



***Camptopoeum (Camptopoeum) baldocki* spec. nov., a new panurgine bee species from Portugal and a description of the male of *Flavipanurgus fuzetus* Patiny (Andrenidae: Panurginae)**

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Abstract

Camptopoeum (Camptopoeum) baldocki spec. nov., a new European panurgine bee species is described and diagnosed. It is currently known only from saltmarshes along the southern coast of the central and eastern Algarve, Portugal. Observations and analysis of scopal pollen loads suggest narrow oligolecty on the similarly halophilous *Frankenia laevis* (Frankeniaceae). In addition, the allotype male of the Portuguese endemic *Flavipanurgus fuzetus* Patiny is described and the pollen preferences of *Flavipanurgus* are reviewed with the addition of new data from Portugal. As a genus, *Flavipanurgus* species appear to be narrowly oligolectic on a range of flowers from the botanical families Caryophyllaceae, Cistaceae and Crassulaceae.

key words: Hymenoptera, Iberian endemic species, host plant choice, solitary bees, Panurgini

Introduction

Panurgine bees (Panurgini) form a tribe within the subfamily Panurginae in the family Andrenidae (Michener 2007; Danforth *et al.* 2013). In the Western Palearctic the Old World panurgine genus *Camptopoeum* is represented by 18 species in two subgenera (Kuhlmann *et al.* 2016). Most of these species have an eastern bias with the greatest species richness found around Turkey and the Near East, with only seven species reaching into the Western Mediterranean region and only one species, *C. (C.) friesei* Mocsáry, recorded with certainty from Iberia (Table 1). Recent surveys in southern Portugal have revealed a new species of *Camptopoeum*, a country with no previously confirmed records from this genus.

The genus *Flavipanurgus* was first proposed by Warncke (1972) as a subgenus of *Panurgus* but this was raised to genus level by Patiny (1999a). All six species are endemic to Iberia, with five species known from Spain and four from Portugal (Table 2). *F. fuzetus* Patiny is the only member of the genus found solely in Portugal and was described on the basis of a single female collected in 1978, with no records since then (Patiny 1999b). *F. fuzetus* was rediscovered at the same site and day that the new *Camptopoeum* species was found for the first time. In the present publication, the new *Camptopoeum* species and the male of *F. fuzetus* are described. In addition, pollen host preferences amongst *Flavipanurgus* are reviewed and updated with new data from Portugal.

Material and methods

Terminology follows Michener (2007). Field observations of general behaviour and pollen preferences were made *in situ*. Supplementary photographs were also taken. Collected bees showing pollen loads were relaxed and pollen was removed from the scopa and identified using the method detailed in Müller & Kuhlmann (2008).

TABLE 1. Summary of known geographic distribution for the Western Palearctic species of *Camptopoeum*.

Species	Distribution
<i>Camptopoeum (Camptopoeum) armeniacum</i> Warncke	Caucasus (Armenia and Azerbaijan)
<i>Camptopoeum (Camptopoeum) baldocki</i> spec. nov.	Portugal
<i>Camptopoeum (Camptopoeum) friesei</i> Mocsáry	Spain, Italy, Austria, Slovakia, Hungary, Romania, Bulgaria, Greece, Turkey, Azerbaijan, Russia
<i>Camptopoeum (Camptopoeum) frontale</i> Fabricius	Central Europe through to the Caucasus (eastern Germany, Poland, Czech Republic, Austria, Italy, Slovakia, Hungary, Slovenia, Croatia, Serbia, Bosnia and Herzegovina, Macedonia, Montenegro, Romania, Bulgaria, Greece, Turkey and Azerbaijan)
<i>Camptopoeum (Camptopoeum) handlirschi</i> Friese	northern Africa (Algeria and Tunisia)
<i>Camptopoeum (Camptopoeum) nasutum</i> Spinola	southern France and Italy
<i>Camptopoeum (Camptopoeum) negevensis</i> Warncke	Near East (Israel and Jordan)
<i>Camptopoeum (Camptopoeum) rufiventre</i> Morawitz	Caucasus (Armenia and Azerbaijan)
<i>Camptopoeum (Camptopoeum) sacrum</i> Alfken	Near East (Syria, Lebanon, Israel, Jordan)
<i>Camptopoeum (Epimethea) abbasi</i> Warncke	Israel
<i>Camptopoeum (Epimethea) guichardi</i> Patiny	Oman
<i>Camptopoeum (Epimethea) nadigi</i> Warncke	Morocco
<i>Camptopoeum (Epimethea) nigrotum</i> Warncke	Near East (Turkey, Syria, Lebanon, Israel, Jordan)
<i>Camptopoeum (Epimethea) pictipes</i> Morawitz	Turkey and Israel
<i>Camptopoeum (Epimethea) pseudoruber</i> Warncke	Morocco
<i>Camptopoeum (Epimethea) ruber</i> Warncke	Turkey
<i>Camptopoeum (Epimethea) simile</i> Pérez	northern Africa (Morocco, Algeria, Tunisia)
<i>Camptopoeum (Epimethea) subflavum</i> Warncke	Turkey
<i>Camptopoeum (Epimethea) variegatum</i> Morawitz	northern Africa (Morocco and Algeria) and southeastern Europe to the near East (Romania, Bulgaria, Greece, Turkey, Syria, Lebanon, Israel, Jordan)

