The honey bee colony

by C Roff

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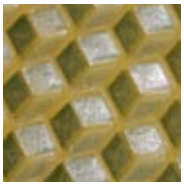

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It is essential for beekeepers to know the composition of a colony and the behaviour of the honey bees. Successful bee husbandry requires the beekeeper to understand the purpose and timing of management methods.

The nest

Honey bees kept in modern hives are no more domesticated than those occupying nests in nature. In both cases, honey bees live in a nest of comb constructed by workers. The compact, hexagonal-shaped cell design is structurally strong and provides protection for eggs, larvae, pupae and surplus food in the form of honey and pollen.

In the wild, the honey bee colony is usually established in hollow limbs or trunks of trees and occasionally in a sheltered rock cavity or hanging from a large limb in the open. In urban locations, cavity walls of houses are favoured sites for nests.

Man provides standard-sized homes for honey bees when he keeps them in modern, movable frame hives.

Castes of the colony

A colony of honey bees in the active season (September to March), consists of a queen, several hundred to several thousand drones, many thousands of workers, and brood (eggs, larvae and pupae) in all stages of development. The various castes (queens, drones, workers) are so highly specialized that none is capable of maintaining or establishing a nest alone.

The honey bee nest has often been described as a living organism with individual bees as component cells which are replaced as they wear out. The nest comprises a number of combs about 7-9 mm apart, made up of six-sided cells constructed from beeswax, a product of their own bodies. Hive temperature during wax secretion is between 35-37˚C.

Cells are of two principal sizes, worker and drone cells. Worker cells are 5mm wide and drone cells are 6.25mm wide. Honey may be stored in both types of cells although pollen is mostly stored in worker cells.

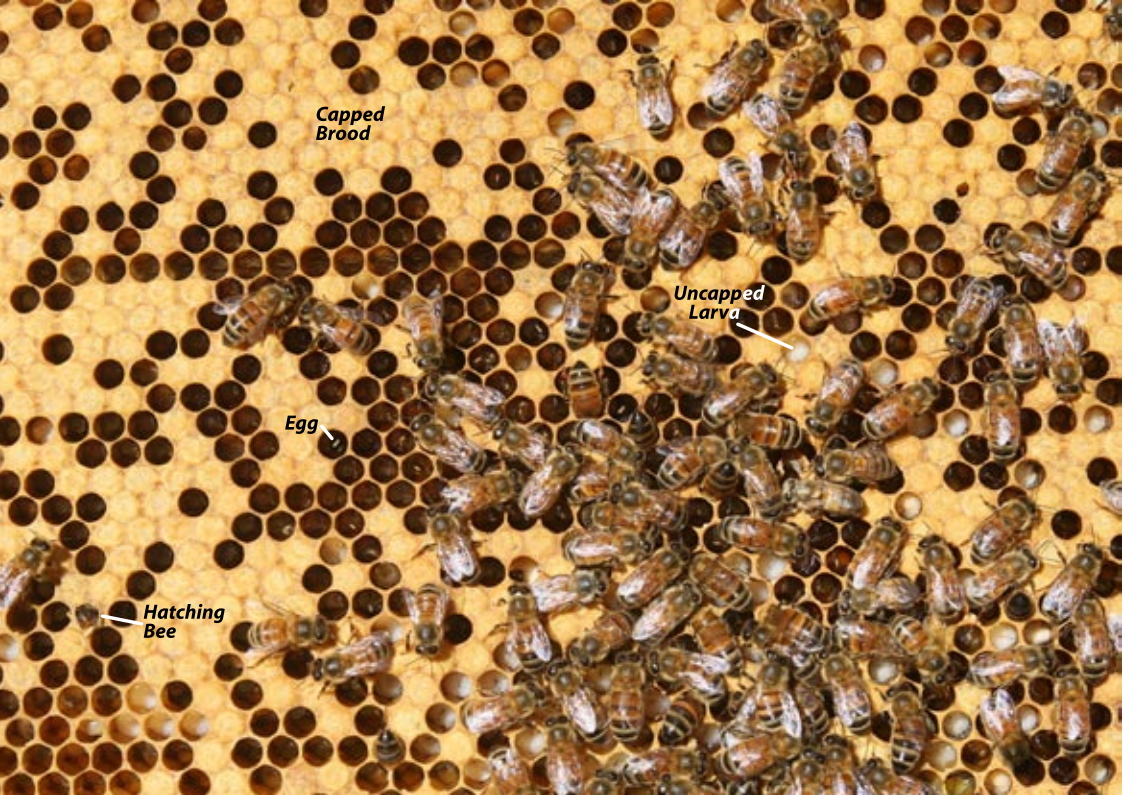
Special cells are constructed in which queen bees are reared known as queen cells. These cells are about 25mm long and are somewhat larger at the base than the tip. Queen cells are worker cells which have been extended down the face of the comb.

