How to behave in a beehive

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Did you know that the European honeybee has other interesting properties besides producing honey? It is a widely studied insect today, but the fascination goes back to the19th century and Sir Charles Darwin. So what is this fascination about? They have a strange genetic makeup which is very different from ours. How can a female be more related to her sister than to her offspring, and why are some individuals sterile? Moreover, some bees seem to work every waking hour while others spend their time doing practically nothing!

Eusociality, what is it?

Honeybees are social animals. However, their social system is organized in a different fashion than ours. Eusociality is in fact the most advanced social system known in the animal kingdom! What makes it special is that it is made up of large colonies where the tasks of guarding, nursing, foraging and reproducing are divided amongst its members. Individuals are usually born into performing particular tasks and are unable to change this. Moreover, at least some members in these systems are sterile, and others help the reproducers to nurse offspring. Many theories have tried to explaining this behaviour. They all hope to answer the question why sterile individuals have evolved. The most famous theory is called kin selection, which is a modification of Darwin's theory. It suggests that the gene - rather than the individual itself - is the fundamental unit of selection. It is thus the gene that "wants" to survive. Therefore it could be clever to help the survival of a relative, with whom you share genes. A more recent theory called the monogamy hypothesis builds on this theory, but can also explain behaviour of insects with a special genetic makeup.

The colony - An inside look

A honeybee colony consists of three different types of individuals. These groups are called "castes", and those of the honeybee are workers, drones and queens. Every colony has one queen, whose job is to lay eggs. The workers are female offspring of the queen, while the drones are the males. Drones have one task which is to mate with other queens. The workers perform foraging, cleaning the hive and feeding the queen's young. The queen flies away to mate in the beginning of her life. She mates with multiple males on this flight, and stores sperm in a sack-like organ which she uses later to fertilize her eggs.

The genetics of helping

Honeybees are haplodiploid. This is a system where males only have one set of chromosomes, while females have two. Haplodiploidy causes properties that are unique for this kind of genetic system. The queen can choose whether to have a male or female offspring by controlling secretion of sperm from the sack-like organ, while laying the egg. If she chooses

not to fertilize the egg, this will be a drone. A fertilized egg will result in a worker or queen. This is the reason for the unusual relationship between relatives. The drone does not have a father and cannot have sons. He is thus 100% related to his mother. Females have both a mother and a father, to which they are 50% related. However, since their father is haploid, they share more genes with a sister than with a parent because they always get an identical genome from the father. So why don't the workers reproduce but instead stay and help the queen? Because a worker shares more genes with her sister than with a potential offspring, kin selection predicts that this should make her want sisters instead of offspring. This could explain why she stays.

Beewords

Eusociality	The most advanced social system in the animal kingdom that is characterized by castes, helping others in the care of young, living together in overlapping generations, and sterility in some groups. The word eusocial comes from the Greek word "eu", meaning good or real.
Kin selection	A theory by Hamilton, stating that the focus of evolution is the genes rather than the whole individual. In this way, close relatives are prone to help each other to survive since they share genes.
Caste	Groups within the same species that express different behavior and often also different physical appearance.
Queen	The one reproductive female in the colony, who lays the eggs.
Drone	The males in the colony, whose job is to mate with queens.
Worker	All female bees except the queen. They carry out all tasks in the hive such as gathering food, producing honey and nursing of the young.
Haplodiploidy	A genetic system where males have only one set of genes while females have two.

Read more

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