Survey of knowledge of the Andrenidae Family (Insecta: Hymenoptera)

Carlos Henrique Marchiori[1]

1 Instituto Federal Goiano

Funding: No specific funding was received for this work.

Potential competing interests: No potential competing interests to declare.

Abstract

They are typically solitary, so each female builds her own nest, consisting of one or a few cells at the end of a gallery, each cell presenting a clear bilateral symmetry. Some species can present a gregarious behavior, so they can be found forming aggregations of up to 40 females. Exceptionally, groups of up to 500 females have been found sharing a single entrance to the nest, a behavior that gives them an advantage over some parasites The family Andrenidae (Bulldozer bees) are not offensive, only when defending their eggs will they take the initiative to attack. Their claw needles are not powerful and usually cannot penetrate the skin. After being stabbed, they feel only mild pain. The female digs branching tunnels and forms a cell at the end of each one, where she deposits an egg after supplying it with pollen and nectar. The objective of this paper is to know the characteristics of the Family Adrenidae. In terms of the type of research source, we worked with scientific articles published in national and international journals. This modality of production, in addition to being commonly the most valued in the set of bibliographic production, is the most easily accessed. Access to articles was through virtual libraries such as SciELO, ResearchGate, Hall, USP, UNB, CAPES and LILACS.

Carlos Henrique Marchiori*

Department of Biological Science, Instituto Federal Goiano, Goias, Brazil

***Correspondence to:** Carlos Henrique Marchiori, PhD, Professor, Department of Biological Science, Instituto Federal Goiano, Rua T-65 No. 1050, Goiânia, Goiás 74230120, Brazil; Email: chmarchiori@yahoo.com.br

Keywords: Bee, Behavior, Gallery, Gregarious, Nests.

1. Introduction

The Andrenidae are a large family of almost cosmopolitan bees (absent in Australia), not parasitic. It has 3,000 spp. in 45 genres. Most species inhabit temperate or arid areas. This family includes some huge genera. Those in the subfamily, Oxaeinae, are so different in appearance that they were historically in separate families, but phylogenetic analysis revealed that they should be classified in the Andrenidae, very close to the Andreninae. Common in dry areas, Andrenidae also visit plants in search of nectar (Figure 1-3) [1][2][3].

Figure 1. Genus *Andrena* mining bees
Source: Determined by John S. Ascher, https://elp.tamu.edu/ipm/bugs/bees/hymenoptera-andreninae-andrena-mining-bees-a/

Figure 2. Second generation ashy mining bee *Andrena cinerea* Brullé, 1832. Female insect in the family Andrenidae, showing long black and white hair and the compound eye

Source: https://stock.adobe.com/br/search?k=andrenidae

Figure 3. Mining bee from the Andrenidae Family: Andrenidae is small to average-sized ground-nesting insects that are most active early evening. They don't enjoy hot weather and don't have accurate night vision. Andrenid bees mostly live in South America, Africa, Europe, and western North America. *Andrena crataegi* Robertson, 1893, is part of this family and is excellent at pollinating apples

Source: https://beeprofessor.com/what-are-the-seven-bee-families/

1.1. Description

The bees belonging to this family present the most distinctive character of the presence of two sub-antennal sutures, which are not strongly convergent. The sub-antennal area is rectangular or square, and not triangular as in some other species that possess both sub-antennal sutures, although these may not be evident in species with a black face and

strong stippling. In addition, the family is characterized by a short, glossy, punctate tongue, sometimes ending in a flagellum (Figures 4-6) [4][5][6].

Figure 4. *Andrena semiadesus* sp. nov. (1) female profile (2) female face (3) female dorsum (4) female tergites (5) male profile (6) male face (7) male tergites (8) male genitalia

Source: https://zookeys.pensoft.net/article/54794/element/2/16/

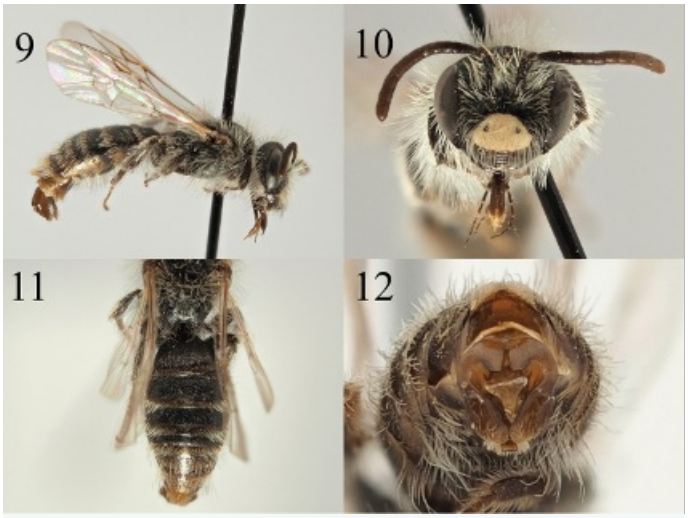

Figure 5. *Andrena triangulivalvis* sp. nov. (9) male profile (10) male face (11) male tergites (12) male genitalia

Source: https://zookeys.pensoft.net/article/54794/element/2/16/

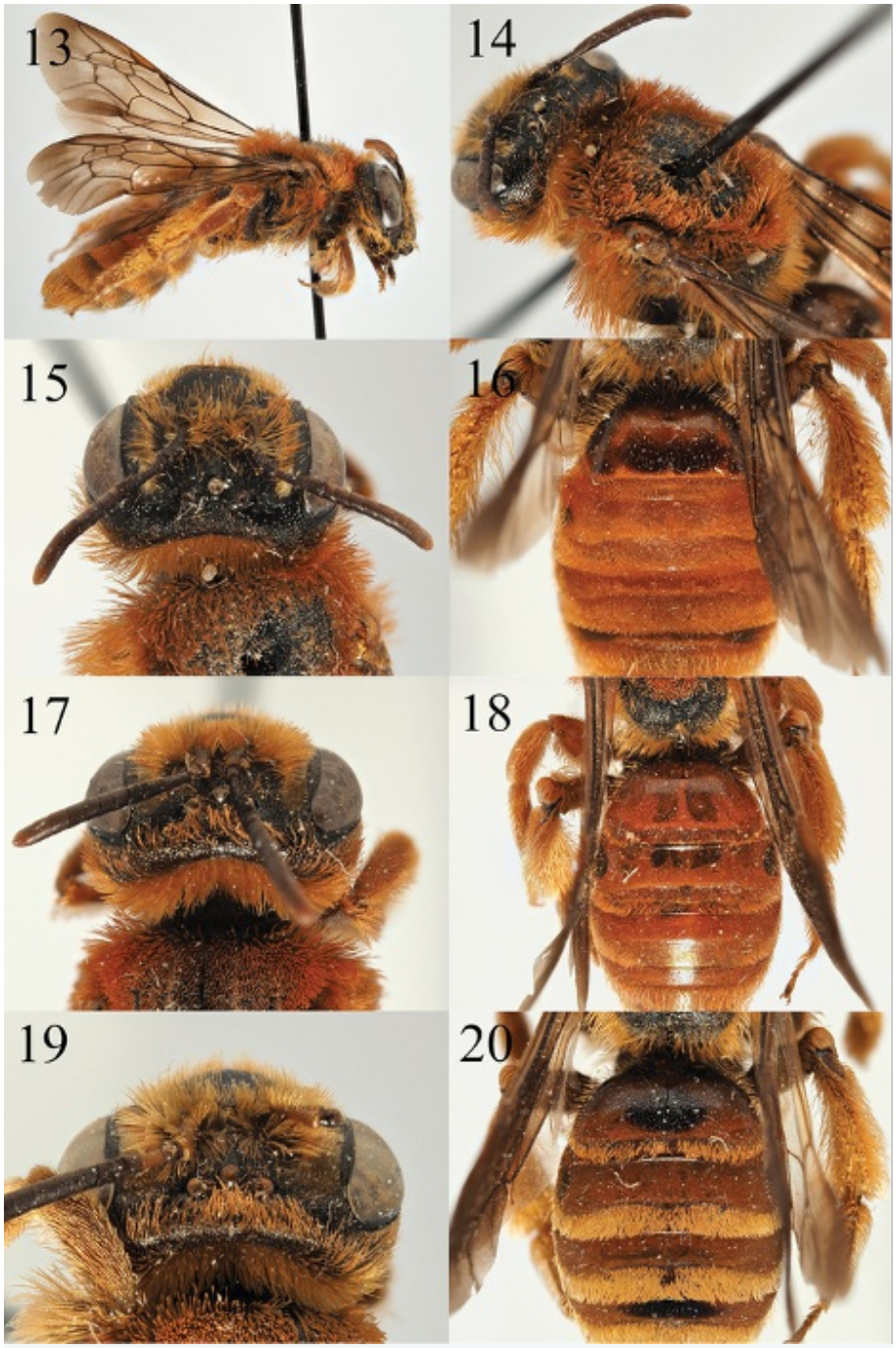

Figure 6. *Andrena sparsipunctata* sp. nov. (13) female profile (14) female mesonotum in semi-profile (15) female head dorsal view (16) female tergites. *Andrena succinea* Dours, 1872 (17) female head dorsal view (18) female tergites. *Andrena caroli* Pérez, 1895 (19) female head dorsal view (20) female tergites

Source: https://zookeys.pensoft.net/article/54794/element/2/16/

They can be separated from other bee families by the presence of two sub-antennal sutures on the face, a primitive aspect shared with Spheciformes wasps. Many groups also have depressions or channels called "fovea" on the head near the upper margin of the eyes. They are typically small to moderate bees, often with scops on the basal segments of the leg, in addition to the scop present on the tibia, for pollen collection (Figures 7-13) [7][8][9].

