Abc Taxa

The Bee Genera and Subgenera of sub-Saharan Africa

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by

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Cover picture: background: Nimba mountain in Guinea; Honey bee (*Apis mellifera*) on *Tradescantia* (Commelinaceae), Meliponine bee (*Dactylurina staudingeri*) on *Jatropha* (Euphorbiaceae), honey and fruits on market in Kinshasa (R.D. Congo) (Pictures: Didier VandenSpiegel and Nicolas Vereecken)

Picture on this page: Carpenter bee (*Xylocopa combusta*) pollinating a flower of passion fruit (*Passiflora edulis*) (Congo Kinshasa) (Picture: Nicolas Vereecken)**.**

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Preface

I congratulate the distinguished authors and editors of *Abc Taxa* and the Belgian Global Taxonomy Initiative for this important publication as the seventh volume of *Abc Taxa*. This series has positioned itself as an excellent advocate of capacity building in taxonomy and specimen collection management.

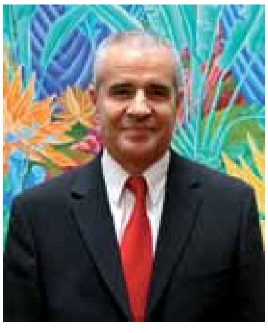
This volume on the bees of sub-Saharan Africa will lead to better documentation and understanding of bee biodiversity in Africa. Such comprehensive work on African bees is extremely important considering the formidable challenge of halting the worrisome world-wide loss of pollinators. The issue of loss of pollinators has been recognized by the Conference of the Parties to the Convention on Biological Diversity (CBD) in decision V of its fifth meeting, which established the International Initiative for the Conservation and Sustainable Use of Pollinators.

The Global Taxonomy Initiative calls for several tangible outcome-oriented deliverables one of which is the production of keys to all genera of bees of the world (COP decision IX/22; output 4.12.2). This volume is an important step in that direction and it hoped that other workers will follow the example of Eardley, Kuhlmann and Pauly and that similar taxonomic keys for other regions will emerge.

I also wish to express my praise to each of all authors for delivering this fine piece of work. The clarity, completeness, and high quality illustrations that enrich the book will ensure that it will remain a valuable tool for bee identification and research for a long time to come, and underpin better knowledge and management of this very beneficial group of insect pollinators. Moreover, many bee species are producers of honey, an important component of healthy diets and source of income for local communities.

Loosing bee biodiversity is a severe threat that would seriously jeopardize not only the long-term survival of flowering plants in natural ecosystems but also those used in agriculture, which underpins sustainable development in Africa.

This is a valuable contribution to capacity building, awareness raising and to the scientific literature. I am pleased to welcome it as an outstanding contribution during the International Year of Biodiversity.



Ahmed Djoghlaf
Executive Secretary
Convention on Biological Diversity

1. Introduction

There are few, if any, ecosystems that are not affected by man. Therefore, to a greater or lesser extent, they are all managed, this is especially true for agro-ecosystems. Understanding how our ecosystems function is important for effective management. Although all organisms contribute to ecosystem function, some appear to provide essential ecosystem services. Pollination is such a service. This is because most flowering plant species (Angiosperms) require the inadvertent services of an animal for cross-pollination; that is to move the pollen from the anthers of one plant to a stigma of another plant of the same species.

Pollination precedes fertilization but does not necessarily result in fertilization. When the pollen grains are deposited on a receptive stigma a pollen tube must grow down the style for the male gametes to reach an ovum and only then fertilization occurs. This does not always happen. Mostly, fertilization results in seed and fruit. Therefore, fertilization is not only needed for plant reproduction, but also for fruit and seeds production, making pollinators vital for agriculture. Many flowering plants are self-pollinated or pollinated by wind and water. Cereal crops are wind pollinated, but pollinators are needed for many fruit and seed crops. In natural ecosystems pollination is needed for food for animals and micro-organisms. Therefore pollination is important for the conservation of biological diversity.

Bees are the most important pollinators because they visit plants with the intention of collecting pollen and move from flower to flower before taking the pollen to their nests. Moreover, they often focus on just one plant species. However, they are not the only group of pollinators, and not even the only group that deliberately collects pollen, as the pollen wasps (Masaridae) do the same. Most pollinators visit plants to acquire nectar, pollen and/or plant oils for food for themselves or their larvae, and un-intentionally pollinate plants. Pollinators that do not deliberately collect pollen include moths, beetles, flies, wasps, bats, birds and there are a host of other organisms that have interesting relationships with plants.

Among the different groups of bees there are a variety of different biologies. Most are solitary, many are semi-social and some are eusocial. Whereas most are pollen collectors some are social parasites (they replace the queen and use the host workers to raise their progeny), cleptoparasites (cuckoo bees, who lay their eggs on the host species larval provisions) or robbers (who steal pollen and honey from other bee’s nests). Mostly they nest in cavities, more or less spherical cavities for social species (honey bees and stingless bees), pre-existing tunnels (like wood boring beetle burrows), self-made tunnels in wood (carpenter bees) or in the soil, or make external nests from plant material (carder bees), sand and/or mud (dauber bees) or resin. O’Toole & Raw (1991) describe the different behaviours in more detail. Generally, understanding the taxonomy enables one to predict the behaviour of the bee species.

In first place this book is designed to help novices with the identification of bees to genus and subgenus level. To achieve this, we used as many images as possible to illustrate the bees and their morphological structures. It was not our intention to write a monography of the sub-Saharan bee fauna and therefore the additional information given about genera and subgenera is mostly limited to distribution. To facilitate bee studies, the taxonomy, systematics and morphological terminology used here, even though debatable in some cases, is fully compatible with Michener (2007). To everyone who wishes to learn more about bees or wants to start an advanced study we recommend they consult this essential book on the bees of the world and the references to more detailed publications listed in table 1 at the end of the book.

2. The conservation of bees

Bees contribute to plant reproduction, and plants are the fundamental building blocks of most terrestrial ecosystems. Plants photosynthesise, produce food through foliage, fruit and seed, provide building material, consolidate the soil, maintain water tables, sequestrate carbon and much more. Plant biodiversity enables ecosystems to cope with changing seasons and climate. The maintenance of plant biodiversity therefore depends on pollinator biodiversity, and their conservation goes hand in hand. Bee pollinators can however be disturbed by a number of factors

- Their nests are destroyed for honey (honey bees and stingless bees).
- Wood with tunnels (*e.g*., wood boring beetle burrows) that could be used as nests, or in which carpenter bees can burrow, is collected for firewood.
- Soils in which they burrow is trampled by stock or tilled for crops.
- Flowers they visit are sprayed with insecticides, poisoning adults directly and resulting in bees feeding their larvae with contaminated pollen and nectar.
- Social species are easily moved, if kept in domestic hives, and hybridize with native varieties/subspecies.
- Water is often kept in reservoirs and/or canalized and may not produce enough mud for daubers.
- Water is polluted by stock and people.
- Food plants are lost when there is selective grazing, cultivation of crops, forestry, removal of bush to open grasslands and by the spread of invasive plants.
- Exotic bee species diminish food (nectar, pollen) for indigenous species.
- Moving bees and the introduction of new species / subspecies by bee-keepers results in the spread of pests and disease (*e.g. Varroa* mites).
- Their sex determination mechanism, which is called haplodiploidy, results in the production of increasing numbers of sterile diploid males in small populations. This "diploid male extinction vortex" results in a very high genetic load and a very high extinction rate in comparison to other organisms with similar population parameters but lacking the sex determining mechanism of bees (Zayed and Packer, 2005). As natural areas provide

many services that reach beyond their boundaries, bee conservation measures should be adopted in both natural and agricultural ecosystems.

Eardley et *al* (2006) gives several case examples of pollinator biodiversity conservation.

Pollination is directly related to agricultural production for crops that require a pollinator. If the ecosystem surrounding farmlands is healthy farmers will usually receive adequate pollination. When agriculture expands to the point where there is insufficient natural areas to function as a healthy ecosystem, pollination must be managed. In Africa pollination management is through managing honey bees. In other continents solitary bees (*Megachile, Osmia, Nomia, Xylocopa* and *Amegilla*), other social bees (Meliponini and *Bombus*), oil palm beetles, bats and many other species are managed. Pollination management must follow certain guidelines, as it involves moving animals to different places and this can have severe consequences.

Before working with bees the taxonomy of the group must be understood. This book is thus best regarded as a precursor to pollination management. Pollination management as such is beyond the scope of this book.

3. How to collect bees

Bees like most insects can rarely be reliably identified in the field. Generally taxonomic training is required and the use of a microscope is inevitable. Thus, it is necessary to collect and adequately prepare bees before they can be studied.

Collectors each have their own unique techniques and equipment. Therefore what is said below is a broad guideline only. Enthusiastic collectors should adapt the equipment to suit themselves and the environment in which they work. Good guidelines can be found in Uys and Urban (2006).

Specimens collected for accurate identification and museum specimens should preferably be kept dry at all times. Wet specimens, like those preserved in alcohol, collected in yellow pans or killed in bottles with condensation on the sides make ugly museum specimens because their pubescence becomes mattered and discoloured. They are difficult to identify. There are techniques to rehabilitate them, but the cleaned bees are never as nice as a specimen that has been kept dry. Also, there are a few groups with little hair that are not seriously harmed by alcohol and moisture. When a series of specimens are collected it is good practice to keep one in a small bottle submerged in 90% ethyl alcohol for genetic barcoding. It should be labelled to indicate that it is part of a series with dry specimens, which are needed for an accurate identification.

Hand nets are the best tools for collecting bees as they allow catching specimens without too much damage, and make field observation possible. Hand nets comprise a handle with a circular frame supporting a gauze bag at one end of the handle. The handle should be about 1 m long; extendible handles are made with two aluminium pipes, one that slides over the other, and a clamp on the end of the outer tube (Fig 1). The outer tube slides up and down the inner tube to alter the length of the net handle, and is secure when clamped. The circular frame should have a 35 cm diameter and be firmly attached to the handle, yet detachable so that the gaze bag can be easily replaced. The gaze bag should be made of a fine, light, yet strong gauze. White material makes it easier to see the bee in the net. It should be about twice as long as the diameter of the net. This allows the net handle to be rotated after catching a bee to prevent it from escaping, *i.e.*, the bee in the apex of the gauze bag lands in the circular frame of the net but with the bag folded over the frame. The gaze bag may have a sleeve around the opening for sliding over the circular frame, or, if the frame is made of a flat material with holes in it, it is sewn to the circular frame.

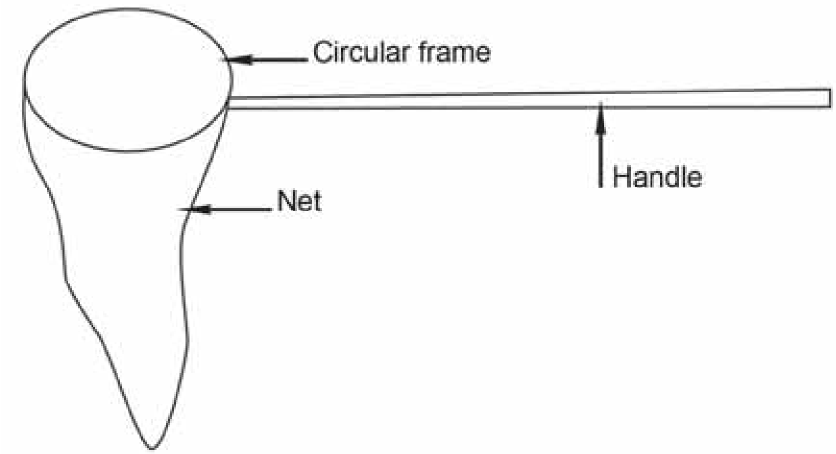


Fig. 1. Hand net.

Malaise traps are useful for collecting bees in certain ecosystems. They are ineffective in catching large bees, like *Xylocopa* and some *Megachile*. They also do not work well in deserts, forests and machia (fynbos). They work best in savannah. If well placed they can collect a large number of small and medium sized bees. A malaise trap looks like a gauze tent (Fig. 2). The short ends are gauze (one is higher than the other), the long sides are open, between the open ends there is a gauze central panel (flight interceptor) and the roof is gauze. The sides and central panel should be black and the roof white. Bees fly into the central panel and then make their way to the highest point of the trap where it opens into a killing bottle. Townes (1972) provides a pattern and they can be purchased from entomological equipment distributors. It is preferable not to place alcohol in the killing bottle, rather an insecticide that will kill the bees and keeps them dry. This results in the absence of preservatives, and therefore the traps should be emptied at least once a day. The killing bottle should not be left on the trap overnight because they collect moths and the bees get covered with moth wing scales. The malaise trap should be placed in a flight path, such as across a narrow foot/game path with dense vegetation on each side.

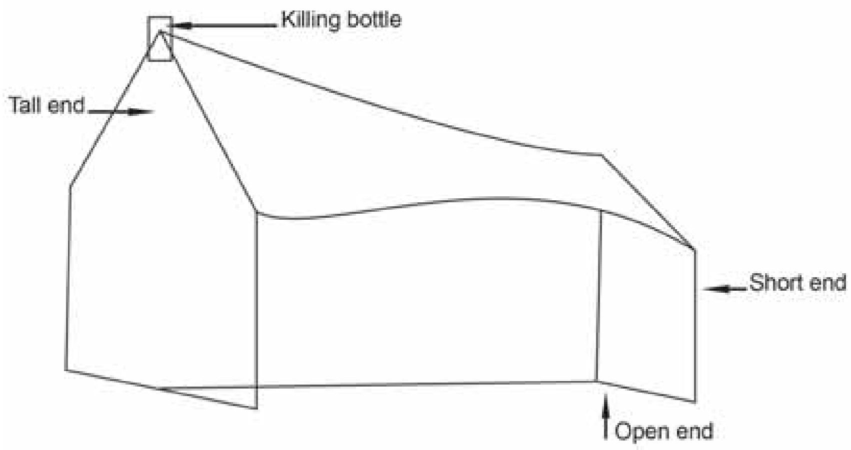


Fig. 2. Malaise trap.

Pan traps are easy to use and transport, but they produce wet bees. A pan trap is a shallow dish of soapy water. The soap reduces the surface tension of the water and prevents the bees from escaping when they drift to the side. Foam on the water surface must be avoided. Yellow pans are the most common, but blue and white ones are used as well and might attract different species. The various colours provide different results in different ecosystems. Bees collected in this way should be temporarily preserved in 70% ethyl alcohol and then dried. To dry bees place them in 96% alcohol and then in a sieve with a gauze top and blow them dry with a hair dryer, but not for too long because this leads to wing damage. Blowdry them until their thoracic hair is dry and fluffy. There are a number of other ways for doing this but they involve expensive equipment, such as a critical point dryer, and hazardous chemicals.

Trap-nests are twigs and blocks of wood (or synthetic material) with holes in them for bees to nest in. Reeds and/or bamboo work well for bees that nest in hollow twigs. They are usually placed horizontally in bundles. They are also easy to split open to observe and extract the specimens inside. Blocks of wood are better when made from planks fastened together to form a block with holes drilled in the joints so that the nests can be opened. Some have a transparent window on one side so that the contents can be observed without disturbing the larvae (see Krombein, 1967). Care should be taken to keep ants away from trap nests. A frame with its feet in water, or car grease on the legs of the frame or wire holding the trap nests tends to keep ants away.

Natural bee nests can be collected. If above ground (in twigs, wood, snail shells, exposed mud nests or exposed plant fibre nests) they can be collected and opened or kept in an emergence box. The latter is simply a box with a funnel in the side of the box and a glass bottle on the end of the funnel (Fig. 3). The bees go through the funnel to the light and don't return to the box. Care must be taken to avoid trapping spiders in the box because they may spin webs and destroy the bees.

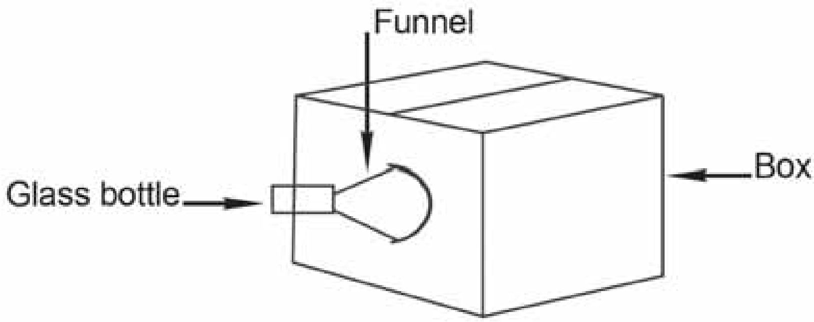


Fig. 3. Emergence box

Bees in natural nests in the ground can also be collected. To collect only the adults a glass jar can be placed over the entrance of the nest whereby the bee will be collected in the jar when it leaves the nest. Ground nests can also be excavated. To follow the nest tunnel in the ground blow white power down the nest and follow the white line created by the powder. It is easier to excavate ground nests by digging a hole next to the nest and slowly shaving away the ground laterally to expose the nest tunnel and cells. Larvae can be raised by putting them with their provision in a glass tube with a tissue paper plug. When the adults emerge they are easily killed in a freezer, which avoids handling.

Once collected the bee must be killed. Killing bottles should be in plastic to avoid breakage. They should contain potassium cyanide crystals with a porous stopper above the crystals in the bottom of the bottle. A drop of water added before use improves the effectiveness of the killing bottle. Potassium cyanide and water produce hydrogen cyanide gas, which is very toxic to insects, and people so it must be used carefully and responsibly. Tissue paper added to the bottle reduces condensation that will make the specimens wet. Ethyl acetate tends to make the bees greasy, but is not as toxic to people as potassium cyanide. It should not be used for specimens collected for molecular research.

4. How to prepare specimens and curate a bee collection

As with collecting, curators have their own specific ways. The best bee collections for scientific study are those with dry specimens that are neatly pinned and labelled. The less bees are handled the better their condition when pinned. For molecular work they are best preserved in 96% ethyl alcohol.

They must be pinned on stainless steel insect pins (about 39 mm long). The pin must be paced vertically through the right hand side of the scutum (Fig. 8A) and out the lower mesepisternum. About 9 mm of the pin should project above the specimen. It is good to pin them on a foam board so that the legs do not hang down which results in them being easily broken. Sometimes small bees are pinned sideways with minute pins, *i.e.* by placing a minute pin laterally though the mesosoma and into a small polyporpous square on the pin. It is best to pin specimens in the field to avoid relaxing, which often leads to specimens getting wet and/or excessively handled. Boxes with newly pinned specimens should be opened periodically to allow them to dry. When not observed place the insect box into a securely sealed plastic bag or place the box on an inverted dish in a larger dish of water to avoid ants from eating the specimens.

The first (upper) label should have the country, province/state, city/town, precise locality (*i.e*., farm name or number of kilometres from the nearest town), grid co-ordinates (indicate whether in degrees and minutes or decimal), altitude, date, collector and accession number, if available. Subsequent labels have biological, collecting and/or other data if available.

Fig. 4. Correctly pinned and labelled specimen.

Permanent storage should be in insect cabinet drawers. All material should be frozen for about a week before going into a drawer. Cabinets must be inspected periodically (*e.g.*, every 3 months) for museum pests. In the drawers they should be placed in neat rows behind the species name.

Bees can be carried or posted. For this they should be pinned into some foam glued to the base of a small, secure box. If the specimen looks like it will move on the pin and damage other insects bracing pins should be placed on each side of it, and the box covered with thin plastic. For posting it should be placed in a bigger box with at least 40 mm of lightweight packaging all around it, the outer box sealed, with “fragile and handle with care” stickers on it and posted via registered or insured mail.

Fig. 5. Permanent storage in well-designed cabinets

Fig. 6. Carrying or sending specimens requires carefull packing.

5. How to conduct a pollination study

Pollination biology and ecology is a science of its own with a number of sub-disciplines. It is beyond the scope of this book to give an introduction to the field or detailed instructions for conducting a field study. Depending on the focus of a research project different methods need to be applied to get the required data. A large set of different methods covering the entire field of pollination biology and ecology are presented in two books by Kearns & Inouye (1993) and Dafni *et al.* (2005). They provide detailed methodological information on how to perform a study on all relevant fields of pollination biology.

Before starting a pollination study be aware: not every flower visitor is a pollinator and the most abundant ones are not necessarily the most efficient / important. To demonstrate that a certain flower visitor is a pollinator it needs to be shown that pollen is successfully transferred from the anthers of one flower to the stigma of a conspecific one. This can be tricky at times and, thus, careful planning and design of the fieldwork is required.

6. Terminology

Several excellent publications discuss bee morphology and terminology in detail (Michener, 1944; 2007). It thus suffices to provide explanation of the terms used in the keys and descriptions of the taxa treated here. It is assumed that the reader has a basic knowledge of insect morphology, and the focus is on terminology peculiar to bees.

Aerolium	Small pad at apex of leg between pretarsal claws (Fig. 8B).
Antenna	Feeler in middle of face, made up of scape, pedicel and flagellum (Fig. 7A).
Antennal socket	Hole in face where antenna is inserted, either near middle of face (Fig. 7A) or distinctly below middle of face.
Axilla	Small sclerite lateral to scutellum adjacent to scutum (Fig. 8A).
Basal vein	Diagonal vein in middle of forewing, between radial and first medial cells (Fig. 8D), either straight or curved.
Basitarsus	First, enlarged, segment of tarsus (Fig. 8B).
Basitibial plate	Plate near base of outer surface of hind tibia (Fig. 8B).
Chalicodomiform	In leaf-cutter bees, metasoma about as wide as high (as in *Chalicodoma*).

Cleptoparasitic	Form of parasitism where bees lay their eggs in other bee's nests and then leave the host's nest.
Clypeus	Sclerite in middle of lower half of face (Fig. 7A).
Corbicula	Scopa modified to form a pollen basket.
Coxa	Basal segment of each leg (Fig. 8A, 8B).
Epistomal suture	Suture surrounding clypeus (Fig. 7A).
Femur	Third segment of leg (first long segment) (Fig. 8B).
Flagellum	Third to tenth (females) or eleventh (males) segments of antenna (Fig. 7A).
Galea	Tongue cover (Fig. 7C-D).
Glossa	Tongue (Fig. 7C-D), pointed or bifid.
Gonocoxa	Sclerotized part of male genitalia between basal area (gonobase) and gonostylus (Fig. 9B).
Gonoforceps	Fused gonocoxa and gonostylus.
Gonostylus	In male, distal end of gonocoxa (Fig. 9B)
Gradulus	Ridge across metasomal terga (Fig. 9A).
Hypostomal area	Back of head around chamber for mouthparts (Fig. 7B).
Integument	Hard outer covering of bee body.
Jugal lobe	Basoposterior lobe of hind wing (Fig. 8C).
Juxta-antennal carina	Vertical carina mesad to antennal socket.
Labrum	Hinged sclerite below clypeus (Fig. 7A).
Labial palp	Palp arising from base of glossa (Fig. 7C-D).
Long-tongued	Labial palp with basal two segments long, apical two segments short (Fig. 7C).
Malar area	Area between eye and mandible (Fig. 7A).
Mandible	Jaws, below clypeus (Fig. 7A).
Mandibular teeth	Teeth at distal end of jaw (Fig. 7A).
Marginal cell	Anterior distal cell in forewing (Fig. 8C).
Megachiliform	Metasoma flattish, wider than high (as in *Megachile*).

Mesepisternum	Large sclerite on side of mesosoma, below wing, and comprising most of posterior region of mesopleuron.
Mesopleuron	Side of mesosoma, largely area below wings (Fig. 8A).
Mesosoma	Thorax together with first abdominal segments (propodeum) (Fig. 8A).
Metalic	A shiny gloss to integument, usually blue or green, sometimes red or copery.
Metanotum	Mesosomal sclerite between scutellum and propodeum (Fig. 8A).
Metasoma	Abdomen excluding first abdominal segment (propodeum), which is fused to thorax (Fig. 9A).
Metatibia	Middle tibia (Fig. 8B).
Occiput	Area just before posterior surface of head (Fig. 7B).
Ocellus (pleural ocelli)	Three small round ‘eyes’ near top of face (Fig. 7A).
Ocellocular	Area between lateral ocelli and eye.
Omaulus	Curved, carina or lamella separating anterior (foreward facing) region of mesepisternum from lateral, posterior, region (Fig. 8A).
Pedunculate	Club-shaped, refers to thickened distal end of antennal flagellum.
Preoccipital area	Where dorsal and lateral regions of head curve into posterior region (Fig. 7B).
Prepygidial fimbriae	Subapical hairs on metasoma tergum V (Fig. 9A).
Prestigma	Sclerotized (darker area) before pterostigma (Fig. 8D).
Proboscidial fossa	Cavity under head where mouthparts are concealed at rest (Fig. 7B).
Pronotal lobe	Posterolaterally lobe of pronotum, jutting into mesepisternum anteroventral to base of forewing (Fig. 8A).
Pronotum	First segment of mesosomal dorsum (Fig. 8A).
Propodeal triangle	Dorsomedial area on propodeum, posterior view.

Propodeum	Posterior region of mesosoma, first abdominal segment fused to thorax (Fig. 8A).
Pseudopygidium	Area on tergum V that resembles a pygidium (Fig. 9A).
Pterostigma	Scerotized (dark) area on anterior edge of forewing (sometimes called stigma), preceeded by prestigma (Fig. 8D).
Punctate	Indentations in integument.
Pygidial plate	Posteromedian plate on tergum VI (Fig. 9A).
Scopa	Pollen carrying structure, in female pollen collecting bees only, mostly on hind leg or under metasoma.
Sculpture	Pattern in integument.
Scutellum	Third sclerite of mesosomal dorsum (Fig. 8A).
Scutum	Second sclerite of mesosomal dorsum (Fig. 8A), largest sclerite.
Scutoscutellar suture	Join between scutum and scutellum (Fig. 8A).
Sternum (plural sterna)	Ventral segments of metasoma, abbreviated 'S', third sternum being S3 (Fig. 9A).
Short tongued	Labial palp with four similar segments (Fig. 8B).
Subantennal sutures	Line between antennal socket and clypeus, either one or two (Fig. 7A).
Submarginal cells	Cells in forewing, posterior to marginal cell and pterostigma (Fig. 8C), there may be one, two or three cells.
Pretarsal claws	Two pointed teeth at distal end of tarsus (Fig. 8B).
Tarsus	Distal five segments of all legs (Fig. 8B).
Taxon	A taxonomic group, family, tribe, genus or subgenus.
Tegula	Cap over wing base (Fig. 8A).
Tentorial pits	Small pit on lateral margin of clypeus, usually in epistomal suture (Fig. 7A).
Tergum (plural terga)	Dorsal segments of metasoma (Fig. 9A), abbreviated 'T', third tergum being T3.
Tibia	Forth segment of legs (second long segment) (Fig. 8B).

Tibial spur	Spine on distal end of tibia (Fig. 8B).
Tomentum	Mat of fine hairs on basal or distal regions of metasomal terga.
Vannal lobe	Second posterobasal lobe of hind wing (Fig. 8C).
Vein cu-a	Vein bisecting vein a, in hind wing (Fig. 8D).
Vein M+Cu	Posterior vein in hind wing, divided into two parts (abcissas) (Fig. 8D).
Veins 1rs-m and 2rs-m	First and second veins distal to second and third submarginal cells (Fig. 8D).
Veins 1m-cu and 2m-cu	First and second veins distal to first and second medial cells (Fig. 8D).
Vein a	Distal vein in hind wing (Fig. 8D).
Vertex	Region of head above ocelli and eyes (Fig. 7A).

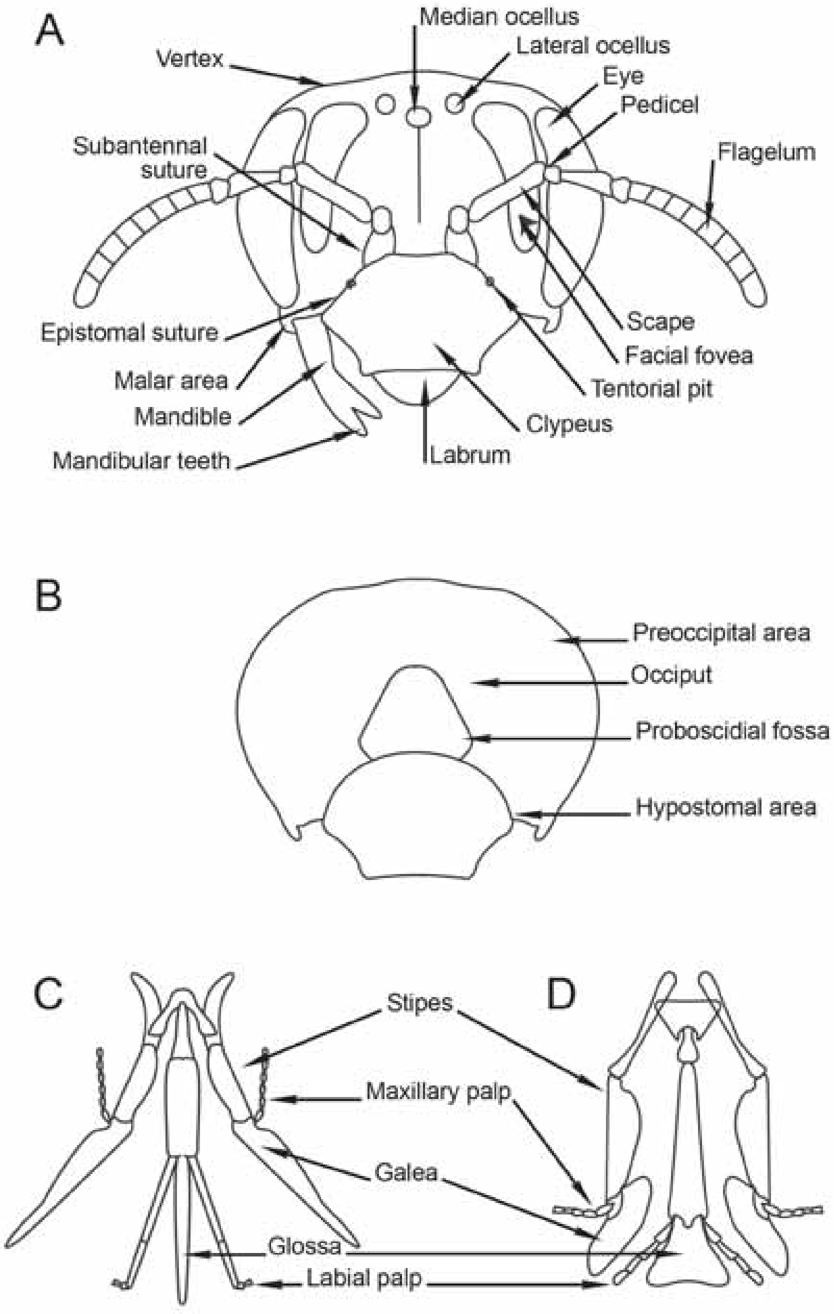


Fig. 7. Bee morphology and taxonomic characters. A. Face; B. Back of head; C. Mouthparts of long-tongued bee; D. Mouthparts of short-tongued bee.

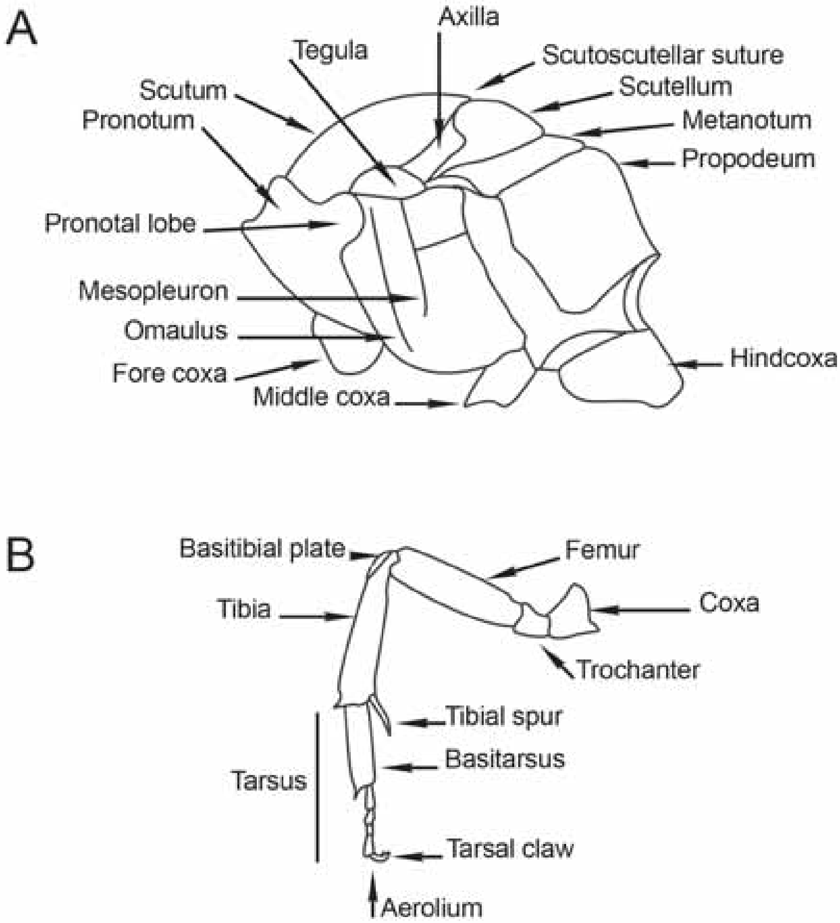


Fig. 8. Bee morphology and taxonomic characters. A. Mesosoma, side view; B. Leg.

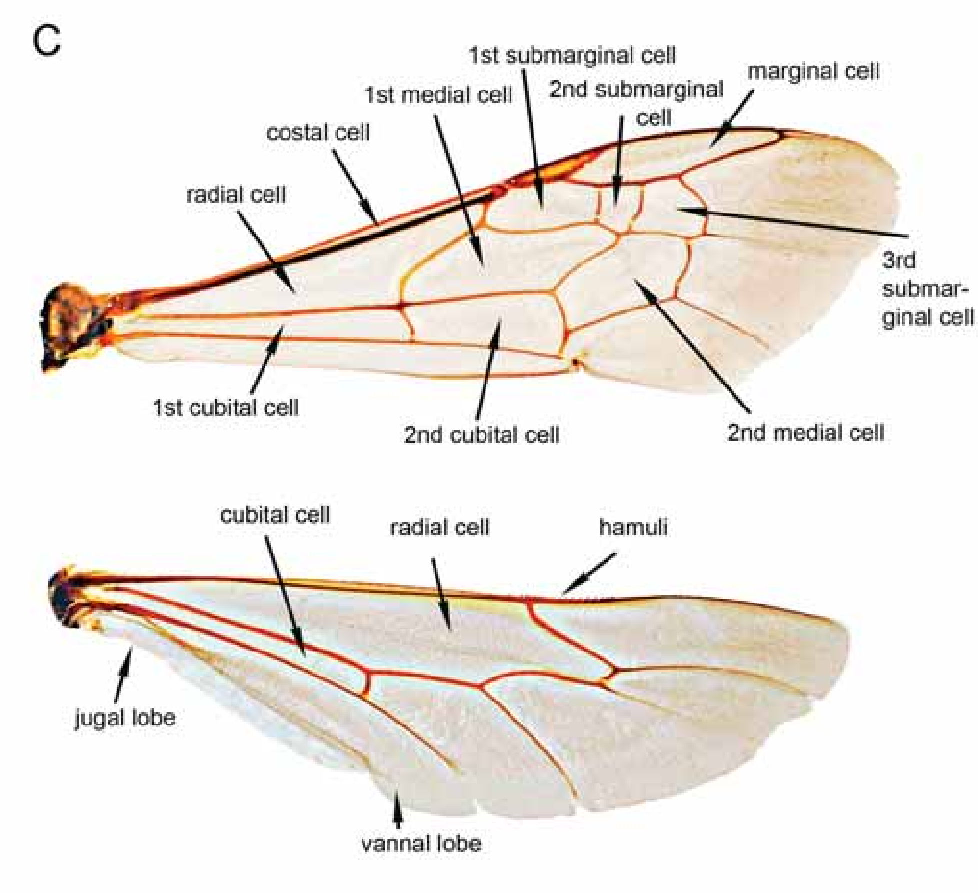


Fig. 8. Bee morphology and taxonomic characters. C. Wing with membranous cells and gross anatomical structures labeled. Upper picture is a forewing; lower picture is a hind wing.

