Teasel-plant specialised bees in Europe

Conservation action plan 2023–2030

Dark Pantaloon Bee (*Dasypoda braccata*), Spiny Pantaloon Bee (*Dasypoda spinigera*), Swollen Pantaloon Bee (*Dasypoda suripes*), Silvery Pantaloon Bee (*Dasypoda argentata*), Large Scabious Mining Bee (*Andrena hattorfiana*), Scabious Resin Bee (*Trachusa interrupta*)

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European Commission
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buglife

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Introduction

This document was drafted within the framework of an EU funded project 'Action Plans for conservation of threatened pollinator species in the EU', launched by the European Commission in the context of the implementation of the EU Pollinators Initiative[1]. The objective of the project was to develop three EU Species Action Plans for the most threatened pollinator species, by building on existing experience and using the European Red List as a reference. The methodology to develop these actions plans is based on the *Guidelines for Species Conservation Planning* (IUCN SSC, 2017), developed by the former IUCN SSC Conservation Planning Sub-Committee, as well as the *CPSG Species Conservation Planning Principles and Steps* (CPSG, 2020), developed by IUCN SSC Conservation Planning Specialist Group (CPSG).

Over the course of the project, the experts shortlisted 15 species candidates for an action plan. This list has been verified during a dedicated workshop on 18 June 2021. After the validation of the selection, three Conservation Action Plans were selected, including one for teasel-plant specialised bees.

Background on teasel-plant specialised bees

Wild bees are known to represent the most important pollinator group of wild plants and crops (Ollerton, 2017). Approximately 2,000 wild bee species occur in Europe, 9% of which are classified as threatened, but more than half of them are classified as Data Deficient as a consequence of lack of information (Nieto *et al.,* 2014). Due to the importance of wild bees as pollinators, there is a strong need for conservation action. Conservation projects for wild bees are still scarce and focus either on large bumble bee species, or on untargeted action, such as the creation of bee hotels or flower strips. While these actions may benefit some bee species, they are usually not sufficiently specific to improve or restore populations of highly threatened bee species. Many wild bee species are strongly specialised on specific pollen sources and require appropriate nesting sites (Westrich, 2018). The lack of their food plants is a key constraint. Wild bees specialised on teasel plants (Dipsacoideae, such as *Scabiosa*, *Knautia, Cephalaria,* etc.) are at particular risk of extinction. Most teasel plants flower in summer and thus they provide nectar and pollen not only for specialised wild bees, but also for many other pollinators and flower visitors. Grassland rich in teasel plants is not only a habitat of high ecological importance, but also of high aesthetic value, providing a colourful scene and indicating species-rich landscapes. This document provides the basis for a Conservation Action Plan for these wild bee species, including the Dark Pantaloon Bee (*Dasypoda braccata*), the Spiny Pantaloon Bee (*Dasypoda spinigera*), the Swollen Pantaloon Bee (*Dasypoda suripes*), the Silvery Pantaloon Bee (*Dasypoda argentata*), the Large Scabious Mining Bee (*Andrena hattorfiana*) and the Scabious Resin Bee (*Trachusa interrupta*), four of which are classified as Endangered on the European Red List and two as Near Threatened. These species are considered umbrella species for the conservation of teasel-plant rich grassland communities. For each of these species, a comprehensive review of the known information on taxonomy and systematics, biology and ecology, functions and values, historical and current distribution and demography, habitat and resource availability and threats is provided. This review will provide the information necessary to identify major knowledge gaps and necessary conservation action for these wild bee species.

1 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52023DC0035&qid=1676305603129

Status review

Dark Pantaloon Bee, *Dasypoda braccata* (Eversmann, 1852)

Species description

Systematics / taxonomy

Dasypoda braccata (Eversmann, 1852) is a bee specialised on teasel plants, listed as Endangered on the European Red List (Michez & Nieto, 2012a). The species belongs to the short-tongued bee family Melittidae (Nieto *et al.,* 2014), subfamily Dasypodainae (Michez *et al.,* 2004a; Michez & Nieto, 2012a). The genus *Dasypoda*, pantaloon bees, consists of 39 species distributed in the Palearctic and having its hotspot with 29 species in the Mediterranean basin. *Dasypoda* are medium- to large-sized bees (8–18 mm), short-tongued, and have two submarginal cells, the first larger than the second (Figure 1). The females can be recognised immediately from other bees by their enormous pollen brushes borne on the hind tibias and tarsi (Figure 1). Their metasoma shows a glossy black cuticle with hair bands, more or less interrupted, usually of light-coloured hairs (except for *D. maura*, which has dark brown hair bands). It is slightly flattened dorso-ventrally and reaches its greatest breadth at the level of segments 4 and 5. The hind tibiae lack a basal plate. The hair cover is quite variable in colour, sometimes russet, sometimes grey-brown. The males show a more uniform beige to white pilosity covering the whole metasoma. The first tarsal segments are very narrow, strongly elongated and with very long hairs (Figure 1). Michez *et al.* (2004a) identified four subgenera based on cladistic analyses (based on 32 morphological characters), biogeographical distribution and flower choices of the species: *Microdasypoda* Michez, 2004, *Heterodasypoda* Michez, 2004, *Dasypoda* s.str. (Latreille, 1802) and *Megadasypoda* Michez, 2004. *D. braccata* belongs to the subgenus *Megadasypoda* containing nine species (Figure 2). All the species are characterised by a long malar space (Figures 3–4, 9–10, 14–15, 19–20).

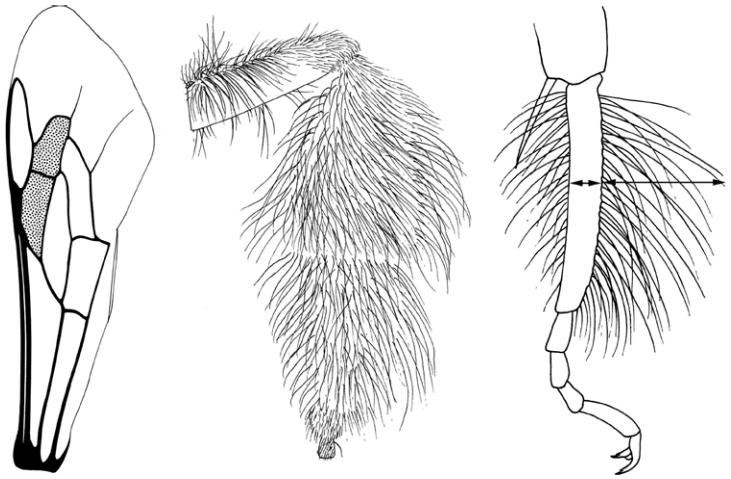


Figure 1A–C: General morphology of Dasypoda. A, anterior wing with two submarginal cells, B, female scopa; C, male hind leg (From Michez et al., 2019).

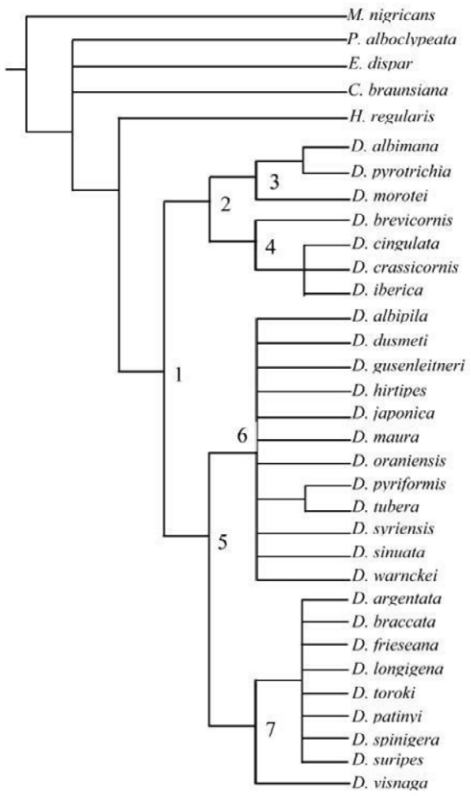


Figure 2: Strict consensus tree of the Dasypoda branch based on the cladistic analysis of Michez et al. (2004a). Clade 1: Dasypoda; clade 2: Heterodasypoda + Microdasypoda; clade 3: Heterodasypoda; Clade 4: Microdasypoda; Clade 5: Dasypoda s.str. + Megadasypoda; Clade 6: Dasypoda s.str.; Clade 7: Megadasypoda.

Males of the nine species of the subgenus *Megadasypoda* are characterised by the sternum 7 with latero-apical spines, sternum 8 with two dorso-apical teeth and without lateral hooks at the basal part, and genitalia gonostylus with 3 extensions (Figure 3). The males of *D. suripes*, *D. spinigera* and *D. braccata* are covered by an appressed and bright coat (Praz *et al.,* 2008) (Figure 3). Compared to the two other species, *D. braccata* does not have thickened posterior tibiae (as *D. suripes*), nor a spine on the anterior femur (as *D. spinigera*). The genitalia of *D. braccata* and *D. argentata* are similar. The two species differ in the pubescence of the clypeus and metasoma, which is appressed in *D. braccata*, whereas it is erected in *D. argentata*.

Females of the nine species of the subgenus *Megadasypoda* are characterised by a pygidial plate with adpressed pubescence (Figure 4). Females of *D. braccata* show a dark scopa similar to *D. argentata* but they have a complete apical hair band on the tergum 4 while this band is interrupted in *D. argentata* (Figure 4). Moreover, the face of *D. braccata* females has dark hair instead of yellowish hair in *D. argentata*. *D. longigena, D. spinigera* and *D. suripes* can look similar in size and behaviour to *D. braccata* but the scopa, the face, the ventral side of the mesosoma and metasoma of *D. braccata* have a completely dark pubescence (Figure 4) while the colour of the pilosity is mainly reddish or yellowish in the other species.

The name *braccata* originates from the Latin *braccatus* – wearing breeches or sleeved, which is a reference to the well-developed scopa of the female. We here propose the common name 'Dark Pantaloon Bee' for the species to refer to the overall darker pilosity of this species compared to its closely related species.

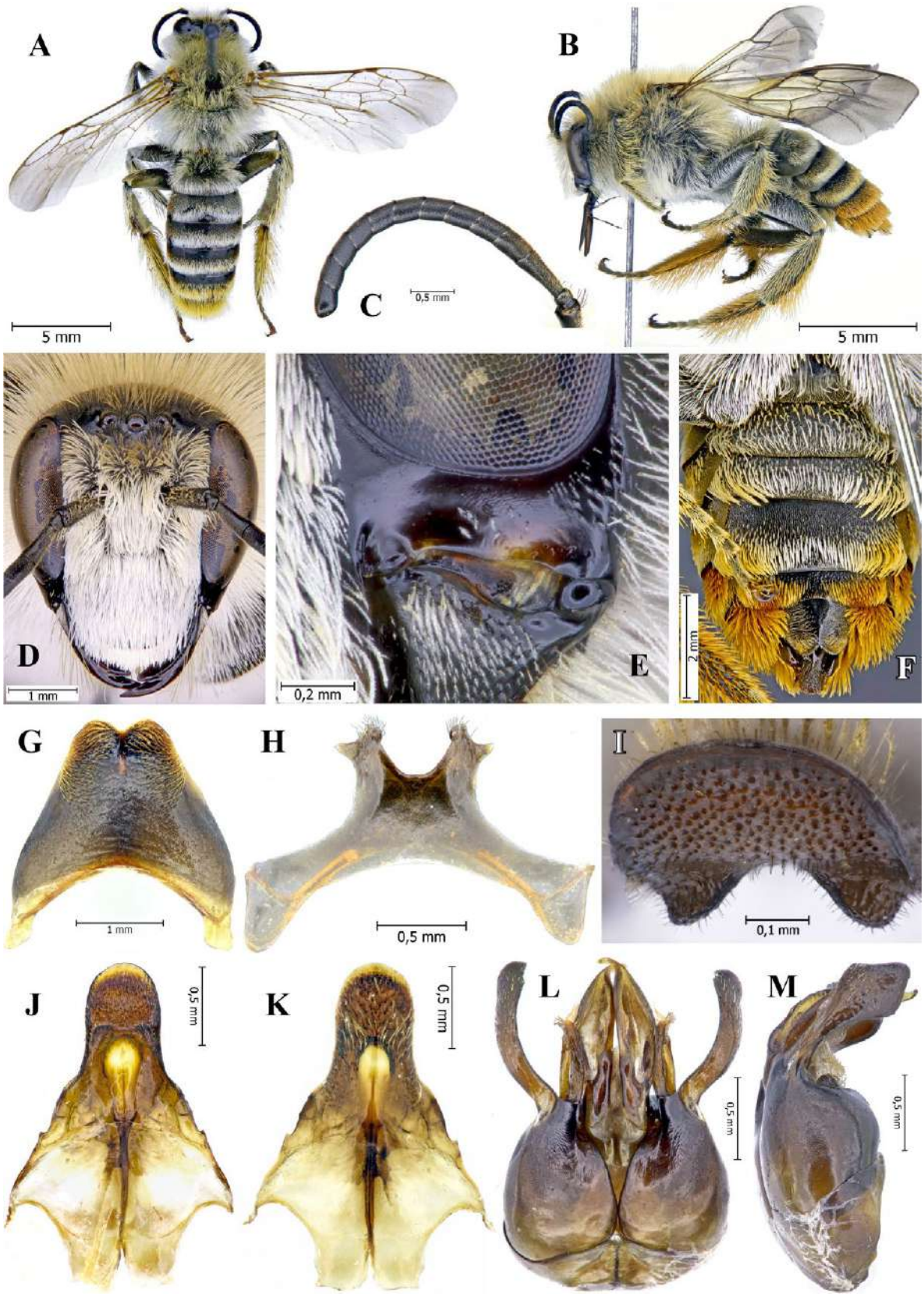


Figure 3A–M: Male of Dasypoda braccata. A, general habitus in dorsal view; B, general habitus in lateral view; C, flagellum; D, face; E, malar space; F, metasoma in ventral view; G, sternum 6; H, sternum 7; I, sternum 8 in dorso-apical view; J, sternum 8 in dorsal view; K, sternum 8 in ventral view; L, genitalia in dorsal view; M, genitalia in lateral view. (Pictures: V. Radchenko)

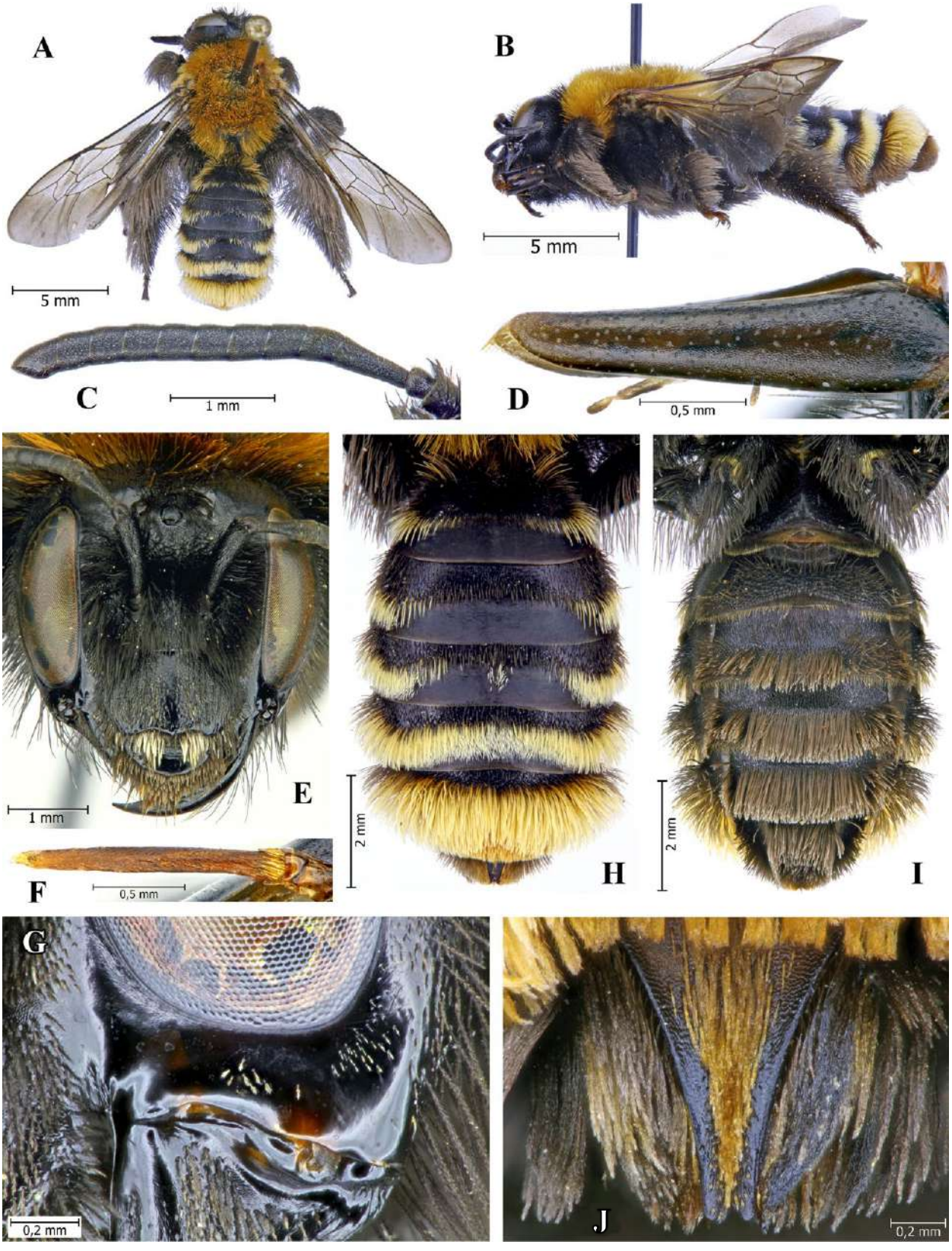


Figure 4A–J: Female of Dasypoda braccata. A, general habitus in dorsal view; B, general habitus in lateral view; C, flagellum; D, galea; E, head in frontal view; F, glossa; G, malar space; H, metasoma in dorsal view; I, metasoma in ventral view; J, pygidial plate. (Pictures: V. Radchenko)

Biology and ecology

Figure 5 shows the general life cycle of *Dasypoda* bees. As far as we know, all pantaloon bees are solitary and univoltine (Michez, 2005, 2007). After the males' emergence, the copulation with a virgin female takes place on host plants around the males' hatching place. Then the gravid female digs and builds the ground nest in clay or sandy soil (El Abdouni *et al.,* 2021; Michez, 2007).

Radchenko (1988) described the species' nest architecture: from the outside, the nest of *D. braccata* is recognised by a cone-shaped mound 2.5 cm high and 16 cm in diameter, that is 4 cm from the nest entrance. The upper part of the tunnel is 20 cm long and tilted to the surface at 15 degrees. The main tunnel then bends down at a right angle, and extends for a further17 cm curving from side to side. Each bend leads to a side gallery with a height of 1.5–2 cm. The females of *D. braccata* construct 1–3 cells at the end of each lateral gallery. The lateral passages are arch-shaped and 8 mm in diameter. Unlike most other ground-nesting bees, *D. braccata*, like all other species of this genus, does not cover the cell walls with secretory lining. The female deposits the eggs (length 5.6 mm, diameter 1 mm) on the top of the pollen and closes the cell with fine soil material. The larva feeds for ten days and uses pseudopodia to eat from every side of the pollen (Radchenko, 1988). Radchenko (1988) emphasises that the pollen balls of the species have three projections to prevent the development of mould as is observed in other species of the genus (e.g. El Abdouni *et al.,* 2021). After defecation, the larva overwinters and develops into a pupa (Figure 5) (Michez, 2007). According to Radchenko (1988), the larva does not form a cocoon which is different to the other bees of the family Melittidae (with the exception of *Hesperapis regularis*). The flight period of the adult bees is from the end of June to mid-August (Praz *et al.,* 2008).

The main host plants of *Dasypoda braccata* are Caprifoliaceae (46%) (Table 1), but it also visits the plant families Asteraceae (9%), Boraginaceae (9%) and Lamiaceae (36%), probably for nectar. However, 99% of the pollen is collected from Caprifoliaceae (Michez *et al.,* 2008). Praz *et al.* (2008) report that the species visits *Scabiosa ochroleuca* (Caprifoliaceae) in Austria and *Scabiosa rotata* (Caprifoliaceae) in Türkiye.

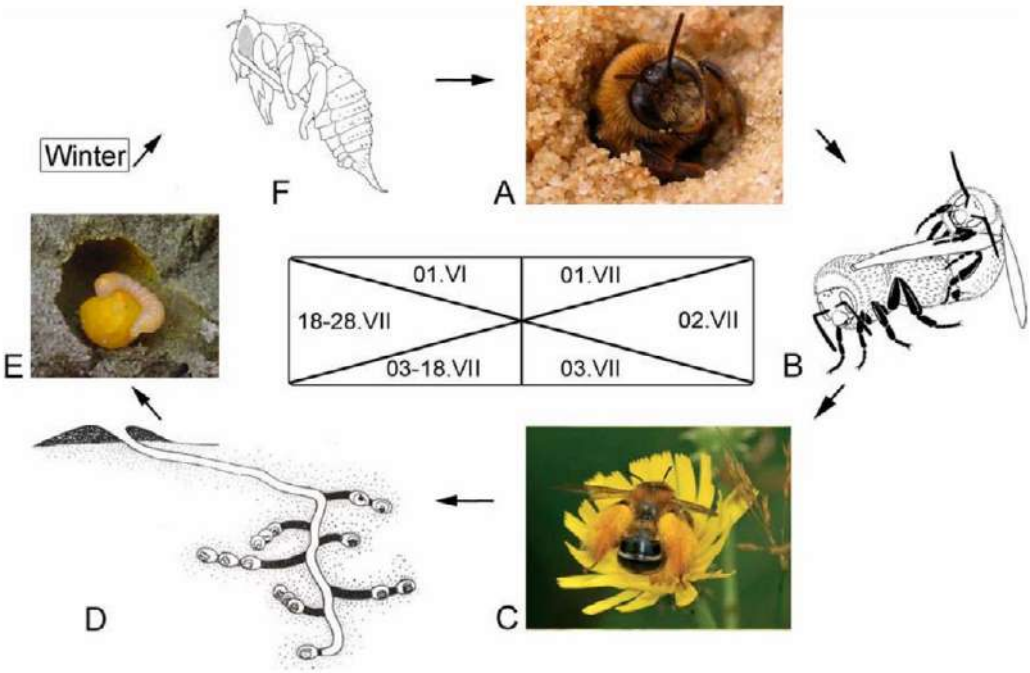


Figure 5A–F: General life cycle of Melittidae. A. Emergence of Dasypoda hirtipes female (picture: N. J. Vereecken). B. Copulation (drawing: M. Terzo). C. Female of D. hirtipes foraging on Hypochaeris radicata (picture: N. J. Vereecken). D. Nest of Dasypoda braccata (from Radchenko, 1988). E. Larva of D. hirtipes (picture M. Gosselin). F. Pupa of Hesperapis trochanterata (From Rozen, 1987, Michez, 2007)

*Table 1: Host plants of the genus Dasypoda. N = number of specimens with field data and number of localities. Pollen = number of specimens with palynological data; number of sampled localities. In parentheses is the percentage of the main host-plant family; pollen counts are corrected by volume; * = 100%. 1 = Preliminary palynological analysis. (From: Michez et al., 2008).*

Species	N	Main host plant	Pollen	Main host plant
Dasypoda argentata	191:41	Dipsacoideae	54:40	Dipsacoideae (99%)
Dasypoda braccata	285:18	Dipsacoideae	38:19	Dipsacoideae (91%)
Dasypoda spinigera	0:0	Dipsacoideae	44:25	Dipsacoideae (100%)
Dasypoda suripes	3:3	Dipsacoideae	32:24	Dipsacoideae (100%)

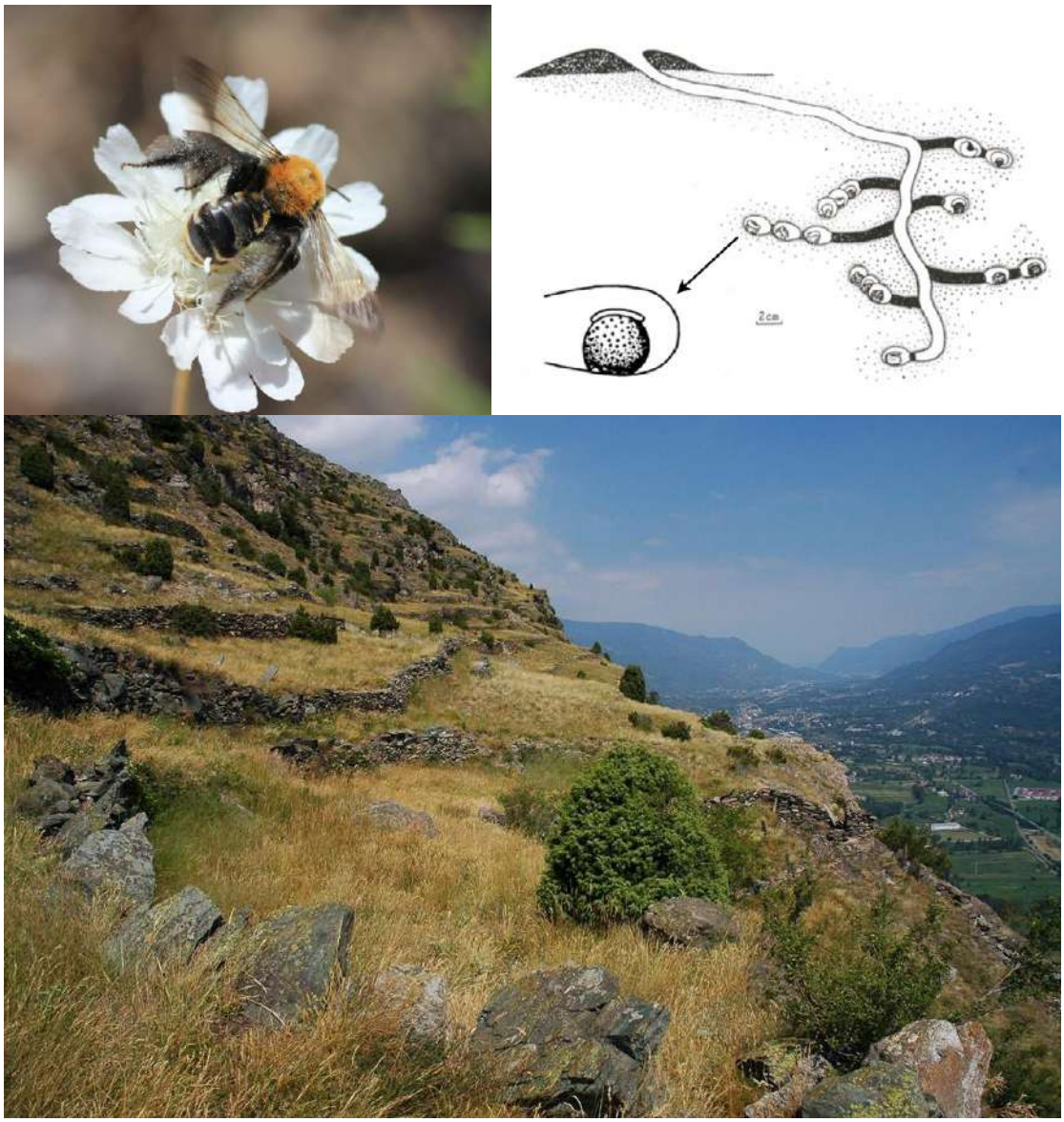


Figure 6A–C: Dasypoda braccata biology and ecology. A, female foraging pollen of Scabiosa sp. (picture S. Ivanov from Ukraine); B, nest architecture including larval cells, pollen and larva (from Radchenko, 1988); C, habitat of the Italian population (Italy, Piemont, 50 km east of Torino, valley di Susa, (45°08'53''N, 7°03'57''E, 820 m of altitude) (From: Praz et al., 2008).

