male of *Sphex funerarius* from Tunisia; (**14**) Sternite VIII, ventral view, male of *Sphex leuconotus* from Greece; (**15**) Sternite VIII, ventral view, male of *Sphex afer*.



Figs 16-21: (**16**) Sternite VIII, ventral view, male of *Sphex libycus*; (**17**) Sternite VIII, ventral view, male of *Sphex maroccanus*, holotype; (**18**) Sternite VIII, ventral view, male of *Sphex schlaeflei*, holotype; (**19**) Mesoscutum, female of *Sphex flavipennis*, Sardinia; (**20**) Petiole, male of *Sphex afer*; (**21**) Head in lateral view, female of *Sphex schlaeflei*.