Figure 7. *Andrena sparsipunctata* sp. nov. (21) male profile (22) male genitalia (23) male face and labrum (24) male tergites. *Andrena succinea* Dours, 1872 (25) male face and labrum (26) male tergites. *Andrena caroli* Pérez, 1895 (27) male face and labrum (28) male tergites

Source: https://zookeys.pensoft.net/article/54794/element/2/16/

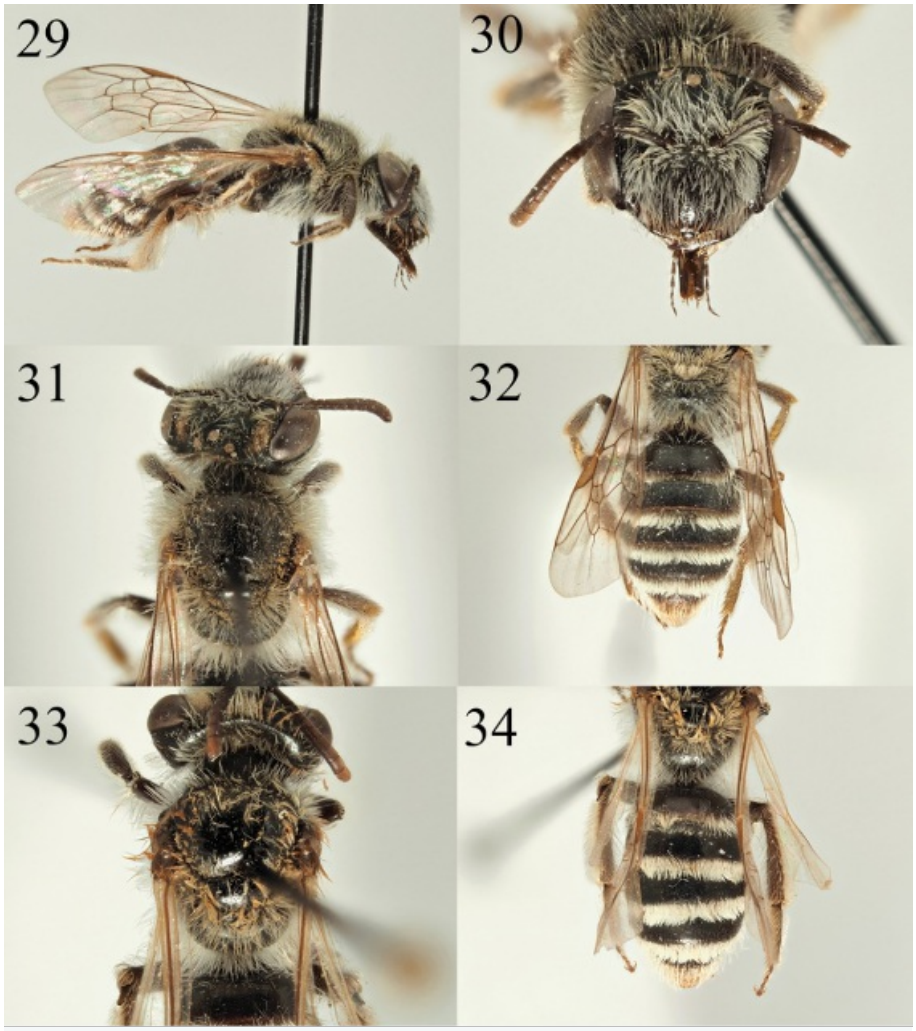

Figure 8. *Andrena hebescens* sp. nov. (29) female profile (30) female face (31) female dorsum (32) female tergites. *Andrena euzona* Pérez, 1895 (33) female dorsum (34) female tergites.

Source: https://zookeys.pensoft.net/article/54794/element/2/16/

Figure 9. *Andrena gafsensis* sp. nov. (55) female profile (56) female face (57) female propodeum (58) female tergites (59) male profile (60) male face (61) male tergites (62) (male) genitalia.

Figure 10. *Andrena tenebricorpus* sp. nov. (63) female profile (64) female face (65) female propodeum (66) female tergites.

Source: https://zookeys.pensoft.net/article/54794/element/2/16/

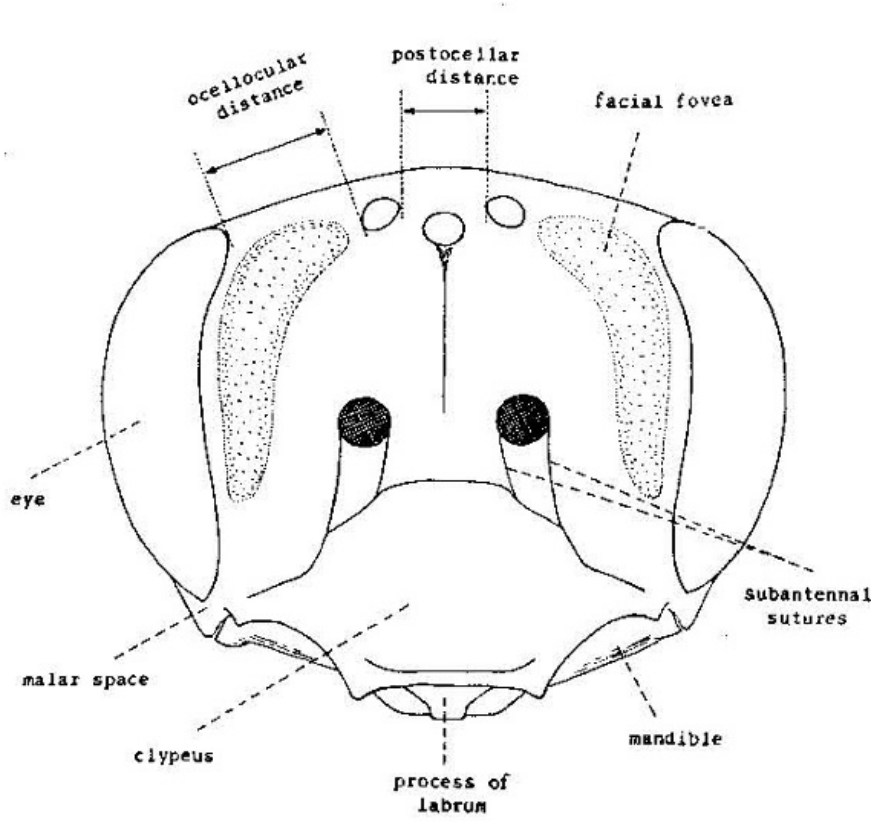

Figure 11. *Andrena japonica* (Smith, 1873), female, head in front view

Source: https://www.semanticscholar.org/paper/Systematic-and-biological-studies-of-the-family-of-Hirashima-%E5%B9%B3%E5%B6%8B/3d4dbd82042aa02f615d373ce4dcd085b5691fff/figure/0

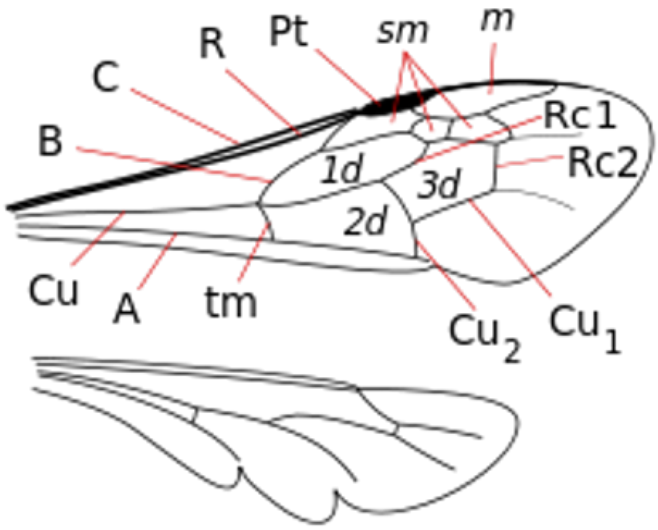

Figure 12. Andrena's wings: (Pt): pterostigma. Veins: (C): costa; (R): radius; (B): basal; (Cu): ulna; (A): anus; Rc1 and Rc2: first and second recurring; tm: median transverse. Cells: 1d, 2d, 3d: first, second, and third discs; sm: first, second and third submarginals; m: marginal
Source: https://es.wikipedia.org/wiki/Andrenidae

