# Ant executions serve a higher purpose, research shows

February 1 2013

Natural selection can be an agonizingly long process. Some organisms have a way of taking matters into their own hands, or—in the case of the ant species Cerapachys biroi—mandibles.

Researchers at The Rockefeller University and Paris University have found that when a C. biroi ant steps out of line and attempts to lay eggs when it shouldn't, the other ants will drag it out of the nest and bite and sting it until it dies. And in a new study published this month in Current Biology, they believe they've discovered why. Rather than being a competitive behavior between ants over who gets to reproduce more, it appears the killing is a means of keeping the whole colony functioning properly. It's a mechanism, the researchers say, that parallels processes in other areas of biology, even inside a single individual—like when the body attacks cancer cells proliferating out of control.

Daniel Kronauer, head of the Laboratory of Insect Social Evolution at Rockefeller, and his colleagues in Paris chose to study C. biroi because of the special characteristics it has. For one, each worker ant in the species can lay eggs—there are no queens. Also, each of its colonies is made up of ants that are genetically identical. All this makes these ant-killings even more surprising. From an evolutionary perspective, there shouldn't be conflict over who gets to reproduce—with each ant being genetically equal, there's no motivation for reproductive dominance.

"Similar policing behavior has been observed in several other ant species , and over the past decade it has been debated whether the behavior is a

way to repress reproductive conflicts between individuals, or if it serves as a regulatory mechanism to increase efficiency of the whole group," says Kronauer. "These two factors are very difficult to disentangle in other species. But by examining the behavior in Cerapachys biroi we can conclude that, at least in this species, the executions are a colony-level mechanism, because individual differences that might lead to conflict are controlled for."

The researchers monitored 11 C. biroi colonies for 13 months. The ants have a reproductive cycle whereby the whole colony produces eggs at the same time and once the larvae hatch from the eggs, the ants stop laying eggs and begin to forage for food to feed the hungry larvae. The researchers observed the executions when errant ants would continue to produce eggs while others were off looking for food. Several ants would ambush the perpetrator and bite and sting it for several hours or even days until it died.

Upon dissection, Serafino Teseo, a graduate student at Paris University, and his colleagues found that the ants that rebelled had a high number of ovarioles, meaning they had a greater capacity for reproduction. They were also found to be about one month old, indicating that the discretion occurred following their first reproductive phase, when their ovaries were activated for the first time.

"It appears this is an evolutionary mechanism to eliminate individuals who do not respond properly to the normal social cues that tell the ants when to start laying eggs and when to stop," says Kronauer.

Kronauer's lab is interested in illuminating the processes that allow simple biological units to cooperate and form more complex higher-level units. Ant and bee colonies are often described as "super-organisms," because the individual insects cooperate to create an efficient higher-level entity, much as the different cells of a body work together to keep

a person alive.

"This system in C. biroi shows striking analogies to immunosurveillance on cancer cells," says Kronauer. "In both cases, the individuals—single ants and cells, respectively—that are not responsive to regulatory signals proliferate uncontrollably and are attacked and removed to protect the higher-level unit. It's a fascinating example of how evolution converges on analogous solutions to similar problems at different levels of biological organization."

**More information:** Teseo, S. et al. Enforcement of reproductive synchrony via policing in a clonal ant. *Current Biology* online: January 31, 2013. dx.doi.org/10.1016/j.cub.2013.01.011

Provided by Rockefeller University