



## Eight new species of *Andrena* Fabricius (Hymenoptera: Apoidea: Andrenidae) from Israel—a Mediterranean hotspot for wild bees

GIDEON PISANTY<sup>1,4</sup>, ERWIN SCHEUCHL<sup>2</sup> & NETTA DORCHIN<sup>3</sup>

<sup>1</sup>Department of Zoology, Tel Aviv University, Tel Aviv 69978, Israel. E-mail: [gdpisa79@yahoo.com](mailto:gdpisa79@yahoo.com)

<sup>2</sup>Kastanienweg 19, Ergolding, Germany. E-mail: [erwin.scheuchl@t-online.de](mailto:erwin.scheuchl@t-online.de)

<sup>3</sup>Department of Zoology, Tel Aviv University, Tel Aviv 69978, Israel. E-mail: [ndorchin@tauex.tau.ac.il](mailto:ndorchin@tauex.tau.ac.il)

<sup>4</sup>Corresponding author

### Abstract

More than 150 solitary bee species of the genus *Andrena* Fabricius are known from Israel and the West Bank, where they are distributed along a broad climatic gradient and diverse habitats and vegetation types. Extensive collecting throughout Israel in recent years has yielded eight new species and one new subspecies, adding to the rich bee fauna of the region: *A. crocusella* Pisanty & Scheuchl **n. sp.**, *A. danini* Pisanty & Scheuchl **n. sp.**, *A. hermonella* Scheuchl & Pisanty **n. sp.**, *A. israelica* Scheuchl & Pisanty **n. sp.**, *A. judaea* Scheuchl & Pisanty **n. sp.**, *A. menahemella* Scheuchl & Pisanty **n. sp.**, *A. palaestina* Pisanty & Scheuchl **n. sp.**, *A. perahia* Pisanty & Scheuchl **n. sp.**, and *A. sphecodimorpha mediterranea* Pisanty & Scheuchl **n. ssp.** The previously unknown female of *A. fimbriatoides* Scheuchl 2004 and male of *A. wolffi* Gusenleitner & Scheuchl 2000 are also described here for the first time. The discovery of males of *A. wolffi* lead us to reinstate *A. iohannescaroli* Nobile 2000 as a valid taxon. Detailed morphological description and differential diagnosis against closest relatives are provided for all species, as well as information on the distribution, phenology and flower visitation, when available. A neotype is designated for *A. sphecodimorpha* Hedicke, the holotype of which is considered to be lost. Additional collecting efforts in diverse habitats and seasons, incorporating diverse collecting techniques, are required in order to deepen our knowledge of the rich bee fauna in threatened habitats in the Mediterranean Basin, which constitutes one of the world's major hotspots for wild bees.

**Key words:** Eastern Mediterranean, Levant, neotype, new species, pan trap, solitary bee

### Introduction

The importance of wild pollinator communities, and specifically wild bees, has been repeatedly demonstrated in recent decades (Klein *et al.* 2007; Garibaldi *et al.* 2013), following accumulating evidence for pollinator decline (Potts *et al.* 2010) and a growing demand for animal pollination in agriculture (Aizen *et al.* 2008). Mediterranean biomes host some of the most diverse bee faunas in the world (Michener 1979), and Israel and the West Bank alone are home to approximately 1100 known species (O'Toole & Raw 1991; M. Guershon, pers. comm.), distributed along a broad climatic gradient in diverse habitats and vegetation types. Unfortunately, a steady growth in human population and increasing development pressures throughout the Mediterranean Basin jeopardize the unique biodiversity in this region (Cuttelod *et al.* 2009; Underwood *et al.* 2009). Rare species of small insects can easily become extinct under such conditions, sometimes disappearing even before they have been discovered (Dunn 2005). Systematic studies of the rich arthropod fauna of this region are therefore crucial for devising local conservation priorities and protecting the region's rich biodiversity (Cuttelod *et al.* 2009; Underwood *et al.* 2009).

*Andrena* Fabricius is a diverse bee genus of roughly 1500 species that are distributed mostly throughout the northern hemisphere, with more than 900 species in the Palaearctic region, 500 in North America, and only nine species known from the southern hemisphere (Gusenleitner & Schwarz 2002; Michener 2007). *Andrena* spp. are solitary to communal, ground-nesting bees, whose body size varies greatly among species. Many species specialize on pollen from a distinct plant taxon, whereas others are generalists (Michener 2007). Nevertheless, pollen

preferences are unknown for the majority of species, especially in relatively poorly studied regions such as the Middle East. This large genus has been divided into about 100 subgenera, largely on the basis of morphological characters (Warncke 1968; Gusenleitner & Schwarz 2002; Michener 2007; Dubitzky *et al.* 2010). More than 150 *Andrena* species have been recorded from Israel and the West Bank (Gusenleitner & Scheuchl 2000), and many new species have been described from the region (Gusenleitner & Schwarz 2002). The genus occurs throughout Israel's broad climatic gradient, from the snowy and windy heights of Mount Hermon, to the extreme desert of the southern Negev and Arava. The *Andrena* fauna of Israel has been studied by several researchers, in particular Klaus Warncke, who published a comprehensive checklist of the Israeli species (Warncke 1969). In the 47 years that followed, additional records from Israel have accumulated, including descriptions of new species (e.g. Gusenleitner & Scheuchl 2000). Following a growing worldwide concern about pollinator decline in the late 1990s, several community-scale studies were conducted throughout Israel, which included extensive collecting surveys. These studies assessed the structure of pollinator communities, their potential as crop pollinators, and the effects of anthropogenic disturbances on them (e.g. Potts *et al.* 2003; Gotlieb *et al.* 2011; Dorchin 2013; Pisanty & Mandelik 2015). The surveys included both active net collecting and passive collecting using pan traps (LeBuhn *et al.* 2003), and yielded tens of thousands of specimens, with numerous new records to Israel as well as several undescribed species. The use of pan traps in particular has made an important contribution to the collecting efforts, resulting in the recovery of taxa that were rarely if ever captured by net. Based on these recent collecting efforts, we hereby describe eight new species and one new subspecies of *Andrena*, as part of the ongoing studies on the Israeli bee fauna.

## Materials and methods

This study is based largely on examination of specimens collected in studies of bee communities of the Judean Foothills (Pisanty & Mandelik 2015; Shapira 2015; Y. Mandelik, unpublished data) and Arava Valley (A. Gotlieb, unpublished data). During 2015–2016, the first author revisited selected sites to gather more specimens and search for unknown sexes. Additional material from various collecting excursions throughout Israel, which had been deposited over the years in the Steinhardt Museum of Natural History at Tel Aviv University (SMNHTAU), was also examined. Specimens were compared with type and non-type specimens in the collection of Biologiezentrum Linz, Austria, which is one of the most important collections of western Palaearctic bees.

All measurements were done with an ocular scale on a Leica M80 stereomicroscope. Unless otherwise specified, all indicated lengths and widths were measured at the longest/ broadest point of the relevant part, respectively. Body length was measured in lateral view as the sum of distances from the antennal sockets to the posterior end of the propodeum and from the latter to the tip of the metasoma. Measurement of the glossa refers only to the distal segment of the proboscis, without the prementum, as defined by Michener (2007). Other morphological terms also follow Michener (2007). Photographs were taken using a Leica DMC295 camera through a Leica 12.5 stereomicroscope. Some male specimens were dissected to reveal characters of the genitalia and hidden sterna, which are vital for identification. The dissected parts were glued to cardboards, photographed, and mounted on the same pins with the respective specimens.

Most type material is deposited in SMNHTAU. Other depositories are listed in the relevant parts of the descriptions below under the following abbreviations: AMNH—American Museum of Natural History, New York, NY, USA; ES—Private collection of Erwin Scheuchl, Ergolding, Germany; OLML—Biologiezentrum Linz, Oberösterreichisches Landesmuseum, Linz, Austria; USNM—National Museum of Natural History, Washington DC, USA; ZSMC—Zoologische Staatssammlung München, Germany.

## Results and discussion

Our examination of material from various collecting excursions throughout Israel has yielded eight species and one subspecies of *Andrena* new to Science. Additionally, the previously unknown sexes of two known species were discovered. For each taxon, we provide detailed morphological description, differential diagnosis against the closest relatives, and information on distribution, phenology and flower visitation. Interestingly, almost each of the newly described taxa belongs to a different subgenus. Two new species originate from the country's two extreme

habitats, the top of Mount Hermon and the Arava Valley; the remaining seven taxa inhabit diverse Mediterranean shrublands. One new species was collected during late autumn to early winter, which is probably the period with the lowest wild bee activity in the region, and when bee surveys are rarely conducted. Furthermore, some species were collected mostly or almost exclusively using pan traps. It appears that some bee species tend to evade capture by standard netting techniques, possibly due to distinct foraging habits and/or small body size, and other collection methods such as pan traps are needed to recover them. However, pan traps should be used with caution, as their long-term use may have negative consequences on bee communities (Schindler et al. 2013). Our findings highlight the need for extensive sampling of bees in diverse habitats and seasons, and with the aid of diverse collecting techniques, in order to achieve a comprehensive and reliable representation of the native bee communities. The following descriptions appear in alphabetical order of the subgenera.

***Andrena* (?*Aciandrena*) *israelica* Scheuchl & Pisanty n. sp.**

(Figs. 1A, C, E, G, 2A, C, E, G, 12A, 13A)

**Female** (Fig. 1A). **Body length:** 5–5.5 mm.

**Color.** Head, mesosoma and terga black to dark brown; head, mesonotum, scutellum and metanotum sometimes with weak metallic hue. Apical half of mandible reddish-brown. Flagellomeres 3–10 reddish-orange anteriorly (Fig. 1C), reddish-brown posteriorly. Legs and sterna brown. Tergal marginal zones yellowish-brown (Fig. 2C). Wings transparent, veins brown (Fig. 2A).

**Pubescence.** Head and dorsal side of mesosoma with short, yellowish-white plumose hairs (Fig. 1C, G). Mandibles with simple hairs of varying length. Facial foveae hairs brown in dorsal view (Fig. 1G). Anterior side of mesepisternum with long, white plumose hairs. Propodeal corbicula incomplete, posterodorsal margin with long, white, strongly plumose hairs. Surface of corbicula with few long, white, simple hairs. Legs with mostly white hair. Flocculus hairs plumose; scopal hairs mostly simple. Discs of terga 1–2 almost bare, 3 and especially 4–5 with short inconspicuous hairs (Fig. 2C). Terga 2–3 with weak lateral tufts of hair. Premarginal line of tergum 4 with continuous weak band of sparse golden hairs. Prepygidial fimbria golden (Fig. 2C). Sterna with white hairs, longer and more plumose towards marginal zone.

**Head** (Fig. 1C, E, G). Slightly broader than long (Fig. 1C). Galea shagreened. Labral process narrow, curved-trapezoidal. Clypeus convex, somewhat shiny, strongly shagreened except near apex, sparsely and very shallowly punctured, distance between punctures 2–4 puncture diameters, puncture size medium (Fig. 1E). Facial foveae long, occupying about 1/2 of paraocular area width, slightly tapering at lower part, shallow above and deepening downwards, extending from level of lower end of lateral ocellus to slightly below lower end of antennal socket (Fig. 1C, G). Flagellomere 1 slightly longer than broad, shorter than or equal to 2+3; 2–3 broader than long, 2 slightly shorter than or equal to 3; 4–5 almost square (Fig. 1C). Distance of fovea from lateral ocellus 1–1.5 ocellus diameters. Ocelloccipital distance 1/2–3/4 ocellus diameter (Fig. 1G).

**Mesosoma** (Figs. 1G, 2A). Dorsolateral angle of pronotum not to very weakly elevated. Mesonotum and scutellum strongly shagreened allover but shiny, sparsely and very shallowly punctured, distance between punctures 2–4 puncture diameters, puncture size medium (Fig. 1G). Mesepisternum shagreened-alveolate. Propodeal corbicula reticulately shagreened. Propodeal triangle finely reticulated. Basal part of propodeum broad, almost horizontal (Fig. 1G). Hind leg pretarsal claws with hint of minute inner tooth. Submarginal crossvein 1 reaching marginal cell 0–2 vein widths from stigma (Fig. 2A). Recurrent vein 1 meeting submarginal cell 2 at 1/3–1/2 of distance between submarginal cells 1–2. Nervulus strongly antefurcal, distance from basal vein 2.5–4.5 vein widths (Fig. 2A).

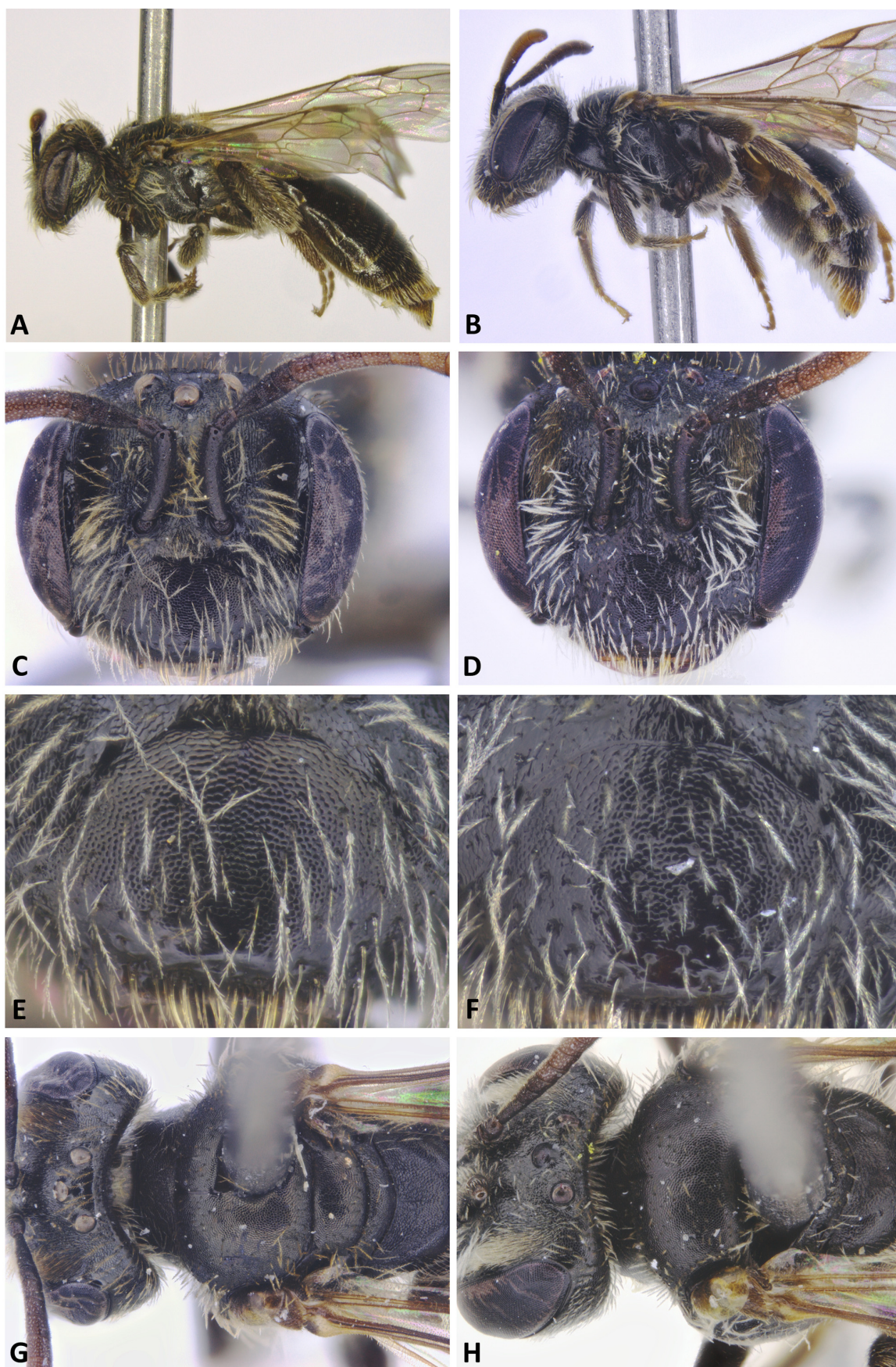
**Metasoma** (Fig. 2C). Terga shiny, shagreened and impunctate. Marginal zones 2–4 depressed. Pygidial plate concave, shagreened.