Table 2: The visited plant families of the genus Dasypoda, sorted by its four subgenera. The total number of observations is in parentheses, the plant choice is described in percentages and the highest amount is in bold. (From: Michez et al., 2004a).

Visited plant families	Apiaceae (2)	Asteraceae (440)	Boraginaceae (2)	Brassicaceae (2)	Campanulaceae (12)	Cistaceae (63)	Caprifoliaceae (298)	Ericaceae (2)	Fabaceae (33)	Geraniaceae (9)	Lamiaceae (4)	Linaceae (9)	Malvaceae (59)	Ranunculaceae (1)	Rosaceae (4)
Subgenus Dasypoda															
D. dusmeti (11)	-	91	-	-	-	-	-	-	-	-	-	-	9	-	-
D. hirtipes (323)	-	93	-	-	3	-	2	1	-	1	-	-	-	-	-
D. japonica (lit.)	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
D. maura (14)	-	72	-	-	-	-	7	-	-	-	21	-	-	-	-
D. sinuata (4)	-	100	-	-	-	-	-	-	-	-	-	-	-	-	-
Subgenus Megadasypoda															
D. argentata (291)	-	3	3	-	-	-	94	-	-	-	-	-	-	-	-
D. braccata (11)	-	9	9	-	-	-	46	-	-	-	36	-	-	-	-
D. spinigera (lit.)	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
D. suripes (8)	-	-	-	-	12	-	88	-	-	-	-	-	-	-	-
D. toroki (8)	-	100	-	-	-	-	-	-	-	-	-	-	-	-	-
D. visnaga (67)	2	98	-	-	-	-	-	-	-	-	-	-	-	-	-
Subgenus microdasypoda															
D. cingulata (61)	-	15	3	-	-	-	-	-	5	-	-	-	77	-	-
D. crassicornis (111)	-	21	-	2	-	32	-	-	-	27	-	8	8	1	1
Subgenus Heterodasypoda															
D. albimana (11)	-	55	-	-	-	-	-	-	-	-	18	-	-	-	27
D. morotei (11)	-	-	-	-	-	100	-	-	-	-	-	-	-	-	-
D. pyrotrichia (18)	-	-	-	-	-	88	-	-	-	6	-	-	6	-	-

Functions and values

Wild bees are major pollinators of crops and wild plants. Nieto *et al.* (2014) describe them as "a global keystone in wild and agricultural ecosystem dynamics". Gallai *et al.* (2009) highlight the economic dependence of food production on global pollinators. The annual economic value of animal pollination services to agriculture was estimated to be US$ 235–577 billion in 2015 (IPBES, 2016). Sexual reproduction of crops and plants depends on the ecosystem service of pollination

(Wilson-Rich *et al.,* 2014). In addition, bees provide important ecosystem functions by creating habitat for other invertebrates. Representatives of various groups of organisms (including certain beetles, butterflies, flies, ichneumon wasps, cuckoo wasps and birds) live on bees or develop in their nests (Westrich *et al.,* 2011). Finally, bees have a positive image with the public, making them suitable flagship species for insect conservation (Schönfelder & Bogner, 2017).

Historical account

Historical records of *Dasypoda braccata* were collected in the framework of the partial revision of the genus *Dasypoda* by Michez *et al.* (2004a) and updated in the present report. Records were obtained from specimens hosted in collections of museums like Oberösterreichische Landesmuseum Linz (Austria), Natural History Museum (London, UK), Musée national des Sciences naturelles (Paris, France), Naturalis (Leiden, Netherlands) or Naturhistorisches Museum Wien (Austria) and from the literature. A total of 7,724 specimens were considered for the full genus in the revision of Michez *et al.* (2004a).

The known records (2008) of *Dasypoda braccata* are shown in Figure 7. The species mainly occurs around the Black Sea (Praz *et al.,* 2008). Populations in the Balkans, Hungary and Italy are extremely isolated (Michez & Nieto, 2012a). The western distribution border is in Italy (Val di Susa), the eastern in Russia (Orenburg, 51.78°N, 55.05°E), the southern in Anatolia (Çamardi, 37.83°N 35.00°E) and the northern in Russia (Novospasskoye, 53.16°N, 47.76°E) (Praz *et al.,* 2008). Proshchalykin *et al.* (2019) report the occurrence of the species in Russia in the North Caucasus, the European Russian part and the Urals. Furthermore, Kazakhstan and Türkiye are part of the distribution area. The extent of occurrence (EOO) is 2,631,776 km² and the area of occupancy (AOO) is 148 km² (Michez & Nieto, 2012a).

Figure 7: Records of Dasypoda braccata according to Michez et al. (2004a) updated with data from GBIF, Observation.org, M. Filatov, V. Radchenko and J. Straka.

Figure 8: Recent records (since 2000) of Dasypoda braccata. The data are from D. Michez, V. Radchenko, B. Tkalcu, M. Filatov, GBIF and Observation.org.

Current distribution and demography

Figure 8 illustrates the most recent records of the species. The population trend is considered negative even if there is no study available on the demography of *Dasypoda braccata* (Michez & Nieto, 2012a). The species is listed as Endangered on the IUCN Red List of Threatened Species (Michez & Nieto, 2012a) under criterion B2ab (iii,v). At national level, the species was assessed as Critically Endangered (CR) in Italy, where it is present exclusively in Piedmont (Val di Susa) with an extent of occurrence of less than 100 km² and an area of occupancy (AOO) less than 10 km². No recent records exist from the northern part of the range (Slovakia, Hungary). They might have gone extinct like many populations of teasel bees in northern and Central Europe. This species is included in the Red List of Ukraine (2021) as Endangered.

Habitat and resource assessment

The habitat of *Dasypoda braccata* consists of Mediterranean xerothermic shrub and grassland vegetation. Praz *et al.* (2008) described the habitat of *Dasypoda braccata* as follows (Figure 6): Downy oak (*Quercus pubescens*) and Scots pine (*Pinus sylvestris*) dominate the tree formations, which are very open due to drought and rocky terrain. The herbaceous vegetation consists mainly of lawn steppe mosaic with less xeric facies, especially on deeper soils. The bushy formations include juniper (*Juniperus communis*) as an indicator of past pasture use, now largely abandoned. The herbaceous stratum is dominated by grasses (*Stipa* spp., *Festuca* spp., *Melica ciliata*, *Koeleria* spp.) and to a lesser extent by sagebrush (*Artemisia* spp.) and *Eryngium campestre*. Some flowering plants noted are: *Centaurea valesiaca*, *Ononis natrix*, *Teucrium chamaedrys*, *Inula montana*, *Achillea tomentosa*, *Nepeta nepetella*, *Laserpitium siler*.

The most abundant Caprifoliaceae was *Scabiosa triandra*. For pollen collection, it seems that *D. braccata* needs large-scale occurrence of *Scabiosa* (Michez & Nieto, 2012a). Further studies are needed to understand the link between the abundance of this species and the amount of host plant available.

Threat analysis

Land use change has led to a decline of suitable habitats of the species and is thus its greatest threat (Michez & Nieto, 2012a). This process is mainly driven by arable farming. As *Dasypoda braccata* is a specialised bee and cannot use alternative plant resources, the decline of the main pollen source *Scabiosa* represents a major threat (Michez & Nieto, 2012a). The species is affected by the general decline of grasslands with abundant *Scabiosa* spp. caused by poor grassland management, such as abandonment, inappropriate mowing regimes or the application of fertilisers and herbicides. It could also be affected by intensive grazing in areas suitable for the species.

The Italian population is severely isolated from other European populations, which are themselves isolated from each other and with almost no possibility of gene exchange. It undergoes a continuing decline due to habitat deterioration and decrease of the host plant. Direct conservation measures do not exist for this species, but the Italian population occurs in a protected area (IT1110030, Xerothermic oasis of Val di Susa and Orrido di Chianocco and Foresto) which is threatened by infrastructural works (AA.VV., Dossier of environmental impact on the SCIs of the new Turin-Lyon line CUP C11J05000030001) (Quaranta *et al.,* 2018). It is necessary to shed light on the Italian distribution and on the trend of the population.

Conservation actions for xerothermal grasslands, like preventing excessive reforestation, should also be initiated to stop the induced decline of the host plant (*Scabiosa* spp.).

Spiny pantaloon bee, *Dasypoda spinigera* (Kohl, 1905)

Species description

Systematics / taxonomy

Dasypoda spinigera (Kohl, 1905) is another bee specialised on teasel plants and belonging to the family Melittidae and the subgenus *Megadasypoda* (Michez *et al.*, 2008; Michez & Nieto, 2012b). The species has a body size of 14–18 mm. Like the other males of the nine species of the subgenus *Megadasypoda*, males of *D. spinigera* are characterised by the sternum 7 with latero-apical spines, the base of the sternum 8 laterally without hooks and genitalia with 3 extensions of the gonostylus (Figure 9). They can be distinguished from the other males of the subgenus by a pale pubescence, a curvy anterior tarsus, continuous apical hair bands on terga 4–5 and a very characteristic long spine at the base of its anterior femur (Warncke, 1973) (Figure 9).

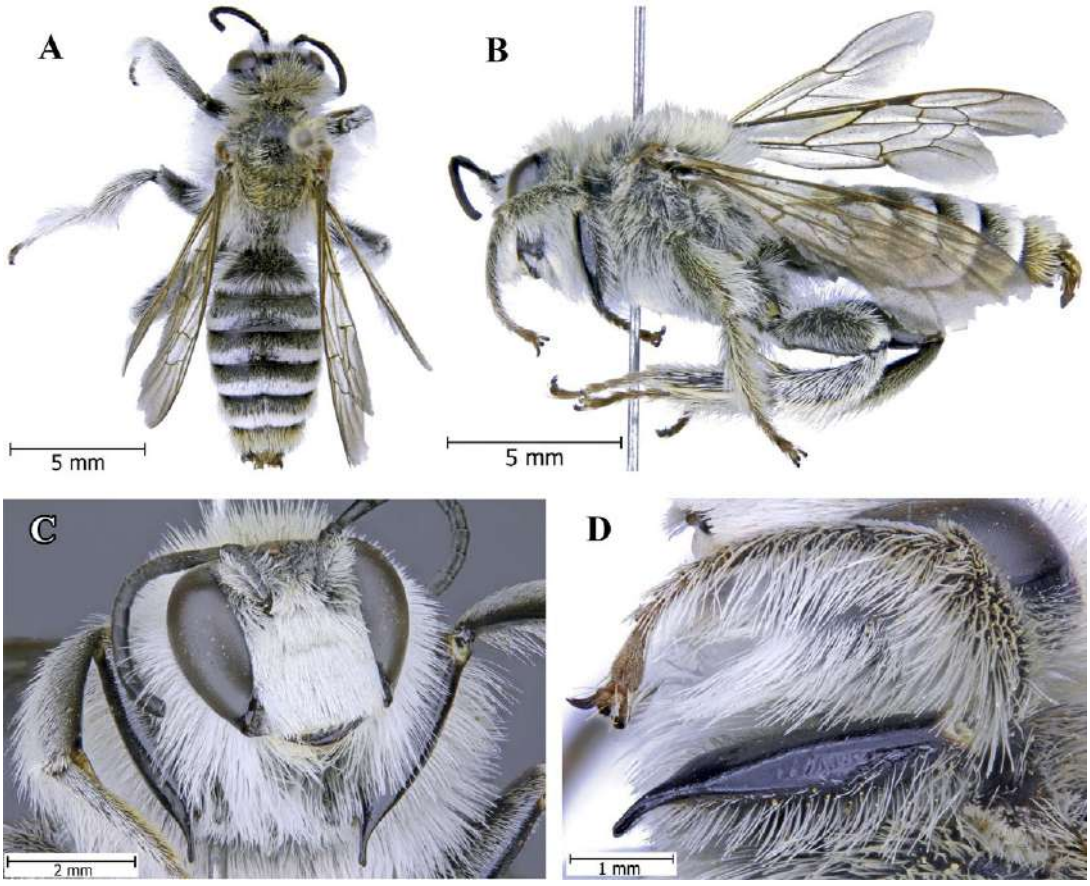


Figure 9A–D: Dasypoda spinigera male. A, general habitus in dorsal view; B, general habitus in lateral view; C, head in facial view and the forelegs with femoral spines; D, detail on the spine on the basal part of the anterior femur. (Pictures: V. Radchenko)

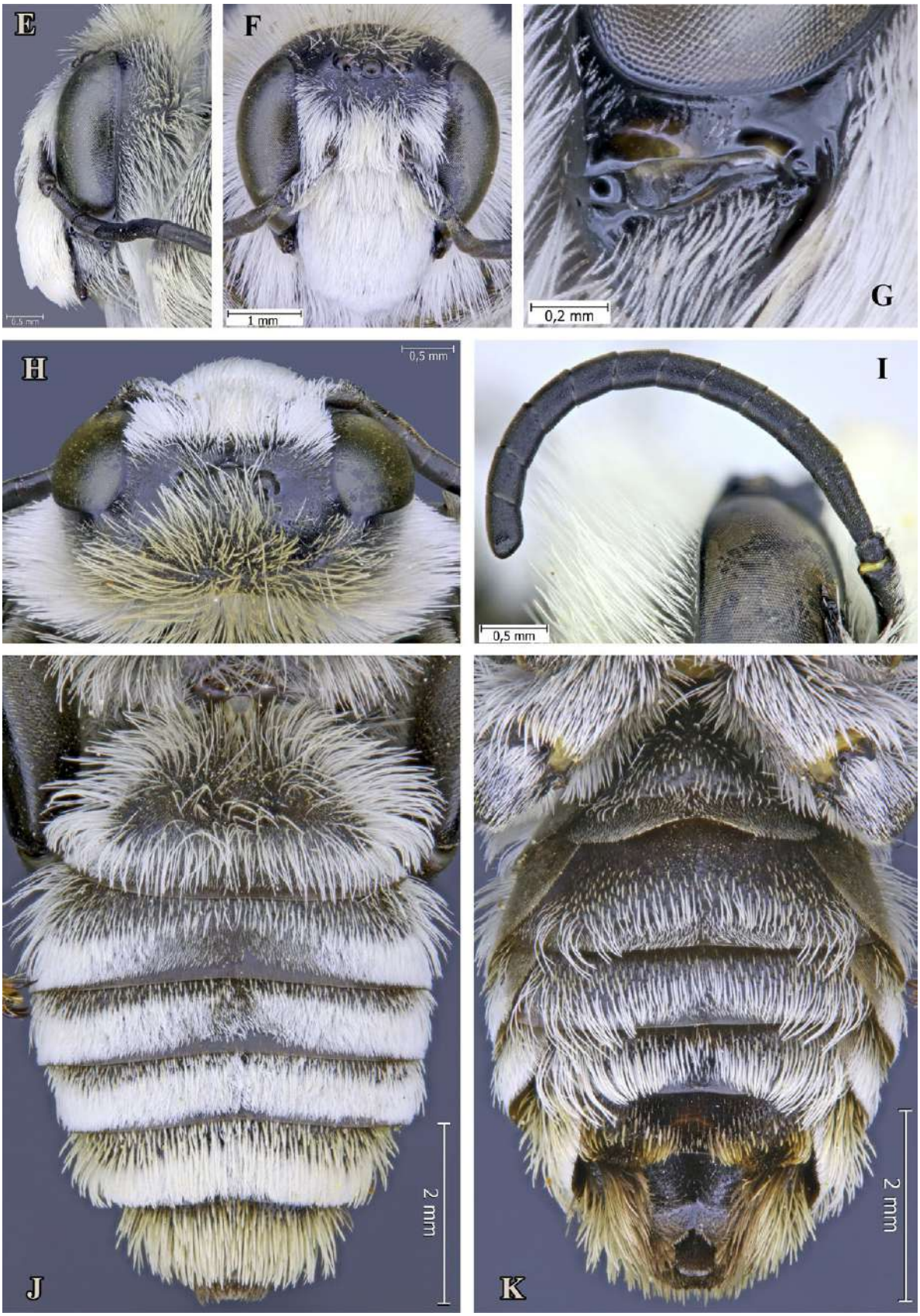


Figure 9E–K: Dasypoda spinigera male. E, head in lateral view: F, head in frontal view; G, malar space; H, head in dorsal view; I, flagellum; J, metasoma in dorsal view; K, metasoma in ventral view. (Pictures: V. Radchenko)

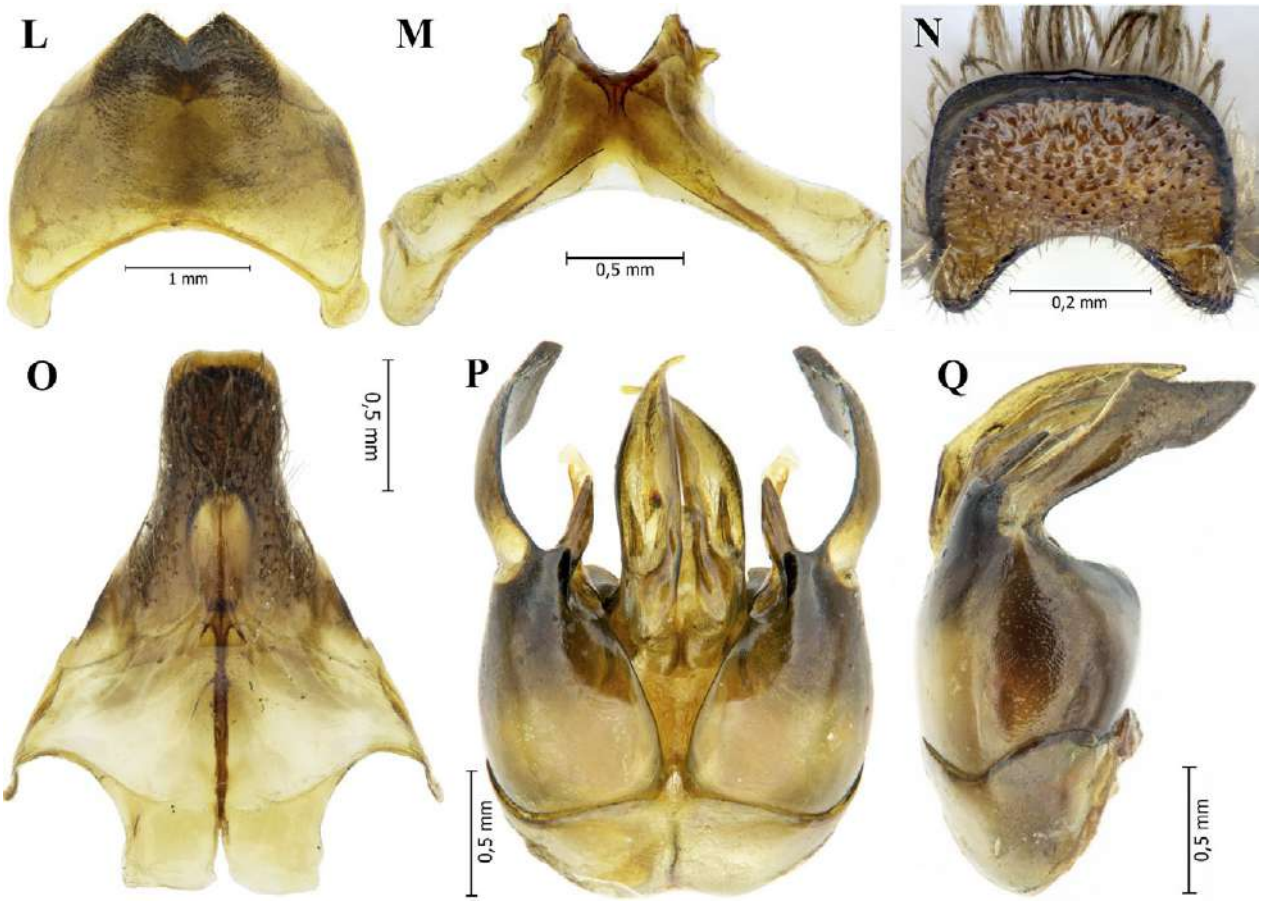
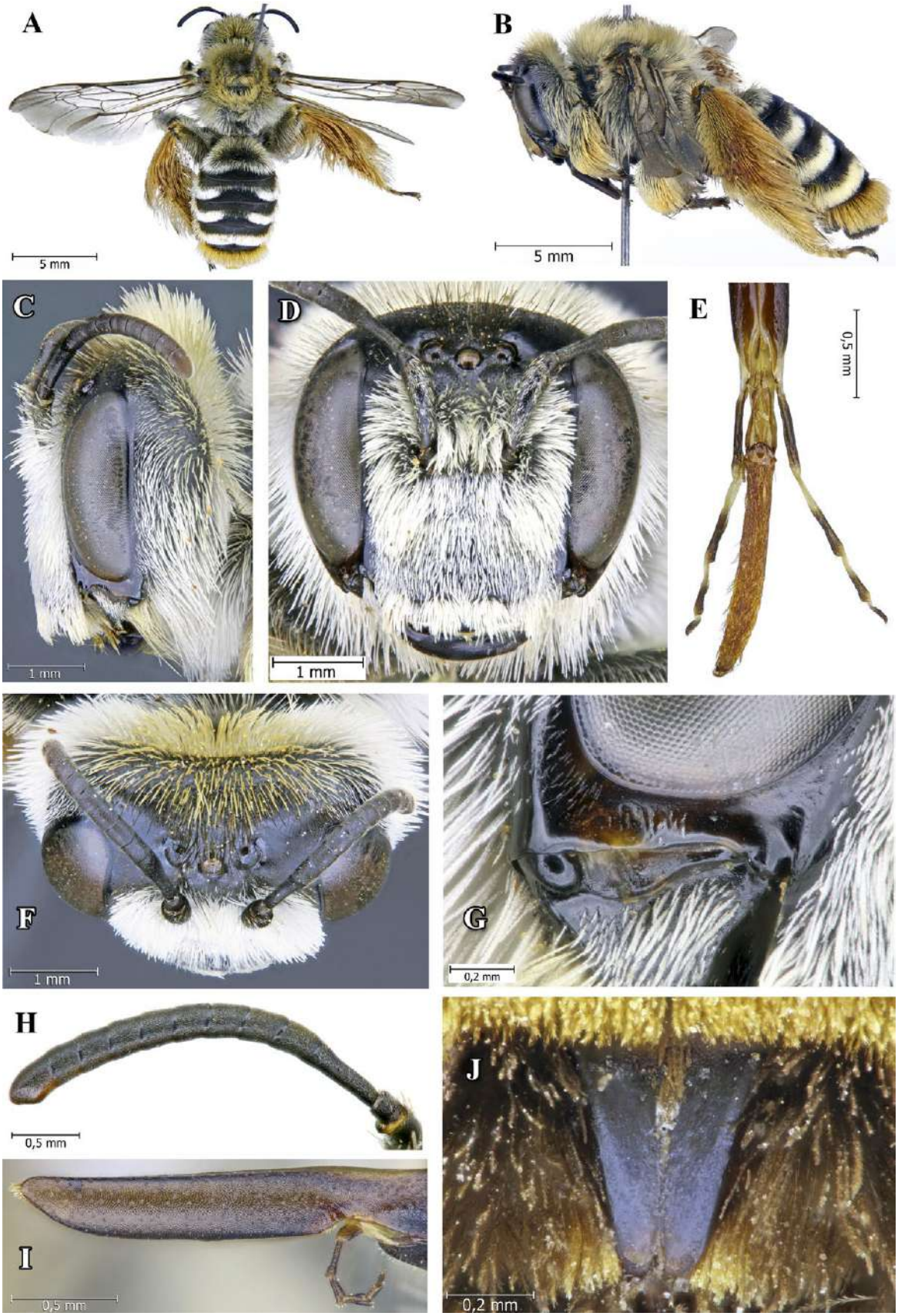


Figure 9L–Q: Dasypoda spinigera male. L, sternum 6; M, sternum 7; N, sternum 8 in dorso-apical view; O, sternum 8; P, genitalia in dorsal view; Q, genitalia in lateral view. (Pictures: V. Radchenko)

Dasypoda spinigera females show, like the females of the nine species of the subgenus *Megadasypoda*, a pygidial plate with appressed pubescence (Figure 10). *Dasypoda spinigera* females have a reddish scopa similar to *D. suripes*, but different from the dark scopa of *D. argentata* and *D. braccata* (Figure 4). Females can be distinguished from *D. suripes* by the light pilosity on the vertex and the clypeus, while these areas show dark pilosity in *D. suripes* (Figure 15). Terga 2–4 of *D. spinigera* in the middle of the postgradular area are covered with dense fine, tightly adpressed pubescence (Figure 10), which are sparser and longer and with a significant admixture of semi-adjacent or erected hair in *D. suripes*. Moreover, the wing venation is different as the position of the nervulus is postfurcal in *D. spinigera* and antefurcal in *D. suripes*.