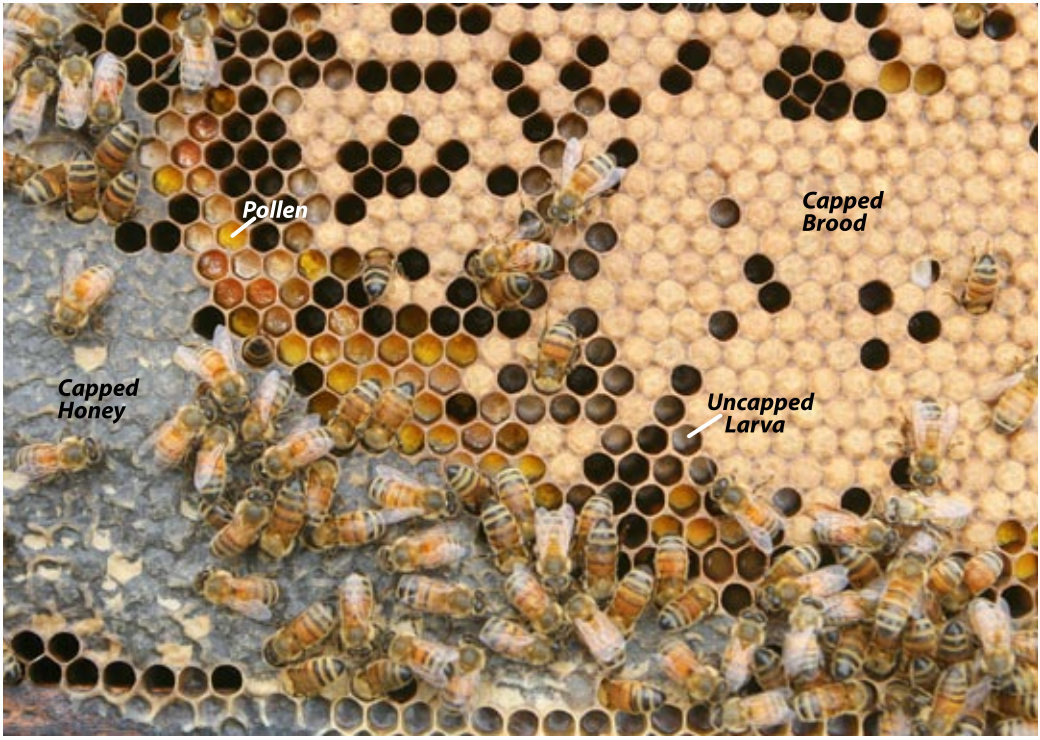
The queen usually deposits a single egg in each cell which develops to a larva, a pupa, and then the adult bee. Newly-mated queens and laying workers, however, may deposit several eggs in a cell.

Combs are nearly white when first constructed but those used for brood-rearing become darker because of the accumulation of excreta and cast skins left by the larvae and travel stains from bees passing over them.

Brood cappings, light brown in colour, are constructed from pieces of wax taken from various other combs. They are combined to form a porous cover through which the developing insect can breathe. Whitish cappings over honey are usually made from new wax. Eventually these may become travel-stained.

Cells are never completely filled with pollen, and are not capped unless the pollen is covered with honey which acts as a preservative.


Capped
Brood
Uncapped
Larva
Egg
Hatching
Bee


Pollen
Capped
Brood
Capped
Honey
Uncapped
Larva

Queen bees

The longest bee in the colony is the queen and she is required to be a prolific egg-layer if a colony is to be strong and efficient. She is an egg-laying machine and may lay about 1,200 eggs in twenty-four hours for a short period under favourable conditions. When food is scarce or conditions are cold, egg-laying may cease.

Queens are reared under three conditions, supersedure, swarming and queenless-ness. The queen is the only member of the colony capable of depositing eggs which have been fertilized by drone spermatozoa.

Queens develop in special large cells which are constructed as required then dismantled shortly after being vacated. However, bees regularly partly construct queen cells and demolish them without ever developing a queen in them. These dismantled cells are known as dummy queen cells.

The queen emerges by cutting her way out of a cell with her mandibles. She may help herself to some honey but she does not appear to take pollen. Occasionally, she will solicit food from workers. When mated, workers feed her with large quantities of brood food.