TABLE 2. Summary of known geographic distribution and pollen preferences for the genus *Flavipanurgus*.

Species	Distribution	Pollen host preferences	Reference
<i>Flavipanurgus flavus</i> Friese	Iberia	Possibly monoleptic on <i>Cistus ladanifer</i>	Current publication
<i>Flavipanurgus fuzetus</i> Patiny	Portugal only	Narrowly oligolectic on <i>Spergularia</i>	Current publication
<i>Flavipanurgus granadensis</i> Warncke	Iberia	Unknown – the only published flower record is <i>Helianthemum syriacum</i>	Ortiz-Sánchez & Patiny (2007)
<i>Flavipanurgus ibericus</i> Warncke	Iberia	Narrowly oligolectic on <i>Sedum</i>	Current publication
<i>Flavipanurgus merceti</i> Vachal	Spain only	Unknown	-
<i>Flavipanurgus venustus</i> Erichson	Spain, no confirmed records from Portugal	Monoleptic on <i>Cistus crispus</i>	González-Varo <i>et al.</i> (2016)

Species description

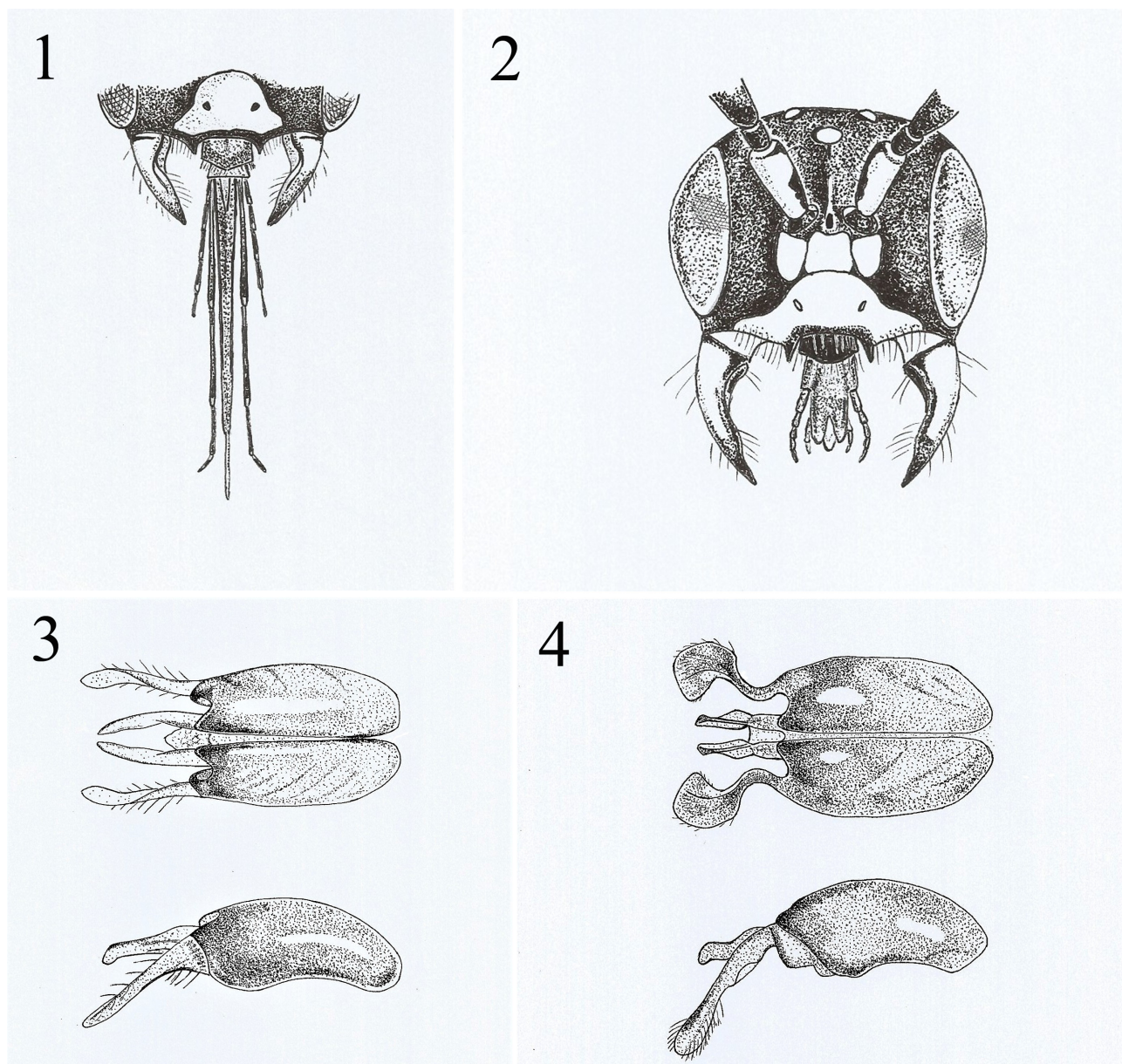
Camptopoeum (Camptopoeum) baldocki Wood and Cross, **spec. nov.**