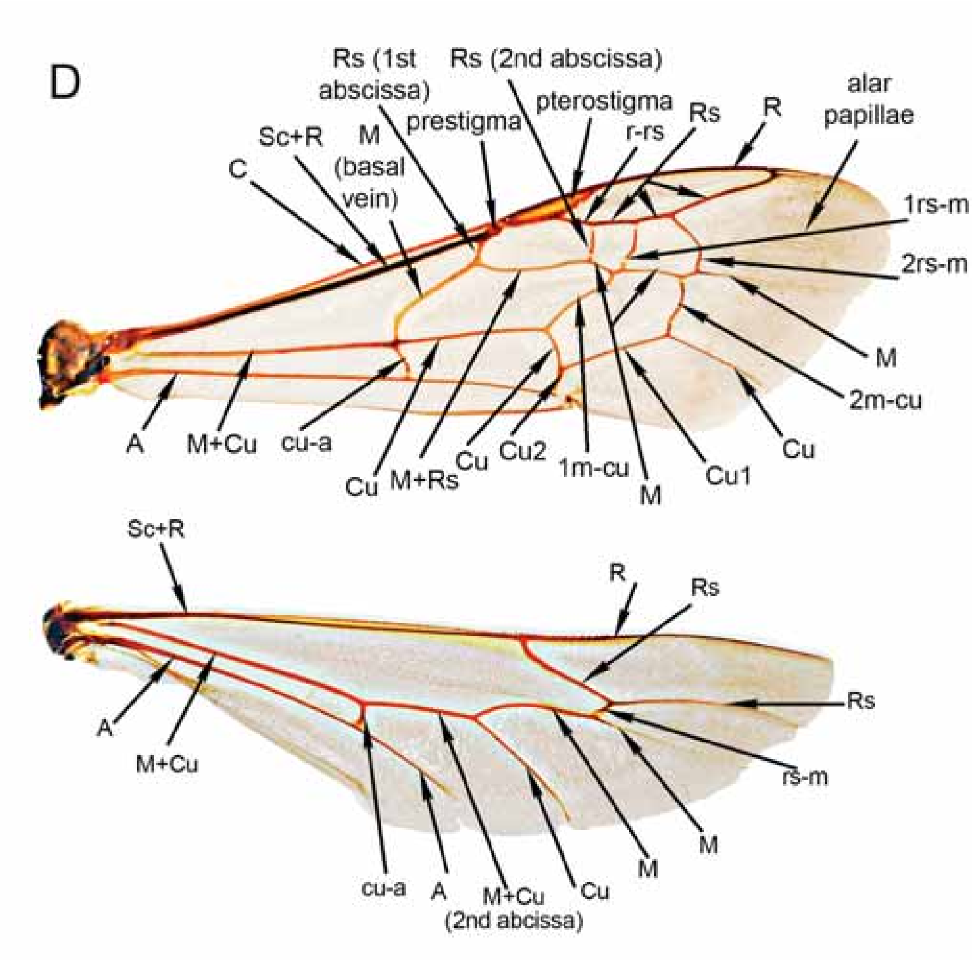


Fig. 8. Bee morphology and taxonomic characters. D. Wing with longitudinal and cross veins labeled together with single membrane feature (*i.e.* alar papillae). Upper picture is a forewing; lower picture is a hind wing.

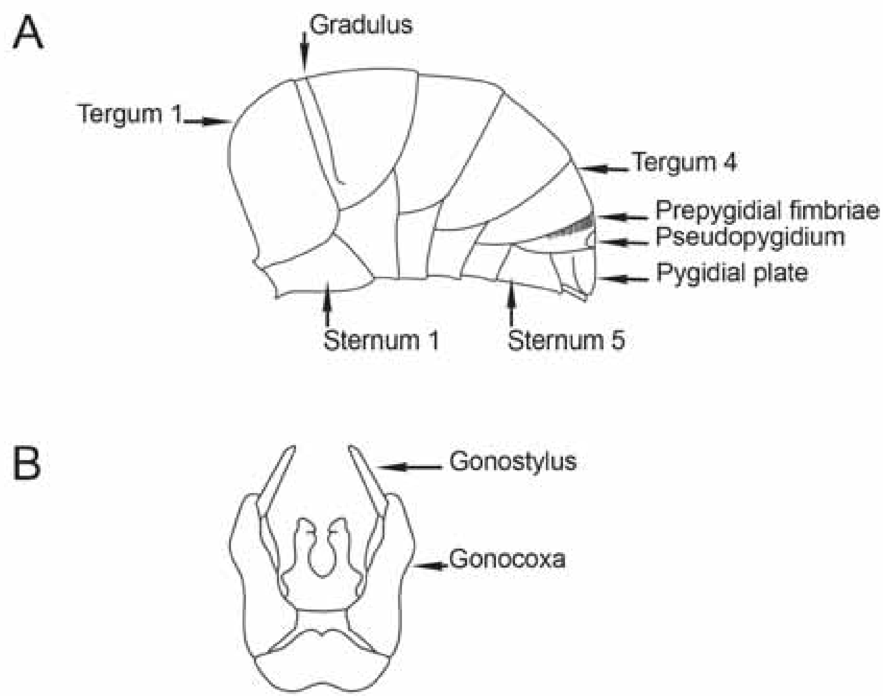


Fig. 9. Bee morphology and taxonomic characters. A. Metasoma, side view; B. Males genitalia, dorsal view.

7. The taxonomy and identification of bees

Bees all belong to the Class Insecta, Order Hymenoptera, Superfamily Apoidea. The Apoidea comprises two groups, the Anthophila (bees) and the Spheciformes (sphecid wasps). This book treats only the bees or Anthophila. The Anthophila has six families in the Afrotropical Region: Colletidae, Andrenidae, Halictidae, Melittidae, Megachilidae and Apidae. These families can in turn be separated into several subfamilies (scientific names ending with –inae), which can be further divided into tribes (scientific name ending with –ini). There may be several subfamilies or tribes in the World, but only one in Africa. In the text below these will be indicated by only one taxon in the higher category.

All species' names are binomial. That is they have a generic name followed by a specific epithet, such as *Apis mellifera*, the honey bee. The specific epithet is never used in isolation. The genus name may be abbreviated to its first letter, like *A. mellifera,* after it has been used in full earlier in the text. Bee genera are sometimes divided into subgenera. Subgeneric names may be incorporated into the name, but then they are placed in parenthesis between the genus and species names, for example *Xylocopa* (*Mesotrichia*) *flavorufa*, a large carpenter bee. The name of the author who originally described the species, and the date of publication is placed behind the species name - e.g. *Apis mellifera* Linnaeus, 1758 - the first time it is used in a document. The author name is placed in parenthesis if the species has been moved to another genus - e.g. *Xylocopa flavorufa* (DeGeer, 1778), which was described as *Apis flavorufa* De Geer, 1778.

This book is designed for the identification of the bee genera and subgenera that occur in sub-Saharan Africa. Taxonomic revisions should be used to identify up to species level. Table 1, in annex to this work provides a list of references to various taxonomic revisions.

Bees are divided into two broad, informal groups, short-tongued bees and long-tongued bees. Although these structures are often difficult to see, it still appears to be the best starting point. Most families of bees have an additional unique feature that does not occur in any other bee family, so they can mostly be identified without studying the mouth parts, which are often hard to see. Unfortunately female, cleptoparasitic, long-tongued bees do not have such unique features, which makes some of them more difficult to identify. A key for these genera is included near the end of this publication.

The following section is to enable the identification of the bee families, genera and subgenera. Most of the diagnostic characters are given in the keys. The short discussion on each taxon might give additional characters but those given in the keys are not repeated unless they need to be emphasized. Distribution data is given because it might facilitate identification but care must be taken as the distribution of many bees is incompletely known.

8. Systematic account

Students beginning with bee identification often find separating short and long-tongued bees difficult. However, keys avoiding the use of these characters tend to be more cumbersome and have many exceptions. It is not always necessary to dissect the mouthparts to separate short and long -tongued bees.

When the mouthparts are contracted, and when viewed from below, short-tongued bees have the stipes visible, the distal end of the galea only visible near the mandibles, and the stipes tightly concealed in the proboscidial fossa. In long-tongued bees the galea are clearly visible, concealing the stipes, and the hypostomal carina is not visible. The stipes is longitudinally fused, while in the galea the two sides are separate.

Only short-tongue bees have: two subantennal sutures (Andrenidae), a forked glossa (Colletidae), strongly curved basal vein in the forewing (Halictidae), scopa laterally on metasoma (*Systropha*, Halictidae), laterally directed hair on T4-T5 (*Thrinchostoma*, Halictidae) or mediolongitudinally directed fasciae on T5 (Halictini, Halictidae), weakly developed veins distally in forewing (*Lasioglossum*, Halictidae), greatly expanded hind femur (Halictidae and Melittidae) or pale coloured integument distally on T2-T5 (*Patellapis* and *Nomia*, Halictidae). Only long-tongued bees have the scopa under the abdomen (Megachilidae), basally greatly expanded hind tibial spur (*Ctenoplectra*, Apidae), pale stripes on paraocular area adjacent to lower eye edges (*Allodape*, Apidae), long antennal flagellum (*Tetraloniella* males, Apidae) or a corbicula (Apidae). Some of these features do not occur in all species and many other taxa have unique features;

for example some *Tetraloniella* males have short antennal flagella. These characters are conspicuous, commonly encountered and easy to remember, and help as a guide before venturing into keys. Regulars at identifying bees should attempt to develop a bigger suit of character for the bees they commonly encounter.

Key to the Afrotropical bee families

1. Short-tongued (Labial palp with four similar segments) (Fig. 7D) **2**

1'. Long-tongued (Labial palp with basal two segments long, apical two segments short (Fig. 7C) **5**

2. Glossa bifid apically . . . . **Colletidae**

2'. Glossa pointed apically **3**

3. Two subantennal sutures . . . .**Andrenidae**

3'. One subantennal suture **4**

4. Basal vein distinctly curved . . . .**Halictidae**

4'. Basal vein straight or nearly straight . . . .**Melittidae**

5. Female scopa on ventral surface of metasoma, except cleptoparasitic species; male metasoma curled under distally; labrum longer than wide; mostly two submarginal cells (*Fidelia* with three submarginal cells) . . . . **Megachilidae**

5'. Female scopa on hind leg, except cleptoparasitic species; male metasoma more or less straight; one, two or three submarginal cells; labrum mostly wider than long . . . . **Apidae**

8.1. Family Colletidae

The Colletidae are short-tongued bees with one subantennal suture, a forked glossa and a straight basal vein in the forewing. The structure of the glossa is unique. The hairs on the metasoma terga T3-T5 are all directed posteriorly.

In the Afrotropical Region the Colletidae has two subfamilies; the Colletinae and the Hylaeinae. The Colletinae has two tribes: Colletini, with one genus *Colletes*; and Scraptrini with *Scrapter*. The other subfamily is the Hylaeinae, with genera *Calloprosopis* and *Hylaeus*.

These bees are collectively known as cellophane bees. This is because of their habit of applying a transparent secretion onto the walls of their brood cells. They nest in tunnels in the ground or in hollow twigs. The African species are all pollen collecting bees. *Hylaeus* and *Calloprosopis* do not have a scopa and carry their pollen in the crop. Most *Colletes* and all *Scrapter* have a scopa on the hind leg.

The family is cosmopolitan, but has its greatest diversity in Australia.

Key to the Colletidae

1. Three submarginal cells in forewing . . . . ***Colletes***
1'. Two submarginal cells in forewing **2**

2. Integument metallic . . . . ***Calloprosopis***
2'. Integument not metallic (mostly black or black and reddish, sometimes with pallid maculation) **3**

3. Mostly hairy, female with scopa on hind leg; inter-antennal socket area flat or gently convex . . . .***Scrapter***
3'. Largely naked; female without scopa; inter-antennal socket area strongly and steeply raised . . . . ***Hylaeus***

8.1.1. Subfamily Colletinae

8.1.1.1. Tribe Colletini

Genus *Colletes* Latreille (Fig. 10A-B)

A quick indication as to whether a bee belongs to this genus is, a medium sized, hairy bee with eyes distinctly convergent below. In Africa *Colletes* bees mostly occur in southern and eastern Africa.

8.1.1.2. Tribe Scraptini

Genus *Scrapter* Lepeletier and Serville (Fig. 10C-D)

Scraptini is endemic and monotypic, occurring mostly in southern Africa, but are also recorded from Kenya. They vary from very hairy to largely naked, and very small to quite large (5-12 mm), but always with the scopa on the hind leg and two submarginal cells in the forewing.

8.1.2. Subfamily Hylaeinae

Genus *Calloprosopis* Snelling (Fig. 10E-F)

Calloprosopis is monotypic and endemic to high altitudes in Kenya. It is metallic blue-green, and its status as a distinct genus is questionable, as its only representative is possibly a metallic *Hylaeus*. They do not have a scopa and carry their pollen in the crop.

Genus *Hylaeus* Fabricius (Fig. 10G-H)

Hylaeus are also largely naked, without a scopa, and mostly black with red and/or yellow maculations, never metallic. There are six subgenera in the Afrotropical Region (*Alfkenylaeus*, *Cornylaeus*, *Deranchylaeus*, *Metylaeus*, *Nothylaeus* and *Prosopisteron*) (Michener, 2007). *Prosopisteron* was introduced into South Africa from Australia.

Key to the subgenera of *Hylaeus*

1. Interantennal socket area gently convex; propodeum smooth and without definite basal area; male S7 with four similar, hairy lobes . . . .***Hylaeus* (*Prosopisteron*)**

1'. Interantennal socket area abruptly raised, with juxta antennal carina; propodeum with definite, usually coarsely sculptured, basal area; male S7 either 2 lobed or with 4 dissimilar lobes, one pair naked **2**

2. Mandible long and slender, apex acute . . . .***Hylaeus* (*Nothylaeus*)**

2'. Mandible short, broad, apex oblique, two or three teeth, outer surface usually ridged **3**

3. Integument coarsely punctured, scutum and scutellum usually each with a pair of spines; occiput and omaulus carinate . . . . ***Hylaeus* (*Metylaeus*)**

3'. Punctation variable; scutum and scutellum without lateral spines; occiput and omaulus often without carinae (males needed for further identification) **4**

4. Male S7 with two, small lobes; gonoforceps narrowed and attenuate distally, ending beyond apex of penis . . . .***Hylaeus* (*Alfkenylaeus*)**

4'. Male S7 with four lobes; gonoforceps truncate distally, apex about at end of penis valve **5**

5. Discs of T1-T3 with abundant erect hairs; S7 with proximal, apical lobes either naked or with median row of small setae, ... ***Hylaeus* (*Cornylaeus*)**

5'. Discs of T1-T3 with few or no erect hairs; S7 with proximal, apical lobes either naked or with maginal row of large setae . . . . ***Hylaeus* (*Deranchylaeus*)**

Subgenus *Hylaeus* (*Alfkenylaeus*) Snelling

Hylaeus (*Alfkenylaeus*) is endemic to and occurs through much of sub-Saharan Africa. There are five species including the unique *Hylaeus arnoldi* (Friese) that was included by Michener (2007). Females cannot be separated from *Deranchylaeus*. The single pair of lateroapical lobes directed laterobasally on the male S7 is the only diagnostic feature.

Subgenus *Hylaeus* (*Cornylaeus*) Snelling

This subgenus appears to be wide spread in Central Africa and extends its distribution southwards along the eastern half of the continent. There are two species. Apart from being larger than its close relative *Deranchylaeus*, this subgenus can only be indentified by the hairyness of the lobes of the male S7. Its status is questionable.

Subgenus *Hylaeus* (*Deranchylaeus*) Bridwell

Hylaeus (*Deranchylaeus*) is a large subgenus, with 49 species, and occurs throughout sub-Saharan Africa.

Subgenus *Hylaeus* (*Metylaeus*) Bridwell

This subgenus is widespread in the Afrotropical Region, with four African and two Madagascan species. The well-developed occipital carina and carinate omaulus are diagnostic.

Subgenus *Hylaeus* (*Nothylaeus*) Bridwell

Hylaeus (*Nothylaeus)* is widespread through Africa and Madagascar. Snelling (1985) recorded 34 species. They are unlike the other hyaline bees in that the mandibles are slender, smooth and pointed. Snelling (1985) considered *Nothylaeus* to be a genus, but Michener (2007) considers this single apomorphy to be insufficient to justify generic status.

Subgenus *Hylaeus* (*Prosopisteron*) Cockerell

This genus is indigenous to Australia, New Zealand and several Pacific islands. During 1930 and 1948 a number of specimens of *Hylaeus* (*Prosopisteron*) *perhumilis* (Cockerell) were found in South Africa (Michener, 2007). As no specimens have been recently collected, it has presumable disappeared from Africa.

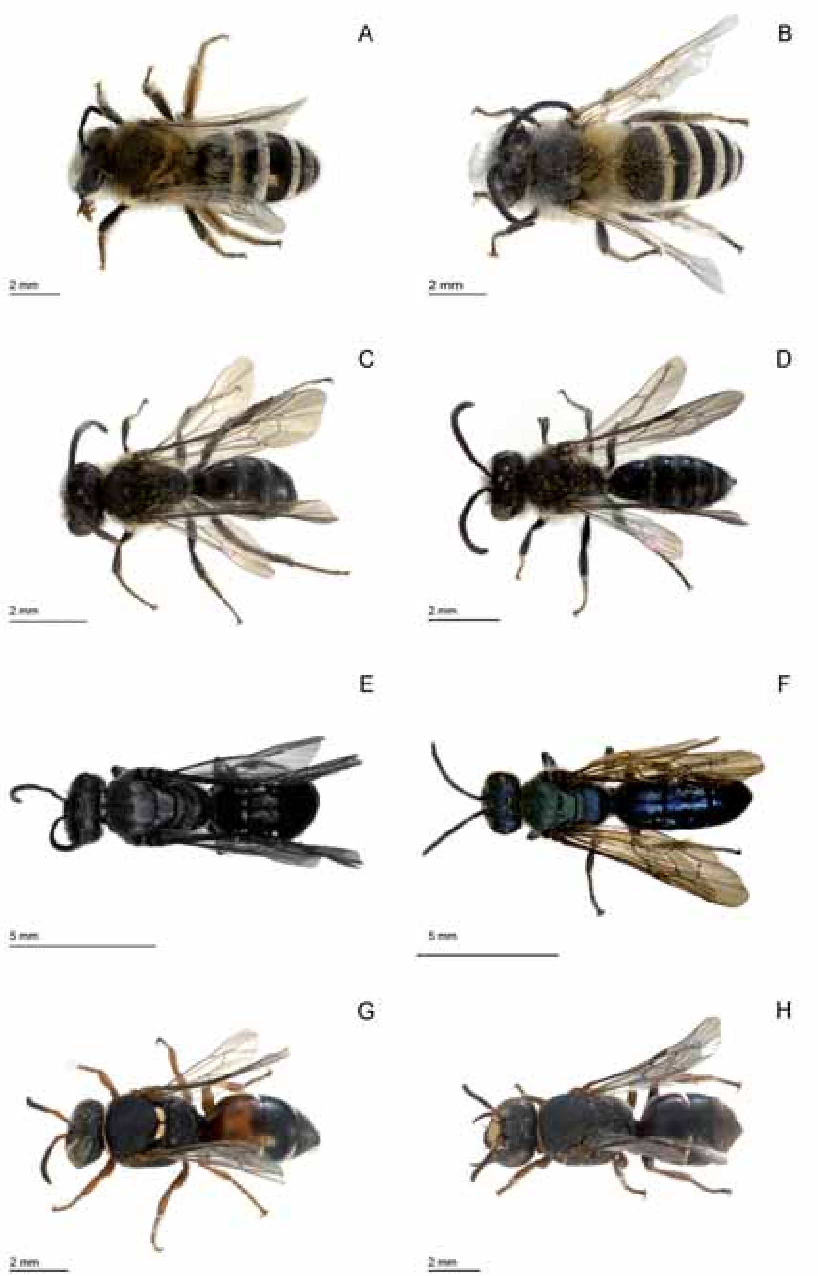


Fig. 10. A-B. *Colletes capensis* Cameron; A. Female; B. Male; C-D. *Scrapter nitidus* (Friese); C. Female; D. Male; E-F. *Calloprosopis magnifica* (Cockerell); E. Female; F. Male; G-H. *Nothylaeus junodi* (Friese); G. Female; H. Male.

8.2. Family Andrenidae

The Andrenidae are short-tongued bees with two subantennal sutures, a pointed glossa and straight basal vein in the forewing. The subantennal sutures, which are the diagnostic feature, are easy to see in most panurgine bees, but difficulty to see in the Andreninae. This is because the former are sparsely hirsute (some have the lower face yellow with black subantennal sutures) and the latter are very hairy with black facial integument. The hairs on the metasoma terga T3-T5 are all directed posteriorly.

In the Afrotropical Region they are all pollen collectors. They nest in burrows in the soil.

Key to the Andrenidae

1. Head, mesosoma and metasoma clothed with long hairs . . . . ***Andrena***

1'. Body sparsely clothed with mostly short hairs, except scopa [Panurginae] **2**

2. Two submarginal cells . . . . ***Mermiglossa***

2'. Three submarginal cells **3**

3. Large bees, more than 10 mm long, forewing with first and third submarginal cells subequal in length; male eyes much wider than interocular area near antennal sockets . . . .***Melitturga***

3'. Small bees, less than 10 mm long; forewing with first submarginal cell about twice as long as second submarginal cell; male eyes narrower or subequal in width to interocular area near antennal sockets **4**

4. Scutum mostly with sparse, semi-erect, hairs; male T7 simple apically; male S6 and S7 transverse or convex distally; male gonostylus robust, half as long as gonocoxa . . . . ***Meliturgula***

4'. Scutum densely clothed with appressed hair, intermixed with semi-erect hairs; male T7 bifid apically; male S6 and S7 emarginate distally; male gonostylus slender, as long as gonocoxa . . . .***Borgatomelissa***

8.2.1. Subfamily Andreninae

Genus *Andrena* Fabricius (Fig. 11A-B)

All the Afrotropical species of the Andreninae occur in the genus *Andrena*. They are densely hirsute. It does not have a tribal classification.

Andrena is very diverse in the Holarctic Region (more than 1400 species), and is represented in the Afrotropical Region by only 14 species, several of which most likely also occur in the Palaearctic Region, *i.e.*, they occur in north-eastern Africa. There are many subgenera in the Northern Hemisphere and only five are recorded in the Afrotropical Region (*Andrena, Euandrena, Melandrena, Micrandrena* and *Zonandrena*), all of whose occurrence in sub-Saharan Africa can be regarded with circumspection. The subgeneric classification of the Afrotropical *Andrena* needs revision and a subgeneric classification is therefore not applied here. The single southern African species and its differences to a closely related East African species, were documented by Eardley (2007a).

8.2.2. Subfamily Panurginae

8.2.2.1. Tribe Melitturgini

These bees are sparsely hirsute. They are dorso-ventrally flattish and sometimes have a reddish metasoma. They are mostly southern African. *Borgatomelissa, Melitturga* and *Meliturgula* also occur in the Palaearctic. *Mermiglossa*, however, is endemic and monotypic.

The Melitturgini are the only panurgine bees that occur in the Afrotropical Region. The tribe is represented by four genera (*Borgatomelissa*, *Melitturga, Meliturgula* and *Mermiglossa*) and 18 species. None of the genera have a subgeneric classification.

Genus *Borgatomelissa* Patiny (Fig. 11C)

Borgatomelissa is widely distributed across the southern border of the Sahara Desert, from Mauritania to Ethiopia and Arabia. There are two described species.

Genus *Melitturga* Latreille (Fig. 11E-F)

This genus occurs in southern Africa, around the Mediterranean and through southern Asia to China. In the Afrotropical Region there are four southern African species.

Genus *Meliturgula* Friese (Fig. 11G-H)

Meliturgula occurs in North Africa (1 endemic species), southern Africa (7 species), and there is one widespread species (*Meliturgula scriptifrons* (Walker)). They occur mostly in arid areas, except *M. scriptifrons*, which occurs in savannah.

Genus *Mermiglossa* Friese (Fig. 11D)

The concave lower edge of the *Mermiglossa* clypeus is distinct. It is monotypic and endemic to Namibia.

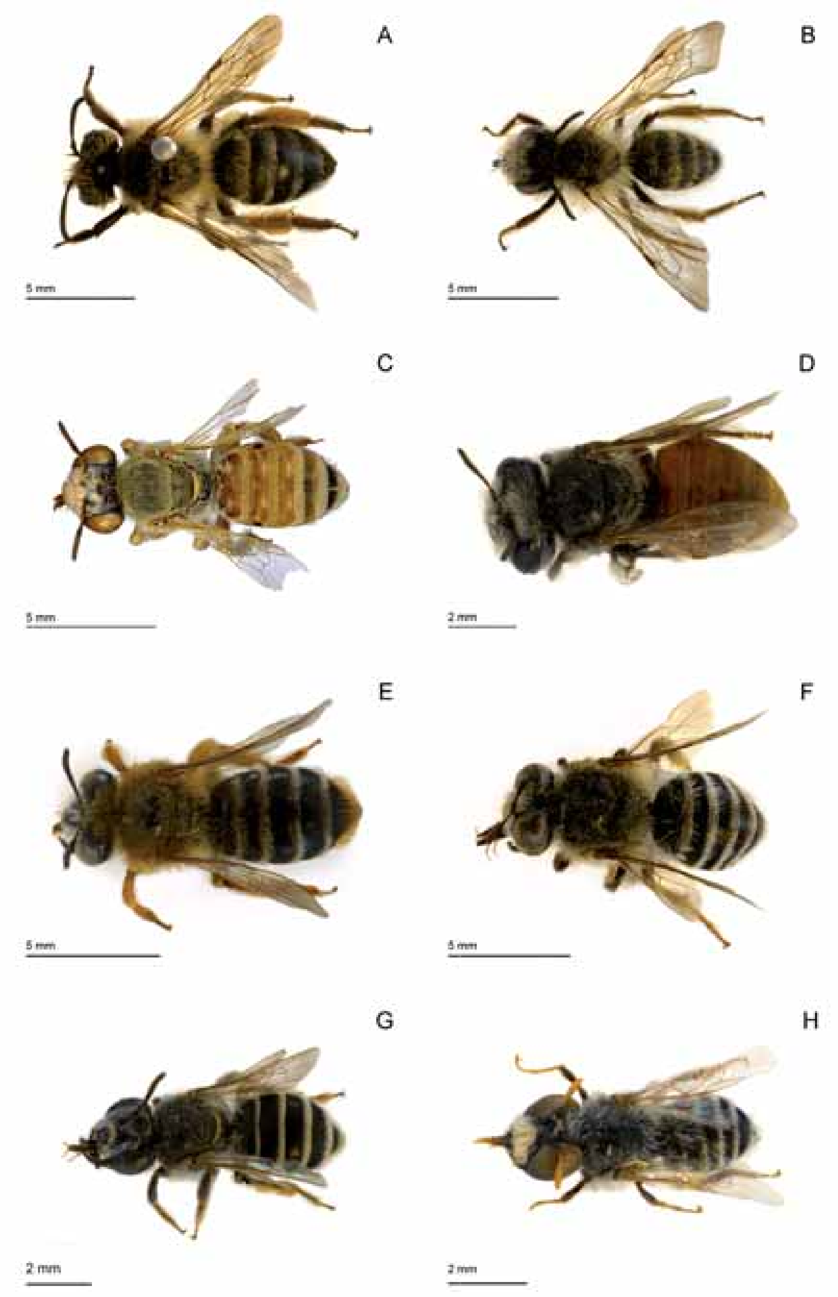


Fig. 11. A-B. *Andrena notophila* Cockerell; A. Female; B. Male; C. *Borgatomelissa* brevipennis (Walker), female; D. *Mermiglossa rufa* Friese, female; E-F. *Melitturga penrithorum* Eardley; E. Female; F. Male; G-H. *Meliturgula scriptifrons* (Walker); G. Female. H. Male.

8.3. Family Halictidae

The Halictidae are short-tongued bees with one subantennal suture, a pointed glossa and a strongly curved basal vein in the forewing. Within the short-tongued bees the shape of the basal vein is unique; some long-tongued bees have a weakly curved basal vein.

This is the largest family of short-tongued bees in the Afrotropical Region. It accounts for about one-third of all the Afrotropical bee species, and this family is possibly the most abundant because many species occur in large numbers. There are 16 genera and four subfamilies.

Key to the Halictidae

1. Antennal sockets below middle of face; scopa on side of metasoma, not on legs [Rophitinae] . . . . ***Systropha***

1'. Antennal sockets near middle of face; scopa on hind legs, rarely on sterna (this excludes parasitic genera that do not have a scopa) **2**

2. First and third submarginal cells subequal in length, longer than second submarginal cell (rarely only 2 submarginal cells) [Nomiinae] **3**

2'. First submarginal cell longest, second and third submarginal cell shorter than first and more or less subequal in length (always three submarginal cells) **7**

3. Two submarginal cells in forewing . . . .***Steganomus***

3'. Three submarginal cells in forewing **4**

4. Metasoma with pale integument bands on T2-T5 . . . .***Nomia***

4'. Metasoma without pale integument bands on T2-T5 . . . .**5**

5. Tegula greatly enlarged; lower margin of eye carinate . . . . . . ***Pseudapis***

5'. Tegula not modified (some exceptions, then body elongated, without carina below eye) **6**

6. Male last antennal segments narrowly pedunculate; female mandible simple; large species (13-15 mm); red metasoma, without bands of tomentum . . . .***Spatunomia***

6'. Male last antennal segment not narrowly pedunculate, mostly cylindrical; female with mandible bidentate or tridentate; metasoma mostly with bands of tomentum . . . .***Lipotriches***

7. Minute species (3-6.5 mm) often with yellow integument maculations on head, mesosoma and metasoma; prepygidial fimbria of female not divided medially [Nomioidinae] **8**

7.' Minute to large species; body without pale maculations; prepygidial fimbria of female divided by longitudinal median furrow (absent in cleptoparasitic genera) [Halictinae] **10**

8. Second submarginal cell petiolate; black; female inner metatibial spur unidentate . . . . ***Cellariella***

8'. Second submarginal cell not petiolate; mostly metallic, rarely black; female inner metatibial spur bi or multidentate **9**

9. Metasoma with pale integument bands on base of terga (posterior depressed marginal zone of tergum 2 and frequently other terga translucent yellowish, so that yellow base of tergum 3 shows through) . . . . ***Nomioides***

9'. Metasoma with pale integument bands on apical part of terga . . . .***Ceylalictus***

10. Hairs on distal ends of metasomal terga 3-5 directed laterally; malar area usually long, one-third to four times as long as wide . . . . ***Thrinchostoma***

10'. Hairs on distal ends of metasomal terga 3-5 directed backwards; malar area short **11**

11. Cleptoparasitic (no scopa in female); without clear hair bands on distal ends of metasomal terga; metasoma often red (sometimes black or metallic blue), rarely with tomentum **12**

11'. Pollen collector, scopa on female hind leg; metasoma rarely red, often with distinct hair bands on base of metasomal terga **13**

12. Body coarsely pitted; mandible of female often with preapical tooth; fourth antennal segment a little longer than third in females, twice as long as third in males . . . . ***Sphecodes***

12'. Body usually more finely punctate; mandible simple; third and fourth antennal segment distinctly broader than long in both sexes . . . . ***Eupetersia***

13. Forewing with vein 2rs-m weakly developed than vein Rs (more prominent in females) . . . .***Lasioglossum***

13'. All veins of submarginal cells equally well developed **14**

14. Body mostly black . . . . ***Patellapis***

14'. Body with metallic green, gold or blue reflections **15**

15. Glossa very long, about twice as long as head . . . .***Glossodialictus***

15'. Glossa short . . . . ***Seladonia***

8.3.1. Subfamily Nomiinae

The Nomiinae, in large, have the first and third submarginal cells in the forewing subequal in length and distinctly longer than the second submarginal cell. The exception is *Steganomus*, which has only two submarginal cells, and is the only halictid genus in Africa with two submarginal cells. They are all pollen collecting bees. They nest in tunnels in the ground.

Genus *Lipotriches* Gerstaecker

This is the largest genus of Nomiinae in the sense of Michener (2007), and it includes the species that Pauly (1990; 2009) separated into several genera. It is difficult to identify and determination usually results from the elimination of the genera with more conspicuous diagnostic features. This may turn out to be a paraphyletic taxon (Michener, 2007).

Key to the subgenera of *Lipotriches*

1. Female mandible tridentate, bidentate in male; basal region of propodeum forming a thin line or groove . . . . .***Lipotriches* (*Nubenomia*)**
1'. Female mandible bidentate, usually simple in male, sometimes bidentate in *Lipotriches s.str.*, if so base of propodeum broader than described above **2**

2. Pronotum carinate, sometimes notched, scutum not bent down anteromedially (inner hind tibial spur of female not toothed but lamellate) . . . . **Lipotriches (*Lipotriches*)**
2'. Pronotal carina absent or broadly notched medially, anterior part of scutum bent down medially to depressed pronotal margin **3**

3. Ocellocular distance less than twice ocellus diameter; glossa as long as face; small species with red metasoma . . . . .***Lipotriches* (*Maynenomia*)**
3'. Ocellocular distance at least twice ocellus diameter; glossa shorter than face; colour of metasoma variable (females needed for identification) . . **4**

4. Margin of basitibial plate in female carinate posteriorly only . . . . ***Lipotriches* (*Macronomia*)**
4'. Anterior and posterior margins of female basitibial plate carinate **5**

5. Propodeum base entirely sub-horizontal . . . .***Lipotriches* (*Austronomia*)**
5'. Propodeum base sub-vertical medially **6**

6. T1 minutely tessellate and finely punctured; male hind tibia with three large teeth ventrally . . . . ***Lipotriches* (*Trinomia*)**
6'. T1 shiny, often shagreened, coarsely punctured; male hind tibia with zero, one or two teeth ventrally . . . .***Lipotriches* (*Afronomia*)**

Subgenus *Lipotriches* (*Afronomia*) (Fig. 13A-B)

Species of *Afronomia* are very similar to African *Austronomia* but much larger (10-18 mm). The males of *Afronomia* cannot be separated from males of *Macronomia.* This endemic subgenus is widely distributed in southern and eastern Africa (7 species), and is absent from West Africa.

Subgenus *Lipotriches* (*Austronomia*) (Fig. 13G-H)

This subgenus is widespread in Australasia and Africa. Males of *Austronomia* cannot be separated from males of *Macronomia*. About 20 minute species occur in Africa, most of them have not been described.

Subgenus *Lipotriches* (*Lipotriches*) (Fig. 12E-F)

Lipotriches s. str. is widely distributed through Africa (about 70 species), Madagascar (4 species), southern Asia (27 species), New Guinea (3 species), the Solomon Islands (1 species) and northern Australia (3 species). Most groups of species forage pollen of Poaceae (grasses) exclusively.

Subgenus *Lipotriches* (*Macronomia*) (Fig. 12A-B)

This subgenus is widely distributed and diversified in the Afrotropical (about 45 species) and Oriental regions (11 species).

Subgenus *Lipotriches* (*Maynenomia*) (Fig. 12C-D)

Three species occur in sub-Saharan Africa and about ten in the Oriental Region. The absence of a pronotal carina, enlarged ocellae, long glossa, red metasoma and short scape are diagnostic for the African species.

Subgenus *Lipotriches* (*Nubenomia*) (Fig. 13D)

These are relatively large species (9-12 mm). Except for the subgenus *Melittidia* from New-Guinea, *Nubenomia* is the only nomiine with a tridentate female mandible. Other diagnostic characters are the clypeus that extends as a lip below a fringe of apical hairs, the head is about as long as broad, unlike the great majority of *Lipotriches*, and the distal part of the forewing is strongly darkened. The ocellae are large and *Nubenomia* are often crepuscular. It is endemic to Africa, with seven species in forested area.

Subgenus *Lipotriches (Trinomia)* (Fig. 13E-F)

This subgenus is near *Austronomia*, differing in that the propodeal triangle is vertical. The posterior leg of the male is swollen, and there are three teeth on the underside of the femur. It is endemic to Africa, with six species.

Genus *Nomia* Latreille

Nomia can be easily recognised, in the Nomiinae, by the pallid, distal integument bands on the metasomal terga (this also occurs in *Patellapis*, which is in the Halictini). This possibly paraphyletic genus was split into several genera by Pauly (1990; 2009).

Key to the subgenera of *Nomia*

1. Metanotum lamellate . . . . ***Nomia* (*Crocisaspidia*)**
1’. Metanotum not lamellate **2**

2. Female with basitibial plate completely carinate; tegula auriform; outer hind tibia spur bent near apex, with projection near bend; middle tibial spur long, with a few conspicuous preapical teeth . . .***Nomia* (*Acunomia*)**
2’. Female with basitibial plate carinate posteriorly only; tegula oval; outer hind tibia spur unmodified; middle tibial spur short and with only minute teeth **3**

3. T1 without coloured band; T2-T4 with coloured bands yellow or whitish; male hind tibia mostly unmodified, femur rarely with tooth ventrally near base . . . . ***Nomia* (*Leuconomia*)**

3’. T1-T4 with whitish or yellow bands; male hind tibia enlarged, femur ventrally with one preapical tooth . . . . ***Nomia* (*Nomia*)**

Subgenus *Nomia* (*Acunomia*) Cockerell (Fig. 14C-D)

This subgenus is widespread through Africa, Asia, North and Central America. Michener (2007) suggested that it is a paraphyletic group, which means that it may be divided in years to come. The structure of the outer hind and mid tibial spurs are diagnostic. All Asian species are now placed in *Nomia* (*Curvinomia*), *N. (Maculonomia)* and *N. (Gnathonomia)* (Pauly 2009).

Subgenus *Nomia* (*Crocisaspidia*) Ashmead (Fig. 14A-B)

Nomia (*Crocisaspidia*) is widespread in the Afrotropical Region (9 species) and occurs in India (1 species). The laminate scutellum is diagnostic, and they often have pale blue metasomal bands, resembling *Thyreus*, but in *Thyreus* the pale blue is coloured pubescence and in *Crocisaspidia* it is integument. *Crocisaspidia* are oligolectic on Fabaceae (beans).

