All the buzz—bigger honeybee colonies have quieter combs

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When honeybee colonies get larger, common sense suggests it would be noisier with more bees buzzing around.

But a study recently published in *Behavioral Ecology and Sociobiology* reports that bigger honeybee colonies actually have quieter combs than smaller ones.

"The surprising result was that - and at first I thought something must be wrong - when there are more bees on the comb, the vibrations are actually reduced," said Michael Smith, a doctoral student in neurobiology and behavior and the paper's lead author. Po-Cheng Chen, a former doctoral student in the field of electrical and computer engineering, is a co-author of the paper.

The researchers found the bees actively damp vibrations in the comb, possibly by the way they grasp the combs, though more study is needed to verify the mechanism.

The finding is important because bees communicate with substrate vibrations in the comb. Bees perform a waggle dance to communicate to other bees the exact location of a patch of flowers; the dance vibrates the comb to spread the message to other bees. Even queen bees transmit vibrational signals to communicate with other queens. But in order to convey these messages, or any message, one must eliminate noise.

The study underlines the universal need to separate signals from noise in all biological systems - from unicellular organisms sensing their environment to human bodies trying to sense hormone concentrations, Smith said.

Smith searched for someone who had the expertise to measure the comb vibrations, and was directed to Chen, who built computer chips that contain an accelerometer for measuring vibrations in three dimensions.

"The chip takes 800 samples in one-eighth of a second and does that for as long as you need," said Smith. They attached these chips to the

outside of honeycombs in the lab.

Smith and Chen varied the number of bees on the combs by taking measurements with half a colony and then with an entire colony. In another experiment, they took measurements of an active colony at different times of the day, since their numbers fluctuate as bees move in and out. Smith counted the bees on the combs with each measurement.

The researchers suspect that the secret to how the bees damp the vibrations could be in their posture, where individual bees straddle many comb cells at once and act as "little staples" by connecting different cells together, Smith said. Another hypothesis is that, like sailors on a teetering boat, bees lean into and compensate for the vibrations, in a manner that has a stabilizing effect.

Smith and Chen also tested whether the mass or sheer weight of bees was damping the comb vibrations, the way a piece of paper with paper clips might wiggle less than a plain sheet. Smith added dead bees into comb cells, and Chen took accelerometer measurements with 400, 600, 800, 1,000, 1,200, 1,400 and 1,600 dead bees on the comb.

The additional bees "had absolutely no effect whatsoever on the comb vibrations, which showed us that the bees are actually doing something to damp these vibrations," Smith said.

The results demonstrate how living systems, including superorganisms such as honeybee colonies, can overcome physical obstacles with curiously simple and elegant solutions, Smith said.

More information: Michael L Smith et al, Larger but not louder: bigger honey bee colonies have quieter combs, *Behavioral Ecology and Sociobiology* (2017). DOI: 10.1007/s00265-017-2399-9

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