Holotype. PORTUGAL: Cacela Velha (Latitude 37.157, Longitude -7.543), 27.4.2016, 1♂ (leg. T.J. Wood). Deposited in the Natural History Museum, London (NHML), reference code NHMUK010265327.

Paratypes. PORTUGAL: Cacela Velha, 27.4.2016, 5♂ (leg. T.J. Wood); Pêra, Praia Grande (Latitude 37.100,

Longitude -8.351) 15/19.5.2016, 4♂, 5♀ (leg. I. Cross); Tavira (Latitude 37.121, Longitude -7.620), 29–31.5.2016, 1♂ (leg. A. Livory & R. Coulomb). 1♀ deposited in the BMNH with the remaining material retained in the private collections of the authors and A. Livory & R. Coulomb (Manche).

Diagnosis. Small black and creamy-white marked (henceforth referred to as pale) bee with a body length of 4 mm in both sexes. The glossa is longer than the prementum and the first segment of the labial palpus is subequal to the length of the second to the fourth segments taken together, placing *C. baldocki* in subgenus *Camptopoeum* sensu strictu (Figure 1). The female is characterised from other members of this subgenus by the almost completely black face and reduced pale markings on the metasomal terga (Figure 5). The male is also characterised by the facial markings (Figure 1), with pale maculation restricted to the ventral surface of the antennal scape, the clypeus and the basal half of the mandibles.



FIGURES 1–4. 1: *Camptopoeum* (*C.*) *baldocki* lower face and mouthparts. 2: *Flavipanurgus fuzetus* male face and mouthparts. 3: Male genitalia of *Camptopoeum* (*C.*) *baldocki*, dorsal (above) and lateral (below) views. 4: Male genitalia of *Flavipanurgus fuzetus*, dorsal (above) and lateral (below) views.

Description. FEMALE: Body length 4 mm. Female material is pictured in Figure 5. *Head:* Head slightly wider than long, ground colour black. The eyes are blue-grey in life though this disappears after death. Proboscis long, three to four times the length of a mandible. Glossa long, approximately three times the length of the