Subgenus *Nomia* (*Leuconomia*) Pauly (Fig. 14G-H)

These bees are small, have pale, inconspicuous tergal bands, and therefore superficially resemble *Lipotriches*. They can be identified by the lack of tergal band on T1 and the incomplete basitibial plate in the female. *Nomia* (*Leuconomia*) is widespread in Africa (25 species), one species occurs in Madagascar and two in India.

Subgenus *Nomia* (*Nomia*) Latreille (Fig. 14E-F)

Nomia s. str. has only six described species, and they occur throughout the Afrotropical Region (3 species), Madagascar (1 species) and tropical Asia (2 species).

Genus *Pseudapis* Kirby

Pseudapis has a very large tegula and three submarginal cells in the forewing. Not to be confused with *Steganomus*, which has a large tegula, but always has two submarginal cells. Some *Lipotriches* also have an enlarged tegula but they can be distinguished by the lack of a carina along the lower margin of the eye, a character shared only by the subgenera of *Pseudapis*.

Key to the subgenera of *Pseudapis*

1. Female basitibial plate with anterior and posterior margins carinate; male hind leg often swollen and with one or no apical spines . . . .***Pseudapis* (*Pseudapis*)**

1’. Female basitibial plate with only posterior margin carinate; male hind tibia not enlarged and with two apical spurs . . . . ***Pseudapis* (*Pachynomia*)**

Subgenus *Pseudapis* (*Pachynomia*) Pauly (Fig. 15E-F)

This subgenus is widespread in Africa (four species) and two species occur in India.

Subgenus *Pseudapis* (*Pseudapis*) Kirby (Fig. 15A-C, D, H)

Pseudapis s. str. is widespread, occurring through Africa and Asia. It does not occur in Australia and Madagascar. Two groups, the sub-Saharan *Stictonomia* Cameron and the Palaearctic *Nomiapis* Cockerell are included in *Pseudapis* by Michener (2007) but have generic status in Pauly (1990) and Baker (2002). *Nomiapis* is characterized by the lack of apical hair bands on the terga and has only basal bands of tomentum. *Stictonomia* females have a pointed basitibial plate while it is rounded in *Pseudapis s.str. Stictonomia* is endemic to Africa (ten species) and inhabits forested area. *Pseudapis* (40 species) occurs mostly in xeric areas of tropical Africa and Asia. A monotypic genus, *Ruginomia* Pauly (1990), was erected to include *Ruginomia rugiventris* (Friese), a very strongly punctate and isolated southern African species, which Michener (2007) includes in *Pseudapis.*

Genus *Spatunomia* Pauly (Fig. 13C)

Spatunomia was described for two widely separated, large (13-15 mm) species with a red metasoma and without bands of tomentum on the terga. The most remarkable features of the genus are the simple mandibles in the female and the pedunculate last antennal segment in the male. They occur in widely separated areas, in Sudan and southern Africa.

Genus *Steganomus* Ritsema (Fig 15G)

Steganomus has two submarginal cells in the forewing and a large tegula. It lacks a carina along the lower margin of the eyes. The genus is Afrotropical (5 species) and Oriental (6 species).

8.3.2. Subfamily Nomioidinae

The Nomioidinae are minute bees. The anterior tentorial pits are lateral to the epistomal suture. The subfamily comprises three genera, and is not divided into tribes. They are all pollen collecting bees that nest in sandy areas.

Genus *Cellariella* Strand (Fig. 16A-B)

This is a small genus known from 5 species, all minute and black with extensive yellow maculations. The petiolate second submarginal cell of the forewing is unique. All the species live in deserts and the genus is endemic to sub-Saharan Africa and Madagascar.

Genus *Ceylalictus* Strand

Ceylalictus are minute bees with extensive yellow maculations. The distal region of tergum 2 is not transparent and yellow bands occur on the apical part of the terga.

Key to the subgenera of *Ceylalictus*

1. Metanotum with median tubercle bearing a dense bunch of long plumose hairs . . . . **Ceylalictus (Meganomioides)**

1’. Metanotum without median tubercle **2**

2. Male mandible without subapical tooth; female mesoscutum usually with integumental yellow, median, transverse spot before hind margin; female inner metatibial spur with two teeth . . . .***Ceylalictus* (*Ceylalictus*)**

2’. Male mandible with subapical tooth; female mesoscutum without pale markings; female inner metatibial spur with three or four teeth . . . . ***Ceylalictus* (*Atronomioides*)**

Subgenus *Ceylalictus* (*Ceylalictus*) Strand (Fig. 16C-D)

This is a widespread subgenus. Only four species are known from Africa. All have metallic green reflections.

Subgenus *Ceylalictus* (*Atronomioides*) Pesenko (Fig. 16E)

It is mostly a Palaeotropical and tropical Asian subgenus. One species inhabits southern Africa, two larger species (5,5 mm) are endemic to the Cape Verde Islands and six are endemic of Madagascar. The species are black or with metallic green reflections.

Subgenus *Ceylalictus* (*Meganomioides*) Pesenko (Fig. 16F)

The subgenus includes three principally Palaearctic species, one of them reaches the southern border of the Sahara in Mauritania. They are relatively large (5-5,5 mm) and the female metasoma is completely yellow.

Genus *Nomioides* Schenck (Fig. 16G-H)

The genus includes 62 species mostly inhabiting the deserts of Asia and North Africa. There are 8 sub-Saharan species. They are minute black or metallic species with extensive yellow maculations. The distal region of tergum 2 is transparent with a yellow band basally on the tergum. A monotypic subgenus, *Erythronomioides*, differs in having a large body (5 mm long), strongly elongate mandible and a red metasoma. It is included by Michener (2007) in *Nomioides* and is endemic to Socotra Island.

8.3.3. Subfamily Halictinae

8.3.3.1. Tribe Halictini

The Halictinae have the antennal sockets in the middle of the face, the anterior tentorial pit on the epistomal suture, the first submarginal cell of the forewing is longer than the second and third submarginals, which are similar in size, and the pollen collecting females have a median specialized area on tergum 5 (a longitudinal median furrow that divides the prepygidial fimbria), which is unique. It is divided into two tribes; the Halictini and the Augochlorini, of which only the former occurs in Africa. This genus comprises five pollen collecting and two cleptoparasitic genera.

Genus *Eupetersia* Blüthgen

Eupetersia are mainly red and black, sometimes with blue metallic reflections (in the subgenus *Calleupetersia* Cockerell). The propodeum is not strongly pitted, as in another, similar halictid genus, *Sphecodes*. The length of the antennal segments (see keys) is diagnostic and separates it from *Sphecodes*. They are cleptoparasitic.

Key to the subgenera of *Eupetersia*

1. Body with blue metallic reflections . . . . ***Eupetersia* (*Calleupetersia*)**
1'. Body black or red **2**

2. Scutum densely punctate; scutellum with two sparsely punctate convexities . . . . ***Eupetersia* (*Eupetersia*)**
2'. Scutum and scutellum with widely separated punctures; scutellum evenly convex . . . . ***Eupetersia* (*Nesoeupetersia*)**

Subgenus *Eupetersia* (*Calleupetersia*) Cockerell (Fig. 17D)

Eupetersia (*Calleupetersia*) is confined to Ethiopia and East Africa. It is considered to be a synonym of *Eupetersia sensu stricto* by Michener (2007), but as a valid genus by Pauly (1999a). The body has blue metallic reflections, and in one species an extended tomentum (7 species).

Subgenus *Eupetersia* (*Eupetersia*) Blüthgen (Fig. 17A)

Eupetersia s. str. is known from East Africa and Madagascar. There are more than 14 species.

Subgenus *Eupetersia* (*Nesoeupetersia*) Blüthgen (Fig. 17B-C)

Eupetersia (*Nesoeupetersia*) appears to be confined to tropical Africa, as well as southern India and Indonesia. There are more than eight species.

Genus *Glossodialictus* Pauly (Fig. 20G)

Glossodialictus possibly should be regarded as a subgenus of *Patellapis* with an extraordinary long glossa and some metallic reflections. The genus is monotypic and occurs in Central Africa. The only species is *Glossodialictus wittei* Pauly.

Genus *Lasioglossum* Curtis

Lasioglossum have the distal veins in the forewing distinctly fainter than those to the wing base (diagnostic feature). They are all pollen collecting bees.

Key to the subgenera of *Lasioglossum*

1. Second submarginal crossvein (1 rs-m) as strong as first (Rs). **2**
1'. Second submarginal crossvein (1 rs-m), at least in females, weaker than first (Rs). **3**

2. Female with inner hind tibial spur pectinate; propodeum with hexagonal carina; glossa usually short, rarely long . ***Lasioglossum* (*Ctenonomia*)**

2'. Female with inner hind tibial spur dentate, first tooth large and rounded; propodeum with a rectangular carina; glossa mostly very long . . . . ***Lasioglossum* (*Ipomalictus*)**

3. Female hind leg without a scopa or with only a few hairs . . . . ***Lasioglossum* (*Paradialictus*)**

3'. Female hind leg with a well developed scopa **4**

4. Female terga with basal spots of tomentum; male T2 with broad basal band of erect and plumose white hair . . . . ***Lasioglossum* (*Sellalictus*)**

4'. Female terga without tomentum; male T2 without basal hair band **5**

5. Propodeum carinate . . . .***Lasioglossum* (*Evylaeus*)**

5'. Propodeum without carina between basal and posterior subvertical surfaces . . . . ***Lasioglossum* (*Afrodialictus*)**

Subgenus *Lasioglossum* (*Ctenonomia*) Cameron (Fig. 18E-F)

Numerous species occur in sub-Saharan Africa (over 100 species). The pectinate hind tibial spur and the hexagonal carina on the propodeum are diagnostic. Some species have green metallic reflections (group *duponti*). Two species, classified by Pauly (1999b) in *Oxyhalictus*, have a very long glossa. Most species are broadly polylectic.

Subgenus *Lasioglossum* (*Ipomalictus*) Pauly (Fig. 18A-D)

Many species occur in sub-Saharan Africa (over 40 species). The large rounded first tooth on the inner hind tibial spur is diagnostic. The glossa is very long in most species (as long as the head or longer). Some species have metallic reflections. Most species are oligolectic on Convolvulaceae, Malvaceae and Cucurbitaceae. The subgenus *Rubrihalictus* Pauly from South Africa is close to *Ipomalictus* but has a short glossa and a regularly dentate hind tibial spur.

Subgenus *Lasioglossum* (*Afrodialictus*) Pauly (Fig. 19A-B)

Lasioglossum (*Afrodialictus*) is a montane subgenus that is endemic to sub-Saharan Africa. Most species are oligolectic on Asteraceae. There are about 36 species.

Subgenus *Lasioglossum* (*Evylaeus*) Robertson

In the Afrotropical Region this largely Holarctic subgenus is only known from a few species near the southern border of the Sahara (Mauritania, Sudan). Three species in Central Africa are tentatively placed in *Evylaeus* (group *schubotzi*), and a group of 5 species have been placed in the subgenus *Mediocralictus* by Pauly (1984c). Males of *Mediocralictus* have a pectinate hind tibial spur, as in the Oriental subgenus *Sudila.*

Subgenus *Lasioglossum* (*Paradialictus*) Pauly (Fig. 17G)

Lasioglossum (*Paradialictus*) has close affinities with *Lasioglossum* (*Afrodialictus*). Numerous features suggest that this subgenus is cleptoparasitic. *Lasioglossum (Paradialictus) synavei* Pauly was the only species but Gibbs (2009) has described a second cleptoparasitic species from Africa close to *Afrodialictus*. *Paradialictus* is confined to the mountains of East Africa.

Subgenus *Lasioglossum* (*Sellalictus*) Pauly (Fig. 19C-D)

Nearly all the species have spots of tomentum on the terga. All halictine males with a large spot of tomentum on the base of tergum 2 belong to this subgenus. They are Afromontane and South African, foraging commonly on Asteraceae. There are about 36 species.

Genus *Patellapis* Friese

The generic name *Patellapis,* used here in a broad sense, includes a rather diverse group of African halictines with strong distal wing venation. Males often have bristles on the fourth sternum. *Patellapis* are most easily identified by the absence of the diagnostic features of other Halictini with strong distal wing venation (see key above).

Key to the subgenera of *Patellapis*

1. Posterior margins of T1-T3 naked with pallid (white, yellow, blue or green) integument . . . . ***Patellapis* (*Zonalictus*)**

1'. Posterior margins of terga brownish, sometimes translucent **2**

2. Female lower margin of hind tibia with a fringe of pectinate or palmate hairs **3**

2'. Female lower margin of hind tibia without pectinate or palmate hairs (long hairs on lower margin either with well separated long branches or branched in such a way that the rachis is only identifiable basally) **4**

3. Terga with distinct apical hair bands; female lower margin of hind tibia with palmate hairs; female sterna without distinct scopa; male sternum 4 without bristles . . . .***Patellapis* (*Lomatalictus*)**

3'. Terga without distinct apical hair bands; female with lower margin of hind tibia with pectinate hairs; female sterna with distinct scopa of plumose hairs; male sternum 4 with bristles . . . . ***Patellapis* (*Dictyohalictus*)**

4. Large to moderate sized species; basitibial plate well defined, apex rounded; terga with conspicuous apical hair bands . . . .***Patellapis* (*Patellapis*)**

4'. Small to moderate-sized species (length 4 to 8 mm); basitibial plate poorly defined anteriorly, apex angulate or pointed; terga either without or with weak apical hair bands . . . . ***Patellapis* (*Chaetalictus*)**

Subgenus *Patellapis* (*Chaetalictus*) Michener (Fig. 20C-D)

This subgenus occurs in southern Africa, and in the high mountains of Cameroon, East Africa and Madagascar. Numerous species in southern Africa await description. For some species it is difficult to choose whether they belong to the subgenus *Patellapis* or *Chaetalictus* because they combine a mixture of characters of both subgenera. A more precise definition of the subgenera is given by Timmermann & Kuhlmann (2008). There are about 50 described and a number of undescribed species.

Subgenus *Patellapis* (*Dictyohalictus*) Michener (Fig. 20H)

Pectinate hairs on the lower margin of the hind tibia in the female are diagnostic (a feature shared also by *Homalictus* in Australasia) for this subgenus. The pectinate hairs are strongly curved, their branches close together and tending to be at right angle to the rachis. Females also bear a scopa of plumose setae on the sterna and hind femur. Eleven species occur in West and Central Africa where they are confined to forested areas and they are always rare. One species occurs in southern Africa.

Subgenus *Patellapis* (*Lomatalictus*) Michener (Fig. 20F)

This subgenus is known from only one South African species, *Patellapis* (*Lomatalictus*) *malachurina* (Cockerell). The status of the subgenus is uncertain and it might be synonymized with *Patellapis* (*Chaetalictus*) (Timmermann & Kuhlmann 2008).

Subgenus *Patellapis* (*Patellapis*) Friese (Fig. 20E)

Patellapis s. str. comprises South African species that are mostly quite large. Twenty-three described species are known.

Subgenus *Patellapis* (*Zonalictus*) Michener (Fig. 20A-B)

The most conspicuous diagnostic feature of this subgenus is the white, yellow, greenish or bluish apical integumental bands, which are suggestive of *Nomia*. In females the lower margin of the hind tibia has pectinate or palmate hairs. However, the subgenus seems to be paraphyletic (Danforth et al. 2008). It occurs in the mountains of West, Central, East and southern Africa, Sokotra, Yemen and Madagascar. It is endemic to these areas and there are more than 70 species.

Genus *Seladonia* Latreille

Sub-Saharan species of *Seladonia* all have metallic reflections. Some other species of sub-Saharan halictine bees have metallic reflections but they can be separated by a carinate propodeum (*Ctenonomia, Ipomalictus),* lack of apical hair bands (*Afrodialictus)* or weak distal wing venation.

Key to the subgenera of *Seladonia*

1. Both sexes densely punctate; female with scopa; T5 with posterolongitudinal area of inward directed hairs . . . . ***Seladonia***

1'. Both sexes sparsely punctate; female without scopa; T5 without modified vestiture . . . .***Paraseladonia***

Subgenus *Seladonia* Robertson (Fig. 18G-H)

Seladonia (*Seladonia*) are abundant throughout the Old World and some species occur in the Western Hemisphere. They all have metallic gold, blue or green metallic reflections and apical hair bands on the terga. There are 18 African species.

Subgenus *Paraseladonia* Pauly (Fig. 17H)

The only known species, *Halictus* (*Paraseladonia*) *chalybaeus* (Friese), occurs throughout tropical Africa and is cleptoparasitic.

Genus *Sphecodes* Latreille (Fig. 17E-F)

Sphecodes are cleptoparasitic, *i.e*., females do not have a scopa. They are mostly red and black. The genus is noteworthy for the coarse sculpture on the thorax and propodeum. Males have antennal segments more strongly constricted than in other halictines. There are about 50 species in sub-Saharan Africa.

Genus *Thrinchostoma* Saussure

This is a genus of relatively large (length 8-16 mm), elongate bees. The clypeus is strongly produced, they are not metallic and the metasomal terga have laterally directed vestiture, which is unique. *Thrinchostoma* is Afrotropical and Oriental. It is divided into three subgenera: *Diagonozus*, *Eothrincostoma* and *Thrinchostoma*. They are pollen collecting bees. The genus is commonly found on flowers of *Impatiens* but also visits other plants.

Key to the subgenera of *Thrinchostoma*

1. Forewing of males without patch of dense hairs near second submarginal crossvein . . . .***Thrinchostoma* (*Eothrincostoma*)**

1'. Forewing of males with patch of dense hairs around second submarginal crossvein **2**

2. Head greatly extended below eyes, malar area almost as long as eye . . . .***Thrinchostoma* (*Diagonozus*)**

2'. Head moderately produced below eyes, malar area much shorter than eye, one-third to three times as long as wide . . . .***Thrinchostoma* (*Thrinchostoma*)**

Subgenus *Thrinchostoma* (*Diagonozus*) Enderlein (Fig. 21A-B)

Bees in this subgenus have an extremely long clypeus and proboscis. The subgenus *Diagonozus* only occurs in forested areas of West and Central Africa. There are three described species. One of these species is known from Sumatra (Sakagami *et al*., 1991).

Subgenus *Thrinchostoma* (*Eothrincostoma*) Blüthgen (Fig. 21C-D)

Eothrincostoma occurs in Central and East Africa, south to KwaZulu-Natal. There are four described species.

Subgenus *Thrinchostoma* (*Thrinchostoma*) Saussure (Fig. 21E-F)

The subgenus *Thrinchostoma* is widespread in tropical and sub-tropical Africa (over twenty species), Madagascar (12 species) as well as tropical Asia (ten species) (Michener & Engel, 2010).

8.3.4. Subfamily Rophitinae

Genus *Systropha* Illiger (Fig. 21G-H)

Rophitinae is represented in the Afrotropical Region by a single genus, namely *Systropha*. It is characterized by the scopa being on the side of the metasoma and the male flagellum being flattened and curled distally. The antennal sockets are well below the middle of the face. They are pollen collecting bees. There are nine Afrotropical species. They are frequently collected in Convolvulaceae flowers.

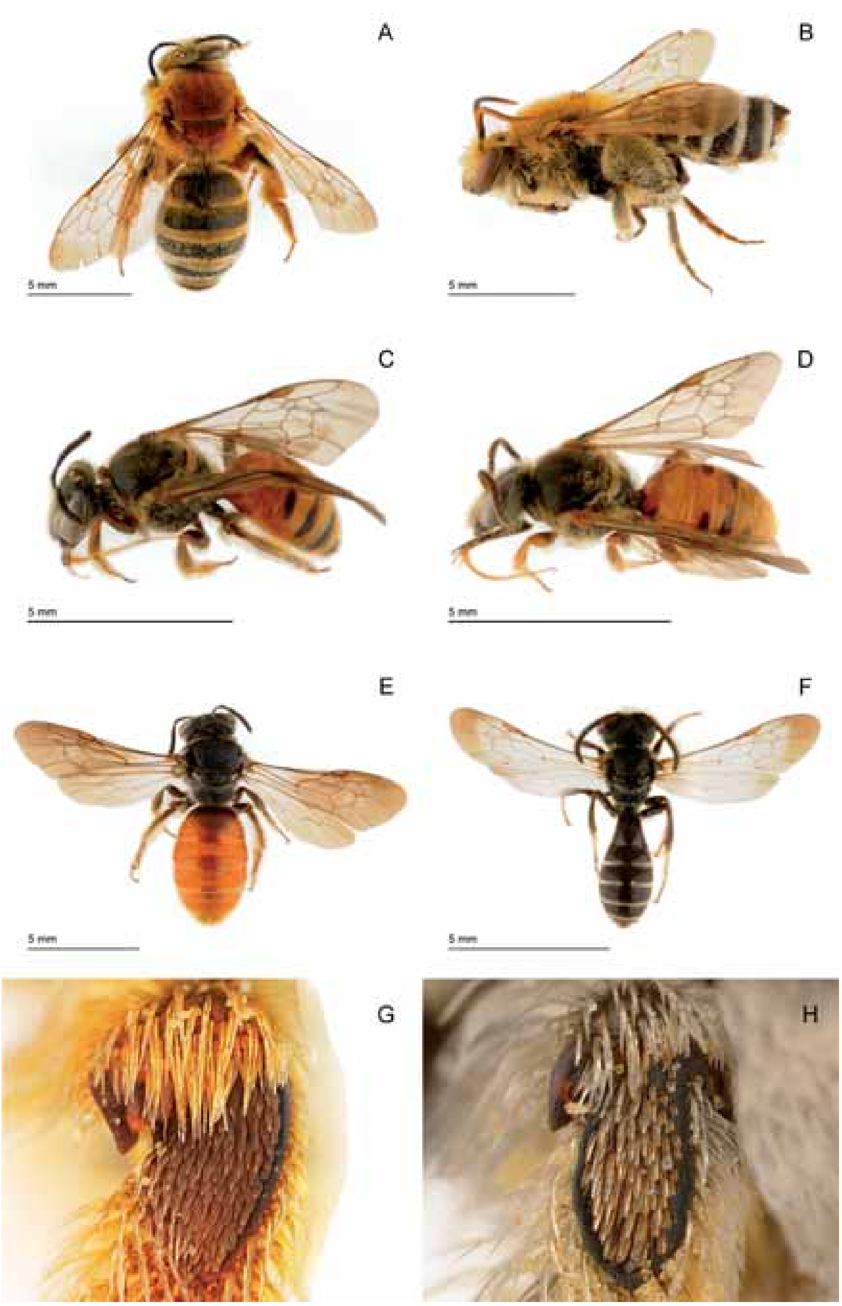


Fig. 12. A. *Lipotriches (Macronomia) vulpina*, female; B. *Lipotriches (Macronomia) vulpina*, male; C. *Lipotriches (Maynenomia) testacea*, female; D. *Lipotriches (Maynenomia) testacea*, male; E. *Lipotriches (Lipotriches) cribrosa*, female; F. *Lipotriches (Lipotriches) hylaeoides*, male; G. basitibial plate of female margined by carina only on posterior side (*Lipotriches*); H. basitibial plate of female with marginal carina complete (*Nomia*).

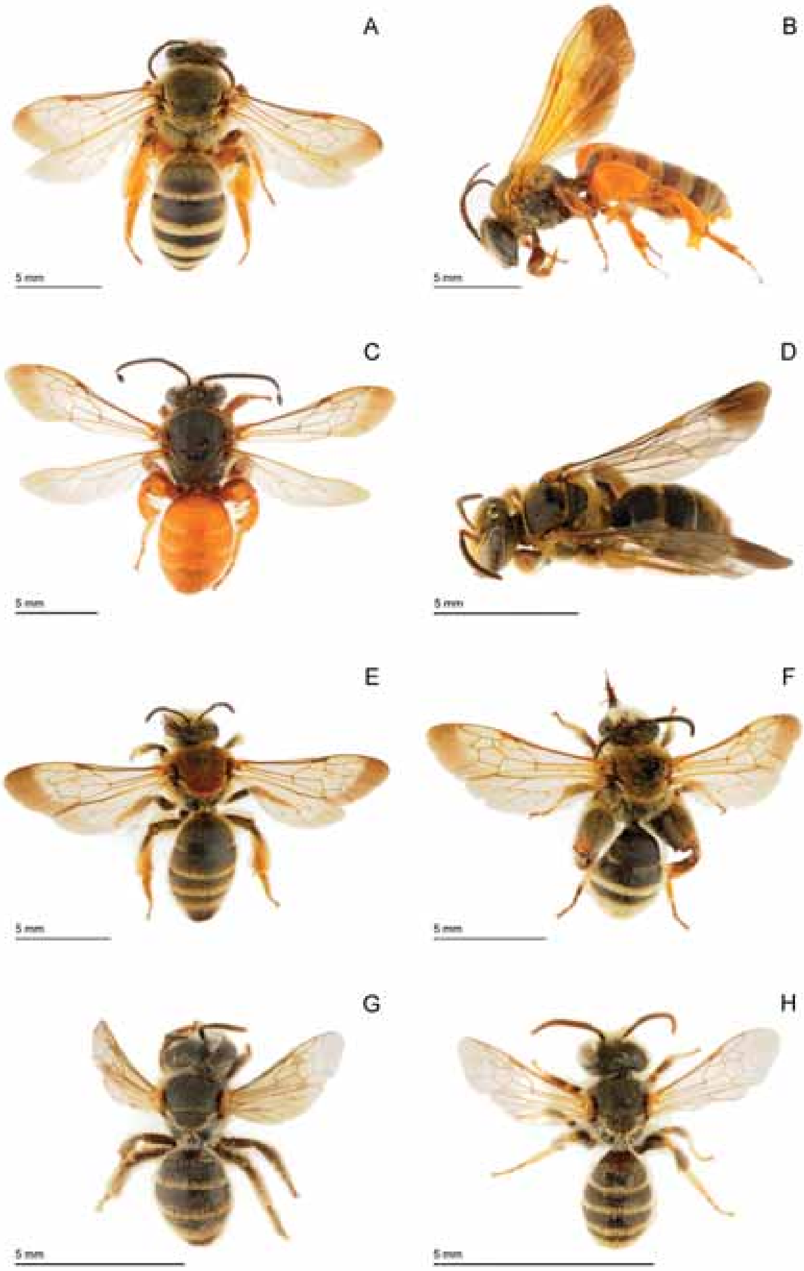


Fig. 13. A. *Lipotriches (Afronomia) meridionalis*, female; B. *Lipotriches (Afronomia) picardi*, male; C. *Spatunomia rubra*, male; D. *Lipotriches (Nubenomia) derema*, male; E. *Lipotriches (Trinomia) orientalis*, female; F. *Lipotriches (Trinomia) orientalis*, male; G,.*Lipotriches (Austronomia*) sp., female; H. *Lipotriches (Austronomia)* sp., male.

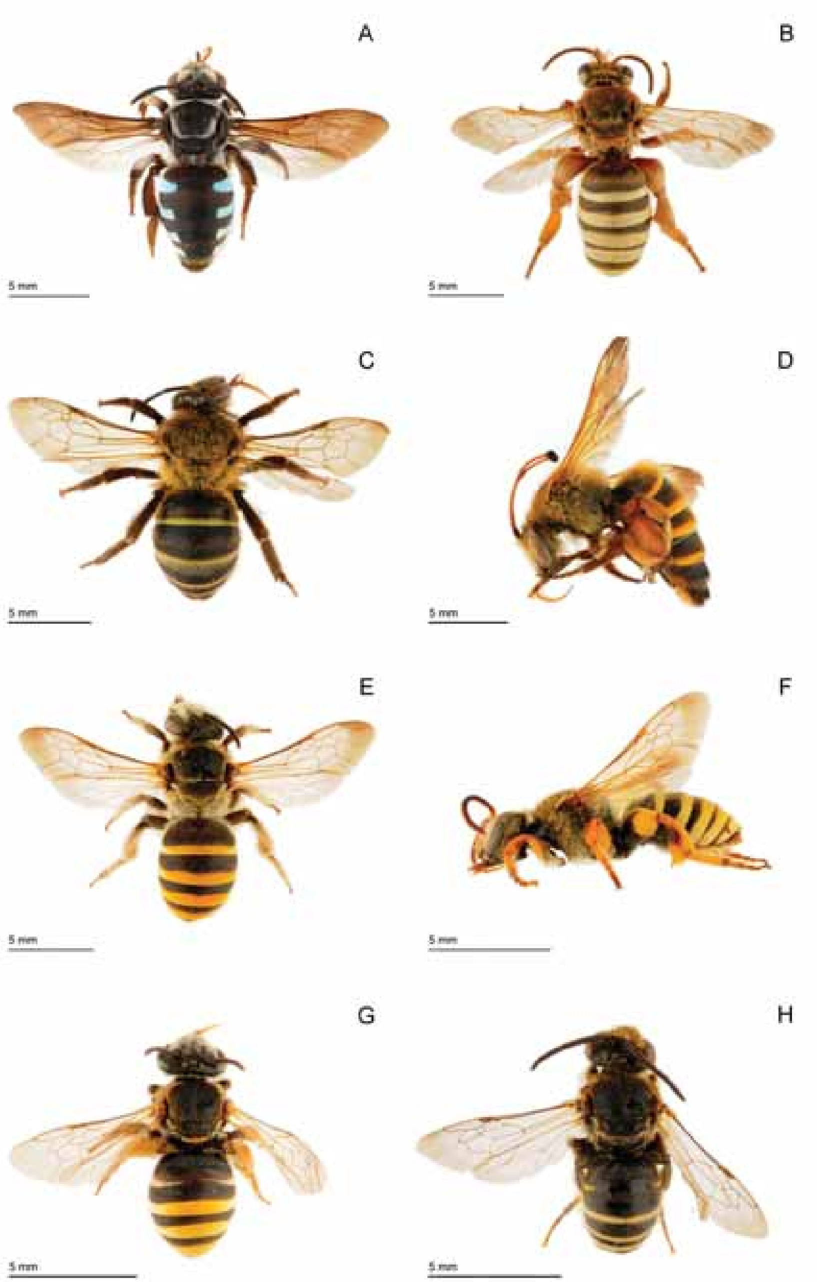


Fig. 14. Nomiinae with colored tergal bands. A. *Nomia (Crocisaspidia) chandleri*, female; B. *Nomia (Crocisaspidia) zonaria*, male; C. *Nomia (Acunomia) viridicincta*, female; D. *Nomia (Acunomia) ivoirensis*, male; E. *Nomia (Nomia) scitula*, female; F. *Nomia (Nomia) antecedens*, male; G. *Nomia (Leuconomia)* sp., female; H. *Nomia (Leuconomia) bouyssoui*, male.

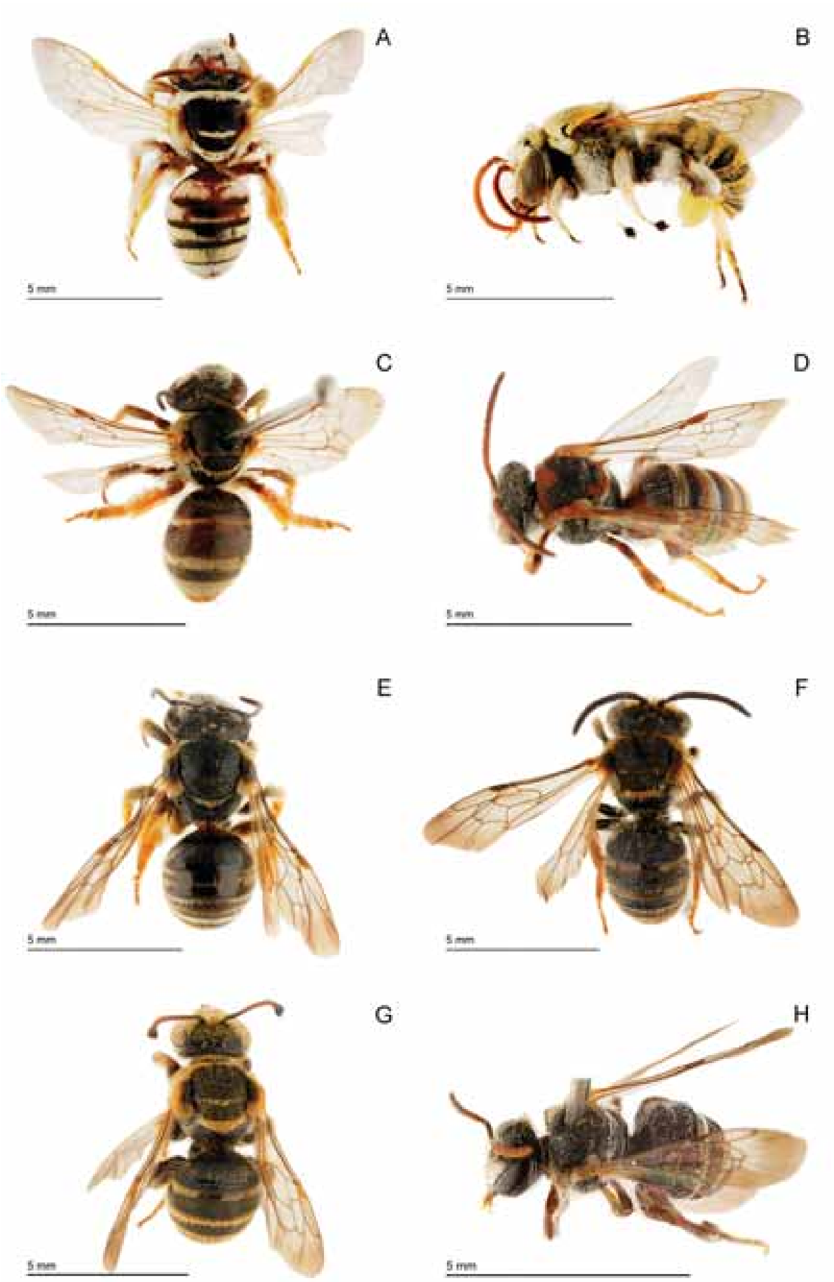


Fig. 15. Nomiinae with enlarged tegulae. A. *Pseudapis (Pseudapis) nilotica*, female; B. *Pseudapis (Pseudapis) nilotica*, male; C. *Pseudapis (Stictonomia) aliceae*, female; D. *Pseudapis (Stictonomia) aliceae,* male; E. *Pseudapis* (*Pachynomia) amoenula*, female; F. *Pachynomia amoenula*, male; G. *Steganomus* sp., male; H. *Pseudapis (Ruginomia) rugiventris*, male.

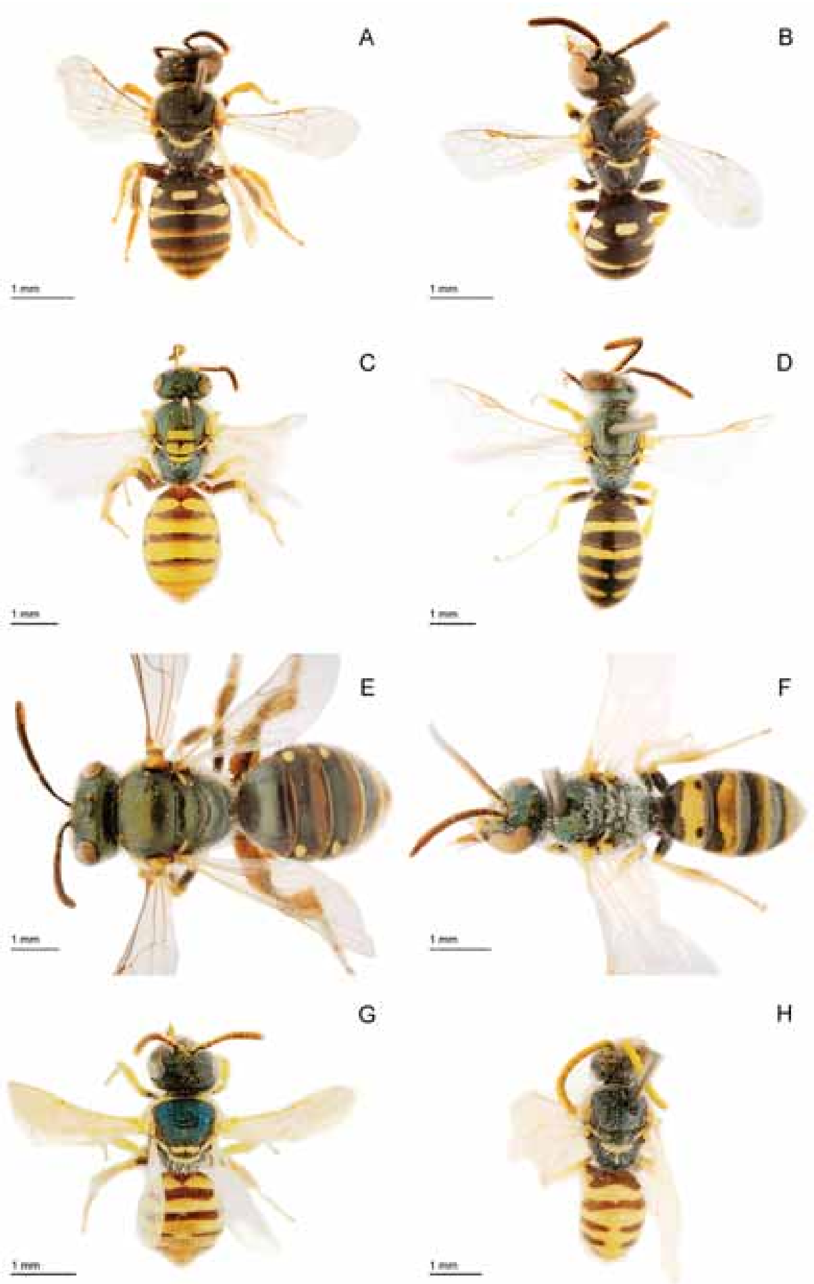


Fig.16. Nomioidinae. A, *Cellariella kalaharica*, female; B. *Cellariella kalaharica*, male; C. *Ceylalictus (Ceylalictus) muiri*, female; D. *Ceylalictus (Ceylalictus) punjabensis*, male; E. *Ceylalictus* (*Atronomioides*) *capverdensis*, female; F. *Ceylalictus* (*Meganomioides*) *karachensis*, male; G. *Nomioides maculiventris*, female; H. *Nomioides maculiventris*, male.

