ScienceWatch – Tuning into Your Host: A Parasitic Beetle Sings the Right Melodies

"We were stunned by finding such a complex pattern of signals." – A. Di Giulio

An ant colony is an impenetrable fortress. Any intruders are quickly detected and ripped apart by soldier ants using their huge mandibles. But ant nest beetles are ant parasites that can safely enter the colony. They are even welcomed by their hosts. Worker ants will swarm around a beetle, not to kill it, but to groom and possibly feed it—while the beetle is sinking its jaws into an ant and sucking out its body fluids.

Ant nest beetles are obligate parasites, spending all of their lives in an ant colony feeding on ant eggs, larvae and adults. It's an enviable life style with lots of food and constant protection—one that has given rise to an astonishing 10,000 species of ant nest beetles. The beetles and other ant parasites are accepted by the ants because they produce the chemical signals (pheromones) that ants use to communicate among themselves.

Ants also produce sounds (stridulations) to communicate by rubbing two body parts together. One parasitic butterfly, the Mountain Alcon Blue (*Maculinea rebeli*), has gone beyond relying on pheromones to gain nest access. The butterfly spends its caterpillar stage being fed and cared for by ants. It gains this "royal treatment" because it can mimic the sound made by the queen ant. Now a report in the July 8, 2015 issue of *PLOS One* shows that one ant nest beetle species has also figured out how to get the royal treatment by hacking into the ant's intimate communication system.

The study by entomologist Andrea Di Giulio and his colleagues at Roma Tre University, Rome, Italy, looked at *Paussus favieri*, an ant nest beetle that infiltrates nests of a Moroccan ant (*Pheidole pallidula*). First the team recorded the stridulations made by *Pheidole* ants housed in artificial nests. They found that the ants produce repeated pulses lasting up to 10 seconds and that each caste (workers, soldiers, and queen) makes a characteristic sound. Ants use the sounds to identify one another and as distress calls. For example, ants buried in a cave-in will elicit help from others to dig them out.

The researchers had already seen beetles structures that looked like they could produce sounds and had used scanning electron microscopy to take fine-structure photos. The photos showed a finely ridged "file" on the hind legs that can rub against a "scraper," a row of tiny spines on the abdomen. Now the team listened to the beetles by recording the stridulations made by male and female ant nest beetles living with the ants. To their great

surprise they found that the beetle stridulations clustered into three groups and each group closely mimicked the sounds made by a different ant caste.

To determine if the beetle calls were directed at the ants, the researchers set up tiny boxes with a speaker attached to the base and covered in sand. They placed *Pheidole* ant workers in the boxes and monitored behavior during playback of the ant nest beetle stridulations. When any beetle call was played, the ants moved toward the speaker waving their antennae in the same way they would when investigating another ant. In some instances they began digging in the sand over the speaker as if to rescue someone. Playback of "queen" beetle calls elicited a posture known as guarding behavior, which occurs when ants attend the queen, and was identical to behavior observed during playback of an actual queen call. White noise controls elicited none of this behavior.

These results show that the beetle can move freely among the ants because it has learned to "speak" three ant "languages." The team concluded that "… by mimicking stridulations of the queen, *Paussus* is able to dupe the workers of its host and be treated as royalty." "When we think of parasites, we are reminded of unpleasant simplified creatures, said Di Giulio. "But in this case, the parasite is actually more complex than the related beetles that are not parasites."

Ants have evolved a highly sophisticated communication system allowing them to efficiently function as a super-organism. But just like modern day identity thieves, *Paussus* ant nest beetles have hacked into the system.

Maybe the ants can change their passwords.

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