prementum. The length of the first segment of the labial palpus is subequal to the length of the second to the fourth segments taken together. Head entirely black except for a narrow white line along the upper clypeal margin, where this abuts the supraclypeal area. At its greatest extent this spans the entire width and is broader in the centre. At its least extent it is reduced to a single, pale central dot. Mandibles dull orange-yellow in the basal half, apically dark reddish-brown. Antennal scape entirely black. Antennal segments 3–13 ventrally marked with dull orange-yellow, dorsally dark to brown. *Mesosoma*: Mesonotum with punctures superficial, barely discernible against the faint background microreticulation, distance between the punctures approximately equal to a puncture width. Puncture interspaces weakly shining with faint microreticulation. The mesosoma is entirely black apart from pale markings as follows: the rear half of the pronotal lobes, two very fine lines on the rear margin of the scutellum (absent in one out of four specimens) and a broad band occupying much of the dorsal surface of the metanotum. The tegulae are transparent brown with some obscure pale markings on the wing bases. Legs black-brown apart from the following pale markings: a small dorsal apical spot on femora 1–2 and a broad streak almost the entire length of the front of tibia 1–2. The tarsi and tibia 3 are a slightly paler, translucent brown. Pilosity silvery. The tibial scopa of sparse, pale, curved hairs: the ventral ones roughly twice as long as the dorsal. Stigma and veins of forewing brown. *Metasoma*: Terga densely but weakly punctured, the punctures barely visible against the background reticulation. The distance between the punctures one to two times a puncture width. Tergal margins 1–4 impressed, colour varying from black (concolourous with ground colour of terga) to reddish brown. Terga with pairs of lateral pale spots immediately anterior to the depressed marginal area. On tergum 1 there is a single pair. On terga 2–4 there are two on both sides, each pair formed by an irregular, subtriangular spot at the rear corner and a short dash between this and the centre line of the tergite. The exterior spots on T4 are frequently missing and the dashes may be absent progressively from T2 to T4, such that the darkest specimens only have the exterior spots on T1–3. Sterna entirely dark. The pygidium is subtriangular, roughly as wide at the base as long, with slightly convex sides and a rounded tip. There is a very faint hint of a longitudinal, central raised area.

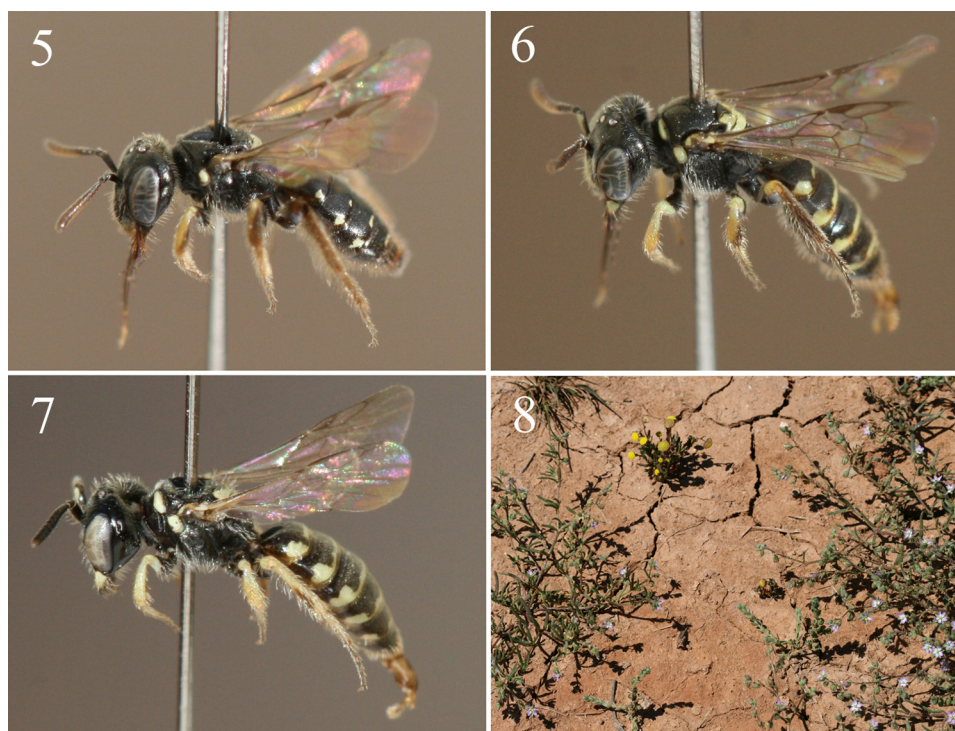
MALE: Characters are identical to the female unless mentioned as follows. Male material is pictured in Figure 6. *Head*: Clypeus pale except for a pair of small black dots, each located towards the midpoint of the lateral clypeal margin (Figure 1). Some males may additionally have two or three small, linear pale dots at the lower edge of the supraclypeal area and a small, irregular dot in the lower half of the paraocular area. Mandibles yellow in the basal third to half, apically reddish brown. Antennal scape ventrally pale marked, dorsally black. Antennal segments 3–13 ventrally marked with orange, dorsally dark to orange-brown. *Mesosoma*: Pronotum, pronotal lobes, scutellum and metanotum pale marked. Tegulae and wing bases brown with variable faint pale markings. Proximal margin of scutellum black with a central black marking extending posteriorly, separating the two pale patches on the distal scutellar margin (seen in Figure 10). Legs black-brown apart from the following pale markings: the apical third of femora 1–3, the entirety of tibia 1–2, tarsi 1 and basitarsi 2 in the basal half. *Metasoma*: Terga 1–5(6) with a pale band immediately anterior to the depressed marginal area, this band generally reaching the lateral margin on terga 1–3. Genitalia illustrated in Figure 3.