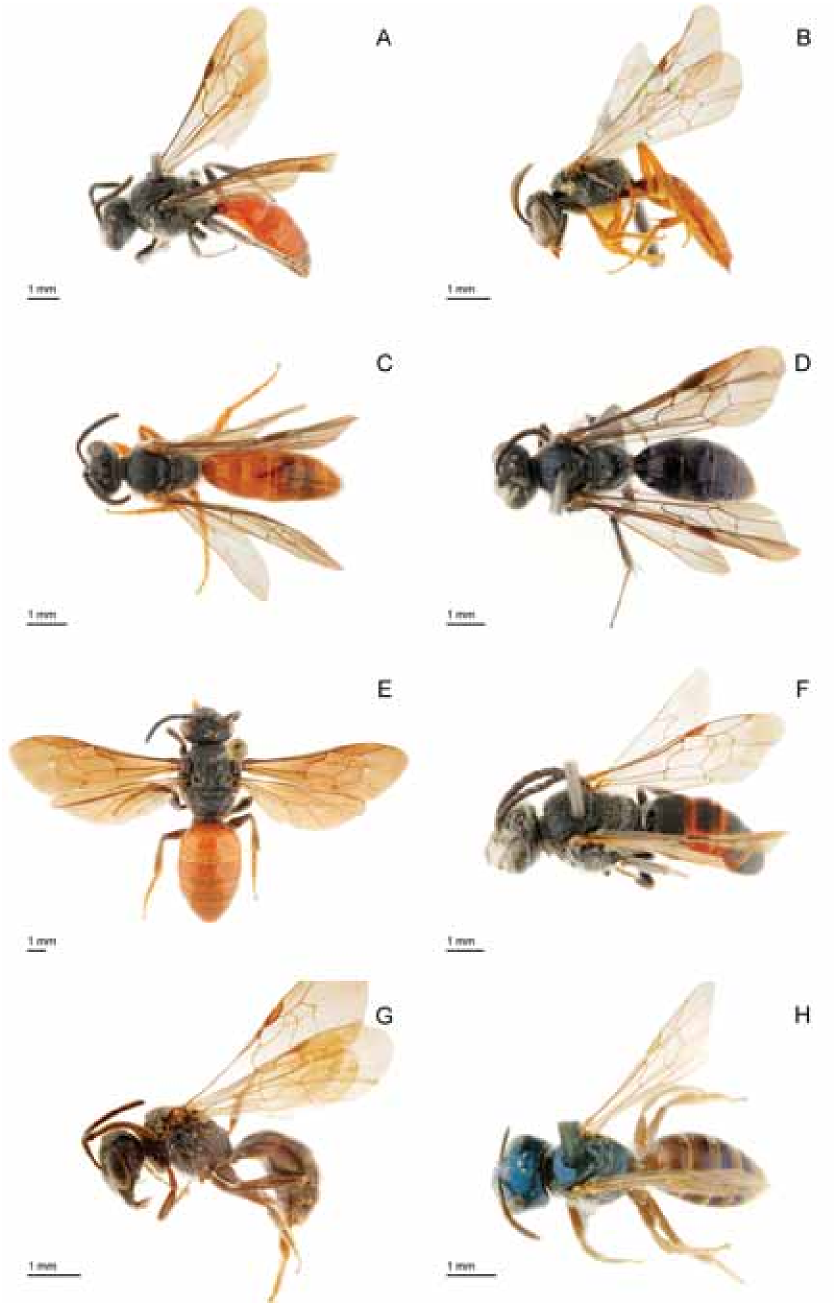


Fig. 17. Parasitic Halictinae. A. *Eupetersia (Eupetersia)* sp., male; B. *Eupetersia (Nesoeupetersia) emini*, male; C*. Eupetersia (Nesoeupetersia) emini*, female; D. *Eupetersia (Calleupetersia)* sp., female; E. *Sphecodes* sp., female; F. *Sphecodes* sp., male; *G. Lasioglossum (Paradialictus) synavei,* female; H. *Seladonia (Paraseladonia) chalybaea*, female.

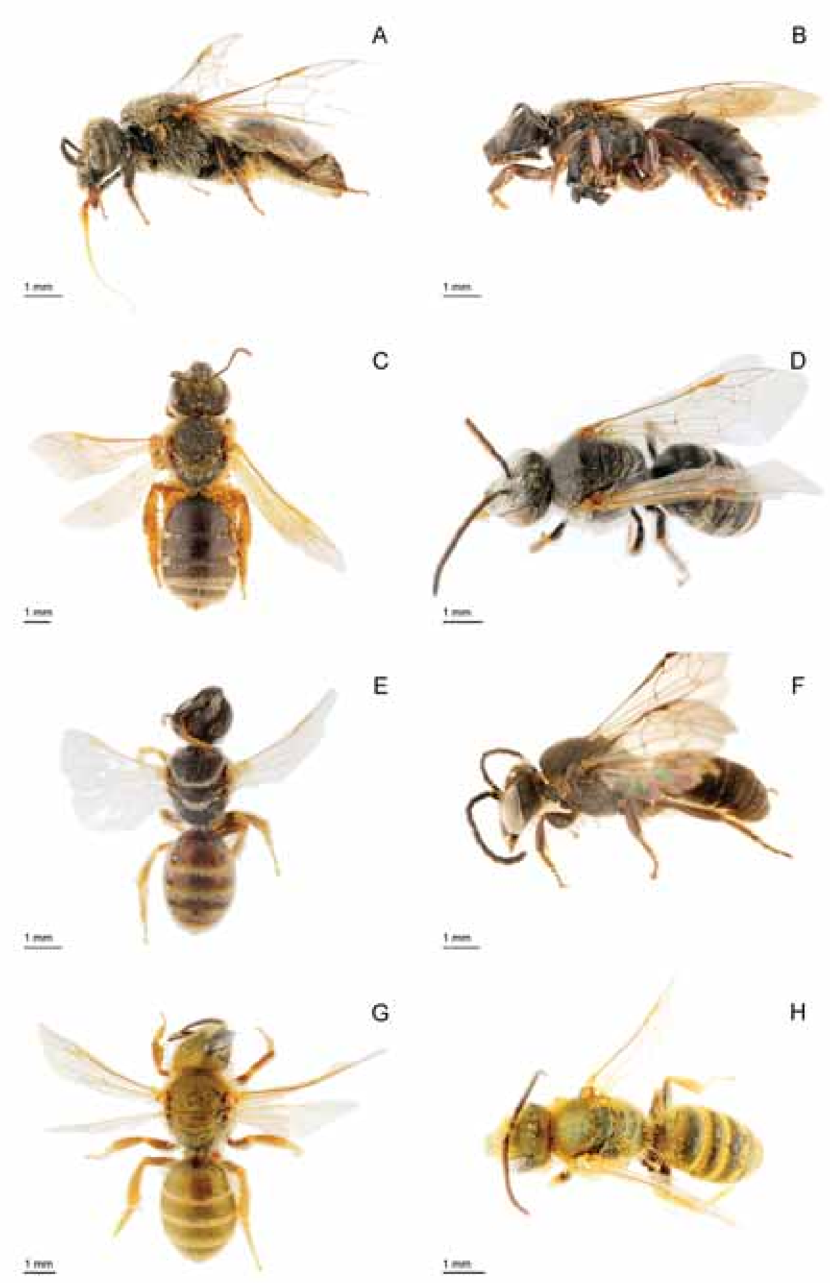


Fig. 18. A., *Lasioglossum (Ipomalictus)* sp., female; B, *Lasioglossum (Ipomalictus*) sp., male; C, *Lasioglossum (Rubrihalictus)* sp., female; D, *Lasioglossum (Rubrihalictus)* sp., male; E, *Lasioglossum (Ctenonomia)* sp., female; F, *Lasioglossum (Ctenonomia)* sp., male; G, *Seladonia jucunda*, female; H, *Seladonia jucunda*, male.

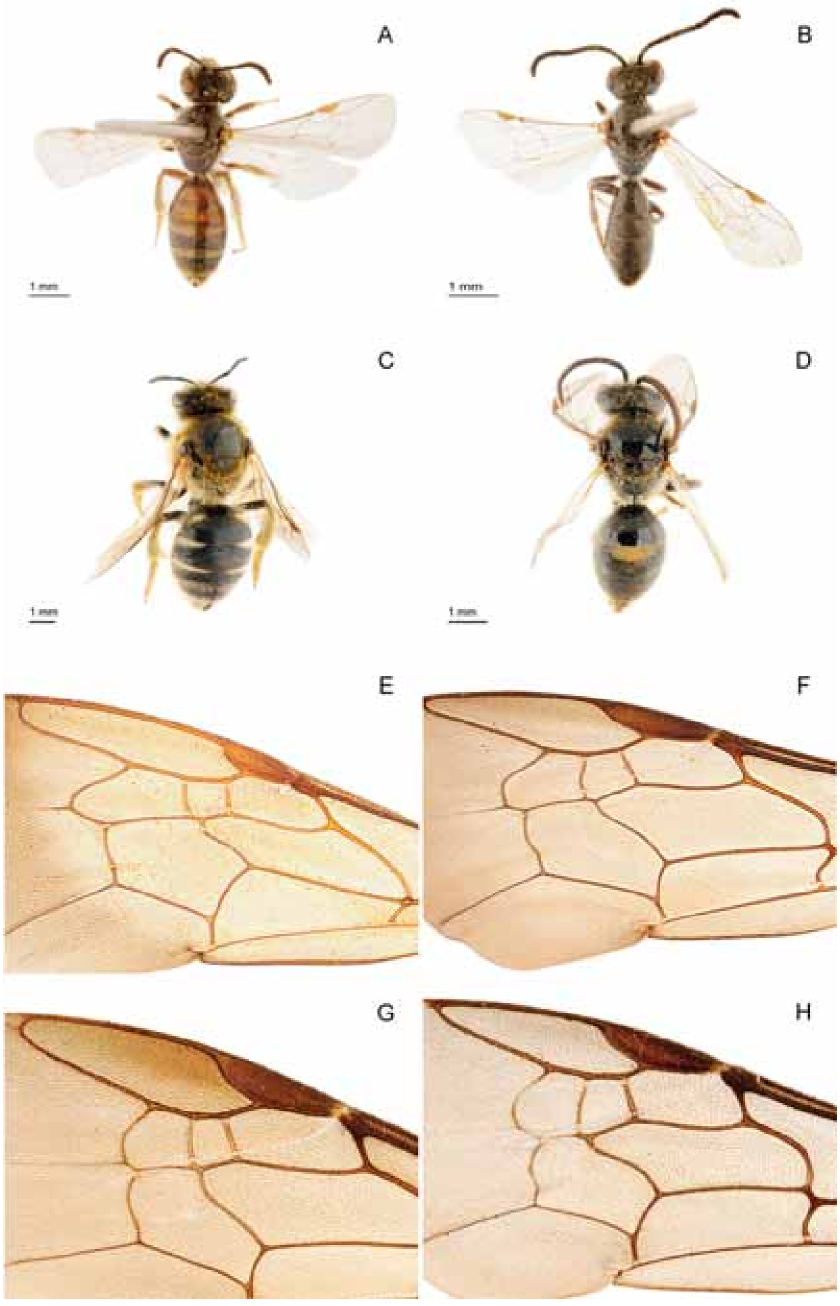


Fig. 19. A, *Lasioglossum (Afrodialictus)*, female; B. *Lasioglossum (Afrodialictus*), male; C. *Lasioglossum (Sellalictus) deceptum*, female; D. *Lasioglossum (Sellalictus)* sp., male; E. forewing of Nomiinae; F. forewing of *Patellapis (Zonalictus)* sp.; G. forewing of *Lasioglossum (Ipomalictus)* sp.; H, forewing of *Lasioglossum (Sellalictus*) sp.

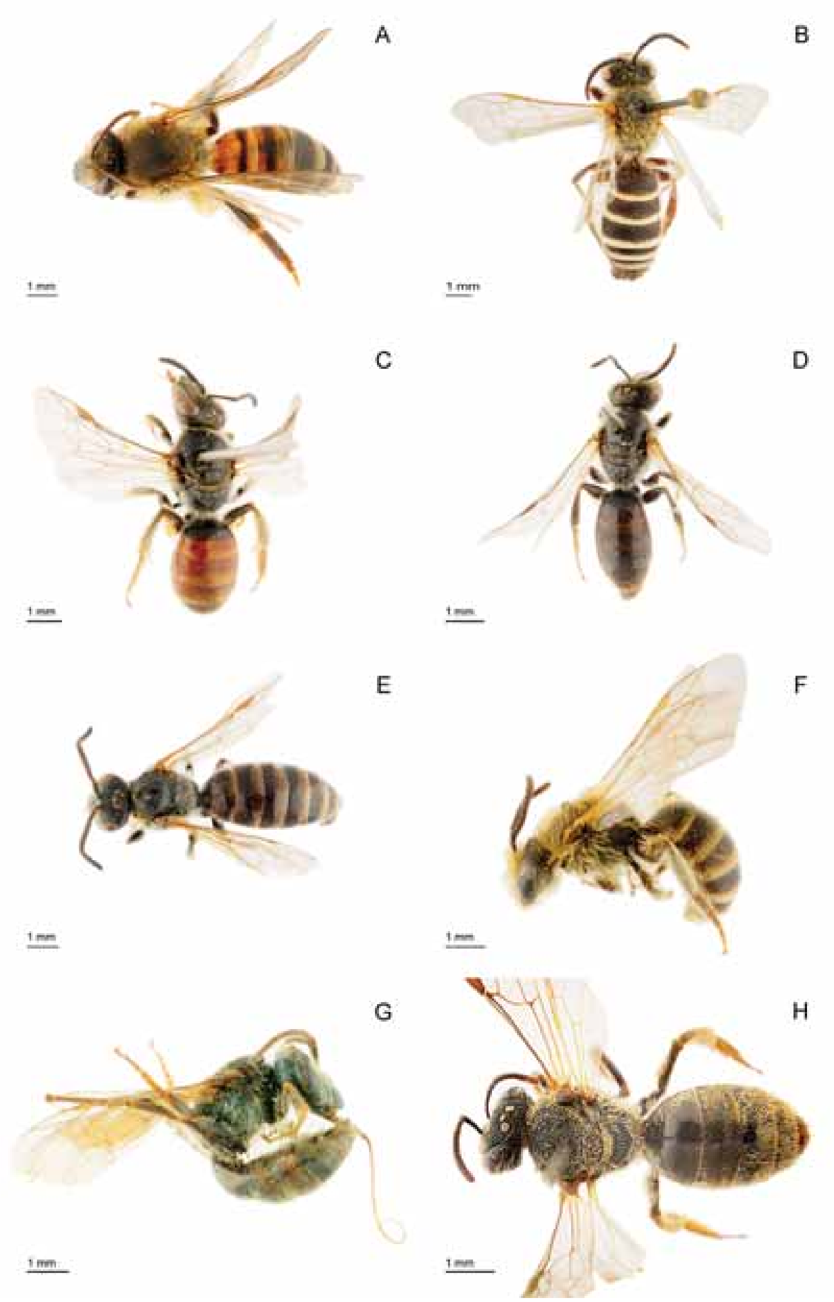


Fig. 20. A. *Patellapis (Zonalictus) kabetense*, female; B. *Patellapis (Zonalictus) albofasciata*, male; C. *Patellapis (Chaetalictus)* sp., female; D. *Patellapis (Chaetalictus)* sp., male; E. *Patellapis (Patellapis)* sp., male; F. *Patellapis (Lomatalictus)* sp., male; G. *Glossodialictus wittei*, male; H. *Patellapis (Dictyohalictus) plicatus*, female.

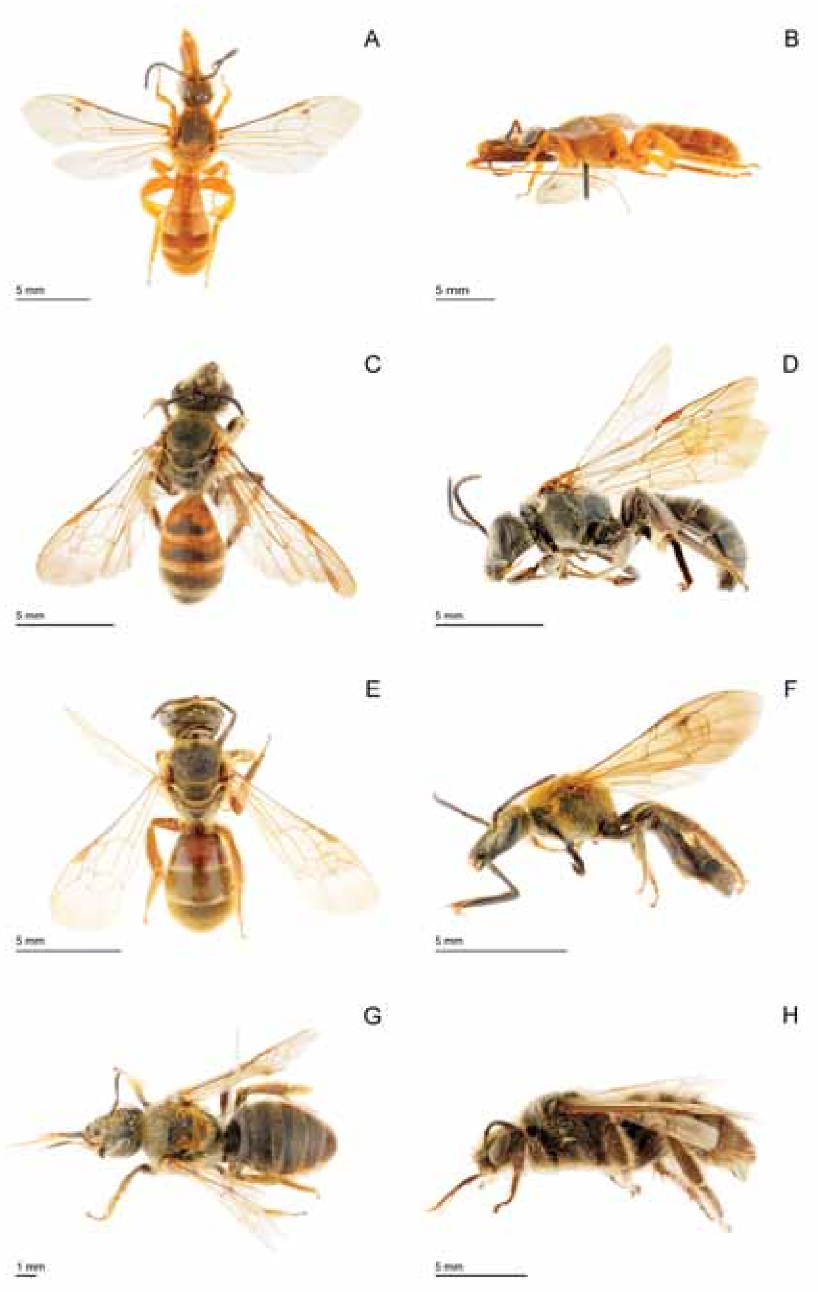


Fig. 21. A, *Thrinchostoma (Diagonozus) lettowvorbecki*, male; B. idem, lateral view; C. *Thrinchostoma (Eothrincostoma) torridum*, female; D. *Thrinchostoma (Eothrincostoma) torridum*, male; E. *Thrinchostoma (Thrinchostoma)* sp., female; F. *Thrinchostoma (Thrinchostoma) emini*, male; G. *Systropha* sp., female; H. *Systropha* sp., male.

8.4. Family Melittidae

The Melittidae are short-tongued bees with one subantennal suture, a pointed glossa and a straight basal vein in the forewing. Unlike all the other short-tongued bees they do not have one, clearly visible, unique feature. There are 10 genera, eight of which are endemic (*Capicola, Haplomelitta*, *Samba, Ceratomonia, Meganomia, Pseudophilanthus, Uromonia, Melitta*, *Rediviva, Redivivoides*) and these all have limited distributions. *Melitta* is the only genus that occurs outside the Region, through much of the Old World. In the Afrotropical Region it is confined to southern and East Africa. They are pollen collecting bees and probably all nest in the ground. The Melittidae are basal, and polyphyletic, in a cladogram on bee phylogeny (Danforth *et al*., 2006), suggesting all bees evolved from a melittid-like ancestor.

Key to the Melittidae

1. Two submarginal cells **2**
1'. Three submarginal cells **5**

2. Vertex convex, laterally above eyes . . . . ***Capicola***
2'. Vertex about straight, weakly concave to weakly convex, laterally about level with upper eye edges **3**

3. Male clypeus yellow; female metasomal venter with fasciae of long, white, erect vestiture . . . . ***Afrodasypoda***
3'. Male clypeus black; female metasomal venter without distinct fasciae . .**4**

4. Female with one hind tibial spur; male hind basitarsus with hairy patch basally on outer surface . . . .***Samba***
4'. Female with two hind tibial spurs; male hind basitarsus without hairy patch . . . .***Haplomelitta***

5. Integument mostly black, metasomal sometimes reddish **6**
5'. Integument with extensive yellow maculation **8**

6. Propodeal triangle dull . . . . ***Melitta***
6'. Propodeal triangle shiny **7**

7. Scopa with densely plumose understory; male S7 deeply bifid or with two long, slender processes, lateral lobes naked . . . . ***Rediviva***
7'. Scopa unmodified; male S7 weakly emarginate, lateral lobes with long, erect hairs . . . . ***Redivivoides***

8. Aerolium absent . . . . ***Meganomia***
8'. Aerolium present **9**

9. Ocelli distinctly in front of vertex, separated by two or more ocelli diameters . . . . ***Pseudophilanthus***
9'. Ocelli about an ocellus diameter from vertex **10**

10. Glossa at least half as long as prementum; sterna 4-5 without stridulating areas; male flagellum not expanded apically . . . .***Uromonia***

10’. Glossa less than one-third as long as prementum; sublateral stridulating areas on sterna 4-5, but hidden under preceeding tergum; male flagellum expanded apically . . . .***Ceratomonia***

8.4.1. Subfamily Dasypodainae

These are small, mostly black bees with two submarginal cells; the first cell is shorter than the second. Three tribes occur in the Afrotropical Region; they are the Dasypodaini, Promelittini and the Sambini.

8.4.1.1. Tribe Dasypodaini

Genus *Capicola* Friese (Fig. 22A-B)

In the Dasypodaini the summit of the vertex is raised above the eyes and distinctly convex.

Capicola is closely related to the Northern Hemisphere *Hesperapis.* Michener (2007) treats *Capicola* as a subgenus of *Hesperapis*, but Michez et al (2007) considered it to be a distinct genus and the latter classification is followed here.

Key to the subgenera of *Capicola*

1. Outer surface of hind tibia with only slender pubescent scopal hairs; male S7 disc distinctly narrowed medially with densely hirsute, lateral lobes . . . .***Capicola (Capicola)***

1’. Outer surface of hind tibia with short, thick, blunt setae between pubescent scopal hairs; male sternum 7 disc slightly narrowed medially, without lateral lobes . . . .***Capicola (Capicoloides)***

Subgenus *Capicola (Capicola)* Friese

Capicola s. str. occurs in the xeric areas of southern Africa. There are 11 described species.

Subgenus *Capicola (Capicoloides)* Michener

Capicola (Capicoloides) is known from two species that occur in the arid areas of Namibia and South Africa.

8.4.1.2. Tribe Promelittini

Genus *Afrodasypoda* Engel (Fig. 22C)

This genus is monotypic with the only species *Afrodasypoda plumipes* (Friese) being endemic to western South Africa.

8.4.1.3. Tribe Sambini

Sambini has two Afrotropical genera. However, current research will probably result in their synonymy, making *Hapolomelitta* a junior synonym of *Samba*.

Genus *Haplomelitta* Cockerell (Fig. 22D-E)

There are five southern African, subgenera; namely *Atrosamba, Haplomelitta, Haplosamba, Metasamba* and *Prosamba*. Each subgenus has one described species, although all but *Haplomelitta* and *Haplosamba* have an undescribed species.

Key to the subgenera of *Haplomelitta*

1. Tergal hair bands well developed; female clypeus with small medio-longitudinal ridge; male hind leg with tibia swollen, basitarsus with pre-apical inner tooth . . . .***Haplomelitta* (*Metasamba*)**

1'. Without tergal hair bands; female clypeus flat; male hind leg neither swollen nor with pre-apical tooth on basitarsus **2**

2. Female mandible tridentate; male T1 red and propodeal triangle weakly differentiated, smooth basally . . . . ***Haplomelitta* (*Haplosamba*)**

2'. Female mandible bidentate; male T1 black or red, if red then propodeal triangle strongly differentiated, rugose basally **3**

3. Propodeal triangle distinctly differentiated between anterior and posterior areas; male hind basitarsus inflated . . . . . . ***Haplomelitta* (*Haplomelitta*)**

3'. Propodeal triangle weakly differentiated; male hind basitarsus narrower than tibia **4**

4. Second submarginal cell about as long as first . . . .***Haplomelitta* (*Atrosamba*)**

4'. Second submarginal cell distinctly shorter than first . . . . ***Haplomelitta* (*Prosamba*)**

Subgenus *Haplomelitta* (*Atrosamba*) Michener

This subgenus has one South African species, although an undescribed species possibly also occurs in Namibia.

Subgenus *Haplomelitta* (*Haplomelitta*) Cockerell

Haplomelitta is monotypic and endemic to South Africa.

Subgenus *Haplomelitta* (*Haplosamba*) Michener

Haplosamba is monotypic and endemic to South Africa.

Subgenus *Haplomelitta* (*Metasamba*) Michener

This subgenus has one described species. It occurs in Namibia and the region of South Africa that is adjacent to the Namibian border.

Subgenus *Haplomelitta* (*Prosamba*) Michener

Samba (*Prosamba*) occurs in South Africa and is known from one described species.

Genus *Samba* Friese (Fig. 22F)

Samba s. str. has one described species, and one undescribed species is known. They both occur only in East Africa.

8.4.2. Subfamily Meganomiinae

The Meganominae have extensive yellow markings and three submarginal cells in the forewing. It is endemic to the Afrotropical Region (it occurs in Africa and Yemen). There are four genera: *Ceratomomia*, *Meganomia, Pseudophilanthus* and *Uromonia.*

Genus *Ceratomonia* Michener (Fig. 23A-B)

Ceratomonia has an arolium, the lateral ocelli are close to the posterior edge of the vertex and the male antenna is expended apically. The female has an ill defined basitibial plate. It is Namibian and monotypic.

Genus *Meganomia* Cockerell (Fig. 23C-D)

In *Meganomia* the arolium is absent, the lateral ocelli are not particularly close to the vertex and the male antennae are flattened distally. There are four Africa species (occurring from Kenya to northern South Africa and Namibia), and one from Yemen.

Genus *Pseudophilanthus* Alfken (Fig. 23E)

Subgenus *Pseudophilanthus* (*Pseudophilanthus*) Alfken

Only the nominative subgenus occurs in Africa, namely East Africa. The other is Madagascan, namely *Pseudophilanthus* (*Dicromonia*)*. Pseudophilanthus* s. str. has an aerolium, the lateral ocelli are separated from the posterior edge of the vertex by more than an ocellar diameter and the male antenna is not modified.

Genus *Uromonia* Michener (Fig. 23F)

Subgenus *Uromonia* (*Uromonia*) Michener

Only the nominative subgenus occurs in Africa. It has one species that was described from Kenya and later caught in Mali (Pauly et al. 2001). The other subgenus is Madagascan, namely *Uromonia* (*Nesomonia*), and monotypic. *Uromonia* has an arolium, the ocelli are close to the posterior edge of the vertex and the male antenna is not modified. The female has an ill defined basitibial plate.

8.4.3. Subfamily Melittinae

The *Melittinae* have three submarginal cells in the forewing and are mostly black or black and brownish. There are four genera, three of which occur in the Afrotropical Region, namely *Melitta, Rediviva* and *Redivivoides*.

Genus *Melitta* Kirby

Subgenus *Melitta* (*Melitta*) Kirby (Fig. 24A-B)

Only *Melitta* s. str. occurs in sub-Saharan Africa. The propodeal triangle is dull and well developed, and the second submarginal cell of the forewing is usually wider than long, or as wide as long. There are eight African species, six occur in southern Africa and two in East Africa.

Genus *Rediviva* Friese (Fig. 24C-D)

In *Rediviva* the propodeal triangle is shiny and small, the second submarginal cell of the forewing is usually longer than wide and the scopa has dense plumose hairs under long simple bristles (unique). It is endemic to southern Africa and the females collect oil from flowers. There are 24 species in this genus

Genus *Redivivoides* Michener (Fig. 24E-F)

Redivivoides resembles *Rediviva*, except for the structure of the scopa, in the female, and the genitalia, in the male. It has one described species that is endemic to South Africa, although others await description.

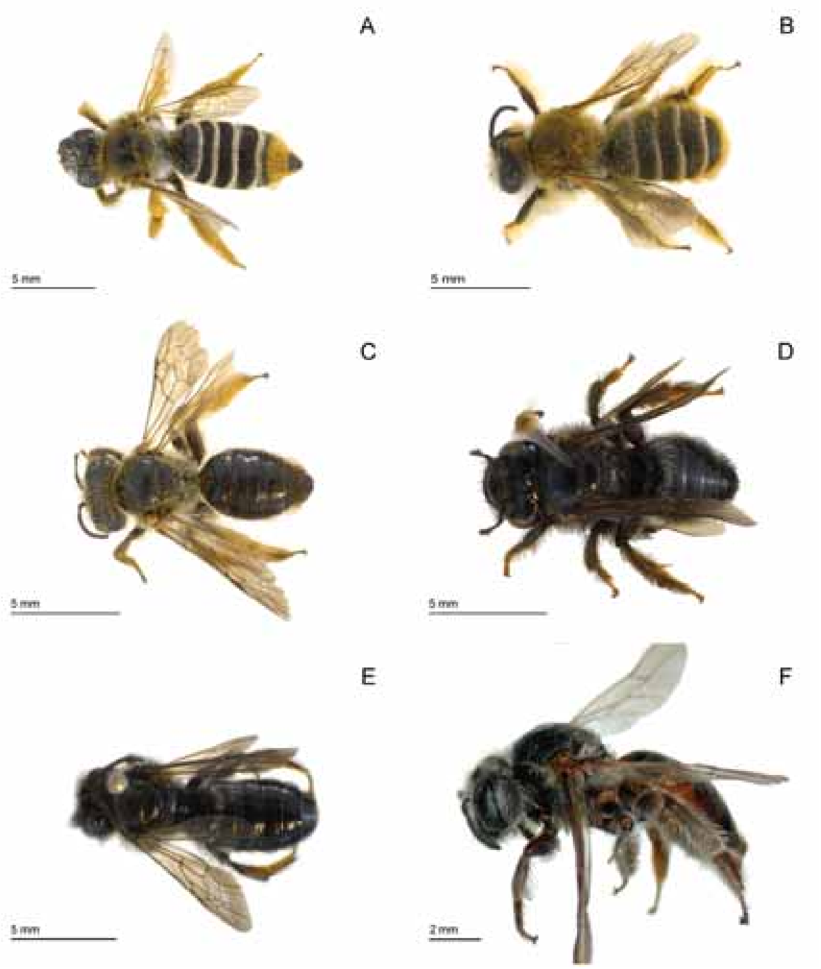


Fig. 22. A-B. *Capicola danforthi* Eardley: A. Female; B. Male; C. *Afrodasypoda plumipes* (Friese), female; D-E. *Haplomelitta atra* Michener: D. Female; E. Male; F. *Samba calcarata* Friese, female.

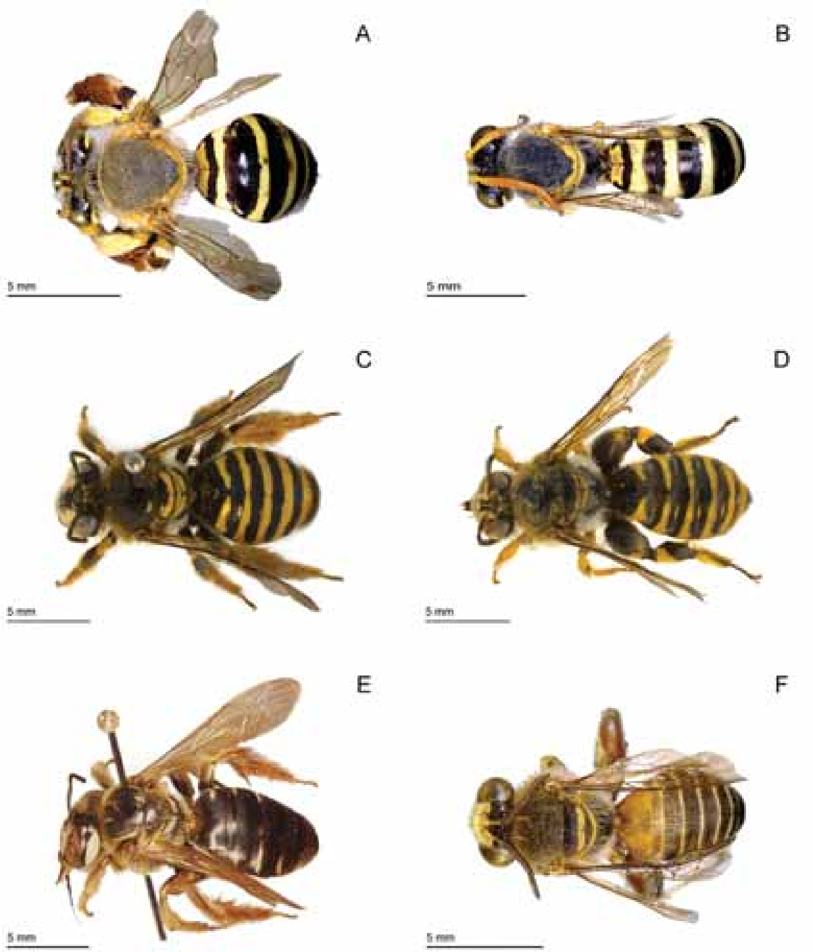


Fig. 23. A-B. *Ceratomonia rozenorum* Michener. A. Female; B. Male; C-D. *Meganomia binghami* (Cockerell); C. Female; D. Male; E. *Pseudophilanthus tsavoensis* (Strand, 1920), Female; F. *Uromonia stagei* Michener, male.

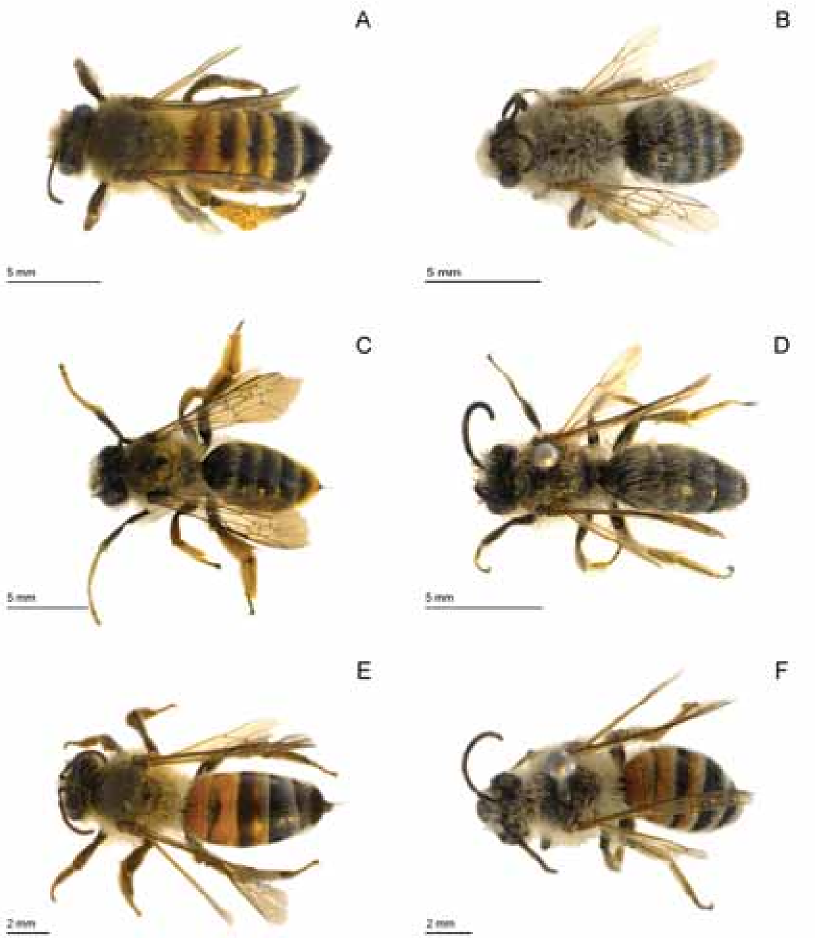


Fig. 24. A-B. *Melitta arrogans* (Smith): A. Female; B. Male; C-D. *Rediviva macgregori* Whitehead & Steiner: C. Female; D. Male. E-F. *Redivivoides simulans* Michener; E. Female; F. Male.