**Male** (Fig. 2E). **Body length:** 4.5–5 mm.

**Color.** Flagellomeres 3–11 reddish-brown anteriorly, reddish-brown to brown posteriorly (Fig. 2G). Rest of body similar to female (clypeus and paraocular area black).

**Pubescence.** Clypeus, vertex, paraocular, supraclypeal and genal areas, mesepisternum, mesonotum, scutellum and lateral parts of propodeum with long white to golden plumose hairs. Legs with white hairs. Metasomal hair as in female.





**FIGURE 1.** *Andrena israelica* n. sp. (A, C, E, G) and *A. judaea* n. sp. (B, D, F, H), females: A–B, habitus, lateral view; C–D, head, anterior view; E–F, clypeus; G–H, head and mesosoma, dorsal view.





**FIGURE 2.** *Andrena israelica* n. sp. (A, C, E, G) and *A. judaea* n. sp. (B, D, F, H): A–B, female, forewing (arrow indicates nervulus–basal vein distance); C–D, female, metasoma, dorsal view; E–F, male, habitus, lateral view; G–H, male, head, anterior view.

**Head** (Fig. 2G). Flagellomere 1 about as long as broad, slightly longer than 3; 2–3 broader than long, 2 shorter than 3; 4–5 square. Rest of head similar to female.

**Mesosoma.** Similar to female, but shagreenation of mesonotum and scutellum stronger.

**Metasoma.** Similar to female.

**Genitalia and hidden sterna** (Figs. 12A, 13A). Dorsal lobe of gonocoxite short and rounded. Gonostylus flat, elongate, slightly broadening apically. Penis valves long and narrow, tapering apically, apex needlelike (Fig. 12A). Sternum 8 columnar, elongate, ventral side with dense long hairs, apex broadened (Fig. 13A).

**Differential diagnosis.** *A. israelica* is characterized by the combination of a finely reticulated propodeal triangle, relatively broad and not much tapering facial foveae, and black male clypeus, which distinguishes it from most members of *Aciandrena*, *Graecandrena* and *Micrandrena*. Additional important features include the small body size, shiny cuticle (especially the mesonotum), convex, weakly punctured, mostly shagreened clypeus, and strongly antefurcal nervulus. The female of *A. israelica* closely resembles that of *A. judaea* n. sp., but differs from it in the following characters: head and mesosoma often with metallic hue, hairs covering facial fovea brown in dorsal view (whitish in *A. judaea*, Fig. 1G–H), punctation of mesonotum and especially clypeus weaker and sparser (Fig. 1E–F), nervulus usually more strongly antefurcal (Fig. 2A–B), and shagreening of terga 1–2 weaker (Fig. 2C–D).

**Flight period:** February–April.

**Flower records:** none. The majority of specimens collected from pan traps.

**Etymology.** The species is named after the State of Israel, where it was collected and appears to be common. The names of the closely related species *A. israelica* and *A. judaea* allude to the neighboring biblical kingdoms of Israel and Judah, whose boundaries loosely reflect the species' currently known distributions.

**Holotype:** ♂, ISRAEL: Lakhish, 5km ENE, 18.ii.2013, T. Shapira [SMNHTAU].

**Paratypes:** ISRAEL: Alonim, 17.iii, H. Bytinski-Salz (1♀)<sup>a</sup>; Bet Nir, 28.iii.2010, G. Pisanty (1♀); Bet Oren, 23.iii.1973, A. Freidberg (2♀)<sup>a,b</sup>; Devira, 12.iv.2009, L. Friedman (1♂); Ein Avazim, S Qyriat Shemona, 6.iii.1995, R. Kasher (1♀, 1♂); Elon, 8.iii.1970, H. Bytinski-Salz (2♀, 1♂)<sup>a</sup>; En Harod, 5.iii.1948, H. Bytinski-Salz (1♀)<sup>a</sup>; Haifa, 17.ii.1973, A. Freidberg (6♀, 8♂)<sup>a</sup>; 26.ii.1977, A. Freidberg (1♀); HareGilboa', Merav, 420m, 11.iv.2011, A. Freidberg (1♀); Kohav Ya'ir, 160m, 16.ii.2010, L. Friedman (1♀); Kfar Menahem, 1.iii.2008, Y. Mandelik (3♀, 1♂); 2.iii.2008, U. Roll (1♀); Kineret, 4.iii.1968, H. Bytinski-Salz (1♀, 1♂)<sup>a</sup>; Lahav, 27.ii.1974, A. Freidberg (1♂)<sup>a</sup>; Lakhish, 2km E, 22.ii.2012, T. Shapira (2♂); 4.iii.2016, G. Pisanty (1♀); Lakhish, 2.5km ENE, 6.iii.2013, T. Shapira (3♀, 1♂); 13.iv.2013, T. Shapira (3♀); Lakhish, 3km NE, 19.ii.2016, G. Pisanty (1♀, 2♂); 26.ii.2016, G. Pisanty (1♀, 1♂); 4.iii.2016, G. Pisanty (1♂); Lakhish, 5km ENE, 18.ii.2013, T. Shapira (38♀, 49♂); 7.iii.2013, T. Shapira (13♀, 1♂); 19.iii.2013, T. Shapira (9♀, 1♂); 8.iv.2013, T. Shapira (18♀); Monfort, 10.iii.1981, F. Kaplan (2♀); Nahal Oren, 4.iii.1975, F. Kaplan (1♀); Nahal 'Iyyon, 430m, 15.iii.2011, A. Freidberg (1♂); Ramat Hanadiv, 13.ii.2013, T. Shapira (3♀, 1♂); Tel Kazir, 5.iii.1968, H. Bytinski-Salz (1♀)<sup>a</sup>. WEST BANK: Nahal Teqoa', 31.iii.2009, A. Freidberg & M. Guershon (8♀) [AMNH, ES, OLML, SMNHTAU, USNM, ZSMC].

<sup>a</sup>These specimens bear a red “Paratype” label and a white label “*Andrena minutissima* War. det. Dr. Warncke”.

<sup>b</sup>This specimen bears a red “Holotype” label and a white label “*Andrena minutissima* War. det. Dr. Warncke”.

**Other material examined:** ISRAEL: Dovev, 19.iv.2015, O. Winberger (1♀, 1♂); Lakhish, 2.5km ENE, 20.iii.2013, T. Shapira (1♀); Lakhish, 5km ENE, 8.iv.2013, T. Shapira (1♀); Ramat Hanadiv, 13.ii.2013, T. Shapira (1♀); Malkiyya, 28.iv.2015, O. Winberger (1♀); Ramot Naftali, 5.iv.2015, O. Winberger (2♀).

**Remarks.** The subgeneric classification of *A. israelica* is not sufficiently clear. The species exhibits a unique combination of characters (especially those of the facial foveae and propodeal triangle), which does not conform well to any particular subgenus, and appears to fall between *Aciandrena* and *Micrandrena*. The species was originally recognized as new by Klaus Warncke, who labeled a holotype and numerous paratypes under the name *A. minutissima*. Warncke donated a considerable number of his intended paratypes to other collections, but was killed in a car accident in Egypt in 1993 before he could publish a proper description of this species. Consequently, *A. minutissima* is a nomen nudum and there may be many samples in a number of European collections, which are incorrectly labeled as types. Adding to the confusion, Osytshnjuk (1995) described a different, Eastern Palaearctic species of *Andrena* under the name *A. minutissima*. We have therefore chosen a new name for Warncke's species—*A. israelica*.



***Andrena* (?*Aciandrena*) *judaea* Scheuchl & Pisanty n. sp.**

(Figs. 1B, D, F, H, 2B, D, F, H, 12B, 13B)

**Female** (Fig. 1B). **Body length:** 4.5–5 mm.

**Color.** Head and mesosoma black (Fig. 1D, H). Apical half of mandible reddish-brown. Flagellomeres 4–10 (sometimes also 3) orange anteriorly, reddish-brown posteriorly (Fig. 1B, D, H). Legs black to brown. Wings transparent, veins brown, stigma orange (Fig. 2B). Terga black to dark brown. Tergal marginal zones yellowish-brown (Fig. 2D). Sterna brown.

**Pubescence.** Head and dorsal side of mesosoma with short, white to yellowish plumose hairs (Fig. 1D, H). Mandibles with simple hairs of varying length. Facial fovea hairs white to yellowish-white in dorsal view (Fig. 1H). Anterior side of mesepisternum with long, white plumose hairs. Propodeal corbicula incomplete, posterodorsal margin with long, white, strongly plumose hairs. Surface of corbicula with few long, white, simple hairs. Leg hairs white to golden. Flocculus hairs plumose; scopal hairs mostly simple. Discs of terga 1–2 almost bare, 3 and especially 4–5 with short inconspicuous hairs (Fig. 2D). Terga 2–3 with white, discontinuous apical hair bands. Tergum 4 with continuous weak apical band of sparse golden hairs. Prepygidial fimbria golden (Fig. 2D). Sterna with white hairs, longer and more plumose towards marginal zone.

**Head** (Fig. 1D, F, H). Slightly broader than long (Fig. 1D). Galea finely shagreened. Labral process trapezoidal to triangular. Clypeus convex, shiny, strongly shagreened except near apex, distance between punctures 1–2 puncture diameters, punctures of medium size and depth (Fig. 1F). Facial foveae long, occupying about 1/2 of paraocular area width, slightly tapering at lower part, shallow above and deepening downwards, extending from level of lower end of lateral ocellus to lower end of antennal socket (Fig. 1D, H). Flagellomere 1 about 1.5 times as long as broad, shorter than or equal to 2+3; 2–3 slightly broader than long, of equal length; 4–5 almost square (Fig. 1D). Distance of fovea from lateral ocellus 0.5–1 ocellus diameters. Ocelloccipital distance 1/2–3/4 ocellus diameter (Fig. 1H).

**Mesosoma** (Figs. 1H, 2B). Dorsolateral angle of pronotum not elevated. Mesonotum and scutellum strongly shagreened allover but shiny, sparsely punctured, distance between punctures 2–4 puncture diameters, punctures of medium size and depth (Fig. 1H). Mesepisternum shagreened-alveolate. Propodeal corbicula reticulately shagreened. Propodeal triangle finely reticulated. Basal part of propodeum broad, almost horizontal (Fig. 1H). Hind leg pretarsal claws with minute inner tooth. Submarginal crossvein 1 reaching marginal cell 1–2 vein widths from stigma (Fig. 2B). Recurrent vein 1 meeting submarginal cell 2 at 1/3–1/2 of distance between submarginal cells 1–2. Nervulus weakly to moderately antefurcal, distance from basal vein 1.5–3.5 vein widths (Fig. 2B).

**Metasoma** (Fig. 2D). Terga shiny and impunctate, 1–2 and sometimes 3 strongly shagreened, apical terga moderately so. Marginal zones 2–4 weakly depressed. Pygidial plate concave, shagreened.

**Male** (Fig. 2F). **Body length:** 4–4.5 mm.

**Color.** Clypeus yellow, with two lateral black spots, and sometimes a narrow black basal margin (Fig. 2H). Paraocular area black. Flagellum black to dark brown, slightly brighter apically. Mesosoma black. Legs black to brown. Wings transparent, veins brown, stigma brownish-orange. Terga black, marginal zones yellowish-brown. Sterna brown to black.

**Pubescence.** Clypeus, paraocular and supraclypeal areas with white hairs (Fig. 2H). Genal area with white hairs, very long on ventral side. Mesosoma with long white hairs, sparse on dorsal side and dense on mesepisternum. Legs with white to yellowish-white hairs. Tergal discs with short and thin, inconspicuous hairs, slightly longer on apical terga. Tergum 1 with small lateral tufts of short white hair. Terga 2–4 with white, discontinuous, weak apical hair bands, weaker on tergum 4. Tergum 5 with continuous weak apical band of sparse yellowish hairs. Anal fimbria yellowish. Sterna with white hairs, longer towards marginal zone.

**Head** (Fig. 2H). Broader than long. Galea finely shagreened. Clypeus convex, shagreened, distance between punctures 1–2 puncture diameters, punctures of medium size and depth. Flagellomere 1 about 1.3 times as long as broad, much shorter than 2+3; 2 broader than long, slightly shorter than 3; 3–5 almost square. Ocelloccipital distance 1/2 ocellus diameter.

**Mesosoma.** Similar to female, but position of nervulus more variable (interstitial to strongly antefurcal).

**Metasoma.** Similar to female.

**Genitalia and hidden sterna** (Figs. 12B, 13B). Dorsal lobe of gonocoxite weak, very short and rounded. Gonostylus flat, elongate, slightly broadening apically. Penis valves long and narrow, tapering apically, apex



needlelike (Fig. 12B). Sternum 8 columnar, elongate, ventral side with dense, long hairs, apex broadened, trapezoidal (Fig. 13B).

**Differential diagnosis.** *A. judaea* is characterized by the combination of a very small body size, finely reticulated propodeal triangle, relatively broad and not much tapering facial foveae, and very weak dorsal gonocoxite lobe, which distinguishes it from most members of *Aciandrena*, *Graecandrena* and *Micrandrena*. Additional important features include the shiny cuticle (especially the mesonotum), convex, moderately punctured, mostly shagreened clypeus, and the female's weakly to moderately antefurcal nervulus. The female of *A. judaea* closely resembles that of *A. israelica* n. sp., but differs from it in the following characters: head and mesosoma lacking metallic hue (often present in *A. israelica*), hairs covering facial fovea whitish in dorsal view (brown in *A. israelica*, Fig. 1G–H), punctation of mesonotum and especially clypeus stronger and denser (Fig. 1E–F), nervulus usually more weakly antefurcal (Fig. 2A–B), and shagreening of terga 1–2 stronger (Fig. 2C–D).

**Flight period:** March–April.

**Flower records:** Crassulaceae: *Sedum hispanicum* (10♀, 1♂); *Sedum* sp. (15♀, 26♂).

**Etymology.** The species is named after the Judean Foothills in Israel, where it was collected. The names of the closely related species *A. israelica* and *A. judaea* allude to the neighboring biblical kingdoms of Israel and Judah, whose boundaries loosely reflect the species' currently known distributions.