Pollen hosts. Several days of observation at Pêra and the analysis of one scopal load showed exclusive use of *Frankenia laevis* as a pollen host (Figure 9). Given the absence of co-flowering congeners this observed pattern of pollen use is best referred to as a special case of narrow oligolecty (Müller & Kuhlmann 2008). Ideally a greater number of pollen loads would have been collected, but given this subfamily's propensity for narrow oligolecty, exclusive use of *Frankenia* is highly likely. Further observation and pollen load analysis would of course strengthen this claim. Data on the pollen hosts of other *Camptopoeum* species are scarce. *C. (C.) friesei*, the only other *Camptopoeum* species recorded with certainty from Iberia, and the closely related *C. (C.) frontale* Fabricius are both oligolectic on Asteraceae, predominantly foraging from *Centaurea* and *Carduus* (Friese 1926). To our knowledge, there are no published records of Frankeniaceae as a pollen host for oligolectic Old World panurgine bees. Narrow oligolecty on *Frankenia* has been observed in *Hoplitis (Stenosmia)*, species of dry, desert environments (Müller 2014, Table 3). No data on *Frankenia* oligolecty are readily available for other bee species.

Distribution. Known only from saltmarsh edges along the southern coast of the central and eastern Algarve, Portugal. The pollen host plant, *Frankenia laevis*, is distributed irregularly along the entire Portuguese coast, with the majority of records in the southern half of the country (Flora-On 2014). Given the ecologically similar and extensive areas of saltmarsh, *C. baldocki* could well occur, and should be searched for, in the Marismas de Isla Cristina, Rio Piedras and Odiel in Huelva Province or the mouth of the Guadalquivir in Sevilla Province, Andalucía, Spain.

TABLE 3. Geographic distribution of species of Western Palearctic bees strongly associated with *Frankenia*.

Species	Distribution	Pollen host preferences	Reference
<i>Camptopoeum (Camptopoeum) baldocki</i> spec. nov.	Portugal	Narrowly oligolectic on <i>Frankenia</i>	Current publication
<i>Hoplitis (Stenosmia) hartliebi</i> Friese	northern Africa (Morocco, Tunisia, Libya, Egypt) and Israel	Narrowly oligolectic on <i>Frankenia</i>	Müller 2014
<i>Hoplitis (Stenosmia) kotschia</i> Warncke	Turkey	Possibly narrowly oligolectic on <i>Frankenia</i>	Müller 2014
<i>Hoplitis (Stenosmia) tagmouta</i> Warncke	Morocco	Possibly narrowly oligolectic on <i>Frankenia</i>	Müller 2014

**FIGURES 5–8.** 5: *Camptopoeum (C.) baldocki* female. 6: *Camptopoeum (C.) baldocki* male. 7: *Flavipanurgus fuzetus* male. 8: *Camptopoeum (C.) baldocki* and *Flavipanurgus fuzetus* habitat at Pêra showing cracked, saline soil with *Spergularia marina* and *Cotula coronopifolia*.