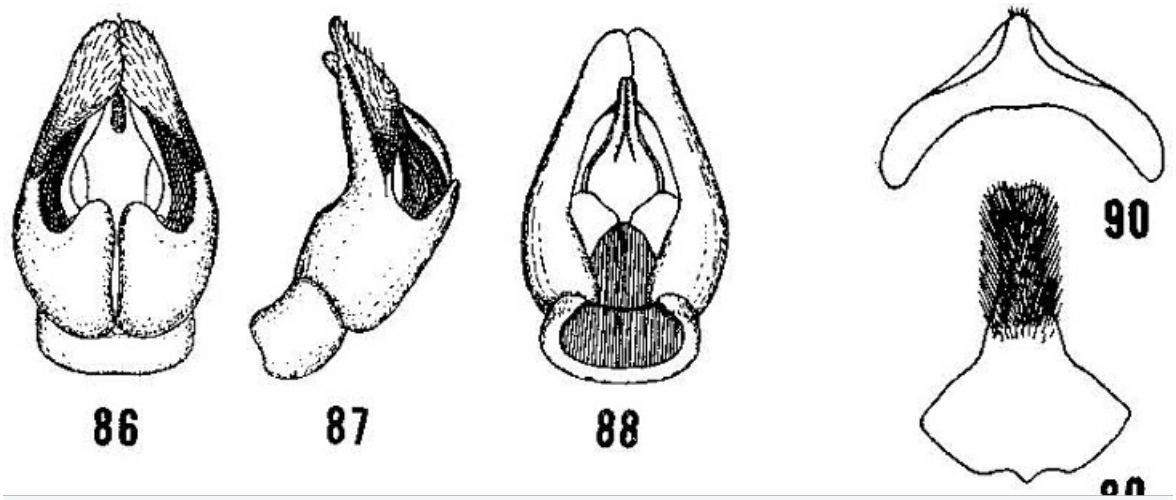

Figure 13. Dorsal view of genitalia, (87): lateral view of the same. (88): ventral view of the same, (89): Rth sternite, (90): 7th sternite,
Source: https://www.semanticscholar.org/paper/Systematic-and-biological-studies-of-the-family-of-Hirashima-%E5%B9%B3%E5%B6%8B/3d4dbd82042aa02f615d373ce4dcd085b5691fff/figure/0

1.2. Biology

The family Andrenidae (Bulldozer bees) are not offensive bulldozer bees, only when defending their eggs will they take the initiative to attack. Their claw needles are not powerful and usually cannot penetrate the skin. After being stabbed, they feel only mild pain. The female digs branching tunnels and forms a cell at the end of each one, where she deposits

an egg after supplying it with pollen and nectar.

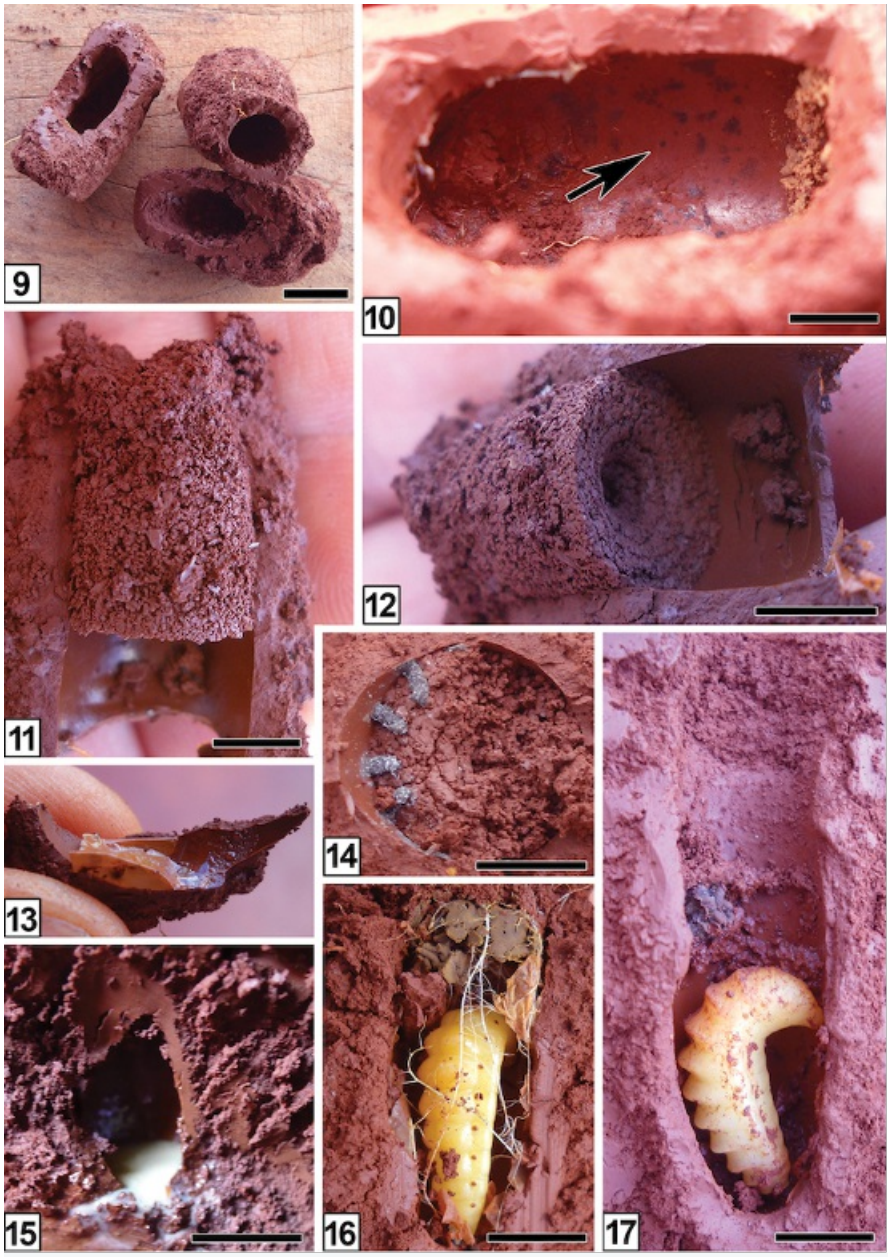

Figure 14. (9) Three individual *Oxaea austera* Gerstaecker, 1867 cells removed from soil (10) Black manganese mottles on the inner surface of the chamber (arrow), (11) Closed cell showing the antechamber filled with unconsolidated soil, (12) Internal view of a closed cell showing the spiral closure, (13) Cellophane-like lining (14) Radial arrangement of fecal pellets in contact with the spiral closure, (15) Longitudinal section of a cell showing the semiliquid provisions, (16) Cell with a post-defecating larva, the mass of fecal pellets in the upper part and a mesh of rootlets originally developed between the lining and the soil wall, (17) Post-defecating larva inside another cell showing remains of the antechamber, spiral closure and fecal pellets

Source: https://jhr.pensoft.net/article/4110/

Solitary bees in the sense that each raises its own family, but they tend to form large nest groups. Adults of many species are active only in the spring. The larva grows, undergoes metamorphosis and remains in the cell until the following year (Figures 15-16G) [10][11].