**Holotype:** ♂, ISRAEL: Lakhish, 3km NE, 23.iii.2016, G. Pisanty [SMNHTAU].

**Paratypes:** ISRAEL: Bet Jamal, 23.iii.1968, H. Bytinski-Salz (2♂); Gal'on, 23.iii.2010, G. Pisanty (1♂); Jerusalem, 10.iv.1899 (1♂); Jerusalem, Rehavia West, 27.iv.1945 (10♀, 1♂); Lakhish, 2km E, 21.iii.2012, T. Shapira (9♂); 4.iii.2016, G. Pisanty (1♀); Lakhish, 2.5km ENE, 6.iii.2013, T. Shapira (2♀); 20.iii.2013, T. Shapira (3♀, 2♂); 13.iv.2013, T. Shapira (14♀); Lakhish, 3km NE, 11.iii.2016, G. Pisanty (1♀); 19.iii.2016, G. Pisanty (2♀, 9♂); 23.iii.2016, G. Pisanty (15♀, 19♂); Lakhish, 5km ENE, 19.iii.2013, T. Shapira (2♀); 8.iv.2013, T. Shapira (10♀); Nahshon, 25.iii.2010, G. Pisanty (1♀); Park Britannia, 7.iv.2010, T. Koznichki (2♀); Wadi Fallah (Nahal Oren), 14.iii.1970, H. Bytinski-Salz (3♂) [AMNH, ES, OLML, SMNHTAU, USNM, ZSMC].

**Other material examined:** ISRAEL: Lakhish, 2.5 km ENE, 13.iv.2013, T. Shapira (1♀); Lakhish, 5 km ENE, 8.iv.2013, T. Shapira (1♀).

**Remarks.** Individuals of this species were observed flying very close to the ground among patches of small, annual *Sedum* spp. The subgeneric classification of the species is not sufficiently clear, as it exhibits a unique combination of characters (especially those of the facial foveae, propodeal triangle, male clypeus and genitalia), which does not conform well to any particular subgenus, and appears to fall between *Aciandrena* and *Micrandrena*.

### *Andrena (Chlorandrena) danini* Pisanty & Scheuchl n. sp.

(Fig. 3)

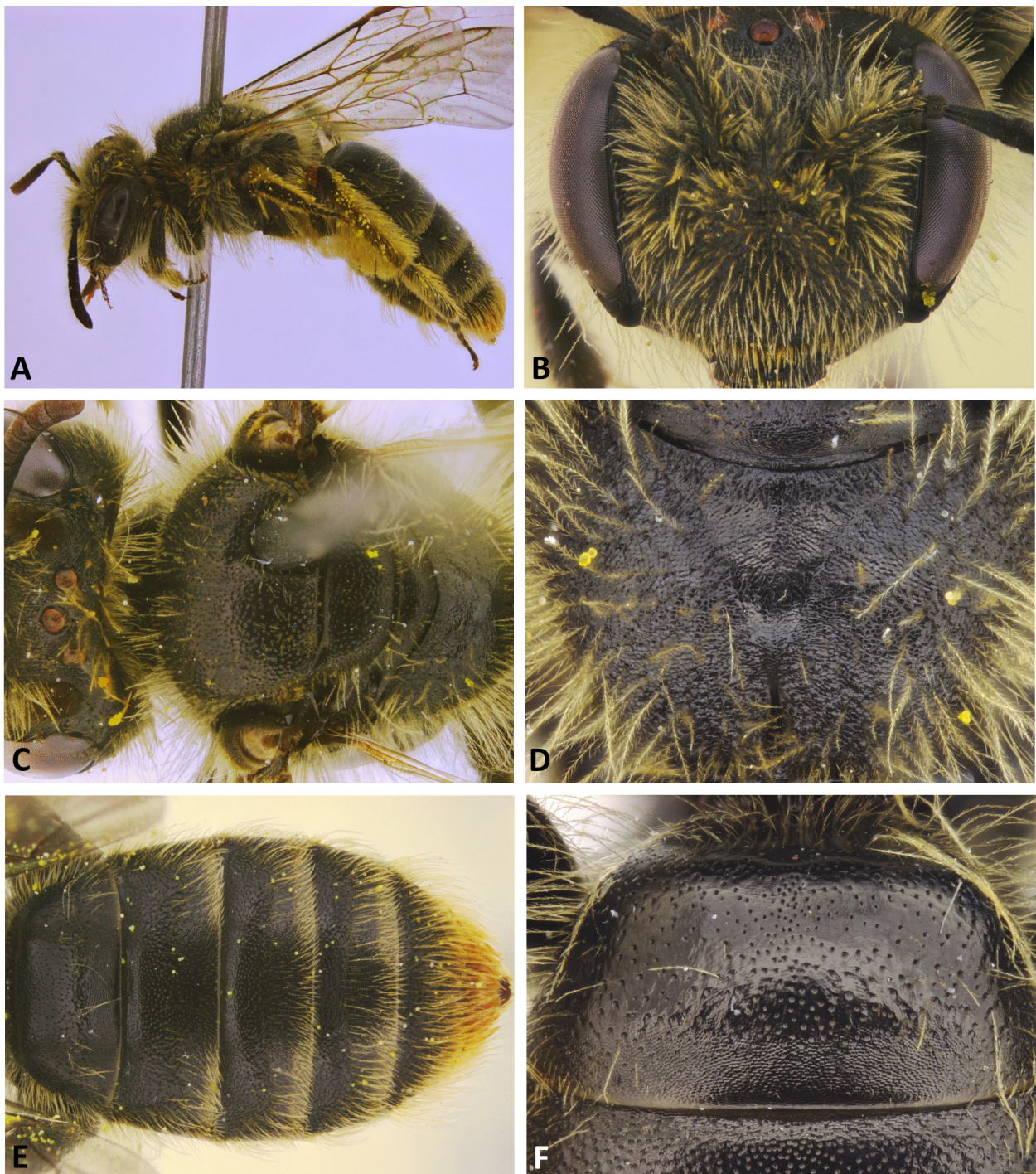
**Female** (Fig. 3A). **Body length:** 8–9 mm.

**Color.** Head and mesosoma black (Fig. 3A–C). Posterior side of flagellomeres black; anterior side of flagellomeres 1–3 black, 4 partly reddish, 5–10 reddish-orange. Legs dark brown to black. Wings transparent, veins and stigma golden. Tergal discs black; marginal zones brownish-yellow (Fig. 3E). Sternal discs brown to black; marginal zones brownish-yellow.

**Pubescence.** Hairs mostly whitish-golden and plumose. Face with long golden hairs (Fig. 3B). Facial foveae with brown hairs above, whitish hairs below. Genal area with golden hairs, much longer ventrally. Mesonotum, scutellum and metanotum with sparse, very short bright hairs covering entire surface, and long whitish-golden hairs along lateral margins (Fig. 3C). Mesepisternum with long whitish-golden hairs. Propodeal corbicular incomplete, posterodorsal margin with long golden hairs; surface of corbicular with very short hairs. Legs with white to golden hairs; flocculus white; scopa golden. Tergal discs with short, thin bright hairs covering entire surface and long whitish-golden hairs laterally (Fig. 3E–F). Marginal zones of terga 2–4 with bands of dense whitish hairs, discontinuous on tergum 2, continuous on terga 3–4. Prepygidial fimbria golden (Fig. 3F). Marginal zones of sterna with long whitish-golden hairs.

**Head** (Fig. 3B–C). Broader than long (Fig. 3B). Glossa 6 times as long as broad. Labral process rectangular to trapezoidal, apex concave. Clypeus weakly convex, strongly punctured, basal part shagreened, apical part smooth to superficially shagreened, distance between punctures 1 puncture diameter. Flagellomere 1 twice as long as

broad, slightly shorter than 2+3+4; 2–4 shorter than broad, 2–3 more or less equal in length; 5 almost square. Facial fovea broad, broadest and deepest above, shallower and slightly narrower below, occupying 1/3–1/2 of paraocular area, extending from level of middle of lateral ocellus to slightly below antennal sockets (Fig. 3C). Distance of fovea from lateral ocellus and ocellocipital distance about 1 ocellus diameter (Fig. 3C).



**FIGURE 3.** *Andrena danini* n. sp., female: **A**, habitus, lateral view; **B**, head, anterior view; **C**, head and mesosoma, dorsal view; **D**, propodeum, posterior view; **E**, metasoma, dorsal view; **F**, tergum 1.

**Mesosoma** (Fig. 3C–D). Dorsolateral angle of pronotum not elevated. Mesonotum coarsely punctured, distance between punctures 0.5–2 puncture diameters; anterior 1/4–1/2 of mesonotum shagreened, posterior part smooth (Fig. 3C). Scutellum smooth, more finely punctured than mesonotum, distance between punctures 0.5–2 puncture diameters (Fig. 3C). Mesepisternum reticulately shagreened, shiny, coarsely but shallowly punctured,



distance between punctures 0–1 puncture diameters. Surface of propodeal corbicula reticulately shagreened, shiny, its center impunctate. Propodeal triangle rugose basally, reticulately shagreened and shiny apically (Fig. 3D). Posterolateral part of propodeum roughened, shiny, reticulated (Fig. 3D). Inner side of hind femur with row of ca. 11–14 small peg-shaped projections. Hind leg pretarsal claws with distinct inner tooth. Recurrent vein 1 meeting marginal cell 2 at about 2/3 of distance between submarginal crossveins 1–2. Nervulus interstitial to antefurcal.

**Metasoma** (Fig. 3E–F). Terga with medium-sized, regular, not crater-like punctures (i.e. puncture margins not raised). Disc of tergum 1 superficially shagreened to smooth, distance between punctures 1–3 puncture diameters (Fig. 3F). Discs of terga 2–4 shiny, shagreened to smooth, distance between punctures 1–2 puncture diameters (Fig. 3E). Marginal zones of terga 1–4 shagreened, very finely and shallowly punctured, those of terga 2–4 occupying about 1/2 tergum width (Fig. 3E). Pygidial plate almost flat, central part alveolate.

**Male.** Unknown.

**Differential diagnosis.** This species resembles *A. exquisita* Warncke and *A. tadauchii* Gusenleitner, but differs from them by its smaller body size, slightly longer flagellomere 1 (in *A. exquisita* and *A. tadauchii* only slightly longer than 2+3), different sculpturing of dorsal part of propodeum (posterolateral parts of propodeum and apex of triangle almost smooth in *A. exquisita*, strongly reticulate-alveolate in *A. tadauchii*), and different punctation of tergum 1 (finer and sparser in *A. exquisita*, with distinct crater-like punctures in *A. tadauchii*). *A. danini* differs further from *A. exquisita* by the narrower and straighter facial foveae, orange flagellomeres 4–10 (brown in *A. exquisita*), denser punctation of mesonotum, and interstitial to antefurcal nervulus (postfurcal in *A. exquisita*). The tergal marginal zones of *A. danini* are broader than those of *A. tadauchii*.

**Flight period:** February–April. One specimen was apparently collected in July (note in pencil), but this could be an error.

**Flower records:** none. The species likely forages on Asteraceae as do many other related *Chlorandrena* spp. (Westrich 1989).

**Etymology.** The species is named in honor of Avinoam Danin, a prominent Israeli botanist (1939–2015).

**Holotype:** ♀, ISRAEL: Lakhish, 3km NE, 19.ii.2016, G. Pisanty [SMNHTAU].

**Paratypes:** ISRAEL: Har Tuv, 22.ii.1955, student (1♀); Jerusalem, 2.vii.1940, H. Bytinski-Salz (1♀); Lakhish, 2.5km ENE, 6.iii.2013, T. Shapira (1♀); 20.iii.2013, T. Shapira (2♀); 13.iv.2013, T. Shapira (2♀); Lakhish, 3km NE, 19.ii.2016, G. Pisanty (1♀); 4.iii.2016, G. Pisanty (3♀); 11.iii.2016, G. Pisanty (1♀); 19.iii.2016, G. Pisanty (2♀); Lakhish, 5km ENE, 8.iv.2013, T. Shapira (1♀); Nahal Besor, 4.iii.1985, E. Shney-Dor (1♀); Netiv Halamed He, 2km WNW, 26.ii.2009, G. Pisanty (1♀); Park Canada, 18.iii.2016, G. Pisanty (1♀) [ES, OLML, SMNHTAU].

### *Andrena (Chrysandrena) palaestina* Pisanty & Scheuchl n. sp.

(Figs. 4, 12C, 13C)

**Female** (Fig. 4A). **Body length:** 6–7 mm.

**Color.** Head and mesosoma black. Posterior side of flagellomeres black-dark brown; anterior side of 1 black, 2–3 black to orange, 4–10 orange (Fig. 4B–C). Legs dark brown. Wings transparent, veins brown. Tergal discs dark brown; marginal zones light brown (Fig. 4D). Sterna brown; basal part of sterna 2–4 and sometimes 5 with darkened medial line.

**Pubescence.** Head, mesosoma and legs with sparse, long, brightly coloured and strongly plumose hair. Clypeus, scape, vertex, supraclypeal and genal areas with more or less white hair (Fig. 4B–C). Paraocular areas, frons and upper part of foveae with reddish-brown hair (Fig. 4B–C). Mesosoma with white hair (Fig. 4A, C). Propodeal corbicula incomplete, posterodorsal margin with long white plumose hairs. Surface of corbicula with sparse, simple white hairs. Legs with white to light brown hair; flocculus and scopa with long, strongly plumose white hairs. Tergal discs with short and thin inconspicuous hairs; marginal zones 2–4 with white hair bands, discontinuous in 2, almost continuous in 3, continuous in 4 (Fig. 4D). Prepygidial fimbria beige-golden (Fig. 4D). Apical parts of sterna with medium to long white hairs, longer and more plumose towards marginal zone.

**Head** (Fig. 4B–C). Broader than long (Fig. 4B). Labral process more or less trapezoidal, not much broader than long, apex notched to almost blunt. Clypeus broader than long, almost flat, very shiny, basal half shagreened, apical half almost smooth; puncture size medium, distance between punctures 1–3 puncture diameters, puncture



density decreasing apically. Facial foveae occupying 1/3 of paraocular area, slightly tapering downwards, extending from level of lower end of lateral ocellus to middle of antennal socket (Fig. 4B–C). Distance of fovea from lateral ocellus 1–1.5 ocellus diameters (Fig. 4C). Flagellomere 1 as long as 2+3+4; 2 equal to or slightly shorter than 3; 2–5 broader than long (Fig. 4B). Ocelloccipital distance 1 ocellus diameter (Fig. 4C).

**Mesosoma** (Fig. 4C). Dorsolateral angle of pronotum not to weakly elevated. Mesonotum and scutellum very shiny, discs very smooth, sparsely and shallowly punctured, puncture size small to medium, distance between punctures 1–4 puncture diameters. Propodeal triangle shiny but roughened and rugose. Mesepisternum finely alveolate, impunctate. Propodeal corbicular reticulately shagreened, impunctate. Hind leg pretarsal claws minutely bidentate. Submarginal crossvein 1 meeting marginal cell 2–3 vein widths from stigma. Recurrent vein 1 meeting submarginal cell 2 at its distal half. Nervulus antefurcal.

**Metasoma** (Fig. 4D). Terga shiny, finely punctured; 1 smooth, sparsely punctured, distance between punctures 3–5 puncture diameters; 2–4 shagreened basally and smooth apically, more densely punctured, distance between punctures 2–3 puncture diameters. Pygidial plate flat, central area very densely punctured, distance between punctures less than 1 puncture diameter.