8.5. Family Megachilidae

The Megachilidae are long-tongued bees in which the non-parasitic species have the scopa under the metasoma. The male tergum 7 is often not visible from above. They are commonly called the leaf-cutter bees; but in reality the family comprises almost every type of nest building behaviour: leaf-cutters, daubers, carpenters, carders and soil nesters. The genera of the Osmiini and Anthidiini are notoriously difficult to separate. Especially the males are problematic and not all specimens can be assigned to a genus using this simplified key. Thus, Michener (2007) should be consulted for additional information.

Key to the Megachilidae

1. Three submarginal cells . . . . ***Fidelia***
1'. Two submarginal cells **2**

2. Pygidial plate present . . . . ***Lithurgus***
2'. Pygidial plate absent **3**

3. Metanotum with median spine . . . . ***Aglaoapis***
3'. Metanotum without median spine **4**

4. Pterostigma over twice as long as broad **5**
4'. Pterostigma less than twice as long as broad (Anthidiini) (females only) Note: identification of male Anthidiini is very difficult and, thus, they are omitted here. Consult Michener (2007) for further information **28**

5. Arolium absent at least on hind leg (Megachilini) **6**
5'. Arolium present on all legs (Osmiini) **7**

6. Metasoma rounded distally, often toothed in males but always curled under . . . .***Megachile***
6'. Metasoma pointed distally, bifurcate in males, not curled under . . . .***Coelioxys***

7. Males, 13 antennal segments **8**
7'. Females, 12 antennal segments **17**

8. Tergum 7 weakly sclerotized and invisibile, hidden by tergum 6 . . . . . .**9**
8'. Tergum 7 strongly sclerotized and visible **11**

9. Scutellum with transverse apical carina . . . .***Noteriades***
9'. Scutellum without carina **10**

10. Metanotum well below level of most of scutellum . . . .***Wainia***
10'. Metanotum medially about on same level as most of scutellum . . . .***Heriades***

11. T6 with transverse preapical carina **12**
11'. T6 without transverse preapical carina **13**

12. Preapical carina of tergum 6 smooth . . . . ***Othinosmia***
12'. Preapical carina of tergum 6 crenulate or spined . . . . ***Stenoheriades***

13. Tergum 7 about quadrate, sometimes with apical processes, and placed in a large emargination in tergum 6 . . . . **14**
13'. Tergum 7 not quadrate and not placed in emargination in tergum 6 . . .**15**

14. S3 with median apical spike . . . .***Pseudoheriades***
14'. S3 without median apical spike . . . . ***Afroheriades***

15. Scutum elongate, at least as long as width of intertegular distance . . . .***Ochreriades***
15'. Scutum not elongate, shorter than width of intertegular distance **16**

16. Tergum 7 broad and truncate, bulging dorsally . . . .***Haetosmia***
16'. Tergum 7 different, if broad and truncate then not bulging dorsally . . . .***Hoplitis***

17. Ridge on posterolateral corner of scutellum with marginal ridge not carinate, its lateral surface with long, dense pubescence . . . . ***Afroheriades***
17'. Ridge of posterolateral corner of scutellum strongly carinate, its lateral surface naked **18**

18. Scutum elongate, at least as long as width of intertegular distance . . . .***Ochreriades***
18'. Scutum not elongate, shorter than width of intertegular distance **19**

19. Mesopleuron elongate, ventrally about as long as scutum **20**
19'. Mesopleuron not elongate, ventrally much shorter than scutum **23**

20. Clypeus with strong longitudinal carina . . . .***Noteriades***
20'. Clypeus without strong longitudinal carina **21**

21. Hypostomal area with fringe of long curled hair laterally . . . .***Pseudoheriades***
21'. Hypostomal area without fringe **22**

22. Mouthparts long, in repose, exceeding proboscial fossa . . . . ***Stenoheriades***
22'. Mouthparts short, in repose, hardly exceeding proboscial fossa . . . .***Heriades***

23. Labrum with tuft of erect hair . . . . ***Othinosmia* (part)**
23'. Labrum without tuft of erect hair or with marginal fringe **24**

24. Axilla angulate . . . . ***Othinosmia* (part)**
24'. Axilla rounded **25**

25. Labrum with fringe of hairs **26**
25'. Labrum without fringe **27**

26. Posterior lateral angle of scutum either right-angular or acutely angled . . . .***Wainia* (part)**
26'. Posterior lateral angle of scutum obtusely angled . . . . ***Hoplitis***

27. Tergum 6 with preapical carina . . . . ***Haetosmia***
27'. Tergum 6 without preapical carina . . . .***Wainia* (part)**

28. Female mandible with 5-18 teeth separated by acute notches **29**
28'. Female mandible with 3-4 teeth, if 5-10 teeth then teeth separated by rounded notches **36**

29. Tergum 5 with posterior margin depressed and more finely punctate than rest of tergum **30**
29'. Tergum 5 with posterior margin not depressed, or if depressed then punctures same as rest of tergum **31**

30. Posterior margin of tergum 6 denticulate . . . .***Afranthidium*** **(part)**
30'. Posterior margin of tergum 6 not denticulate . . . . ***Anthidium***

31. Vein 1m-cu joins first submarginal cell . . . .***Serapista***
31'. Vein 1m-cu joins second submarginal cell **32**

32. Basal part of propodeum hairless and black . . . . ***Anthidioma***
32'. Basal part of propodeum hairy, usually with yellow maculation **33**

33. Preoccipital ridge and omaulus lamellate . . . .***Pachyanthidium*** **(part)**
33'. Preoccipital ridge and omaulus rounded or mostly carinate **34**

34. Subantennal suture distinctly arcurate outwards . . . . .***Pseudoanthidium***
34'. Subantennal suture straight or slightly arcurate **35**

35. Female mandible with 13-14 teeth . . . . ***Gnathanthidium***
35'. Female mandible with 8 teeth or fewer . . . . ***Afranthidium*** **(part)**

36. Basal vein of forewing curved; female hind leg with scopa-like hairs . . . . ***Aspidosmia***
36'. Basal vein of forewing about straight; female hind leg with short hairs **37**

37. Omaular lamella continued over venter of thorax and separated from middle coxa by less than width of middle trochanter **38**
37'. Omaulus not lamellate, or if lamellate then distance of lamella to middle coxa at least as wide as width of middle trochanter **39**

38. Preoccipital ridge dorsally rounded or with low carina . . . . ***Anthidiellum*** **(part)**
38'. Preoccipital ridge behind vertex lamellate . . . . . . ***Pachyanthidium*** **(part)**

39. Axilla pointed posteriorly, scopa present . . . .***Icteranthidium***
39'. Axilla not pointed posteriorly, or if pointed than scopa absent **40**

40. Face with three longitudinal ridges . . . .***Euaspis***
40'. Face with only one or without longitudinal ridges **41**

41. Vein cu-a of hind wing usually half as long as second absissa of M+Cu . . . . ***Trachusa***
41'. Vein cu-a of hind wing less than half as long as second absissa of M+Cu **42**

42. Arolium absent (parasitic) . . . . ***Larinostelis***
42'. Arolium present **43**

43. Scopa absent (parasitic) **44**

43’. Scopa present **46**

44. Tegula of normal size . . . .***Stelis***
44’. Tegula enlarged **45**

45. Body black, without yellow markings . . . .***Afrostelis***
45’. Body with yellow markings (endemic to Sokotra) . . . .***Xenostelis***

46. Juxtantennal carina present, sometimes weakly developed . . . .***Eoanthidium***
46’. Juxtantennal carina absent **47**

47. Scutoscutellar suture usually open and shiny, medially divided into two parts; if closed subantennal suture strongly arcurate outward . . . . ***Anthidiellum*** **(part)**
47’. Scutoscutellar suture usually closed, if open and shiny then not divided **48**

48. Body length 8.5 mm or less, metasoma with continuous yellow bands . . . . ***Cyphanthidium***
48’. Body length usually greater than 8.5 mm, or if less then metasoma without yellow or with broken yellow bands . . . .***Plesianthidium***

8.5.1. Subfamily Fideliinae

8.5.1.1. Tribe Fideliini

Genus *Fidelia* Friese (Fig. 25A-B)

The Fideliinae is unique in the Megachilidae in that it has three submarginal cells in the forewing. Females have the scopa under the metasoma. Males have large projections on the seventh metasomal tergum. It comprises one genus, *Fidelia*, which is endemic to Africa. One species, however, occurs in the Palaearctic Region of Africa. They are all pollen collecting bees.

Key to the subgenera of *Fidelia*

1. Mandible bidentate, teeth acutely pointed . . . . ***Fidelia*** **(*Fideliopsis*)**
1’. Mandible, broadly bilobate, with large apical tooth and small subapical tooth or simple **2**

2. Marginal cells not extending beyond apex of third submarginal cell . . . . ***Fidelia*** **(*Fidelia*)**
2’ Marginal cells extending beyond apex of third submarginal cell **3**

3. Marginal cells about as long as combined length of second and third submarginal cells . . . . ***Fidelia*** **(*Fideliana*)**
3’ Marginal cells longer than combined length of second and third submarginal cells . . . .***Fidelia*** **(*Parafidelia*)**

Subgenus *Fidelia* (*Fidelia*) Friese

This subgenus occurs in South Africa and Namibia.

Subgenus *Fidelia* (*Fideliana*) Michener

Fidelia (*Fideliana*) occurs in southern Africa and Morocco.

Subgenus *Fidelia* (*Fideliopsis*) Engel

This subgenus is recorded from South Africa and Namibia, and there exists an unpublished record from South-West Angola.

Subgenus *Fidelia* (*Parafidelia*) Brauns

This subgenus occurs in South Africa, Namibia and Botswana.

8.5.2. Subfamily Megachilinae

The Megachilinae comprises five tribes: Lithurgini, Osmiini, Anthidiini, Dioxyini and Megachilini, and they all occur in the Afrotropical Region. They all have two submarginal cells in the forewing, and the female pollen collectors have the scopa on the metasomal sterna. Males and cleptoparasitic species are more difficult to identify.

8.5.2.1. Tribe Lithurgini

Genus *Lithurgus* Berthold (Fig. 25C-D)

Subgenus *Lithurgus* (*Lithurgus*) Berthold

This tribe comprises the stone bees, so names because of their flat appearance. They are pollen collecting bees that build nests in dead wood. The Lithurgini have a pygidial plate, which is unique among the Megachilinae. There is one Afrotropical genus, *Lithurgus*, which has two subgenera of which only one occurs in Africa.

8.5.2.2. Tribe Osmiini

The Osmiini have arolia on all legs, which separates them from Anthidiini and most *Megachile*; *Megachile (Heriadopsis*) has arolia on the fore and middle legs. However, they are mostly small bees with white crossbands on the metasomal dorsum and the scopa under the metasoma, in females, or the metasoma curled under posteriorly, in males. They are difficult to identify to genus, except *Hoplitis*, which is comparatively large. This tribe comprises ten genera: *Afroheriades, Haetosmia*, *Heriades, Hoplitis, Noteriades, Ochreriades, Othinosmia, Pseudoheriades, Stenoheriades* and *Wainia.* They burrow in the ground, make aerial nests out of mud or resin and nests in hollow sticks. The genera and subgenera are often difficult to separate and Michener (2007) should be consulted for additional information.

Genus *Afroheriades* Peters (Fig. 26A-B)

This genus of minute to small bees is endemic to South Africa. They are pollen collecting bees.

Genus *Haetosmia* Popov (Fig. 26C-D)

This genus of pollen collecting bees is known from Kenya but is widespread from Central Asia through Saharan Africa to the Canary Islands. It most likely also occurs in North-East Africa.

Genus *Heriades* Spinola (Fig. 26E-F)

With at least 97 species, *Heriades* is by far the biggest osmiine genus in Africa. They are pollen collecting bees.

Key to the subgenera of *Heriades*

Males

1. Sternum 1 produced apically, with brush of fine hair under distal margin **2**
1'. Sternum 1 neither produced apically, nor with brush of fine hair **5**

2. Mandible with two teeth . . . .***Heriades* (*Michenerella*)**
2'. Mandible with three teeth. **3**

3. Sternum 2 without distal fringe . . . .***Heriades* (*Pachyheriades*)**
3'. Sternum 2 with distinct distal fringe **4**

4. Tergum 6 with distinct, longitudinal crest abruptly terminated in a V-shaped, flattened apical area . . . . ***Heriades* (*Toxeriades*)**
4'. Tergum 6 without longitudinal crest . . . . ***Heriades* (*Tyttheriades*)**

5. With pair of juxta antennal carinae . . . .***Heriades* (*Amboheriades*)**
5'. Without juxta antennal carinae . . . .***Heriades* (*Heriades*)**

Females

1. With pair of juxta antennal carinae . . . .***Heriades* (*Amboheriades*)**
1'. Without juxta antennal carinae **2**

2. Lateral line of tergum 1 short and not reaching spiracle . . . .***Heriades* (*Heriades*)**
2'. Lateral line of tergum 1 longer, reaching spiracle **3**

3. Fore tibia with patch of felt-like hair on inner surface . . . . ***Heriades* (*Michenerella*) (part)**
3'. Fore tibia without patch of felt-like hair on inner surface **4**

4. Basal zone of propodeum about horizontal, with distinct carina posteriorly **5**
4'. Basal zone of propodeum sloping, without or with only weakly developed carina posteriorly **6**

5. Scutum anteriorly with transverse crest of dense, plumose hair . . . . ***Heriades* (*Michenerella*) (part)**

5’. Scutum anteriorly without transverse crest of dense, plumose hair . . . . ***Heriades* (*Pachyheriades*)**

6. Margin of clypeus excavated, base of labrum visible . . . .***Heriades* (*Toxeriades*)**

6’. Margin of clypeus about straight or denticulate, overhanging base of labrum . . . . ***Heriades* (*Tyttheriades*)**

Subgenus *Heriades* (*Amboheriades*) Griswold

This subgenus is widespread in Africa.

Subgenus *Heriades* (*Heriades*) Spinola

This subgenus is found throughout Africa and occurs in the whole of Europe, Central Asia and India.

Subgenus *Heriades* (*Michenerella*) Krombein

Heriades (Michenerella) occurs in the whole of Africa and is known from South-East Europe through to Japan and South-East Asia.

Subgenus *Heriades* (*Pachyheriades*) Griswold

This subgenus is found in tropical Africa and the subtropical eastern region of South Africa.

Subgenus *Heriades* (*Toxeriades*) Griswold

The subgenus *Heriades* (*Toxeriades*) is monotypic and the only species, *Heriades apricula* Griswold, is endemic to South Africa.

Subgenus *Heriades* (*Tyttheriades*) Griswold

Heriades (*Tyttheriades*) is endemic to southern Africa.

***Genus Hoplitis* Klug (Fig. 26G-H)**

Hoplitis seem to lack obvious diagnostic features. This is a large genus that is represented in the Afrotropical Region by two species, one in Kenya and the other along most of the eastern part of the Continent. A few Palaearctic species are recorded from Sudan, where the two regions meet. They are representatives of the subgenera *Hoplitis* (*Annosmia*) and *Hoplitis* (*Pentadentosmia*). Except for *Hoplitis* (*Bytinskia*) that appears to be cleptoparasitic, they are all pollen collecting bees.

Key to the subgenera of *Hoplitis*

1. Base of labrum obscured by closed mandibles and lower clypeus **2**

1’. Base of labrum visible between closed mandibles and lower clypeus . . **3**

2. Male tergum 7 bilobed; female tergum 1 with distinct angle separating anterior and dorsal surfaces . . . .***Hoplitis* (*Anthocopa*)**

2’. Male tergum 7 deeply trifid; female tergum 1 without distinct angle separating anterior and dorsal surfaces . . . . ***Hoplitis* (*Pentadentosmia*)**

3. Male tergum 7 shallowly emarginate; female mandible four-toothed, scopa reduced (cleptoparasite) . . . .***Hoplitis* (*Bytinskia*)**

3’. Male tergum 7 bidentate and deeply emarginate between teeth; female mandible three-toothed, scopa developed . . . .***Hoplitis* (*Annosmia*)**

Subgenus *Hoplitis* (*Annosmia*) Warncke

This subgenus is most diverse in the Mediterranean Basin and it also occurs in Sudan.

Subgenus *Hoplitis* (*Anthocopa*) Lepeletier & Serville

Hoplitis (*Anthocopa*) occurs in the southern Palaearctic and from East Africa to South Africa. The species of this subgenus are difficult to identify and there are many undescribed species.

Subgenus *Hoplitis* (*Bytinskia*) Mavromoustakis

One undescribed species is known from Kenya. Four other species occur in Turkey and Israel. The species of this subgenus seem to be cleptoparasites.

Subgenus *Hoplitis* (*Pentadentosmia*) Warncke

This subgenus is restricted to desert areas, from Saharan Africa to Central Asia and also occurs in Sudan.

Genus *Noteriades* Cockerell (Fig. 27A-B)

This genus is Old World and found throughout Africa. They are all pollen collecting bees.

Genus *Ochreriades* Mavromoustakis (Fig. 27C-D)

Ochreriades is unique in that it has pallid integumental markings and an enlarged pronotum. It has two species, one in the Palaearctic Region and the other in Namibia (*Ochreriades rozeni* Griswold). It is a pollen collecting bee.

Genus *Othinosomia* Michener (Fig. 27E-F)

The diagnostic features for this genus are a receding clypeus, exposing the base of the labrum in the female, and in the male a preapical transverse carina (not toothed) on tergum 6 and an exposed tergum 7. This genus is confined to sub-Saharan Africa, has three subgenera and 13 described species. They are pollen collecting bees.

Key to the subgenera of *Othinosomia*

1. Front tibia with apical spine long and curved posteriorly . . . .***Othinosmia* (*Othinosmia*)**

1'. Front tibia with apical spine short and straight **2**

2. Axilla acutely angulate . . . .***Othinosmia* (*Afrosmia*)**
2'. Axilla rounded . . . . ***Othinosmia* (*Megaloheriades*)**

Subgenus *Othinosomia* (*Afrosmia*) Griswold (Fig. 27A)

This subgenus has a single species, *Othinosmia stupenda* Griswold that is endemic to Kenya.

Subgenus *Othinosomia* (*Megaloheriades*) Peters

This subgenus occurs in South Africa and Namibia, and includes a number of undescribed species.

Subgenus *Othinosomia* (*Othinosmia*) Michener

Othinosmia s. str. occurs in South Africa and Namibia, and includes some undescribed species.

***Genus Pseudoheriades* Peters (Fig. 27B)**

Pseudoheriades resembles *Heriades*, differing in that the carina behind the basal zone of the propodeum does not extend laterally beyond the spiracle, and the male tergum 7 is exposed. This genus is Old World. They are pollen collecting bees.

Genus *Stenoheriades* Tkalců (Fig. 27C)

Stenoheriades resembles *Heriades*, differing in the long proboscis in the female and in the male by the combination of a preapical, transverse carina on tergum 6 (often toothed) and an exposed tergum 7. This genus occurs in Europe and Africa. They are pollen collecting bees.

Genus *Wainia* Tkalců (Fig. 27D)

Wainia resembles *Heriades*, except the male tergum 7 is completely invaginated. This small genus has three subgenera, with seven Afrotropical species and one Palaearctic species. They are pollen collecting bees.

Key to the subgenera of *Wainia*

1. All metasomal tergal with subapical cross-bands; male mandible three-toothed . . . .***Wainia* (*Wainia*)**
1'. Distal margins of T2-T4 with cross-bands; male mandible bidentate **2**

2. Omaular carina distinct . . . . ***Wainia* (*Wainiella*)**
2'. Omaular carina absent . . . .***Wainia* (*Caposmia*)**

Subgenus *Wainia* (*Caposmia*) Peters

This subgenus, in Africa, is confined to South Africa where three species occur. One species is known from Israel.

Subgenus *Wainia* (*Wainia*) Tkalců

Wainia s. str. is widespread in southern and East Africa and known through South Asia to the Philippines.

Subgenus *Wainia* (*Wainiella*) Griswold

This subgenus has two species that occur in East and South Africa.

8.5.2.3. Tribe Anthidiini

Anthidiini mostly have pallid markings on the integument and a small pterostigma, which is less than twice as long as wide. These are the carder bees. They mostly use plant fibre in nest construction and mostly collect pollen; some species, however, are parasitic. The genera and subgenera, especially males, are often difficult to separate and Michener (2007) should be consulted for additional information.

Genus *Afranthidium* Michener (Fig. 29A-B)

Afranthidium has five or more mandibular teeth, no arolia and the male tergum 5 has the distal margin depressed and more finely punctate than the remainder of the tergum. In spite of its name, *Afranthidium* occurs in both the Afrotropical and Palaearctic regions. It is a large genus of pollen collecting bees with 11 subgenera.

Key to the subgenera of *Afranthidium*

1. Impunctate marginal zones of terga 2-5 transparent brown or cream-coloured . . . . ***Afranthidium* (*Immanthidium*)**

1’. Marginal zones of terga 2-5 either punctate or if narrowly impunctate, impunctate part dark to translucent brown **2**

2. Scutellum rounded in profile, not or little overhanging metanotum **3**

2’. Scutellum acute angled or right-angled in profile, sometimes rounded, medially often strongly overhanging metanotum **7**

3. Terga 2-5 with apical hair bands, broken medially . . . . ***Afranthidium* (*Zosteranthidium*)**

3.’ Terga 2-5 without apical hair bands **4**

4. Female hind basitarsus with apical projection over base of second tarsomere; male hind trochanter with apicoventral denticle . . . . ***Afranthidium* (*Nigranthidium*)**

4’. Female hind basitarsus with apex truncate; male hind trochanter without apicoventral denticle **5**

5. Female tergum 5 without lateral spine; male tergum 7 with two apical lobes, each lobe two to three times as broad as long . . . .***Afranthidium* (*Domanthidium*)**

5’. Female tergum 5 with lateral spine; male tergum 7 with three apical lobes or, if bi-lobed, each lobe about as long as broad **6**

6. Female mesepisternum covered with bristles, apically flattened, minutely barbed, blunt or abruptly tapered; male gonostylus tapered distally and as long as or only slightly longer than distal end of gonocoxite . . . .***Afranthidium* (*Oranthidium*)**

6'. Vestiture on female mesepisternum not modified; male gonostyly expanded apically, about twice as long as gonocoxite . . . . ***Afranthidium* (*Afranthidium*)**

7. Female tergum 6 with preapical denticulate ridge, male unknown . . . .***Afranthidium* (*Xenanthidium*)**

7'. Female tergum 6 without preapical denticulate ridge **8**

8. Male tergum 6 preapical ridge usually denticulate, female tibiae not tuberculate on outer surface, coarsely punctate . . . .***Afranthidium* (*Capanthidium*)**

8'. Male tergum 6 without preapical denticulate ridge, female tibiae strongly tuberculate on outer surface **9**

9. Preoccipital carina present . . . .***Afranthidium* (*Mesanthidiellum*)**

9'. Preoccipital carina absent . . . .***Afranthidium* (*Branthidium*)**

Subgenus *Afranthidium* (*Afranthidium*) Michener

Afranthidium s. str.is endemic to South Africa and Namibia.

Subgenus *Afranthidium* (*Branthidium*) Pasteels

This subgenus occurs through much of the Afrotropical Region south of the equator.

Subgenus *Afranthidium* (*Capanthidium*) Pasteels

In the Afrotropical Region the subgenus *Capanthidium* is only known from the south-western region of southern Africa. However, it has a disjunct distribution and also occurs in a Morocco and Spain, which is a similar pattern to *Fidelia*.

Subgenus *Afranthidium* (*Domanthidium*) Pasteels

This subgenus is monotypic and the only species *Afranthidium abdominale* Friese occurs throughout South Africa.

Subgenus *Afranthidium* (*Immanthidium*) Pasteels

Afranthidium (*Immanthidium*) is widespread in East and southern Africa, but uncommon in the xeric areas of the Cape and Namibia.

Subgenus *Afranthidium* (*Mesanthidiellum*) Pasteels

This subgenus is widespread in Africa.

Subgenus *Afranthidium* (*Nigranthidium*) Pasteels

The subgenus *Afranthidium* (*Nigranthidium*) occurs in South Africa and Namibia.

Subgenus *Afranthidium* (*Oranthidium*) Pasteels

This subgenus only occurs in South Africa and Namibia.

Subgenus *Afranthidium* (*Xenanthidium*) Pasteels

This subgenus is monotypic with *Afranthidium biserratum* (Pasteels) being the only species, and it is endemic to Cameroon.

Subgenus *Afranthidium* (*Zosteranthidium*) Michener & Griswold

Afranthidium tergofasciatum (Pasteels) is its only species and it is endemic to western South Africa.

Genus *Afrostelis* Cockerell (Fig. 29B)

Afrostelis are small and black, have a large tegula and are devoid of a scopa. They are cleptoparasitic and occur throughout Africa south of the equator.

Genus *Anthidiellum* Cockerell (Fig. 29C)

In *Anthidiellum* the omaular carina is lamellate, as is the pronotal lobe and the scutellum. They have extensive yellow maculations and are pollen collecting bees. The genus has five subgenera that occur widely in the Old World, three of these occur in the Afrotropical Region.

Key to the subgenera of *Anthidiellum*

1. Terga 2-5 in females and terga 2-6 in males swollen laterally, appearing lobate from above . . . . ***Anthidiellum* (*Anthidiellum*)**

1'. Terga 2-5/6 not swollen laterally **2**

2. Preoccipital ridge absent behind vertex . . . .***Anthidiellum* (*Chloranthidiellum*)**

2'. Preoccipital ridge present behind vertex . . . .***Anthidiellum* (*Pycnanthidium*)**

Subgenus *Anthidiellum* (*Anthidiellum*) Cockerell

This subgenus is mostly Palaearctic, but also occurs in Ethiopia.

Subgenus *Anthidiellum* (*Chloranthidiellum*) Mavromoustakis

Anthidiellum flavescens (Friese) is the only species in this subgenus and it occurs in East Africa and Zimbabwe.

Subgenus *Anthidiellum* (*Pycnanthidium*) Krombein

This subgenus is widespread in the Old World.

Genus *Anthidioma* Pasteels (Fig. 29D)

Anthidioma lacks conspicuous diagnostic features; it has no maculation and no carinae or lamellae. It is a small genus of pollen collecting species; endemic to southern African, with two described species.

Genus *Anthidium* Fabricius (Fig. 30A-B)

Anthidium can be identified by a combination of characters: straight subantennal suture; female tergum 6 with an apically depressed rim, posteromedian notch and lateral tooth, on angle or on shoulder. The species in *Anthidium* are pollen collecting bees. The genus occurs through the Holarctic and is widely spread in Africa.

Key to the subgenera of *Anthidium*

1. Scutellum rounded in profile, not greatly overhanging metanotum and propodeum . . . . **Anthidium (Anthidium)**

1'. Scutellum angulate in profile, greatly overhanging metanotum and propodeum **2**

2. Pronotal lobe carinate . . . . **Anthidium (Nivanthidium)**

2'. Pronotal lobe lamellate . . . .**Anthidium (Severanthidium)**

Subgenus *Anthidium* (*Anthidium*) Fabricius

Anthidium s. str. occurs on all continents, except Australia.

Subgenus *Anthidium* (*Nivanthidium*) Pasteels

Anthidium niveocinctum Gerstaecker is the only known species and it is endemic to South-East Africa.

Subgenus *Anthidium* (*Severanthidium*) Pasteels

This subgenus is widespread in the Afrotropical Region.

Genus *Aspidosmia* Brauns (Fig. 30C-D)

Aspidosmia is unique in that it has a scopa on the hind tibia, as well as a sternal scopa. They are generally more hairy than other anthidiine bees. It has two species that are endemic to South Africa. They are Pollen collecting bees restricted to western South Africa.

Genus *Cyphanthidium* Pasteels

Cyphanthidium closely resembles *Afranthidium,* differing in that the former has fewer than five mandibular teeth and the latter six or more teeth. It comprises pollen collecting bees. The genus has two described species and is endemic to southern Africa.

Genus *Eoanthidium* Popov (Fig. 30E)

Eoanthidium are large yellow and black bees with a juxtantennal carina. They are pollen collecting bees and the genus is widespread in the Old World.

Key to the subgenera of *Eoanthidium*

1. Fore coxa with distinct carina or lamella . . . .***Eoanthidium (Clistanthidium)***

1'. Fore coxa not carinate or lamellate . . . .***Eoanthidium* (*Eoanthidium*)**

Subgenus *Eoanthidium* (*Clistanthidium*) Michener & Griswold

This subgenus is widespread in Africa, occurring though East Africa from Ethiopia to KwaZulu-Natal Province, South Africa, and inland to Shaba Province, Democratic Republic of the Congo and Namibia.

Subgenus *Eoanthidium* (*Eoanthidium*) Popov

In the Afrotropical Region this subgenus is only known from Kenya, and it also occurs from the South-East Mediterranean to South-West Asia.

Genus *Euaspis* Gerstaecker (Fig. 31A)

In *Euaspis* the head and mesosoma are black and the metasoma is orange, there is a distinct juxtantennal carina, the scutellum is produced posteriorly and overhangs the propodeum. It is a small Old World genus with three cleptoparasitic species that are widespread in Africa.

Genus *Gnathanthidium* Pasteels (Fig. 31B)

Gnathanthidium has a strongly carinate preoccipital ridge and a large hind basitarsus in the female. The genus is monotypic with a single pollen collecting species, *Gnathanthidium prionognathum* (Mavromoustakis) occurring in eastern and South Africa.

Genus *Icteranthidium* Michener (Fig. 31C)

In *Icteranthidium* the preoccipital carina behind the vertex is absent but well developed laterally. It is mostly Palaearctic, with some species in the Sahel and northern Kenya. It is a pollen collecting bee. This genus is widespread in the Old World, occurring across the northern region of the Afrotropical Region.

Genus *Larinostelis* Michener and Griswold

Larinostelis has strongly developed carinae mesal to the antennal sockets, on the pronotal lobe, omaulus, axilla, scutellum and basal zone of the propodeum. The single cleptoparasitic species is *Larinostelis scapulata* Michener & Griswold is only known from Kenya.

Genus *Pachyanthidium* Friese (Fig. 32A)

Pachyanthidium vary from black and yellow to black with an orange metasoma, have a lamellate scutellum and posteriorly pointed metasoma. The genus has four subgenera all of which occur in the Afrotropical Region. They are pollen collecting bees.

Key to the subgenera of *Pachyanthidium*

1. Eyes without hairs **2**
1'. Eyes hairy **3**

2 Arolia present . . . . ***Pachyanthidium*** **(*Ausanthidium*)**
2'. Arolia absent . . . .***Pachyanthidium*** **(*Pachyanthidium*)**

3. Terga 3-5 with slender, lateral spines . . . .***Pachyanthidium*** **(*Trichanthidium*)**
3'. Terga 3-5 without lateral spines . . ***Pachyanthidium*** **(*Trichanthidioides*)**

Subgenus *Pachyanthidium* (*Ausanthidium*) Pasteels

Ausanthidium is monotypic with *Pachyanthidium ausense* (Mavromoustakis) being the only species, and it is endemic to Namibia.

Subgenus *Pachyanthidium* (*Pachyanthidium*) Friese

This subgenus is widespread in Africa.

Subgenus *Pachyanthidium* (*Trichanthidioides*) Michener & Griswold

The only species is *Pachyanthidium semiluteum* Pasteels and it occurs in Kenya.

Subgenus *Pachyanthidium* (*Trichanthidium*) Cockerell

This subgenus is widespread in Africa, and also occurs in the Palaearctic Region.

Genus *Plesianthidium* Cameron (Fig. 32B)

Plesianthidium mostly have no conspicuous carinae and no pallid maculation. They collect pollen. There are four subgenera, all of which occur in sub-Saharan Africa.

Key to the subgenera of *Plesianthidium*

1. Preoccipital carina behind vertex . . ***Plesianthidium*** **(*Spinanthidiellum*)**
1'. Preoccipital area without carina **2**

2 Female sternum 6 with distinct, longitudinal carina; black except for white pubescence on male face . . . .***Plesianthidium*** **(*Carinanthidium*)**
2'. Female sternum 6 not carinate; pubescence brown, grey or white on face and venter **3**

3 Male tergum 7 trifid with median tooth exceeding the lateral ones, females hardly distinguishable from *Plesianthidium* s. str. . . . . ***Plesianthidium* (*Spinanthidium*)**

3'. Male tergum 7 bifid, except minute median tooth may be visible . . . . ***Plesianthidium* (*Plesianthidium*)**

Subgenus *Plesianthidium* (*Carinanthidium*) Pasteels

This subgenus is only known from the South African species *Plesianthidium cariniventre* (Friese).

Subgenus *Plesianthidium* (*Plesianthidium*) Cameron

Plesianthidium fulvopilosum (Cameron) from western South Africa is the only known species.

Subgenus *Plesianthidium* (*Spinanthidiellum*) Pasteels

This subgenus has two species that occur in western South Africa.

Subgenus *Plesianthidium* (*Spinanthidium*) Mavromoustakis

The subgenus *Plesianthidium* (*Spinanthidium*) is endemic to western South Africa.

Genus *Pseudoanthidium* Friese (Fig. 32C)

Pseudoanthidium have extensive pallid maculations, the metasomal bands broken and reduced to spots laterally. The subantennal suture is arcurate. They are pollen collectors. There are six subgenera in *Pseudoanthidium*, four occur in sub-Saharan Africa.

Key to the subgenera of *Pseudoanthidium*

1. Preoccipital carina behind gena **2**

1'. Preoccipital area behind gena rounded, without carina **3**

2. Preoccipital area behind vertex lamellate . . . . ***Pseudoanthidium* (*Micranthidium*)**

2'. Preoccipital area behind vertex weakly carinate . . . . ***Pseudoanthidium* (*Semicarinella*)**

3. Propodeum shagreened . . . . ***Pseudoanthidium* (*Tuberanthidium*)**

3'. Propodeum shiny . . . . ***Pseudoanthidium* (*Exanthidium*)**

Subgenus *Pseudoanthidium* (*Exanthidium*) Pasteels

There are four described species in this subgenus. One of them is known from Sudan, the others occur from the Mediterranean Basin to Central Asia.

Subgenus *Pseudoanthidium* (*Micranthidium*) Cockerell

This subgenus is widespread in tropical Africa.

Subgenus *Pseudoanthidium* (*Semicarinella*) Pasteels

Pseudoanthidium latitarse Pasteels is known from Senegal and is the only species in this subgenus. Being based on a single male, the status of the subgenus is uncertain.

Subgenus *Pseudoanthidium* (*Tuberanthidium*) Pasteels

This subgenus occurs in southern Africa.

Genus *Serapista* Cockerell (Fig. 32D)

Serapista have black integument with dense patches of white hair. It is widespread in Africa.

Genus *Stelis* Panzer (Fig. 32E, F)

Subgenus *Stelis* (*Stelidomorpha*) Morawitz

Stelis are cleptoparasitic, they lack strongly developed carinae and have extensive yellow markings. There are two African species that occur in Kenya and South Africa.

Genus *Trachusa* Panzer (Fig. 32F)

Trachusa are large pollen collecting bees arguably without carinae and lamellae in the preoccipital areas, mesopleuron and scutellum, and with extensive yellow maculation.

Key to the subgenera of *Trachusa*

1. Subantennal suture distinctly arcurate outwards . . . . **Trachusa (*Paraanthidium*)**

1'. Subantennal suture nearly straight **2**

2. Omaulus distinctly *carinate* . . . . ***Trachusa (Massanthidium)***

2'. Omaulus not carinate . . . . ***Trachusa* (*Congotrachusa*)**

Subgenus *Trachusa* (*Congotrachusa*) Pasteels

Trachusa shoutedeni (Vachal), is the only species. It is known from the Democratic Republic of the Congo and Angola.

Subgenus *Trachusa* (*Massanthidium*) Pasteels

This subgenus is described from Ethiopia and Kenya, however, an undescribed species occurs in Namibia.

Subgenus *Trachusa* (*Paraanthidium*) Friese

This subgenus is widespread in the Old World, but has only one sub-Saharan species, namely *Trachusa aquifilum* (Strand), that occurs in South Africa and Namibia.

Genus *Xenostelis* Baker (Fig. 33A)

Xenostelis is endemic to the island of Sokotra (Yemen) and is only represented there by one species, *Xenostelis polychroma* Baker.

8.5.2.4. Tribe Dioxyini

Genus *Aglaoapis* Cameron (Fig. 33B-C)

Dioxyini have a unique, median, tubercular spine on the metanotum. They are all cleptoparasitic. *Aglaoapis alata* (Michener) is the only Dioxyini that has been recorded from the Afrotropical Region. It occurs in South Africa.

8.5.2.5. Tribe Megachilini

The Megachilini is a large cosmopolitan tribe of bees. In sub-Saharan Africa there are two genera, *Coelioxys*, which are cleptoparasites, and *Megachile*, which are pollen collectors.

