WILD BEES

KRAAL BEES

A documentation of several different wild bee species and a busy wasp, sighted on a short visit to the KRAAL garden in Prince Albert in early December 2023.

1.HONEYBEES

Apis mellifera capensis or *A. mellifera scutellata*?

Prince Albert is very much in the marginal area where these two races of honeybee meet.

The Cape honeybee (*Apis mellifera capensis*) is restricted to the winter rainfall region of southern Africa but is purported to have an interface with the Savannah bee (*Apis mellifera scutellata*) along the margins of this region which has been designated as the ‘hybrid zone’.

Because the outer margins where the two honeybee races converge are mostly semi-desert, it has been suggested that the low numbers of wild colonies and the correspondingly reduced population pressure between the two sub-species, could result in co-existence, but changes in the winter and summer rain could influence the success of a given species occupying the zone.

2.DIGGER BEES

Digger bees of the genus *Amegilla* with their black and white bands. On *Pelargonium abrotanifolium (top* left*), Blepharis inermis* (centre), heating up on the hot sand (top right).

There are over 100 species of bees in southern Africa belonging to the family Anthophoridae. The Greek word Anthophora means "flower-producer," but these bees are commonly referred to as “digger bees”. Digger bees generally resemble the basic stout form of small carpenter bees, but with abdomens that are usually striped in shades of black and grey. The flight of these hairy bees is fast and erratic and accompanied by a shrill hum. Many have a long tongue.

Males of many anthophorid species often form ‘sleeping clusters’ where they congregate by attaching themselves to a twig within a bush by means of their large mandibles.

To heat up quickly, male bees can be seen lying with their bodies pressed flat on the warmer ground or on a stone.

2.DIGGER BEES (CONT.)

A fast flying female Anthophora bee, Amegilla atrocincta. She has a larger block of rusty orange colour on her abdomen.

Most African species nest between roots in the soil, usually in sandy banks where they construct a deep central burrow from which short side burrows lead. These end in cell chambers in which their brood is reared. The brood cells are lined with a waxy material and are provisioned by the female with a mixture of nectar and pollen onto which she lays an egg.

Some species like *Amegilla atrocincta* construct an elaborate turret-like entrance made of soil particles cemented together with saliva, and which projects from the soil and leads to her burrows below.

The burrow of Amegilla atrocincta has an elaborate entrance turret above ground. She nests in clay-rich soil and collects water which she uses to soften the clay, making excavation of the soil easier.

3.CUCKOO BEES



A cuckoo bee of the genus Thyreus seeks out the burrow nests of Amegilla.

Almost 20% of all bee species are so-called cuckoo bees. Cuckoos, or kleptoparasites, have given up the nesting habit and lead a life of deceit! They behave like cuckoo birds and lay their eggs in the nests of other bees to be fed and reared.

All cuckoo bees have several characteristics in common:

- They do not forage and therefore do not have pollen baskets on their hind legs, or scopae.
- They have a thick cuticle in order to defend themselves.
- Many are brightly coloured.
- Female cuckoo bees produce many more eggs than their hosts and have more mature eggs in their ovaries at any one time. This allows them to exploit a host population which they mostly find by smell.

The *Thyreus* cuckoo bees at KRAAL are eye catching in their colours. Some species of *Thyreus* have blue spots while others have white spots. Another kind of cuckoo bee, *Coelioxys*, lays its eggs in the nests of leaf cutter bees (*Megachilidae*), also prevalent at KRAAL.

4.LEAF CUTTER BEES

A female leaf cutter bee (*Megachile*) with visible scopa on the underside of her abdomen where pollen grains are collected..

Megachile are solitary bees commonly known as leaf cutter bees, though their nests may be lined with various materials besides leaves. Unlike in other solitary or sub-social bee groups, secreted cell linings are absent. Material for cell walls and linings, depending on the species, includes pieces of leaves, chewed leaf material, resin, mud, or pebbles.

The distinguishing feature of the family Megachilidae are the conspicuous yellow tufts of hair found on the underside of the abdomen and known as a scopa. Females carry pollen on this special apparatus instead of on their hind legs.

Leaf cutter bees are stoutly built brown or black bees. Some are tiny, but others can be the size of a honeybee. The female leaf cutter bee is opportunistic when it comes to nesting sites, and often seeks out a tube or tunnel that is of the correct dimensions which is dry and sheltered. Such cavities include hollow stems, deserted cavities constructed by wood-boring beetles and even holes in walls in old buildings, or empty snail shells.

5.CARPENTER BEES

A male carpenter bee (*Xylocopa*).

