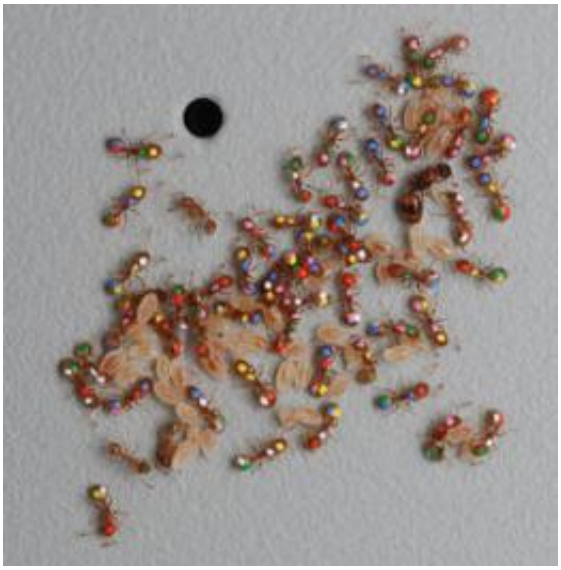
Ants compete, recruit to identify best colony (w/ Video)

November 4 2010



Temnothorax ants are marked for a research experiment. These ant colonies are small enough that all workers can be individually marked, and they thrive in glass-walled nests that allow detailed video analysis of every social interaction.

(PhysOrg.com) -- Professor Stephen Pratt studies how small ant colonies pick a new nest when theirs is destroyed or is no longer viable, and has found that the "brain" of the colony is distributed throughout the group of workers.

Ants have amazed, and annoyed us, for decades. They invade our homes and gardens, but they also manage to choose and build tightly structured

colonies using a group mentality that nearly mimics humans.

How do they do this? Through what's called collective intelligence.

The video above shows a group of Aphaenogaster cockerelli workers engaging in collective retrieval. These ants are unusually effective at cooperating to retrieve food items too large for a single ant. To learn how they do this, ASU researchers designed this artificial food item and made it attractive by smearing it with fig paste. The forces exerted by each ant can potentially be measured through the deflections of the sensor arms.

Stephen Pratt, a core faculty member of Arizona State University's Center for Social Dynamics and Complexity, a member of ASU's Consortium for Biosocial Complex Systems, studies how small (roughly 200) ant colonies pick a new nest, or home, when theirs is destroyed or is no longer viable. He found that the "brain" of the colony is distributed throughout the group of workers, and that there is no one ant doing the thinking or making the decisions for all of them.

Pratt said that ant colonies do have a "queen" ant, but she is mostly the reproductive system for the colony.

"Ants have to reach a consensus if they want to move the colony to a different location," said Pratt, an associate professor at the School of Life Sciences in the College of Liberal Arts and Sciences. "There are a few key ingredients to how they do this. The main thing is that they have to communicate, and that communication has to say something about how good a site it is."

According to Pratt, colonies show strong preferences for important nest attributes and can pick the best of several sites, even when few ants visit more than one site.

His research shows that the decision emerges from recruitment at each site, organized by a minority of active “scout” ants. When one of these ants find a site, the decision to bring nestmates there depends on how good the ant thinks it is, a simple rule that leads to stronger recruitment at better sites.

In a sense, he added, there is a “snowball effect.”

“There is a competition going on here,” he said. “There are some ants advertising one site and other ants advertising another. The number of ants visiting and advertising is rapidly growing for the good site. The ants essentially ‘vote’ based on the number of ants visiting a site. If the site reaches a quorum, or threshold, they increase the advertising and basically make a higher level of commitment to that site.”

He added that while the subset of ants are out recruiting nest sites the rest of the colony is at the old nest waiting to be carried to the new site… literally. Once a quorum is reached on a new site, the ants who founded or are advertising the new site head back to the old nest and start to physically carry ants, like the passive ants, the queen and young ants, to their new home.

In addition to his study on collective intelligence, Pratt also researches how the size of an ant colony affects decision performance; whether ant colonies show ‘personalities;’ and if colonies make rational decisions.

Pratt said the division of labor, quorums, positive feedback and communication that allow an ant colony to make a decision without a leader are all features you find in many other complex adaptive systems, such as human social systems, nervous systems and ecosystems.

To further his research, he is working with engineers to build an ant robot that can be used to manipulate communication within actual

colonies to recruit ants to new sites. Pratt is also in the process of developing ways to better observe the hundreds of ants in a colony by using computer vision tools, and he is starting to incorporate ideas from psychology and economics to the study of ant colonies.

Pratt said, “If an ant colony is one ‘brain,’ we should be able to take methods from these fields to study and understand how a colony thinks, which I am focusing on right now.”

More information: www.public.asu.edu/~spratt1/index.html

Provided by Arizona State University