**Male** (Fig. 4E). **Body length:** 6 mm.

**Color.** Head and mesosoma similar to female (clypeus black) (Figs. 4F–H). Legs dark brown to black. Tergal discs brown to black; marginal zones light brown (Fig. 4E). Sterna brown.

**Pubescence.** Head, mesosoma and legs with sparse, long, strongly plumose hair. Clypeus, supraclypeal area, scape, frons, vertex and genal area with white hair; paraocular area with brown hair (Fig. 4F). Mesosoma and legs with white hair. Metasoma similar to female (Fig. 4E).

**Head** (Figs. 4F–H). 1.4 times as broad as long (Fig. 4F). Clypeus flat, much broader than long, very shiny and almost smooth except at apical margin, finely punctured, distance between punctures 2–3 puncture diameters. Flagellomere 1 strongly compressed ventrally, almost as long as 2+3+4; 2–3 much broader than long, 4 weakly so, 5 square (Fig. 4G). Ocelloccipital distance 1.3 ocellus diameters (Fig. 4H). Genal area 1.2 times as broad as compound eye. Preoccipital ridge not carinate.

**Mesosoma** (Fig. 4H). Pronotum with weakly elevated dorsolateral angle, lateral part not carinate. Mesonotum shiny, its periphery shagreened and shallowly punctured, distance between punctures 1.5–2 puncture diameters, puncture size medium; center of mesonotum very shiny, almost smooth and impunctate. Scutellum shiny, very smooth except at posterior margin, more strongly and coarsely punctured than mesonotum, distance between punctures 1.5–3 puncture diameters. Rest of mesosoma similar to female.

**Metasoma.** Similar to female, terga 2–4 somewhat smoother and more sparsely punctured, distance between punctures 3–4 puncture diameters.

**Genitalia and hidden sterna** (Figs. 12C, 13C). Gonocoxites connected. Dorsal lobe of gonocoxite distinct, tooth-shaped. Gonostyli shovel-shaped, suddenly broadening apically. Penis valves spade-shaped (Fig. 12C). Sternum 8 columnar, narrow, apex suddenly broadened (Fig. 13C).

**Differential diagnosis.** *A. palaestina* is smaller than most other species of *Chrysandrena*. It resembles *A. aegyptiaca* Friese and *A. alluaudi* Benoist by the mostly smooth and shiny cuticle and strong dorsal gonocoxite lobe. However, it differs from them by the smaller body size, dark metasoma (partly reddish in *A. aegyptiaca*, at least in females), almost flat clypeus (more convex in *A. aegyptiaca* and *A. alluaudi*), unmodified female abdominal apex (prepygidial fimbria broadened and pygidial plate truncated and longitudinally striated in *A. alluaudi*), ventrally compressed flagellomere 1 in the male (more rounded in *A. aegyptiaca*), and narrow sternum 8 in the male (broader in *A. aegyptiaca*).

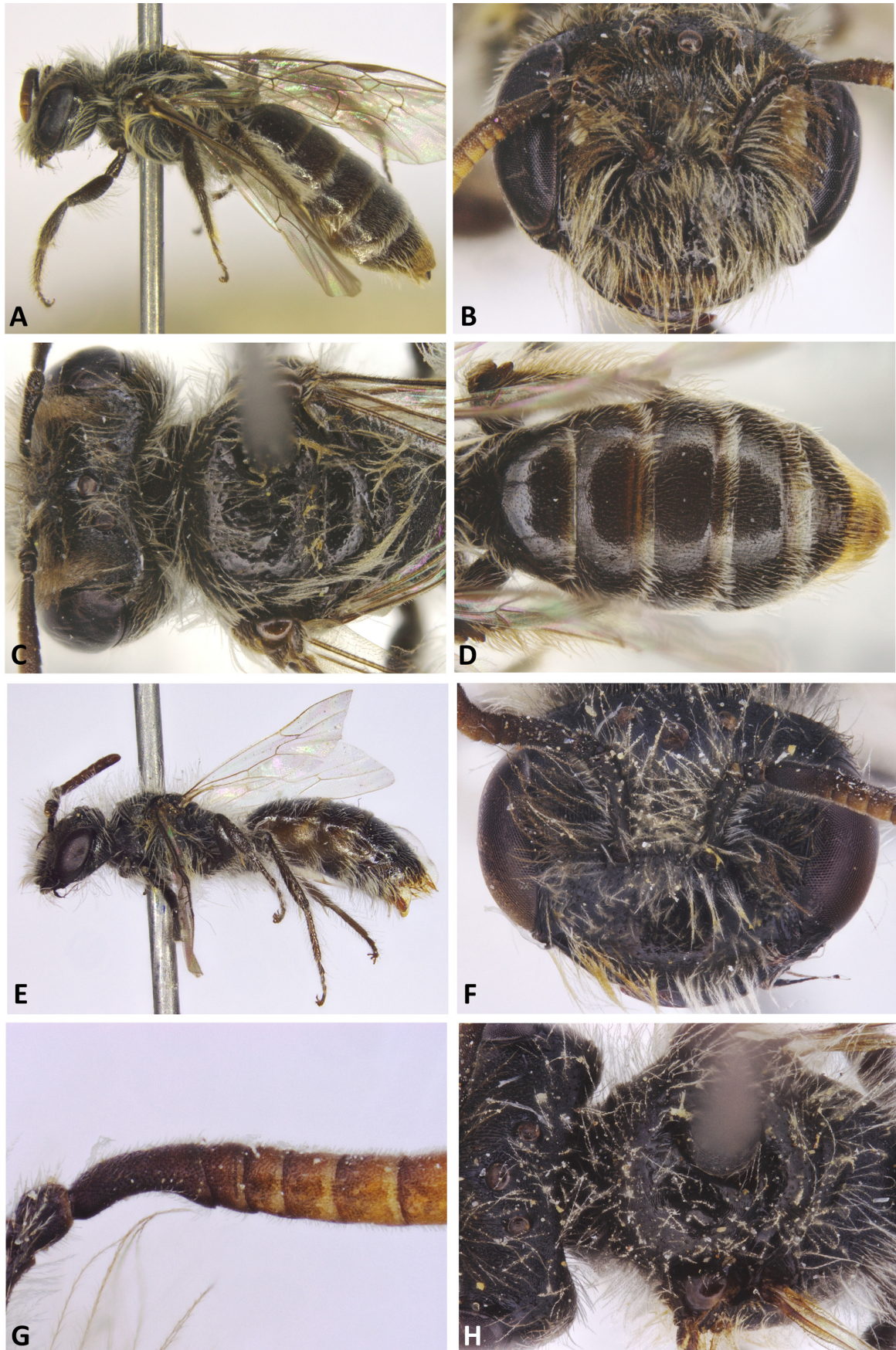
**Flight period:** February–March.

**Flower records:** none; all specimens but one collected from pan traps.

**Etymology.** The species name is derived from Palestine, one of the historic names for the Land of Israel.

**Holotype:** ♂, ISRAEL: Kefar Menahem, 1.5 km S, 6.ii.2010, G. Pisanty [SMNHTAU].

**Paratypes:** ISRAEL: Lakhish, 2 km E, 5.ii.2016, G. Pisanty (1♂); Lakhish, 2.5 km ENE, 21.ii.2013, T. Shapira (5♀); Lakhish, 2.5 km ESE, 21.iii.2012, T. Shapira (1♀); Netiv Halamed Heh, 24.ii.2009, G. Pisanty (1♀) [ES, OLML, SMNHTAU].



**FIGURE 4.** *Andrena palaestina* n. sp., female (A–D) and male (E–H): A, E, habitus, lateral view; B, F, head, anterior view; C, H, head and mesosoma, dorsal view; D, metasoma, dorsal view; G, base of flagellum.



***Andrena (Euandrena) hermonella* Scheuchl & Pisanty n. sp.**

(Figs. 5, 12D, 13D)

**Female** (Fig. 5A). **Body length:** 9 mm.

**Color.** Head and mesosoma black. Flagellum dark brown to black (Fig. 5A, C). Coxae, trochanters, femora and tibiae dark brown; tarsi brown. Wings transparent, veins brown, stigma tan. Tergal discs black, marginal zones golden-brown (Fig. 5D); sterna brown to black.

**Pubescence.** Paraocular and genal areas and lateral parts of clypeus mostly with long black hairs; tufts of long whitish hairs occur around antennal sockets and behind base of mandible (Fig. 5B). Facial foveae with short brown hairs. Vertex mostly with long whitish hairs. Dorsal side of mesosoma with long whitish hairs. Mesepisternum mostly with long black hairs; whitish hairs occur on anteriodorsal part and ventral part. Propodeal corbícula incomplete, posterodorsal margin with long, plumose, both black and white hairs. Surface of corbícula with few simple hairs, long white ones on dorsal part, short black on ventral part. Foreleg and midleg with black, brown and white hairs. Flocculus with both black and white hairs. Main part of hind femur with long white hairs. Scopa mostly white to light brown, darker towards base of tibia; scopal hairs mostly simple, some unilaterally plumose. Hind tarsi with white to brown hairs. Tergum 1 with sparse long white hairs (Fig. 5D). Terga 2–4 mostly bare on disc, with sparse, inconspicuous short and narrow hairs; premarginal lines with very weak, continuous bands of sparse long whitish hairs. Lateral parts of terga 1–5 with long, both black and white hairs, proportion of black hairs increasing towards tergum 5. Prepygidial fimbria brown (Fig. 5D). Sterna with continuous apical bands of long brown to black hairs.

**Head** (Fig. 5B–C). Broader than long (Fig. 5B). Labral process trapezoidal, much broader than long, apex shallowly notched. Clypeus flat centrally, shiny, smooth except for a narrow basal margin, without distinct impunctate midline, punctures of medium size, distance between punctures 0–1 puncture diameters (Fig. 5B). Facial fovea moderately elongate, occupying 1/3 of paraocular area, extending from level of lower end of lateral ocellus to lower end of antennal socket, gradually tapering downwards (Fig. 5B–C). Distance of fovea from lateral ocellus 2 ocellus diameters (Fig. 5C). Flagellomere 1 2–2.5 times as long as broad, much longer than 2+3; 2–3 broader than long, 2 slightly shorter than 3; 4–5 square (Fig. 5C). Ocelloccipital distance 1 ocellus diameter.

**Mesosoma** (Fig. 5C). Dorsolateral angle of pronotum weakly elevated, without lateral carina. Mesonotum matt and strongly shagreened on periphery, shiny and moderately shagreened, with some smooth areas, on disc; punctures of medium size, distance between punctures 1–1.5 puncture diameters. Scutellum similar, shiny. Propodeal triangle coarsely rugose basally, very finely alveolate apically. Propodeal corbícula finely alveolate. Hind leg pretarsal claws distinctly bidentate. Nervulus weakly antefurcal.

**Metasoma** (Fig. 5D). Disc of tergum 1 smooth, punctures fine to medium-sized, distance between punctures 2–4 puncture diameters. Discs of terga 2–4 shagreened to smooth basally, smooth apically, finely and sparsely punctured, distance between punctures 3–5 puncture diameters. Marginal zones of terga 1–4 shagreened, those of 2–4 weakly depressed, depressions covering up to 2/5 of tergum width. Central area of pygidial plate elevated.

**Male** (Fig. 5E). **Body length:** 7.5–8.5 mm.

**Color.** Similar to female (clypeus and paraocular area black, Fig. 5F). Proboscis mostly brown, segments of labial and maxillary palps white near joints.

**Pubescence.** Base of clypeus, area surrounding antennal sockets, ventral half of genal area, and vertex with long white hairs (Fig. 5F–G). Apex of clypeus, apical and lateral parts of paraocular area, and dorsal half of genal area with mostly black hairs (Fig. 5F). Mesosoma covered on all sides with mixture of long whitish hairs and somewhat shorter and narrower black hairs (Fig. 5G). Femora and tibiae with both black and white hairs. Tarsi with white to brown hairs. Tergal discs with sparse, short white hair. Tergal marginal zones with broad discontinuous bands of sparse, long white hair. Anal fimbria whitish-golden.

**Head** (Fig. 5F–G). Broader than long (Fig. 5F). Galea finely shagreened. Glossa 3 times as long as broad. Clypeus flat medially, entirely smooth, densely punctured, distance between punctures 0.5–1 puncture diameters, puncture size medium. Flagellomere 1 1.5–2 times as long as broad, slightly longer than 2+3; 2 broader than long, much shorter than 3; 3 square; 4–5 slightly longer than broad (Fig. 5F). Ocelloccipital distance 1–1.25 ocellus diameters (Fig. 5G). Genal area broadened.

**Mesosoma** (Fig. 5G). Mesonotum shagreened, shiny on disc, distance between punctures 0.5–1.5 puncture diameters, puncture size medium to large. Scutellum shiny, superficially shagreened, coarsely punctured, distance





**FIGURE 5.** *Andrena hermonella* n. sp., female (A–D) and male (E–H): A, E, habitus, lateral view; B, F, head, anterior view; C, G, head and mesosoma, dorsal view; D, H, metasoma, dorsal view.

between punctures 0.5 puncture diameter. Propodeal triangle rugose, basal part radially grooved. Nervulus interstitial to weakly antefurcal.

**Metasoma** (Fig. 5H). Terga mostly smooth and shiny, punctation somewhat coarser and denser than in female, distance between punctures 2–3 puncture diameters. Marginal zones of terga 2–4 weakly depressed, depressions covering up to 1/2 of tergum width.

**Genitalia and hidden sterna** (Figs. 12D, 13D). Gonocoxites separated at apical half by protruding penis valves; dorsal lobe absent. Gonostyli strongly arched, broadening apically. Penis valves narrow, with distinctly pointed, lateral lamellar projections (Fig. 12D). Sternum 8 strongly tapering apically, almost triangular, apex curved and not broadened (Fig. 13D).

**Differential diagnosis.** *A. hermonella* resembles *A. bicolor* Fabricius. In *A. hermonella*, the clypeus is smoother and flatter, and the terga are also smoother and with finer and sparser punctation. The males are easily distinguished from those of *A. bicolor* by the white hair on the face, longer flagellomere 1 (shorter than 2+3 in *A. bicolor*), and very different genitalia.

**Flight period:** May–July.

**Flower records:** none.

**Etymology.** Named after Mount Hermon, where the species was collected.

**Holotype:** ♂, ISRAEL: Mount Hermon, 2000m, 22.v.1973, H. Bytinski-Salz [OLML].

**Paratypes:** ISRAEL: Mount Hermon, 2000m, 22.v.1973, H. Bytinski-Salz (2♂); 2.vii.1984, F. Kaplan (1♂); 1.vii.1986, A. Freidberg (1♂); 2050m, 31.v.1991, K. Warncke (2♀) [OLML, SMNHTAU].

**Additional material examined.** ISRAEL: Mount Hermon, 2000m, 22.v.1973, H. Bytinski-Salz (1♀, 1♂).

### *Andrena (Holandrena) fimbriatoides* Scheuchl 2004

(Fig. 6)

**Female** (Fig. 6A). **Body length:** 10.5–11 mm.

**Color.** Head, mesosoma and terga black; sterna brown. Anterior side of flagellomeres 4–10 brownish-black. Femora, tibiae and basitarsi black to dark brown; distal part of tarsi brown. Forewings transparent, slightly brownish; hindwings transparent; wing veins brown.

