The making of a queen: Road to royalty begins early in paper wasps

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Paper wasps of the genus Polistes build nests out of chewed wood pulp. (shown here: *Polistes olivaceous*) Credit: Available on Wikimedia Commons under a Creative Commons license

Social status in paper wasps is established earlier in life than scientists thought, says a study published this month in the journal *PLoS ONE*.

While many social insects have distinct social classes that differ in appearance and are fixed from birth, paper wasp society is more fluid — all castes look alike, and any female can climb the social ladder and become a queen. Now, molecular analysis reveals that paper wasp social hierarchy is less flexible than it appears. Queens diverge from their lower-status sisters long before they reach adulthood, scientists say.

Slender reddish-brown wasps with black wings, Polistes metricus paper wasps are a common sight throughout the Midwestern and Southeastern U.S. Hidden in papery umbrella-shaped nests in the eaves and rafters of your house, a complex society is hard at work.

Female wasps develop into one of two castes that take on different roles within the nest. While young queens don't work and eventually leave the nest to reproduce and rule colonies of their own, workers forego reproduction and spend their lives defending the nest and raising their siblings.

"All offspring look alike but some work and some don't," said lead author James Hunt, currently a visiting scholar at the National Evolutionary Synthesis Center in Durham, NC. "The workers are the ones that fly out and sting you if they feel their colony is threatened."

Hunt and his colleagues wanted to find out if hidden molecular mechanisms set some paper wasps on the path to becoming workers, and others to becoming queens. "Many scientists think that paper wasp social status isn't decided until they are adults, but some think there is more to it than that," said Hunt, also a biologist at North Carolina State University.

With co-authors Amy Toth and Tom Newman at the University of Illinois and Gro Amdam and Florian Wolschin at Arizona State University, the researchers measured gene activity and protein levels in young paper wasp larvae before they took on different roles.

Although all wasp larvae look and act alike, the researchers discovered several differences during development that predispose them to one caste or the other.

The larvae that become queens have high levels of a group of proteins

that enable them to survive the winter and reproduce next year, whereas the ones that become workers are much shorter-lived and have low levels of these proteins, said Hunt. "There's less upward mobility in the ones that become the workers. They may look just like the future queens, but they are strongly biased toward the worker role."

Future queens also showed higher activity of several genes involved in caste determination in other, more recently evolved insects that have more visible distinctions between castes. "Paper wasps and honey bees are separated by 100 million years of evolution, but we see some of the same gene and protein patterns in paper wasps that lead to different types of adults in bees," he explained.

The results help shed light on how insect social behavior comes to be, Hunt explained. "It is sometimes argued that adult wasps actually choose to become workers in order to help their mother reproduce and raise their sisters — hence the term 'altruistic,'" he said. "What we found is that really the choice is limited by how they develop as larvae."

The team's findings were published online in the May 17 issue of PLoS ONE.

More information: Hunt, J., F. Wolschin, et al. (2010). "Differential gene expression and protein abundance evince ontogenetic bias toward castes in a primitively social wasp." PLoS ONE. dx.plos.org/10.1371/journal.pone.0010674.

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