10A–J: Dasypoda spinigera female. A, general habitus in dorsal view; B, general habitus in lateral view; C, head in lateral view; D, head in facial view; E, glossa and labial palpi; F, head in dorsal view; G, malar space; H, flagellum; I, galea; J, pygidial plate. (Pictures: V. Radchenko)

Figure 10K–L: Dasypoda spinigera female. K, metasoma in dorsal view; L, metasoma in ventral view. (Pictures: V. Radchenko)

The species name '*spinigera*' originates from the Latin *spini* – spine and *gera* – to bear, which is a reference to the well-developed spines at the base of the anterior femur of the male. There is no common name, but we propose here to name the species 'the Spiny Pantaloon Bee' to refer to the unique spines of the males.

Figure 11: Dasypoda spinigera biology and ecology: male foraging on nectar of Scabiosa sp. (Picture: M. Boustani from Jabal Moussa, Lebanon)

Figure 11C–F: Dasypoda spinigera biology and ecology: habitat and potential nesting site in sandy area. (Pictures: M. Boustani)

Biology and ecology

The life cycle of *Dasypoda spinigera* is probably similar to the life cycle of *Dasypoda braccata* even if no published study has focused on the ecology and biology of this species so far. Based on the few observations of the species and data on its host plant, *Dasypoda spinigera* is probably restricted to grassland with high densities of the host plant *Scabiosa* (Michez & Nieto, 2012b). Table 1 shows Caprifoliaceae as the exclusive source for pollen nutrition (Michez *et al.,* 2008).

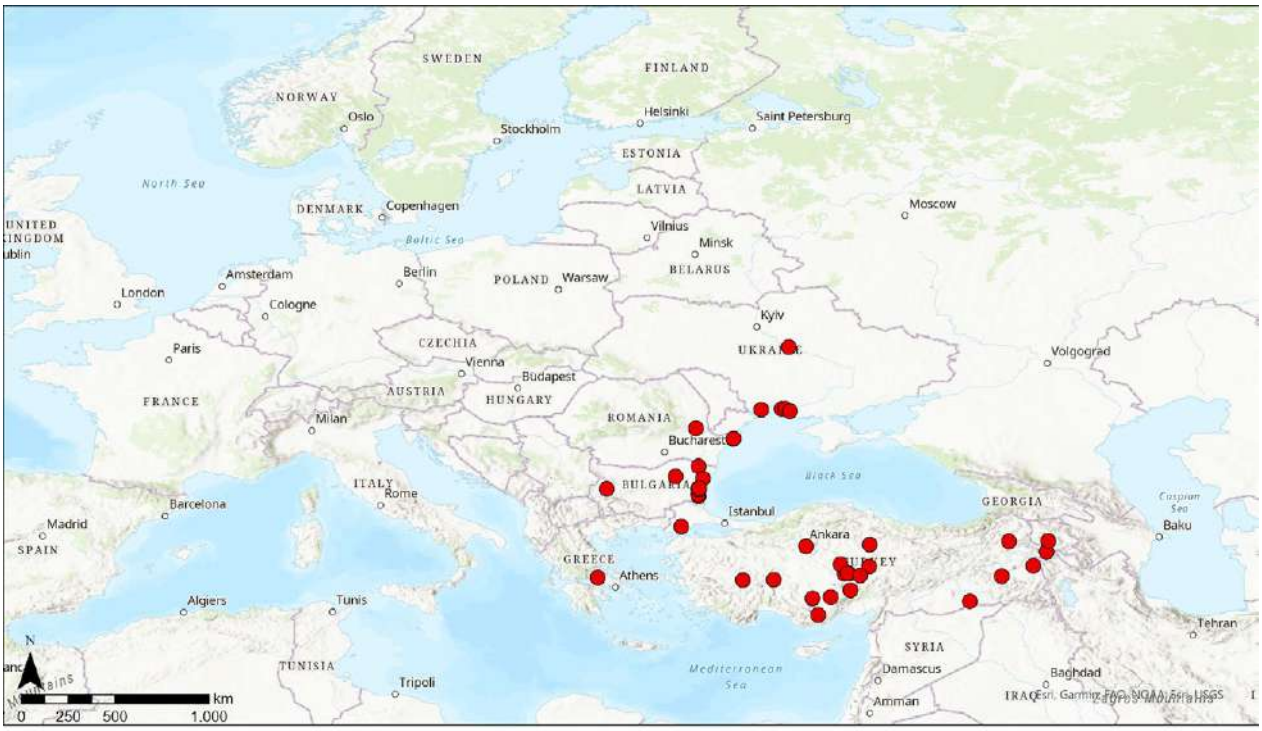


Figure 12: All known records of Dasypoda spinigera according to GBIF, Koucourek, D. Michez, V. Radchenko, K. Schmidt, Observation.org and K. Warncke (1973).

Historical account

Spatial records were collected in the same framework as *Dasypoda braccata* (see before; Figure 12). The species is distributed around the Black Sea (Ukraine and Türkiye) (Michez & Nieto, 2012b). Some isolated populations are recorded in Italy and Hungary (Michez *et al.*, 2004a,b; Warncke, 1973). Proshchalykin and Astafurova (2017) also report occurrences in the North Caucasus, Crimea, the European part of Russia and Armenia. The extent of occurrence (EOO) is more than 1.25 million km², but the area of occupancy (AOO) is 92 km² (Michez & Nieto, 2012b).

Current distribution and demography

Figure 13 shows the recent spatial records of *Dasypoda spinigera*. These are limited to Lebanon, Türkiye and Ukraine. *D. spinigera* is listed as Endangered on the European Red List and in the Red Data Book of Ukraine as Vulnerable (Radchenko, 2009).

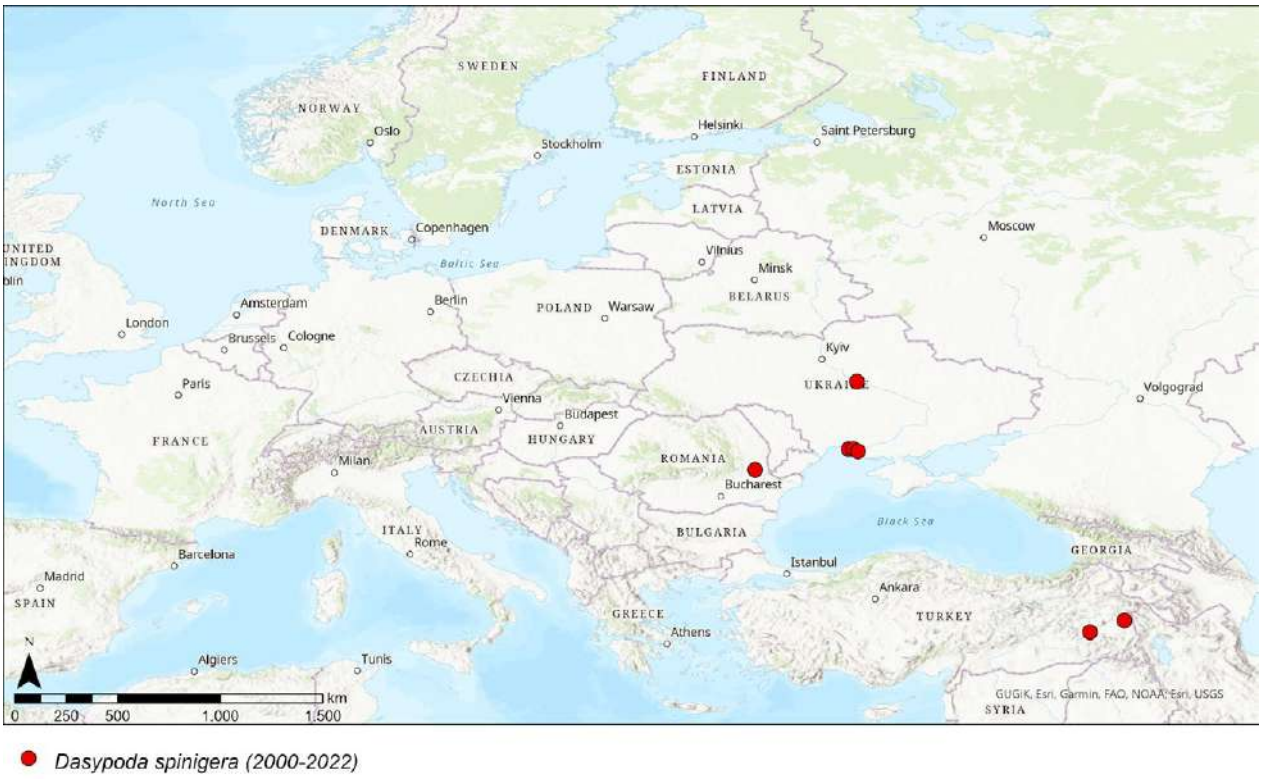


Figure 13: Recent records of Dasypoda spinigera. The data are based on GBIF, V. Radchenko and D. Michez.

Habitat and resource assessment

According to Boustani *et al.* (2021), who collected the species in Lebanon, *Dasypoda spinigera* is very localised like other *Dasypoda* species (Celary, 2002; Howe *et al.,* 2010), but abundant when present. *D. spinigera* was found in two localities in Lebanon at medium altitude (around 900 m), in sandy clearings between woods of *Quercus* sp. and *Pistachia* sp. The localities both had bare and sloped sandy surfaces that would be suitable nesting sites. Further studies are needed to understand the link between the abundance of this species, the amount of host plant available and the quality of the soil for nesting.

Threat analysis

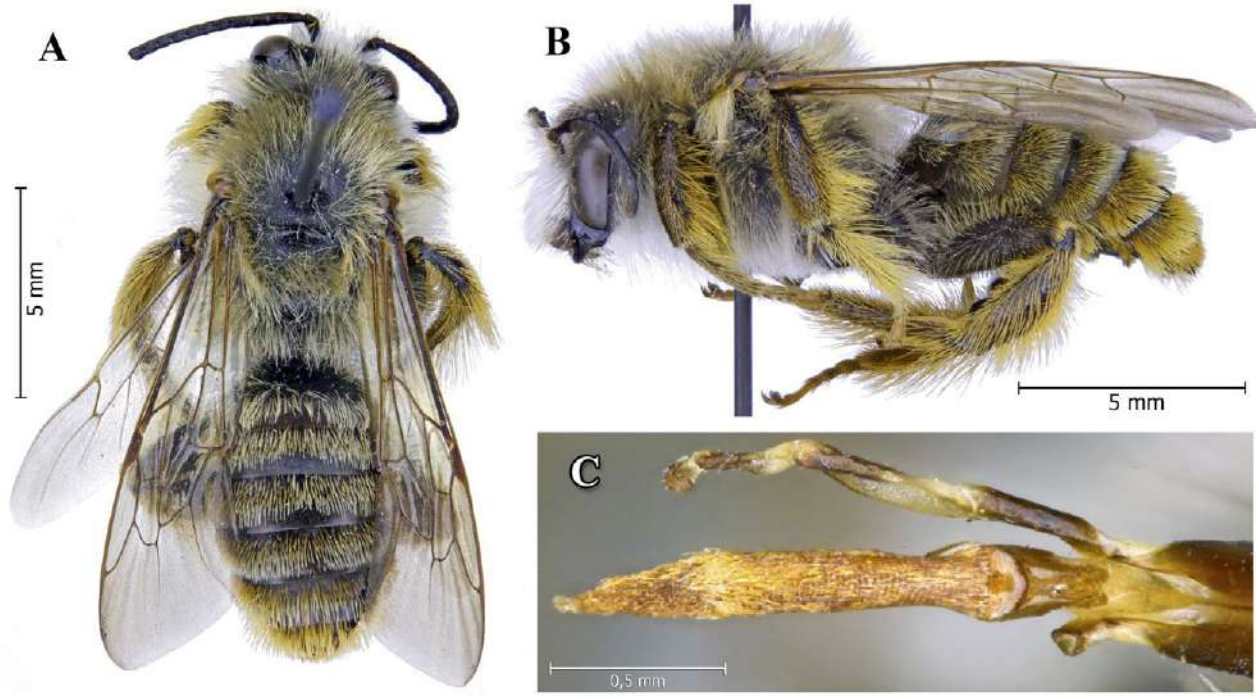
Very little information on the threats to this species exists. Michez and Nieto (2012b) named habitat loss as a major threat to the species, like other species of the subgenus. The reduction of the host plants due to the intensification of agriculture and significant decrease in the area of xerothermic grassland, which are the main suitable habitats of this species, leads to its disappearance.

Swollen Pantaloon Bee, *Dasypoda suripes* (Christ, 1791)

Species description

Systematics / taxonomy

Dasypoda suripes (Christ, 1791) (Figures 14–15) is another teasel-plant specialised bee in Europe. Similar to the other species, *Dasypoda suripes* belongs to the family Melittidae, and the subgenus *Megadasypoda* (Michez *et al.,* 2004a). The species has a body size of 15–17 mm. Like the other males of the nine species of the subgenus *Megadasypoda*, males of *D. suripes* are characterised by the sternum 7 with latero-apical spines, sternum 8 laterally without basal hooks and genitalia with 3 extensions of the gonostylus (Figure 14). They can be distinguished from the other males of the subgenus by a pale reddish pubescence, a swollen posterior tibia on the interior side, no swollen antennal flagellomeres, no spine on the anterior femur and no apical hairband on the terga (Warncke, 1973) (Figure 14).



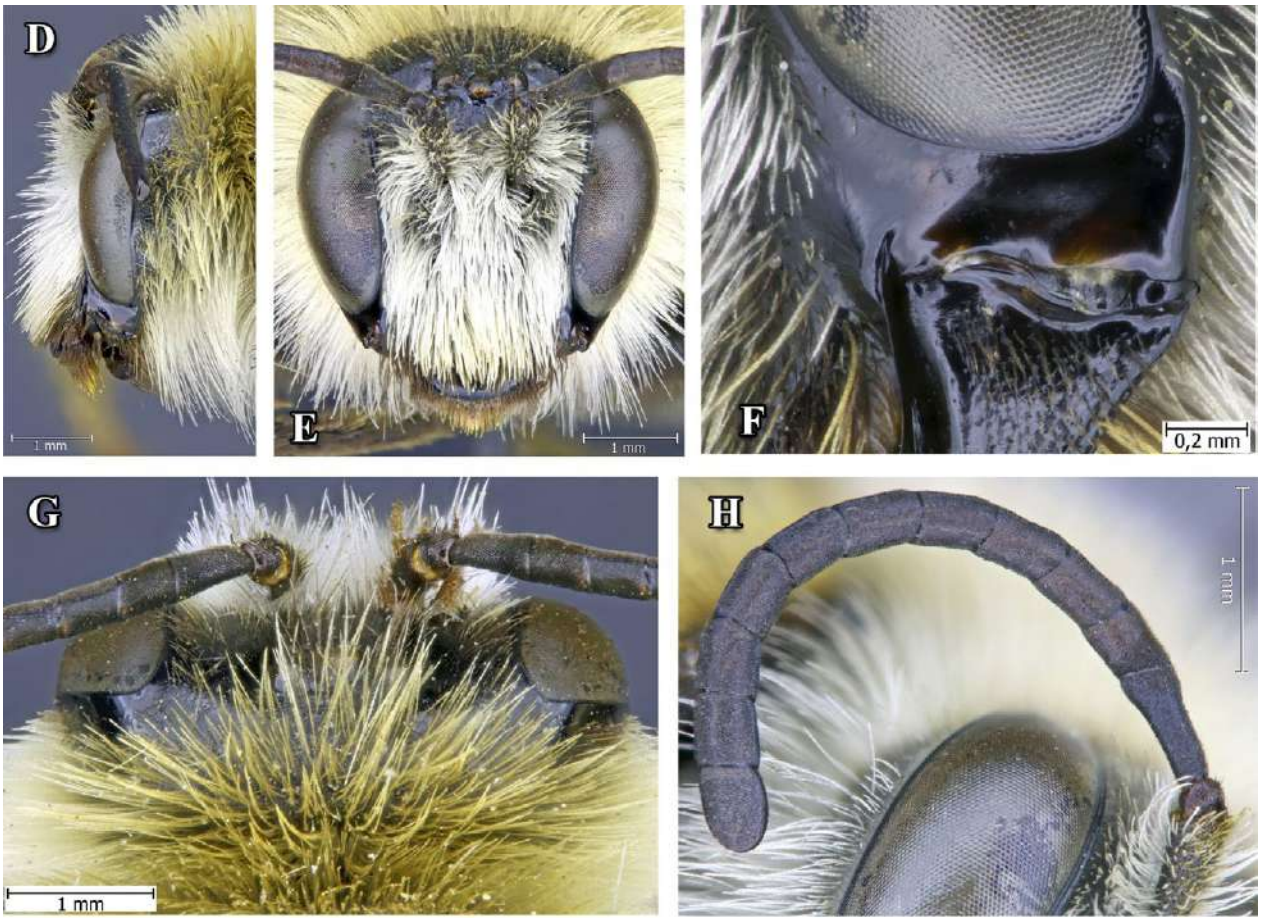
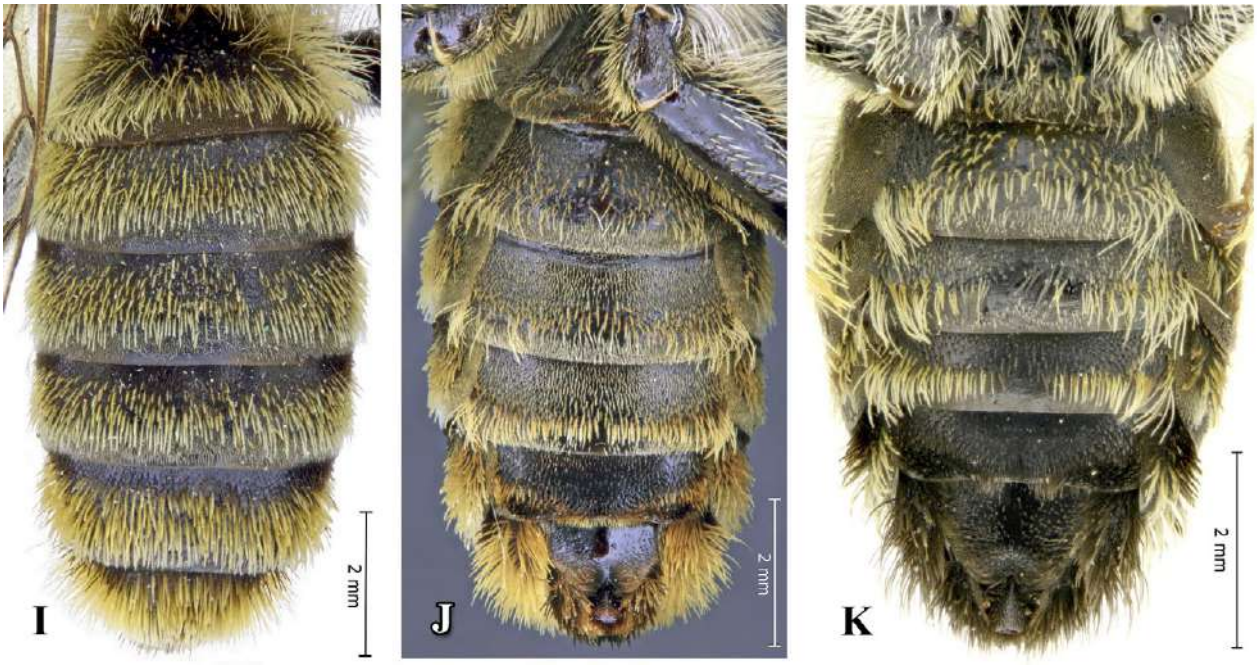


Figure 14A–H: Dasypoda suripes male. A, general habitus in dorsal view; B, general habitus in lateral view; C, glossa and labial palpus; D, head in lateral view; E, head in facial view; F, malar space; G, head in dorsal view; H, flagellum. (Pictures: V. Radchenko)



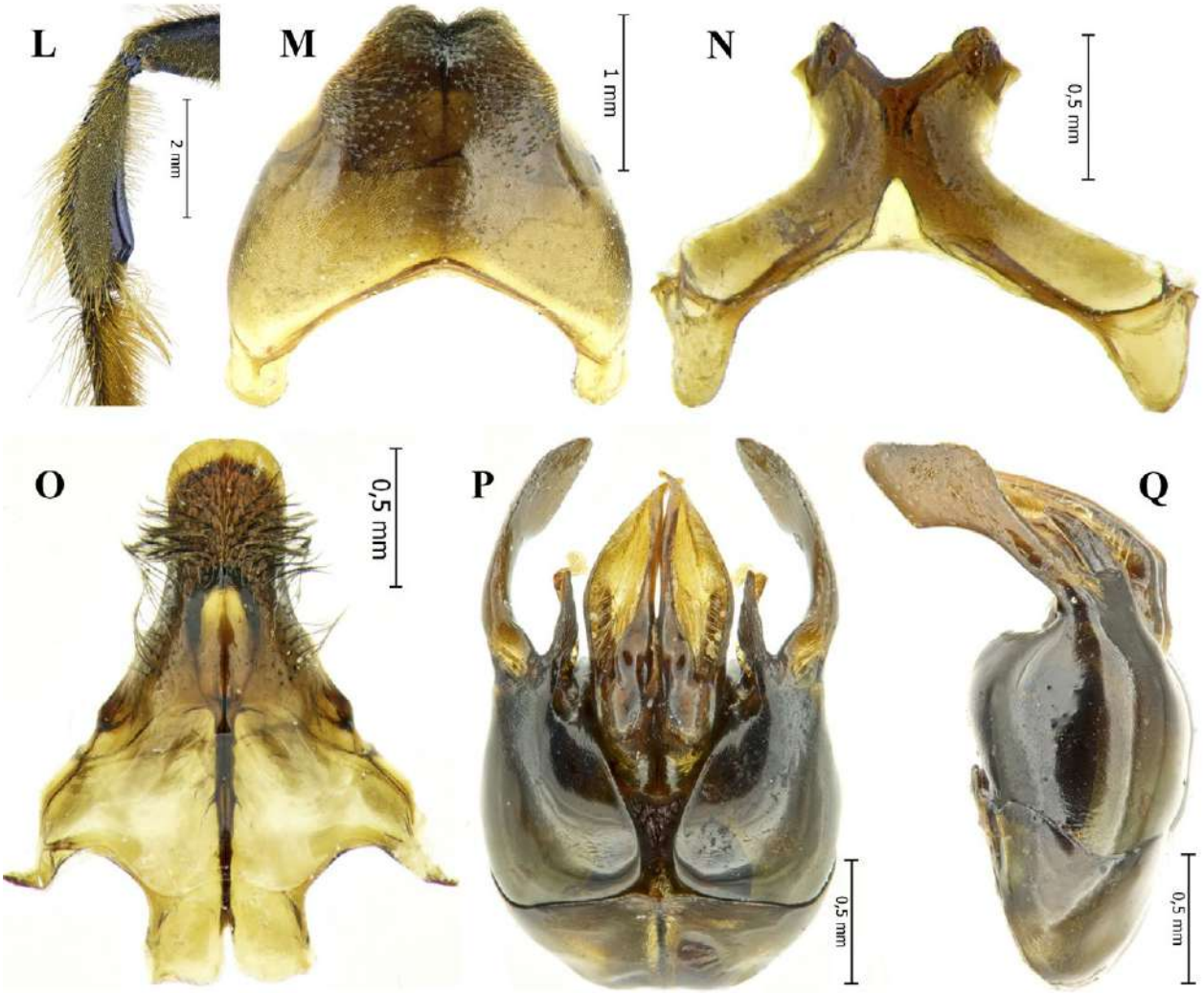


Figure 14I–Q: Dasypoda suripes male. I, metasoma in dorsal view; J, metasoma in ventral view with pale pubescence of the last sterna; K, metasoma in ventral view with dark pubescence of the last sterna; L, posterior leg and swollen posterior tibia in lateral view; M, sternum 6; N, sternum 7; O, sternum 8; P, genitalia in dorsal view; Q, genitalia in lateral view. (Pictures: V. Radchenko)

Dasypoda suripes females show, like the females of all nine species of the subgenus *Megadasypoda*, a pygidial plate with appressed pubescence (Figure 15). *Dasypoda suripes* females have a reddish scopa similar to *D. spinigera*, but different from the dark scopa of *D. argentata* and *D. braccata* (Figures 4 and 20). Females can be distinguished from *D. spinigera* by the dark pilosity on the vertex and the clypeus, and the wing venation (the position of the nervulus is antefurcal in *D. suripes* and postfurcal in *D. spinigera*) (Figure 15). Terga 2–4 of *D. suripes* in the middle of the postgradular area are covered by short appressed pubescence significantly admixtured with longer semi-adjacent or erected hair, while *D. spinigera* has only short appressed pilosity in these areas.