If another virgin queen emerges, a battle ensues until one of the queens is stung to death. If the virgin comes across any other sealed queen cells she will destroy them by attacking at the base of the cell and tearing a hole in it.

Even when they are still in the cell prior to emergence, virgin queens make a curious shrill sound called 'piping'. An old queen prior to swarming will "pipe" when adjacent to a queen cell. The manner in which this noise is made is not fully understood; it may be due to the forcible expulsion of air through the breathing spiracles or to the vibration of small plates at the wing bases.

After several days, the queen will take orientation flights. She will gradually extend the distance and time she is away from the hive. Queens take on or more mating flights and have been known to mate when only four days old; some take up to sixteen days. The usual time appears to be between six and ten days. She may mate from one to ten times on such flights, and seldom leaves the hive after commencing to lay eggs, except to accompany a swarm. Mating takes place on the wing between 6 and 60 metres above ground level.

It was once accepted that the presence of the drone organ attached to the queen indicated that she mated only once. Actually, this mating sign becomes detached readily from the queen and she then successfully mates with other drones.

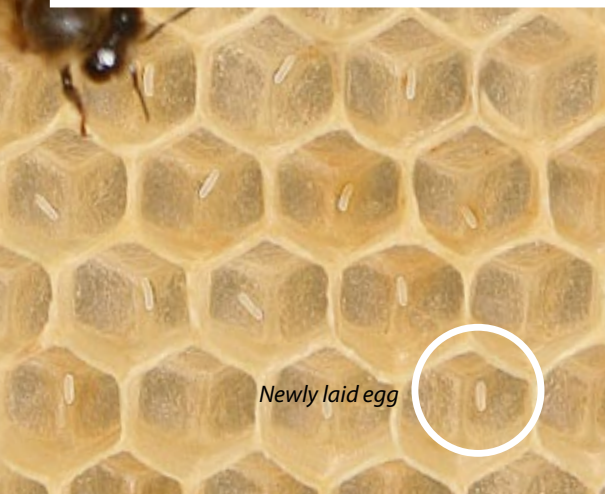
After mating, the workers in the colony pay great attention to the queen, continually touching her body with their antennae, and also licking her. Pheromones from her mandibular glands, referred to as queen substance, serve to integrate the colony.

After mating, the abdomen increases enormously in size and three or four days later she commences egg-laying. A brood area is maintained by the workers at a temperature of between 35 and 36.5C, and it is in this area that she lays.

The queen does not lay eggs in concentric circles, she lays in the brood area at random, constantly recrossing her tracks. She lays unfertilised eggs in drone cells and fertilised eggs in worker cells.

Capped queen cells in a hive preparing to swarm

Queen, having just laid an egg, is searching for another empty cell . Note the larvae, pupae and worker bees.



As she is laying, young household bees form a circle around her and constantly attend to her needs such as grooming, feeding and removing faeces.

A queen may live 6 to 7 years and lay as many as 600,000 eggs during her lifetime. Maximum egg production occurs during the first two seasons when she may lay at the rate of 200,000 or more a year. Eventually, in natural circumstances when the queen begins to fail, she is superseded by one of her own daughters especially reared for the purpose. Supersedure activity is started when the queen stops producing glandular pheromones.

The queen possesses a sting which does not have barbs and is seldom used apart from destroying a rival queen.

Drones

The drones are the male bees. They do not have stings, nor do they perform hive duties. Structurally, drones are incapable of collecting food in the field. Their food supply is stopped when brood rearing slackens. This occurs in late autumn or when a dearth period is experienced. In the hive, they are fed by worker bees.

Because of limited food stores, drones are not maintained in the hive during winter. When weakened, their wings may be torn off by the workers, their legs pulled and eventually they will be dragged out of the hive. Also, drone larvae and pupae are sometimes removed from the hive.

Their definite function is to mate with a virgin queen on a mating flight. When about ten days old, they are capable of impregnating a queen. This takes place outside the nest in the air (6 metres or higher) and the successful drone dies following the act.

Copulation may take place up to 12.8 kilometres away from the hive and there is considerable evidence to suggest that drones frequent drone congregating areas. A pheromone produced by the drones may identify such an area.

Drones contribute to the natural equilibrium of a colony and hives from which drones have been artificially trapped and removed during principal brood rearing periods do not prosper as well as those with a relevant complement of drones.

Drones that drift into a strange hive when nectar and pollen are abundant often are not attacked and are permitted to stay.

Drone bee

Drone pupae in larger, dome-capped cells

Larger drone cells

Worker bees

At the peak of the season, the colony may consist of anywhere from 30,000 to 80,000 worker bees.