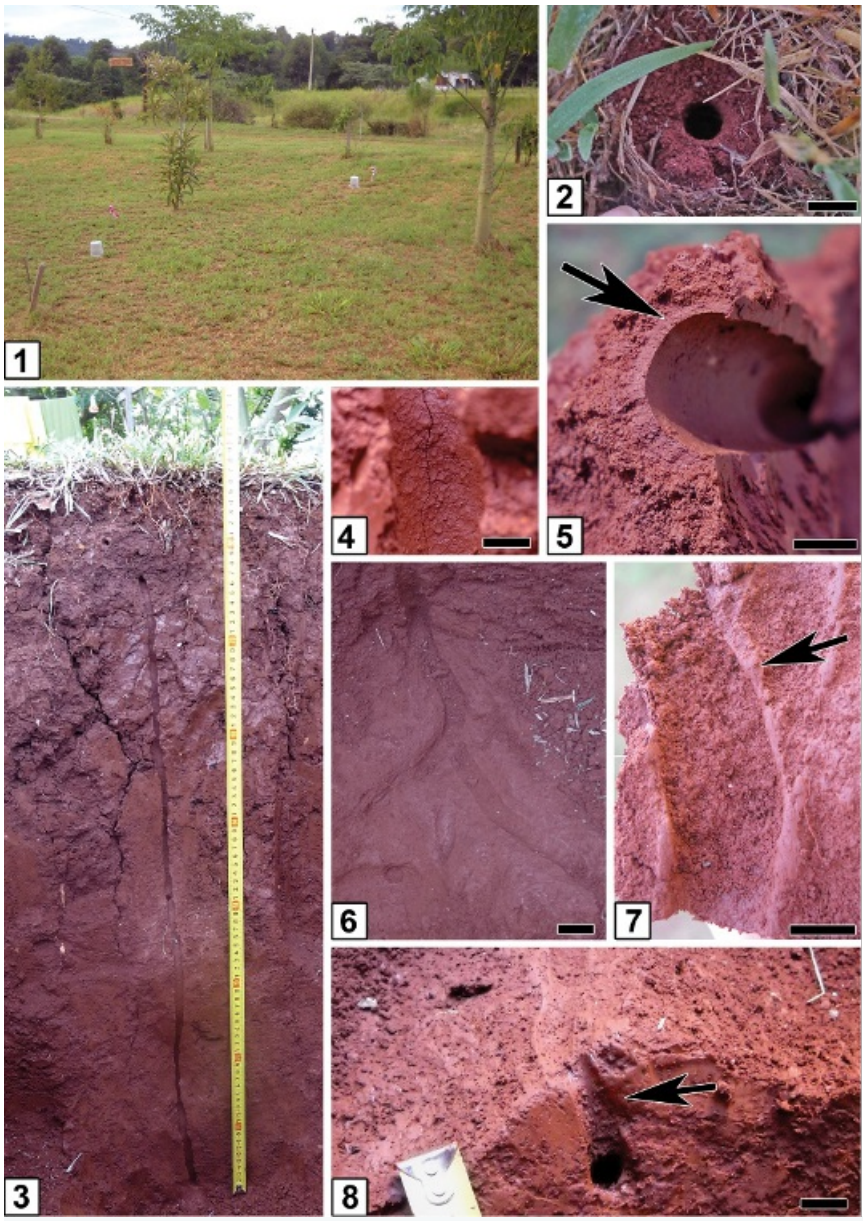

Figure 15*Oxaea austera* Gerstaecker, 1867 (1) General view of the nesting site of *O. austera* at Karadya Bioreserve (2) Tumulus and open nest entrance, (3) Main shaft (4) Surface texture of the first portion of the shaft showing marks, (5) Cross section of the shaft showing the discrete wall (arrow), (6) Curved portion of the main tunnel (left) with a lateral one (right) of nest 1 (7) A portion of the lateral tunnel showing the discrete wall (arrow), (8) The antechamber (arrow) connected to the end of the lateral tunnel.
Source: https://jhr.pensoft.net/article/4110/

Figure 16. *Oxaea austera* Gerstaecker, 1867

Source: https://www.usgs.gov/media/images/oxaea-austera-back-m-rurrenbaque-bolivia

A

B

C

D

F

G

Figures 16. A-G. Steps for forming nests in the soil: Insecta, Hymenoptera, Aculeata, Apoidea, Andrenidae. mining bees (Family Andrenidae). Invertebrates around Las Vegas, wildlife around Las Vegas. Colonial bees dig holes and nest in the ground. Each bee has its own hole and nest, but all of the bees nest in the same area

Sources: Jim Boone and https://www.birdandhike.com/Wildlife/Invert/Ph_Arthropoda/SubP_Hexapoda/Cl_Insecta/Hymenoptera/SO_Apocrita/Andrenidae/_Andren.htm

They are typically solitary, so each female builds her own nest, consisting of one or a few cells at the end of a gallery, each cell presenting a clear bilateral symmetry. Some species can present a gregarious behavior, so they can be found forming aggregations of up to 40 females. Exceptionally, groups of up to 500 females have been found sharing a single entrance to the nest, a behavior that gives them an advantage over some parasites (Figure 17) [12][13][14].

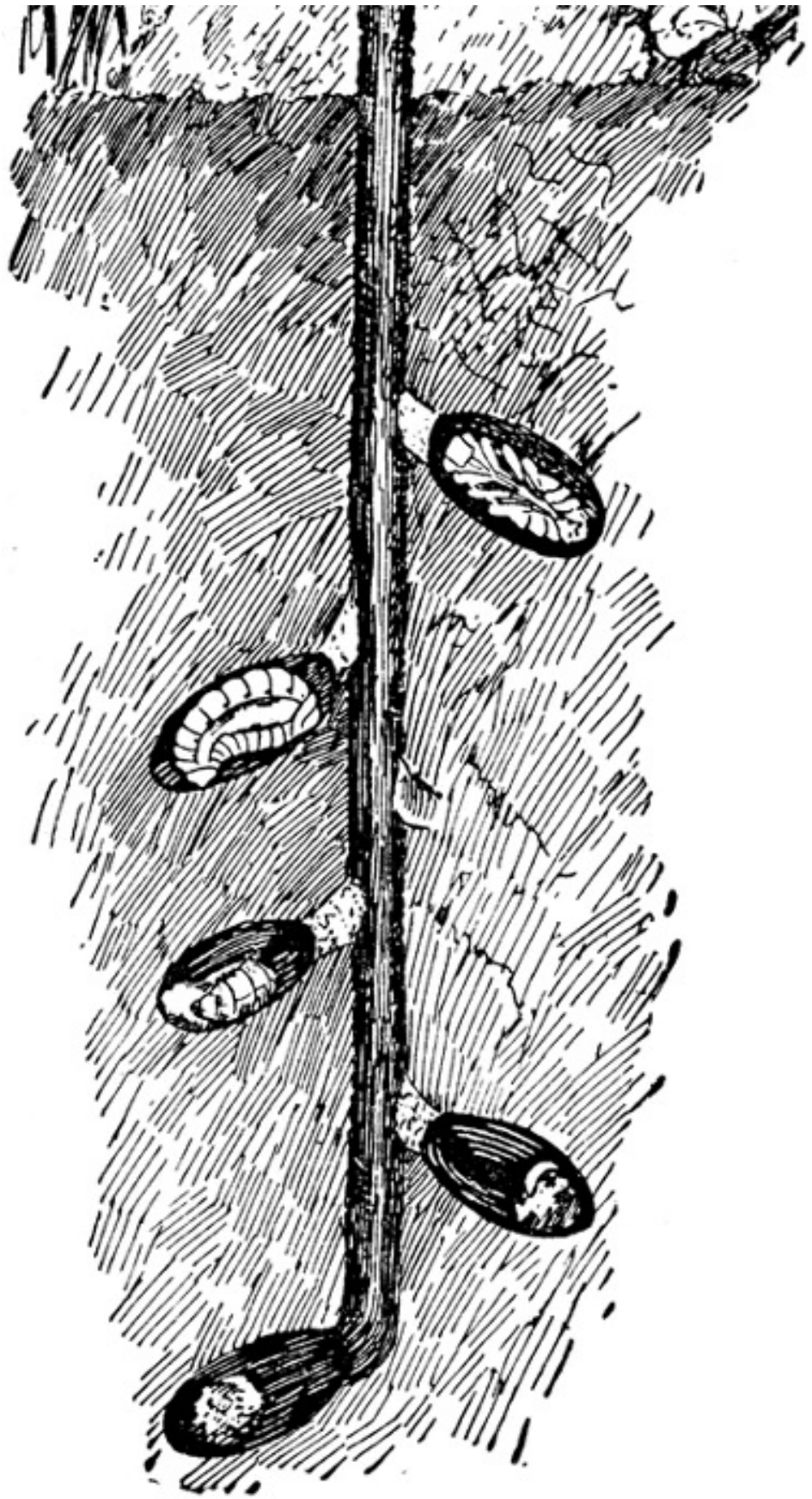

Figure 17. Mining bees, or digger bees, (Families Andrenidae & Anthophoridae) nest in burrows in the ground. Each mining bee female usually digs her own individual burrow to rear her own young. Large numbers of these bees may nest near one another if soil conditions are suitable

Source: https://etc.usf.edu/clipart/69500/69506/69506_insects_bee.htm

1.4. Distribution and Habitat

The distribution of the species of the Andrenidae family is very wide, being present in all the continents except Australia and the tropical region of Asia. In the western hemisphere, especially in the temperate and xeric parts of the north and south of America, there are numerous genera and species, while, on the contrary, its representation is scarce in tropical areas such as sub-Saharan Africa (Figure 18) [15][16].

Figure 18. Habitat mining bees-Andrenidae

Source: http://www.floridasnativebees.com/mining-bees.html

1.5. Classification

It is divided into 4 subfamilies: Alocandrenidae, Andreninae, Panurginae and Oxaeinae, the latter being clearly different from the previous ones in some of the characters that give the family its status. Different authors have expressed an evident problem in the classification within the family, emphasizing the subfamily (Figure 19) [17][18].