Carpenter bees, as their name suggests, make their nests in wood or woody substrates. The small carpenter bees choose old flowering stalks, or pithy stems, and the larger of the species burrow their holes in dead wood. Holes often take a long time to excavate by chewing. In Sub-Saharan Africa there are only carpenter bees and no bumble bees. Some of the larger carpenter bees have evolved specialised chambers on their body in which they carry and harbour mites. The relationship is an example of a mutualism that is of benefit to both the bee and the mite. Mites are thought to feed on fungi and other organisms in the nest, keeping these away from the pollen provisions and the carpenter bee larvae.

Large predators have difficulty getting at the larvae of bees that construct their nests in the ground. But targeting the contents of nests in stems or wood is easier. One might find the smaller insectivorous birds pecking holes in stems to get at the tiny pith-nesting bees, or luring them out as we have witnessed the Sunbirds and Familiar Chats doing on the Cape peninsula. These birds mimic the distinctive alarm calls made by the small carpenters when danger is close. The bees look out of their holes, only to be eaten by the alarm-sounding bird.

WILD BEES

KRAAL STORIES 01

Honeybees and *Gomphocarpus filiformis* (lammerlat): a source of propolis in the Great Karoo

Gomphocarpus filiformis (lammerlat)

The honeybees of Southern Africa are renowned for their propensity in the use of propolis which enhances their survival in the wild. The vast amount of propolis collected and deposited in and around a wild colony attests to its value to the honeybees. But where do the bees collect the waxes, resins and plant exudates that form the basis of propolis, and in such large amounts? Individual honeybees are occasionally seen scraping waxes from buds of Protea species or resin oozing from a wound on the trunks of Vachellia karroo, but most sources of propolis are largely unknown. Although the topography and hence plant species composition may vary greatly between regions, the honeybees appear to have little difficulty in locating a source.

Recorded here is an observation of honeybees collecting the exudate from an oviposition puncture caused by a tephritid fruitfly whose larvae feed on the seeds of a plant widespread in the Little Karoo.

Gomphocarpus filiformis, a plant commonly known as lammerlat (an Afrikaans word, lammer = lambs, lat = stick, often used as a stick to chivy lambs when herding), is widespread across Namibia and the western arid interior of South Africa primarily in Desert, Nama-Karoo and Succulent Karoo habitats. Honeybees were first documented on lammerlat early in December 2023 at KRAAL, a garden in the Prince Albert municipality, where they were collecting resins on horn-like seed pods. The horns - indicate that it belongs to the Asclepiadaceae into which family the stapeliads are prominent. There is a fruitfly species which lays its eggs in the stapelia pods where the fly larvae consume the seeds as they develop. A limited survey showed that 98% of the seeds on several Hoodia gordonii plants were entirely consumed (G. Tribe, unpub.). Was this happening on the horn-like seed pods of lammerlat?

Resins are a defensive mechanism of plants and have a physical function (expelling an organism or encasing it) and a chemical antibiotic function (especially for fungi but also insects). For especially mammalian predators, there are heart poisons called cardiac glycosides (also in Erythrina seeds), hydrogen cyanide, etc. Yet porcupines feed without consequence on a wide variety of poisonous bulbs that are deadly to other animals. Nomadic peoples eat locusts or saturniid caterpillars by first removing the guts for they may contain poisonous plant material. Fireflies make cardiac glycosides and they have evolved warning colouration. Toads also possess such compounds. In very small doses these cardiac glycosides may stimulate the heart and are thus used in the treatment of congestive heart failure and arrhythmia, but at higher doses can cause havoc and death.

When injured, lammerlat oozes a milky sap-like resin, a latex, as a defensive response against pathogens. This sap contains cardiac glycosides that are likewise toxic to herbivorous animals. But some insects, like the monarch butterfly and locusts, incorporate it as a defence mechanism and thus become toxic to their predators (S. Milton-Dean, pers. com., Dec. 2023). Thus a defence strategy evolved by a plant to avoid being eaten can be co-opted by another organism so that it too can avoid being eaten. Most early medicines used by humans involved the same principle in plant-based medication when taken at the correct dosage rate.

When its seed pods are punctured, lammerlat immediately exudes a resin to seal the pod and protect the seeds within. The puncture is usually a sign that eggs have been laid by the tephritid fly. Seed pods were collected and examined. The larvae pupate in the pod after completing feeding. At Wolwekraal Nature Reserve (113ha) on the outskirts of Prince Albert are several populations of lammerlat where honeybees were immediately observed on the lammerlat collecting resin, but there were also milkweed bugs Spilostethos, muscid flies, and allodapine bees at various locations on the plant. The allodapines collected mostly nectar from the flowers together with a male Coelioxys kleptoparasite bee.