Genus *Coelioxys* Latreille (Fig. 33D-E)

Coelioxys are cleptoparasitic. Apparently they mostly parasitize *Megachile*. Pasteels (1968) recognized three subgenera; *Coelioxys, Hemicoelioxys* and *Liothyrapis*. Later he (Pasteels 1977) recognised four subgenera: *Coelioxita*, *Coelioxys, Hemicoelioxys* and *Liothyrapis.* Michener (2007) on the other hand has four subgenera that are different to Pasteels (1977). They are: *Allocoelioxys* (which includes *Coelioxita), Coelioxys, Liothyrapis* (which includes *Hemicoelioxys*) and *Torridapis.*

Key to the subgenera of *Coelioxys*

1. Eyes naked **2**
- Eyes hairy **3**

2. Female sternum 5 enlarged, exposed part much longer than exposed part of sternum 4; T6 without keel; male T6 without lateral tooth . . . . ***Coelioxys* (*Torridapis*)**
- Female with exposed parts of sternum 4 and sternum 5 similar in length; tergum 6 with mediolongitudinal keel ending in a spine; male tergum 6 with anterolateral tooth . . . . ***Coelioxys* (*Liothyrapis*)**

3. Transverse subocular carina joining preoccipital carina; male tergum 6 with eight teeth . . . . ***Coelioxys* (*Allocoelioxys*)**
- Transverse subocular carina absent or ending free; male tergum 6 with six teeth . . . . ***Coelioxys* (*Coelioxys*)**

Subgenus *Coelioxys* (*Allocoelioxys*) Tkalců

This subgenus is widespread in the Old World and occurs throughout Africa. Pasteels (1977) recorded 21 African species.

Subgenus *Coelioxys* (*Coelioxys*) Latreille

This subgenus occurs throughout Africa, and is apparently cosmopolitan. Pasteels (1977) recorded 31 African species.

Subgenus *Coelioxys* (*Liothyrapis*) Cockerell

This subgenus occurs throughout Africa and is widely distributed in the Old World. Pasteels (1968) recorded 26 species from sub-Saharan Africa.

Subgenus *Coelioxys* (*Torridapis*) Pasteels

This subgenus is widespread in Africa and it is also widespread in southern Asia, the Pacific Islands and Australia. There are seven African species.

Genus *Megachile* Latreille (Fig. 34A-F)

Megachile are the only pollen collecting bees in the Megachilini. They were revised by Pasteels (1965), who recognised three distinct genera; *Chalicodoma* Lepeletier, *Creightonella* Cockerell and *Megachile* s. str. Michener (2007) grouped them into one genus, *Megachile*. This will not be the last word on the classification of *Megachile* s. lat. As Gonzalez (personal communication, 2008) wrote an impressive dissertation in which *Megachile* s. lat. is again divided into more than one genus. However, here we need to adhere to the latest revision, which is Michener (2007). There are 15 sub-Saharan subgenera: *Amegachile*, *Chalicodoma*, *Callomegachile*, *Creightonella*, *Cuspidella,* *Eutricharaea*, *Gronoceras*, *Heriadopsis*, *Largella,* *Maximegachile*, *Megella,* *Paracella*, *Platysta,* *Pseudomegachile* and *Stenomegachile*.

Key to the subgenera of *Megachile*

1. Fore and middle legs with aerolia (osmine in appearance) . . . . ***Megachile* (*Heriadopsis*)**
1'. Fore and middle legs without aerolia **2**

2. Fore tibia with three spines near distal end **3**
2'. Fore tibia with one or two spines near distal end **4**

3. Fore tibia with two distinct spines and a third, small spine hidden among denses, short hairs; occurring in Zanzibar . . . .***Megachile* (*Largella*)**
3'. Fore tibia with three large, distinct, naked, spines near distal end . . . .***Megachile* (*Gronoceras*)**

4. Female, antennal flagellum 10-segmented; metasoma 6-segmented **5**
4'. Male, antennal flagellum 11-segmented; metasoma 7-segmented **16**

5. Mandible enlarged, parallel sided or narrowest preapically; mandibular ridges smooth and shiny **6**

5’. Mandible not enlarged, narrowest basally; mandibular ridges rough and dull **7**

6. Mandible four toothed . . . . ***Megachile* (*Stenomegachile*)**
6’. Mandible three toothed . . . . ***Megachile* (*Maximegachile*)**

7. Upper clypeus and entire supraclypeus tuberculate; this excludes tubercles on lower clypeus margin . . . . ***Megachile* (*Callomegachile*)**
7’. Clypeus flat, if tuberculate with 2-3 tubercles on lower clypeal margin **8**

8. Clypeus emarginate apicomedially **9**
8’. Clypeus not modified apicomedially, except it may extend below base of labrum, one species with three distinct tubercles and strongly emarginate between tubercles on ventral clypeal margin, middle tubercle horn-like . . **10**

9. Clypeus impunctate mediolongitudinally, weakly concave medioventrally, with two small, indistinct tubercles, one on each side of emarginated area . . . .***Megachile* (*Amegachile*)**
9’. Clypeus broadly and deeply emarginate apicomedially . . . .***Megachile* (*Cuspidella*)**

10. Clypeus distinctly overhanging base of labrum . . . .***Megachile* (*Chalicodoma*)**
10’. Clypeus level with or slightly lower than base of labrum **11**

11. Mandible without recessed cutting edges between teeth . . . .***Megachile* (*Pseudomegachile*)**
11’. Mandible with recessed cutting edges (mostly appear like slightly recessed knife edges between pointed teeth) in third and sometimes also second inter-tooth areas **12**

12. Mandible with dissimilar recessed cutting edges in interspaces between 3-5 dissimilar teeth **13**
12’. Mandible with small, similar recessed cutting edges; 4-6 similar teeth . . . .***Megachile* (*Creightonella*)**

13. Mandible five-toothed, with upper two teeth close together, recessed cutting edge between them (forth interspace) as well as a small cutting edge in third interspace . . . .***Megachile* (*Platysta*)**
13’. Mandible three to four-toothed, with recessed cutting edge in first and/or second interspace **14**

14. Mandible with recessed cutting edge in second and usually third inter spaces . . . . ***Megachile* (*Paracella*)**
14’. Mandible with recessed cutting edge only in upper interspace **15**

15. Mandible with basal and apical ends about equal in width, outer margin slightly incurved . . . . ***Megachile* (*Eutricharaea*)**
15’. Mandible much broader apically, outer margin strongly concave. . . . .***Megachile* (*Megella*)**

16. Sternum 6 exposed; tergum 6 forming a well developed plate with distinct lateral carina directed basally . . . .***Megachile* (*Creightonella*)**

16'. Sternum 6 contracted; tergum 6 not plate-like, often with subapical carina but not a distinct lateral carina **17**

17. Mandible with ventral tooth near base . . . .***Megachile*** **(*Amegachile*)**
17'. No ventral tooth on mandible **18**

18. Clypeus distinctly convex dorsally, pointed below, lower region densely pubescent; tergum 6 bilobed **19**
18'. Clypeus flat to slightly convex dorsally, truncate ventrally, uniformly pubescent, tergum 6 toothed, entire or weakly bilobed **21**

19. Front tibia with distinct longitudinal carina along outer posterior angle . . . .***Megachile*** **(*Stenomegachile*)**
19'. Front tibia without longitudinal carina **20**

20. Tergum 6 strongly bilobed; mandible more or less parallel sided; black and white. . . . .***Megachile*** **(*Maximegachile*)**
20'. Tergum 6 weakly bilobed; mandible broader basally, tapering apically; with some orange vestiture . . . .***Megachile*** **(*Callomegachile*)**

21. Tergum 6 extended medioposteriorly into elongate, narrow, truncate plate with longitudinal median carina . . . .***Megachile*** **(*Cuspidella*)**
21'. Tergum 6 not extended, without longitudinal median carina, sometimes ridged **22**

22. Metasoma gently convex and less than twice as long as wide (megachiliform); sternum 8 without lateral marginal hairs **23**
22'. Metasoma strongly convex and twice as long as wide (chalicodomiform); sternum 8 with lateral marginal hairs **24**

23. Subapical carina on tergum 6 short, about one-fifth width of tergum . . . . ***Megachile*** **(*Platysta*)**
23'. Subapical carina on tergum 6 wide, occupying most of tergum width . . . . ***Megachile*** **(*Eutricharaea*), *Megachile*** **(*Paracella*)**

24. Tergum 6 with mesally directed spine posterolaterally and medioposterior tooth . . . . ***Megachile*** **(*Megella*)**
24'. T6 with subapical carina dentate **25**

25. Fore coxa spinose . . . .***Megachile*** **(*Chalicodoma*)**
25'. Fore coxa not spinose. . . . . ***Megachile*** **(*Pseudomegachile*)**

Subgenus *Megachile* (*Amegachile*) Friese

This subgenus is widespread in Africa and occurs through much of southern Asia through to Australia. They are large, conspicuous bees. There are nine African species.

Subgenus *Megachile* (*Callomegachile*) Michener

Megachile (*Callomegachile*) is widespread in Africa, and occurs through southern Asia, in northern Australia and on several Indian Ocean Islands. They are large bees. There are 26 species in Africa.

Subgenus *Megachile* (*Chalicodoma*) Lepeletier

Megachile (*Chalicodoma*) are large bees that occur throughout Africa, and much of the Old World. There are 20 African species.

Subgenus *Megachile* (*Creightonella*) Cockerell (Fig. 34C-D)

They occur throughout Africa, through much of southern Europe and Asia, the West Indies and northern Australia. Forty species occur in sub-Saharan Africa.

Subgenus *Megachile* (*Cuspidella*) Pasteels

This subgenus is only known from the Congolese species, *Megachile quadraticauda* (Pasteels).

Subgenus *Megachile* (*Eutricharaea*) Thomson (Fig. 34A-B)

These are the most common, most diverse and most difficult to identify leaf cutter bees. The subgenus is cosmopolitan, and has 120 sub-Saharan species.

Subgenus *Megachile* (*Gronoceras*) Cockerell

These bees are endemic to Africa and occur throughout the Region. There are 10 species.

Subgenus *Megachile* (*Heriadopsis*) Cockerell

These are small osmiform bees that have aerolia on the fore and middle legs. The subgenus is monotypic (*Megachile striatula* (Cockerell) being the only species) and it occurs in the Democratic Republic of the Congo, Malawi and Zimbabwe.

Subgenus *Megachile* (*Largella*) Pasteels

Megachile semivestita (Smith) is the only described species, although others apparently exist. It occurs naturally in Asia and Indonesia, and has been introduced into Zanzibar.

Subgenus *Megachile* (*Maximegachile*) Guiglia and Pasteels (Fig. 34E-F)

This subgenus is widespread in the Afrotropical Region and occurs in neighbouring parts of the Palaearctic Region. The only described species, *Megachile maxillosa* (Guérin), is large and black and white. The grotesque face of the female is easily recognisable. There are apparently one or two undescribed species in Africa.

Subgenus *Megachile* (*Megella*) Pasteels

This species occurs in West and Central Africa. There are two African species and one Asiatic species.

Subgenus *Megachile* (*Paracella*) Michener

This subgenus is widespred in sub-Saharan Africa, and has about 39 species. Undescribed species are also found in India and Indonesia.

Subgenus *Megachile* (*Platysta*) Pasteels

This subgenus has only two species, but they occur through much of tropical Africa, from Senegal to Botswana.

Subgenus *Megachile* (*Pseudomegachile*) Friese

This subgenus occurs through much of the Old World. There are apparently about 30 Africa species.

Subgenus *Megachile* (*Stenomegachile*) Pasteels

This subgenus occurs through greater East Africa, from Eritrea to Zambia, and in Madagascar. There are four African species.

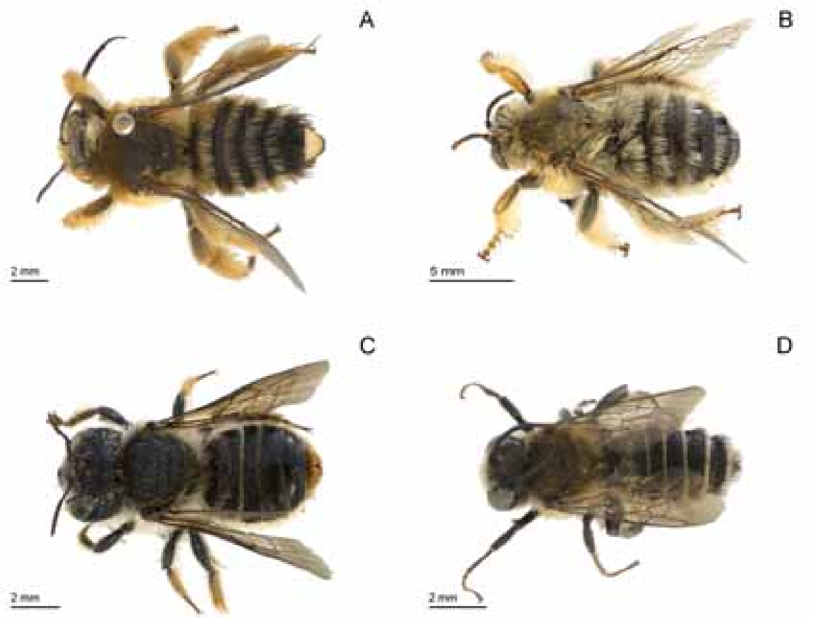


Fig. 25. A-B. *Fidelia braunsiana* Friese. A. Female; B. Male. C-D. *Lithurgus spiniferus* Cameron: C. Female; D. Male.

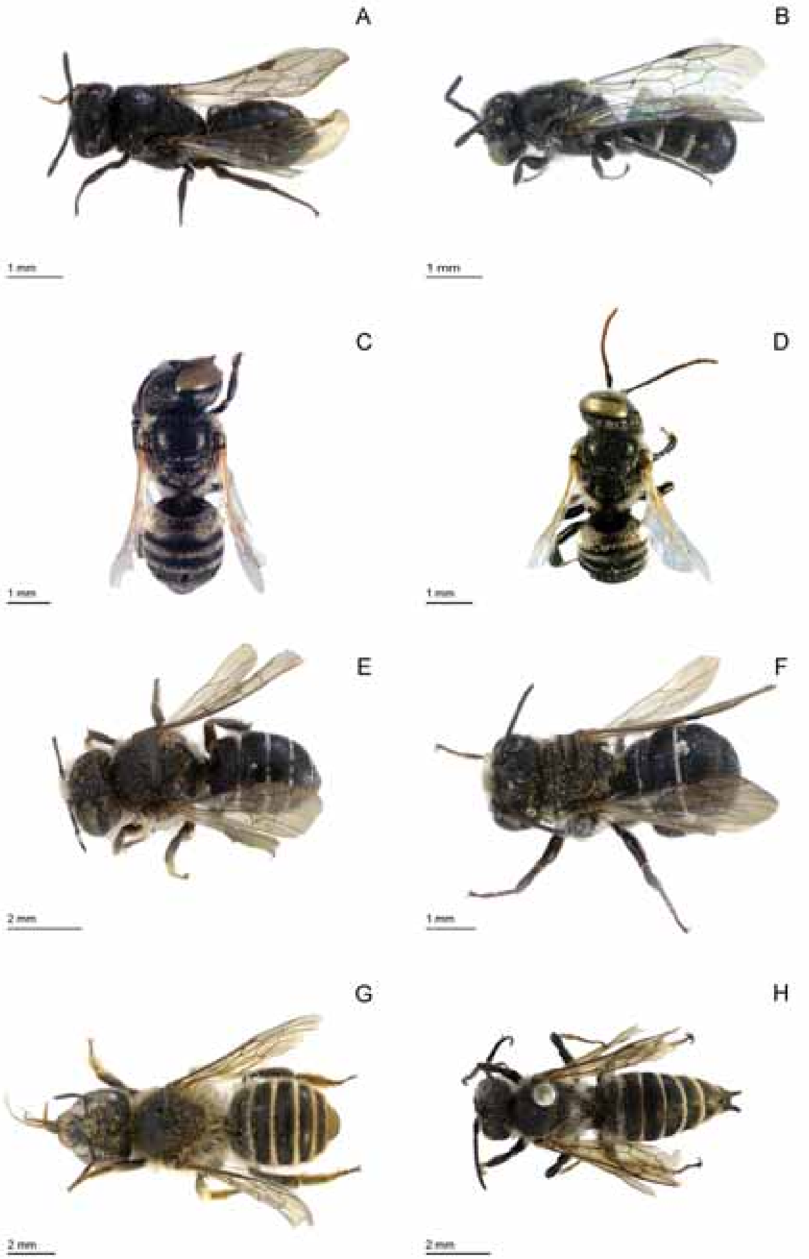


Fig. 26. A-B. *Afroheriades* sp. A. Female; B. Male; C-D. *Haetosmia circumventa* (Peters). C. Female; D. Male; E.-F. *Heriades freygessneri* Schletterer; E. Female; F. Male. G-H. *Hoplitis similis* (Friese): G. Female; H. Male.

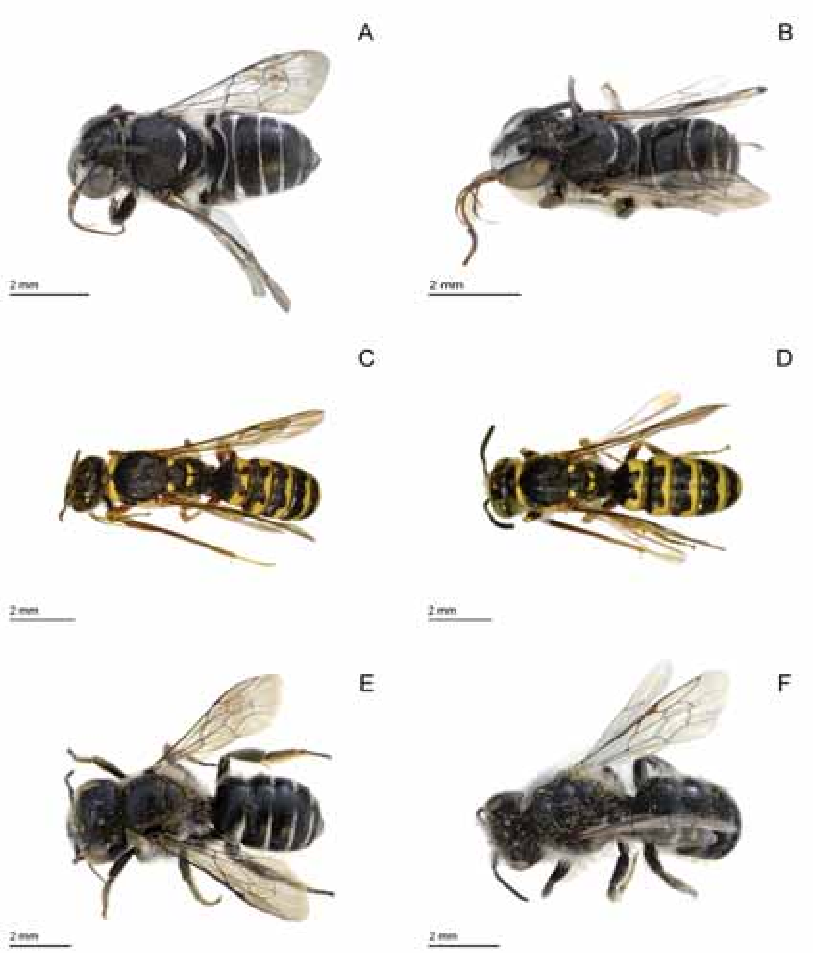


Fig. 27. A-B. *Noteriades* sp. A. female; B. Male. C-D. *Ochreriades fasciatus* (Friese): C. Female; D. Male; E-F. *Othinosmia* sp; E. Female; F. Male.

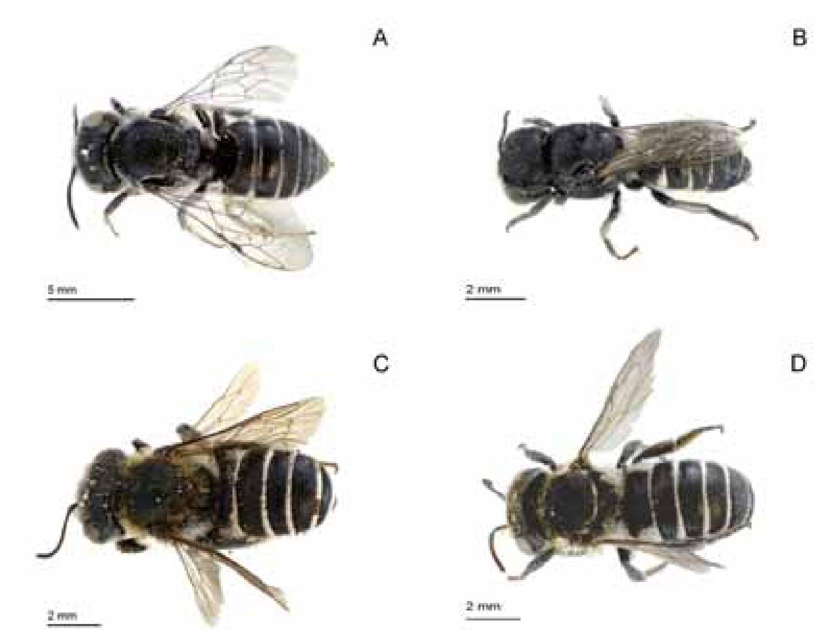


Fig. 28. A. *Pseudoheriades* sp., female; B. *Stenoheriades* sp., female; C-D. *Wainia* sp.: C. Female; D. Male.

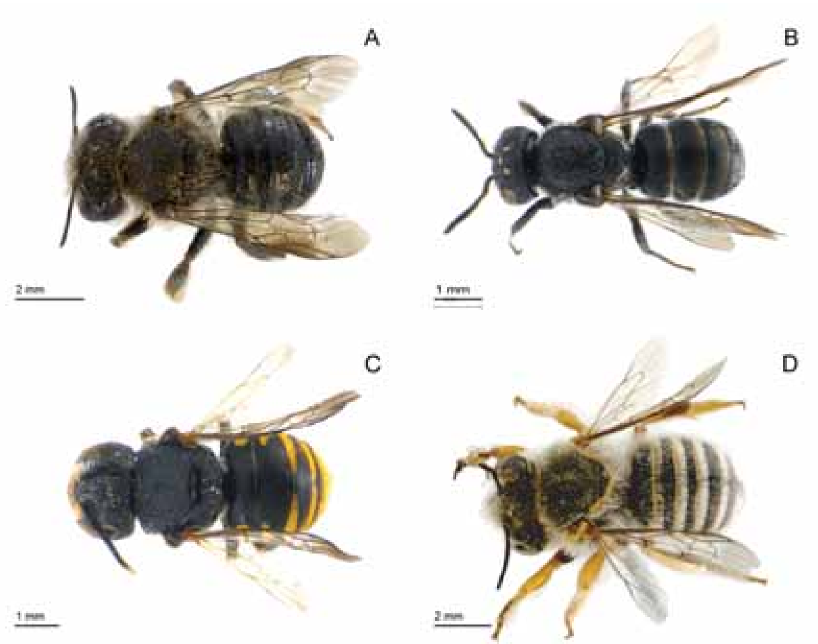


Fig. 29. A. *Afranthidium concolor* (Friese), female. B. *Afrostelis tegularis* Cockerell, female; C. *Anthidiellum absonulum* (Cockerell), female. D. *Anthidioma murinum* Pasteels, female.

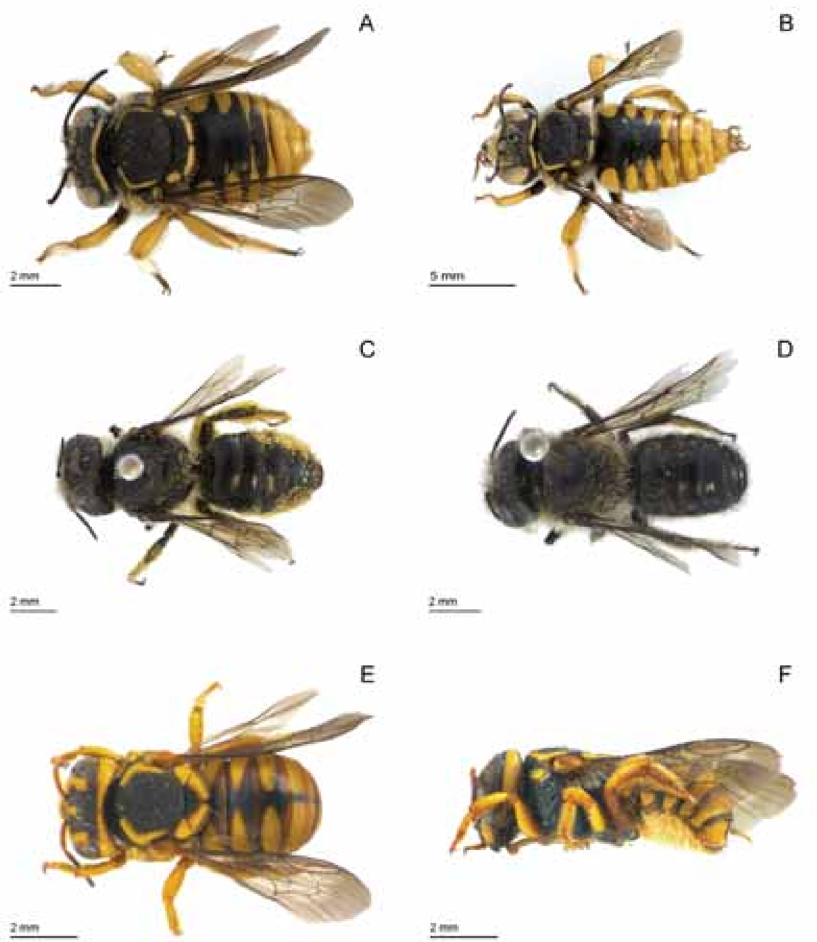


Fig. 30. A-B. *Anthidium severini* Vachali. A. Female; B. Male; C. *Aspidosmia arnoldi* (Brauns), Female; D. *Aspidosmia* sp., Male; E. *Eoanthidium rothschildi* (Vachal), male.

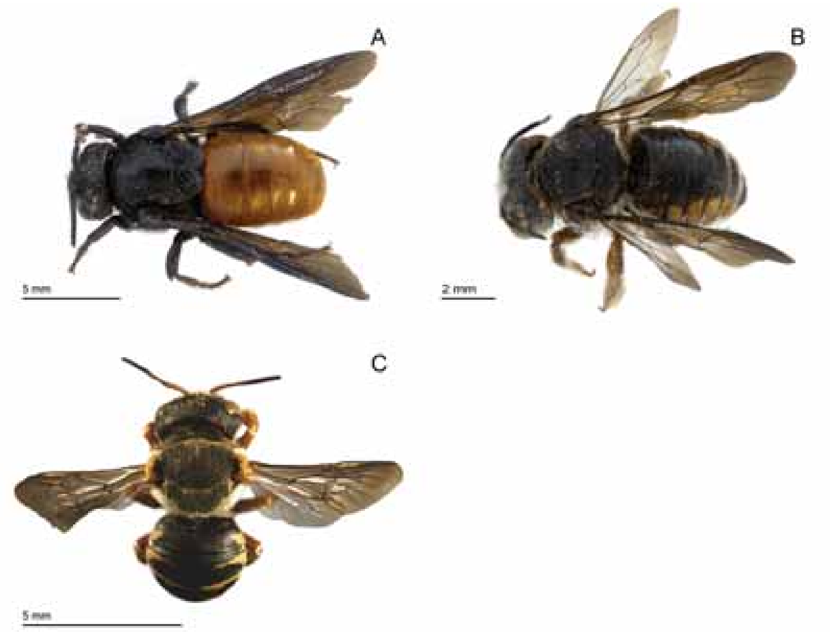


Fig. 31. A. *Euaspis abdominalis* (Fabricius), female; B. *Gnathanthidium prionognathum* (Mavromoustakis), female; C. *Icteranthidium grohmani*, female.

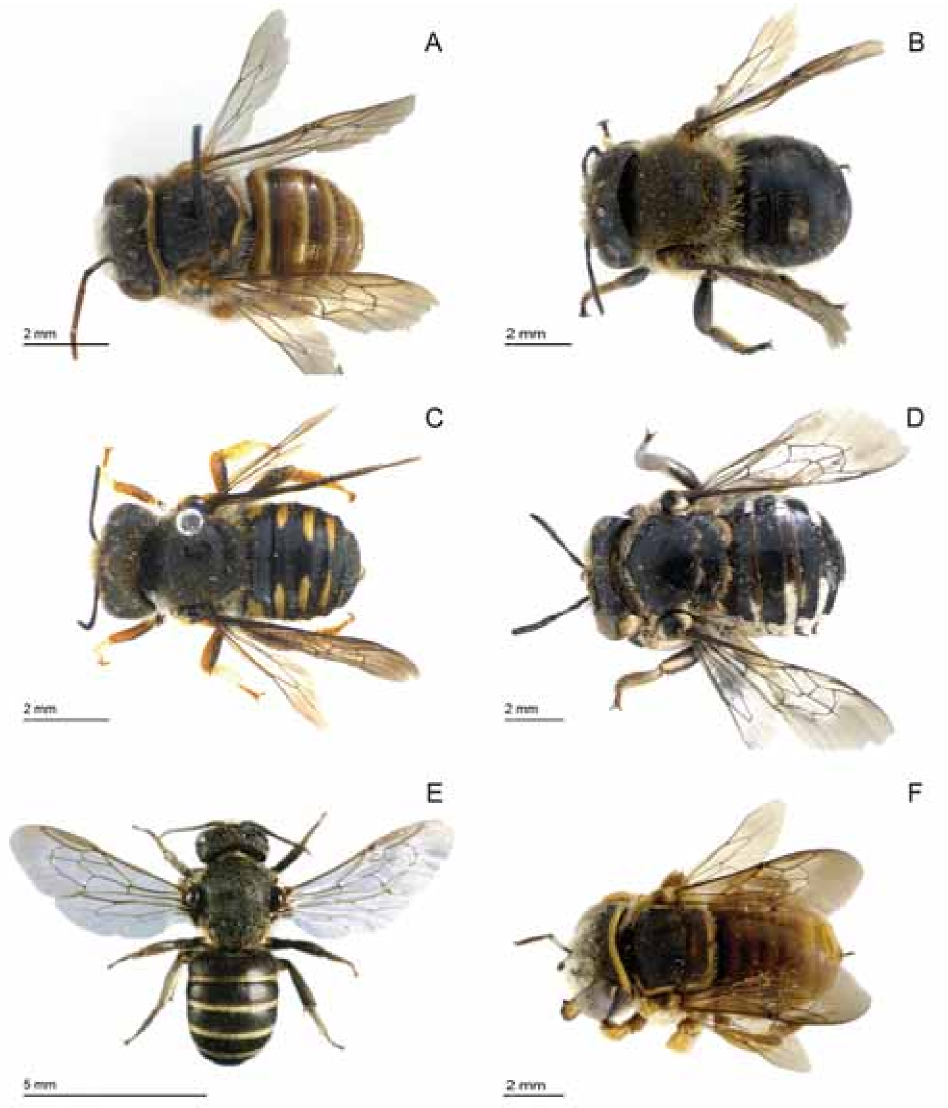


Fig. 32. A. *Pachyanthidium* sp., female; B. *Plesianthidium volkmanni* (Friese), female; C. *Pseudoanthidium tuberculiferum* Friese, female; D. *Serapista rufipes* (Friese), female; E. *Stelis* sp., female; F. *Trachusa* sp., female.

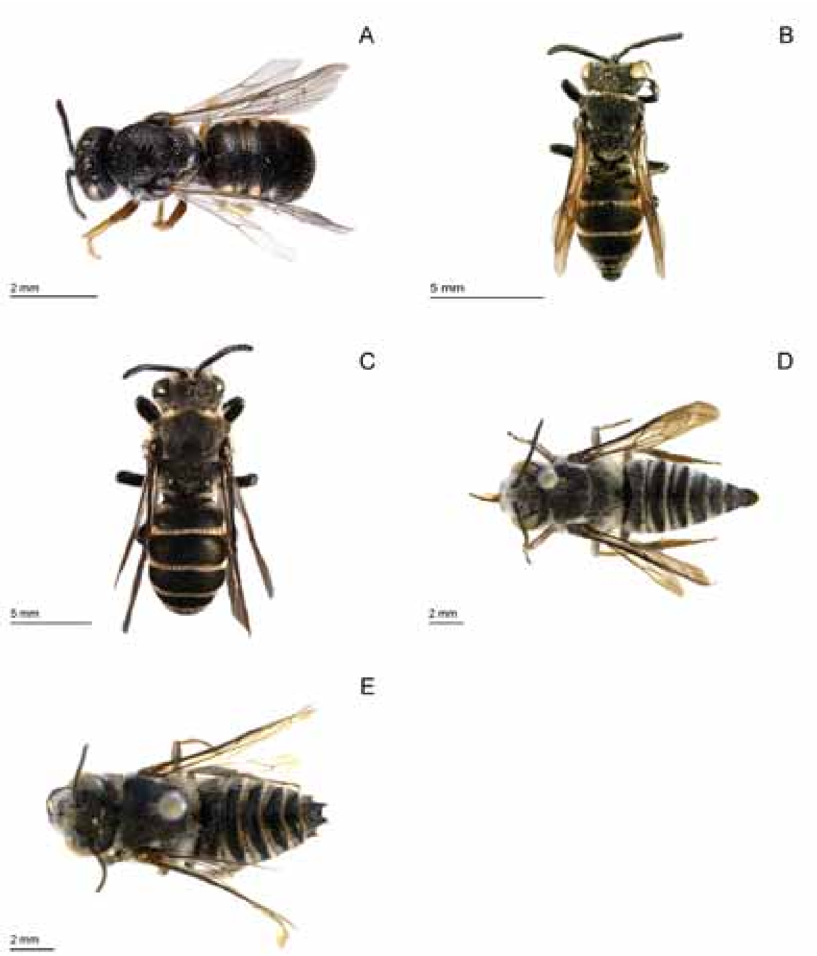


Fig. 33. A. *Xenostelis polychroma* Baker, female; B-C. *Aglaoapis trifasciata* (Nylander); B. Female; C. Male; D-E. *Coelioxys circumscriptus* Schulz: D. Female; E. Male.

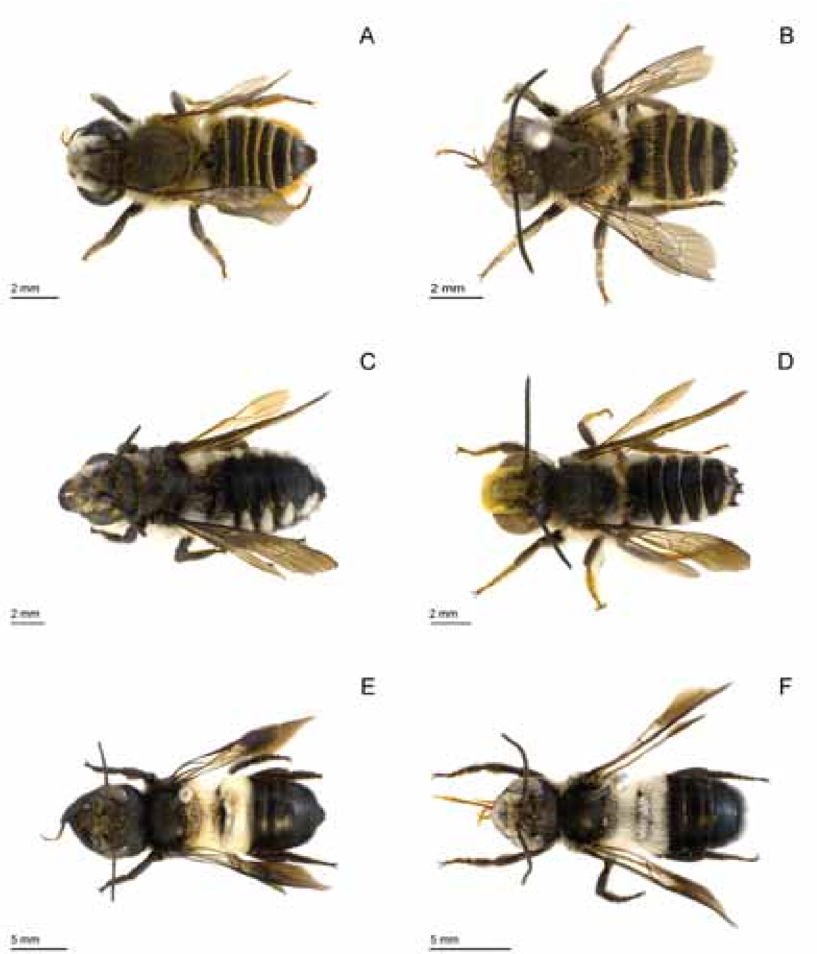


Fig. 34. A-B. *Megachile frontalis* Smith. A. Female. B. Male. C-D. *Megachile ianthoptera* Smith. C. Female. D. Male. E-F. *Megachile maxillosa* Guérin-Méneville. E. Female. F. Male.

8.6. Family Apidae

The Apidae is one of two long-tongued bee families that occur in Africa, the other is the Megachilidae. It is very diverse. Within the long-tongued bees, the scopa on the hind leg and the male tergum 7 not largely concealed ventrally are diagnostic; parasitic genera, however, pose a challenge. Characters unique to Apidae, but not occurring in all Apidae are: a long antennal flagellum; pale yellow stripes adjacent to the eye; a corbicula; a sickle-shaped hind tibial spur; a pseudopygidium on tergum 5; a posteromedial concavity on sternum 5. The best way to identify this family is by excluding the short-tongued bees and the Megachilidae. As the parasitic genera do not have a scopa, the females are more difficult identify. A key to the long-tongued parasitic bees is therefore given.

