Parasite morphs ant into ripe red berry

January 16 2008

When the ant Cephalotes atratus is infected with a parasitic nematode, its normally black abdomen turns red, resembling the many red berries in the tropical forest canopy. According to researchers, this is a strategy concocted by nematodes to entice birds to eat the normally unpalatable ant and spread the parasite in their droppings. (Steve Yanoviak/University of Arkansas)

A newly discovered parasite so dramatically transforms its host, an ant, that the ant comes to resemble a juicy red berry, ripe for picking, according to a report accepted for publication in *The American Naturalist*. This is the first example of fruit mimicry caused by a parasite, the co-authors say.

Presumably, the dramatic change in appearance and behavior tricks birds into eating infected ants - parasites and all - so that the bird can spread the parasite in its feces. The fruit-eating birds' droppings, which are mostly seeds and insect parts, are gathered by other ants who then feed

and unwittingly infect their young.

This bizarre lifecycle of a parasitic nematode, or roundworm, plays out in the high canopy of tropical forests ranging from Central America to the lowland Amazon, according to Robert Dudley, a professor of integrative biology at the University of California, Berkeley.

"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," Dudley said.

"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, who noted that numerous tropical plants produce small red, orange and pink berries. "When you see them in the sunlight, it's remarkable."

Dudley chanced upon the infected ants while he, Yanoviak and ant ecologist Michael E. Kaspari of the University of Oklahoma in Norman were studying the gliding ability of a species of ant, Cephalotes atratus, common in the tropical forest canopy. Three years ago, their team described the ant's ability to make mid-air maneuvers so that, if knocked off a branch, they can glide toward the tree trunk, grab hold and climb back up, avoiding the treacherous forest floor. Both Dudley and Kaspari are affiliated with the Smithsonian Tropical Research Institute in Panama. Yanoviak is also with the Florida Medical Entomology Laboratory in Vero Beach, Fla.

In May 2005, when searching for a colony of the 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 he, Yanoviak and Kaspari had never before seen. Taking several of the ants

back to the lab and opening them up, Yanoviak discovered that the red abdomen was full of hundreds of nematode eggs.

"Like other ant biologists, I initially thought this was another species of Cephalotes," said Kaspari. "Robert didn't think so, and we made a bet over beers. Then Steve opened one up under the scope and - wow! I lost the bet."

Because the red abdomen clearly mimicked in both size and color the many red berries that attract birds, the biologists quickly suspected that the nematode had found a unique way to guarantee its transmission from ant host to bird host. The researchers spent the next couple of years trying to prove their hypothesis.

Yanoviak first consulted the world's authority on the nematodes that parasitize insects: George Poinar Jr., a former UC Berkeley researcher now at Oregon State University in Corvallis. Poinar and Yanoviak describ the new species of tetradonematid nematode, Myrmeconema neotropicum, in a paper to appear in the February 2008 issue of the journal *Systematic Parasitology*.

They also discovered that infected ants with red abdomens had been recorded 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, near the Peruvian rainforest city of Iquitos, and demonstrated 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. After the pupae become adults, the adults tend the brood while the nematode females incubate their eggs inside them, stunting the ant's growth somewhat.

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 American Naturalist article will appear in print sometime this spring.

Source: UC Berkeley