**Pubescence.** Clypeus almost bare (Fig. 6B). Paraocular, supraclypeal and genal areas with white hair (Fig. 6B). Foveae and vertex with golden hair (Fig. 6C). Anterior side of mesonotum with whitish-golden hair. Mesepisternum with white hair. Propodeal corbicula incomplete, posterodorsal margin with white hair; surface of corbicula with sparse white hair. Legs with white to golden hair, the latter especially on tarsi. Flocculus white, strongly plumose. Scopa with white, usually simple hairs; few hairs on outer side of tibia unilaterally plumose. Terga with very short and thin inconspicuous hairs; marginal zones of 2–4 with narrow white hair bands (Fig. 6D). Prepygidial fimbria golden (Fig. 6D). Premarginal lines of sterna with long, white to golden hairs.

**Head** (Fig. 6B–C). Broader than long, sometimes weakly so (Fig. 6B). Galea finely shagreened. Labral process very broad, trapezoidal. Clypeus more or less flat medially, fully shagreened and uniformly punctured, without impunctate midline; distance between punctures 1–2 puncture diameters, puncture side medium to large (Fig. 6B). Facial foveae very shallow above, tapering and deepening downwards, occupying 1/3–1/2 of paraocular area, extending from level of medial ocellus to lower end of antennal socket (Fig. 6B–C). Distance of fovea from lateral ocellus 1.5–2 ocellus diameters (Fig. 6C). Flagellomere 1 2.5 times as long as broad, slightly shorter than 2+3+4; 2–3 broader than long (Fig. 6B); 4–5 almost square. Ocelloccipital distance 1–1.5 ocellus diameters (Fig. 6C).

**Mesosoma** (Fig. 6C). Dorsolateral angle of pronotum elevated, with strong carina extending down laterally. Mesepisternum very coarsely and densely punctured, distance between punctures 0–0.5 puncture diameters. Mesonotum shiny, superficially shagreened, smooth on top; puncture size large to medium, distance between punctures 1–3 puncture diameters. Scutellum similar, smooth. Propodeal triangle and corbicula strongly rugose-areolate, corbicula more coarsely so. Posterolateral part of propodeum smooth and shiny, strongly and densely punctured, distance between punctures 0–0.5 puncture diameters, puncture size medium-large. Hind leg pretarsal claws bidentate. Nervulus postfurcal.

**Metasoma** (Fig. 6D). Terga 1–3 smooth and shiny; 4 smooth to superficially shagreened; 5 shagreened. Terga



1–4 densely and very strongly punctured, distance between punctures 0.5–1 puncture diameters, slightly sparser on tergum 1; puncture size large to medium, decreasing from tergum 1 to 4. Marginal zones of terga 2–4 weakly depressed. Tergum 5 very shallowly punctured, distance between punctures 1–2 puncture diameters, puncture size medium to small. Pygidial plate flat, central part shagreened and not elevated.



**FIGURE 6.** *Andrena fimbriatoides*, female: **A**, habitus, lateral view; **B**, head, anterior view; **C**, head and mesosoma, dorsal view; **D**, metasoma, dorsal view.

**Differential diagnosis.** The female of *A. fimbriatoides* is easily distinguished from other members of the subgenus *Holandrena* by the fully shagreened clypeus (smooth to superficially shagreened in *A. decipiens* Schenck, *A. forsterella* Osytshnjuk, *A. labialis* (Kirby), *A. variabilis* Smith and *A. wilhelmi* Schuberth) and the smooth and shiny, coarsely punctured tergum 1 (shagreened and matt in *A. fimbriata* Brullé; more finely punctured in *A. decipiens*, *A. forsterella*, *A. labialis*, *A. labiatula* Osytshnjuk, *A. variabilis* and *A. wilhelmi*).

**Flight period:** March–April.

**Flower records:** Fabaceae: *Trifolium purpureum* (1♀).

**Material examined.** ISRAEL: Aderet, 24.iii.2010, G. Pisanty (1♂); Bet Nir, 28.iii.2010, G. Pisanty (1♀); Gal'on, 23.iii.2010, G. Pisanty (1♀, 4♂); Har Meron, 21.iv.2016, G. Pisanty (4♀); Hare Gilboa', Har Lapidim, 400m, 11.iv.2011, L. Friedman (1♀); Kinneret, 1.iv.1968 (1♀); Park Britannia, 7.iv.2010, T. Koznichki (1♀); Sha'alvim, 24.iv.2012, Y. Berner (1♀) [ES, OLML, SMNHTAU].

***Andrena (Margandrena) menahemella* Scheuchl & Pisanty n. sp.**  
(Figs. 7, 12E, 13E)

**Female** (Fig. 7A). **Length:** 7.5 mm.





**FIGURE 7.** *Andrena menahemella* n. sp., female (A–D) and male (E–H): A, E, habitus, lateral view; B, F, head, anterior view; C, G, head and mesosoma, dorsal view; D, H, metasoma, dorsal view.

**Color.** Head, mesosoma, legs, and disc of tergum 1 black. Marginal zone of tergum 1, terga 2–3 and sterna 2–3 nearly always reddish-orange (1 specimen with fully black metasoma); terga 2–3 often with black spot on center of disc (Fig. 7A, D). Terga 4–5 and sterna 1, 4–5 black to reddish-orange. Marginal zones of terga 4–5 red to yellow (Fig. 7D). Antennae black to brown, anterior side of flagellomeres 3–10 brighter than 1–2 (Fig. 7B–C). Wings transparent, veins brown.

**Pubescence.** Clypeus, paraocular area, supraclypeal area and frons with long black hairs (Fig. 7B). Vertex with long white to golden hairs (Fig. 7B–C). Facial foveae with grey and black hairs. Mesonotum, scutellum, metanotum and centre of propodeum with sparse long white to yellowish hairs and few shorter gray hairs (Fig. 7C). Mesepisternum with long black hairs. Propodeal corbicula incomplete, posterodorsal margin with long black hairs; surface of corbicula with sparse, whitish, long simple hairs. Leg hair mostly dark brown. Flocculus, hind femur and scopa with both dark black to brown hair and lighter grayish-white hair. Outer side of hind tibia with long, simple scopal hairs, brighter on anterior part and darker on posterior part; inner side of hind tibia with dark, shorter, unilaterally plumose hairs. Terga with sparse, very short dark hairs, gradually thicker and denser laterally and towards metasomal apex; tergum 1 with also few long white hairs (Fig. 7D). Prepygidial fimbria black to brown (Fig. 7D).

**Head** (Fig. 7B–C). Head and clypeus broader than long (Fig. 7B). Galea shagreened, maxillary and labial palps longer than glossa. Labral process trapezoidal to semi-circular, shiny. Clypeus convex, basal 1/3–1/2 strongly shagreened, apical part only superficially so, very shiny and almost smooth. Clypeus puncturing medium-sized, its density decreasing towards apex, distance between punctures 0.5–2 puncture diameters; a broad impunctate midline runs through apical half of clypeus, narrowing or completely disappearing towards base (Fig. 7B). Facial foveae shallow above, deeper and somewhat tapering downwards, occupying 1/3–1/2 of paraocular area width, extending from level of middle–lower end of lateral ocellus to lower end of antennal socket (Fig. 7B). Distance of fovea from lateral ocellus 1.25–1.5 ocellus diameters. Flagellomere 1 about as long as 2+3+4; 2–3 almost the same length, broader than long; the following almost square (Fig. 7B). Ocelloccipital distance about 3/4 ocellus diameter (Fig. 7C).

**Mesosoma** (Fig. 7C). Dorsolateral angle of pronotum weakly elevated, forming short carina extending laterally. Mesonotum shagreened but shiny, sometimes almost smooth in portions of disc, sparsely punctured, distance between punctures 1.5–2 puncture diameters. Scutellum shagreened and punctured mostly at periphery, smoother and impunctate on disc, except for a punctured midline. Propodeal corbicula shagreened but very shiny. Propodeal triangle more finely shagreened and completely matt, with narrow band of radial grooves at base. Nervulus interstitial to strongly postfurcal.

**Metasoma** (Fig. 7D). Terga smooth to superficially shagreened and finely punctured, shagreenation and density of punctures increasing from tergum 1 to 5, distance between punctures 2–3 puncture diameters. Pygidial plate flat to dorsally concave, honeycomb-alveolate; central part does not appear lifted.

**Male** (Fig. 7E). **Length:** 6.5–7 mm

**Color:** Similar to female. Clypeus black (Fig. 7F). Disc of tergum 2 sometimes completely black.

**Pubescence:** Clypeus, paraocular area, sides of vertex and dorsal part of genal area with black hairs (Fig. 7F). Supraclypeal area, antennal sockets, scapes, middle of vertex and ventral part of genal area with white to grey hairs (Fig. 7F–G). Mesepisternum with long hairs, black dorsally and white ventrally. Legs with both brighter, golden-white and darker brown hairs, the latter especially on femora. Rest of mesosoma and metasoma as in female.

**Head** (Fig. 7F–G). Broader than long (Fig. 7F). Clypeus weakly convex, much broader than long, apical part very smooth and punctured more sparsely than in female (Fig. 7F). Flagellomere 1 about 2.5 times as long as broad, almost as long as 2+3+4; 2–3 broader than long; the following longer than broad. Ocelloccipital distance about 1 ocellus diameter. Genal area broadened, preoccipital ridge with lateral carina.

**Mesosoma** (Fig. 7G). Similar to female.

**Metasoma** (Fig. 7H). Terga very smooth and shiny, finely and more sparsely punctured than in female, distance between punctures 3–4 puncture diameters.

**Genitalia and hidden sterna** (Figs. 12E, 13E). Dorsal lobes of gonocoxites only weakly developed and rounded. Gonostylus spatulate, apical part broadening into a long, flattened blade. Penis valves broad basally and tapering apically, with only hint of lateral lamellar projections (Fig. 12E). Sternum 8 broad, gradually tapering apically, apex rounded and very slightly broadened (Fig. 13E).

**Differential diagnosis.** *A. menahemella* can be distinguished from other species of the subgenus *Margandrena*



with red terga by the abundance of black hair, especially on the face and mesepisternum (hair predominantly white or golden in *A. marginata* Fabricius, *A. pellucens* Pérez, *A. sibthorpi* Mavromoustakis and *A. testaceipes* Saunders), shagreened mesonotum and somewhat smoother scutellum (disc of mesonotum smooth in *A. marginata* and *A. pellucens*; scutellum fully shagreened in *A. krausiella* Gusenleitner), mixed red and black terga 2–5 (fully red in females of *A. marginata* and *A. testaceipes*), black male clypeus (yellow in *A. marginata*), four segments of the labial palpus (five in *A. quinquepalpa*), and nervulus which is postfurcal in the majority of specimens (interstitial to slightly antefurcal in *A. quinquepalpa*; antefurcal in *A. testaceipes*). *Andrena menahemella* is easily distinguished from the sympatric *A. krausiella* by the shorter clypeus, smoother scutellum, and the female's darker facial hair and absence of a lateral black spot on tergum 2. The genital capsule of *A. menahemella* resembles that of *A. krausiella* and *A. sibthorpi*, but has narrower penis valves, without lateral lamellar extensions.

**Flight period:** the main flight period is January–March, but a single male was collected in late May.

**Flower records:** none; all specimens but one male collected from pan traps.

**Etymology.** Named after kibbutz Kefar Menahem, where the species was first collected.

**Holotype:** ♀, ISRAEL: Lakhish, 18.ii.2013, T. Shapira [SMNHTAU].

**Paratypes:** ISRAEL: Kefar Menahem, 1.iii.2008, Y. Mandelik (1♀); 2.iii.2008, U. Roll (4♀); 7.iii.2008, U. Roll (2♀); Lakhish, 22.ii.2012, T. Shapira (1♀); 21.iii.2012, T. Shapira (4♀); 4.ii.2013, T. Shapira (9♀, 3♂); 18.ii.2013, T. Shapira (12♀); 21.ii.2013, T. Shapira (2♀); Lehavim, 28.i.2015, G. Pisanty (14♀); Nahshon, 8.ii.2009, G. Pisanty (1♀); Netiv Halamed Heh, 16.ii.2010, G. Pisanty (1♀); Park Britannia, 10.ii.2011, T. Koznichki (1♂); 11.ii.2011, T. Koznichki (1♂); Revadim, 30.v.2011, A. Golan (1♂); Ya'ar Adulam, 14.ii.2011, T. Koznichki (8♀, 2♂); Ya'ar Nehosha, 15.ii.2011, T. Koznichki (1♀); Ya'ar Yish'i, 18.ii.2011, T. Koznichki (4♀) [AMNH, ES, OLML, SMNHTAU, USNM, ZSMC].

### *Andrena (Parandrena) wolfi* Gusenleitner & Scheuchl 2000

(Figs. 8, 12F, 13F)

**Male** (Fig. 8A). **Body length:** 7–8 mm.

**Color.** Mandibles black basally, reddish-brown to black apically. Clypeus with large rhomboid yellow spot occupying most of its area; two dark lateral wedge-shaped spots penetrate the yellow area from above (Fig. 8B). Rest of face, including paraocular area, black. Scape, pedicel and flagellomere 1 black; flagellomeres 2–11 dark brown to black (Fig. 8B–C). Mesosoma black. Legs brown to black. Wings transparent, veins brown, stigma tan. Terga and sterna brown to black, marginal zones light brown (Fig. 8D).

**Pubescence.** Head, mesosoma, femora and tergum 1 with long white to golden hairs. Tibiae and tarsi with white to golden hairs. Discs of terga 2–5 with medium white hairs (Fig. 8D). Marginal zones of terga 2–4 with white hair bands, discontinuous in terga 2–3, continuous in tergum 4. Anal fimbria with white to yellowish hairs (Fig. 8D). Sterna with long white hairs, especially on marginal zones, forming apical hair bands.

**Head** (Fig. 8B–C). Broader than long (Fig. 8B). Mandibles long and sickle-shaped, crossed (Fig. 8B). Labral process snout-shaped, thickened apically. Clypeus broad, almost flat, shagreened, very shallowly punctured, with impunctate midline, distance between punctures 1–3 puncture diameters, puncture size medium. Flagellomere 1 matt, shorter than 2; 2–11 shiny; 2–4 of equal length, longer than broad (Fig. 8C). Ocelloccipital distance 1.5–2 ocellus diameters (Fig. 8C). Genal area very broad, preoccipital ridge with lateral carina.

**Mesosoma** (Fig. 8C). Dorsolateral angle of pronotum elevated, with strong lateral carina extending down. Mesonotum and scutellum shagreened, distance between punctures 0.5–2 puncture diameters, punctures coarse on mesonotum and medium-sized on scutellum. Propodeum roughened and rugose. Forewing usually with two submarginal cells of similar size (recurrent veins 1–2 ending at submarginal cell 2), more rarely with three submarginal cells. Nervulus interstitial to antefurcal.

**Metasoma** (Fig. 8D). Terga very shiny, shagreened basally, smooth to superficially shagreened apically. Punctures of medium size and density, distance between punctures 0.5–2 puncture diameters.

**Genitalia and hidden sterna** (Figs. 12F, 13F). Gonocoxites with strong, pointed dorsal lobes. Gonostylus spatulate, broadening apically. Penis valves of moderate width, tapering apically, basal part with broad ventral lamella projecting laterally (Fig. 12F). Sternum 8 columnar, narrow and elongate, apex broadened (Fig. 13F).