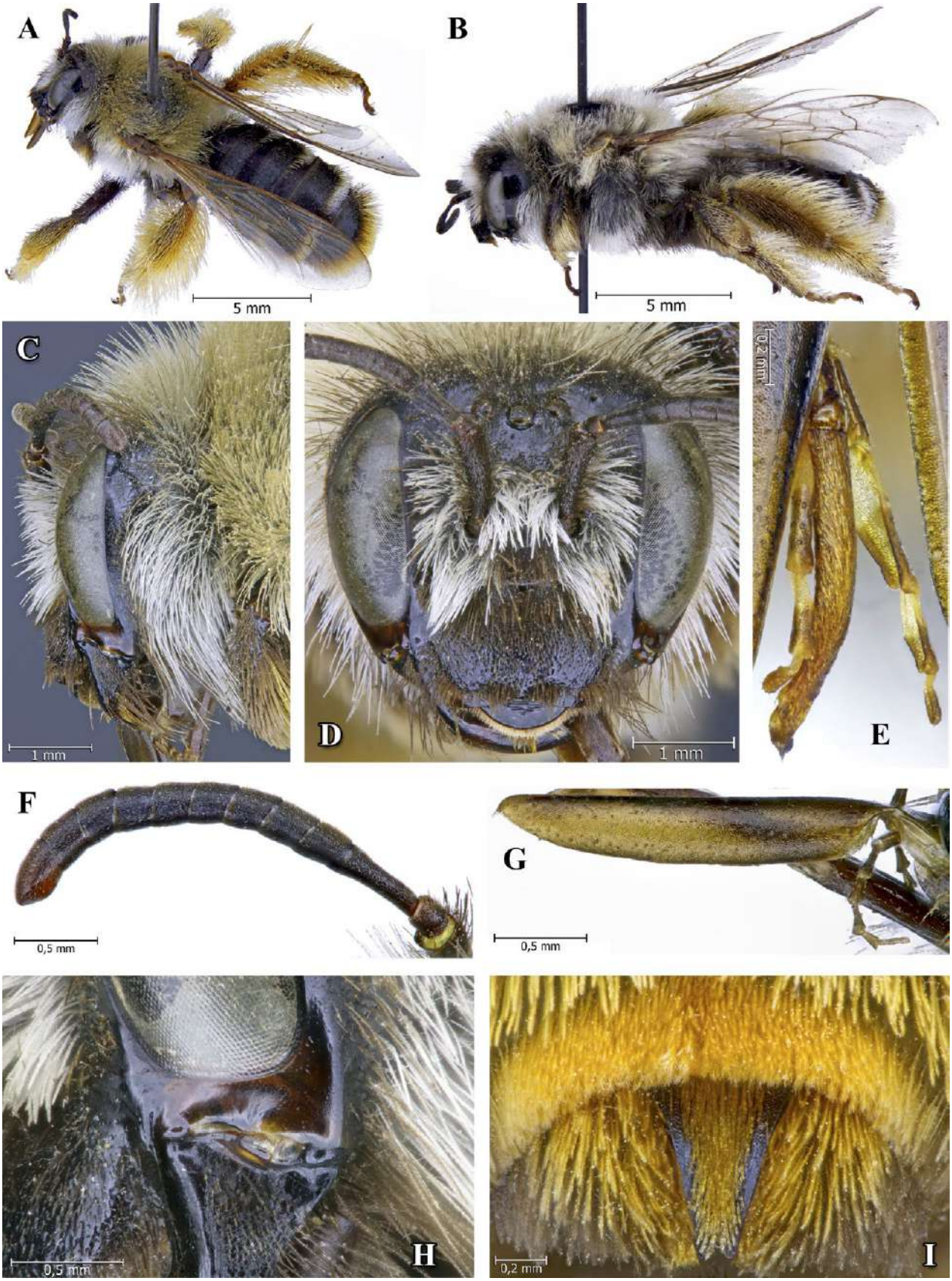


Figure 15A–I: Dasypoda suripes female. A, general habitus in dorsal view; B, general habitus in lateral view; C, head in lateral view; D, head in facial view; E, glossa and labial palpi; F, flagellum; G, galea; H, malar space; I, pygidial plate. (Pictures: V. Radchenko)

The species name '*suripes*' originates from the Latin *suri* – swollen and *pes* – feet, which is a reference to the swollen posterior tibia of the male. There is no common name but we propose here to name the species the 'Swollen Pantaloon Bee' to refer to the unique swollen tibia of the males.

Biology and ecology

The species occurs in Mediterranean-type shrubby and temperate grassland (Michez & Nieto, 2012c). Michez *et al.* (2004a) describe predominant plant visits on Caprifoliaceae (88%) (Table 2) and 12% on Campanulaceae. Caprifoliaceae are the main host plants of *Dasypoda suripes* (Table 1) (Michez *et al.,* 2008). The species is specialised on *Scabiosa sp.* (Caprifoliaceae) and *Knautia sp.* (Caprifoliaceae) (Michez & Nieto, 2012c). In Germany, Westrich (2018) reports on *Knautia arvensis* as a pollen source of the species (Figure 16). In Italy, the species is also reported as oligolectic on Caprifoliaceae such as *Scabiosa* spp. and *Knautia* spp. (Quaranta *et al.,* 2018).

The species is probably solitary and univoltine (see Figure 4 for general presentation of the genus). Adults fly from July to September (Westrich, 2018). Like *Dasypoda braccata*, *Dasypoda suripes* is a ground-nesting species. It prefers sandy soils, in which the females dig their nests (Westrich, 2018).

Figure 16: Dasypoda suripes biology and ecology. A, male foraging on nectar from Knautia sp. (picture Jelle Devalez from Greece); B, female foraging on pollen from Knautia (Pictures: Henrik Gyurkovics).

Functions and values

Dasypoda suripes is an important pollinator of Caprifoliaceae. Further information about its functions and values is not available.

Historical account

Dasypoda suripes used to occur from Anatolia and Cyprus via Greece and the Balkans to Sweden (Michez & Nieto, 2012c; Proshchalykin & Astafurova, 2017) (Figure 17). Proshchalykin and Astafurova (2017) also describe the distribution of the species in the North Caucasus, Crimea, the Urals and the European part of Russia. Single finds of *D. suripes* have recently been noted in the north-east of Ukraine (M. Filatov, personal communication).

Figure 17: All known records of Dasypoda suripes according to J. D. Alfken and Baldovski (1983), Burger, W. Celary, Dylewska et al. (1963), Franz (1982), Gbif, L-Å. Janzon, D. Michez, D. Mócsáry and A. Moeschler. (1938), National Initiative Sweden, L. Norén, Observation.org, K. Warncke (1973), V. Radchenko and H. Wolf

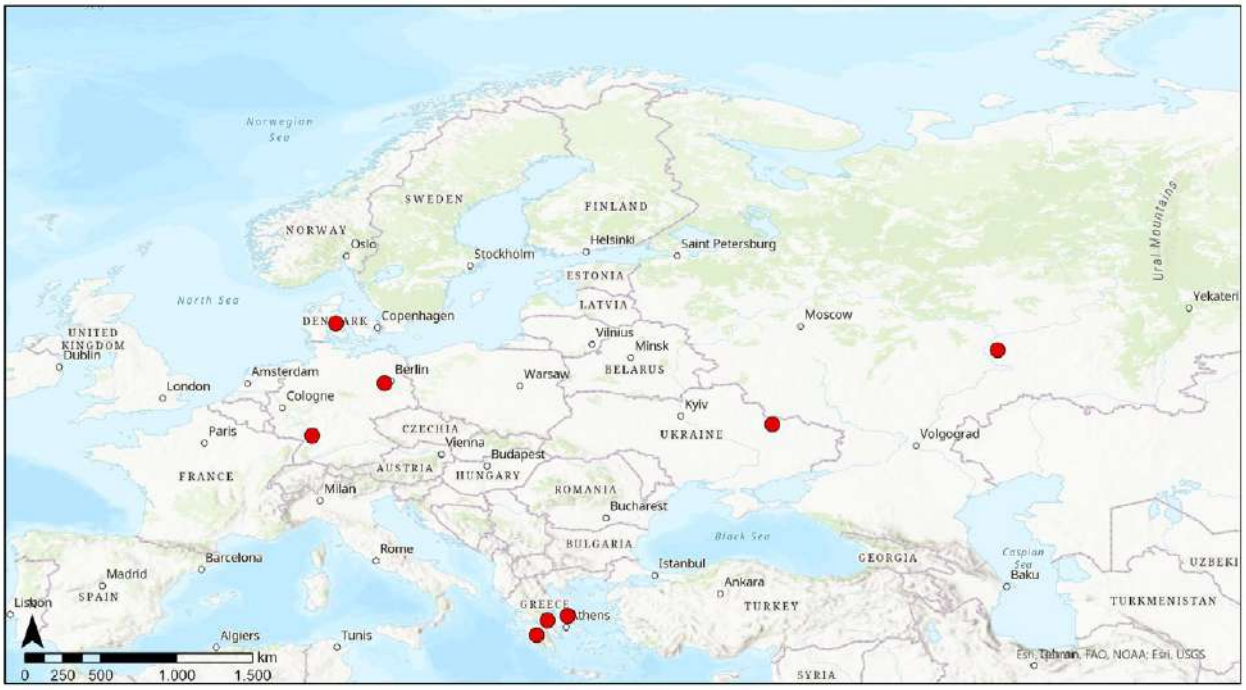


Figure 18: Recent records of Dasypoda suripes. The data are based on GBIF and D. Michez.

Current distribution and demography

The population of *Dasypoda suripes* is severely fragmented (Michez & Nieto, 2012c), most recent European records are from Greece (Figure 18). At European level, the species is listed as Endangered based on the B2ab (iii,iv,v) criterion on the IUCN Red List of Threatened Species (Michez & Nieto, 2012c). The extent of occurrence (EOO) is 1.5 million km², but the area of occupancy (AOO) is only 208 km² (Michez & Nieto, 2012c). At national level, it is Regionally Extinct in the Czech Republic (Hejda *et al.,* 2017) and Sweden (Gärdenfors, 2010). In Germany it is Critically Endangered (Westrich *et al.,* 2011), but the last record in Brandenburg was from 2001, after which the species was no longer found in the now destroyed habitat, despite repeated searches (Westrich, 2018). In Italy the assessment of the species is Endangered (EN), based on the B2ab (iii) criterion, as it has an area actually occupied (AOO) of less than 500 km², being reported in two very isolated locations, the distribution is severely fragmented (Quaranta *et al.,* 2018). The Italian populations are severely isolated from the European ones with almost no possibility of gene exchange.

Habitat and resource assessment

Dasypoda suripes lives in dry sand heathland and steppes (Westrich, 2018). As this species is specialised on Caprifoliaceae, it can be found only in habitats where these plants are present in abundance. It appears to be mostly present in xerothermic grassland or shrub areas with Mediterranean species. Further studies are needed to understand the link between the abundance of this species, the amount of host plant available and the quality of the soil for nesting.

Threat analysis

Michez and Nieto (2012c) describe a declining population trend connected to a declining habitat and declining occurrence of *Scabiosa*. The authors name land-use changes as the main reason behind the loss of the species' host plant. Industrial agriculture is a main threat to many wild bee species (Westrich *et al.,* 2011), involving large-scale crops, frequent mowing (4 or 5 cuts), mechanical and chemical control of wild plants and displacement of plant species through the application of mineral fertilisers and alluvial manure. In Italy, *Dasypoda suripes* is affected by the decline of grassland with Caprifoliaceae caused by the change in land use. It can also be threatened by grassland abandonment or mismanagement like inappropriate mowing, fertilisers, herbicides and intensive grazing regimes (Quaranta *et al.,* 2018). The species is not subject to targeted conservation actions and has probably not been monitored in protected areas. More research is needed to shed light on the Italian distribution and population trends. Xerothermic grasslands with Caprifoliaceae should be carefully managed to stop the decline of the host plants and prevent excessive reforestation.

Silvery Pantaloon Bee, *Dasypoda argentata* (Panzer, 1809)

Species description

Systematics / taxonomy

Dasypoda argentata (Panzer, 1809) is another teasel-plant specialised bee in Europe (Figures 19–20). There are certain problems with the taxonomic status of this species (see: Radchenko & Pesenko, 1989) that require further revision. Similar to the other species, *D. argentata* belongs to the family Melittidae, and the subgenus *Megadasypoda* (Michez *et al.,* 2004a). It is the most common species of the subgenus. Like the other males of the nine species of the subgenus *Megadasypoda*, males of *D. argentata* are characterised by the sternum 7 with latero-apical spines, sternum 8 laterally without basal hooks and genitalia with 3 extensions of the gonostylus (Figure 19). The males of *D. argentata* have a body size of 13–16 mm. They can be distinguished from males of other species of the subgenus by a reddish not appressed pilosity (including on the clypeus), the specific shape of the genitalia, a reddish apical hair band on the terga, no swollen posterior tibia, no swollen antennal flagellomeres and no spine on the anterior femur (Michez *et al.,* 2004a; Warncke, 1973) (Figure 19).

Females, like other representatives of the subgenus *Megadasypoda,* are characterised by a pygidial plate with appressed pubescence (Figure 20). Females of *D. argentata* show a dark scopa similar to *D. braccata* but they have an interrupted apical hair band on the tergum 4 (Figure 20) while this band is continuous in *D. braccata* (Figure 4). Moreover, the face of *D. argentata* females has yellowish hair instead of dark hair in *D. braccata*. *D. longigena, D. spinigera* and *D. suripes* can look similar in size and behaviour to *D. argentata* but the scopa of *D. argentata* has a completely dark pubescence while the scopa is mainly reddish or yellowish in the other three species mentioned above.

Figure 19A–I: Dasypoda argentata male. A, general habitus in dorsal view; B, general habitus in lateral view; C, flagellum; D, head in lateral view; E, head in facial view; F, malar space; G, galea; H, metasoma in dorsal view; I, metasoma in ventral view. (Pictures: V. Radchenko)

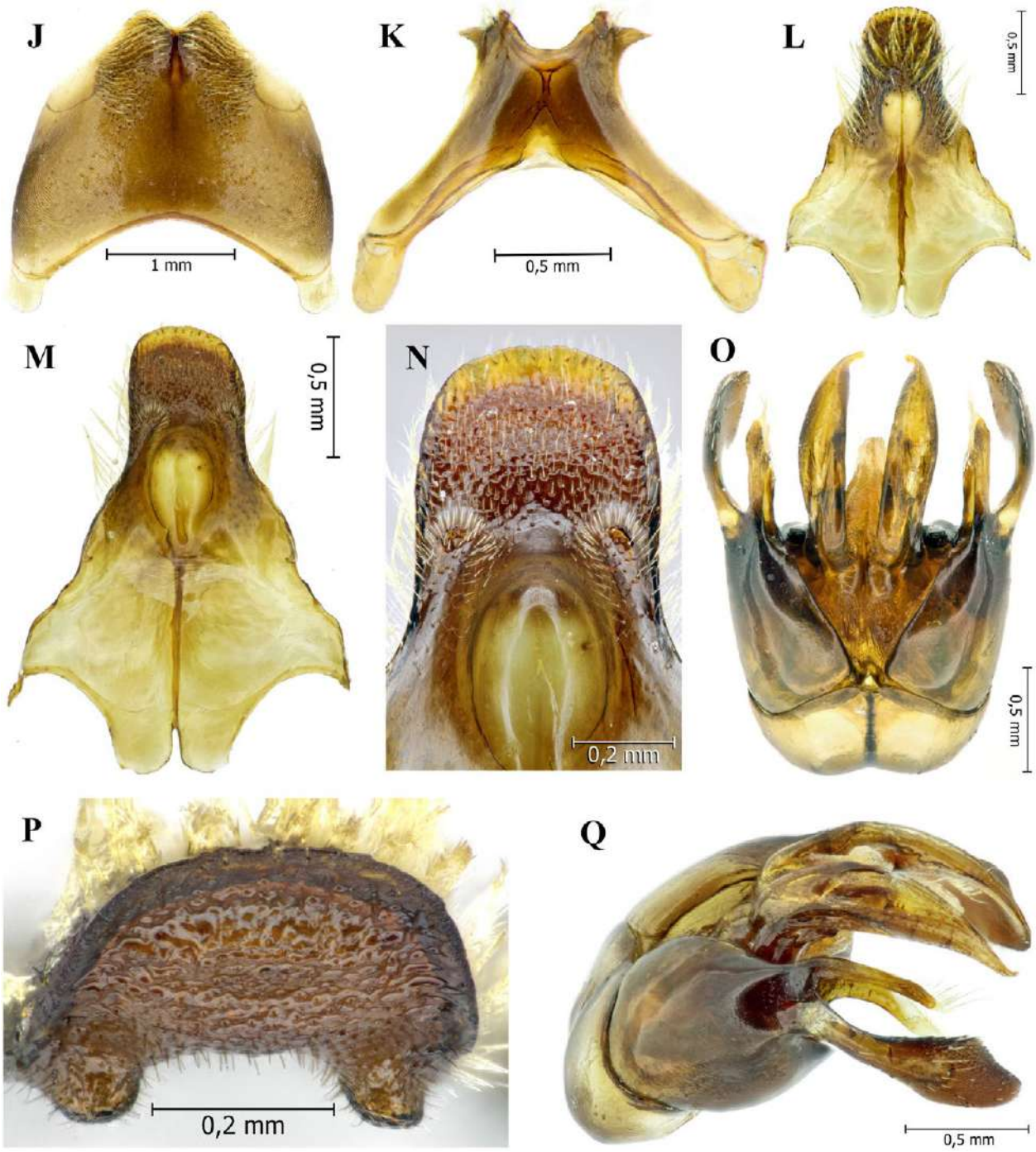


Figure 19J–Q: Dasypoda argentata male. J, sternum 6; K, sternum 7; L, sternum 8 in ventral view; M, sternum 8 in dorsal view; N, sternum 8 apical part in dorsal view; O, genitalia in dorsal view; P, sternum 8 in apico-dorsal view; Q, genitalia in dorso-lateral view. (Pictures: V. Radchenko)

The species name '*argentata*' originates from the Latin *argentate* – silver, which is a reference to the shiny aspect of the cuticle. There is no common name but we propose here to name the species the 'Silvery Pantaloon Bee' to refer to the unique spines of the males.

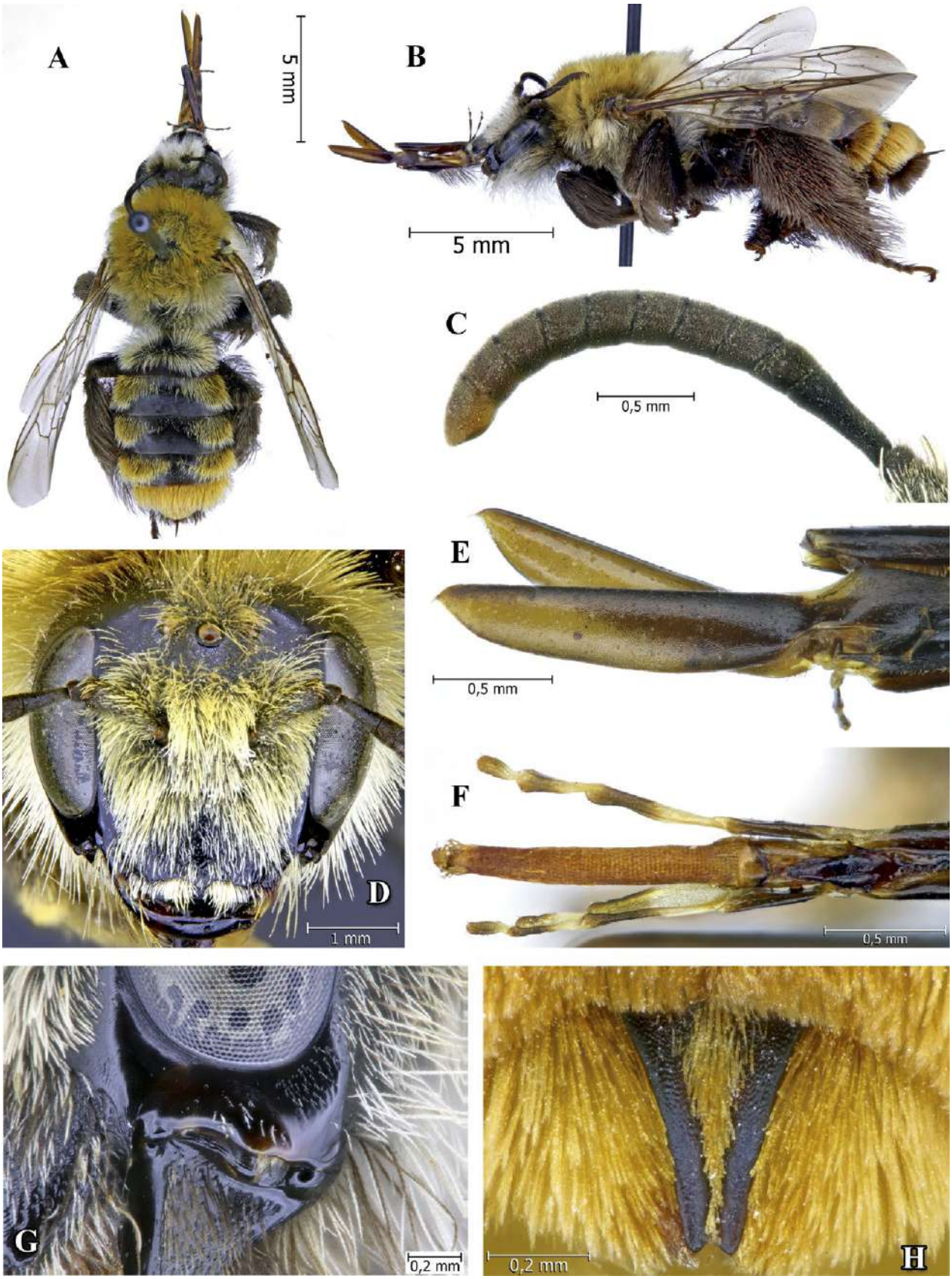


Figure 20A–H: Dasypoda argentata female. A, general habitus in dorsal view; B, general habitus in lateral view; C, flagellum; D, head in facial view; E, galea; F, glossa and labial palpi; G, malar space; H, pygidial plate. (Pictures: V. Radchenko)

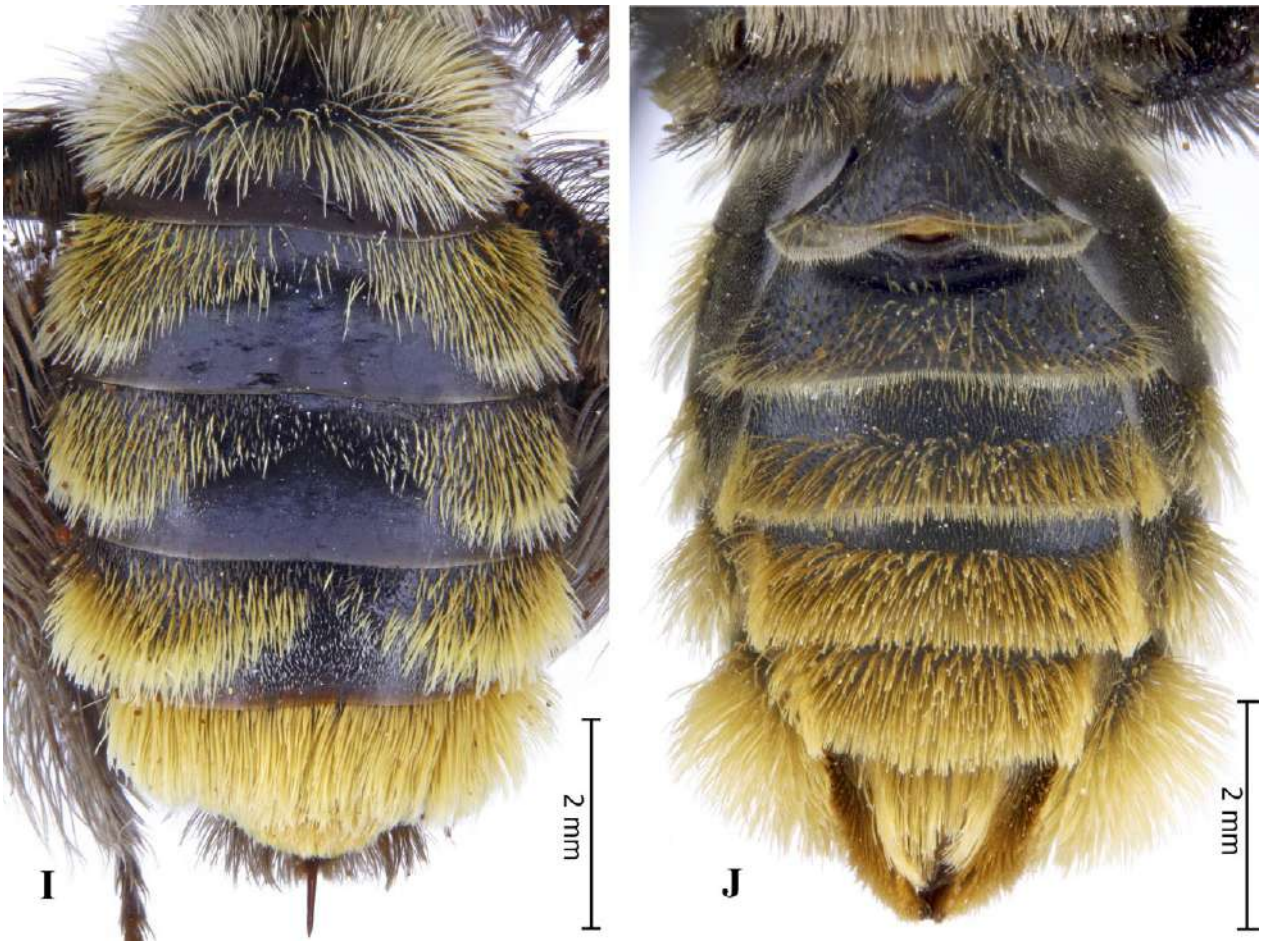


Figure 20I–J: Dasypoda argentata female. I, metasoma in dorsal view; J, metasoma in ventral view. (Pictures: V. Radchenko)

Biology and ecology

Dasypoda argentata lives in loess and river sand areas and in sand pits showing spatial proximity to dry grasslands (Westrich, 2018). Table 2 shows visits of the species on Asteraceae and Boraginaceae (3% flower choice each), but with a clear focus on Caprifoliaceae (94% of flower choice). According to Westrich (2018) the species is oligolectic on Caprifoliaceae with *Scabiosa* as the main pollen source. Of particular importance are the following species: *Scabiosa columbaria* (southern Germany), *Scabiosa ochroleuca* (south-eastern Central Europe) and *Scabiosa canescens* (on dry and steppe grasslands). Besides *Scabiosa* spp., *Succisa pratensis* is also used as a pollen source. The males patrol around the flowering *Scabiosa* blossoms.