Nesting biology. All known panurgines are ground nesters (Rozen 1967; Michener 2007). *C. baldocki* was observed nesting in bare saline soils at Pêra. At both Cacela Velha and Pêra, male bees were seen investigating possible nest holes, running quickly between entrances and flying low over the ground. Nesting was only observed within a short distance from the coast, and only on soils which had a clear saline influence (Figure 8). The association with high-salinity soils is not unusual for this genus. *C. (C.) friesei* and *C. (C.) frontale* are associated with areas of dry steppes or silvostepes (Tomozei & Patiny 2006). Many of these areas have soils with a high salt content, such as the Pannonic salt steppe of Austria and Hungary, and here *C. (C.) friesei* is classed as a halophilous species (Anon 2005). *C. (C.) nasutum* Spinola is known only from the south of France and north of Italy where it is associated with coastal sand dunes (Anon 2012). Within this context, the existence of a new species of *Camptopoeum* in the extensive but understudied coastal saltmarshes of southern Portugal is less surprising.

Etymology. The epithet *baldocki* was chosen to commend the work of David Baldock, Surrey, United Kingdom, who has worked tirelessly since 1999 to improve the knowledge of the extensive but poorly studied Portuguese bee fauna.

Description of the allotype male of *Flavipanurgus fuzetus* Patiny

Allotype. PORTUGAL: Cacela Velha, 27.4.2016, 1♂ (leg. T.J. Wood). Deposited in the NHML, reference code NHMUK010265328.

Other material examined. PORTUGAL: Cacela Velha, 27.4.2016, 1♂, 3♀ (leg. T.J. Wood); Fuzeta (Latitude 37.051, Longitude -7.744), 21.6.1978, 1♀ (holotype, leg. K.M. Guichard, NHML); Pêra, Praia Grande 30.4.2016, 2♂, 1♀, 1–13.v.2016, 3♂, (all leg. I. Cross)

Diagnosis. Small black and pale marked bee with a body length of 4 mm in the male and 4.5 mm in the female (Patiny 1999). *F. fuzetus* males are similar to *F. ibericus* Warncke in size and colouration, but males of *F. fuzetus* are characterised by the facial markings (Figure 2), with pale maculation on the ventral surface of the antennal scape, the clypeus, the basal half of the mandibles, the supraclypeal area and two small patches on the paraocular areas, located immediately adjacent to and of similar size to the supraclypeal area. In addition, the genitalia are unique amongst *Flavipanurgus*, with the gonostylus strongly bent inwards at its base towards the penis valve (Figure 4).

Description. MALE: Body length 4 mm. Male material is pictured in Figure 7. *Head:* Head slightly wider than long, ground colour black. Proboscis short, approximately the length of a mandible. Clypeus, supraclypeal area and two small patches of the paraocular areas either side of and of an approximately similar size to the supraclypeal area pale marked (Figure 2). Mandibles pale marked in the basal half, apical half black. Antennal scape ventrally pale marked, dorsally black. Antennal segments 2–13 uniformly black. *Mesosoma:* Mesonotum densely and weakly punctate, distance between the punctures approximately equal to a puncture width. Puncture interspaces weakly shining with faint microreticulation. Pronotum, pronotal lobes, scutellum and metanotum pale marked. Tegulae and wing bases brown with variable faint pale markings. Scutellum pale, with a broad triangular black indentation on the front edge. Legs black-brown with the apical third of femora 1–3, the entirety of tibia 1–3 and basitarsi 1–3 pale marked. Tibia 3 with a central brown marking on both the anterior and posterior faces. Pilosity silvery. Stigma and veins of forewing light translucent brown. *Metasoma:* Terga consistently but weakly punctured, distance between the punctures one to two times a puncture width. Tergal margins 1–5 impressed, reddish brown. Terga 1–5 with a pale band immediately anterior to the depressed marginal area, this band generally reaching the lateral margin on terga 1–4. Tergite 6 with only two reduced pale dots centrally. Sterna reddish brown, without pale markings. Genitalia illustrated in Figure 4.