**Differential diagnosis.** The male of *A. wolfi* is easily distinguishable from *A. iohannescaroli* by the partially



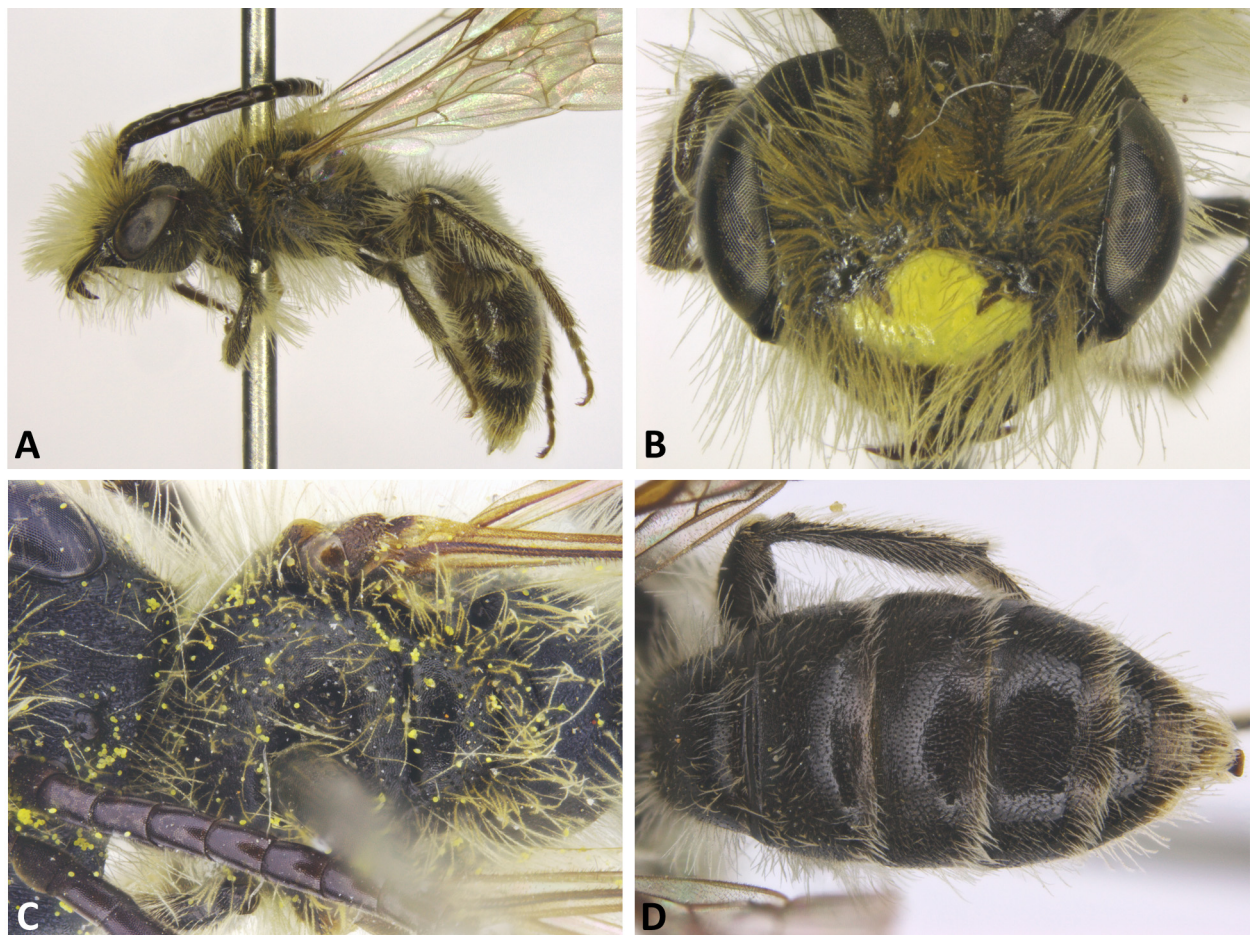
yellow clypeus (fully black in *A. iohannescaroli*) and short flagellomere 1 (almost as long as 2+3 in *A. iohannescaroli*).

**Flight period:** February–April.

**Flower records:** Brassicaceae: *Erucaria microcarpa* (2♀); Caryophyllaceae: *Silene aegyptiaca* (1♂).

**Material examined:** ISRAEL: Bet Guvrin, 27.iii.1976, A. Freidberg (1♀); Devira, 12.iv.2009, L. Friedman (1♂); Gal'on, 2 km NW, 5.iv.2015, G. Pisanty (1♀); Lakhish, 3 km NE, 4.iii.2016, G. Pisanty (1♀); Yiftach, 21.iv.2015, O. Winberger (1♀). WEST BANK: Berakha, 2 km S, 6.iii.2015, L. Friedman (4♀, 2♂); En Mabua, 28.ii.2007, L. Friedman (2♀); Jerusalem, upper Nahal Darga, 8.iii.2015, T. Jumah (1♂); Kefar Adummim, north-facing slope of Nahal Perat, 27.ii.2007, A. Freidberg & L. Friedman (22♀, 6♂); Kefar Adummim, southern slope, 28.ii.2007, L. Friedman (1♀); Nahal Perat, 14.iii.2015, G. Pisanty (2♀); Nahal Perat, south-facing slope, 28.ii.2007, L. Friedman (1♂); Za'atara, 6.iii.2015, T. Jumah (2♀). ISRAEL/WEST BANK?: Judean Desert, 11.iii.1980, A. Hefetz (3♀, 1♂) [ES, OLML, SMNHTAU].

**Remarks.** *Andrena wolffi* was hitherto known from only two females collected in the West Bank (Gusenleitner & Scheuchl 2000). A single male collected in Sicily and described as *Parandrena iohannescaroli* Nobile 2000, was assumed to be the male of *A. wolffi* and hence synonymized (Gusenleitner & Schwarz 2002). However, our discovery of males collected very close to the type locality, and appearing radically different from the Sicilian specimen, lead us to reinstate *A. iohannescaroli* as a valid species.



**FIGURE 8.** *Andrena wolffi*, male: **A**, habitus, lateral view; **B**, head, anterior view; **C**, head and mesosoma, dorsal view; **D**, metasoma, dorsal view.

## *Andrena (Poecilandrena) sphecodimorpha* Hedicke 1942

*Andrena potentillae pendelica* Mavromoustakis 1958

**Neotype:** ♀, GREECE: Saloniki, Langadikia, 1.iv.1977, K. Warncke [OLML].

**Remarks.** The holotype of this species (♀, BULGARIA: Umgebung von Sofia, 17.iv.1915, A.K. Drenowski) could not be located in Hedicke's collection in the Museum für Naturkunde, Berlin and is presumed to be lost (F. Koch, pers. comm.). Therefore, a neotype is hereby designated based on the information in Hedicke's original description.

## *Andrena (Poecilandrena) sphecodimorpha mediterranea* Pisanty & Scheuchl n. ssp.

(Figs. 9, 12G, 13G)

**Female** (Fig. 9A). **Body length:** 6.5–8 mm.

**Color.** Head, thorax, basal part of tergum 1, and tergum 5 black. Apical part of tergum 1, terga 2–4, sterna 2–3 and often parts of sternum 4 reddish-orange (Fig. 9D). Flagellum brownish-orange anteriorly (Fig. 9B). Wings tarnished slightly brownish, veins dark brown.

**Pubescence.** Head with golden hairs (Fig. 9B–C). Facial foveae golden (Fig. 9C). Mesonotum, scutellum and metanotum with dense golden hairs, most of them very short; cuticle visible (Fig. 9C). Mesepisternum with very long white to golden hairs. Propodeal corbícula incomplete, posterodorsal margin with dense and long, white to golden hairs; surface of corbícula with long, unbranched hairs. Coxae, trochanters and femora with golden-white hairs; flocculus white; apex of hind femur with brown hairs. Tibiae and tarsi with brown to brownish-white hairs; scopa white to light brown anteriorly and dark brown posteriorly. Terga with very short and fine, inconspicuous bright hairs; marginal zone of tergum 4 with continuous band of short white to golden hairs (Fig. 9D). Prepygidial fimbria brown (Fig. 9D). Sternal marginal zones with bands of long white hairs.

**Head** (Fig. 9B–C). Slightly broader than long (Fig. 9B). Glossa about 2.5 times as long as broad. Galea very finely shagreened. Labral process trapezoidal. Clypeus weakly convex, shagreened, sometimes almost smooth apically, distinctly punctured, distance between punctures 1–2 puncture diameters, puncture size medium to large, with narrow impunctate midline (Fig. 9B). Fovea extending from level of middle of lateral ocellus to slightly below lower edge of antennal socket, occupying about 1/4 of paraocular area width. Distance of fovea from lateral ocellus 1.5–1.7 ocellus diameters (Fig. 9C). Flagellomere 1 slightly longer than 2+3; 2–3 broader than long (Fig. 9B). Ocelloccipital distance about 1/2 ocellus diameter (Fig. 9C).

**Mesosoma** (Fig. 9C). Mesonotum shagreened, finely and densely punctured, distance between punctures 0–1 puncture diameters. Scutellum shagreened, sometimes almost smooth on top, puncturing somewhat sparser than mesonotum, distance between punctures 0.5–1.5 puncture diameters. Propodeal triangle finely rugose basally, finely shagreened apically. Recurrent vein 1 meeting submarginal cell 2 at 1/3–2/3 of distance between submarginal crossveins 1 and 2. Nervulus interstitial to strongly antefurcal.

**Metasoma** (Fig. 9D). Terga 1–3 smooth on disc, shagreened on marginal zones; tergum 4 weakly shagreened and tergum 5 strongly so. Punctures on terga 1–3 of moderate size, on terga 4–5 finer, distance between punctures about 1 puncture diameter. Marginal zone of tergum 1 hardly depressed, those of following terga depressed weakly. Pygidial plate without raised central zone.

**Male** (Fig. 9E). **Length:** 6–6.5 mm.

**Color.** Head and mesosoma black; Clypeus yellow to white except along margins; two darker lateral spots sometimes only barely discernible (Fig. 9F). Paraocular area usually with small yellow to white spot near apex, not reaching anterior tentorial pit (Fig. 9F). Flagellomeres 3–11 brown (Fig. 9E–F). Metasoma as in female; sternum 4 usually fully reddish-orange (Fig. 9H).

**Pubescence.** Head and mesosoma (excluding propodeum) with long hairs, golden dorsally, white ventrally (Fig. 9F–G). Paraocular and supraclypeal areas with golden hairs (Fig. 9F). Clypeus, genal area and mesepisternum with golden hairs dorsally and white hairs ventrally (Fig. 9E–F). Mesonotum, scutellum and metanotum with golden hairs (Fig. 9G). Coxae, trochanters and femora with white hairs; tibiae and tarsi with golden to white hairs. Terga with very short and fine, inconspicuous bright hairs (Fig. 9H). Marginal zone of tergum 5 with continuous

band of long white to golden hair; anal fimbria white to golden (Fig. 9H). Sterna with bands of long white hairs on marginal zones.

**Head** (Fig. 9F–G). Broader than long (Fig. 9F). Clypeus moderately convex, shagreened basally and almost smooth apically, moderately punctured, distance between punctures 1–2 puncture diameters, often with narrow impunctate midline on apical part. Flagellomere proportions as in female. Ocelloccipital distance about 3/4 ocellus diameter (Fig. 9G).

**Mesosoma** (Fig. 9G). Mesonotum and scutellum shagreened but shiny on top, finely punctured, distance between punctures 1–1.5 puncture diameters. Propodeal triangle and wing venation as in female.

**Metasoma** (Fig. 9H). Tergum 1 smooth to superficially shagreened. Terga 2–4 shagreened on basal part of disc, smooth to superficially shagreened on apical part of disc, and lightly shagreened on marginal zones. Terga 5–6 shagreened. Punctures on terga 1–4 of moderate size, on terga 5–6 finer, distance between punctures 1–1.5 puncture diameters. Marginal zone of tergum 1 hardly depressed, those of following terga weakly depressed.

**Genitalia and hidden sterna** (Figs. 12G, 13G). Dorsal lobes of gonocoxites absent. Apex of gonostylus extremely elongate and thin. Penis valves very long and narrow, tapering apically, with raised dorsal carina (Fig. 12G). Sternum 8 columnar, very narrow and elongate, apex very slightly broadened (Fig. 13G).

**Differential diagnosis.** *Andrena s. mediterranea* differs from the nominate subspecies by the stronger shagreenation of the clypeus, mesonotum and scutellum, mostly golden pilosity of the female (black in *A. s. sphecodimorpha*), and smaller yellow paraocular maculae in the male. Similar differences distinguish *A. s. mediterranea* from *A. hybrida* (in *A. hybrida* the pilosity is more whitish), as well as the absence of a lateral black spot on tergum 2 (usually present in *A. hybrida*) and darker flagellum.

**Flight period:** February–April.

**Flower records:** Amaryllidaceae: *Allium trifoliatum* (1♀); Brassicaceae: *Diplotaxis erucoides* (1♀, 1♂); *Hirschfeldia incana* (1♀); Iridaceae: *Moraea sisyrinchium* (1♀). The majority of specimens collected from pan traps.

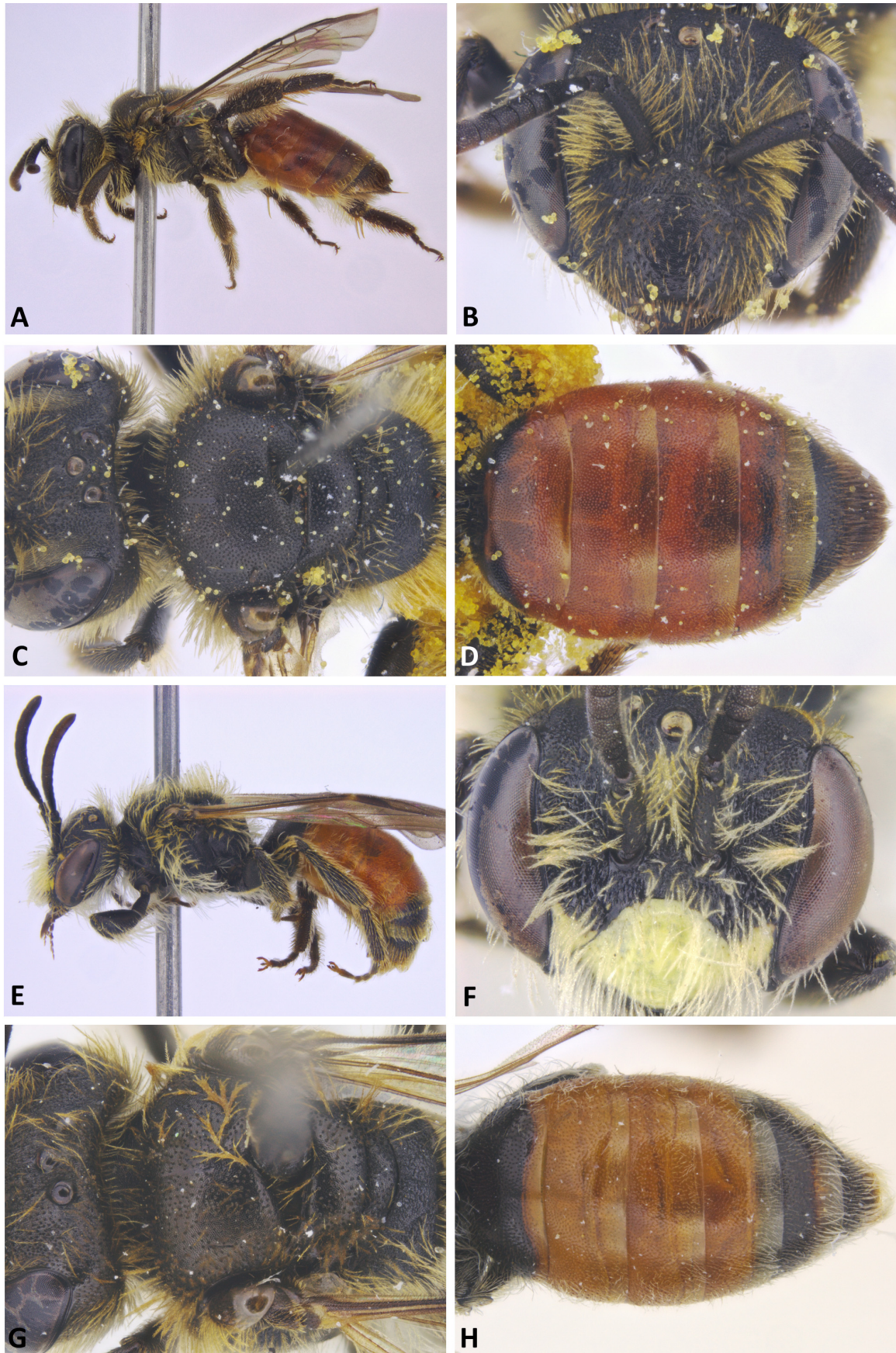
**Etymology.** Named after the Mediterranean distribution and habitat characteristic of the subspecies.

