Cape Honey Bee *Apis mellifera capensis* Escholtz[1]

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Introduction

The Cape honey bee, *Apis mellifera* capensis Escholtz, is a subspecies (or race) of the western honey bee, *A. mellifera* Linnaeus, that occurs naturally in the Cape region of South Africa. Upon casual observation, Cape bees look very similar to another race of honey bee present in South Africa, *A.m. scutellata* Lepeltier (the 'African' honey bee of the Americas). Yet reproductively, Cape bees differ significantly from *A.m. scutellata* and other honey bee races, making it perhaps the most distinctive race of *A. mellifera* worldwide.

Figure 1. Cape honey bees, *Apis mellifera capensis* Escholtz, at a feeding station in South Africa.
Credits: Anthony Vaudo, University of Florida

Distribution

The natural distribution of Cape bees mirrors that of the fynbos region in the southwestern section of South Africa. Part of the Cape Floral Kingdom (one of six floral kingdoms worldwide), the fynbos is a narrow strip of land stretching from the southwestern-most corner of South Africa, eastward to Port Elizabeth. Even though it is small, the fynbos region contains over 80% of the flower diversity found in the Cape Floral Kingdom, and it has more plants species than any area in the world, including tropical rain forests.

Because it is rich in plant biodiversity, the fynbos region is able to support a remarkable diversity of life, from insects to higher animals. Cape honey bees specialize in foraging on plant species found in the fynbos, and beekeepers in this area use Cape bees as their bee of choice. Like other western honey bee races, Cape bees can be managed readily for purposes of pollination and honey production.

Because the fynbos region is limited climatically to the small belt stretching from southwestern South Africa, eastward to Port Elizabeth, Cape bee distribution is limited to this area as well. Here, one can find the 'pure' race of Cape bee. However, Cape bees can hybridize with *A.m. scutellata*, and they begin to do so just north of the fynbos belt. This zone of hybridization also encompasses a narrow stretch of land, running the entire length of area just north of the fynbos region. North of the zone of hybridization, one will find the 'pure' race of *A.m. scutellata*.

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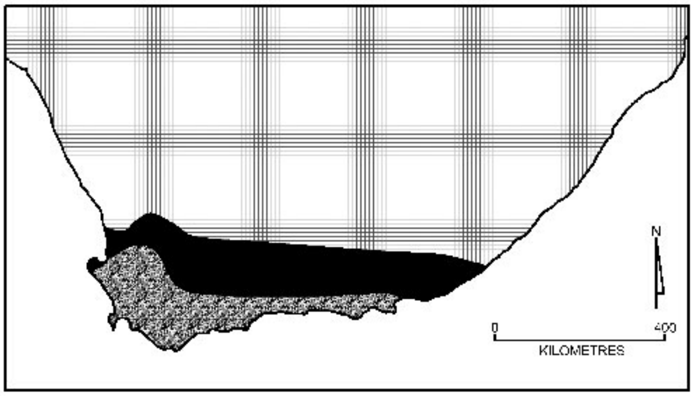

Figure 2. The distribution of Cape honey bees in South Africa (shaded gray). The area shaded black represents where *A.m. capensis* and *A.m. scutellata* hybridize. The checkered area indicates the natural distribution of *A.m. scutellata*. (modified from Hepburn and Radloff, 1998)

Identification

Cape bees have been distinguished from *A.m. scutellata* and other African races of honey bees using morphometric techniques. Genetic analyses are used increasingly as complications with morphometric techniques arise. Most beekeepers in South Africa use other characteristics to identify Cape bees, namely:

- the ability of worker bees to produce female offspring
- the highly developed ovaries in Cape laying-workers, and
- small, queenless swarms.

Once these phenotypes can be detected, Cape bees usually are established already.

Figure 3. An adult female Cape honey bee, *Apis mellifera capensis* Escholtz, collecting pollen and nectar on a flower in South Africa. Credits: Thomas Scarborough

Honey Bee Reproduction

Understanding reproduction in Cape bees is fundamental to understanding their biology and behavior. For the most part, reproduction in Cape bees follows that of other races of honey bees. Queens are the reproductive individuals in honey bee colonies. When queens emerge from the waxy cells in which they pupate, they spend the first 10–14 days of their lives maturing and mating. During this time, a queen bee will leave the colony in search of drones or male honey bees. Queens and drones mate in the air, following which, the drones die. The queen will repeat this process over the course of a few days, mating with anywhere from 10–20 drones. Queens store all of the semen collected from the various drones in anorgan called a spermatheca.