Figure 19. Subfamily Andreninae

Source: https://en.wikipedia.org/wiki/Andreninae

Andreninae, which can be considered a paraphyletic group when establishing the systematic position of the family, presents an extensive discussion on the different characters, both plesiomorphic and apomorphic, as well as on their phylogenetic relationships (Figures 20-21) [18][19].

Figure 20. Subfamily Panurginae

Source: https://en.wikipedia.org/wiki/Panurginae

Figure 21. Subfamily Oxaeinae

Source: https://journals.ku.edu/melittology/article/view/4902

They are specialist bees, common in dry areas. Most Andrenidae representatives in Brazil belong to the Panurginae subfamily. Among the most common genera are: *Anthrenoides, Panurginus, Callonychium, Panurgillus, Psaenythia, Parapsaenythia,* and *Cephalurgus*. The Andreninae subfamily is almost inexpressive in South America. They are specialist bees, common in dry areas. Most Andrenidae representatives in Brazil belong to the Panurginae subfamily. Among the most common genera are: *Anthrenoides, Panurginus, Callonychium, Panurgillus, Psaenythia, Parapsaenythia* and *Cephalurgus*. The subfamily Andreninae is almost inexpressive in South America[20][21][22].

nest with pollen and nectar, nest in burrows in the soil (Figures 22-23).

Figure 22. Fossil bee cells from the early Eocene Asencio Formation of Uruguay (21) external aspect of *Palmiraichnus castellanosi* sp. nov., (22) longitudinal section of *P. castellanosi* showing the chamber and the filled antechamber

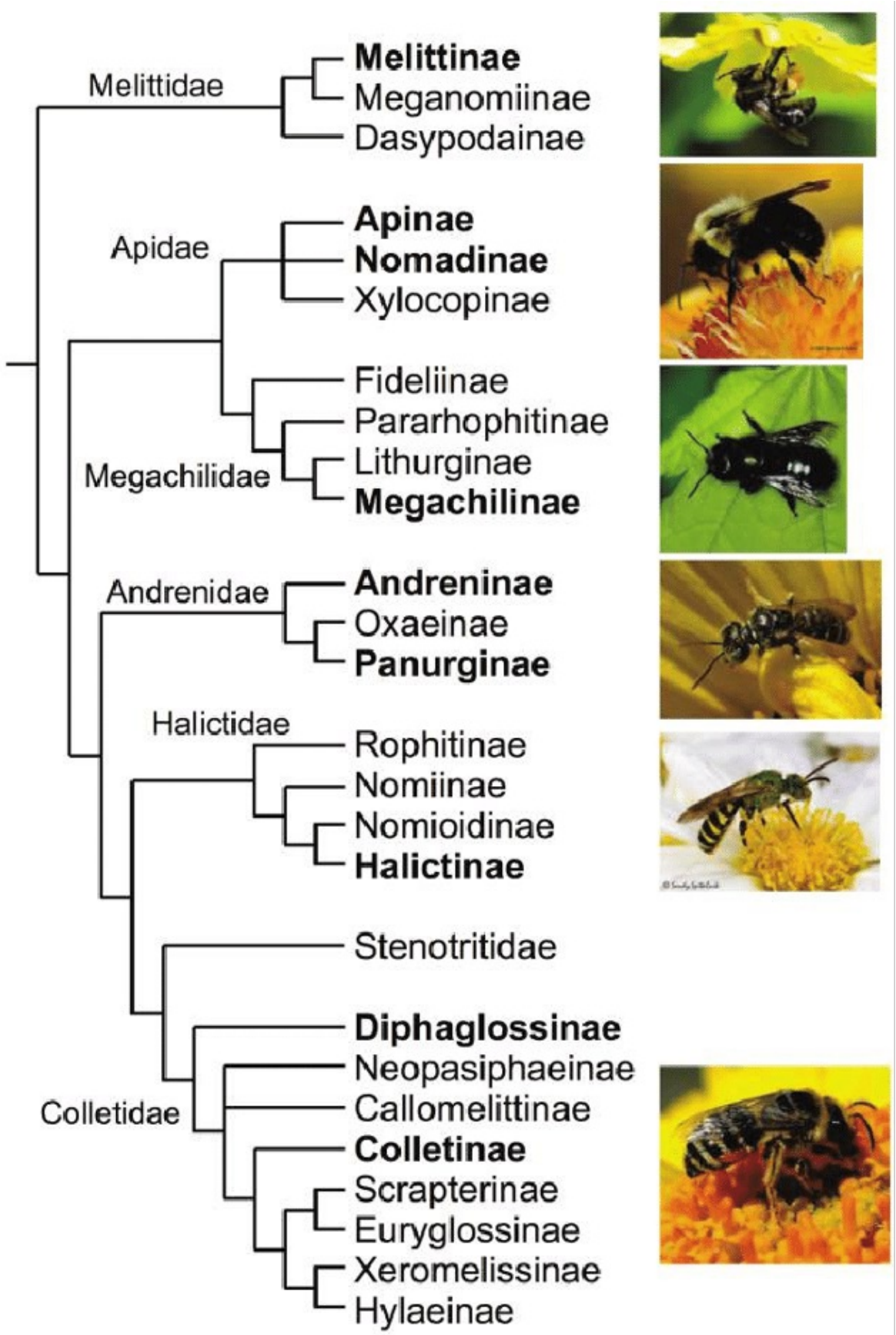

Figure 23. Family and subfamily-level phylogeny for bees (based on Danforth et al. 2013). Subfamilies sampled in this study are in bold. Pictured bees (from top to bottom): Macropis nuda (Provancher, 1882) (Melittidae), Bombus impatiens Cresson, 1863 (Apidae), Osmia lignaria Say, 1837(Megachilidae), Calliopsis rhodophila Cockerell, 1897, 1897(Andrenidae),

Agapostemon virescens (Fabricius, 1775) (Halictidae), and Colletes (Colletidae)

Source: Photos courtesy of J. D. Gardner (Melittidae), Donna K. Race (Apidae), Lynette Elliott (Megachilidae), Ron Hemberger (Andrenidae), Sanwdra Spitalnik (Halictidae), and Hartmut Wisch (Colletidae)

1.6. Objective

The objective of this paper is to know the characteristics of the Family Adrenidae.

2. Method

In terms of the type of research source, we worked with scientific articles published in national and international journals. This modality of production, in addition to being commonly the most valued in the set of bibliographic production, is the most easily accessed. Access to articles was through virtual libraries such as SciELO, ResearchGate, Hall, USP, UNB, CAPES and LILACS.

3. selection of articles

3.1. Study 1

Classification of Afrotropical Hymenoptera (Wasps, Bees, Ants).

1-Subfamily: Andreninae and Panurginae.

Distribution: Worldwide, except for Australia.

Biology: Provision their nest with pollen and nectar, nest in burrows in the soil.

Andrena Fabricius, 1775 (Figure 24).

Figure 24. Genus *Andrena* Fabricius, 1775

Sources: Photographs © Connal Eardley, Michael Kuhlmann, Alain Pauly first published in Eardley et al. 2010, http://www.waspweb.org/Apoidea/Andrenidae/Panurginae/Mermiglossa/index.htm and Photographs © Connal Eardley, Michael Kuhlmann and Alain Pauly first published in Eardley et al. 2010

Distribution: Afrotropical, Nearctic, Oriental, and Palaearctic regions.

Biology: Provision their nest with pollen and nectar, nest in burrows in the soil.

Some Species: *Andrena africana* Friese, 1909 *Andrena argentata* Smith, 1844, and *Andrena bonnefoiensis* Strand, 1921.

2-Subfamily Panurginae.

Genus: *Borgatomelissa* Patiny, 2000*, Melitturga* Latreille, 1809, *Meliturgula* Friese, 1903 and *Mermiglossa* Friese, 1912 (Figures 25-28).

Figure 25. Genus *Borgatomelissa* Patiny, 2000

Source: https://commons.wikimedia.org/wiki/Category:Borgatomelissa

Figure 26. Genus *Melitturga* Latreille, 1809

Sources: Photographs © Connal Eardley, Michael Kuhlmann, Alain Pauly first published in Eardley et al. 2010 and *http://www.waspweb.org/apoidea/Andrenidae/Panurginae/Melitturga/Melitturga_penrithorum.htm*

Figure 27. Genus *Meliturgula* Friese, 1903

Sources: Photographs by Sheila Dumesh (PCYU - Packer Collection York University) © Laurence Packer's website: Bee Tribes of the World and *http://www.waspweb.org/apoidea/Andrenidae/Panurginae/Meliturgula/Meliturgula_haemotospila.htm*

Figure 28. Female holotype of *Mermiglossa*. 1. Lateral habitus. 2. Dorsal habitus. 3. Facial aspect

Source: https://www.researchgate.net/figure/Figures-1-3-Female-holotype-of-Mermiglossa-voicola-new-species-1-Lateral-habitus-2_fig1_321246147

Distribution: Afrotropical, Nearctic, Neotropical, Palaearctic regions.