**Holotype:** ♀, ISRAEL: Lakhish, 2km E, 4.iii.2016, G. Pisanty [SMNHTAU].

**Paratypes:** ISRAEL: east of Hadera, 8.iv.2015, R. Salomon (1♀); Har Meron, 1000m, 1.iv.2012, A. Freidberg (1♀, 1♂); Karei Deshe, 27.ii.2012, T. Shapira (18♀, 24♂); 19.iii.2012, T. Shapira (10♀, 1♂); 20.iii.2012, T. Shapira (1♀); 8.iv.2012, T. Shapira (1♀); 23.iv.2012, T. Shapira (1♀); 9.ii.2013, T. Shapira (1♀, 2♂); 10.ii.2013, T. Shapira (1♀, 8♂); 1.iii.2013, T. Shapira (22♀, 3♂); 2.iii.2013, T. Shapira (23♀, 5♂); 13.iii.2013, T. Shapira (1♀, 3♂); 14.iii.2013, T. Shapira (2♀, 1♂); 4.iv.2013, T. Shapira (1♀); 24.iv.2013, T. Shapira (1♀); Kefar 'Avoda, 13.iii.2012, O. Afik (1♀); 1.iv.2012, O. Afik (1♀); Kefar Menahem, 2.iii.2008, U. Roll (1♀); 14.ii.2010, M. Dorman (1♀); 19.ii.2010, G. Pisanty (1♂); Kefar Szold, 1948, H. Bytinski-Salz (1♂); Lakhish, 21.iii.2012, T. Shapira (1♂); 18.ii.2013, T. Shapira (1♀); 6.iii.2013, T. Shapira (2♀); 13.iii.2013, T. Shapira (1♀); 18.iii.2013, T. Shapira (1♀); 19.iii.2013, T. Shapira (2♀); Lakhish, 2km E, 4.iii.2016, G. Pisanty (1♀); Malkiyya, 28.iv.2015, O. Winberger (2♀); Mount Carmel, 9.iii.2014, G. Ballantyne (1♀); 27.iii.2014, G. Ballantyne (1♀); 9.iii.2015, G. Ballantyne (1♀); Nahal Dishon, 1.iv.1991, R. Kasher (1♀); Netiv Halamed Heh, 16.ii.2010, G. Pisanty (1♂); Park Britannia, 24.iv.2011, T. Koznichki (1♀); Qasabiya, 17.ii.1984, I. Nussbaum (1♀); Ramat Hanadiv, 22.iii.2012, T. Shapira (2♀); 11.iv.2012, T. Shapira (2♀); 26.ii.2013, T. Shapira (5♀); Rosh Pina, 12.iii.1974, A. Freidberg (1♂); Sasa, 27.iv.2015, O. Winberger (1♀); Ya'ar Adulam, 14.ii.2011, T. Koznichki (2♂); 20.iv.2011, T. Koznichki (1♀); 20.ii.2013, Y. Berner (1♂); Ya'ar Yish'i, 26.iv.2011, T. Koznichki (1♀); 26.ii.2013, Y. Berner (1♀); Zur Moshe, i.iv.2012, O. Afik (1♀). WEST BANK: Qedumim, 27.ii.2015, L. Friedman (1♂) [AMNH, ES, OLML, SMNHTAU, USNM, ZSMC].

**Remarks.** The various subspecies of *A. sphecodimorpha* and *A. hybrida* are very closely related, and differ mostly in color and in the degree of shagreening. The genitalia are essentially identical, whereas most species of *Poecilandrena* exhibit significant variation in genital morphology. *A. s. mediterranea* is separated geographically from other members of the group, especially from its nominate subspecies. It occurs in northern and central Israel and possibly in neighboring countries, whereas the nominate subspecies occurs in Eastern Europe from Ukraine to Greece. Judging from the geographical distribution and morphological variation, we regard *A. s. mediterranea* as a borderline case in terms of species divergence, and this taxon may well be regarded by others as a distinct species. The level of divergence within the *A. sphecodimorpha*–*A. hybrida* complex merits further investigation, preferably with the aid of molecular data, which could not be obtained in the current study due to the old age of the available specimens.





**FIGURE 9.** *Andrena sphecodimorpha mediterranea* n. ssp., female (A–D) and male (E–H): A, E, habitus, lateral view; B, F, head, anterior view; C, G, head and mesosoma, dorsal view; D, H, metasoma, dorsal view.

***Andrena (Poliandrena) perahia* Pisanty & Scheuchl n. sp.**

(Figs. 10, 12H, 13H)

**Female** (Fig. 10A). **Body length:** 8 mm.

**Color.** Head, mesosoma and terga black. Legs and sterna brown to black. Dorsal side of flagellum dark brown to black; ventral side of flagellomeres 3–10 and apicoventral part of flagellomeres 1–2 orange (Fig. 10BC). Wings transparent, veins brown, stigma orange.

**Pubescence.** Labrum and vertex with golden hairs (Fig. 10B–C). Clypeus with sparse white to golden hairs of medium length (Fig. 10B). Paraocular area, frons and genal area with dense white hairs of medium length (Fig. 10B). Mesonotum, scutellum and metanotum with sparse, short whitish-golden hairs (Fig. 10C). Mesepisternum and propodeum with long white hairs. Propodeal corbicula incomplete, posterodorsal margin with long white hairs. Surface of propodeal corbicula with long, simple white hairs. Femora with long white hairs. Tibiae and tarsi with whitish to golden hairs. Scopal hairs simple anteriorly, partly plumose posteriorly. Tergal discs with inconspicuous short thin hairs, gradually lengthening from tergum 1 to tergum 4 (Fig. 10D). Marginal zone of tergum 1 bare except for lateral patches of white hair. Marginal zones of terga 2–4 with conspicuous bands of dense white hair, continuous in terga 3–4, almost continuous in tergum 2. Prepygidial fimbria whitish to light brown (Fig. 10D). Sternal discs with short whitish-golden hairs; marginal zones with long white hairs.

**Head** (Fig. 10B–C). Galea shagreened. Labral process trapezoidal. Clypeus almost flat, very smooth and shiny except at basolateral margin, sparsely and irregularly punctured, with impunctate midline, distance between punctures 0.5–3 puncture diameters, puncture size large to medium (Fig. 10B). Foveae broad, occupying 1/2–2/3 of paraocular area, very broad and shallow above, narrower and deeper below, extending from level of lower half of lateral ocelli to lower end of antennal socket or slightly below (Fig. 10B). Distance of fovea from lateral ocellus and ocelloccipital distance about 1 ocellus diameter (Fig. 10C). Flagellomere 1 as long as 2+3; 2–3 broader than long, 2 slightly shorter than 3; 4–5 almost square (Fig. 10B).

**Mesosoma** (Fig. 10C). Dorsolateral angle of pronotum weakly elevated. Mesonotum and scutellum very shiny; anterior 1/3 of mesonotum shagreened, posterior 2/3 and scutellum smooth; disc of mesonotum and scutellum sparsely and irregularly punctured, distance between punctures 0.5–3 puncture diameters, puncture size small to medium. Propodeal triangle matt, roughened and rugose. Propodeal corbicula shagreened, not to superficially punctured. Hind leg pretarsal claws bidentate. Nervulus antefurcal.

**Metasoma** (Fig. 10D). Terga 1–4 smooth and shiny, finely and densely punctate, distance between punctures 0.5–1.5 puncture diameters. Tergum 5 superficially shagreened, coarsely punctured, distance between punctures 0.5–2 puncture diameters. Pygidial plate flat and almost smooth.

**Male** (Fig. 10E). **Body length:** 6 mm.

**Color.** Clypeus yellowish-white with two lateral black spots (Fig. 10F). Apical part of paraocular area ivory-coloured (Fig. 10F). Stigma yellowish-transparent. Flagellum, mesosoma, legs and metasoma as in female.

**Pubescence.** Labrum with golden hairs (Fig. 10F). Clypeus, paraocular area, frons, vertex and genal area with white hairs (Fig. 10F). Mesosoma with long white hairs on all sides. Trochanters, femora and tibiae with white hairs. Tarsi with whitish to golden hairs. Basal half of tergum 2 with conspicuous short white hairs; otherwise tergal discs with inconspicuous short thin hairs. Marginal zones of terga 1–6 with conspicuous bands of dense white hair, continuous on terga 2–6, discontinuous on tergum 1. Anal fimbria whitish. Sternal discs with short whitish-golden hairs; marginal zones of sterna 2–5 with conspicuous white hair bands.

**Head** (Fig. 10F). Galea shagreened. Clypeus weakly convex, very smooth and shiny, with broad impunctate midline, distance between punctures 1–2 puncture diameters, puncture size medium. Flagellomeres 1, 3–5 slightly longer than broad, 1 slightly longer than 3; 2 broader than long. Ocelloccipital distance about 1 ocellus diameter.

**Mesosoma.** Similar to female.

**Metasoma.** Similar to female.

**Genitalia and hidden sterna** (Figs. 12H, 13H). Gonocoxites connected, with elongate dorsal lobes. Gonostylus spatulate, apical part suddenly broadened, apex rounded. Penis valves broad, spade-shaped, with short, pointed lateral projections near visual base (Fig. 12H). Sternum 8 columnar, narrow, apex shaped as inverted triangle (Fig. 13H).

**Differential diagnosis.** *A. perahia* is easily distinguished from similar species of the subgenus *Poliandrena* (e.g. *A. relata* Warncke) by several characters, especially the smaller body size, the extremely smooth and shiny, sparsely punctured clypeus and mesonotum, and the male's elongate dorsal gonocoxite lobes.





**FIGURE 10.** *Andrena perahia* n. sp., female (A–D) and male (E–F): A, E, habitus, lateral view; B, F, head, anterior view; C, head and mesosoma, dorsal view; D, metasoma, dorsal view.

**Flight period:** March.

**Flower records:** Brassicaceae: *Diplotaxis acris* (1♀); *D. harra* (1♀, 1♂); *Erucaria rostrata* (4♀); *Zilla spinosa* (2♀).

**Etymology.** The species is named in honor of the American pianist Murray Perahia (born 1947). The species epithet is a noun in apposition.

**Holotype:** ♀, ISRAEL: Ir Ovot, 5km NE, 6.iii.2010, A. Gotlieb [SMNHTAU].

**Paratypes:** ISRAEL: En Yahav, 3km N, 3.iii.2010, A. Gotlieb (1♂); 19.iii.2010, A. Gotlieb (1♀); Hazeva, 1.5km WSW, 10.iii.2010, Y. Hops (1♀); Hazeva, 2km NW, 8.iii.2010, Y. Hops (1♀); Hazeva, 2km S, 2.iii.2010, A.



Gotlieb (1♂); Hazeva, 3km SW, 10.iii.2010, A. Gotlieb (1♀); Ir Ovot, 4km NE, 6.iii.2010, H. Marshall (1♀); Ir Ovot, 5km NE, 6.iii.2010, A. Gotlieb (1♀); 7.iii.2010, A. Gotlieb (1♀); Yotvata, 19.iii.1988, I. Yarom (1♀). WEST BANK: Mizpe Shalem, 10.iii.2015, T. Jumah (1♀) [ES, OLML, SMNHTAU].

***Andrena (Ptilandrena) crocusella* Pisanty & Scheuchl n. sp.**

(Figs. 11, 12I, 13I)

**Female** (Fig. 11D). **Body length:** 8.5–9.5 mm.

**Color.** Head, mesosoma and metasoma black. Proboscis mostly brown; segments of labial and maxillary palps white near joints (Fig. 11A). Flagellum black. Legs mostly black; distal part of tarsi black to brown (Fig. 11D). Wings transparent; veins dark brown to black; stigma entirely black. Tergal marginal zones dark brown to black (Fig. 11C).

**Pubescence.** Head and mesosoma mostly with long, minutely plumose hairs (Fig. 11A, B, D). Clypeus and genal area with long black hairs (Fig. 11A, B). Paraocular and supraclypeal areas, frons and scape with long black hairs and few white hairs (Fig. 11A). Vertex with black hairs anteriorly, long golden-white hairs posteriorly (Fig. 11A). Mesonotum, scutellum and metanotum with both long golden-white hairs and somewhat shorter black hairs (Fig. 11B). Mesepisternum with very long black hairs and few golden-white hairs, the latter mostly on ventral part. Posterior side of propodeum with long black hairs. Propodeal corbicula incomplete, posterodorsal margin with long black plumose hairs. Surface of corbicula with few long plumose hairs. Coxae, trochanters, femora and tibiae with black hairs on foreleg and midleg, and both white and brown to black hairs on hindleg. Tarsi with brown hairs. Flocculus with both white and black, strongly plumose hairs. Scopa two-coloured, outer side with brown plumose hairs, inner side with very long, white plumose hairs. Tergum 1 with long black hairs basally and long white hairs apically (Fig. 11C). Terga 2–5 with short black hairs. Marginal zones of terga 2–3 with discontinuous white hair bands. All terga with long hairs laterally, black and white on 1–2, black on 3–5. Prepygidial fimbria black (Fig. 11C). Sterna with black hair on mid part and whitish hair laterally, hair gradually longer towards marginal zone.

**Head** (Fig. 11A–B). Slightly broader than long (Fig. 11A). Glossa 5–6 times as long as broad. Labial and maxillary palps 4- and 6-segmented, long, extending much beyond glossa (Fig. 11A). Galea shagreened. Labral process much broader than long, more or less rectangular. Clypeus convex, shiny, basal half transversely grooved, apical half more or less smooth and with impunctate midline; punctures of medium size, distance between punctures 1 puncture diameter (Fig. 11A). Facial foveae narrow and elongate, lower part slightly broadened, fovea occupying 1/5 of paraocular area, extending from level of middle ocellus to lower end of antennal socket or slightly below (Fig. 11A). Distance of fovea from lateral ocellus 2.5–3 ocellus diameters. Flagellomere 1 about 2.5 times as long as broad, nearly as long as 2+3+4; 2–3 slightly broader than long, 2 slightly shorter than or equal to 3; 4–5 almost square. Ocellocipital distance about 2 ocellus diameters (Fig. 11B).

