Worker bees 'know' when to invest in their reproductive future

August 20 2014

Honeybees build a new comb on a wooden frame of a beehive. The piece of comb on the right shows the transition from worker comb (small inner cells) to drone comb (large outer cells). Credit: Madeleine M. Ostwald

When a colony of honeybees grows to about 4,000 members, it triggers an important first stage in its reproductive cycle: the building of a special type of comb used for rearing male reproductive, called drones. A team of experts from the Department of Neurobiology and Behaviour at Cornell University, led by Michael Smith, studied what starts the reproductive cycle of honeybee colonies. The results are published in Springer's journal *Naturwissenschaften - The Science of Nature*.

Reproduction isn't always a honeybee colony's top priority. Early in a

colony's development, its primary focus is on survival and growth. When the colony reaches a certain stage, its workers start investing in reproduction. The first step in this whole reproductive process is building cells of drone comb, the special comb made of large cells in which drones are reared.

Drones are male honeybees that develop from unfertilized eggs. Their sole purpose in a colony is to mate with virgin queens from other colonies, thereby spreading the genes of the colony that produced the successful drones. Virgin queens in turn need to mate with drones before they can lay fertilized eggs that will become workers. Queens will mate with over a dozen drones during their single nuptial flight, after which they are stocked with sperm for life.

Smith and his team were puzzled about precisely which colony features kick-start this key process of building drone comb. Is it the number of workers in the colony? Is it the total area of worker comb in the colony? Is it the amount of brood in the colony? Or perhaps it's the size of the colony's honey stores? The Cornell University researchers therefore set out to carefully manipulate each of these features in different groups of colonies, while keeping the other colony features identical.

They found that while every colony built worker comb (non-reproductive comb), not every colony built drone comb (reproductive comb). In fact, only an increase in the number of workers stimulated the workers to start constructing drone comb. This was seen whenever colonies contained 4,000 or more worker bees.

The researchers were still left wondering about precisely how an individual worker bee 'knows' how many other workers there are in its colony. Smith and his team speculate that this might have to do with how crowded individuals feel while working side-by-side in the hive. They are currently engaged in further research to shed more light on this

mystery.

"Colonies with more workers built a greater proportion of drone comb, but colonies with more comb, more brood, or more honey stores, did not do so," Smith summarizes. "We estimate that a colony needs approximately 4,000 workers to invest in building drone comb."

The researchers believe that their findings are also relevant to other social systems in which a group's members must adjust their behaviour in relationship to the group's size.

More information: Smith, M. L. et al. (2014). A critical number of workers in a honey bee colony triggers investment in reproduction. *Naturwissenschaften - The Science of Nature*. DOI: 10.1007/s00114-014-1215-x

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