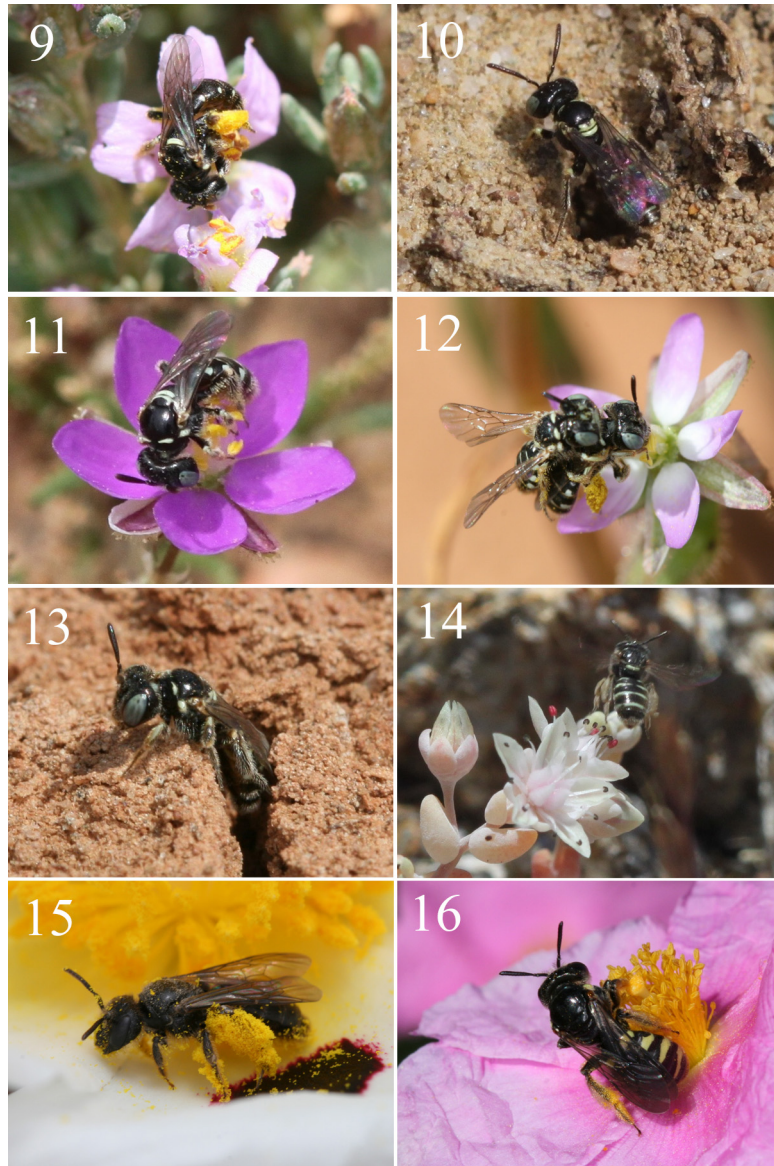
Pollen hosts. The pollen loads of three females (two from Cacela Velha and one from Pêra) contained pure *Spergularia*-type (Caryophyllaceae) pollen. Field observations at Cacela Velha recorded only *Spergularia purpurea* as a pollen host (Figure 11), and observations at Pêra recorded only *Spergularia marina* as a pollen host (Figure 12), with the females apparently ignoring *Spergularia media*. Further investigation of these pollen preferences are warranted. To our knowledge, there are no published records of Caryophyllaceae as a pollen host for oligolectic Old World panurgine bees.

Nesting biology. *F. fuzetus* was observed nesting in desiccation cracks present in saline soils at Pêra (Figure 13). The nesting biology of the genus *Flavipanurgus* has not been studied and so no association with saline soils has previously been reported. All other *Flavipanurgus* species are known from various scrubby coastal and inland areas (Ortiz-Sánchez & Patiny 2007; González-Varo *et al.* 2016).

Distribution. Known only from saltmarsh edges along the southern coast of the central and eastern Algarve, Portugal. The pollen host plants, coastal species of *Spergularia*, are well distributed throughout southern Iberia, and so *F. fuzetus* could well occur in Marismas de Isla Cristina, Rio Piedras and Odiel in Huelva Province or the mouth of the Guadalquivir in Sevilla Province, Andalucía, Spain.

Pollen use by *Flavipanurgus* bees

A great number of panurgine bees appear to be oligolectic or monolectic (Rozen 1967; Danforth *et al.* 2013). From the limited published works and our own field observations and analysis of scopal pollen loads, this trend appears to apply to *Flavipanurgus* (Table 2). In addition to the pollen loads from *F. fuzetus* described above, seven pollen loads of *F. ibericus* (Trás-os-Montes e Alto Douro, Serra do Montesinho, Longitude 41.952 Latitude -6.764, 30.6.2016) and one pollen load of *F. flavus* Friese (Algarve, Aljezur, Longitude 37.311, Latitude -8.870, 9.5.2016) were analysed and pollen foraging behaviour was observed.