**Mesosoma** (Fig. 11B). Dorsolateral angle of pronotum elevated, with weak carina extending down laterally. Mesonotum fully shagreened, matt anteriorly and somewhat shiny on top, punctures of medium size, distance between punctures 0.5–1 puncture diameters. Scutellum similar. Mesepisternum finely rugose-areolate. Propodeal corbicula finely rugose, shiny, ventral part with long, strong vertical grooves. Propodeal triangle rugose-areolate, grooves much finer apically and laterally. Hind leg pretarsal claws distinctly bidentate. Nervulus more or less interstitial.

**Metasoma** (Fig. 11C). Tergum 1 shiny, smooth to very superficially shagreened, finely and very sparsely punctured. Terga 2–5 superficially shagreened, 2 sometimes almost smooth on disc; terga finely punctured, distance between punctures 2–3 puncture diameters; marginal zones of 2–4 weakly depressed. Central area of pygidial plate elevated.

**Male** (Fig. 11E). **Body length:** 9–10.5 mm.

**Color.** Similar to female. Clypeus and supraclypeal areas black (Fig. 11F).

**Pubescence.** Head and mesosoma similar to female (Figs. 11F–G). Coxae, trochanters and femora with long black hairs and few white hairs, the latter especially on hindleg. Tibiae with black, golden-brown and white hairs. Tarsi with golden-brown and black hairs. Hair on terga similar to female, but white apical hair bands often weaker or absent, especially on tergum 3 (Fig. 11H). Sterna with brown to white hair, brighter and longer laterally.



**FIGURE 11.** *Andrena crocusella* n. sp., female (A–D) and male (E–H): A, F, head, anterior view; B, G, head and mesosoma, dorsal view; C, H, metasoma, dorsal view; D, E, habitus, lateral view.





**FIGURE 12.** Male genital capsules, dorsal view: **A**, *Andrena israelica* n. sp.; **B**, *A. judaea* n. sp.; **C**, *A. palaestina* n. sp.; **D**, *A. hermonella* n. sp.; **E**, *A. menahemella* n. sp.; **F**, *A. wolff*; **G**, *A. sphecodimorpha mediterranea* n. ssp.; **H**, *A. perahia* n. sp.; **I**, *A. crocusella* n. sp.





**FIGURE 13.** Male eighth sterna, ventral view: **A**, *Andrena israelica* n. sp.; **B**, *A. judaea* n. sp.; **C**, *A. palaestina* n. sp.; **D**, *A. hermonella* n. sp.; **E**, *A. menahemella* n. sp.; **F**, *A. wolffi*; **G**, *A. sphecodimorpha mediterranea* n. ssp.; **H**, *A. perahia* n. sp.; **I**, *A. crocusella* n. sp.



**Head** (Fig. 11F–G). Slightly broader than long. Proboscis similar to female (Fig. 11F). Mandibles long, sickle-shaped, significantly crossed (Fig. 11F). Clypeus weakly convex to almost flat, much broader than long, shiny, basal half transversely grooved, apical half more or less smooth and with very broad impunctate midline; punctures of medium size, distance between punctures 1–1.5 puncture diameters (Fig. 11F). Flagellomere 1 about 2.5 times as long as broad, much longer than 2+3; 2–3 slightly broader than long, 2 slightly shorter than or equal to 3; 4–5 almost square (Fig. 11F). Ocelloccipital distance about 2 ocellus diameters (Fig. 11G).

**Mesosoma** (Fig. 11G). Dorsolateral angle of pronotum strongly elevated, with strong carina extending down laterally. Mesonotum more shallowly punctured than in female. Rest of mesosoma similar to female.

**Metasoma** (Fig. 11H). Similar to female, but discs of terga 2–4 often smoother.

**Genitalia and hidden sterna** (Figs. 12I, 13I). Gonocoxites connected, with short, somewhat rounded dorsal lobes. Gonostyli spatulate, apical part suddenly broadened, flattened and hairy, apex curved. Penis valves broad, basal part not tapering and with short pointed lateral projections, apical part tapering (Fig. 12I). Sternum 8 columnar, of more or less uniform breadth, apex notched (Fig. 13I).

**Differential diagnosis.** *A. crocusella* resembles *A. grossella* Gründwaldt and another undescribed species of the subgenus *Ptilandrena* from Crete (E.S., unpublished; see also remarks section). The most important difference between the species is the number of maxillary and labial palps—9 and 9 in *A. grossella*, 7 and 7 in the undescribed species, and 6 and 4 in *A. crocusella*. The female of *A. crocusella* further differs from *A. grossella* by the shorter impunctate midline of the clypeus (in *A. grossella* the midline reaches clypeus base), longer ocelloccipital distance, shagreened scutellum (smooth on disc in *A. grossella*), presence of white hair bands on terga 2–3, and more or less interstitial nervulus (postfurcal in *A. grossella*). The male of *A. crocusella* further differs from *A. grossella* by the shagreenation of clypeus and discs of mesonotum and scutellum (very smooth and shiny in *A. grossella*), and more or less interstitial nervulus (postfurcal in *A. grossella*). There are no major differences in genitalia and hidden sterna between the two species.

**Flight period:** November–December.

**Flower records:** Iridaceae: *Crocus hyemalis* (16♀, 6♂); *Crocus* sp. (1♂).

**Etymology.** Named after the plant genus *Crocus*, which appears to be the species' main forage plant.

**Holotype:** ♀, ISRAEL: Horbat Raqqit (2 km SSE of Bet Oren), 9.xii.2015, G. Pisanty [SMNHTAU].

**Paratypes:** ISRAEL: Horbat Raqqit, 9.xii.2015, G. Pisanty (1♀, 15♂); 21.xii.2015, G. Pisanty (14♀, 1♂); Ya'ar Odem Nature Reserve, Jubat Al Kabira, 20.xi.2015, G. Pisanty (1♂) [ES, OLML, SMNHTAU].

**Remarks.** *A. crocusella* belongs to a group of closely related species within the subgenus *Ptilandrena*, which are active during autumn to early winter (October–December), forage on large geophyte flowers typical of the season (*Crocus* and *Sternbergia* spp.), and exhibit similar morphology, with extremely elongated labial palps. Currently, three such species are known, the others being *A. grossella* from mainland Greece and a yet undescribed species from Crete (Erwin Scheuchl, unpublished data). Bees are rarely collected during autumn and winter, and systematic surveys should be conducted throughout the Mediterranean region to potentially discover additional species with similar phenology.

## Acknowledgements

We thank Fritz Gusenleitner and Martin Schwarz for their kind help in hosting the first author at the Biologiezentrum Linz and loaning material for study. The extensive collecting efforts of Tal Shapira, Ariella Gotlieb, Ariel-Leib-Leonid Friedman and Amnon Freidberg yielded many of the specimens included in this study. Esther Ockermüller kindly provided photographs of *A. hermonella*. We thank Hans Richard Schwenninger, an anonymous reviewer, and the subject editor for helpful comments on the manuscript.

## References

- Aizen, M.A., Garibaldi, L.A., Cunningham, S.A. & Klein, A.M. (2008) Long-term global trends in crop yield and production reveal no current pollination shortage but increasing pollinator dependency. *Current Biology*, 18 (20), 1–4.  
<http://dx.doi.org/10.1016/j.cub.2008.08.066>
- Cuttelod, A., García, N., Abdul Malak, D., Temple, H.J. & Katariya, V. (2009) The Mediterranean: a biodiversity hotspot under

- threat. In: Vié, J.-C., Hilton-Taylor, C. & Stuart, S.N. (Eds.), *Wildlife in a Changing World—An Analysis of the 2008 IUCN Red List of Threatened Species*. IUCN, Gland, pp. 89–104.
- Dorchin, A. (2013) *The Effects of Habitat Fragmentation on the Community Structure and Diversity of Native Bees in a Threatened Mediterranean Habitat*. PhD thesis, University of Haifa, Haifa, 105 pp.
- Dubitzky, A., Plant, J. & Schönlitzer, K. (2010) Phylogeny of the bee genus *Andrena* Fabricius based on morphology. *Mitteilungen der Münchner Entomologischen Gesellschaft*, 100, 137–202.
- Dunn, R.R. (2005) Modern insect extinctions, the neglected majority. *Conservation Biology*, 19 (4), 1030–1036.  
<http://dx.doi.org/10.1111/j.1523-1739.2005.00078.x>
- Garibaldi, L.A., Steffan-Dewenter, I., Winfree, R., Aizen, M.A., Bommarco, R., Cunningham, S.A., Kremen, C., Carvalheiro, L.G., Harder, L.D., Afik, O., Bartomeus, I., Benjamin, F., Boreux, V., Cariveau, D., Chacoff, N.P., Dudenhöffer, J.H., Freitas, B.M., Ghazoul, J., Greenleaf, S., Hipólito, J., Holzschuh, A., Howlett, B., Isaacs, R., Javorek, S.K., Kennedy, C.M., Krewenka, K., Krishnan, S., Mandelik, Y., Mayfield, M.M., Motzke, I., Munyuli, T., Nault, B.A., Otieno, M., Petersen, J., Pisanty, G., Potts, S.G., Rader, R., Ricketts, T.H., Rundlöf, M., Seymour, C.L., Schüepp, C., Szentgyörgyi, H., Taki, H., Tscharnkte, T., Vergara, C.H., Viana, B.F., Wanger, T.C., Westphal, C., Williams, N. & Klein, A.M. (2013) Wild pollinators enhance fruit set of crops regardless of honey bee abundance. *Science*, 339 (6127), 1608–1611.  
<http://dx.doi.org/10.1126/science.1230200>
- Gotlieb, A., Hollender, Y. & Mandelik, Y. (2011) Gardening in the desert changes bee communities and pollination network characteristics. *Basic and Applied Ecology*, 12 (4), 310–320.  
<http://dx.doi.org/10.1016/j.baae.2010.12.003>
- Gusenleitner, F. & Scheuchl, E. (2000) Zwei neue *Andrena*-Arten aus dem nahen Osten sowie Beschreibung des Männchens von *Andrena isabellina* Warncke (Hymenoptera: Apidae: Andreninae). *Entomofauna*, 21 (11), 117–132.
- Gusenleitner, F. & Schwarz, M. (2002) Weltweite Checkliste der Bienengattung *Andrena*: mit Bemerkungen und Ergänzungen zu paläarktischen Arten (Hymenoptera, Apidae, Andreninae, *Andrena*). *Entomofauna*, 10 (Supplement), 1280 pp.
- Hedicke, H. (1942) Über paläarktische Apiden. (Hym.) III. *Mitteilungen der Deutschen Entomologischen Gesellschaft*, 11 (5/6), 63–65.
- Klein, A.M., Vaissiere, B.E., Cane, J.H., Steffan-Dewenter, I., Cunningham, S.A., Kremen, C. & Tscharnkte, T. (2007) Importance of pollinators in changing landscapes for world crops. *Proceedings of the Royal Society of London B: Biological Sciences*, 274 (1608), 303–313.  
<http://dx.doi.org/10.1098/rspb.2006.3721>
- LeBuhn, G., Griswold, T., Minckley, R., Droege, S., Roulston, T.A., Cane, J., Parker, F., Buchmann, S., Tepedino, V., Williams, N., Kremen, C. & Messenger, O. (2003) A standardized method for monitoring bee populations—the bee inventory (BI) plot (draft). Available from: <http://online.sfsu.edu/beeplot/> (accessed 6 January 2016)
- Mavromoustakis, G.A. (1958) On Some Bees from Greece (Hymenoptera: Apoidea). *Entomologische Berichten*, 18, 9–13.
- Michener, C.D. (1979) Biogeography of the bees. *Annals of the Missouri Botanical Garden*, 66 (3), 277–347.  
<http://dx.doi.org/10.2307/2398833>
- Michener, C.D. (2007) *The Bees of the World*, 2nd edition. Johns Hopkins University Press, Baltimore, Maryland, 953 pp.
- Nobile V. (2000) Le Andrene W-paleartiche con due celle cubitali (Hymenoptera, Apoidea, Andrenidae) con descrizione di *Parandrena iohannescaroli* sp. n. *Bollettino dell'Accademia Gioenia di Scienze Naturali*, 33 (358), 35–42.
- Osytsnjuk, A.Z. (1995) Andrenidae. In: Lehr, P.A. (Ed.), *Key to the Insects of Russian Far East. Vol. IV. Neuropteroidea, Mecoptera, Hymenoptera. Part I*. Nauka, St. Petersburg, pp. 489–527. [in Russian]
- O'Toole, C. & Raw, A. (1991) *Bees of the World*. Blandford Press, London, 192 pp.
- Pisanty, G. & Mandelik, Y. (2015) Profiling crop pollinators: life-history traits predict habitat use and crop visitation by Mediterranean wild bees. *Ecological Applications*, 25 (3), 742–752.  
<http://dx.doi.org/10.1890/14-0910.1>
- Potts, S.G., Vulliamy, B., Dafni, A., Ne'eman, G. & Willmer, P. (2003) Linking bees and flowers: how do floral communities structure pollinator communities? *Ecology*, 84 (10), 2628–2642.
- Potts, S.G., Biesmeijer, J.C., Kremen, C., Neumann, P., Schweiger, O. & Kunin, W.E. (2010) Global pollinator declines: trends, impacts and drivers. *Trends in Ecology and Evolution*, 25 (6), 345–353.  
<http://dx.doi.org/10.1016/j.tree.2010.01.007>
- Scheuchl, E., Schindler, M. & Al-Ghzawi, A.M. (2004) *Andrena (Holandrena) fimbriatoides* Scheuchl spec. nov. (Hymenoptera: Apoidea, Andrenidae), a new bee species from Jordan. *Zoology in the Middle East*, 32 (1), 85–90.
- Schindler, M., Diestelhorst, O., Härtel, S., Saure, C., Schanowski, A. & Schwenninger, H.R. (2013). Monitoring agricultural ecosystems by using wild bees as environmental indicators. *BioRisk*, 8, 53–71.  
<http://dx.doi.org/10.3897/biorisk.8.3600>
- Shapira, T. (2015) *The Effects of Cattle Grazing on Spring Foraging Potential of Honeybees and Wild Bees*. MSc thesis, the Hebrew University of Jerusalem, Rehovot, Israel, 90 pp.
- Underwood, E.C., Viers, J.H., Klausmeyer, K.R., Cox, R.L. & Shaw, M.R. (2009) Threats and biodiversity in the Mediterranean biome. *Diversity and Distributions*, 15 (2), 188–197.  
<http://dx.doi.org/10.1111/j.1472-4642.2008.00518.x>
- Warncke, K. (1968) Die Untergattungen der westpaläarktischen Bienengattung *Andrena* F. *Memorias e Estudos Muséu Zoológico da Universidade de Coimbra*, 307, 1–110.
- Warncke, K. (1969) A contribution to the knowledge of the genus *Andrena* (Apoidea) in Israel. *Israel Journal of Entomology*, 4, 377–408.
- Westrich, P. (1989) *Die Wildbienen Baden-Württembergs. Vol. I & II*. Ulmer Verlag, Stuttgart, 972 pp.