Biology: Provision their nest with pollen and nectar, nest in burrows in the soil.

Genus: *Borgatomelissa* Patiny, 2000.

Some Species: *Borgatomelissa brevipennis* (Walker, 1871) (Eritrea, Ethiopia, Mali, Mauritania, Oman, Saudi Arabia, Somalia, Yemen), *Borgatomelissa flavimaura* Ortiz-Sánchez & Patiny, 2019 (Morocco) and *Borgatomelissa niveopilosa* Patiny, 2002 (Yemen), *Melitturga barbarae* Eardley, 1991, *Melitturga capensis* Brauns, 1912, *Melitturga flavomarginata* Patiny, 2000, *Meliturgila braunsi* Friese, 1903, *Meliturgila eardleyana* Patiny, 2000, *Meliturgila flavida* (Friese, 1913) and *Mermiglossa rufa* Friese, 1912.

Distribution: Namibia.

Biology: Provision their nest with pollen and nectar, nest in burrows in the soil.

Distribution: Eritrea, Ethiopia, Mali, Mauritania, Morocco, Oman, Saudi Arabia, Somalia, Yemen.

Biology: Provision their [23][24][25].

3.2. Study 2

It is a very broad family of solitary bees that includes numerous species of small to medium size (4 – 20 mm). The distinctive character of this group is the presence of two sutures on the face, just below the antennae (subantennal sutures). They have short and pointed tongues. All species dig their nests in the ground, preferably in sandy soil, for this reason, they are known as miner bees. Females dig branched tunnels with a brood cell at the end of each tunnel, where they deposit a ball of pollen mixed with nectar and an egg.

1-Genus *Andrena*

There are over 40 species of bees of this genus in the Balearic Islands. The distinguishing characteristic of this group is the presence of facial foveae, bands of very fine hair along the inner margin of the eyes. The coloration of the species varies, but many are brown or black with bands of light hairs on the abdomen (Figure 29).

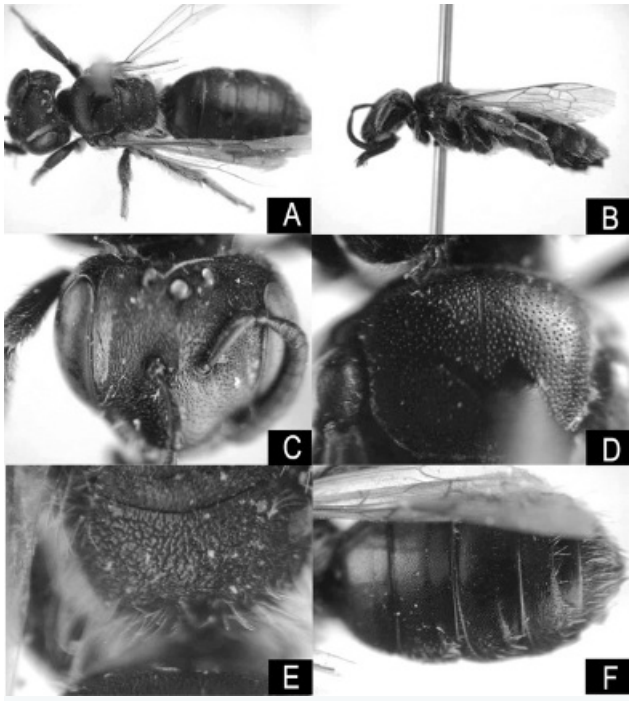

Figure 29. *Micrandrena* Ashmead, 1899. *Micrandrena*, female. (A): general habitus in dorsal view; (B): the same in lateral view; (C): head in frontal view; (D): mesoscutum; (E): propodeum; (F): metasomal terga
https://www.researchgate.net/figure/Andrena-Micrandrena-nanaeformis-Noskiewicz-female-A-general-habitus-in-dorsal-view_fig4_236115671

The size is also variable, there are small species – such as those of the subgenus *Micrandrena* which measure around 5

mm – and others larger (ca. 15 mm). In general, they are quite hairy bees, the females have abundant pollen-loading hairs on their hind legs and a specialized structure, the propodeal corbicula, on the sides of the first abdominal segment. In the Balearic Islands, there are two endemic subspecies of this genus: *Andrena incana* sp. nov. and *Andrena* flavipes Panzer, 1799 (Figure 30).

Figure 30. *Andrena flavipes* Panzer, 1799

Sources: Photo 33807552, (c) Henk Wallays, all rights reserved, uploaded by Henk Wallays and https://www.biodiversity4all.org/photos/33807552

2-Genus *Panurgus*

They are solitary bees of small or medium size with little hair. They are black and shiny. Females have a well-developed scoop on the hind legs. They mainly visit yellow compound flowers. There is only one representative species of this genus in our islands: *Panurgus calcaratus* (Scopoli,1763) (Figure 31) [26].

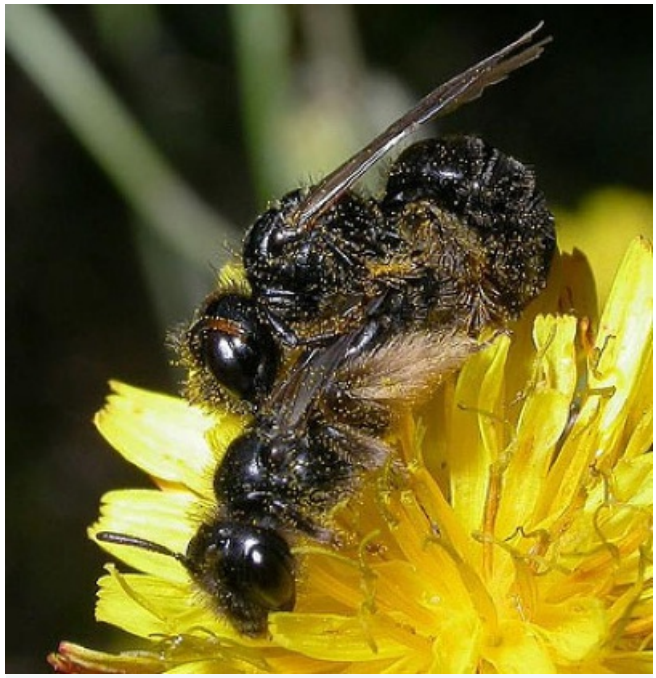

Figure 31. *Panurgus calcaratus* (Scopoli,1763)
Source: https://www.bwars.com/bee/andrenidae/panurgus-calcaratus

3.2. Study 2

The hairy hind legs of bees can carry a variety of sizes of pollen, mixing pollen grains with liquid.

Flower pollen is an important source of protein and nutrients that all bees need at some stage of their life cycle. Pollen collection is carried out only by female bees, which have specialized body parts that allow them to collect and transport pollen grains back to the nest. Modified parts of the female bee's hind legs, for example, are used to collect and store pollen externally. These structures are rows of small hairs (called scopae) or flattened plates with edges of curved hairs (called corbicula) that act as brushes and baskets that can hold pollen grains in place while the bee forages (Figure 32).

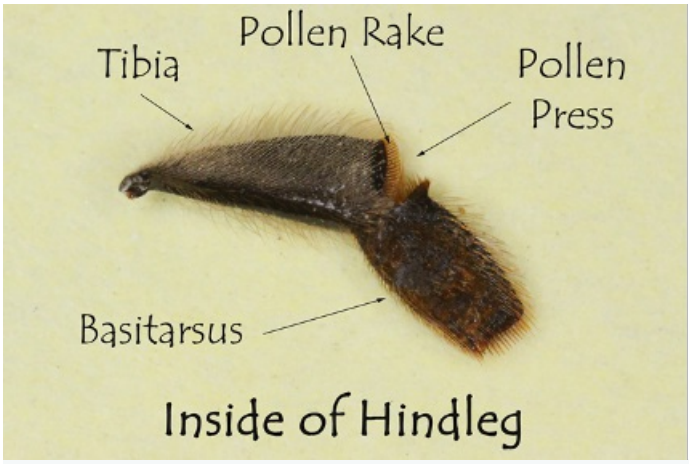

Figure 32. The inside of a hindleg. When the joint is open, the pollen press can be filled by raking the pollen off the opposite leg

Sources: © Rusty Burlew and https://www.honeybeesuite.com/how-the-honey-bee-makes-pollen-pellets/

The size of pollen grains from different flowers can vary from 5 to 210 µm, and the surfaces of pollen grains can similarly vary in their structure and texture. As a result, many bee species specialize in a narrow range of flower and pollen types. The density and thickness of bees' scopic hairs have been shaped through coevolution to work better with specific sizes and shapes of pollen (Figure 33).