FIGURES 9–16. 9: *Camptopoeum* (*C.*) *baldocki* female gathering pollen from *Frankenia laevis*. 19th May 2016 in Algarve, Portugal. 10: *Camptopoeum* (*C.*) *baldocki* male. 27th April 2016 in Algarve, Portugal. 11: *Flavipanurgus fuzetus* female starting to collect pollen from *Spergularia purpurea*. 27th April 2016 in Algarve, Portugal. 12: *Flavipanurgus fuzetus* female at *Spergularia marina* with a full pollen load and attendant male. 30th April 2016 in Algarve, Portugal. 13: *Flavipanurgus fuzetus* female emerging from a desiccation crack. 30th April 2016 in Algarve, Portugal. 14: *Flavipanurgus ibericus* female taking off from *Sedum pedicellatum* with a full pollen load. 30th June 2016 in Trás-os-Montes e Alto Douro, Portugal. 15: *Flavipanurgus flavus* female with *Cistus ladanifer* pollen. 26th May 2016 in Algarve, Portugal. 16: *Flavipanurgus venustus* gathering *Cistus crispus* pollen. 28th April 2014 in Cota Doñana, Spain.

F. ibericus was observed at three localities in northern Portugal in June and July 2016. In all cases male and female bees visited low-growing *Sedum* (Crassulaceae) species only. All seven pollen loads contained pure *Sedum* pollen. *S. brevifolium* and *S. pedicellatum* (Figure 14) were the only observed pollen hosts. To our knowledge, the only other example of narrow oligolecty on *Sedum* is in the recently described *Hoplitis* (*Hoplitis*) *galichicae* from Macedonia (Müller 2016). *F. flavus* was observed for several days in May 2016 at a single locality on the west coast of the Algarve. Females were observed visiting only *Cistus ladanifer* (Cistaceae) and its coastal ecotype *C. l. sulcatus* (also called *C. palhinhae*) for pollen (Figure 15), and males were only seen to patrol this species as well despite the nearby presence of *C. crispus* and *C. monspeliensis*. The one available pollen load contained pure *C. ladanifer* pollen. *F. flavus* and *F. venustus* Erichson form a species pair, being the two largest *Flavipanurgus* species. *F. venustus* is monolectic on *C. crispus* (Figure 16), using it for pollen exclusively even when the similar

C. albidus is available (González-Varo *et al.* 2016). True monolecty (pollen collected exclusively from one plant species in the presence of flowering members of the same genus) in bees is very rare and has been previously described from only six species (Kuhlmann and Timmermann 2011; González-Varo *et al.* 2016). More work is needed to establish whether *C. ladanifer* contains cryptic species and whether *F. flavus* is therefore truly monolectic or only narrowly oligolectic, but it is clear that it is strongly associated with large, white flowered *Cistus*. Much less is known about *F. granadensis* Warncke and *F. merceti* Vachal, with no published pollen records. Only one flower observation is known for *F. granadensis*, that of *Helianthemum syriacum* (Cistaceae, Ortiz-Sánchez & Patiny 2007). More work is needed to characterise the pollen preferences of these two species.

Overall, bees from the genus *Flavipanurgus* appear to use a narrow range of flowers from the botanical families Caryophyllaceae, Cistaceae and Crassulaceae. Patterns of pollen use in panurgine bees are irregular, with some groups of closely related species (such as bees from the genus *Panurgus*) foraging from the same genus or family of plants, and other closely related species (such as bees from the genus *Perdita*) using plants from quite widely dissimilar botanical families (Rozen 1967; Michener 2007). *Flavipanurgus* would appear to fall into the latter group, as the utilised species from these three families apparently have, at least superficially, little in common other than radial symmetry in the shape of their flowers.

Acknowledgements

Bogdan Tomozii (Tomozei *in lit.*, Museum of Natural Sciences, Bacău, Romania) offered extensive advice and discussion as well as access to literature during the identification and naming process. David Baldock (Surrey, United Kingdom) provided helpful advice, identification resources and contacts. Thanks also to David Notton (British Natural History Museum, London) for access to comparative panurgine material and speedy deposition of material. Comments by two reviewers substantially improved the manuscript.

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