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News

The battle of the butterflies and the ants

Parasitic caterpillars show local evolution as never before.

Daniel Cressey

I'll take this one home: an ant is tricked into caring for a butterly caterpillar.

courtesy of David Nash

Butterflies that trick ants into helping to raise their young are driving an evolutionary arms race between the two species, researchers have found. The discovery is important to the conservation of rare Alcon blue butterflies, they say.

Maculinea alcon butterflies infect the nests of *Myrmica* ants by hatching caterpillars nearby, hoping that the caterpillars will be 'adopted' and cared for by ants that mistake them for their own young. The caterpillars achieve this by mimicking the surface chemistry of the ants. Getting this chemistry right is important: if an ant doesn't recognize a caterpillar as one of its own it will eat it, says David Nash, a zoologist at the University of Copenhagen in Denmark.

Successfully adopted caterpillars are bad for the ant colonies, as ants may neglect their own young in favour of the intruders. But the ants are fighting back. "The ant larvae seem to be evolving as a result of being parasitized," says Nash. "It's an ongoing evolutionary arms race."

Intruder alert! Intruder alert!

Nash and his colleagues tracked the ongoing fight at several sites in Denmark, where caterpillars infiltrate the nests of two types of ants: *Myrmica rubra* and *Myrmica ruginodis*. They looked at sites where caterpillars were present and ones where they were absent.

M. ruginodis are genetically very similar to each other between populations, the researchers report in *Science*, and had similar chemical profiles across different populations[1]. This lack of diversity means that adaptation is difficult: they were relatively consistently susceptible to caterpillar infection, at rates of 8-40%.

But *M. rubra*, the researchers found, had different pockets of colonies with different genetics and different chemical profiles. And there was much more diversity in chemical profiles between colonies that had to deal with the caterpillars than there was outside the area of caterpillar infestation, implying that these colonies were adapting to the presence of the pest.

This broad diversity results in a range of susceptibility to caterpillar infection. Infection rates varied widely between 0 and 72% in these ant colonies.

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And the butterflies are in turn adapting to the different ants. The more ants there are with a specific chemical profile, the more heavily they were infected, showing that the butterflies had adapted to take advantage of the prevalent ants.

Running to stay still

This is a perfect example of a co-evolution between two species, says Jeremy Thomas, a zoologist at the University of Oxford and the Natural Environment Research Council's Centre for Ecology and Hydrology.

"The study provides a really good and clear cut empirical example of an exciting area of theory," says Thomas. "Local co-evolution has become a really major area of ecology in the last decade. There's a lot of theory on this but there are very few practical examples," he says.

Co-evolutionary battles such as these are examples of what US biologist Leigh Van Valen named Red Queen Theory[2], after the eponymous character in Lewis Carroll's children's novel *Through the Looking Glass*. In this book, the Red Queen tells Alice (of Wonderland fame): "Now, here, you see, it takes all the running you can do, to keep in the same place." In evolutionary terms: if the butterflies want to stay where they are, living the high life at the ants' expense, they need to race one step ahead of the evolving ant defences.

Conservation consequences

Local adaptation such as this has serious implications for the conservation of the butterflies, the researchers say.

If a butterfly has evolved to specifically invade the nest of a local ant, it may be chemically different enough to be recognized as a fake by the slightly different ants in other areas.

Although the large blue butterfly was successfully reintroduced to the United Kingdom in the 1980s, other reintroductions have failed. It may be that in those cases the ants saw through the disguise, and the would-be nest hijackers instead became dinner. ■

References

1. Nash, D. R. *et al. Science* **319,** 88-90 (2008).
2. Lythgoe, K. & Read, A. F. *Trends Ecol. Evol.* **13,** 473-474 (1998).

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