The species nests in self-dug cavities in the ground. The nests are up to one metre deep and can contain 14–17 brood cells. The cells are elliptical (22–22.5 mm long, 15–17 mm wide and 12–16 mm high) and the cell walls are smooth and unlined. The larval provender (weight: 332–408 mg) is flattened spherically with two parallel ridges reducing the risk of fungus (Westrich, 2018). Nests can form an aggregation covering >200 m² (Celary, 2002). In the aggregation observed by Celary (2002), the ground was sandy with clumps of grass (mainly *Corynephorus canescens*) and *Vincetoxicum hirundinaria* Medik. In places with *Thymus serpyllum* L. em. FR. and *Scleranthus annuus* L. The aggregation included from 130 to nearly 200 nests. The nests were located very irregularly, distances between their entrances being from 5 cm to 120 cm.

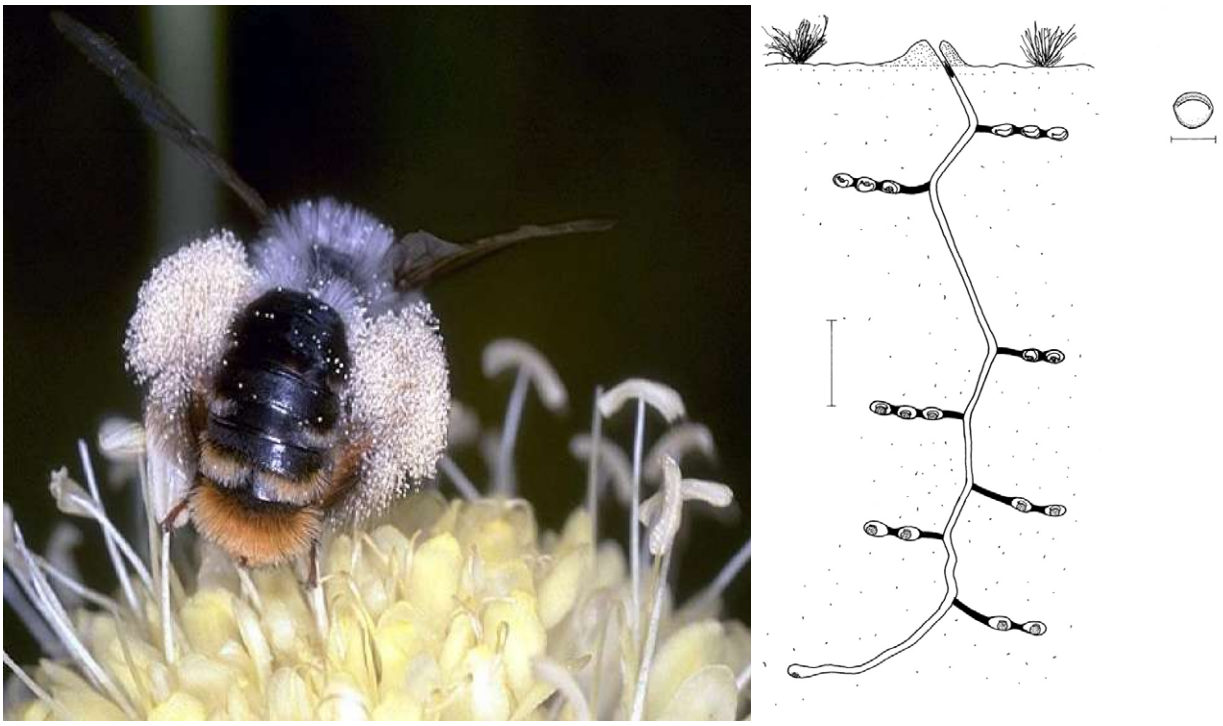


Figure 21: Dasypoda argentata biology and ecology. A, female foraging on pollen of Scabiosa sp. (Picture: Pierre Rasmont from Türkiye); B, nest architecture and pollen ball (from Celary, 2002).

The life cycle of *D. argentata* is similar to the cycle described for *D. braccata* (Figure 5). The species is univoltine and its flight period is from June to early September (Westrich, 2018). Males emerge 3–5 days before females and they live until the end of the female activity (Celary, 2002). The appearance of females is much more extended in time (about 10–12 days) than that of males. Adults usually emerge in the last ten days of June (sometimes in the first days of July) and disappear in the second half of August. At the beginning of the flight season, the females mate with the males and dig burrows. Each female builds only one nest, but sometimes when the nest is destroyed, she begins to dig a second one. The peak of nesting activity depends upon the moment of the first adult emergence and usually occurs at the end of July (to the first half of August) at least in Poland (Celary, 2002).

Functions and values

Specific functions and values of *Dasypoda argentata* have not been reported. It is a pollinator of teasel plants, which maintain numerous other threatened species.

Historical account

Dasypoda argentata is widely distributed in Europe and Asia (Figure 22). It is the second most widespread species of the genus *Dasypoda* after *Dasypoda hirtipes* (Michez & Patiny, 2002; Michez *et al.*, 2004a,b; Warncke, 1973). Westrich (2018) reports that the species used to be more widespread in Germany and also occurred in the southern and northern German lowlands.

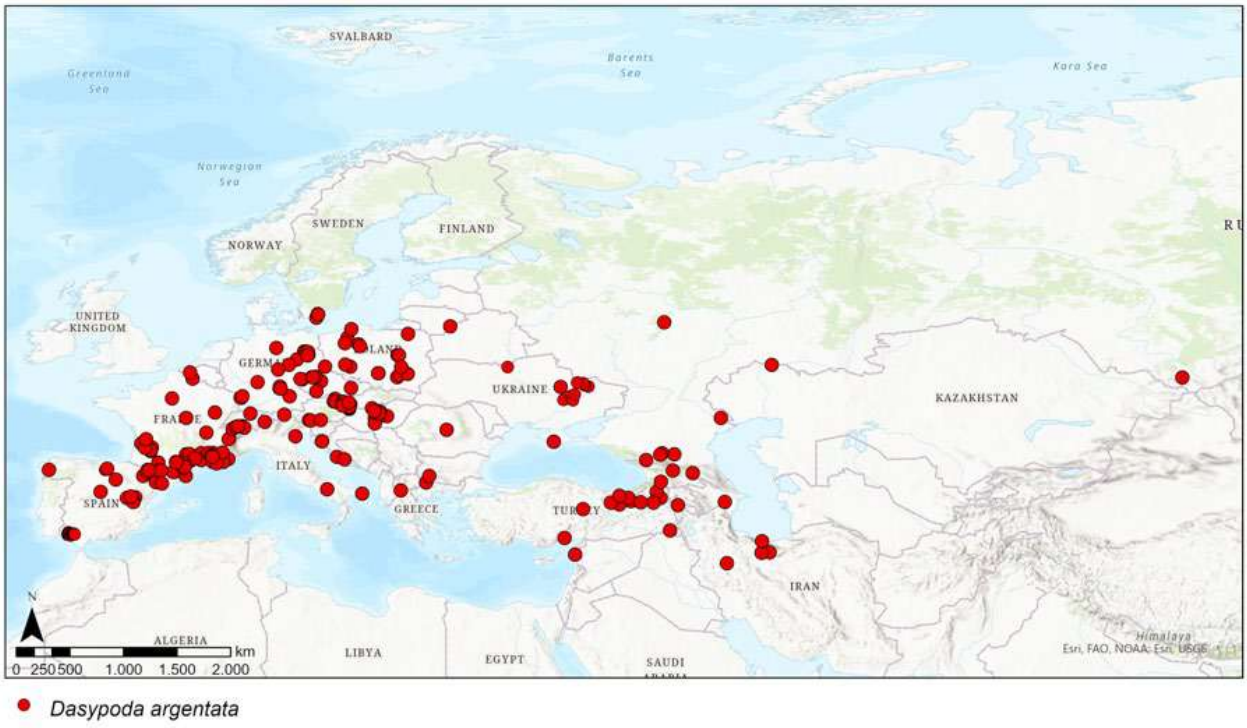


Figure 22: All known records of Dasypoda argentata according to GBIF, iNaturalist, D. Michez, V. Radchenko, National Initiative of Sweden and Observation.org.

Current distribution and demography

Recent spatial records of *Dasypoda argentata* are presented in Figure 23. The extent of occurrence (EOO) is 5.3 million km², but the area of occupancy (AOO) is just 632 km². The species is still present in the south of France, the Alps, and probably in some other parts of southern Europe, such as Italy and the Balkans. The populations in the northern part of the distribution are probably extinct (Belgium, Sweden). In Switzerland, *D. argentata* is a rare species that is only found in Valais. The species was mainly known from Haut-Valais, but a recent mention of the surroundings of Martigny indicates that the species remains in Bas-Valais. Some historical data also come from Ticino. It flies between 500 m and 1500 m altitude. In France, the species was recently recorded in the 'Parc National des Calanques' (Geslin *et al.,* 2018) but also all along the French Mediterranean coast. *Dasypoda argentata* is listed as Near Threatened on the European Red List (Nieto *et al.,* 2014). It is included in the National Red Lists or Red Data Books of the following seven European countries: Belgium (Extinct; Drossart *et al.,* 2019); Czech Republic (Critically Endangered; Hejda *et al.,* 2017), Lithuania (Vulnerable; Rašomavičius, 2007), Germany (Critically Endangered; Westrich *et al.,* 2011), Poland (Critically Endangered; Głowaciński & Nowacki, 2009), Sweden (Extinct; Gardenfors, 2010), Switzerland (Endangered) (Amiet, 1994). In Germany, recent records (> 1990) exist from Thuringia and Saxony-Anhalt (Prosi, 2022).

Figure 23: Recent records of Dasypoda argentata, including one record in Russia. The data are based on GBIF, iNaturalist, D. Michez, M. Filatov, V. Radchenko and Observation.org.

Habitat and resource assessment

Dasypoda argentata lives in Mediterranean-type shrubby and grassland temperate vegetation where there are large areas covered by its pollen host plant *Cephalaria* spp., *Succisa* spp. and *Scabiosa* spp. (Caprifoliaceae) (Celary, 2002, 2005; Michez *et al.,* 2008). These habitats are declining. The presence of sandy soils is necessary for this species for nesting (Celary, 2002, 2005). Celary (2002) describes the habitat and resource of a population of *Dasypoda argentata* (as *Dasypoda thoracica* Baer, 1853) in Poland (vicinity of Kusiêta and Biskupice). *Dasypoda argentata* was known from only a few sites in Poland, but unfortunately, most of them are now extinct. This population is oligolectic and takes pollen from the plants of Caprifoliaceae. The observed individuals visited only flowers of *Knautia arvensis* and *Scabiosa ochroleuca*. Both females and males strongly preferred the flowers of *Scabiosa ochroleuca*. The analysis of pollen loads confirms these observations. Pollen loads contain exclusively pollen grains of *Scabiosa ochroleuca* and *Knautia arvensis,* but the grains of the latter plant constituted only 0–7%. Usually the foraging trips did not exceed 150–200 m, but sometimes marked females were observed up to 400 m away from their nests. Further studies are needed to understand the link between the abundance of this species, the amount of host plant available and the quality of the soil for nesting.

In France, the species was recently recorded in the 'Parc National des Calanques' (Geslin *et al.,* 2018). The Calanques National Park (hereafter 'PNCal') is the 10th and newest (2012) French National Park. It is the first peri-urban national park in Europe. Its flora is well known to botanists (over 800 plant species). The habitat of the PNCal is mainly scrubland or cistus garrigue composed mainly of white cistus (*Cistus albidus* L.), Montpellier cistus (*Cistus monspeliensis* L.), Rosemary (*Rosmarinus officinalis* L.) and Thyme (*Thymus vulgaris* L.). In Switzerland, the species mainly collects pollen from flowers of the genus *Scabiosa*, especially *S. columbaria* and *S. triandra*. *Succisa pratensis* pollen is also sometimes used. (Amiet *et al.,* 2007).

Threat analysis

Similar to the other species, the main threat to *Dasypoda argentata* is habitat loss caused by changes in agricultural land use and excessive reforestation, including those related to climate change.

Large Scabious Mining Bee, *Andrena hattorfiana* (Fabricius, 1775)

Species description

Systematics / taxonomy

Andrena hattorfiana (Fabricius, 1775) belongs to the family Andrenidae, which is found in the Holarctic, Africa, India and Central America. The species is one of the largest members of the family, measuring 14–17 mm and is, therefore, easier to identify in the field than smaller species of the family. Characteristic for the females of Andrenidae are the *fovea facialis*, which are dense and very short hairy depressions along the inner edge of the compound eyes (Figure 24). The males of the family can be identified by the form of the head, the ratio of the antennal flagellomeres and structure of the genitalia. *Andrena hattorfiana* can be characterised by all tergites being black or the first two being red, the long malar space, the shape of the labrum and the shape of the pygidial plate (Figure 24, Westrich, 2018). Dark forms are predominantly found in mountain and humid biotopes. Wood *et al.* (2021) recently described the dark form from Spain as subspecies *Andrena (Charitandrena) hattorfiana nigricauda* Wood, 2021.

Figure 24A: Andrena hattorfiana female foraging on Scabiosa (Picture: Natasha De Manincor)

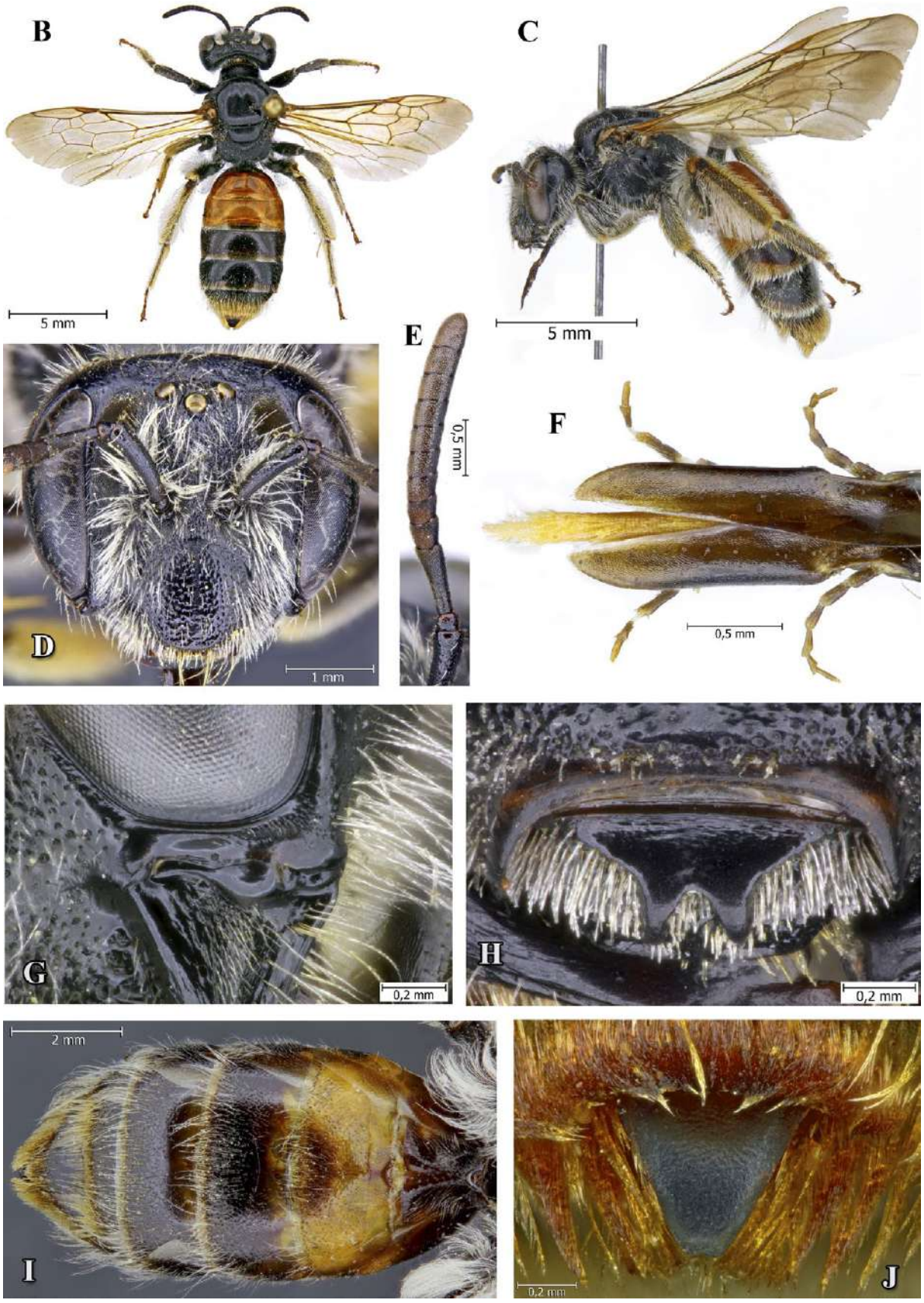


Figure 24B–J: Andrena hattorfiana female. B, general habitus in dorsal view; C, general habitus in lateral view; D, head in facial view; E, flagellum; F, galea, glossa, labial and maxillary palpi; G, malar space; H, labrum; I, metasoma in ventral view; J, pygidial plate. (Pictures: V. Radchenko)

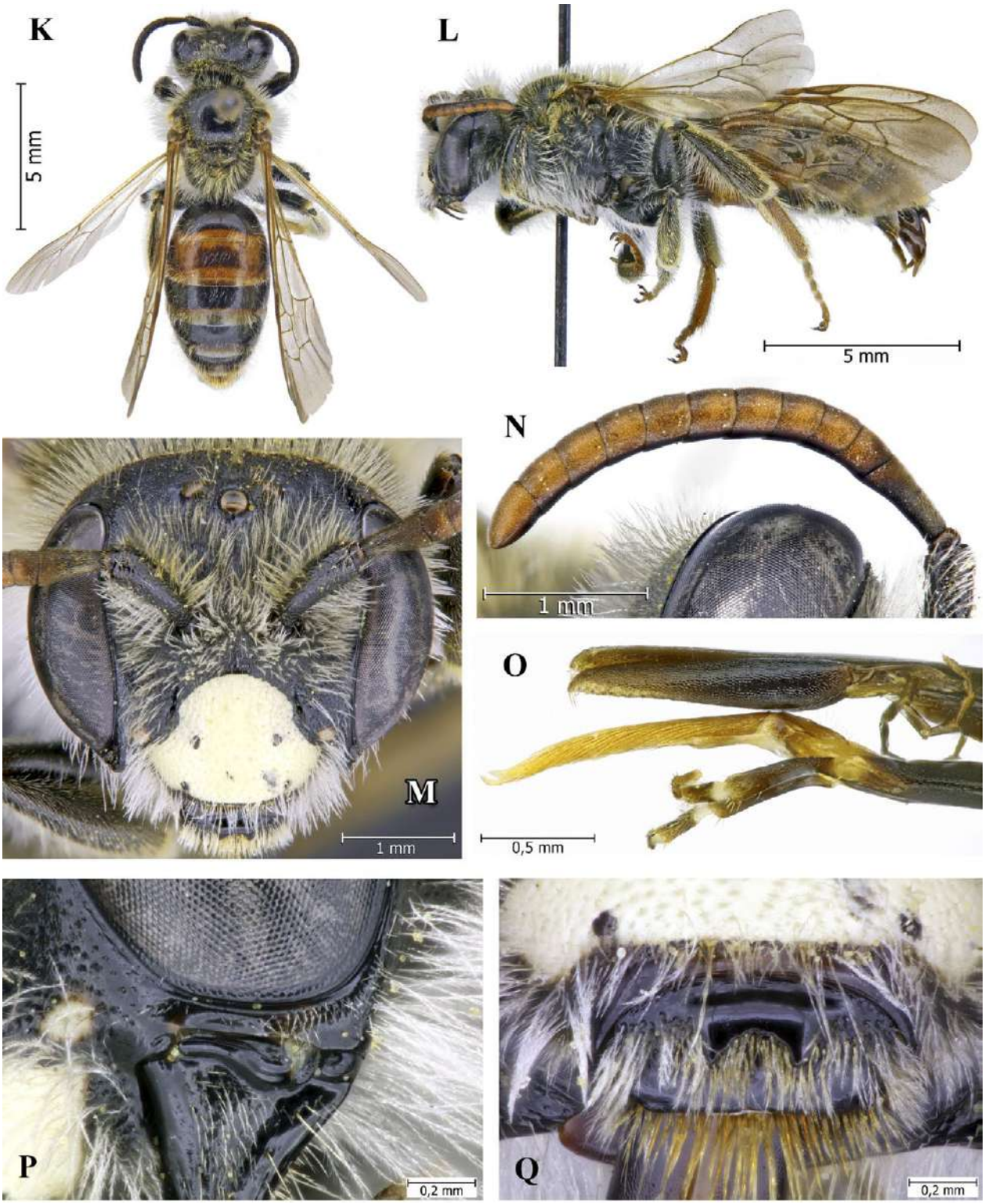


Figure 24K–Q: Andrena hattorfiana male. K, general habitus in dorsal view; L, general habitus in lateral view; M, head in facial view; N, flagellum; O, galea, glossa, labial and maxillary palpi; P, malar space; Q, labrum. (Pictures: V. Radchenko)

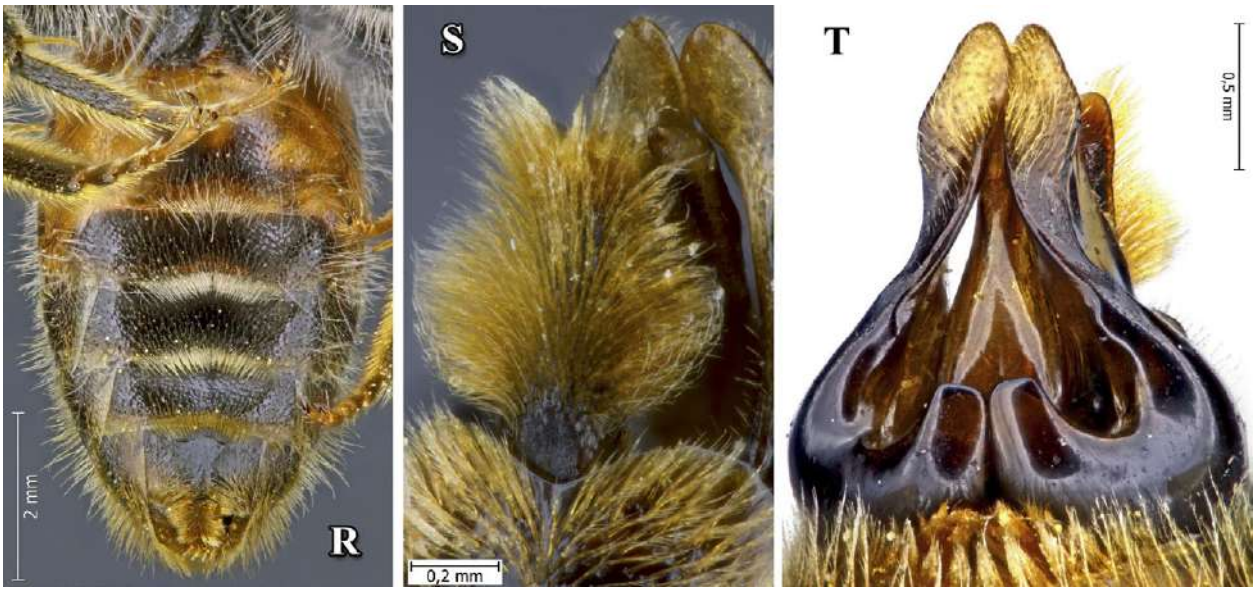


Figure 24R–T: Andrena hattorfiana male. R, metasoma in ventral view; S, apical part of sterna 6 and 8 in ventral view; T, genitalia in dorsal view. (Pictures: V. Radchenko)

Biology and ecology

The species occurs in dry fertile meadows, orchard meadows, flood dams, nutrient-poor grassland and forest edges (Westrich, 2018). In the mountains of Western Europe it occurs at altitudes up to 1800 m (Warncke, 1967). *A. hattorfiana* is oligolectic and specialised on Caprifoliaceae. The main pollen source in Central Europe is *Knautia arvensis* (Caprifoliaceae). Females nesting at forest edges or glades also use *Knautia maxima* and *Knautia drymeia* (both Caprifoliaceae) as pollen sources. Late-flying females of the species have also been observed on *Scabiosa columbaria* (Caprifoliaceae) (Westrich, 2018). The species nests in self-dug cavities in the ground and does not prefer any soil type (Westrich, 2018).

Larsson and Franzén (2007) observed nests of *A. hattorfiana* on rather flat soils covered by sparse herb and grass vegetation. A tumulus was not visible at the nest entrance and the latter was often covered by the rosettes of *Pilosella* spp. (Asteraceae). Nests were located in dry parts of traditionally managed hay meadows, horse pastures with moderate grazing and sparse vegetation, and on anthropogenically trampled paths. The nest architecture is shown in Figure 25: the main burrow is slightly sinuous, mostly vertical and reaches a length of 17.1 ± 1.2 cm. The nests are estimated to contain an average of six cells each (Larsson & Franzén, 2007).

A. hattorfiana is univoltine and has its flight period from May to the end of August (Westrich, 2018). *Andrena hattorfiana* is kleptoparasitised by the host-specific cuckoo bee *Nomada armata* (Larsson & Franzén, 2007; Westrich, 2018).