The worker gnaws through the cappings of her brood cell with her mandibles and after emergence is easily recognizable by her bedraggled appearance and weak condition. After a few days she grows considerably larger, and her appearance is bright and fresh.

The life-span of the worker is short if she is required to work in a winter nectar flow. Workers reared in spring and the early part of summer live about 25 days while those bred at the close of summer and early autumn survive for about 56 days over the winter period. Workers reared in late summer and autumn often die quickly when working pollen-short autumn and winter nectar flows. Those surviving winter often succumb naturally during early spring. A worker bee's life span is related to the condition of her wings which wear out quickly during a busy season.

The worker is a modified female bee and performs the work of establishing and maintaining the colony. She gathers nectar, pollen, propolis and water, builds combs, controls the hive temperature, attends the queen, produces brood food, nurses the brood, cleans the hive, resists diseases, ripens and stores honey and protects the nest against intruders.

The worker is well equipped to carry out these duties. She has a honey sac in which to carry nectar and water and a large receptacle on each hind leg to carry pollen. The worker bee possesses an efficient navigational system and has developed a method of communicating the locations of nectar and pollen sources to other worker bees of the colony. Her wax glands provide nest building materials while other glands provide brood food. By working together, worker bees are able to lower or raise the temperature within the nest.

The worker bee possesses mouthparts with a wide variety of functions. She also possesses genetical and chemical factors that assist her to resist disease. She has a scent gland and secretes an identification odour, and a sting to protect the nest from enemies.

A worker's sting can be thrust into other insects repeatedly; when the sting pierces the skin of a warm-blooded animal, however, barbs hold it fast and it is usually torn from the bee, resulting in her death.

Laying workers

When the colony does not have a queen, the development of laying workers may depend on two factors, a nutritional influence and the absence of an inhibitory pheromone derived from the queen. The ovaries of a number of workers will commence to function when there is no queen. Generally, unfertilised eggs will be laid which produce only drones. Colonies with laying workers endeavour to produce queen cells but rarely is a female bee produced. Abnormality in the division of chromosomes (meiosis) may result in the development of a female bee from an unfertilised egg. This occurs about one in a thousand in unfertilised eggs.

When honey is exposed in the hive, you'll notice how the worker bees will cluster on it immediately and consume the honey

Bees clustering on the outside of the hive in hot, humid weather. This helps to regulate the internal hive temperature, and is natural.

Brood

In Queensland, the active period may extend over the greater part of the year, particularly in the tropics. During this period, there are all stages of developing bees (brood) in addition to adult honey bees within a colony. All castes pass through four stages; egg, larva, pupa and adult. Each caste has a different time to complete their stages of development.

Eggs deposited in worker or queen cells have been fertilised by spermatozoa. Eggs placed in drone cells are unfertilised and this method of development is called parthenogenesis. Accordingly, drones have no male parent and only carry the hereditary features of the queen.

Larvae on hatching are provided with an abundant supply of brood food in which they float. The food of newly-hatched larvae is royal jelly. Those in queen cells receive an abundance of this food throughout their feeding period while the diet of those in worker and drone cells is changed to honey and pollen on the third day of feeding.

Legless honey bee larvae do not leave their cells during development. At the end of the feeding period, adult house bees fix porous wax cappings that seal the cells containing mature larvae.

Cappings of sealed worker brood are slightly raised while those of the drone brood are dome-shaped.

After sealing, larvae spin cocoons which line the insides of the cells, then stretch out and pupate. During growth, each larva sheds its skin (moults) five times. The last moult produces the pupa, which moults once before the adult bee emerges from its cell.

Stages of Development in Days

	EGG	LARVAE	PUPA	EMERGENCE
Queen	**3**	**5·5**	**7·5**	**16** days*
Drone	**3**	**6·5**	**14·5**	**24** days*
Worker	**3**	**6**	**12**	**21** days*

** Emergence times vary slightly depending on colony strength, temperature and availability of food*

Daily Development of Worker Bee

0	Egg laid
1	....
2	....
3	Larvae emerges
4	Floats coiled in brood food
5	....
6	Diet change **
7	....
8	Fills cell space, sealing commences
9	Cell capped with porous wax cover
10	Spins cocoon
11	Mature, lies outstretched
12	Legs and wings forming
13	Pupa formed, eyes white
14	Eyes pink
15	Eyes lilac
16	Eyes purple, body yellowish
17	Eyes dark purple
18	Body brown
19	....
20	Imago formed
21	**Adult bee emerges**
**	*Brood food of less nutritive value is fed*

Collecting a swarm

Two hives are a good unit for hobbyists, this enables manipulation of brood and honey. Sharing knowledge and the workload also helps.