The Apidae have diverse biologies. They bore nests in the wood (carpenter bees), tunnel in the ground (Anthophorini) and use existing cavities (Meliponini and Apini). Most are solitary, but a number of different types of sociality occur: ranging from semi-social to eusocial (sociality also occurs in Halictini, but eusociality is unique to the Apidae in bees). There are no daubers. Parasitism includes social parasites, where the parasite replaces the queen of the host species, cleptoparasites and robbers, in the latter the parasite raids the host's nest to provision its own cells. They occur in all habitat types in Africa.

Key to the Apidae

1. Marginal cell of forewing long, about four times as long as distance between marginal cell and distal end of forewing . . . . ***Apis***
1'. Marginal cell of forewing much shorter **2**

2. Forewing with submarginal cross veins weakly developed or absent . . .**3**
2'. Submarginal cross veins well developed **8**

3. Scopa not corbiculate, outer surface convex . . . . ***Cleptotrigona***
3'. Scopa modified to form a corbicula, outer surface concave or flat, surrounded by hairs **4**

4. Forewing with vein Rs visible **5**
4'. Vein Rs not discernable **7**

5. Outer surface of hind tibia strongly concave . . . .***Meliponula***
5'. Outer surface of hind tibia weakly concave **6**

6. First metasomal segment broader than long; posterodistal part of hind tibia angulate . . . .***Plebeina***
6'. First metasomal segment longer than broad; posterodistal part of hind tibia rounded . . . .***Dactylurina***

7. Propodeum long, dorsal (horizontal) surface longer than vertical surface . . . .***Hypotrigona***
7'. Propodeum short, dorsal surface shorter than vertical surface . . . . ***Liotrigona***

8. Labial palp weakly flattened, not long and sheath-like; resembling short-tongued bees more closely **9**
8'. Labial palp flattened and sheath-like; typical for long-tongued bees . . .**11**

9. Without oil collecting hairs on metasomal venter; three submarginal cells in forewing . . . .***Ancyla***
9'. With oil collecting hairs on metasomal venter; two submarginal cells . . **10**

10. Hind tibial spur greatly expanded . . . .***Ctenoplectra***
10'. Hind tibial spur not expanded . . . . ***Ctenoplectrina***

11. Two submarginal cells in forewing **12**
11'. Three submarginal cells in forewing **24**

12. Clypeus slightly restricted near tentorial pits, parallel above tentorial pits; scopa on female hind leg (reduced in *Eucondylops* – parasitic); softly

sclerotized; distal end of metasoma without pygidial plate or other modification (pointed) **13**

12'. Clypeus converges dorsally; without scopa, parasitic; robustly scletotized; distal end of metasoma with pygidial plate or other modification **19**

13. Tongue relatively long; transverse fasciae of short appressed hair on T2-T5; jugal lobe of hind wing almost as large as vannal lobe . . . .***Macrogalea***

13'. Tongue of normal length; metasomal dorsum sparsely pubescent; jugal lobe extending little, if any, beyond vein cu-a of vannal lobe. **14**

14. Vein 2m-cu absent; scopa weakly developed, parasitic bee . . . . ***Eucondylops***

14'. Vein 2m-cu present; scopa mostly well developed, pollen collecting and parasitic bees **15**

15. Lateral margins of tergum 6 curved sharply under **16**

15'. Curvature on lateral margins of tergum 6 rounded **17**

16. Extensive yellow maculation on entire body or black with strongly concave upper clypeal margin . . . . ***Compsomelissa***

16'. Head and mesosoma black with yellow maculation, metasoma red . . . . ***Allodapula***

17. Integument yellow along inner eye margin . . . .***Allodape***

17'. Integument black along inner eye margin **18**

18. Clypeus with tubercle . . . . ***Nasutapis***

18'. Clypeus flat . . . .***Braunsapis***

19. Marginal cell of forewing truncate apically . . . .***Chiasmognathus***

19'. Marginal cell rounded apically **20**

20. Mandibles cross in repose, head and mesosoma black, metasoma red . . . . ***Sphecodopsis***

20'. Mandibles overlap in repose, colour variable **21**

21. Female sternum 6 broad posteriorly and concave posteromedially; male unknown . . . .***Ammobatoides***

21'. Female sternum 6 spinose **22**

22. Female tergum 5 with pseudopygidium and circular hole through which sternum 6 protrudes; male omaulus carinate . . . .***Schwarzia***

22'. Female tergum 5 without pseudopygidium or circular hole; male omaulus rounded **23**

23. Female sternum 5 concave with gutter posteromedially; male with 13-segments antenna . . . .***Ammobates***

23'. Female sternum 5 concave, without gutter; male with 12-segmented antennal . . . .***Pasites***

24. Jugal lobe less than one forth as long as vannal lobe. **25**

24'. Jugal lobe more than one forth as long as vannal lobe. **27**

25. Pterostigma absent; hirsute; scopa in female. . . . .***Xylocopa***
25'. Pterostigma present; sparse hair or appressed pubescence; female without scopa. ***26***

26. Female with pseudopygidium; metasoma with appressed pubescence . . . . ***Epeolus***
26'. Female without pseudopygidium; metasoma sparsely pubescent, hairs not appresses. . . . . ***Nomada***

27. Female without scopa (parasitic); scutellum modified into spines or a lamella **28**
27' Female with scopa; scutellum gently rounded **29**

28. Scutellum with medio-lateral points . . . .***Afromelecta***
28'. Scutellum distinctly lamellate . . . .***Thyreus***

29. Pygidial plate absent; forewing with basal vein gently curved (entire body sparsely hirsute) . . . . ***Ceratina***
29'. Pygidial plate present in all female and most males; basal vein straight (mostly densely hirsute) **30**

30. Marginal cell of forewing longer than distance from marginal cell to wing tip; wing not hairy **31**
30'. Marginal cell of forewing shorter than distance from marginal cell to wing tip; wing hairy **33**

31. Hind wing with jugal lobe much less than half length of vannal lobe . . . .***Pachymelus***
31'. Hind wing with jugal lobe about half length of vannal lobe **32**

32. Females with scopa sparse; clypeus distinctly protuberant in both sexes (about 0.8x eye width); maxillary palp 3-4 segmented; male never with long antennal flagellum (less than twice as long as eye) . . . . . ***Tetralonia***
32'. Females with scopa dense; clypeus weakly protuberant (about 0.5x eye width); maxillary palp 5-6 segmented; male often with antennal flagellum more than twice as long as eye . . . .***Tetraloniella***

33. Arolia absent . . . .***Amegilla***
33'. Arolia present . . . .***Anthophora***

8.6.1. Subfamily Xylocopinae

The Xylocopinae are commonly known as carpenter bees, although other bees also bore into wood, such as *Lithurgus*. They nest in holes they bore into dead plant material; mostly wood and pithy stems. They have diverse biologies in that they are solitary, solitary with social tendencies, social or social parasites.

8.6.1.1. Tribe Xylocopini

Genus *Xylocopa* Latreille (Fig. 35A-D)

This tribe comprises one Afrotropical genus, *Xylocopa*, commonly known as the large carpenter bees. They are all pollen collectors. They all separate their cells with partitions made of wood shavings. They are mostly large, among the biggest bees in Africa.

Key to the subgenera of *Xylocopa*

1. Tergum 1 with divide between anterior (subvertical) and posterior (subhorizontal) surfaces rounded; female T1 never with pouch **2**

1'. Tergum 1 angulately divided between anterior (subvertical) and posterior (subhorizontal) surfaces; female T1 often with pouch for *Dinogamasus* mites in subvertical surface **4**

2. Female mandible with large tooth on ventral surface; male eyes not enlarged and face black . . . .***Xylocopa* (*Gnathoxylocopa*)**

2'. Female mandible without ventral tooth; male either with eyes not enlarged and clypeus yellow, or eyes enlarged and face black **3**

3. Female without propodeal triangle; male with pronotal lobe short, not prolonged into mesepisternum . . . .***Xylocopa (Xylomelissa)***

3'. Female with propodeal triangular; male with pronotal lobe long, extending into mesepisternum . . . . ***Xylocopa* (*Ctenoxylocopa*)**

4. Female head distinctly enlarged, gena as wide as eye; posterior region of male mesosoma arched, propodeum integument yellow . . . . ***Xylocopa* (*Xenoxylocopa*)**

4'. Female head unmodified; male scutellum angulately divided; propodeal integument black **5**

5. Female with posterior margin of scutellum projecting beyond posterior margin of metanotum; male middle tarsus unmodified . . . . ***Xylocopa* (*Koptortosoma*)**

5'. Female with posterior margin of scutellum not projecting beyond posterior margin of metanotum; male middle tarsus enlarged . . . .***Xylocopa* (*Mesotrichia*)**

Subgenus *Xylocopa* (*Ctenoxylocopa*) Michener

Ctenoxylocopa is mostly Asian and occurs in North-East Africa (3 species). There are six species in this subgenus.

***Xylocopa* (*Gnathoxylocopa*) Hurd and Moure (Subgenus)**

This subgenus comprises one species*, Xylocopa sicheli* Vachal*.* It has a unique tooth on the lower surface of the female mandible. It nests only in dead inflorescences of *Aloe*. They are endemic to southern Africa, occurring through most of the arid areas south of Bulawayo.

Subgenus *Xylocopa* (*Koptortosoma*) Gribodo (Fig. 35C-D)

Koptortosma is a large subgenus and it comprises some of the most common, widespread large carpenter bees. It has a few species that do not have a pouch for *Dinogamasus* mites, *e.g*., *Xylocopa scioensis* Gribodo. There are 58 species in sub-Saharan Africa and about 196 species world wide.

Subgenus *Xylocopa* (*Mesotrichia*) Westwood

Mesotrichia are among the largest large carpenter bees. Mostly they are black with the mesosomal dorsum orange or brownish, or entirely black. There are seven Afrotropical species, and 16 additional species east of the Sahara through South-East Asia.

Subgenus *Xylocopa* (*Xenoxylocopa*) Hurd and Moure

This subgenus superficially looks like *Xylocopa* (*Koptortosoma*), but the females have an enlarged head and the males have a gently curved propodeum. It is endemic to tropical Africa and has two species. The females are banded like some *Koptortosoma*, but the colour of the anterior band (yellow or white) extends onto the mesepisternum, which does not happen in *Koptortosoma*, making the subgenera easy to separate.

Subgenus *Xylocopa* (*Xylomelissa*) Hurd and Moure (Fig. 35A-B)

These are the typical group of large carpenter bees without mite pouches. They are mostly completely black, except males mostly have a yellow clypeus. They are found throughout sub-Saharan Africa, and there are about 65 species.

8.6.1.2. Tribe Ceratinini

Genus *Ceratina* Latreille (Fig. 35E-F)

Ceratina are small carpenter bees. They share this common name with the Allodapini. As with *Xylocopa*, they all separate their cells with partitions made of wood shavings. They have three submarginal veins in the forewing and the marginal vein is weakly curved. They are all pollen collecting bees.

Key to the subgenera of *Ceratina*

1. Prestigma long, about as long as distance from base of pterostigma to vein r; distal regions of middle and hind femora with blade-like edges ventrally . . . .***Ceratina* (*Megaceratina*)**

1’. Prestigma short, much shorter than distance from base of pterostigma to vein r; ventral edges of femora rounded **2**

2. Metallic, usually green or blue, sometimes gold or red; deeply punctured; terga 2-3 without graduli. **3**

2’. Usually black, some with weak lusters of metallic green; small, shallow punctures; terga 2-3 with graduli **4**

3. Axilla not spinose; mandible curved inwards . . . ***Ceratina* (*Protopithitis*)**

3’. Axilla spinose; mandible straight . . . . ***Ceratina* (*Pithitis*)**

4. Metallic green . . . . ***Ceratina (Copoceratina*)**

4’. Head and mesosoma black **5**

5. Posterior margins of terga 2-5 each with a row of coarse, pallid, conspicuous, thickened, posteriorly directed setae **6**

5’. Posterior margins of terga 2-5 without modified setae **7**

6. Scutellum strongly curved, propodeum straight and distinctly declivous in profile . . . . ***Ceratina (Simioceratina)***

6'. Scutellum and propodeum together gently curved, sloped posteriorly in profile . . . .***Ceratina (Ctenoceratina)***

7. Tergum 5 without a gradulus . . . . ***Ceratina* (*Hirashima*)**

7'. Tergum 5 with a distinct gradulus . . . . ***Ceratina* (*Ceratina*)**

Subgenus *Ceratina* (*Ceratina*) Latreille

These are the common, mostly shiny black, small carpenter bees without scale-like setae along the posterior edges of the metasomal terga. *Ceratina rhodura* Cockerell and *Ceratina whiteheadi* Eardley & Daly have a red metasoma. Bees of this subgenus occur through much of the Old World. In sub-Saharan Africa there are about 20 species.

Subgenus *Ceratina* (*Copoceratina*) Terzo and Pauly

Copoceratina has two species. One is African, *Ceratina minuta* Friese, the other occurs in Madagascar and the Seychelles. They are weakly metallic.

Subgenus *Ceratina* (*Ctenoceratina*) Daly and Moure

Ctenoceratina and *Simioceratina* have scales modified to look like teeth along the terga margins. They are common. The slope of the propodeum, in relation to the scutum, separates these two subgenera and in learning how to separate them the comparison of these two subgenera is needed for accuracy. The subgenus is widespread in sub-Saharan Africa and includes 10 species.

Subgenus *Ceratina* (*Hirashima*) Terzo and Pauly

These closely resemble *Ceratina* s. str. However, they are dull black and more deeply punctured, *Ceratina* s. str. being shiny black. There are nine species in southern Africa and more surely occur through the rest of sub-Saharan Africa.

Subgenus *Ceratina* (*Megaceratina*) Hirashima

Ceratina (*Megaceratina*) is the subgenus of the largest tropical, small carpenter bee, *Ceratina sculpturata* (Smith). The metasoma has orangish-red maculations.

Subgenus *Ceratina* (*Pithitis*) Klug

This subgenus represents the fairly common, strongly sculptured, metallic (mostly blue or green) bees. They resemble *Ceratina* (*Protopithitis*), which is much less common. It appears to occur throughout the Old World. Two widespred species occur in southern Africa, several more possibly occur in tropical Africa.

Subgenus *Ceratina* (*Protopithitis*) Hirashima

Ceratina (*Protopithitis*) are fairly rare and occur in tropical Africa. There are two described species, one intrudes into southern Africa.

Subgenus *Ceratina* (*Simioceratina*) Daly and Moure

This subgenus superficially resembles *Ceratina* (*Ctenoceratina*), and after comparing these two subgenera it is fairly easy to identify the declivous propodeum. There are three species that occur, fairly frequently, through most of sub-Saharan Africa.

8.6.1.3. Tribe Allodapini

The Allodapini are also small carpenter bees, but are often called allodapine bees. They have two submarginal cells, they are not strongly sclerotized and are black, reddish or yellowish. Unlike *Xylocopa* and *Ceratina*, they mostly do not have separate cells in their nests and feed their larvae progressively. *Compsomelissa (Halterapis*) is the exception that mass provisions and has separate cells for its larvae. The nesting biology was documented by Michener (1971). This tribe comprises nine African genera; *Allodape, Allodapula, Braunsapis, Hasinamelissa, Macrogalea* and *Compsomelissa,* possibly all have both pollen collecting bees and social parasites. *Effractapis*, *Eucondylops* and *Nasutapis* are parasitic. The greatest diversity of allodapine bees is in Africa and Madagascar, but they also occur in Asia and Australia. The two submarginal cells in the forewing give a good first indication of an allodapine bee.

Genus *Allodape* Lepeletier and Serville (Fig. 36A)

Allodape has pale maculation on the paraocular area adjacent to the inner eye margin. Such marks are found in two species of *Allodapula*, which have a distinctly different tergum 5. They may be completely black or mostly black with a reddish metasoma, and are fairly hard to identify to species.

Genus *Allodapula* Cockerell (Fig. 36B)

Allodapula has the sides of the last metasomal tergum curved strongly under, and the dorsal surface gently concave. They are mostly southern African. They are mostly black with a reddish metasoma; a few species are completely black. The subgenera are difficult to identify, as they are based on male genitalia, and it is possibly easier to identify them to species.

Key to the subgenera of *Allodapula*

1. Male gonostylus minute, stylus-shaped, hairs short and slender . . . . ***Allodapula* (*Dalloapula*)**

1’. Male gonostylus not stylus-like, hairs long and often robust **2**

2. Gonobase reduced to a narrow sclerotized band . . . . ***Allodapula* (*Allodapula*)**

2’. Gonobase unmodified . . . .***Allodapula* (*Allodapulodes*)**

Subgenus *Allodapula* (*Allodapula*) Cockerell

These are southern African and common. Apparently it comprises eight pollen collecting species and one social parasite, *Allodapula guillarmodi* Michener.

Subgenus *Allodapula* (*Allodapulodes*) Michener

Allodapula (*Allodapulodes*) are more robust than *Allodapula* (*Allodapula*) and are endemic to the Cape Province of South Africa. There are five species.

Subgenus *Allodapula* (*Dalloapula*) Michener

Allodapula (*Dalloapula*) comprises two species, both of which are endemic to South Africa.

Genus *Braunsapis* Michener (Fig. 36C)

Braunsapis are mostly black with no distinctive characters within the Allodapini. They are very common.

Genus *Compsomelissa* Alfken (Fig. 36D)

Compsomelissa comprises either yellow and black bees, or black bees with the upper edge of the clypeus distinctly concave. Michener (1975) referred to the two subgenera as genera.

Key to the subgenera of *Compsomelissa*

1. Extensive pallid maculation . . . . ***Compsomelissa* (*Compsomelissa*)**

1'. Mostly black, clypeus, pronotal lobe and legs may be yellow . . . . ***Compsomelissa* (*Halterapis*)**

Subgenus *Compsomelissa* (*Compsomelissa*) Alfken

This subgenus is very conspicuous because of the pallid yellow maculation. They occur in the Sahelian countries, East Africa and southern Africa. There are six species, five of which occur in sub-Saharan Africa.

Subgenus *Compsomelissa* (*Halterapis*) Michener

Compsomelissa (Halterapis) spp. look like black *Braunsapis* spp. They are difficult to separate, as some *Braunsapis* have the clypeus gently concave dorsally; the extent of the concavity separates them. The most common species has very dark wings veins, hence it is called *Compsomelissa nigrinervis* Cameron. They occur in southern Africa (four species). The 18 Malagasy species, previously placed in *Halterapis*, are now all placed in a new endemic genus *Hasinamelissa* Chenoweth & Schwarz (Chenoweth *et al*., 2008).

Genus *Eucondylops* Brauns (Fig. 36F)

Eucondylops does not have a Vein 2m-cu in the forewing.

Genus *Macrogalea* Cockerell (Fig. 36G-H)

Macrogalea has a long proboscis. The males have large eyes, but they do not touch above. There are four African species; at least one is a social parasite on another *Macrogalea* species, and six Madagascan species.

Genus *Nasutapis* Michener (Fig. 36E)

Nasutapis has a distinct projection medioventrally on the clypeus. This genus is monotypic (*Nasutapis straussorum* Michener) and endemic to KwaZulu-Natal, South Africa, and found in nests of *Braunsapis facialis* (Gerstaecker).

8.6.2. Subfamily Nomadinae

In sub-Saharan Africa the Nomadinae comprises four tribes and six genera. They are all cleptoparasitic. Diagnostic features for the subfamily are difficult to define, but almost each tribe has a distinctive feature, except Ammobatoidini.

8.6.2.1. Tribe Nomadini

Genus *Nomada* Scopoli (Fig. 37A)

Nomadini has one genus in sub-Saharan Africa, namely *Nomada*. There are ten species, occurring mostly in North-East and southern Africa.

8.6.2.2. Tribe Epeolini

Genus *Epeolus* Latreille (Fig. 37B)

Epeolini has one genus in sub-Saharan Africa, namely *Epeolus*. There are 13 species that occur mostly on the east side of the continent, along its entire length.

8.6.2.3. Tribe Ammobatoidini

Genus *Ammobatoides* Radoszkowski (Fig. 37C)

Ammobatoidini has one genus in sub-Saharan Africa, and it is known only from the holotype of *Ammobatoides braunsi* Bischoff. It was collected in Willowmore, South Africa. It therefore goes without saying that it is extremely rare.

8.6.2.4. Tribe Ammobatini

The Ammobatini has four sub-Saharan genera. They all comprise cleptoparasitic bees. *Ammobates* has its centre of diversity in the Palaearctic, as does *Chiasmognathus*, which occurs just north of the Afrotropical Region and intrudes into sub-Saharan Africa. *Pasites* is mostly Afrotropical and *Sphecodopsis* is endemic to southern Africa.

Genus *Ammobates* Latreille (Fig. 37D)

This genus has one species, *Ammobates auster* Eardley. It was described from a few specimens that are widely distributed in southern Africa, but also occurs in East Africa (unpublished records, Schwarz collection, Austria).

Genus *Pasites* Jurine (Fig. 37E)

Pasites occur throughout the Afrotropical Region, and this area is its centre of diversity. There are 18 Afrotropical species, and one additional species that occurrs through much of southern Asia.

Genus *Chiasmognathus* Engel

The genus *Chiasmognathus* consists of minute bees (2 mm) who victimize nests of the equally diminutive bees of the subfamily Nomioidinae. There are ten described species. Engel (2010) reported the first species of the genus from sub-Saharan Africa, based on a male collected in southwestern Niger.

Genus *Sphecodopsis* Bischoff (Fig. 37F)

Sphecodopsis is endemic to southern Africa. The diagnostic feature is crossed mandibles, when in repose. There are two subgenera that can only be separated using characters of the female.

Key to the subgenera of *Sphecodopsis*

1. Female tergum 6 forming a slender spine . . . . **Sphecodopsis (Pseudodichroa)**

1'. Female tergum 6 bifurcate . . . .***Sphecodopsis*** **(*Sphecodopsis*)**

Subgenus *Sphecodopsis* (*Pseudodichroa*)

Subgenus *Sphecodopsis* (*Pseudodichroa)* has two species that are endemic to the Western Cape Province, South Africa. One species *Sphecodopsis fumipennis* (Bischoff) is recorded as a parasite of *Scrapter erubescens* (Friese). They are most commonly collected late in the afternoon when their host is also on the wing. The subgenus is easy to recognise, but the species are difficult to separate.

Subgenus *Sphecodopsis* (*Sphecodopsis*) Bischoff

This subgenus is more widespread, occuring through much of the xeric regions of South Africa, and diverse, having 12 species.

8.6.2.5. Tribe Biastini

Genus *Schwarzia* Eardley (Fig. 37G)

Schwarzia is the only Afrotropical genus of Biastini and it is known from one East African species, *Schwarzia emmae* Eardley. The tribe comprises cleptoparasitic bees, and this species possibly parasitises *Systropha*.

8.6.3. Subfamily Apinae

The Apinae comprises six tribes and 16 genera. They cannot be defined by a few distinctive characters (Michener 2007), neither morphological nor behavioural.

There are social species, cleptoparasites, robbers, oil collectors and pollen collectors, including all the corbiculate bees.

8.6.3.1. Tribe Ancylaini

Genus *Ancyla* Lepeletier (Fig. 38A-B)

This genus is mostly Asian, occuring in Sudan and possibly southern Sudan, which is Afrotropical.

8.6.3.2. Tribe Ctenoplectrini

The Ctenoplectrini tongue is intermediate between long and short-tongued bees, together with Ancylaini. Phylogenetic studies, however, indicate that they belong to the long-tongued bee family Apidae (Michener 2007). Some are pollen collectors and others are cleptoparasitic.

Genus *Ctenoplectra* Kirby (Fig. 38C-D)

Ctenoplectra is a pollen and oil collecting bee, and therefore has a scopa and well developed oil collecting hairs on the metasomal venter. The anterior hind tibial spur is greatly expanded basally (sickle-shaped). Some are metallic blue or green and one species has pale integument bands on the distal margins of the metasomal terga. There are five widespread species, but as with *Ctenoplectrina* it is more common in tropical areas.

Genus *Ctenoplectrina* Cockerell (Fig. 38E-F)

Ctenoplectrina is cleptoparasitic and does not have a scopa in the female. The oil collecting hairs are reduced. There are two widespread species, but they appear to be more common in tropical areas.

8.6.3.3. Tribe Eucerini

Eucerini are large, hairy bees. They are ground nesting and collect pollen.

Genus *Tetralonia* Spinola (Fig. 39A-B)

Tetralonia comprises two subgenera; *Tetralonia* (*Eucara*) and *Tetralonia* (*Thygatina*). There are 15 species. It appears as if they collect pollen mostly from plants of the family Malvaceae.

Key to the subgenera of *Tetralonia*

1. Ventral edge of clypeus concave mesally, gently convex laterally; female scopa very sparse; male hind leg with posterior tibial spur usually either curved or swollen near base, and/or basitarsus with a tuft of long hair basoventrally . . . .***Tetralonia* (*Eucara*)**

1’. Ventral edge of clypeus entirely concave; female scopa not very sparse, but not as dense as in *Tetraloniella*; male hind leg not modified as described above . . . .***Tetralonia* (*Thygatina*)**

Subgenus *Tetralonia* (*Eucara*) Friese

This subgenus is endemic to sub-Saharan Africa and widespread, yet uncommon. There are seven species.

Subgenus *Tetralonia* (*Thygatina*) Cockerell

Tetralonia (*Thygatina*) is widespread in sub-Saharan Africa, and also occurs in southern India and Sri Lanka. It is not frequently collected. There are seven species.

Genus *Tetraloniella* Ashmead (Fig. 39C-D)

Subgenus *Tetraloniella* (*Tetraloniella*) Ashmead

Only the nominative subgenus of *Tetraloniella* occurs in Africa and it has 33 species. They are widespread and common. All bees with a male antennal flagellum longer than three times the eye's length belong to this genus. Hence their common name is long-horned bees.

8.6.3.4. Tribe Anthophorini

Anthophorini are large, hairy bees; solitary, ground nesting, pollen collectors. There are three genera.

Genus *Amegilla* Friese (Fig. 40A-B)

Amegilla has one subgenus with 71 species. They are widespread, common and visit flowers of a large variety of plants.

Genus *Anthophora* Latreille (Fig. 40C-D)

Anthophora has three subgenera (*Heliophila, Paramegilla* and *Pyganthophora*) with a total of 54 species. They are widespread and fairly common.

Key to the subgenera of *Anthophora*

1. Female with upper, posterior margin of hind tibia with simple hair; male labrum mostly with two small, subapical, median tubercles and/or tergum 7 without distinct teeth or lobes posteriorly . . . .***Anthophora* (*Heliophila*)**

1'. Female upper, posterior margin of hind tibia with plumose hair; male labrum without tubercles; tergum 7 with submedian teeth **2**

2. Female either with metasomal apical hair bands interrupted medially or metasomal dorsum with appressed hair; male without basitibial plate, if present then pygidial plate and lateral tooth below pygidial plate absent . . . . ***Anthophora* (*Paramegilla*)**

2'. Female with metasomal apical hair bands complete and/or surface covered with erect hair; male with basitibial plate . . . . ***Anthophora* (*Pyganthophora*)**

Subgenus *Anthophora (Heliophila)* Klug

The subgenus *Anthophora* (*Heliophila*) comprises the small common *Anthophora*. They occur throughout Africa, and through much of the Holarctic Region. They mostly have yellow clypeal maculation. Thirty-nine species occur in sub-Saharan Africa.

Subgenus *Anthophora (Paramegilla)* Friese

These are the large, black faced *Anthophora* that are usually found in deserts and dry savannah in Africa. They also occur in the Holarctic Region. Seven species occur in sub-Saharan Africa.

Subgenus *Anthophora (Pyganthophora)* Brooks

In the Afrotropical Region this subgenus is confined to the southern part of South Africa. However, it also occurs in much of the Holarctic Region. There are seven African species.

Pachymelus Smith (Genus) (Fig. 40E-F)

Pachymelus are large bees. Bigger than the average *Anthophora* or *Amegilla*. There are two subgenera.

Key to the subgenera of *Pachymelus*

1. Aerolia absent . . . . ***Pachymelus*** **(*Pachymelopsis*)**
1'. Aerolia present . . . . ***Pachymelus (Pachymelus)***

Subgenus *Pachymelus (Pachymelopsis)* Cockerell

The subgenus *Pachymelus* (*Pachymelopsis*) is wide spread in southern and East Africa. There are four species.

Subgenus *Pachymelus (Pachymelus)* Smith

This subgenus is mostly Madagascan (18 species), except for one species *Pachymelus peringueyi* (Friese) that occurs near the west coast of South Africa.

8.6.3.5. Tribe Melectini

The Melectini are cleptoparasitic; laying their eggs in other bees provisioned cells.

Genus *Afromelecta* Lieftinck (Fig. 41A-B)

Afromelecta comprises two subgenera (*Acanthomelecta* and *Afromelecta*) and three species**.**

Key to the subgenera of *Afromelecta*

1. Maxillar palpus six-segmented; scutellar spines as long as scutellum . . . . ***Afromelecta* (*Acanthomelecta*)**

1'. Maxillar palpus minute, one or two-segmented; scutellar spines about half as long as scutellum . . . . ***Afromelecta* (*Afromelecta*)**

Subgenus *Afromelecta (Acanthomelecta)* Lieftinck

This subgenus is only known from *Afromelecta bicuspis* (Stadelmann) that occurs in Tanzania.

Subgenus *Afromelecta* (*Afromelecta*) Lieftinck

Afromelecta s. str. has two species that occur along the eastern region of Africa.

Genus *Thyreus* Panzer (Fig. 41C-D)

Thyreus are widespread in the Old World. There are 40 species in sub-Saharan Africa. They often have pale blue vestiture, which is metallic in some tropical species.

8.6.3.6. Tribe Meliponini

Meliponini are the stingless bees. They are social and frequently nest in cavities. Mostly their comb is horizontal and surrounded by pots for the storage of honey and pollen. They collect pollen and nectar from flowers, except *Cleptotrigona*, which is a robber bee. Little has been written about their social structure and nesting biology in Africa, although much has been done for the South American species. There are six Afrotropical genera. Keeping stingless bees is called meliponiculture and this is practiced sporadically in Africa, although widely practiced in South America. The species are morphologically similar and certainly some new cryptic species await discovery, especially in the genera *Hypotrigona* and *Liotrigona*.

Genus *Cleptotrigona* Moure (Fig. 42A)

There is one species of *Cleptotrigona* that occurs throughout sub-Saharan Africa, *Cleptotrigona cubiceps* (Friese). It is a robber bee (cleptoparasitic), stealing pollen and nectar from other stingless bee's nests (*Hypotrigona* and probably *Liotrigona*) for the provision of its own nests in tree cavities. They are widely distributed in Africa through the tropics and the savannah.

Genus *Dactylurina* Cockerell (Fig. 42B)

There are two species of *Dactylurina*. They occur through most of tropical Africa. They have exposed nests, often in the fork between tree branches, enclosed in an envelope of batumen and they have vertical comb.

Genus *Hypotrigona* Cockerell (Fig. 42C)

There are four *Hypotrigona* species. They nest in small tree cavities in the tropical areas of Africa, mostly in savannah vegetation. They are all tiny bees and, with *Liotrigona*, they are frequently called sweat bees because they are bothersome to people in hot weather. In South Africa they are also known as mopani bees or mocca bees.

Genus *Liotrigona* Moure

Liotrigona has two described species in Africa and six in Madagascar. At least two additional species in Africa are awaiting description. They are minute bees, and as with *Hypotrigona*, they are frequently called sweat bees. They nest in small tree cavities through much of the tropical areas of Africa, occurring also in savannah and deserts.

Genus *Meliponula* Cockerell (Fig. 42E)

Meliponula is the most diverse African stingless bee genus with nine species, and it has the largest species. It is divided into three subgenera; *Axestotrigona, Meliplebeia* and *Meliponula*. They nest in tree cavities and in the ground, and the comb, at least sometimes, is irregular. They occur in tropical Africa, mostly in forested areas and savannah.

Key to the subgenera of *Meliponula*.

1. Propodeal profile largely vertical; corbicula occupying less than distal half of hind tibia . . . . ***Meliponula* (*Meliponula*)**

1’. Propodeal, in profile, slanting dorsally; corbicula occupying more than distal half of hind tibia **2**

2. Face without yellow markings . . . . ***Meliponula* (*Axestotrigona*)**

2’. Face with yellow markings . . . .***Meliponula* (*Meliplebeia*)**

Subgenus *Meliponula (Axestotrigona)* Moure

These are the largest African stingless bees (two species). Some are black, *Meliponula cameroonensis* (Friese), and some are brown, *Meliponula ferruginea* (Lepeletier). They occur in tropical wooded areas.

Subgenus *Meliponula (Meliponula)* Cockerell

Meliponula bocandei (Spinola), the only included species, is a medium sized, relatively common, stingless bee. It occurs mostly in wooded, tropical areas.

Subgenus *Meliponula (Meliplebeia)* Moure

Meliplebeia are generally smaller than *Meliponula* s. str. and often less hairy. There are six species. They also occur in wooded areas.

Genus *Plebeina* Moure (Fig. 42F)

Plebeina is monotypic with *Plebeina hildebrandti* (Friese) being the only species. They occur widely through the eastern region of Africa and are common. They often nest in termite mounds.

8.6.3.7. Tribe Apini

These are the honey bees. They occur through much of the Old World. Five species occur in Asia and one in both Europe and Africa, although *Apis florea* Fabricius intrudes into North Africa. They are all social, pollen collectors and have vertical comb. Much has been written about their social biology and methods of communications. They are very important to agriculture as pollinators and honey producers.

Genus *Apis* Linnaeus (Fig. 43A-B)

The Apini is represented in Africa by two species. One is the honey bee or *Apis mellifera* Linnaeus. There are, however, a number of subspecies (Hepburn & Radloff, 1998). They occur throughout Africa. They are commonly kept in hives (keeping honey bees is called apiculture) for honey production and pollination. The other species, *Apis florea*, is only known from parts of North-East Africa.

Key to cleptoparasitic long-tongued bees (females only)

1. Two or fewer submarginal cells in forewing **2**
1'. Three submarginal cells in forewing **17**

2. One closed submarginal cell in forewing . . . . ***Cleptotrigona***
2'. Two closed submarinal cells in forewing **3**

3. Metanotum with prominent median tubercle . . . . ***Aglaoapis***
3'. Metanotum flat to gently curved **4**

4. Metasomal venter with oil collecting hairs on S3-S5 . . . . . ***Ctenoplectrina***
4'. Metasomal venter without oil collecting hairs **5**

5. Sternum 6 with a small gutter posteromedially **6**
5'. Sternum 6 not modified **7**

6. Mandibles cross in repose . . . . ***Sphecodopsis***
6'. Mandibles overlap in repose . . . . ***Ammobates***

7. Clypeus with distinct tubercle medioventrally . . . . ***Nasutapis***
7'. Clypeus not tuberculate **8**

8. Clypeus above epistomal pits about parallel sided **9**
8'. Clypeus above epistomal pits converges mesally **10**

9. Body slender and largely naked . . . . ***Eucondylops***
9'. Body robust and hairy . . . . ***Macrogalea***

10. Marginal cell of forewing truncate apically . . . . ***Chiasmognathus***
10'. Marginal cell rounded apically **11**

11. Face with two juxtantennal, longitudinal carinae, and a median, longitudinal carina between antennal sockets . . . . ***Euaspis***
11'. Face without medio-longitudinal carinae **12**

12. Axilla pointed . . . . ***Larinostelis***
12'. Axilla rounded **13**

13. Pterostigma more than twice as long as wide ***14***
13'. Pterostigma about twice as long as wide **15**

14. Metasoma cone-shaped, elongate . . . . ***Coelioxys***
14'. Metasoma more compressed, shorter . . . . ***Schwarzia***

15. Tegula enlarged . . . .***Afrostelis***
15'. Tegula not enlarged **16**

16. Body black, without yellow markings (African) . . . .***Stelis***
16'. Body with yellow markings (endemic to Sokotra) . . . .***Xenostelis***

17. Scutellum strongly laminate . . . .***Thyreus***
17'. Scutellum not laminate **18**

18. Distal parts of wings, beyond venation, hairless and coarsely papillate; scutellum spinose . . . . ***Afromelecta***
18'. Distal parts of wings hairy; scutellum gently rounded or tuberculate . . .**19**

19. Middle coxa much shorter than distance between its summit and posterior wing base . . . . ***Ammobatoides***
19'. Middle coxa at least nearly as long as distance between its summit and base of hind wing **20**

20. Tergum 5 with pseudopygidium . . . .***Epeolus***
20'. Tergum 5 without pseudopygidium **21**

21. Sternum 6 with a conical concavity posteromesally. . . . .***Pasites***
21'. Sternum 6 entire posteromesally . . . .***Nomada***

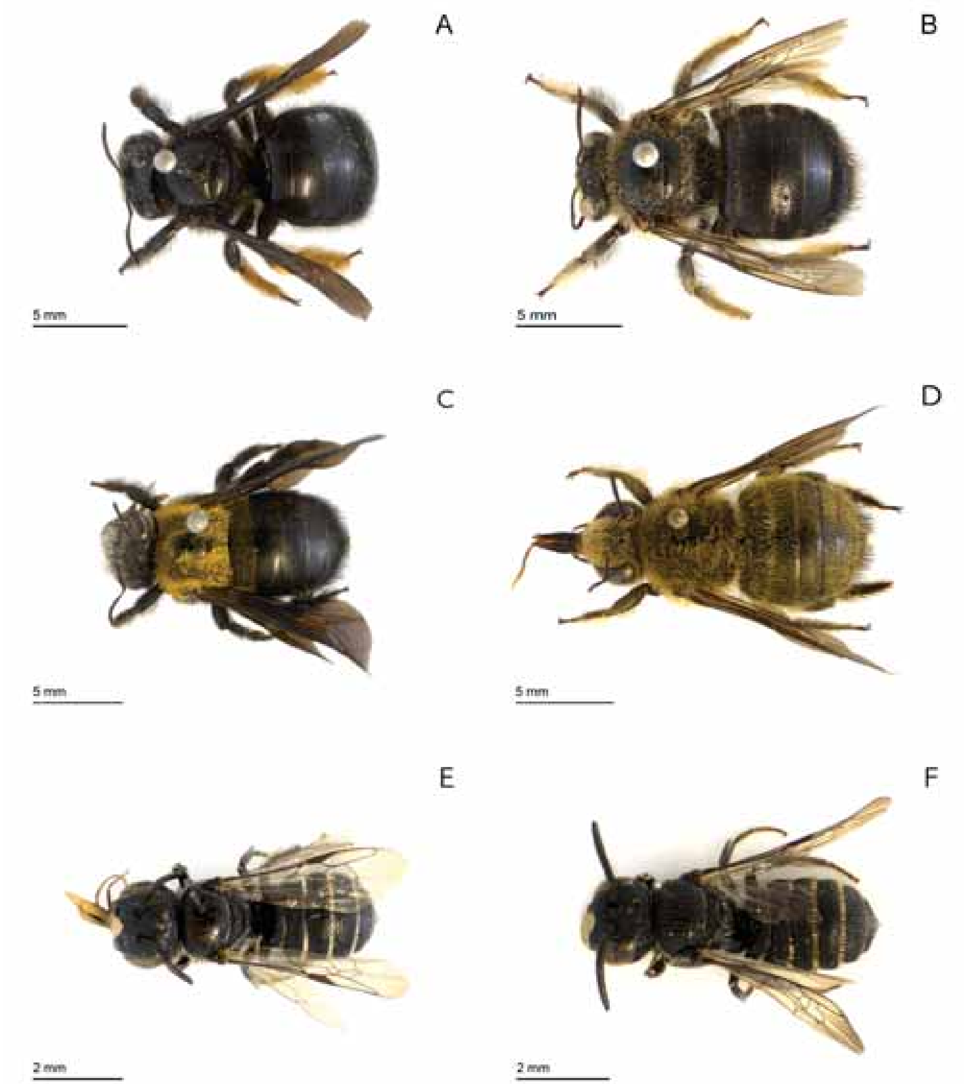


Fig. 35. A-B. *Xylocopa lugubris* Gerstaecker. A. Female; B. Male; C-D. *Xylocopa scioensis* Gribodo: C. Female; D. Male; E-F. *Ceratina moerenhouti* Vachal: E. Female; F. Male.

