Bumblebee house warming -- It takes a village

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All bumblebees always aren't as busy as, well, a bee. It all depends on what their job is.

Researchers have known that a key to the insects' success in adapting to cooler climates is their ability to maintain fairly stable body temperatures when flying to flowers. Whether and how they maintained nest temperature was poorly understood. But now scientists from the University of Washington and the University of Puget Sound have peered into bumblebee colonies and have discovered some answers.

By exposing bumblebee nests to a range of temperatures, the researchers found that the workers are effective at buffering the nest from temperature extremes. Some workers specialized in raising the temperature in a nest when they incubated the colony's young developing bees or brood. Other workers fanned their wings to cool the nest when the temperature became too hot.

Performance of various in-nest tasks is not interchangeable among these social insects. Instead, the researchers found strong evidence for job specialization, even when a colony was artificially forced to step up its rate of incubation, according to Sean O'Donnell, a UW associate professor of psychology and member of the research team.

The researchers challenged colonies by removing their most active incubating workers and lowering the nest temperature. One group of bees was consistently involved incubating across a range of

temperatures. In a second experiment, the researchers removed the most active incubating workers. When this happened a colony's remaining incubators responded within 24 hours by increasing their rate of incubation, rather than having workers involved in other jobs switch tasks, said O'Donnell.

Bumblebee workers vary considerably in size, and body size affects which tasks individuals perform.

"We expected that larger workers would be incubators, but we found to our surprise the opposite was true," O'Donnell said. "We don't know whether the smaller bees are really better at warming the nest, or whether the larger bees avoid incubating for other reasons. In general, larger bumblebee workers are foragers for food and they could be committed to that task. This kind of size-based division of labor might make the colony more efficient."

The researchers studied Bombus huntii, a species of bumblebee common in the Pacific Northwest. Bumblebees, unlike most insects, are warm-blooded. They can heat their bodies, and can remain active at cooler temperatures than many other insects. To achieve optimum conditions for their young, bumblebees rely on nest thermoregulation, actively raising or lowering temperature. Because they are well adapted to cooler and temperate climates, bumblebees are important pollinators of a number of food crops including blueberries, cranberries, huckleberries and greenhouse-grown tomatoes, peppers and eggplants.

To study task performance, the researchers glued a numbered plastic tag to the thorax of workers in three colonies. They observed and videotaped the incubation and wing fanning, or cooling, performed by individual workers under four temperature conditions – cold, moderate, warm and hot. Temperatures ranged from 10.3 to 38.6 degrees Celsius (about 50 to 101 degrees Fahrenheit).

The study focused more on incubation than fanning because the researchers did not want to raise the temperature too high. Excessive heat can kill bumblebees. In looking at the incubation behavior, O'Donnell said workers vibrate wing muscles to shunt down heat to their abdomen, which is held in close contact with a comb containing the brood.

"You can see them shiver to transfer the heat," he said.

"Task switching was previously thought to be common among bumblebee workers," said O'Donnell. "But this study indicates that there is strong specialization in labor among individuals, and body size seems to play a role in what jobs they perform. In addition, their ability to thermoregulate the nest is a key to their ecological success and to their importance as pollinators in cooler habitats."

Source: University of Washington