Genetically identical ants help unlock the secrets of larval fate

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Cerapachys biroi ants, native to Asia and introduced globally on tropical and subtropical islands, have no queens and have minimal genetic variation, making them ideal for research on social behavior.

(Phys.org) —A young animal's genes are not the only genes that determine its fate. The genetic identity of its caretakers matters too. Researchers suspect the interaction between the two can sway the fate of the young animal, but this complex dynamic is difficult to pin down in lab experiments.

However, social insect researchers have found a solution. Rockefeller University's Daniel Kronauer, head of the Laboratory of Insect Social

Evolution, and his colleagues are developing a species of small raider ants as a model organism in order to ask questions about the relationships between genes, social behavior and evolution.
In a pair of recent papers, the researchers first explain the unique, and potentially useful, biology of this 2.5-millimeter-long ant. Then, in work with collaborators at the University of Paris 13, they put it to work exploring the interaction between the larvae and their nursemaids, and the influence on the young ants' reproductive success as adults.

Clonal raider ants, the species Cerapachys biroi, reproduce by cloning, and they live in colonies of as many as a few hundred nearly genetically identical workers. This makes these ants ideal for studies testing how a particular genetic makeup responds to different conditions, the researchers write in Current Biology. With the help of collaborators at BGI China, researchers in Kronauer's lab have sequenced the clonal raider ant's genome. This is an important step toward using the ant in the sorts of experiments conducted for years in traditional model organisms, such as mice and fruit flies.

"We have shown that colony mates are extremely closely related to one another, with all of the individuals in a colony being essentially genetically identical. This gives us precise control in experiments because we don't need to account for individual genetic variation," says Peter Oxley, a postdoc in the laboratory who led work establishing the clonal raider ant as a promising new model organism.

In the second study, one of the first to make use of the clonal raider ant, a team led by Serafino Teseo of the University of Paris 13 used the unique aspects of the ants' biology to test the indirect role genes play in shaping the future identity of larvae and whole colonies by looking at the interaction between larvae and adults. They did so by observing the success of two ant clones, A and B, in pure colonies or mixed together into chimeric colonies. They also swapped broods, so A adults raised B

larvae and vice versa.

It turned out that A and B larvae developed differently depending on whether A or B nurses raised them. Left alone, pure A colonies produced the most young after six generations, making them more successful than B. However, in mixed colonies, B did better because its larvae more frequently turned into large adults that specialize in egg-laying rather than smaller, foraging-focused individuals.

The researchers suspect an indirect genetic effect—specifically, a social influence. To begin to tease apart the dynamic, they had adults from one clone raise larvae from the other. Again, B did better when raised by A nurses than any of the other combinations. The results were published in Nature Communications.

The B colony's strategy of favoring reproduction over foraging when raised by A colony nurses smacks of social parasitism, in which one organism exploits another's social behavior for its own benefit. "This doesn't mean B is a parasite in the making, just that uncoupling the normal interaction between larvae and their nearly identical adult nursemaids reveals the presence of this mechanism," Kronauer says.

The study shows that, in social species, genetic makeup alone does not provide enough information to predict social behavior. Instead, interactions between social partners, such as larvae and their caregivers, are crucial determinants and can lead to surprising outcomes.•

More information: "The genome of the clonal raider ant Cerapachys biroi." Peter R. Oxley, Lu Ji, Ingrid Fetter-Pruneda, Sean K. McKenzie, Cai Li, Haofu Hu, Guojie Zhang and Daniel J.C. Kronauer. *Current Biology* 24: 451–458 (February 17, 2014). www.cell.com/current-biology/a … 0960-9822(14)00019-0

"Epistasis between adults and larvae underlies caste fate and fitness in a clonal ant." Serafino Teseo, Nicolas Châline, Pierre Jaisson and Daniel J.C. Kronauer. *Nature Communications* 5: 3363 (February 24, 2014). www.nature.com/ncomms/2014/140 … /abs/ncomms4363.html

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