Return of the super ants

Hidden ancestry gives *Pheidole* ants potential to develop into huge-headed fighters.

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An entire genus of ants, comprising more than 1,000 species, has been found to have a hidden ability to make 'supersoldiers' — larger-than-average soldier ants that defend the nest against invaders. And all it takes is a dab of hormone.

A few ant species of the *Pheidole* genus were already known to produce supersoldiers that deter invading army ants by blocking nest entrances with their enormous heads. Scientists have only ever seen these supersoldiers in 8 out of 1,100 *Pheidole* species. But a new study now makes it clear that the entire genus has the potential to create this subset of the generic worker caste.

The eight species that routinely produce supersoldiers are found only in the southwestern United States and in northern Mexico. But Ehab Abouheif, a developmental biologist at Canada's McGill University in Montreal, Quebec, who led the study, spotted the same oversized individuals among colonies of a ninth species, *Pheidole morrisi,* found in New York. “I've been collecting these things for 15 years. One day, I was looking at a wild colony and saw that it contained these monstrous soldiers,” he says. “They have larger jaws. If they get you between the fingers, it really hurts.”

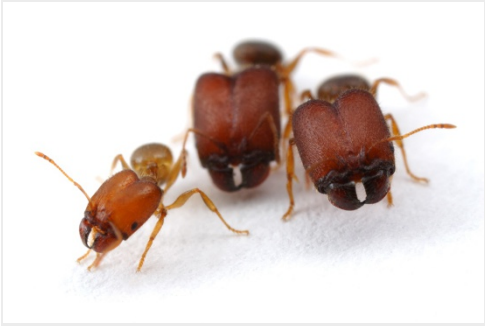

Photo courtesy of Alex Wild/alexanderwild.com

Soldiers and supersoldiers from the hyper-diverse ant genus *Pheidole* marching side by side to defend their nest.

Abouheif and his colleagues found that the ants' supersoldier program is an extension of the same developmental events that set normal soldiers apart from workers. As larvae, their adult fate is set by a hormone called juvenile hormone. If levels of this hormone are low, the larvae develop into small worker ants; if hormone levels exceed a threshold, the larvae continue to grow and eventually become soldiers. In some species there is a second switch. If juvenile hormone levels exceed this second threshold, the ants delay metamorphosis even further, grow even larger and become supersoldiers.

The supersoldier species are spread throughout the *Pheidole* family tree, with the subcaste being found in older species as well as in those that evolved more recently. “A normal evolutionary biologist would look at that and think that they're independent events,” says Abouheif.

Chemical trigger

But that is not the case. By dabbing larvae with methoprene, a chemical that mimics juvenile hormone, Abouheif and his team could induce supersoldiers in species that normally lack them. In a paper published in *Science* today[1], the team demonstrates this in three species, including *P. morrisi*. Abouheif says that he has found the same thing in many other *Pheidole* species too.

This result suggests that supersoldiers existed in the common ancestor of the entire genus. Even though the supersoldier subcaste eventually disappeared in most species, the ants kept the potential to make it. Because the same hormone sets the fate of both supersoldiers and soldiers, it may not have been possible to completely lose one without compromising the other.

“Although it seems all species of *Pheidole* have the ability to 'turn on' supersoldiers, few do,” says Corrie Moreau, an ant biologist at the Field Museum of Natural History in Chicago, Illinois. “Addressing the question of why only 8 of the over 1,100 species produce supersoldiers is the next frontier in ant biology. It's an exciting time.”

Abouheif thinks that the ancestral potential would have repeatedly reactivated throughout the *Pheidole* genus, producing anomalies such as the supersoldiers he saw in *P. morrisi*. Nutrition might have been a trigger. As long ago as 1902, scientists had shown that *Pheidole* ants could produce supersoldiers if they are particularly well nourished.

The social systems of ants might have allowed these odd individuals to persist. “Ants are like humans in a way. We take care of the

less fortunate in our society," says Abouheif. "As long as these anomalies can be fed, they'll be taken care of," says Abouheif. "If we were studying a solitary organism, we'd miss this completely."

In some species that evolved later, such as *Pheidole obtusospinosa,* the supersoldiers became a permanent addition. Whereas most *Pheidole* species simply evacuate their nests when army ants invade, for some reason *P. obtusospinosa* find it beneficial to stay, which makes supersoldiers a useful addition to the community.

However, Abouheif adds, "There are no hints of army ants anywhere near *P. morrisi* and yet they're producing these anomalies." He thinks that the supersoldiers are turning up in *Pheidole* colonies all the time. "These ancestral potentials are locked in place, and mutations release them at low frequencies. They are there for natural selection to take hold of."

Abouheif suggests that such evolutionary throwbacks, or 'atavisms', are everywhere but often overlooked. They are easier to spot in these ants because the supersoldiers are so physically distinct. "These things are totally unappreciated, and have been viewed as slips in the developmental system that don't go anywhere," he says.

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References

1. Rajakumar, R. *et al*. *Science* **335**, 79–82 (2012).