Paper wasps and honey bees share a genetic toolkit

April 27 2010

They are both nest-building social insects, but paper wasps and honey bees organize their colonies in very different ways. In a new study, researchers report that despite their differences, these insects rely on the same network of genes to guide their social behavior.

The study appears in the Proceedings of the Royal Society B*: Biological Sciences.*

Honey bees and paper wasps are separated by more than 100 million years of evolution, and there are striking differences in how they divvy up the work of maintaining a colony, said University of Illinois entomology professor Gene Robinson, who led the study with postdoctoral researcher Amy Toth.

"Honey bees have a sharp division of labor between queens, which reproduce, and workers, which care for the brood and forage for food, while among paper wasps social roles are much more fluid," he said. "And yet the same genes can be used by these different organisms to do similar kinds of things. This is the genetic toolkit idea: The same genetic elements are used for different types of division of labor."

A genetic toolkit already has been found for physical traits, such as the development of eyes, said Robinson, who is also a professor in the Institute for Genomic Biology. For example, the same gene, called PAX-6, is involved in eye development in mammals and insects, even though it is virtually certain that these structures did not evolve from a

similar structure in a common ancestor.

For the new study, the researchers compared the activation of genes in the brains of four groups of female paper wasps (*Polistes metricus*) that have different roles in the nest, with some more active in reproduction and others more active in provisioning the brood.

The purpose of the study was to determine if differences in brain gene activity between the wasps rely on the same networks of genes that in the honey bee (*Apis mellifera*) drive their division of labor.

A previous study of paper wasps by Robinson, Toth and their colleagues obtained a partial sequence of the wasp genome and looked at the expression of 32 genes. That analysis, published in Science in 2007, showed that - as in honey bees - most of the targeted genes are activated differently in different groups of paper wasps. But those genes were hand-picked because they were important to honey bees, Robinson said. For this reason, the team wanted to take a second look at the broad array of genes in the wasp - to be sure that the pattern they had identified was indeed special to wasps as well as bees.

Crop sciences professor Matt Hudson, the team's bioinformatics expert, used a computer algorithm to mine the sequencing data from the previous study to design a microarray. The microarray allowed the researchers to simultaneously measure those genes that were most active in the paper wasp brain.

"We expect that Polistes has got somewhere in the range of 10,000 genes, and we expect that at least half of them, but not all of them, would be expressed in the brain," said Hudson, who also is a professor in the Institute for Genomic Biology. The effort identified more than 4,900 genes that were active in the wasp brain.

The new analysis confirmed that the same genes and gene regulators that are important to the division of labor within a honey bee hive also are used by the wasps as they take on different roles in the nest.

More information: The paper, "Brain transcriptomic analysis in paper wasps identifies genes associated with behavior across social insect lineages," is available here: highwire.stanford.edu/cgi/medline/pmid;20236980

Provided by University of Illinois at Urbana-Champaign

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