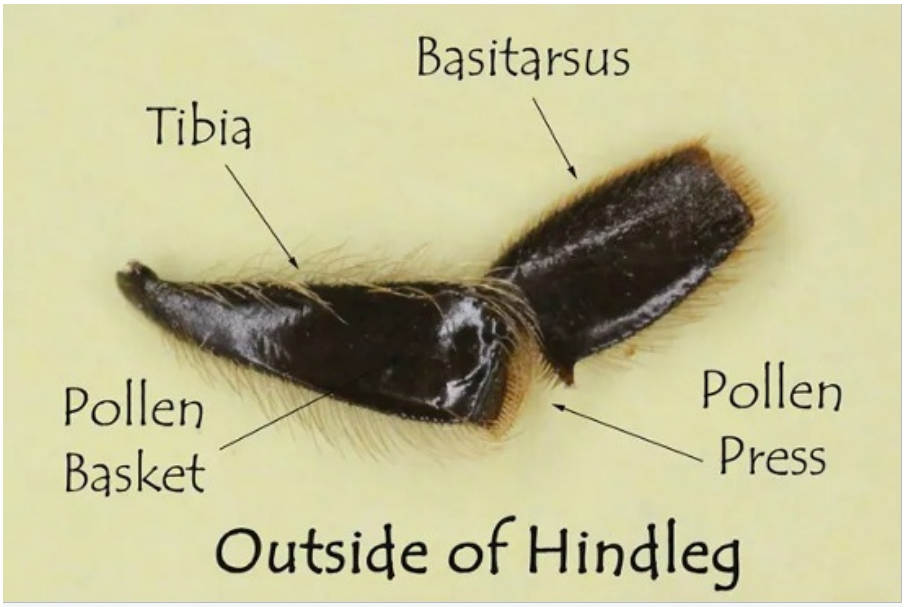

Figure 33. The outside of a hindleg. You can see the indentation where the compressed pollen will accumulate, called a tibial corbicula or “pollen basket

Sources: © Rusty Burlew and https://www.honeybeesuite.com/how-the-honey-bee-makes-pollen-pellets/

Other bees, however, can be more flexible in the types of pollen they collect. One strategy that allows for this flexibility is mixing the collected pollen with liquid, in the form of nectar, saliva, or floral oils. Moistening the pollen as it collects allows the grains to be packed and molded together into a more concentrated bundle. The pollen-collecting structures in the bee's legs need not be specialized to transport individual pollen grains; they can be more streamlined and carry packets consisting of any size and shape of pollen (Figure 34).

Figure 34. The scaly hairs on the hind legs also tend to be less specialized: they are short and sparse with moderate branchi

Source: https://www.museumoftheearth.org/bees/eat-pollination

https://images.squarespace-cdn.com/content/v1/5d3cbf70d8a40e00011d021a/1585230505217-BA0D2R0H88FMWDP54YG4/BanditBee.jpg

Female mining bees (from the family Andrenidae), for example, add nectar to their pollen to moisten it. The scaly hairs on the hind legs also tend to be less specialized: they are short and sparse with moderate branching. Bees that feed on floral oils and pollen have long, stiff hairs with an underlayer of short, flexible, branched hairs. In some species, this undercoat consists of separate hairs, and in other species it consists of offshoots of the main long hairs. Both arrangements work the same way: the thick undercoat absorbs oil, while the longer hairs trap pollen (Figures 35-38) [27][28][29].

Figure 35. Andrenid bee (miner bee) on Flower: To see a particular andrenid species, find out what flowers it specializes in, learn the flower's bloom time and habitat, and seek the bees that way. This is one of the miner bees in the genus *Andrena*

Source: https://education.mdc.mo.gov/discover-nature/field-guide/andrenid-bees-miner-bees

Figure 36. (a) Lateral views of moist and glazed transport. a Moist transport of Loasaceae pollen by *Perdita perplexa* Timberlake, 1962 on simple hairs. (b) Moist transport of Asteraceae pollen by n. sp. 2 aff. *laticincta* on simple hairs. (c) Glazed (25% dry) transport of Asteraceae pollen by *Hesperapis hurdi* Timberlake, 1954 on branched hairs. (d) Glazed (80% dry) transport of Asteraceae pollen by *Perdita albonotata* Timberlake, 1954 on corkscrew-shaped hairs

Source: https://link.springer.com/article/10.1007/s13592-016-0489-8

Figure 37. Dry transport of *Onagraceae* pollen. (a) Sparse, simple scopal hairs of *Perdita pallida* Timberlake, 1954 (b) Denser and longer scopal hairs of *Perdita vespertina* Griswold and Miller, 2010 (c) Dry transport Onagraceae pollen on *P. pallida*. d Closeup of c showing viscin threads binding pollen together

Source: https://link.springer.com/article/10.1007/s13592-016-0489-8

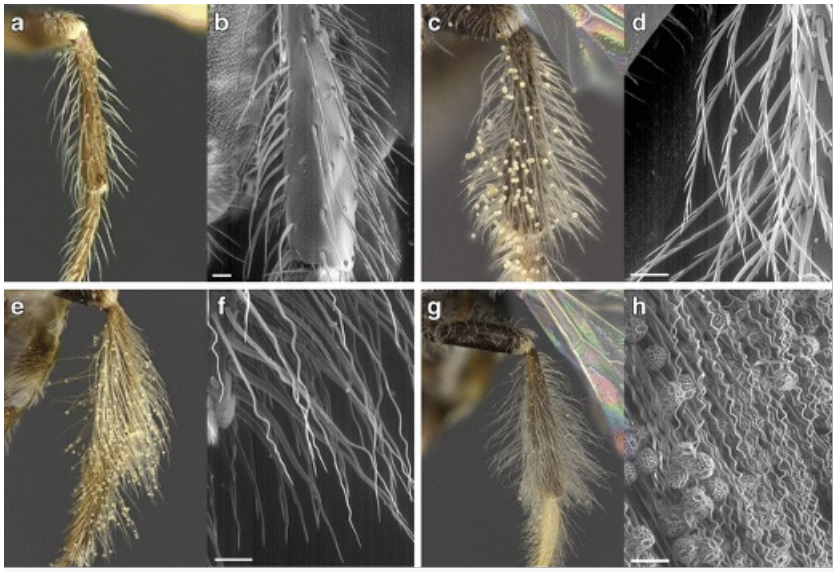

Figure 38. Optical and SEM examples of the different hair types. (a) and (b) Simple hairs on moist-transporting *Perdita koebelei* Timberlake, 1964. (c) and (d) Branched hairs on *Perdita asteris* Cockerel 1922, l. (e) and (f) Wavy hairs on *Perdita lingualis* Cockerell 1896 and *Perdita moabensis* Timberlake, 1971 Cockerell, respectively. (g) and (h) Corkscrew-shaped hairs on *Perdita moabensis* Timberlake, 1971

Source: https://link.springer.com/article/10.1007/s13592-016-0489-8

3.3. Study 3

Oxaea flavescens Klug, 1807

Family: Andrenidae Tribe: Oxaeinae (Figure 39).

Figure 39. *Oxaea flavescens* Klug, 1807

Source: https://nl.wikipedia.org/wiki/Oxaea_flavescens

Adult Size: Medium (1.7 cm).

Generations: 3 to 4 per year.

Activity in flowers: Throughout the year.

Pollen transport: In the hairs of the hind legs (scope).

Way of life: Lonely.

Nests: Excavated in the ground.

Nest entrance: Rounded and covered by low vegetation, such as grasses.

Conservation: Protecting natural nests and soil in areas with nesting potential; do not use pesticides near the nests and on the visited plants.

Management: Non-existent (Figure 40).

Figure 40. *Oxaea flavescens* Klug, 1807

Source: https://nl.wikipedia.org/wiki/Oxaea_flavescens

Plants visited: Caroba, timbó vine, banana, princess thimble, rattlesnake rattle, São João vine, wolfberry, genipapo-bravo, gliricidia, yellow ipe, pink ipe, joá-bravo, loquat, pau-fava, pau-earth, monkey's comb, spring, lent, giant reseda, red sage, sapucaiú, sombrero, tobacco, annatto, witch's broom, among others.

Pollinated agricultural crops: Unknown.

Curiosities: These bees have pointed mouthparts that allow them to pierce the base of flowers whose petals form narrow tubes and prevent access to nectar from the inside of the flower; when they perforate the flowers externally, they do not carry out pollination because they do not come into contact with the reproductive structures of the plant [30][31].

3.4. Study 4

The objective of the study is to present the bee species that occur in the municipality of Quirinópolis, GO, recorded in inventories and monitoring conducted from 2017 to 2022.

A total of 1,728 individuals belong to four families of bees: Andrenidae, Apidae, Halictidae and Megachilidae. So far, only 24 specimens have been identified at the species level, but it is estimated that there are at least 60 species of bees belonging to 34 genera, 16 tribes and five subfamilies (Figure 41).

