Genetic diversity in honeybee colonies boosts productivity

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Worker honeybees construct a new comb, an important part of colony founding. Colonies of promiscuous queens tend to be far more successful in such chores and in surviving their first winter than colonies produced by monogamous queens, report Cornell researchers Tom Seeley and Heather Mattila in Science magazine. Credit: Heather R. Mattila/Cornell University

Why do queen honeybees mate with dozens of males? Does their extreme promiscuity, perhaps, serve a purpose?

An answer to this age-old mystery is proposed in the July 20 issue of *Science* magazine by Cornell scientists: Promiscuous queens, they suggest, produce genetically diverse colonies that are far more productive and hardy than genetically uniform colonies produced by monogamous queens.

"An intriguing trait of honeybee species worldwide is that each honeybee queen mates with an extraordinarily high number of males," said Heather R. Mattila, a Cornell postdoctoral fellow in neurobiology and behavior and co-author of the article with Thomas D. Seeley, Cornell professor of neurobiology and behavior.

In every honeybee species, say the researchers, queens mate with multiple males. The European honeybee -- the common species in North America -- mates with from six to 20 mates on average, for example, while the giant honeybee in Asia has a reported record of 102 mates.

To study the reasons for honeybees' promiscuity, the Cornell biologists inseminated 12 queens with sperm from 15 drones (a different set for each) and nine additional queens with sperm from a single drone (but a different one in each case). They then prompted the hives to swarm in early June to form new colonies.

"After only two weeks of building new nests, the genetically diverse colonies constructed 30 percent more comb, stored 39 percent more food and maintained foraging levels that were 27 to 78 percent higher than genetically uniform colonies," said Mattila.

By the end of the summer, the genetically diverse colonies had five times more bees, eight times more reproductive males and heavier average body weights, mostly because of larger amounts of stored food.

By winter's end, 25 percent of the genetically diverse colonies survived to their one-year anniversary (only about 20 percent of new honeybee colonies make it that long in upstate New York). But all of the genetically uniform hives starved to death.

"These differences are noteworthy considering colonies had similarly sized worker populations when they were first formed," said Mattila. "Undoubtedly, our results reveal enormous benefits of genetic diversity for the productivity of honeybee colonies."

For example, the researchers found that bees in the genetically diverse colonies used sophisticated

mechanisms for communication, including waggle dancing, more often than bees in genetically uniform colonies to discover food sources and direct nest mates to food. Because there was more information available among nest mates about food discoveries, the diverse colonies gained far more weight than did genetically uniform colonies.

Source: Cornell University