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## Strange Parasite Turns Ants into Berries

Researchers at University of California, Berkeley, have discovered the first example of fruit mimicry caused by a parasitic organism. The parasite, a type of roundworm called a nematode, causes its host, in this case an ant, to grow a bright red abdomen that resembles the ripe berries found throughout their tropical forest environment.

The researchers believe the parasite induces this dramatic effect on its hosts as a way to trick birds into eating the infected ants. This provides a mechanism for the parasite to propagate itself as the birds spread the parasite through their droppings.

"It's just crazy that something as dumb as a nematode can manipulate its host's exterior morphology and behavior in ways sufficient to convince a clever bird to facilitate transmission of the nematode," said Robert Dudley, a professor of integrative biology at the University of California, Berkeley, in a press release put out today by the University.

Dudley said the bizarre lifecycle of the nematode can be seen in tropical forests ranging from Central America to the lowland Amazon.

"It's phenomenal that these nematodes actually turn the ants bright red, and that they look so much like the fruits in the forest canopy," said co-author Stephen P. Yanoviak, an insect ecologist and assistant professor of biology at the University of Arkansas at Little Rock. He noted that numerous tropical plants produce small red, orange and pink berries. "When you see them in the sunlight, it's remarkable."

Dudley, Yanoviak and Michael E. Kaspari, an ant ecologist at the University of Oklahoma in Norman, discovered the infected ants while studying the gliding ability of a species of ant, *Cephalotes atratus*, common to the tropical forest canopy.

In May of 2005, when searching for a colony of ants in a downed tree on Panama's Barro Colorado Island, Dudley was puzzled to see some members of the colony with bright red abdomens, something none of the researchers had ever seen before. Once back at the lab, the team examined some of the ants and discovered the red abdomen was full of hundreds of nematode eggs.

Initially, the researchers suspected this was another species of Cephalote, Kaspari said. However, once they opened up the ants under the microscope they discovered that was not the case.

Since the abdomens on the ants so clearly mimicked in both size and color the many red berries that attract birds, the biologists suspected that the nematode had found a unique way to guarantee its transmission from ant host to bird host. The team spent the two years proving their hypothesis.

Yanoviak began by consulting George Poinar Jr., a former U.C. Berkeley researcher now at Oregon State University in Corvallis, and the world's leading authority on nematodes that parasitize insects.

They also learned that infected ants with red abdomens had been discovered before, and that some specimens resided in museum collections labeled as a variety of *Cephalotes*.

Yanoviak collected thousands of normal and infected ants in both Panama and Peru, and found that typically about 5 percent of worker ants in a colony are infected. *Cephalotes* colonies contain between a few hundred and several thousand ants.

Infected ants, normally black, develop a bright red abdomen, called a gaster, and tend to hold it in an elevated position, an alarm posture in ants. The ants also get sluggish, and the gaster is easily broken off, making it easy for birds to pluck. Dudley noted that birds usually don't eat ants, especially *C. atratus*, as the ants are heavily armored and defended by bad-tasting chemical defenses.

Yanoviak and Poinar reconstructed the life cycle of the nematode, though Yanoviak admits that they never saw a bird eat an ant's red gaster.

"Nevertheless, I definitely saw birds come in and seemingly stop and take a second look at those ants before flying off, probably because the ants were moving," Yanoviak said. "So I really suspect that these little bananaquits or tyrannids (flycatchers) are coming in and taking the ants, thinking they are fruit."

Birds apparently are merely a way to spread the parasite's eggs more broadly, since the eggs pass directly through into the feces. Ants become infected when they feed to ant larvae the bird feces containing parasite eggs. The nematodes hatch and migrate to the gaster of the ant pupae, where they mate.

Then, as the nematode eggs mature, the ants' gasters turn red and the ants start foraging outside the nest, setting the scene for fruit-eating birds to be duped into eating an ant they would normally avoid.

"This is a really great example of the kinds of complex host-parasite interactions that can co-evolve, and also of the role of serendipity in tropical biology," Dudley said.

The study was accepted for publication in *The American Naturalist*, and will appear in print sometime this spring. The research was supported in part by the National Geographic Society, the Amazon Conservation Association and the BBC Natural History Unit.

Poinar and Yanoviak describe the new species of nematode, called *Myrmeconema neotropicum*, in a paper to appear in the February 2008 issue of the journal *Systematic Parasitology*.

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