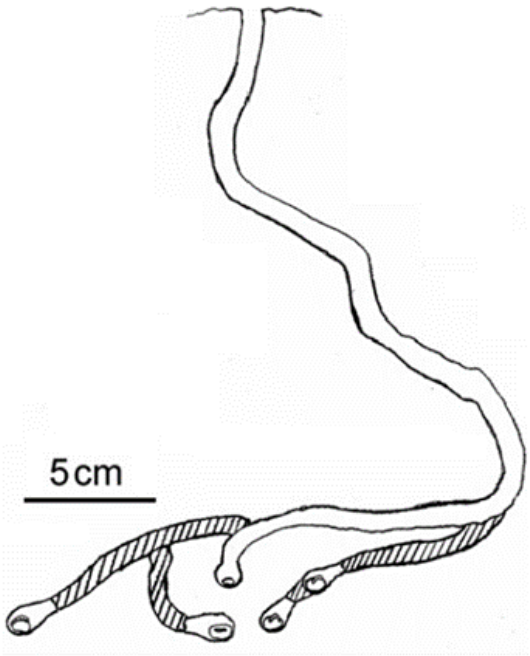


Figure 25: The nest architecture of Andrena hattorfiana. (from: Larsson & Franzén, 2007)

Functions and values

Similar to other insect species, functions and values of *Andrena hattorfiana* have not been reported, but it may have an important pollinator function for Caprifoliaceae.

Historical account

Andrena hattorfiana is distributed over large parts of Europe, the Caucasus and Asia Minor (Figure 26).

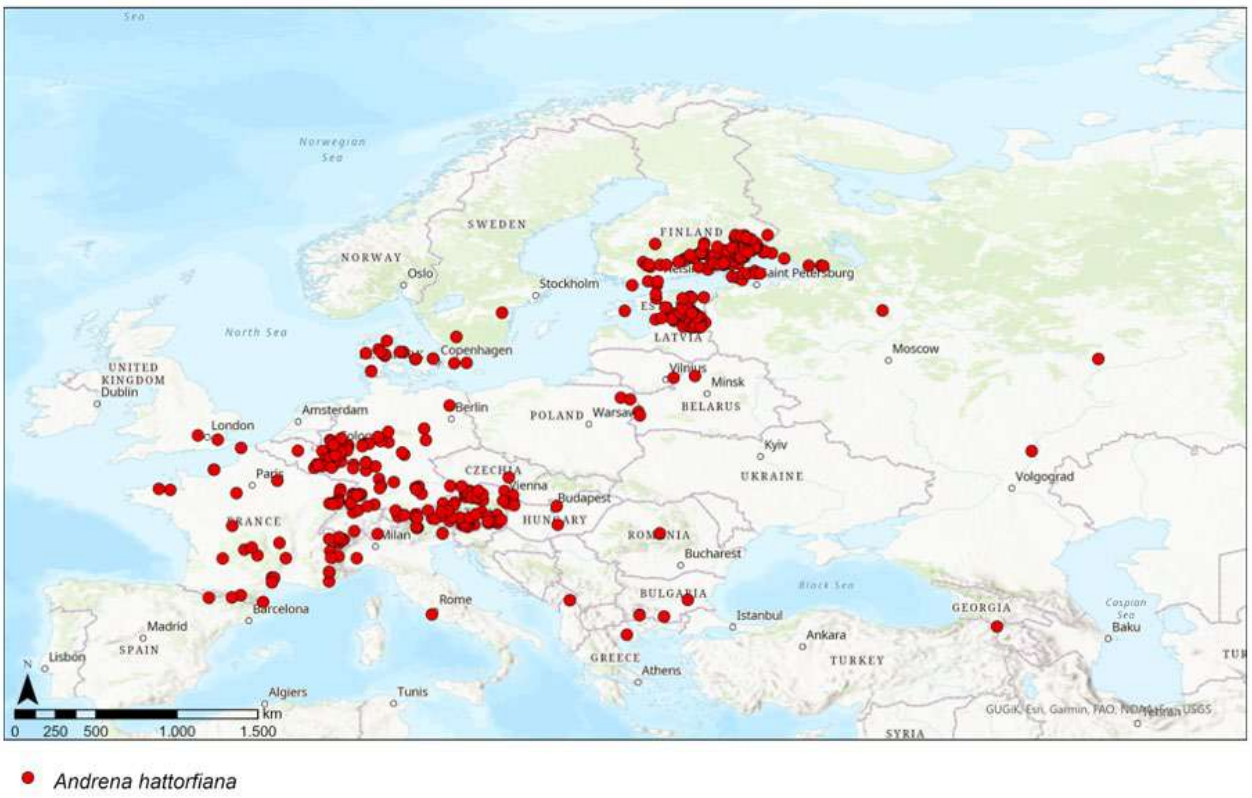


Figure 26: Distribution of records of Andrena hattorfiana on iNaturalist and Observation.org. (Data retrieved in July 2022)

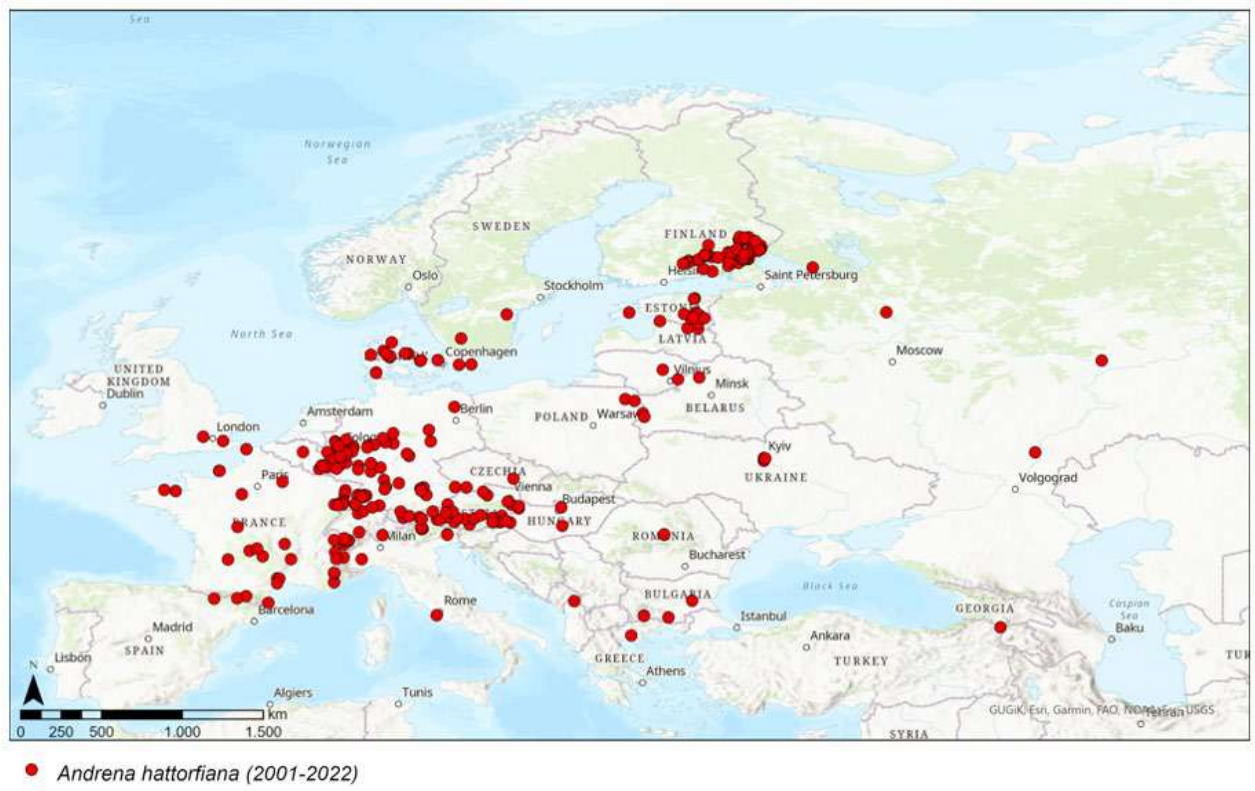


Figure 27: The current distribution of Andrena hattorfiana. The data are based on iNaturalist, Observation.org., V. Radchenko and M. Filatov.

Current distribution and demography

Andrena hattorfiana is listed as Near Threatened on the European Red List (Tomozei, 2014). The area of occupancy (AOO) is about 2,000 km². The species occurs in small and isolated populations (Tomozei, 2014), but it is still relatively widespread in Europe (Figure 27). This species is included in the National Red Lists or Red Data Books of the seven following European countries: Czech Republic (Vulnerable; Farkac *et al.,* 2005), Germany (Vulnerable; Westrich *et al.,* 2008, Westrich *et al.,* 2011), Great Britain (Vulnerable; Shirt, 1987), Netherlands (Endangered; Peeters & Reemer, 2003), Norway (Critically Endangered; Kålås *et al.,* 2010), Sweden (Near Threatened; Gärdenfors, 2010) and Finland (Near Threatened; Rassi, 2010).

Pekkarinen (1998) describes a drastic decline of *A. hattorfiana* since 1969 in Finland (Figure 28) and the species is now listed in Annex 4 – Threatened species of the Nature Conservation Decree no. 160/1997. In Germany, *Andrena hattorfiana* is listed as Vulnerable on the Red List (Westrich *et al.,* 2011) and was elected as 'Wild Bee of the Year 2017'. In 1991, a population threatened by construction works in Berlin was translocated, but the translocated population remained small and high fluctuation of number of individuals was observed (Flügel, 1997). After 2002, the population disappeared as a consequence of changes in the management of the green spaces and associated loss of *Knautia* plants (Flügel, 2014). The species is also mentioned in the European Action Plan to maintain and restore habitat type 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (Olmeda *et al.,* 2019). In the United Kingdom it has its own Species Action Plan for Cornwall (Dimond, 2016).

Habitat and resource assessment

In Sweden, a strong dependence of *Andrena hattorfiana* on its main pollen source (*Knautia arvensis*) has been reported (Larsson & Franzén, 2007). Presence and population size of *A. hattorfiana* were significantly dependent on the number of individuals and the number of flowers of *K. arvensis*, while other habitat factors, such as vegetation height or the presence of other flower visitors did not explain the presence of *A. hattorfiana*. The 'pollen budget' (minimum pollen requirement) for *A. hattorfiana* was calculated as 72 inflorescences of eleven *K. arvensis* individuals for the provisions of one nest (Larsson & Franzén, 2007; Westrich, 2018). Under natural conditions, a larger number of plants is required for the existence of populations of this bee species as pollen needs to be provided for a longer period and for the complete population.

A. hattorfiana shows higher frequented flower visits in large plant populations than in small plant populations (Larsson & Franzén, 2007). Also, Pekkarinen (1998) describes a positive correlation between an increased density of *K. arvensis* and a consequently higher number of *A. hattorfiana* in Finland and north-western Russia.

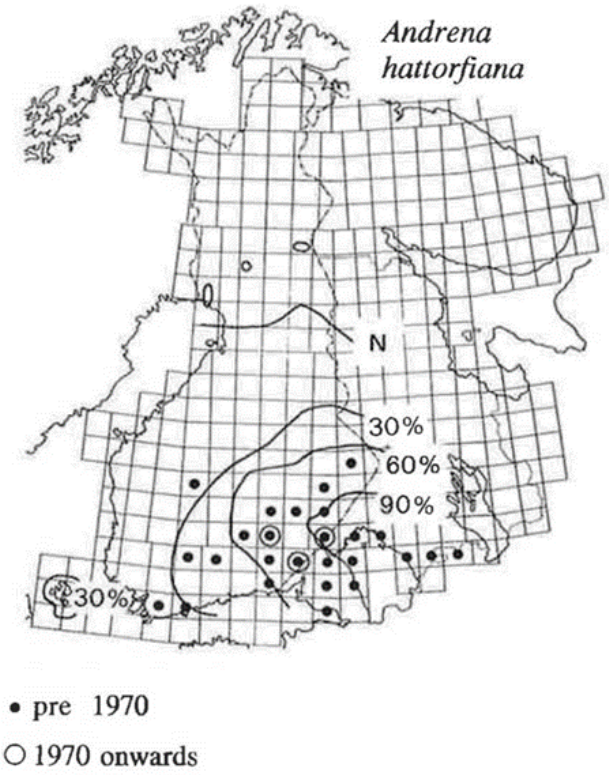


Figure 28: The distribution of Andrena hattorfiana in Finland and north-western Russia based on the European UTM grid system. The lines show the limits of frequencies of the main pollen plant Knautia arvensis and approximate northernmost records in Finland. (from: Pekkarinen, 1998).

Threat analysis

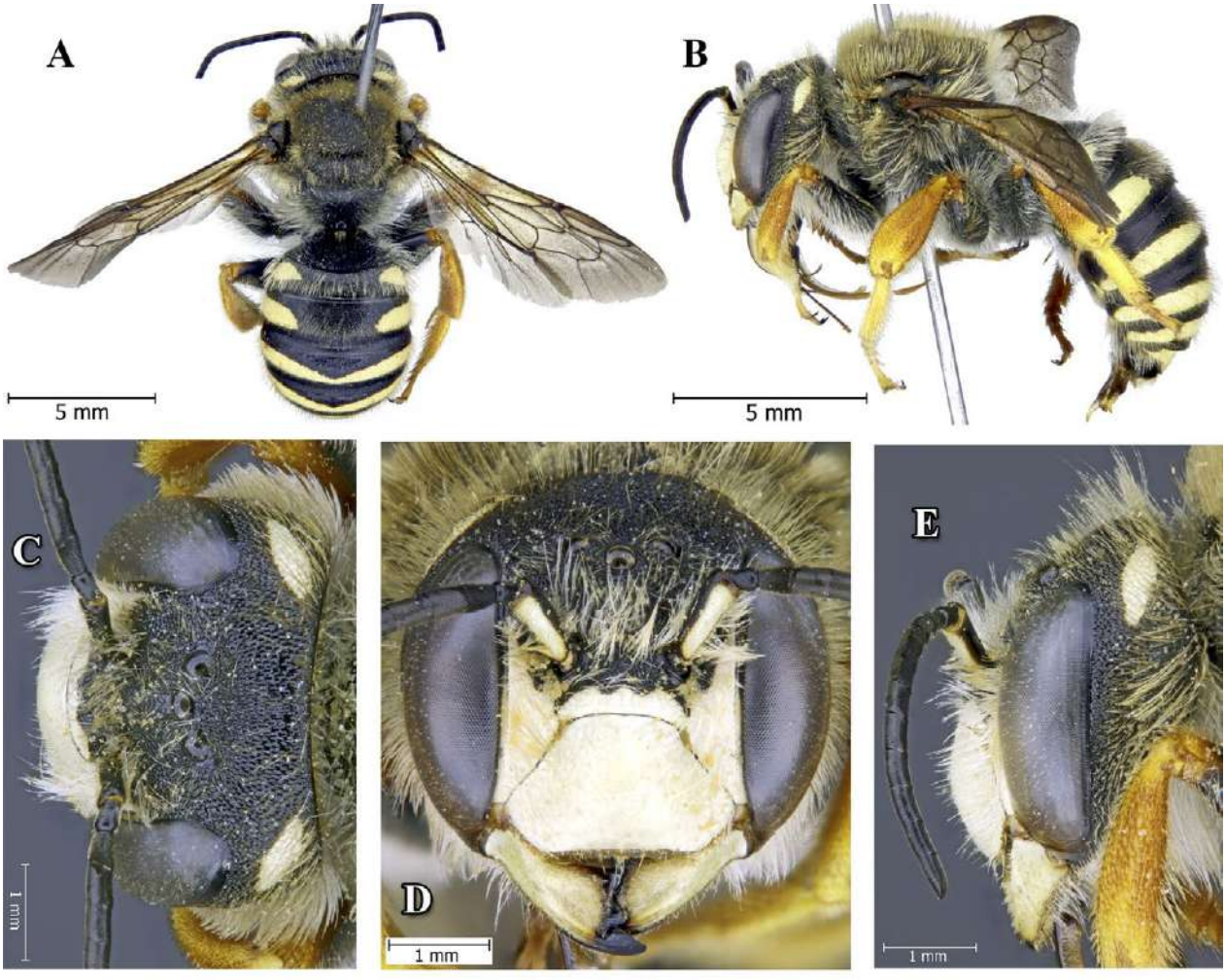
Tomozei (2014) identifies the reduction and loss of the main food source *Knautia arvensis* due to intensive agriculture as the main cause of threat. Both *Knautia arvensis* and *Andrena hattorfiana* depend on extensively managed pastures, field margins and traditional meadows (Pekkarinen, 1998; Tomozei, 2014). Larsson and Franzén (2007) observed that the species needs ten days for sufficient foraging. As *A. hattorfiana* depends on warm and sunny weather for pollen collection, the authors describe rainy and cold summers as a possible negative influence on the population size of the next generation. Martin (2022) reports that fertilisation and frequent cuts of meadows are major threats to the species and recommends a maximum of two cuts or alternate mowing on sites where the species occurs. A conservation project in Wales has a similar analysis on threat (Olds, 2020). Westrich (2022) recommends planting larger stands of *Knautia* or *Scabiosa* in gardens or parks to support the species. Haselböck (2022) reports that the species is also threatened by competition with honey bees.

Scabious Resin Bee, *Trachusa interrupta* (Fabricius, 1781)

Species description

Systematics / taxonomy

Trachusa interrupta (Fabricius, 1781) is listed as Endangered on the European Red List (Bogusch & Straka, 2014). It belongs to the family Megachilidae (including leafcutter bees, mason bees, resin bees and wool carder bees) and the tribe Anthidiini (Michener, 2000). The genus *Trachusa* contains approximately 60 described species. Almost half of the species (24) appear in the New World, six in the Indomalayan region, five in the Afrotropical region, four in the Eastern Palearctic, and ten in the Western Palearctic (Kasparek, 2017).



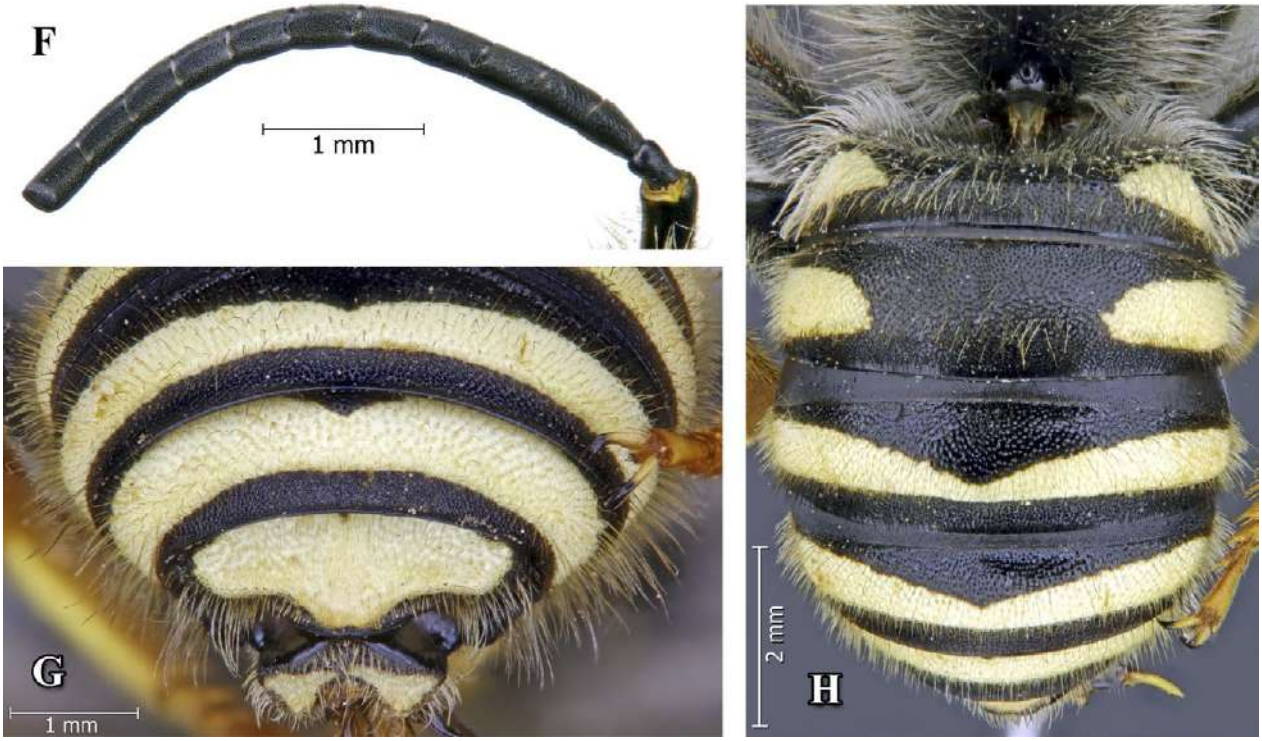


Figure 29A–H: Trachusa interrupta male. A, habitus in dorsal view; B, habitus in lateral view; C, head in dorsal view; D, head in facial view; E, head in lateral view; F, flagellum; G, apex of metasoma in dorsal view; H, metasoma in dorsal view. (Pictures: V. Radchenko)

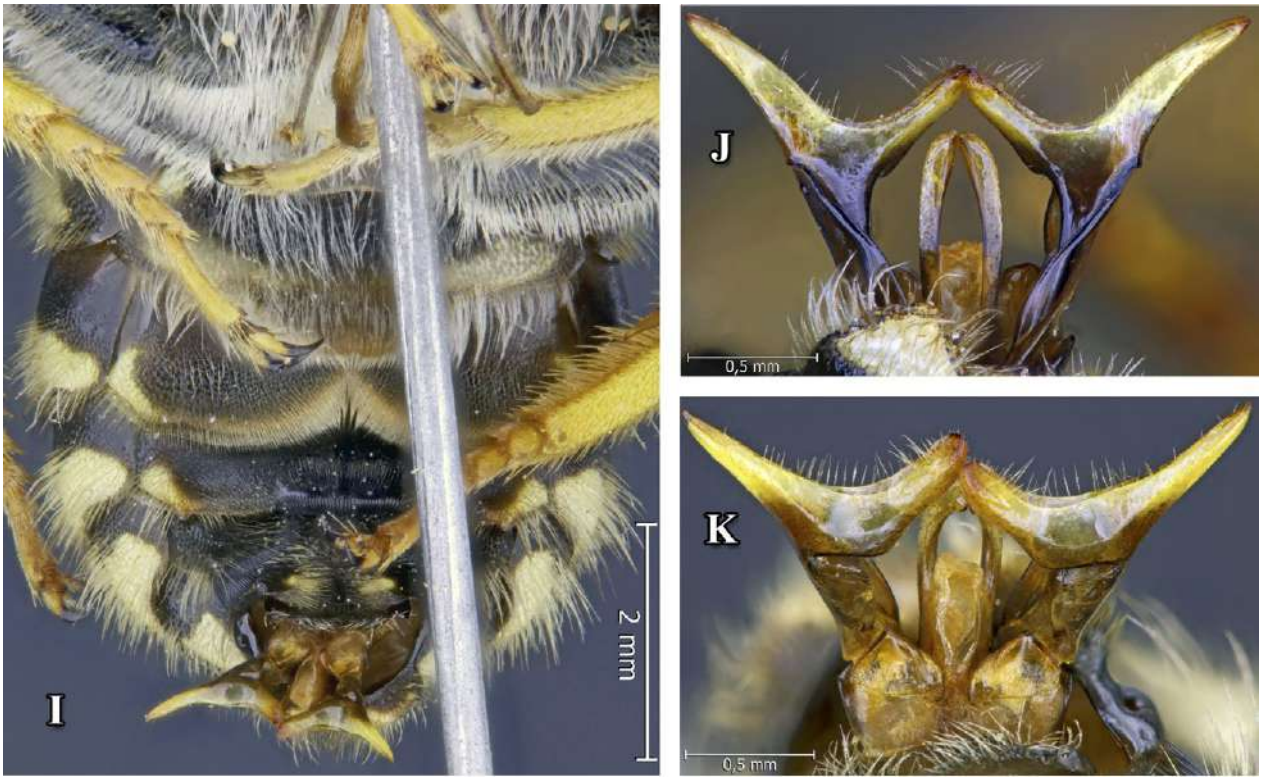


Figure 29I–K: Trachusa interrupta male. J apex of the genitalia in dorsal view; K, apex of the genitalia in ventral view. (Pictures: V. Radchenko)

The *Trachusa interrupta* complex consists of the following three widespread species: *Trachusa interrupta* (Fabricius, 1781) s.str., *T. integra* (Eversmann, 1852), *T. anatolica*, and five other species with limited distribution: *T. varia* (Olivier, 1789), *T. maghrebensis* (both in Spain and north-western Africa), *T. heinzi* (Dubitzky, 2007), *T. grandicornis* and *T. taurica* (all three in Türkiye and Iran). The species are distinguished by their distribution areas and morphological characteristics and features in colouration as well as in size and disposition patterns of these colour marks (Kasparek, 2020).

Trachusa interrupta is a medium-sized species (females: 10–14 mm, males: 11–15 mm), which has a black and bright yellow colouration (Figure 29) (Kasparek, 2017). The first two tergal bands (T1, T2) are interrupted with largely divided lateral bands. The third tergal band (T3) may be interrupted, under these conditions the lateral bands are continuous or almost continuous (Figure 29).

The male resembles *T. taurica*, *T. maghrebensis* and *T. varia* also showing an interruption of T1 and T2. The species can be distinguished by the following characteristics: *T. taurica* has longer antennae, *T. maghrebensis* has broader tergal bands and *T. varia* shows reddish maculations instead of yellow ones. In *T. anatolica* the first two bands are largely discontinuous and the lateral bands at T3 are sub-continuous, which can also occur in *T. interrupta*. The two species can then be differentiated by various yellow colouration on the middle femur. The distribution of *T. integra* partly overlaps with the distribution of *T. interrupta*; in terms of colour pattern, the males of these two species differ in having only an interruption in T1 in *T. integra* but an interruption both on T1 and T2 in *T. interrupta* (Kasparek, 2020). The females of *T. interrupta* and *T. integra* are difficult to distinguish; the pronotal lobe is mostly dark brown or black in *T. interrupta*, but with yellow in *T. integra*.