When a queen bee lays an egg, she can control whether or not the egg is fertilized. If she chooses not to fertilize the egg, the resulting offspring will be a male bee or drone. If she chooses to fertilize the egg, the resulting offspring will be a female bee, either a queen or a worker. This type of reproduction is referred to as haplodiploid reproduction because male honey bees (from unfertilized eggs) are haploid while female honey bees (from fertilized eggs) are diploid.

Queen and worker bees both originate from the same type of egg. The quantity and quality of food they are fed while young determines whether the female larvae will become a queen or a worker. So, it is correct to suggest that workers are under-developed queens (though, some rightly argue that the reciprocal is most true, at least behaviorally and physiologically) because they were fed less food while developing as larvae.

Worker bees, despite being sexually immature, have ovaries but they are unable to mate. However, they can lay eggs; but because the eggs cannot be fertilized, workers are able to produce only drone offspring. This leads to an interesting dynamic in honey bee colonies. The presence of a queen in a colony suppresses a worker's desire to reproduce. As long as the colony has a functioning queen, worker bees typically do not oviposit.

However, honey bee colonies may lose their queens for a number of reasons. This event usually results in the rearing of a new queen, a feat accomplished by worker bees that begin to nurture a young female larva originally produced by the now-deceased queen. Despite this safety mechanism, many colonies fail to requeen themselves before the female larvae in the colony become too old to become queens.

Because of this, many colonies become hopelessly queenless and are destined to perish.

Despite the fact that the colony will die without a queen, it does have one last chance to pass its genetics on to other honey bees in the area. When a colony has become hopelessly queenless for a period of time (usually >2 weeks), some workers' ovaries develop, and the workers begin to oviposit. The resulting, haploid offspring all become drones. Drones produced from laying workers are sexually viable, thus they are able to mate with virgin queens from other colonies in the area.

How Cape Bees Differ

When a Cape bee colony goes queenless, it attempts to rear a new queen. And if, for whatever reason, the colony becomes hopelessly queenless, some workers' ovaries will develop and the workers will begin to oviposit. However, unlike eggs produced by laying workers in other honey bee races, eggs produced by Cape laying workers are usually diploid, even though Cape workers cannot mate. This means that Cape workers are fully capable of producing female offspring, both workers and queens.

The process by which Cape workers produce diploid eggs is called thelytokous parthenogenesis—they can produce males and females parthenogenetically. In this system, the egg pronucleus fuses with one of the polar bodies that result from meiosis, thus forming a diploid nucleus that continues to develop normally into a female bee (either a queen or worker). Queenless colonies of Cape bees can survive for some period of time and even rear a new queen from one of the laying worker's eggs. However, if the colony fails to requeen itself, the population will dwindle and the colony will die. Even multiple laying workers present in a colony cannot maintain the reproductive output of a single queen.

Thelytoky in Cape bees leads to a number of different important considerations. For example, worker offspring produced by Cape laying workers are a type of clone, being genetically identical to their mother (who provided both sets of chromosomes). Furthermore, the ability of workers to lay diploid eggs breeds a type of reproductive conflict not seen in colonies of other races of honey bees. For example, queenless Cape colonies have a number of options:

- produce a new queen from a queen mother egg
- produce a new queen from a worker-laid egg
- proceed as a laying worker colony, or
- proceed as a laying worker colony and later produce a queen from a worker-laid egg.

It is important to note that thelytoky is not unique to Cape bees. It is believed that workers from most, if not all, races of honey bees are capable of laying diploid eggs. However, <1% of worker-laid eggs are diploid in other honey bee races. So while it is the exception, rather than the rule, in other honey bee races, thelytoky is common and the predominant scenario in Cape bee colonies.

A number of hypotheses have been proposed for the prevalence of thelytoky in Cape bees. Perhaps the leading hypothesis is that because the Cape region of South Africa is very windy, Cape colonies experience a significant queen loss when queens leave the colonies to mate. Colonies with thelytokous capabilities would not suffer the loss of a queen the same way as colonies without thelytokous capabilities, thus favoring the propagation of colonies with thelytokous workers.