Then a fly which initially looked very wasp-like was spotted on the seed pods. Sue Milton-Dean who offers guided walks on a trail through the nature reserve had studied tephritid flies in Pteronia seeds. One of the conclusions of this study was that flowering and number of seeds containing tephritid fly embryos, were positively correlated with annual rainfall. Sue had a keen eye for these flies. This tephritid fly which was later identified as most probably Dacus bistrigulatus, was laying an egg into the seed pods. We collected a number of seed pods with visible resin and later dissected them under a microscope. Inside each seed pod a larva was found which Sue recognised as a tephritid larva. In seed pods where all of the seeds had been eaten, the biggest mature larvae were found prior to pupation.

The bees collecting the exudate possibly originated from the two wild honeybee nests located in aardvark burrows on the reserve. At these nests honeybees were seen preparing the surface of the burrow where they were to increase the number and/or length of combs, thereby expanding the size of the colony. Once the surface had been cleaned by worker bees, resins were brought in by the resin-collecting foragers to be used as a sealant. Many of the resins used within a honeybee nest are the main components in propolis. These resins often have beeswax added to it to be more pliable, but can also consist of pure plant exudates in outer structures where it adheres tightly to the substrate, even if the substrate is partly loose.

Once the propolis is adhered to the substrate, comb building begins and the colony is able to expand to the outer edges of the adhered propolis. Elsewhere in the nest architecture, propolis may incorporate sand grains or plant material to strengthen it. Its thickness depends on where the propolis is being applied and its purpose. Resins play an important and essential role in honeybee nests, far beyond being a sealant. Being defensive chemical exudates of plants, propolis has many anti-bacterial and anti-fungal properties and is aromatic and health-giving with its essential oils. Lammerlat resin as a propolis with its cardiac-glycosidic properties could perhaps be beneficial for honeybees in ways that are not yet known, possibly also as a defence mechanism against predators of honeybees or ants, wax moth larvae and the like. An interesting aspect to consider would be whether the use of propolis for human consumption containing lammerlat resins could be toxic if taken in high doses.

Recently on one of Sue's nature walks at Wolwekraal, both Rufouseared warblers and the Karoo eremomelas were seen eating tephritid larvae on the lammerlat. It has also been found that the larvae of these flies are themselves parasitised by a small wasp. The ecological cycle around this arid shrubland species is both complex and remarkable.

SELECTED REFERENCES:

1. Bruyns, P.V. (2002). The Stapeliads of Southern Africa and Madagascar Volume 1 pg 57.Umdaus Press, 329 pgs
2. Ellis J.D. Jr and Hepburn, H.R. (2003). A note on mapping propolis deposits in Cape honeybee (Apis mellifera capensis) colonies. African Entomology 11(1): 122-124.
3. Ghisalberti, E.L. (1979) Propolis: A review. Bee World 60(2):59-84.
4. Iannuzzi, J. (1983). Propolis: The most mysterious hive element. American Bee Journal 123(8): 573-575.
5. Iannuzzi, J. (1983). Propolis: The most mysterious hive element Part II – Conclusion. American Bee Journal 123(9): 631-633.
6. Milton, S.J. (1995), Effects of rain, sheep and tephritid flies on seed production of two arid Karoo shrubs in South Africa, Journal of Applied Ecology 32, 137-144.
7. Tribe G.D., Tautz J, Sternberg K and Cullinan, J. (2017). Firewalls in bee nests – survival value of propolis walls of wild Cape honeybee (Apis mellifera capensis). Sci. Nat. 104:29. DOI 10.1007/s00114-017-1449-5
8. Whiteman, N. (2023), Most Delicious Poison, Little, Brown Spark.