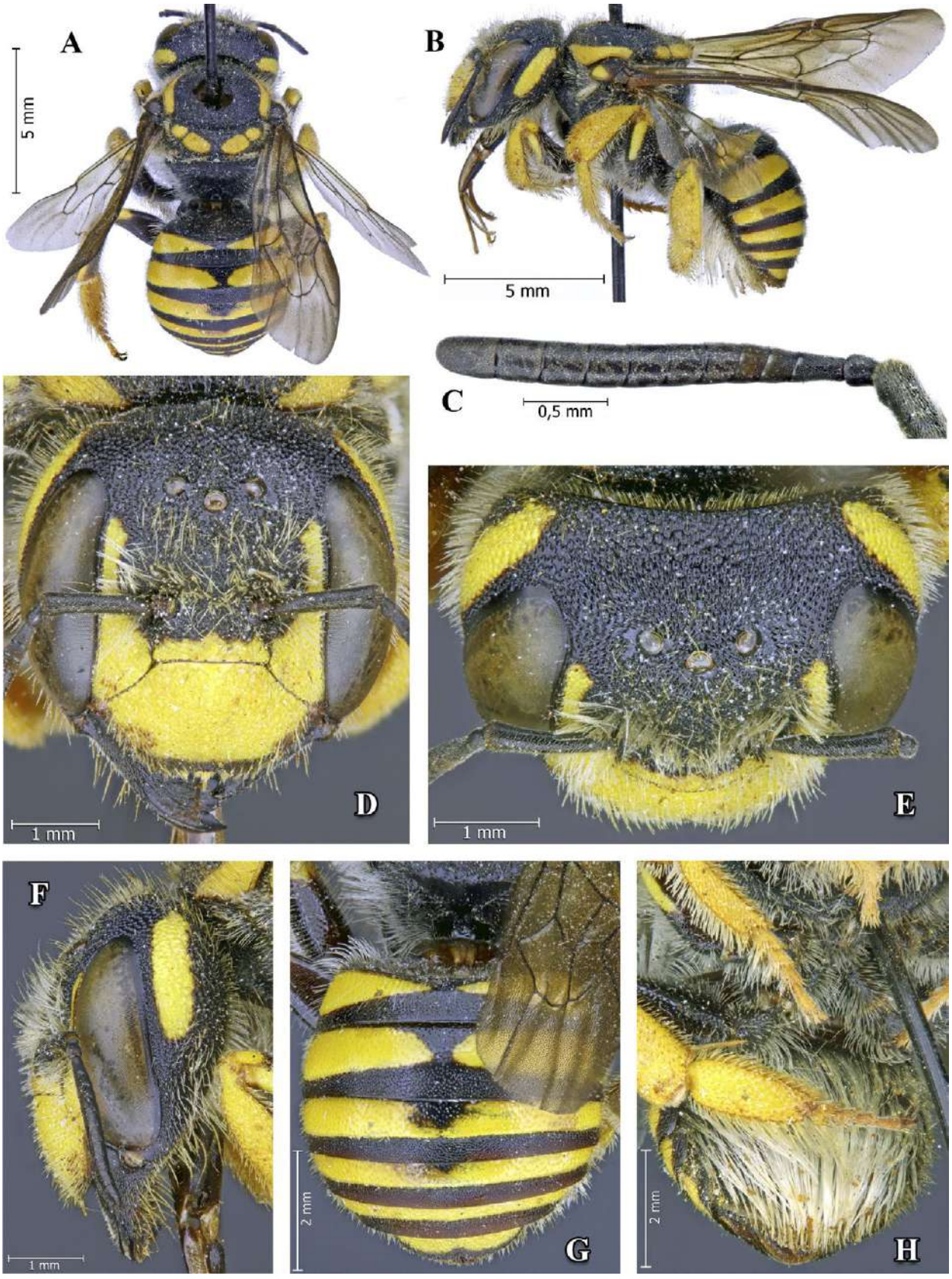


Figure 30A–H: Trachusa interrupta female, France. A, habitus in dorsal view; B, habitus in lateral view; C, flagellum; D, head in facial view; E, head in dorsal view; F, head in lateral view; G, metasoma in dorsal view; H, metasoma in ventral view. (Pictures: V. Radchenko.)

Kasparek (2020) found significant intraspecific variation in the length of the antennae of males from different populations. Neither patterns of a north–south gradient nor a connection to colour differences were detected, suggesting that this trait is not taxonomically relevant.

The female of *T. interrupta* has a dark pronotal lobe (Figure 30). Like *T. anatolica*, it shows a broad yellow maculation of the genae, which in *T. interrupta* does not extend beyond the middle of the eyes, but in *T. anatolica* extends to the orbit and the lower end of the eyes. *T. taurica* and *T. interrupta* also show similar characteristics and can be distinguished by the following: *T. interrupta* shows small yellow maculations at the tip of the middle femora whereas in *T. taurica* a yellow stripe spreads almost over the tibia. Furthermore, the inner side of the posterior tibia is completely yellow in *T. interrupta* and covered with black maculations in *T. taurica*.

In addition to the morphological distinguishing features, the species show different distribution areas: *T. interrupta* is widespread in Europe, while *T. taurica's* occurrence is limited to the south and south-west of Türkiye (Kasparek, 2020).

Biology and ecology

The species is specialised on Caprifoliaceae. In France, flower visits have been observed on *Cephalaria leucantha* and *Scabiosa columbaria* (both Caprifoliaceae) and in Switzerland observations have been made exclusively on *Scabiosa* (Kasparek, 2020). It is mainly found on fallow land (e.g. along roads) (M. Kasparek, pers. comm. 2022).

The main flight period is from June to early August. Kasparek (2020) describes an early record from May (Bulgaria) and a late one in early September (Spain). The seasonal pattern is influenced by geographic differences as it is usually found in August only in higher altitudes (e.g. eastern Türkiye) but the species has also been discovered at sea level at the same time in Croatia (Kasparek, 2017).

Trachusa interrupta was observed in Coustaussa (Pyrenees, France) in different phases of activity during the day. In July 2018, in the late afternoon, they flew halfway up between the stems of wild teasels (*Dipsacus* sp.) and visited the flowers of *Scabiosa* only briefly. Three males and one female were detected within an hour. In comparison, 15 females were observed in the morning hours (9–10 am), mainly visiting the flowers of *Scabiosa* and carrying a lot of pollen. Therefore Kasparek (2020) concludes that the males are mainly active in the afternoon defending their territory and that the females are mainly active in the morning collecting pollen.

For nesting, the females build short channels in the ground, constructing the brood cells from pieces of leaves and resin (Bogusch & Straka, 2014).

Stelis annulata (Lepeletier, 1841) is a cuckoo bee kleptoparasiting its host *Trachusa interrupta*. Both species belong to the family Megachilidae showing morphological similarities and feeding on *Scabiosa* (Kasparek, 2015). Little is known about the relationship between the kleptoparasite and its host.

Functions and values

No specific functions and values of *Trachusa interrupta* have been reported, but it is a pollinator of teasel plants, which are known to be of particular value for many pollinator species.

Historical account

The historical distribution of *Trachusa interrupta* ranges throughout the Mediterranean from southern Portugal to the south of Switzerland in the north, North Africa in the south and via Türkiye and Central Asia to China in the east (Kasparek, 2020). The known distribution

is shown in Figure 31. Former records from Morocco, Algeria, Türkiye, Syria and the Caucasus (Bogusch & Straka, 2014) are doubtful and probably belong to other species (Kasparek, pers. comm.). In Switzerland its highest occurrence is at 1200 m (Amiet *et al.*, 2004).

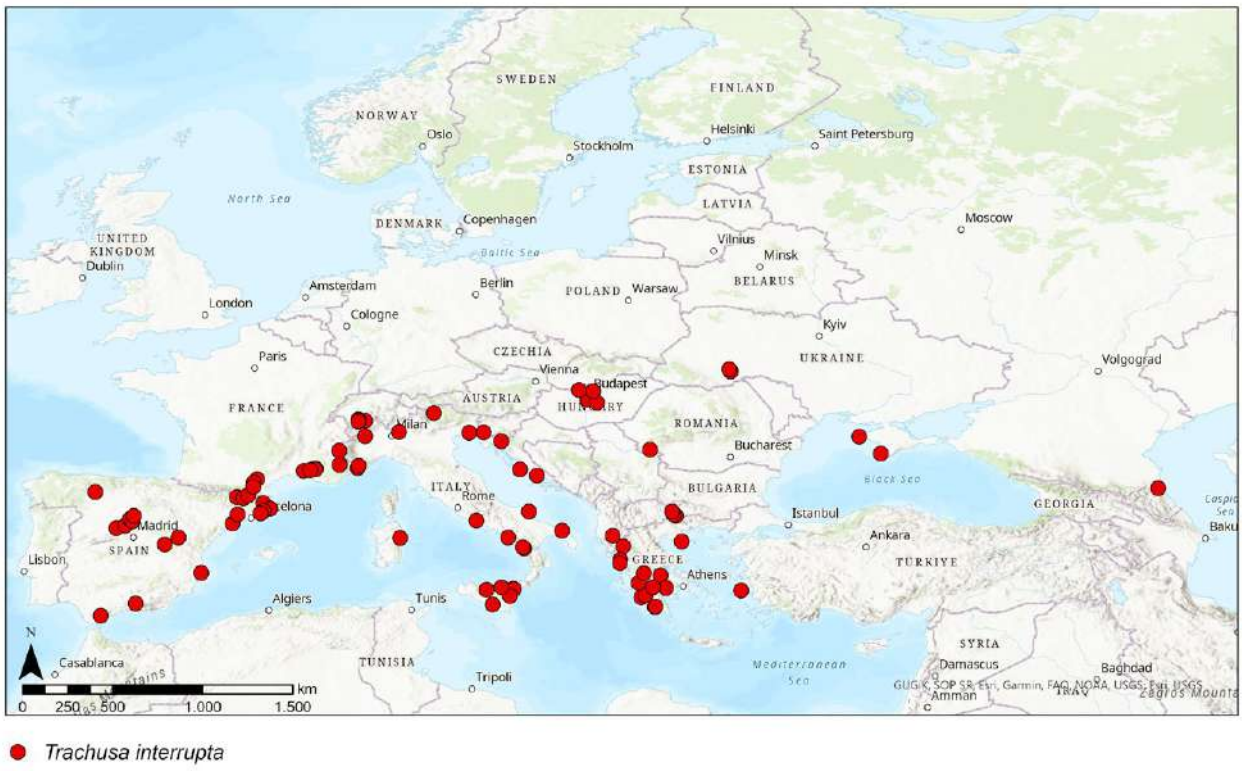


Figure 31: Distribution of Trachusa interrupta. Map created using data from Kasparek (2020)

Current distribution and demography

Bogusch and Straka (2014) report population decreases in Hungary and Slovakia. In general, the authors conclude that the populations of the species are fragmented with morphological differences and suggest a long-term separation of the populations. One specimen of this rare species has recently been found in the Chornobyl Radiation and Ecological Biosphere Reserve, Ukraine (Radchenko V., unpubl. data). Recent records of the species are illustrated in Figure 32.

Figure 32: Recent records of Trachusa interrupta in Europe. Map created using data from Kasparek, 2020

Habitat and resource assessment

The species occurs in open and forest steppe habitats (Bogusch & Straka, 2014), ruderal habitats and open macchia (M. Kasparek, pers. comm.).

Threat analysis

Bogusch and Straka (2014) describe sensitive reactions of the species (decline and population fluctuations) connected to reduced availability of the food plant *Scabiosa*. Accordingly, the main cause of threat is succession of steppe vegetation, which negatively affects the occurrence and quality of *Scabiosa*.

Teasel-plant specialised bees: Population trends, threats and conservation actions

Decline of teasel-plant specialised bees is reported in many European countries (e.g. Drossart *et al.,* 2019; Gärdenfors, 2010). Many species are listed in a threatened category on national red lists or even considered extinct. For example, of the six species specialised on Dipsacoideae in Switzerland, only *Andrena hattorfiana* is not considered threatened. *Trachusa interrupta*, *Andrena marginata*, *Dasypoda argentata*, *Chelostoma grande* and *Hoplitis dalmatica* are all threatened (A. Müller & C. Praz, pers. comm.). In Switzerland, conservation action for bees specialised on Dipsacoideae falls into two categories: those highly threatened (CR and EN) are listed as requiring specific action plans (*Dasypoda argentata*, *Andrena marginata*, *Trachusa interrupta*, *Hoplitis dalmatica*). The rationale is that existing populations are so small that general conservation measures at the landscape scale or habitat scale are unlikely to be sufficient for conservation. Coordination at the European level will help to transfer knowledge on the implementation of the action, and, if possible, create connections among populations at the international level. Teasel-plant specialised bee species that are more widely distributed (*Chelostoma grande*, *Andrena hattorfiana*) require actions at the habitat level, with measures proposed to maintain and connect existing habitats (a large proportion of the habitats are not protected at this point, since they are extensive grasslands), and overall to increase habitat quality at the landscape level. Many other teasel-plant specialised bees also require additional study (e.g. *Tetraloniella pollinosa*, *T. scabiosae*, *Andrena braunsiana*, *A. marginata*, *A. mucida*, *A. pallidicincta*, *Chelostoma grande*, *C. lucens*, *C. transversum*, *Dasypoda frieseana*, *E. cinctella*, *Eucera furfurea*, *E. major*, *E. pollinosa*, *E. scabiosae*, *E. strigata*, *Hoplitis agis*, *H. bisulca*, *H. cretaea*, *H. dalmatica*, *Lasiogossum corvinum*, *Trachusa grandicornis*, *T. integra*). Until now very little data is available for these species and they are listed as DD on the European Red List. The threatened *Dasypoda* species need sandy soil for nesting habitats, whereas *Andrena hattorfiana* and *Trachusa interrupta* are less specialised in nesting substrate. As teasel plants bloom in summer, mowing before summer is usually detrimental to teasel-plant specialised bees.

Figure 33. Habitat hosting numerous teasel bee species (e.g. Dasypoda braccata, D. spinigera, D. toroki) (locality: Crimea, District of Simferopol, valley of the river Beshterek, steppe close to Vendanges village, 45° 04' 15" N, 34° 11' 38.61" E. (Pictures: Alexandre Fateryga)

South-eastern European countries like Greece, Bulgaria, Romania, Hungary or Ukraine still host many teasel bee species, including the pantaloon bees reported here, which are considered umbrella species for species-rich communities. In those countries, meadows with dense populations of *Scabiosa* and/or *Cephalaria* still exist (Figure 33). Two large protected areas in Ukraine have a great importance for the conservation of these bee and plant species: the Black Sea Biosphere Reserve and Askania-Nova, which cover an area of about 500 km² of dry steppe. Future action of land management could be inspired by the experience of managers from these regions.

The main threat to teasel-plant specialised bees is the loss and deterioration of their habitats (i.e. the combination of teasel-plant rich grassland and nesting sites, such as bare sandy ground). This habitat loss has been driven by changes in agricultural land use, including conversion into arable land or forests, intensification of grassland management (early mowing dates or overgrazing), abandonment (i.e. succession into other habitat types). This threat is still ongoing and considered most important for all teasel-plant specialised bees (Table 3). As a result, the populations of teasel-plant specialised bees have become severely fragmented with little genetic exchange between them and low potential for natural recolonisation. Locally, habitat can also be threatened from urbanisation or infrastructure, such as the last remaining population of *D. braccata* in Italy. As teasel-plant rich meadows and bare ground for nesting typically occur in nutrient-poor habitats, nitrogen deposition is also a threat, particularly in north-western Europe, where eutrophication rates are high. Domestic honey bees are known to be a threat to many wild bee species as they represent strong competitors for pollen. This may be particularly problematic in areas or during periods with low numbers of flowers, which is typical for the flowering time of teasel plants. In some areas, invasions of non-native plant species may also deteriorate the quality of the habitat. Pesticides are likely to have negative effects on wild bee populations, even though direct effects on teasel-plant specialised bee species have not been studied so far. Other unknown threats are parasites, which may be transferred from domestic honey bee populations or changes in microbiomes as a consequence of pesticides.

Table 3: Threat analysis

Threat	Timing	Knowledge	Presumed impact
Agricultural land-use change (loss of teasel-plant rich meadows with bare ground), incl. abandonment, overgrazing, conversion into arable land or forests	Ongoing	High	High
Habitat fragmentation	Ongoing	Medium	High
Development of infrastructure or urbanisation	Ongoing	Medium	Local
Nitrogen deposition	Ongoing	Medium	High (NW Europe), Unknown (SE Europe)
Competition with domestic honey bees	Ongoing	Medium	Medium
Spread of alien invasive plant species	Ongoing	Low	Local
Pesticide (spill-over)	Ongoing	Low	Low
Parasites (spill-over from honey bees)	Unknown	Low	Low
Changes in microbiomes	Unknown	Low	Low

Conservation planning

To develop a conservation strategy for the four target pollinator species, the approach of the IUCN Species Survival Commission was adopted according to the *IUCN Guidelines for Species Conservation Planning* (IUCN SSC Species Conservation Planning Sub-Committee, 2017) and the *CPSG Species Conservation Planning Principles and Steps* (CPSG, 2020). A draft strategy was prepared by a core group of stakeholders and discussed and amended during a participatory workshop, involving species specialists and planners, state government agencies, managers, researchers, NGOs and other stakeholders.

Conservation Action Plan

Vision

A large, well-connected network of grassland, rich in teasel plants with nesting sites, particularly dry sandy habitats, exists in Europe, providing sustainable habitat for specialist bee species. The Dark Pantaloon Bee, the Spiny Pantaloon Bee, the Swollen Pantaloon Bee, the Silvery Pantaloon Bee, the Large Scabious Mining Bee and the Scabious Resin Bee have self-sustaining, healthy populations, so that future generations can enjoy them and benefit from the ecosystem services they provide. Authorities, farmers, conservationists and local communities are aware of their importance, the value of their habitats and the threats to their populations and engage in conservation action. High-nature value farming systems support specialist bees, and sustain healthy ecosystems for both nature and humans.

The vision was carefully worded to reflect the following points:

(i) "large, well connected areas of grassland, rich in teasel plants with nesting sites": Meadows and pastures rich in teasel plants have become increasingly rare and fragmented as a consequence of land conversion to cropland or forests, abandonment, and agricultural intensification with earlier mowing times or overgrazing; species affiliated with these ecosystems are threatened by habitat loss and fragmentation; pantaloon bee species also need bare sandy areas to build their nests. As habitat loss and degradation constitute the main threat to teasel-plant specialised bees, these habitats need to be maintained, extended and re-connected by appropriate management and habitat restoration.

(ii) "providing sustainable habitat for specialised bee species": Habitat management is key to the survival of threatened species. This particularly includes sustainable management of meadows with extensive agricultural practices.

(iii) "self-sustaining, healthy populations": This highlights the aim to improve the status of threatened pollinator species for the long term.

(iv) "future generations can enjoy them and benefit from the ecosystem services they provide": Insects, and particularly wild bee species provide multiple ecosystem services, including pollination, but they are also of high aesthetic and educational value. This is particularly true for the teasel-plant specialised bees, but also for the teasel plants, such as *Scabiosa* and *Knautia*, which support large numbers of other species, such as other pollinators, herbivores and frugivores.

(v) "Authorities, farmers, conservationists and local communities are aware of their importance, the value of their habitats and the threats to their populations": This highlights the responsibility of multiple actors and need for increased awareness, not only of the value of pollinators, but also the high value of teasel-plant rich meadows and their main threats.

(vi) "High-nature value farming systems": Farmers and farming systems play a leading role in the maintenance and restoration of healthy bee populations. Abandonment and agricultural intensification are major threats to teasel-plant specialised bees. Late mowing, sustainable livestock densities, and reducing fertiliser and pesticide use will be key steps to maintain them.

(vii) "Healthy ecosystems for nature and humans": Teasel-plant rich meadows have a high aesthetic value, which are not only important for maintaining biodiversity, but also provide a restful environment for human well-being.

Goals, objectives and actions

Goal 1 Governance and protection

Governance and protection established and secured for teasel-plant specialised bees, in their priority countries and at European level, providing leadership and ensuring the implementation of the conservation plan; as well as protection via recognition in plans for associated protected habitats and pollinators.

Objective 1.1 Governance

To establish a steering group by 2022 in order to guide and facilitate implementation of the plan and review progress regularly.

Actions

1.1.1 Creation of a steering group

Purpose: To ensure the implementation of all actions
Note: Regular meetings each year to review progress (more often during the first year)
Who: IUCN SSC Wild Bee SG (WBSG) / IUCN SSC Invertebrate Conservation Committee (ICC) / Buglife (BL) / Université de Mons (UM) / Natural History Museum Vienna (NHMW) / Trier University (TU) / IUCN Brussels (IUCN)
Collaboration recommended: diverse representation required, including experts from key countries with occurrence of teasel-plant specialised bee species (i.e. Greece, Bulgaria, Romania, Hungary) as well as Protected Area (PA) Managers and NGOs
By when: 2022
Indicator: Regular meetings
Resources required: Volunteer time

1.1.2 Develop and secure funding for an EU-wide project to deliver the plan

How: Coordination at European level needed; European Commission to facilitate uptake of the plan by national authorities; exchange on management practices and experiences required
Who: WBSG / ICC / IUCN / UM / TU
Collaboration recommended: European Commission (EC) / National and regional authorities for conservation
By when: 2023 (full timelines of the plan are found in the annex)
Indicator: Coordinator employed
Resources required: 1 full time project coordinator (PC), 2 PhD students, budget for meetings with local actors, training and coordination of citizen scientists, consumables, travel costs

Objective 1.2: Improving national protection

To ensure that wild bee species are assessed on relevant national red lists and that the four Endangered species, *Dasypoda braccata*, *Dasypoda spinigera*, *Dasypoda suripes* and *Trachusa interrupta* are fully protected under national laws in their countries of occurrence.

Actions

1.2.1 Conduct national red list (re-)/assessments for wild bees in the following EU countries: Greece, Hungary, Romania and Bulgaria.

Note: Red List assessments are an essential basis for protection
Who: WBSG
Collaboration recommendation: H2020 Safeguard (for Greece and Hungary) / National conservation agencies
By when: 2026
Indicator: National Red Lists for wild bees exist, including assessments of *D. braccata*, *D. spinigera*, *D. suripes, D. argentata, A. hattorfiana* and *T. interrupta*

Resources required: Master or PhD student for countries not covered by Safeguard (Bulgaria, Romania). Resources to digitise spatial records from collections in national museums (2 euros per specimen, >5,000 specimens to digitise + travel to museum).

1.2.2 Add Dasypoda braccata, Dasypoda spinigera, Dasypoda suripes and Trachusa interrupta to national lists of protected species in EU countries

Details: *D. braccata*: Italy, Hungary, Bulgaria, Greece; *D. spinigera*: Romania, Hungary, Bulgaria; *D. suripes*: Greece, Denmark, Bulgaria, Germany, Italy; *T. interrupta*: Spain, France, Italy, Hungary
Note: Collaboration of researchers, conservationists, authorities required
Who: WBSG / BL
Collaboration recommendation: National NGOs (e.g. Pollinis) / National Environmental Ministries & Conservation authorities
By when: 2028
Indicator: Species on list of protected species
Resources required: Staff time, communication to policy makers

Objective 1.3: Improving European protection

To improve the protection of the four Endangered species, *Dasypoda braccata*, *Dasypoda spinigera*, *Dasypoda suripes* and *Trachusa interrupta* (under existing legislation) in Europe.

Actions

1.3.1 Integrate habitat restoration of teasel-plant rich meadows in implementation of the EU Restoration regulation (Natura 2000 site management)

How: Provide recommendations for habitat restoration of teasel-plant rich meadows / promote teasel bees as potential indicators of EU Annex I habitats
Who: IUCN / WBSG / ICC / BL / Institute for European Environmental Policy (IEEP)
Collaboration recommendation: European Habitats Forum / EC
By when: 2025
Indicator: EU Restoration Strategy considers teasel-plant specialised bees
Resources required: Staff time

1.3.2 Consider occurrence of threatened teasel-plant specialised bees in the expansion of the European protected area network

How: Key habitats of teasel bees (based upon 2.1.1) should be included in protected area network
Who: IUCN / WBSG / BL
Collaboration recommendation: EC
By when: 2025
Indicator: Inclusion of teasel-plant specialised bee habitats in PA network
Resources required: Staff time

1.3.3 Convene a stakeholder platform with bee-keeping community and wild bee conservation community to provide recommendations on bee-keeping in protected areas

Note: Domestic honey bees can represent strong competitors for pollen and are known to threaten wild bee species in areas or during seasons of low availability of flowers
How: Recommendation that the European Commission facilitates dialogue and creation of such a stakeholder platform
Who: IUCN / WBSG
Collaboration recommendation: EC / EPBA
By when: 2025
Indicator: Stakeholder platform exists
Resources required: Staff time, meetings

1.3.4 Instigate EU-wide sustainable management of honey bees in PAs

How: Minimise honey bee-keeping in grassland habitats protected by Habitats Directive / wild bee diversity promotes plant diversity (and vice versa) by outreach and awareness raising
Note: Based upon 3.1.3
Who: WBSG / IUCN

Collaboration recommendation: European Professional Beekeepers Association (EPBA) / EC / National and regional agricultural and environmental authorities
By when: 2026
Indicator: Guidance document for sustainable management of honey bees in PAs exists
Resources required: Staff time, meetings

Objective 1.4: Integration in existing plans

To integrate conservation of teasel-plant specialised bees in existing action plans at European, national and local scale.

Actions

1.4.1 Ensure consideration of threatened teasel-plant specialised bees in the implementation of EU habitat action plan for habitat type 6210 (Semi-natural dry grasslands and scrubland facies on calcareous substrates) or future plans of other relevant habitat types

Note: Synergies between the teasel-plant specialised bee action plan and the plan for habitat type 6210 exist. Currently, it is not clear how the plan for 6210 will be implemented. Collaboration with the implementers is required.
How: Liaise with implementers and facilitate implementing the plan
Who: IUCN / WBSG
Collaboration recommendation: EC / Responsible authorities and implementers in EU member states
By when: 2025
Indicator: Specific teasel-plant specialised bee friendly actions implemented in habitat action plan
Resources required: Staff time

1.4.2 Ensure consideration of threatened teasel-plant specialised bees in National Action Plans for pollinators or insects

Note: Action plans for wild bees and/or other insects exist in Belgium, France, Germany, Ireland, Netherlands, Spain and Portugal; most plans are not very specific, but provide some generic recommendations, some focus on honey bees.
How: Organise meetings with actors on how the action plans are being implemented and how to best consider teasel-plant specialised bees.
Who: IUCN / WBSG
Collaboration recommendation: H2020 Safeguard / EC
By when: 2025
Indicator: Teasel-plant specialised bee specific actions included in national pollinator action plans
Resources required: Staff time

Objective 1.5: Coverage in protected areas

To ensure that all remaining populations of the four Endangered teasel-plant specialised bees (*Dasypoda braccata*, *Dasypoda spinigera*, *Dasypoda suripes* and *Trachusa interrupta*) are covered by protected areas.