Figure 41. Moerich trap

Source: https://www.detevel.com/produtos/listar/equipamentos

Apidae and Halictidae were the most frequent families representing 94.5% of the individuals collected, with a sampling of Centridini representatives, important in the pollination of acerola and *Xylocopa* species, the main pollinators of passion fruit. Bees of the Halictidae family may contribute to the vibration pollination that occurs in tomato flowers and other solanaceous plants, but little is known about their biology (Figure 42).

Figure 42 Adaptations of the Moerich trap

Source: https://www.conhecer.org.br/enciclop/2013b/CIENCIAS%20BIOLOGICAS/avaliacao%20de%20duas%20armadilhas.pdf

Knowing the species of bees that occur locally, as well as the necessary resources, especially for nesting and feeding, are important for their maintenance in the environment [32][33].

4. Conclusion

The behavior of wetting the pollen by adding nectar or oil to it as it is packaged in an external transport device allows a wide variety of pollen grains with different sizes and surface ornamentations to be transported by the same device. Thus, the scope of Panurginae (Andrenidae) and Melittidae females that add nectar to their pollen loads consists of sparse, short, and only moderately branched hairs.

References

1. ^*Antoine CM, Forrest JRK, Cécile MA, Jessica RK. Nesting habitat of ground-nesting bees: a review. Ecologial Entomology. 2021; 46(2): 143-159.*
2. ^*Kilpatrick SK, López-Uribe MM. Andrenidae [Internet]. Philadelphia: University Park; @ 2020 [2023 May 17].*
3. ^*Blaimer BB, et al. Key innovations and the diversification of Hymenoptera. Nature Communications. 2023: 14, 1212.*
4. ^*Kilpatrick SK, Gibbs J, Mikulas MM, Spichiger S-E, Ostiguy N, Biddinger DJ, López-Uribe MM. An updated checklist of the bees (Hymenoptera, Apoidea, Anthophila) of Pennsylvania, United States of America. Journal of Hymenoptera Research. 2020; 77: 1–86.*
5. ^*Mohindru, et al. Bees diversity and distribution dynamics among various agro-climatic regions of Indian Punjab. Authorea. 2023; 1: 1-8.*
6. ^*Wood TJ. Description of a remarkable new Andrena species (Hymenoptera: Andrenidae) from Syria in the Middle East. Zoology. 2020; 66: 262–268.*
7. ^*Salim JA, et al. Data standardization of plant–pollinator interactions.GigaScience. 2022; 11: 1-15.*
8. ^*Pisanty G, Scheuchl E, Martin T, Cardinal S, Wood TJ. Twenty-five new species of mining bees (Hymenoptera: Andrenidae: Andrena) from Israel and the Levant. Zootaxa. 2022; 5185(1): 1-109.*
9. ^*De Santis A, Chacoff NP. Urbanization affects composition but not richness of flower visitors in the Yungas of Argentina. Neotropical Entomology. 2020; 49: 568–577.*
10. ^*Vastern North American Andrenidae, bees, taxonomy, distribution, identification [Internet]. San Francisco: Andrenidae Colletidae Melittidae. A guide to their identification in Eastern North America. Scribd Help Center; @ 2023 [2023 May 18]. Available from https://www.slideshare.net/sdroege/eastern-north-american-andrenidae-bees-taxonomy-distribution-identification-presentation?from_action=save.*
11. ^*Andrenidae, Colletidae and Melittidae [Internet]. São Francisco: A guide to their identification in Eastern North America; @2023 [2023 May 18].*
12. ^*Santos SJL, Barbosa BC, Prezoto F. The stingless bee fauna in urban areas: 50 years of studies and research priorities in Brazil. Full Scientia. 2020; 16(12): 128001.*
13. ^*Barros SSO, Waldesse Júnior PO, Oliveira FF, Andrade NG, Oliveira RJ, Lima Bragança MAL. The bee fauna (Hymenoptera, Apoidea) in Cerrado and Cerrado-Amazon Rainforest transition sites in Tocantins state, Northern Region of Brazil. Biota Neotropica. 2022; 22(3): 1-22.*
14. ^*Braman CA, McCarty E, Ulyshen MD, Janvier AJ, Traylor C, Edelkind-Vealey M, Braman SK. Urban bee functional groups response to landscape context in the Southeastern US. Front. Sustain. Cities. 2023; 5: 1192588.*
15. ^*Antonini Y, Fontenelle JCR, Martins RP. Would the flight interception traps (Malaise) be more efficient for sampling bees? MG.BIOTA. 2020; 12(2): 30-41.*
16. ^*Pires CSS, Maués MM. Insect pollinators, major threats and mitigation measures. Neotropical Entomology. 2020; 49(4): 469-471.*
17. ^*Soroye P, Newbold T, Kerr J. Climate change contributes to widespread declines among bumble bees across*

continents. Science. 2020; 367: 685-688.

18. [a, b]*Moisset B, Buchmann S. Bee basics an introduction to our native bees. 1st ed. Washington: A USDA Forest Service and Pollinator Partnership Publication. 2020.*
19. [^]*Krug C, Hipólito J, Schoeninger K, Montefusco M, Gomes FB, Oliveira MI, Mahlmann T. High diversity of bees detected in guarana crop and natural habitat due to the use of combined sampling methods. EntomoBrasilis. 2021; 14: e975.*
20. [^]*Bees. Brazilian Association for Bee Studies [Internet]. Embu das Artes: Oxeaea flavescens; @ 2021 [2023 May 18]. Available from https://abelha.org.br/oxeaea-flavescens/.*
21. [^]*Da Santos RS, Carneiro LT, Santos O, Silva JP, Milfont MMO, Castro CC. Bee pollination services and the enhancement of fruit yield associated with seed number in self-incompatible tangelos. Scientia Horticulturae. 2021: 276: 109-743.*
22. [^]*Wood TJ, Michez D, Cejas D, Lhomme P, Rasmont P. An update and revision of the Andrena fauna of Morocco (Hymenoptera, Apoidea, Andrenidae) with the description of eleven new North African species. ZooKeys. 2020; 974: 31-92.*
23. [^]*Kline O, et al. Biology, genetic diversity, and conservation of wild bees in tree fruit orchards. Biology. 2023; 12(31): 2-38.*
24. [^]*van Noort. WaspWeb [Internet]. Cap Town: Hymenoptera of the Afrotropical region; @ 2023 [2023 May 18]. Available from www.waspweb.org.*
25. [^]*Astafurova YA, Proshchalykin MY, Sidorov DA. The type specimens of bees (Hymenoptera, Apoidea) deposited in the Zoological Institute of the Russian Academy of Sciences, St. Petersburg. Contribution V. Family Andrenidae, genus Andrena Fabricius, 1775, species described by E. Eversmann. Zootaxa. 2022; 5190(3): 393 - 418.*
26. [^]*Bossert S. Phylogeny, biogeography and diversification of the mining bee family Andrenidae. Systematic Entomology. 2022; 47(2): 283-302.*
27. [^]*Wood TJ, Monfared A. A revision of the Andrena (Hymenoptera: Andrenidae) fauna of Iran, with the description of 16 new species. European Journal of Taxonomy. 2022; 843: 1-136.*
28. [^]*Ferreira MCCS. The importance of ecosystem services provided by bees in organic tomato crops: production and pollinator increment [Ph.D. dissertation]: Uberlandia: Federal University of Uberlândia; 2022.*
29. [^]*Pérez-Marcos M, Ortiz-Sánchez FJ, López-Gallego E, Ibáñez H, Carrasco A, Sanchez JA. Effects of managed and unmanaged floral margins on pollination services and production in melon crops. Insects. 2023; 14(3): 1-296.*
30. [^]*Ackerman JD, Phillips RD, Tremblay RL, Karremans A, Reiter N, Peter CI, Bogarín DAO, Liu H. Beyond the various contrivances by which orchids are pollinated: Global patterns in orchid pollination biology. Botanical Journal of the Linnean Society. Botanical Journal of the Linnean Society. 2023; 20: 1–30.*
31. [^]*Bee collection: Discover the main species of Brazilian native bees [Internet]. Brasília: Empresa Brasileira de Pesquisa Agropecuária; @2023 [2023 May 18]. Avaiable from https://www.embrapa.br/meio-ambiente/abelhas-nativas/abelhas-e-plantas.*
32. [^]*Cooley H, Vallejo-Marín M. Buzz-Pollinated Crops: A Global Review and Meta-analysis of the Effects of Supplemental Bee Pollination in Tomato. Journal of Economic Entomology. 2021; 114(2): 505–519.*

33. ^*Yamamoto M. Bees from Quirinopolis - Goiás [Internet]. Quirinópolis: Teaching, Research and Extension Seminar; @ 2022 [2023 May 18].*