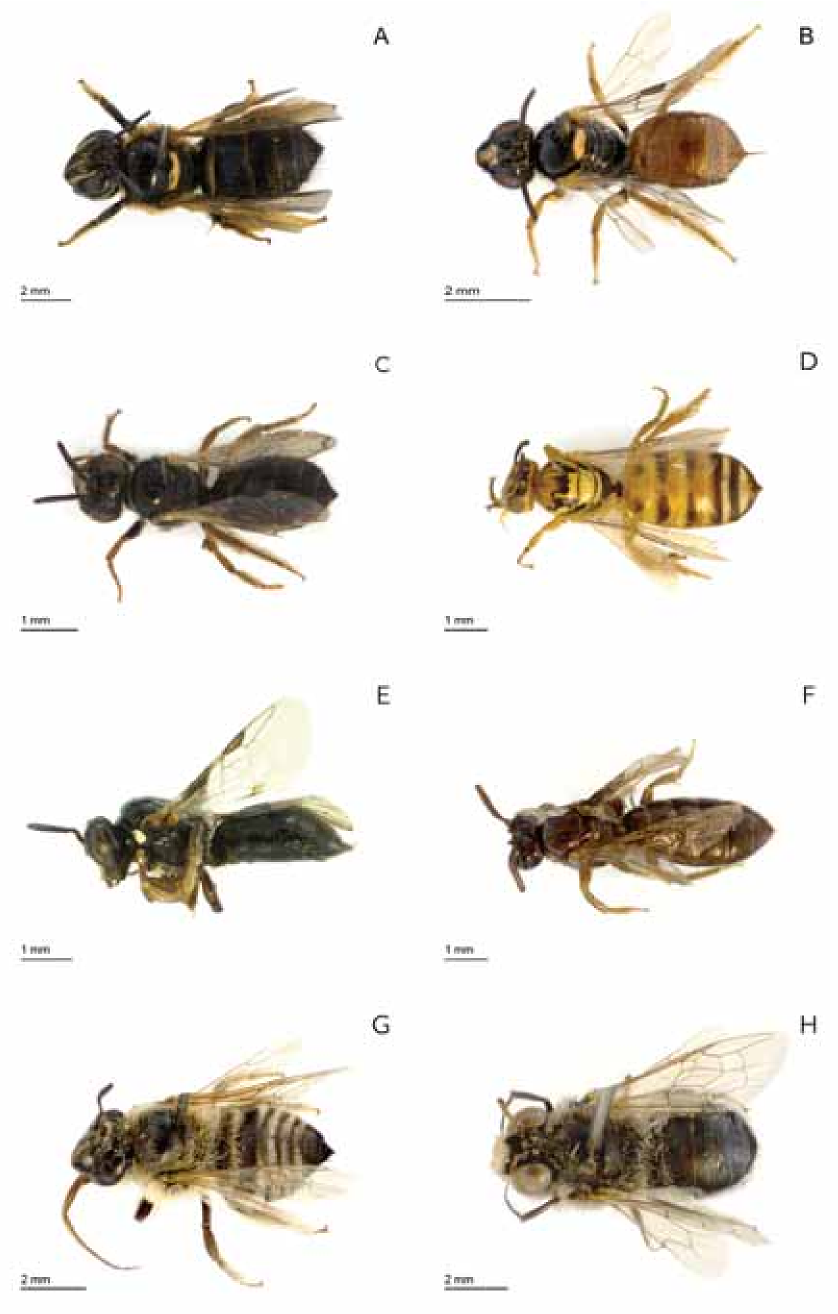


Fig. 36. A. *Allodape punctata* (Lepeletier & Serville), female; B. *Allodapula variegata* (Smith), female; C. *Braunsapis bouyssouri* (Vachal), female; D. *Compsomelissa zaxantha* (Cockerell), female; E. *Nasutapis straussorum* Michener, female; F. *Eucondylops konowi* Brauns, female; G-H. *Macrogalea candida* (Smith): G. Female; H. Male.

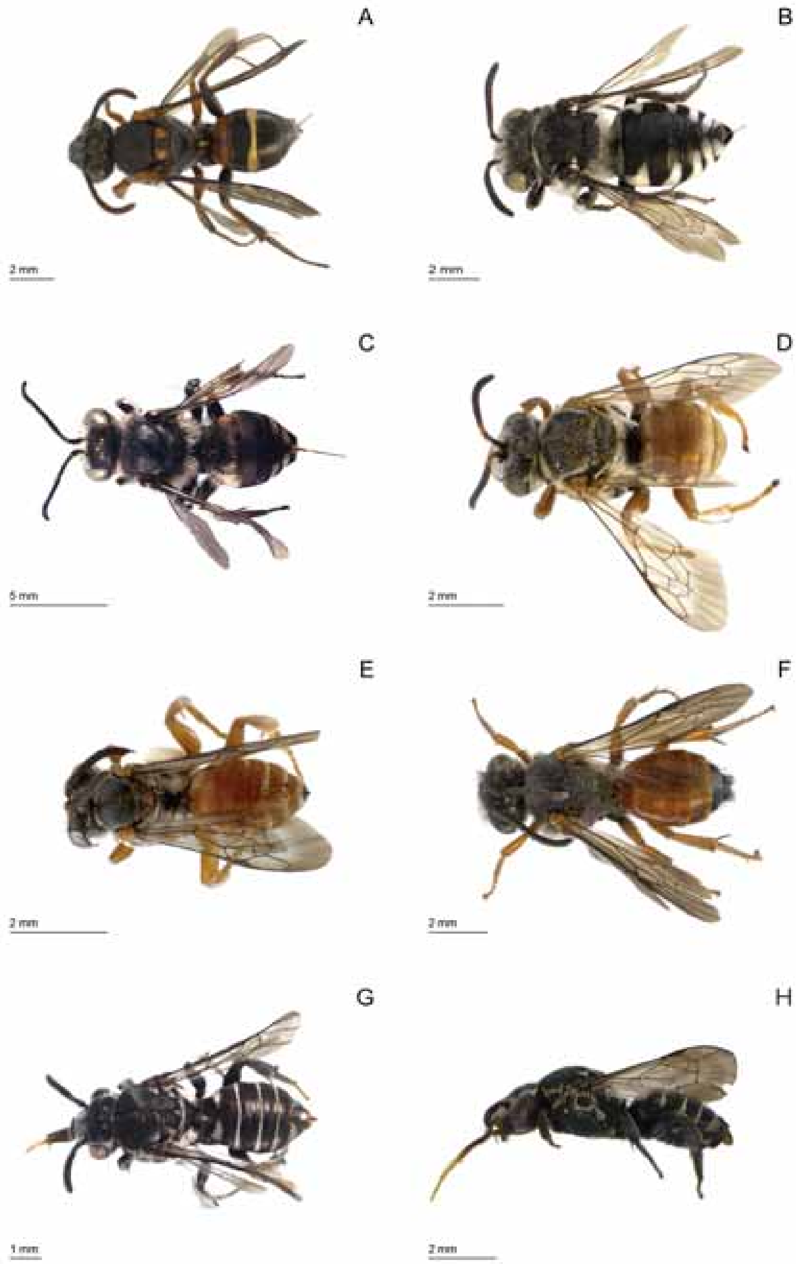


Fig. 37. A. *Nomada gigas* Friese, female; B. *Epeolus natalensis* Smith, female; C. *Ammobatoides scriptus* (Gerstäcker), female; D. *Ammobates auster* Eardley, female; E. *Pasites appletoni* (Cockerell), female; F. *Sphecodopsis vespericena* Eardley, female; G-H. *Schwarzia emmae* Eardley. G. Female. H. Male.

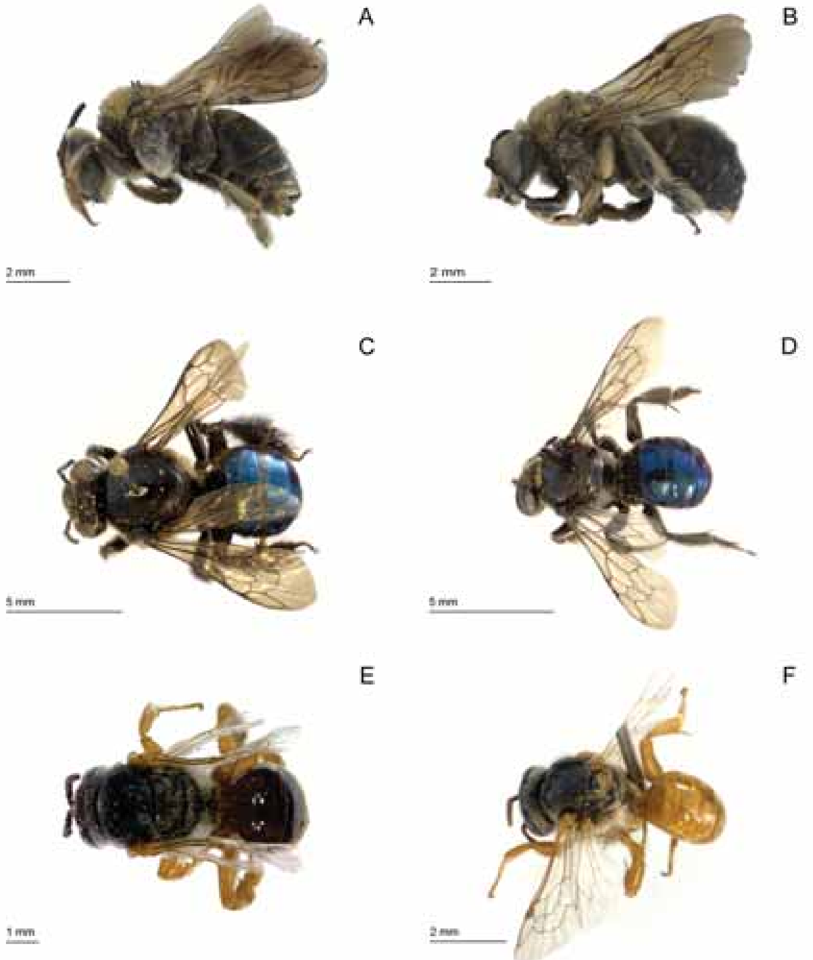


Fig. 38. A-B. *Ancyla* sp.: A. Female; B. Male. C-D. *Ctenoplectra bequaerti* Cockerell: C. Female; D. Male; E-F. *Ctenoplectrina politula* (Cockerell): E. Female; F. Male.

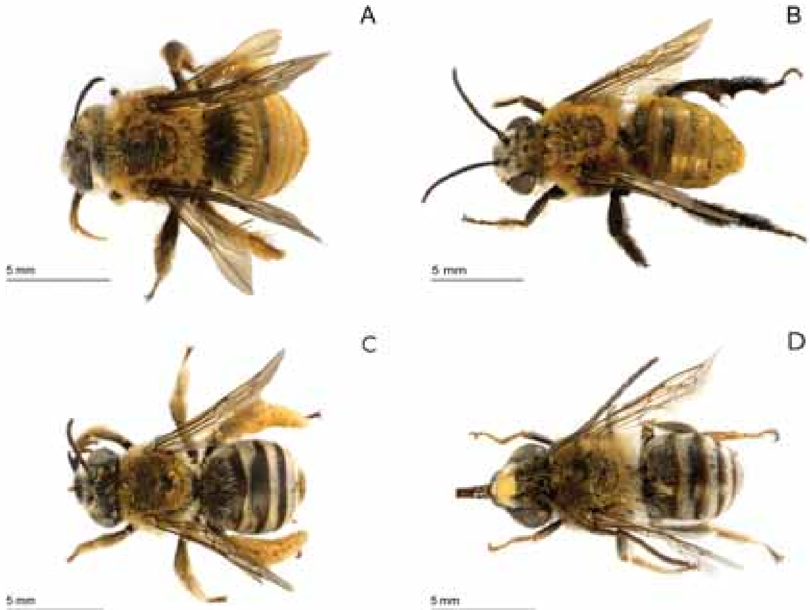


Fig. 39. A-B. *Tetralonia macrognatha* (Gerstaecker): A. Female; B. Male; *Tetraloniella braunsiana* (Friese): C. Female; D. Male.

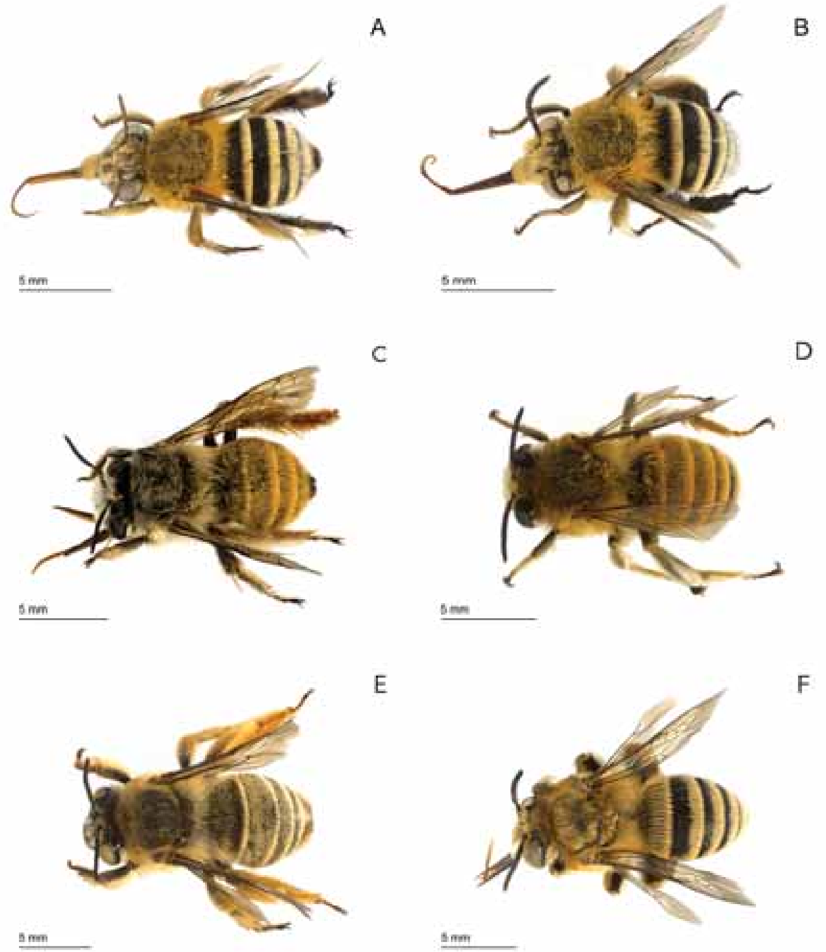


Fig. 40. A-B. *Amegilla calens* (Lepeletier). A. Female; B. Male; C-D. *Anthophora vestita* Smith: C. Female; D. Male E-F; *Pachymelus festivus* (Dours); E. Female; F. Male.

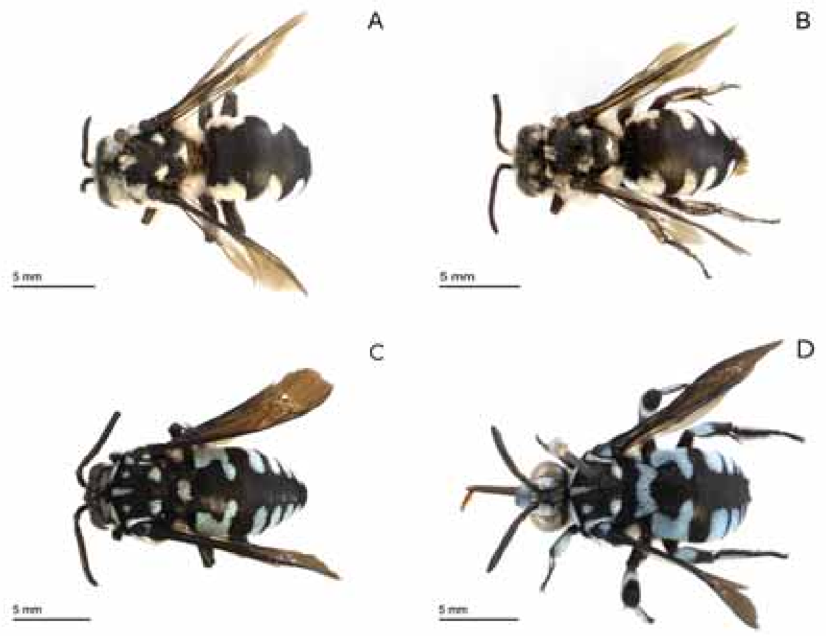


Fig. 41. A-B. *Afromelecta fulvohirta* (Cameron). A. Female. B. Male; C-D. *Thyreus pictus* (Smith); C. Female; D. Male.

Fig. 42. A. *Cleptotrigona cubiceps* (Friese), worker; B. *Dactylurina staudingeri* (Gribodo), worker; C. *Hypotrigona gribodoi* (Magretti), worker; D-E. *Meliponula beccarii* (Gribodo); D. Worker. E. Male; F. *Plebeina denoiti* (Vachal), worker.

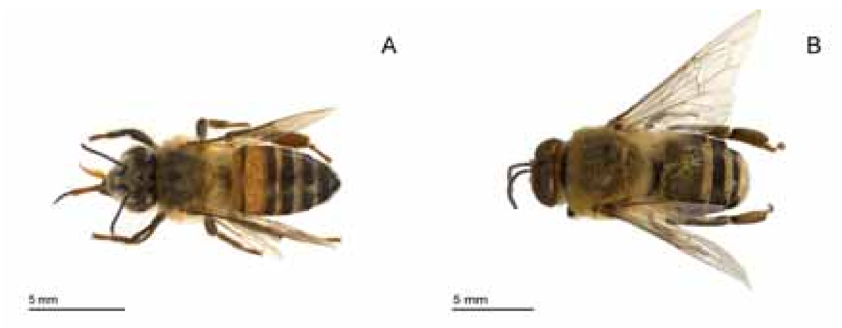


Fig. 43. A-B. *Apis mellifera* Linnaeus. A. Worker; B. Male.

9. Conclusion

Understanding the interactions between organisms is key to the conservation of biological diversity and sustainable management. Gaining knowledge on ecosystem interactions involved identifying the organisms involved. Although the identification is important for recording data and communicating information, it also unlocks information on the species concerned. For example the identity of a bee will enable the researcher to find out much about its nesting biology and/or host plant preferences. Similarly, in bee/plant interactions the plant's identity is also important. The sooner one identifies the species involved the greater the probability of a worthwhile project reaching completion.

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11. Acknowledgements

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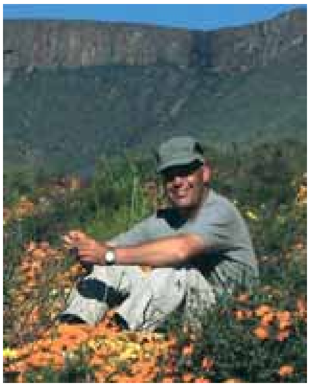
12. About the authors

Connal Eardley (°1954) has worked for 32 years as a bee taxonomist with the Plant Protection Research Institute. His primary research interest is in Afrotropical bees. However, he is keenly interested in the conservation of pollinator biodiversity. He has published over 90 scientific articles, many of them taxonomic revisions of bee genera, and contributed to several books on bee conservation and the importance of bees in natural and agro-ecosystems.



Michael Kuhlmann (°1968) is research entomologist at the Department of Entomology in The Natural History Museum in London. He has a special interest in sub-Saharan African solitary bee taxonomy, systematics, ecology and biogeography as well as global diversity patterns and plant-pollinator interactions as a driving force in evolution and speciation.

Alain Pauly (°1954) is a research associate at the Royal Belgian Institute of Natural Sciences, Brussels. He has conducted numerous field trips in West and Central Africa to study the diversity of bees. He is the first author of the volume 'Bees of Madagascar' and various publications on systematics of bees from Africa, especially in the family Halictidae.

Appendix 1 – Families, subfamilies, genera and subgenera of the bees of sub-saharan Africa with numbers of described species per genus and publications that may be used to identify the species. Species numbers from Eardley & Urban (in press).

Family and Subfamily	Genus	Subgenus	No. sp.	Reference needed to identify species
Colletidae				
Colletinae	*Colletes*		64	Kuhlmann (2005, 2007 (part)). Being revised by Kuhlmann.
Colletinae	*Scrapter*		43	Eardley (1996); Davies *et al.* (2005); Davies & Brothers (2006).
Hylaeinae	*Calloprosopis*		1	Snelling (1985). Being revised by Dathe.
Hylaeinae	*Hylaeus*	*Alfkenylaeus* *Cornylaeus* *Deranchylaeus* *Metylaeus* *Nothylaeus* *Prosopisteron*	86	Snelling (1985). Being revised by Dathe.
Andrenidae				
Andreninae	*Andrena*		10	Eardley (2007, part).
Panurginae	*Borgatomelissa*		1	Patiny (2000b).
Panurginae	*Melitturga*		4	Eardley (1991c); Patiny (2004a & c).
Panurginae	*Meliturgula*		10	Eardley (1991c, 2009a); Patiny (1999a & b, 2000a); Eardley 2009a.
Panurginae	*Mermiglossa*		1	Eardley (1991c).
Halictidae				
Rophitinae	*Systropha*		9	Patiny (2004b); Patiny & Michez (2006).
Nomiinae	*Lipotriches*	*Afronomia* *Austronomia*	135	Pauly (1980b, 1990 (*Afronomia*,

		Lipotriches *Macronomia* *Maynenomia* *Nubenomia* *Trinomia*		*Maynenomia*), Pauly (1999a (*Trinomia*)), Pauly (2003 (*Nubenomia*)). *Austronomia*, *Lipotriches* and *Macronomia* being revised by Pauly.
Nomiinae	*Nomia*	*Acunomia* *Crocisaspidia* *Leuconomia* *Nomia*	66	Pauly (1980b, 1990 (*Acunomia*, *Crocisaspidia*)), Pauly (2000 (*Leuconomia*)), Pauly (2008b (*Nomia*).
Nomiinae	*Pseudapis*	*Pachynomia* *Pseudapis*	31	Pauly (1990).
Nomiinae	*Spatunomia*		2	Pauly (1990).
Nomiinae	*Steganomus*		4	Pauly 1990).
Nomioidinae	*Cellariella*		5	Pesenko & Pauly (2005).
Nomioidina	*Ceylalictus*	*Atronomioides* *Ceylalictus* *Meganomioides*	8	Pesenko & Pauly (2005).
Nomioidina	*Nomioides*		8	Pesenko & Pauly (2005).
Halictinae	*Eupetersia*	*Eupetersia* *Nesoeupetersia*	21	Blüthgen (1928, 1936); Pauly (1981b (*Calleupetersia*).
Halictinae	*Glossodialictus*		1	Pauly (1984c).
Halictinae	*Seladonia*	*Seladonia* *Paraseladonia*	19	Pauly (1997) (Paraseladonia); Pauly (2008a (catalogue)).
Halictinae	*Lasioglossum*	*Ctenonomia* *Ipomalictus* *Oxyhalictus* *Afrodialictus* *Paradialictus* *Sellalictus*	236	Pauly (1999a (catalogue)), Pauly (1980a, 1984a (*Ctenonomia*, part)), Pauly (1981a (*Labrohalictus*)), Pauly (1984b), Arduser & Michener (1987 (*Paradialictus*)), Pauly (2001 (*Ipomalictus*, part)), Pauly *et al.*

				(2008 *Sellalictus*, part)), being revised by Pauly).
Halictinae	*Patellapis*	*Chaetalictus* *Dictyohalictus* *Lomatalictus* *Patellapis* *Zonalictus*	150	Pauly (1989, 2007 (*Dictyohalictus*)), Timmermann & Kuhlmann (2008, 2009 (*Patellapis*, *Chaetalictus*, *Lomatalictus*)). *Zonalictus* needs revision.
Halictinae	*Sphecodes*		45	Needs revision.
Halictinae	*Thrinchostoma*	*Diagonozus* *Eothrincostoma* *Thrinchostoma*	25	Blüthgen (1930, 1933). Being revised by Eardley *et al.*
Melittidae				
Dasypodainae	*Afrodasypoda*		1	Engel (2005).
Dasypodainae	*Capicola*	*Capicola* *Capicoloides*	13	Michez *et al.* (2007); Michez & Kuhlmann (2007).
Dasypodainae	*Samba*		1	Michez *et al.* (submitted).
Dasypodainae	*Haplomelitta*	*Atrosamba* *Haplomelitta* *Metasamba* *Prosamba*	6	Michez *et al.* (submitted).
Meganomiinae	*Ceratomonia*		1	Michener (1981).
Meganomiinae	*Meganomia*		4	Michener (1981).
Meganomiinae	*Pseudophilanthus*	*Pseudophilanthus*	3	Michener (1981).
Meganomiinae	*Uromonia*		1	Michener (1981).
Melittinae	*Melitta*		8	Eardley & Kuhlmann (2006); Michez & Eardley (2007).
Melittinae	*Rediviva*		26	Whitehead & Steiner (2001), Whitehead *et al.* (2008).
Melittinae	*Redivivoides*		1	Being revised by Eardley.
Megachilidae				

Fideliinae	*Fidelia*	*Fidelia* *Fideliana* *Fideliopsis* *Parafidelia*	11	Whitehead & Eardley (2003).
Megachilinae	*Lithurgus*		4	Eardley (1988).
Megachilinae	*Afroheriades*		6	Needs revision.
Megachilinae	*Haetosmia*		1	Peters (1974).
Megachilinae	*Heriades*	*Amboheriades* *Heriades* *Michenerella* *Pachyheriades* *Toxeriades* *Tyttheriades*	93	Needs revision.
Megachilinae	*Hoplitis*	*Annosmia* *Anthocopa* *Bytinskia* *Pentadentosmia*	4	Warncke (1991a, b (*Annosmia*, *Pentadentosmia*)). Needs revision.
Megachilinae	*Noteriades*		11	Needs revision.
Megachilinae	*Ochreriades*		1	Griswold (1994a).
Megachilinae	*Othinosmia*	*Afrosmia* *Megaloheriades* *Othinosmia*	12	Griswold (1994b). (*Afrosmia*). Needs revision.
Megachilinae	*Pseudoheriades*		3	Needs revision.
Megachilinae	*Stenoheriades*		5	Griswold (1994b (part)). Needs revision.
Megachilinae	*Wainia*	*Caposmia* *Wainia* *Wainiella*	4	Peters (1984) (*Caposmia*).Needs revision.
Megachilinae	*Afranthidium*	*Afranthidium* *Branthidium* *Capanthidium* *Domanthidium* *Immanthidium*	44	Pasteels (1984). Being revised by Eardley and Griswold.

		Mesanthidiellum *Nigranthidium* *Oranthidium* *Xenanthidium* *Zosteranthidium*		
Megachilinae	*Afrostelis*		5	Pasteels (1984). Being revised by Eardley and Griswold.
Megachilinae	*Anthidiellum*	*Anthidiellum* *Chloranthidiellum* *Pycnanthidium*	15	Pasteels (1984). Being revised by Eardley and Griswold.
Megachilinae	*Anthidioma*		2	Pasteels (1984). Being revised by Eardley and Griswold.
Megachilinae	*Anthidium*	*Anthidium* *Nivanthidium* *Severanthidium*	22	Pasteels (1984). Being revised by Eardley and Griswold.
Megachilinae	*Aspidosmia*		2	Peters (1972).
Megachilinae	*Cyphanthidium*		2	Pasteels (1984). Being revised by Eardley and Griswold.
Megachilinae	*Eoanthidium*	*Clistanthidium* *Eoanthidium*	4	Pasteels (1984). Being revised by Eardley and Griswold.
Megachilinae	*Euaspis*		2	Pasteels (1984). Being revised by Eardley and Griswold.
Megachilinae	*Gnathanthidium*		1	Pasteels (1984). Being revised by Eardley and Griswold.
Megachilinae	*Icteranthidium*		1	Pasteels (1984). Being revised by Eardley and Griswold.
Megachilinae	*Larinostelis*		1	Pasteels (1984). Being revised by Eardley and Griswold.
Megachilinae	*Pachyanthidium*	*Ausanthidium* *Pachyanthidium* *Trichanthidioides*	16	Pasteels (1984). Being revised by Eardley and Griswold.

		Trichanthidium		
Megachilinae	*Plesianthidium*	*Carinanthidium* *Plesianthidium* *Spinanthidiellum* *Spinanthidium*	7	Pasteels (1984). Being revised by Eardley and Griswold.
Megachilinae	*Pseudoanthidium*	*Exanthidium* *Micranthidium* *Semicarinella* *Tuberanthidium*	8	Pasteels (1984). Being revised by Eardley and Griswold.
Megachilinae	*Serapista*		4	Pasteels 1984. Being revised by Eardley and Griswold.
Megachilinae	*Stelis*	*Stelidimorpha*	1	Griswold and Parker (2003). Being revised by Eardley and Griswold.
Megachilinae	*Trachusa*	*Congotrachusa* *Massanthidium* *Paraanthidium*	5	Pasteels (1984). Being revised by Eardley and Griswold.
Megachilinae	*Xenostelis*		1	Baker (1999).
Megachilinae	*Aglaoapis*		1	Michener (1996).
Megachilinae	*Coelioxys*	*Allocoelioxys* *Coelioxys* *Liothyrapis* *Torridapis*	98	Pasteels (1968). Being revised by Schwarz.
Megachilinae	*Megachile*	*Amegachile* *Callomegachile* *Chalicodoma* *Creightonella* *Cuspidella* *Eutricharaea* *Gronoceras* *Heriadopsis* *Largella* *Maximegachile*	405	Pasteels (1965). Being revised by Eardley (part).

		Megella *Paracella* *Platysta* *Pseudomegachile* *Stenomegachile*		
Apidae				
Xylocopinae	*Xylocopa*	*Ctenoxylocopa* *Gnathoxylocopa* *Koptortosoma* *Mesotrichia* *Xenoxylocopa* *Xylomelissa*	121	Eardley (1983, (southern Africa)).
Xylocopinae	*Ceratina*	*Ceratina* *Ctenoceratina* *Megaceratina* *Pithitis* *Protopithitis* *Simioceratina*	86	Daly (1988 (part)), Eardley & Daly (2007 (southern Africa)).
Xylocopinae	*Allodape*		35	Michener (1975).
Xylocopinae	*Allodapula*	*Allodapula* *Allodapulodes* *Dalloapula*	16	Michener (1975).
Xylocopinae	*Braunsapis*		40	Michener (1975).
Xylocopinae	*Compsomelissa*	*Compsomelissa* *Halterapis*	9	Michener (1975).
Xylocopinae	*Eucondylops*		2	Michener (1975).
Xylocopinae	*Macrogalea*		4	Michener (1975).
Xylocopinae	*Nasutapis*		1	Michener (1975).
Nomadinae	*Nomada*		10	Eardley & Schwarz (1991).
Nomadinae	*Epeolus*		13	Eardley (1991b).
Nomadinae	*Ammobatoides*		1	Bischoff (1923).
Nomadinae	*Ammobates*	*Ammobates*	1	Eardley & Brothers (1997).

Nomadinae	*Chiasmognathus*		1	Engel (2006, 2010).
Nomadinae	*Pasites*		20	Eardley & Brothers (1997).
Nomadinae	*Sphecodopsis*	*Pseudodichroa* *Sphecodopsis*	14	Eardley & Brothers (1997), Eardley (2007b).
Nomadinae	*Schwarzia*		1	Eardley (2009b)
Apinae	*Ancyla*		1	Warncke (1979).
Apinae	*Ctenoplectra*		7	Eardley (2003).
Apinae	*Ctenopectrina*		3	Eardley (2003).
Apinae	*Tetralonia*	*Eucara* *Thygatina*	14	Eardley (1989).
Apinae	*Tetraloniella*	*Tetraloniella*	33	Eardley (1989).
Apinae	*Amegilla*		71	Eardley (1994).
Apinae	*Anthophora*	*Heliophila* *Paramegilla* *Pyganthophora*	55	Eardley & Brooks (1989).
Apinae	*Pachymelus*	*Pachymelopsis* *Pachymelus*	7	Eardley (1993).
Apinae	*Afromelecta*	*Acanthomelecta* *Afromelecta*	3	Eardley (1991a).
Apinae	*Thyreus*		39	Eardley (1991a).
Apinae	*Cleptotrigona*		1	Eardley (2005).
Apinae	*Dactylurina*		2	Eardley (2005).
Apinae	*Plebeina*		1	Eardley (2005).
Apinae	*Meliponula*	*Axestotrigona* *Meliponula*	12	Eardley (2005).
Apinae	*Hypotrigona*		4	Eardley (2005).
Apinae	*Liotrigona*		2	Eardley (2005).
Apinae	*Apis*		1	Michener (2007).
Total	**103**	**216**	**2483**	

Appendix 2 – Taxonomic index to the families, genera and subgenera

A

B

C

The Bee Genera and Subgenera of sub-Saharan Africa

Bees (Apoidea: Anthophila) are among the most important of pollinators in natural and agricultural ecosystems worldwide, and with nearly 20,000 described species they are also wonderfully diverse. The African fauna is certainly no exception, with many splendid forms ranging from the giant carpenter bees to the diminutive stingless bees. While the highly eusocial species of honey bees and stingless bees are perhaps the most familiar, the lesser known solitary and cleptoparasitic lineages dominate and enrich the fauna.

During the last 30 years significant efforts have clarified the generic and to some extent specific diversity of bees in Africa. However, the nesting biology and behavior of most African species remains undiscovered or little understood. Similarly, despite the critical role of bees as pollinators, few floral associations have been documented sufficiently and the precise nature of these relationships and their concomitant importance in supporting African biological diversity requires extensive investigation.

The fundamental requirement for advances on the biology of bees in Africa is a means to easily and accurately identify taxa. Hitherto, the principal guide to African bee genera was Arnold's (1947) long-outdated key and summary, a work also thoroughly lacking necessary illustrations. To rectify this situation, Eardley, Kuhlmann, and Pauly have prepared a lavishly illustrated, modern reference to the fauna at the generic-subgeneric level. For the first time the full diversity of genera is summarized and each gorgeously reproduced in color, significantly aiding their recognition. This wonderful guide will open the gates to new generations of bee research, improving efforts in documenting diversity, elucidating biologies and ecological associations, establishing conservation practices and policies, and informing the wise development of agriculture throughout Africa.

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