Actions

1.5.1 Conduct a gap analysis to obtain an overview of the number and identity of teasel-plant specialised bee populations (Dasypoda braccata, Dasypoda spinigera, Dasypoda suripes and Trachusa interrupta) outside protected areas

How: GIS analysis / use survey data from 2.1.1
Who: WBSG / UM
By when: 2027
Indicator: Report
Resources required: Staff time

1.5.2 Instigate planning and designation of protected areas for currently unprotected populations of Dasypoda braccata, Dasypoda spinigera, Dasypoda suripes and Trachusa interrupta

Note: If protection is not possible, ensure that management becomes suitable for bee species
How: Close collaboration with local authorities and NGOs required
Who: WBSG
Collaboration recommendation: Local NGOs / National, regional and local conservation authorities responsible for protected area planning / PA managers
By when: 2028
Indicator: All key populations covered by protected areas
Resources required: Staff time

1.5.3 Instigate planning and designation of protected areas of currently unprotected populations of Andrena hattorfiana and D. argentata in countries where they are nationally threatened

Note: If protection is not possible, ensure that management remains suitable for bee species
Who: WBSG / PC
Collaboration recommendation: Close collaboration with national, regional or local authorities responsible for protected area planning required / NGOs
By when: 2028
Indicator: Key populations covered by protected areas
Resources required: Staff time

Goal 2: Research

Teasel-plant specialised bee population status, dynamics and associated drivers of decline, their ecological roles, likely future threats and management benefits better understood.

Objective 2.1: Improving knowledge of population status

To improve knowledge of the current population status, distribution and genetic uniqueness of teasel-plant specialised bee populations.

Actions

2.1.1 Conduct field surveys at localities of all historic records of Dasypoda braccata, Dasypoda spinigera, Dasypoda suripes and key localities of Trachusa interrupta in the European Union and neighbouring countries

How: First study museum collections (e.g. in the context of the red list project) and review records from literature; second, conduct targeted field work to update our knowledge on the present distribution of the target species
Details: D. braccata (Italy, Austria, Hungary, Bulgaria, Greece, Serbia, Kosovo, North Macedonia), D. spinigera (Romania, Bulgaria, Greece), D. suripes (Sweden, Denmark, Germany, Poland, Czech Republic, Austria, Hungary, Romania, Croatia, Greece, Italy, Cyprus), T. interrupta (Spain, France, Italy, Croatia, Hungary, Slovakia, Romania, Greece, Bulgaria, Switzerland); if the political situation allows, also include Ukrainian populations (mainland and Crimea)
Who: WBSG / UM / TU
Collaboration required: museums / local PA authorities
By when: 2024
Indicator: Comprehensive information on past and current distribution, publication
Resources required: Staff time, travel costs, digitisation costs

2.1.2 Estimate population sizes of remaining populations of Dasypoda braccata, D. spinigera, D. suripes and selected populations of Trachusa interrupta in the European Union

How: Mark-capture-recapture and/or counting nests in nesting sites

Note: As mark-capture-recapture is quite time-consuming it needs to start early and focus on key populations
Who: WBSG / UM
Collaboration required: Local PA authorities
By when: 2026
Indicator: Comprehensive information on current population status, publication
Resources required: Staff time, travel costs

2.1.3 Study genetic diversity of remaining populations of Dasypoda braccata, D. spinigera, D. suripes and Trachusa interrupta in Europe

Note: This will also help to identify management units and potential cryptic species within any of the currently recognised taxa
How: Non-invasive sampling (tarsi/hair) e.g. via capture-recapture, SNP analysis
Who: UM / TU
Collaboration recommended: experts on wild bee population genetics
By when: 2027
Indicator: Genetic analysis available, publication
Resources required: Staff cost (PhD student), lab costs

2.1.4 Conduct a survey of other teasel-plant specialised bee species, which are currently classified as Data Deficient (e.g. Tetraloniella pollinosa, T. scabiosae, Andrena marginata, A. albopunctata and others)

How: Targeted searches based upon new spatial information from PULSE (update of European Red List)
Note: Red List with updated data on distribution will be available end 2023
Who: WBSG
Collaboration required: National bee experts / PA authorities
By when: 2026
Indicator: Maps with precise spatial records, publication
Resources required: Staff time, travel costs

2.1.5 Study distribution of teasel-plant rich grassland (in combination with bare ground) as potential habitats.

How: Based upon Natura 2000 maps (assess suitability for teasel-plant specialised bees) / remote sensing could be an option
Note: This requires some information on co-occurrence of species / major threats to remaining teasel-plant rich grassland sites should be assessed (abandonment, overgrazing, mowing…)
Who: WBSG / UM / TU
Collaboration recommended: remote sensing experts, citizen science engagement possible, PA staff, foresters
By when: 2027
Indicator: Map with teasel-plant rich meadows
Resources required: Staff time, travel costs

Objective 2.2: Improving knowledge of ecology and habitat requirements

To improve knowledge of the ecological specialisation and habitat preferences of teasel-plant specialised bees, including the number of host plants required to maintain a viable bee population, nesting site requirements, population connectivity, and interactions with other species.

Actions

2.2.1 Research on habitat preferences (nesting sites, preferred teasel-plant species, microclimate (humidity, temperature)) for the six teasel-plant specialised bee species

How: Pollen loads can be studied on museum material (palynological analyses, meta-barcoding) or during a field study, e.g. 2.1.2 (palynological analyses, soil texture analyses); analysis of diet changes over time are possible when using museum material; image-based flow cytometry coupled with machine learning is an efficient method
Who: WBSG / UM / AU (Aarhus University) / TU
Collaboration required: PA managers
By when: 2027

Indicator: Publication
Resources required: Staff time (PhD student), travel costs, lab costs

2.2.2 Research on minimum size of host plant population to maintain a viable bee population (for all six teasel-plant specialised bee species)

How: Measure quantity of pollen produced per plant inflorescence (for different teasel plants) / study phenology of host plant and bees / analyse relationship between body size and pollen need / follow methodology of study by Larsson and Franzén (2007)
Who: WBSG / UM
By when: 2026
Indicator: Publication
Resources required: Staff time (PhD student), travel costs

2.2.3 Study on the connectivity of populations, mobility of bee species with focus on dispersal and foraging capability as well as metapopulation dynamics and role of stepping stones or corridors

How: Mark-recapture (males & females) / population genetics / check newest technological developments (can be studied in combination with 2.1.2)
Who: WBSG / UM / TU
Collaboration required: PA managers
By when: 2026
Indicator: Publication
Resources required: Staff time (PhD student), travel costs

Objective 2.3: Improving knowledge to mitigate threats and improve management

To obtain the information necessary to mitigate threats to teasel-plant specialised bees and improve conservation management of existing and restored habitats.

Actions

2.3.1 Study on the consequences of different grassland management regimes (grazing, mowing) on flower and nesting site availability and the populations of teasel-plant specialised bees

How: Spatial comparison of managed sites with variable management / consider covariates (soil type, climate, surrounding landscape)
Who: WBSG / UM / TU / PC
Collaboration required: PA managers / other scientists
By when: 2027
Indicator: Publication
Resources required: Staff time (PhD student), travel costs

2.3.2 Development of best practice guidance for habitat management and restoration for teasel-plant specialised bees

How: Develop a document with recommendations regarding grazing, mowing (when, how), stock type, creation of nesting habitats
Note: Consider experience with A. hattorfiana (Buglife)
Who: WBSG / BL / ICC / PC
Collaboration required: PA managers
By when: 2027 (update 2030)
Indicator: Guidelines available
Resources required: Staff time

2.3.3 Study on how green infrastructure (roadsides, power lines) can promote the species

How: Analyse how data from 2.2.2 and 2.3.1 matches with such structures
Who: WBSG / UM / PC
By when: 2027
Indicator: Report available
Resources required: Staff time (PhD student), travel costs

2.3.4 Study on parasites

Note: Potential spill-over from honey bees; not a high priority (see threat analysis)
How: Screening of main parasites
Who: UA
Collaboration required: parasitologists
By when: 2029
Indicator: Publication
Resources required: Lab consumables; staff time (PhD student)

2.3.5 Study on microbiomes

Note: Microbiomes of insects are understudied; changes in microbiome as a consequence of contact with chemicals may reduce their fitness; not a high priority (see threat analysis); microbiome studies are usually lethal and therefore should be done towards the end of the season
How: Meta-barcoding
Who: UA / TU
Collaboration recommended: microbiologists
By when: 2030
Indicator: Publication
Resources required: Staff time, lab costs

2.3.6 Study on effects of climate change on the availability of habitat

How: Species distribution modelling / consider soil layers and changes in land use / heat waves
Who: WBSG / UM / TU
Collaboration recommended: H2020 Safeguard
By when: 2027
Indicator: Publication
Resources required: Staff time

Objective 2.4: Monitoring

To develop and implement population monitoring for teasel-plant specialised bees as well as monitoring of the effects of conservation measures.

Actions

2.4.1 Development of a standardised monitoring protocol for teasel-plant specialised bees (D. braccata, D. spinigera, D. suripes, A. hattorfiana, T. interrupta)

How: Use non-lethal monitoring (e.g. counting nesting sites, pictures of female bees on flowers)
Who: WBSG / UM / PC
Collaboration recommended: PA staff, citizen scientists
By when: 2026
Indicator: Standardised monitoring protocol established
Resources required: Staff time, travel costs, management of volunteers

2.4.2 Integration of monitoring scheme for teasel-plant specialised bees (D. braccata, D. spinigera, D. suripes, A. hattorfiana, T. interrupta) into the European Pollinator Monitoring Scheme (EUPOMS)

Details: Monitoring of threatened species is planned in the EUPOMS 'Rare Species Module'
Who: WBSG / ICC / PC
Collaboration required: Strengthening pollinator recovery through indicators and monitoring project (SPRING) / EC
By when: 2026
Indicator: Teasel-plant specialised bees considered in EUPOMS
Resources required: Staff time

2.4.3 Establishment of a monitoring scheme for effectiveness of conservation actions for threatened teasel-plant specialised bees

How: Analyse population trends (as in 2.4.1) in response to conservation action performed / use spatially explicit information
Who: WBSG
Collaboration required: PA managers
By when: 2027
Indicator: Monitoring scheme established
Resources required: Staff time

Goal 3: Conservation action

An increase in large, well connected, sustainable areas of forage habitat (including large populations of teasel plants, such as *Scabiosa*, *Knautia, Cephalaria*) and nesting habitat (including bare sandy areas for the *Dasypoda* species) to increase populations of teasel-plant specialised bees.

Objective 3.1: Management in protected areas

To implement optimised habitat management for threatened teasel-plant specialised bees in protected areas and other areas under conservation management.

Actions

3.1.1 Ensure that existing plans of relevant Natura 2000 sites and other protected areas recognise and integrate action for teasel-plant specialised bees

Note: Protection of habitats for the target species will likely also promote other threatened insect species associated with these habitats.
How: Review existing plans, contact authorities, amend plans if necessary (first focus on the four EN species), check for conflicts with target species of Natura 2000 sites (needs specific spatial planning to avoid conflicts); provide guidance during biogeographical seminars
Who: WBSG
Collaboration recommended: LIFE4pollinators / EC
By when: 2026
Indicator: Number of plans incorporating teasel-plant specialised bees
Resources required: Staff time

3.1.2 Adapt local conservation grasslands management to increase habitat size and reduce habitat fragmentation for threatened teasel-plant specialised bees in areas with occurrence of any of the six target species.

How: Adapt mowing dates to increase amount of flowering teasel plants (late cut, leave some areas unmown), promote suitable nesting habitats (sandy bare soil areas for *Dasypoda* by removing vegetation on a large scale in key habitats or implementing a grazing management type that allows permanent availability of a heterogeneous habitat with high bare ground availability)
Where: Start in areas with currently existing populations: Italy: xerothermic oasis of Val di Susa and Orrido di Chianocco and Foresto (D. braccata), Monti Sibillini NP (A. hattorfiana); Hungary: Kiskunság National Park (T. interrupta, D. braccata); Romania: Hanu Conachi River Sand Dunes Nature Reserve (D. spinigera); Coltesti (D. argentata); France: Cevennes National Park (T. interrupta, A. hattorfiana, D. argentata); Mercantour National Park (T. interrupta, A. hattorfiana, D. argentata); Greece (D. suripes); if political situation allows, also consider important populations in the Ukraine (e.g. Black Sea Biosphere Reserve)
Who: WBSG / IUCN / ICC / PC
Collaboration required: PA managers
By when: 2027
Indicator: Management adapted
Resources required: Staff time, workshops, machines

3.1.3 Minimise impact of honey bees on remaining populations of threatened teasel-plant specialised bees.

Note: Honey bees can threaten wild bees when pollen sources are limited
How: Find local solutions in discussion with local bee-keepers (number of hives, location, seasonality…)
Where: Any location with occurrence of teasel-plant specialised bees
Who: WBSG / PC
Collaboration required: PA managers / Local and regional conservation and agricultural authorities / bee-keepers
By when: 2026

Indicator: Honey bee management agreements with bee-keepers
Resources required: Staff time, meetings

3.1.4 Develop specific (spatially explicit) habitat management protocol documents based upon the surveys and population estimates from actions 2.1.1 and 2.1.2

Where: Start in areas with currently existing populations: Italy: xerothermic oasis of Val di Susa and Orrido di Chianocco and Foresto (*D. braccata*), Monti Sibillini NP (*A. hattorfiana*); Hungary: Kiskunság National Park (*T. interrupta, D. braccata*); Romania: Hanu Conachi River Sand Dunes Nature Reserve (*D. spinigera*); France: Cevennes National Park (*T. interrupta*, *A. hattorfiana*, *D. argentata*); Mercantour National Park (*T. interrupta*, *A. hattorfiana*, *D. argentata*); Greece (*D. suripes*); if political situation allows, also consider important populations in the Ukraine (e.g. Black Sea Biosphere Reserve)
Who: WBSG / ICC / PC
Collaboration required: PA managers
By when: 2026
Indicator: Local management protocols exist
Resources required: Staff time, meetings

3.1.5 Explore options to reintroduce D. braccata, D. spinigera and D. suripes in areas or countries where they are regionally extinct

How: Requires sound knowledge of current population status, habitat requirements, climatic suitability, etc.; explore also whether *ex situ* conservation might be an option: Moving nests with larvae or pupae appears to be promising (provide boxes with sand in existing habitats to obtain nests, which are translocated); needs thorough reintroduction planning (including risk analysis of transport of parasites or pathogens)
Who: WBSG / ICC / PC
By when: 2028
Indicator: Assessment of reintroduction options
Resources required: Staff time

Objective 3.2: Improving population connectivity

To improve population connectivity by restoration or promotion of suitable habitat in critical sites for dispersal and expansion of threatened teasel-plant specialised bee populations.

Actions

3.2.1 Identify areas for an optimised habitat network for teasel-plant specialised bees

How: Identify areas to best restore habitat using 'Buzz lines modelling' (data from Goal 2 required)
Who: BL / WBSG
By when: 2027
Indicator: Spatial model
Resources required: Staff time

3.2.2 Habitat restoration: Restore bare ground areas and teasel-plant rich grassland in potential habitats close to existing populations and/or former occurrences of the species

Note: Needs research on potential restoration sites and good information on population status (see actions 3.2.1 and 2.1.1).
How: Test whether seed bank is sufficient; sow teasel plants if required; create areas of bare ground; support production of local teasel seeds; ensure adequate habitat management in restored sites (e.g. by grazing to promote long-term availability of bare ground areas)
Who: WBSG / PC
Collaboration required: Local conservation authorities / land-owners / local conservation NGOs
By when: 2028
Indicator: Restored habitat
Resources required: Staff time, meetings, machines to create areas with bare ground

Goal 4: Threat reduction

A reduction in key threats and improvement of habitat availability for teasel-plant specialised bees across key sites in priority countries.

Objective 4.1: Reduce threats and enhance habitat availability in the wider landscape

To improve management of meadows in the wider landscape by applying teasel-plant specialised bee friendly techniques (late mowing, integrated pest management, nitrogen reduction, restoration of bare ground habitats).

Actions

4.1.1 Promote late mowing of meadows to benefit teasel-plant rich meadows

How: Support late production of hay for extensive cattle management; may be implemented in agri-environmental schemes of CAP
Who: IUCN
Collaboration required: EC / National agricultural authorities
By when: 2026
Indicator: Mechanism to support late mowing exists
Resources required: Staff time, meetings

4.1.2 Promote late mowing of public spaces (roadsides, power lines, parks, gardens, etc.)

How: Meetings with authorities responsible for public spaces
Who: WBSG / IUCN
Collaboration required: Authorities in charge of green spaces / Environmental authorities
By when: 2027
Indicator: Increase of public spaces with late cuts
Resources required: Staff time, meetings

4.1.3 Promote integrated pest management and reinforce recommendation to ban or reduce pesticides and herbicides in protected areas with occurrence of teasel-plant specialised bees

How: Integration in Sustainable Use of Pesticides Directive has been proposed by the European Commission. A good integration in this directive and Farm to Fork Strategy is required
Who: IUCN / IEEP
Collaboration recommended: EC / National agricultural and environmental authorities
By when: 2026
Indicator: Integrated pest management plans exist for areas with teasel-plant specialised bees
Resources required: Staff time, meetings

4.1.4 Promote reduction of nitrogen deposition in grassland areas rich in teasel plants and ensure maintenance of low nutrient levels in areas which are already suitable

How: Consider EU Nitrogen Directive
Who: IUCN
Collaboration recommended: EC / National agricultural and environmental authorities
By when: 2027
Indicator: Nitrogen reduction plans for areas rich in teasel plants exist
Resources required: Staff time, meetings

Goal 5: Public awareness

An increase in awareness of teasel-plant specialised bees, the value of teasel plants (e.g. *Scabiosa* as medicinal plant) and nesting habitats, and their threats, as well as local communities actively engaged in their conservation.

Objective 5.1: Public awareness of teasel-plant specialised bees

To increase awareness of teasel-plant specialised bees in Europe, their food plants and habitats among the general public, land managers and farmers.

Actions

5.1.1 Prepare general outreach material (infographics, etc.) on teasel-plant specialised bees, including information on their biology, requirements, threats and successful conservation action

Who: WBSG / PC
By when: 2024 (update based upon completed actions 2027)
Indicator: Outreach material available
Resources required: Staff time, designer

5.1.2 Create information signs in protected areas with occurrence of threatened teasel-bee specialised bees to inform about the values, habitats and threats

How: Use outreach material from 5.1.1. (+QR code to more detailed information, e.g. on EU Pollinator Information Hive page)
Who: WBSG / PC
Collaboration required: PA managers / Local conservation authorities
By when: 2025 (update 2028)
Indicator: Signs exist in PAs
Resources required: Staff time, material, designer

5.1.3 Provide information about the teasel-plant specialised bee action plan and implementation on the EU Pollinator Information Hive

Details: Publish action plan on EU Pollinator Information Hive, provide outreach material from 5.1.1 and case studies from 5.1.4
Who: WBSG / ICC / PC / IUCN
Collaboration required: EC
By when: 2023 (annual updates afterwards)
Indicator: Information exists on EU Pollinator Information Hive
Resources required: Staff time

5.1.4 Provide case studies on successful teasel-plant specialised bee management

How: Distribute via IUCN SSC Species e-bulletin / WCPA newsletter / PARKS journal / DG ENV (Natura 2000 newsletter) / EU Pollinator Information Hive / NGOs distribute to farmers and farm advisors / bee-keepers
Who: WBSG / ICC / IUCN
Collaboration recommended: EC / EPBA
By when: 2029
Indicator: Case studies published
Resources required: Staff time

5.1.5 Disseminate information on teasel-plant specialised bee conservation in LIFE project 'LIFE4pollinators'

How: Use communication tools of LIFE project to disseminate information on teasel-plant specialised bees (about this plan and also the outcomes)
Who: WBSG / PC
Collaboration required: LIFE4pollinators
By when: 2023
Indicator: Information on teasel-plant specialised bees disseminated
Resources required: Staff time

5.1.6 Awareness raising with farmers

How: Meet with local farmers to discuss options to adapt management / Use information material for farmers to promote teasel-plant rich meadows (high quality hay) / oasis of biodiversity
Who: WBSG / PC
Collaboration recommended: Poshbee project
By when: 2027
Indicator: Meetings with farmers conducted
Resources required: Staff time, meetings, material

Objective 5.2: Citizen engagement

To provide means for citizens, communities and institutions to engage in the conservation of teasel-plant specialised bees by planting food, improving habitat management or contributing to monitoring.

Actions

5.2.1 Develop a label 'teasel-bee village' to distinguish municipalities which apply teasel-plant specialised bee friendly habitat management

How: Develop a catalogue of requirements to obtain the label (e.g. reducing pesticides, late mowing, planting/sowing teasel plants, developing local action plans)
Who: WBSG / BL / PC
Collaboration required: EC / municipalities
By when: 2028
Indicator: Label exists
Resources required: Staff time, material

5.2.2 Develop an illustrated catalogue of teasel-bee-friendly plants for public spaces and private gardens

How: Include photos to illustrate their beauty
Who: WBSG / PC
By when: 2024
Indicator: Catalogue exists
Resources required: Staff time, designer

5.2.3 Engage citizens in habitat maintenance or restoration

How: Organise local habitat management or restoration events (e.g. scything)
Who: PC
Collaboration required: PA managers / local NGOs
By when: 2028
Indicator: Management event held
Resources required: Staff time, training, event

5.2.4 Engage citizens in teasel-plant specialised bee monitoring

How: Take pictures of bees on teasel plants (like for example www.spipoll.org in France; www.najdije.cz in the Czech Republic) or use more globally active citizen science projects like observation.org or iNaturalist
Who: WBSG / PC
Collaboration required: PA managers / local NGOs
By when: 2027
Indicator: Citizen science monitoring started
Resources required: Staff time, training

Annex (timelines of the plan)

Annex
(timelines of the plan)

The plan is organised in two phases (2023–2026 and 2027–2030). Grey cells show general times of activity, while dark grey cells show the milestones as defined in the action plan.

Action	Short title		2022	2023	2024	2025	2026	2027	2028	2029	2030
1.1.1	Creation of a steering group		x	x	x	x	x	x	x	x	x
1.1.2	Facilitate implementation of the action plan			x							
1.2.1	National Red-Lists assessments			x	x	x	x				
1.2.2	National List of protected species				x	x	x	x	x	x	x
1.3.1	EU restoration strategy			x	x	x					
1.3.2	Expansion of EU protected area network			x	x	x					
1.3.3	Convene a stakeholder platform for recommendations					x					
1.3.4	Sustainable management of honey bees					x	x	x	x	x	x
1.4.1	Teasel bees in N2000 habitat action plans			x	x	x					
1.4.2	Teasel bees in National Action Plans			x	x	x					
1.5.1	Gap analysis (teasel bees outside PAs)			x	x	x	x	x			
1.5.2	PA planning for Endangered teasel bees				x	x	x	x	x	x	x
1.5.3	PA planning for *A. hattorfiana* & *D. argentata*				x	x	x	x	x	x	x
2.1.1	Survey of historic records			x	x	x	x				
2.1.2	Population size estimates (Mark-recapture)				x	x	x				
2.1.3	Genetic diversity of teasel bee populations				x	x	x	x			
2.1.4	Survey on DD teasel bees				x	x	x	x	x	x	x
2.1.5	Habitat survey				x	x	x	x	x	x	x
2.2.1	Research on habitat preferences				x	x	x	x			
2.2.2	Research on minimum number of host plants					x	x				
2.2.3	Study on mobility				x	x	x				
2.3.1	Study on grazing/mowing regime				x	x	x	x			
2.3.2	Best practice guidelines							x			x
2.3.3	Study on green infrastructure					x	x	x			
2.3.4	Study on parasites								x	x	
2.3.5	Study on microbiomes									x	x
2.3.6	Study on effects of climate change					x	x	x			

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Annex(timelines of the plan)

2.4.1	Standardised monitoring protocol						x	x	x	x	x
2.4.2	Integration in EUPOMS						x				
2.4.3	Monitoring effectiveness of conservation action							x	x	x	x
3.1.1	Integration in plans of protected areas					x	x				
3.1.2	Adaptation of grassland management					x	x	x	x	x	x
3.1.3	Minimise impact of honey bees				x	x	x	x	x	x	x
3.1.4	Specific management recommendations						x	x	x	x	x
3.1.5	Assess reintroduction options							x	x	x	
3.2.1	Bee-line modelling						x	x			
3.2.2	Habitat restoration							x	x	x	x
4.1.1	Promote late mowing of meadows				x	x	x	x	x	x	x
4.1.2	Promote late mowing of public spaces				x	x	x	x	x	x	x
4.1.3	Promote reduction of pesticides				x	x	x	x	x	x	x
4.1.4	Promote reduction of nitrogen deposition				x	x	x	x	x	x	x
5.1.1	Prepare general outreach material			x	x	x	x	x	x		
5.1.2	Information signs in PAs			x	x	x	x	x	x		
5.1.3	Info in Pollinator Hive		x	x	x	x	x	x	x	x	x
5.1.4	Case studies on successful management								x	x	x
5.1.5	Dissemination via LIFE for pollinators			x							
5.1.6	Awareness raising with farmers				x	x	x	x	x	x	x
5.2.1	Label ‘teasel-bee village’							x	x	x	x
5.2.2	Illustrated catalogue of teasel-bee plants				x						
5.2.3	Citizens in habitat management & restoration							x	x	x	x
5.2.4	Citizens in teasel-bee monitoring							x	x	x	x

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