Life Cycle Biology

Behaviorally, Cape bees are not unlike other African races of honey bees. They are:

- 'flighty' on the comb (run on the comb when the colony is disturbed)
- abscond (completely abandon the nest) readily in response to nest disturbances or diseases/pests
- have smaller colonies than European races (an artifact of being in a warmer climate)
- use copious amounts of propolis (resins collected from trees and plants - used as a weather-proofing agent and antibiotic in the colony), and
- are well-suited to warm climates.

Unlike other African bee races (especially *A.m. scutellata*), Cape bees are docile, at least usually. Yet, there is a key behavioral difference that separates them from all other races of honey bees. Cape bees are considered social parasites.

Social parasitism in Cape bees is not understood fully. In instances of larger numbers of colonies per unit area (e.g., managed-colony situations), worker bees and drones will 'drift' between colonies. When the drifting bees are Cape worker bees, the worker bees can takeover or parasitize the 'host' colony. In this regard, the mother queen of the host colony is lost (a process not understood fully at this point) and the Cape worker becomes the reproductive individual in the colony. This process can be exacerbated when two or more Cape worker bees drift into the same colony.

Laying workers not only possess the ability to produce female offspring, but their pheromonal bouquet changes from that of a worker to that of a queen. This is especially true with respect to the pheromones of the mandibular glands, which change to a very queen-like scent. This change in scent results in the Cape laying worker being adopted by the parasitized colony as its new queen. That is why it is difficult to requeen a laying worker colony. The bees in the colony think they have a queen. Any introduction of a new queen into a Cape laying worker colony almost always results in the new queen's death.

The ability of Cape workers to produce female offspring elicits another interesting behavior in Cape colonies—worker policing. In worker policing, workers produced from one Cape laying worker can detect eggs oviposited by other laying workers and destroy or eat those eggs. This establishes a dominance hierarchy within Cape laying worker colonies whereby females from the same mother police the colony and destroy their aunts' offspring in favor of their own mother's offspring (their sisters). Research has shown that this behavior has led to territory grabbing within Cape laying worker colonies.

Because a Cape laying worker colony is composed of many laying workers, all whose offspring are working to ensure their mother is the dominant laying force in the colony, bees produced by the same laying worker may congregate in the same area of the colony. So within a colony, one might find smaller 'sub-colonies,' each headed by a laying worker. This system is truly amazing and has advanced the study of the development of sociality and reproductive castes.

Economic Importance and Management

Although the biology and behavior of Cape bees are fascinating, they present a problem for beekeepers in South Africa. Cape workers can parasitize colonies of any race of *A. mellifera*. Migratory beekeepers managing *A.m. scutellata* in the northern part of South Africa have moved bees into the fynbos region of South Africa where the Cape bee is present (the reciprocal also happens). This has allowed Cape workers to drift into and parasitize *A.m. scutellata* colonies. This action has been a significant problem for beekeepers because Cape-parasitized colonies often dwindle and die.

Furthermore, Cape bees are specialist foragers in the fynbos region and they often perform poorly when taken outside of this region. So *A.m. scutellata* colonies parasitized by Cape bees in the northern part of South Africa can become useless to beekeepers. To prevent social parasitism by Cape bees, don't move colonies between regions where Cape bees inhabit. If a colony has been taken over by Cape bees, there are insufficient tools to fix the colony, and it will generally be a complete loss. Prevention is key!

Beekeepers in South Africa often consider Cape bees more of a serious threat to their colonies than the varroa mite, *Varroa destructor*, the most prolific pest of honey bees. Because of this, researchers globally have taken notice of Cape bees. Many fear that if Cape bees ever spread outside of South Africa, they may be a significant problem for beekeepers worldwide.

Selected References

Hepburn HR. 2001. The enigmatic Cape honey bee, *Apis mellifera capensis*. Bee World 82:181-191.

Hepburn HR, Radloff SE. 1998. Honeybees of Africa. Springer-Verlag, Berlin, Germany. 370 pp.

Johannsmeier MF. 2001. Beekeeping in South Africa. Plant Protection Handbook No. 14, Agricultural Research Council, Pretoria, South Africa. 288 pp.