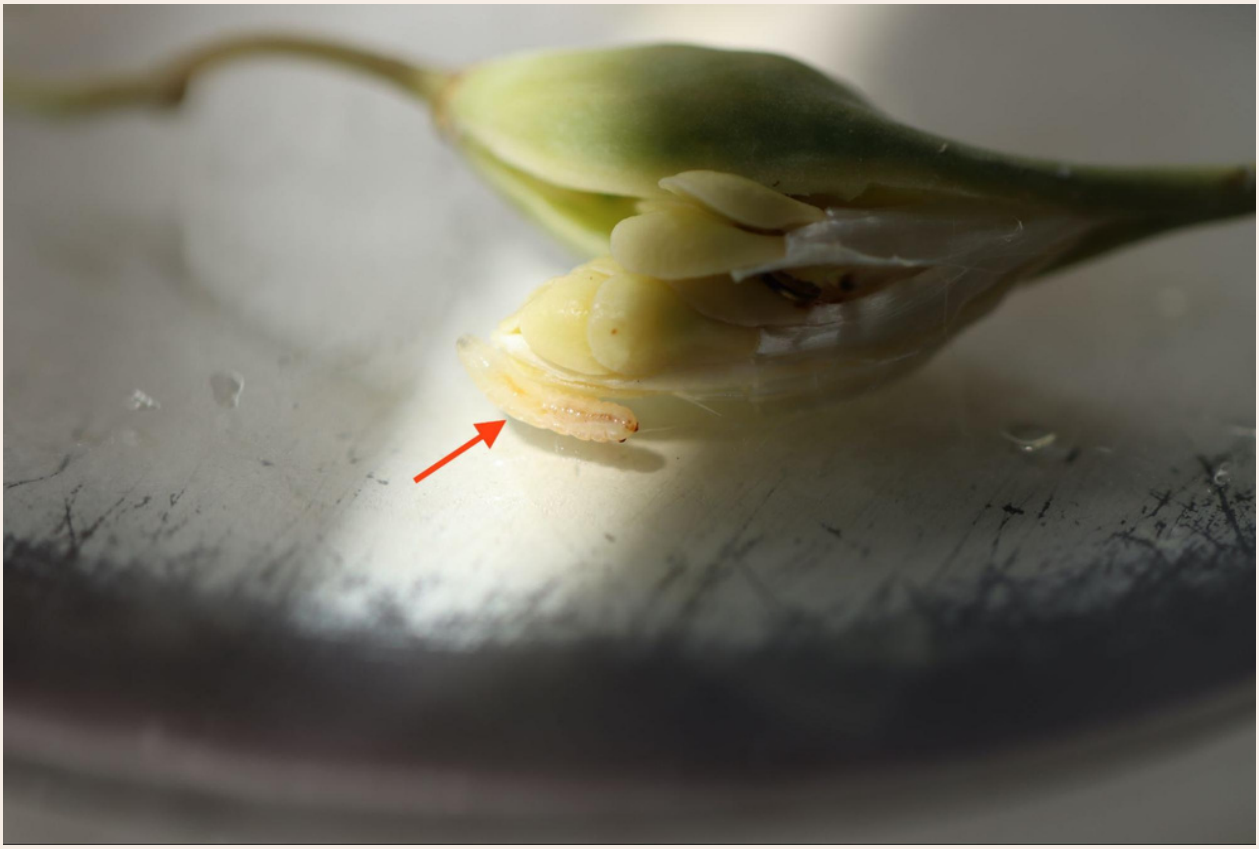
A honeybee on a seed pod collecting resins.

Resins are defensive chemical exudates of plants, with many anti-bacterial and anti-fungal properties.

Honeybees use their front legs and mandibles to gather the resin which is then passed from leg to leg before being patted into the pollen basket on the hind leg. It is a sticky task yet mastered so well by honeybees. Back at the nest, other bees help her remove the sticky substance.

Propolis is used extensively in a wild honeybee nest and has many purposes, one of which is to line the nest cavity. A diversity of resins are collected and are vital to the functioning and health of a colony.
(Photo taken at Wolwekraal Nature Reserve in an aardvark hole.)

The Tephritid fly (*Dacus bistrigulatus*) lays an egg into the seed pod of the lammerlat. As a defense mechanism lammerlat exudes resins and seals the wound from possible fungal pathogens.



Inside the seed pods, the fly eggs hatch into larvae (see red arrow) and the larvae eat the seeds, pupate, and then leave the empty pod as adult flies. The honeybees benefit from the exuded resins as the plant's response to the fly's egg-laying.

KRAAL STORIES 02

Plant: *Pentzia dentata*

A leaf cutter bee on *Pentzia dentata*.

The *Pentzia dentata* is attractive to a variety of pollinators including bees and flies.

In this image taken of the aromatic and water-wise shrub, *Pentzia Dentata*, endemic to South Africa, a leaf cutter bee forages for nectar and pollen. Below her a spider has caught a fly. Besides bees, flies also frequent this flower and both bees and flies are predated on by the very camouflaged spider.

Taking a closer look...

The foraging leaf cutter bee, oblivious of what is happening below.

A spider, specialising in surprise tactics, has caught a hoverfly.

WILD BEES

KRAAL STORIES 03

Digger wasp, genus *Bembix*. *Bembix* are thought to prey mostly on flies, but occasionally on a bee.

Near the population of *Pentzia dentata* shrubs at KRAAL, this *Bembix* digger wasp was sighted. The wasp digs at the surface with speed, using its two forelegs as sand rakes (top photo) before shooting the soil out behind it (3rd image). In this manner it digs it's nest.

It also uses its mandibles (bottom image) like a tool, to lift a bigger clump of soil out of the area being excavated.

One often finds sand wasps and digger wasps on bare patches of soil and regularly returning to the same spot. They press their bodies to the ground and absorb the heat of the sand enabling them to fly fast and react quickly.

Photographs and text by Karin Sternberg
www.wildbees.co.za (coming soon!)