Communal living of the insect kind

November 16 2011

Paper wasps represent an intermediate stage in the evolution of eusocial behavior. While many social insects have distinct social classes that differ in appearance, in paper wasp society all castes look alike. Credit: Photo by J. Meyer

The social lives of ants, wasps and bees have long been a puzzle to scientists. How did complex insect societies — colonies ruled by a queen and many workers — come to be? A new model adds to discontent with old ideas.

Social insect society is divided into specialized castes that take on different roles within the nest. Most of the members of a colony – the workers – forego their own chance for reproduction and instead spend their lives raising offspring that aren't their own. Generations of scientists have tried to understand why. In other words, "what's in it for the workers?" said author James Hunt, who developed his model while at

the National Evolutionary Synthesis Center in Durham, NC.

The question continues to spark debate. For the past 40 years, the dominant answer was based on the idea that having kids of your own isn't the only way to pass on your genes. According to a theory called Hamilton's rule, proposed in 1964 by British biologist William Hamilton, sometimes helping a relative can spread more of your genes to the next generation than having kids of your own. When the benefits to a queen outweigh the costs to her workers, the theory goes, altruism can evolve.

But there's one thing Hamilton's rule fails to consider. "Direct benefit to the worker is not part of the equation," Hunt said. According to Hunt, the evolutionary beginnings of worker behavior may be more selfish than they seem.

He bases his ideas on more than three decades of research on a family of wasps called the Vespidae, which is made up of nearly 5000 species. The majority of those species live alone, but some —such as hornets, yellowjackets, and paper wasps — live in complex societies with specialized castes that take on different tasks within the nest.

In paper wasps, for example, workers help build and defend the nest where they were born and feed and care for the larvae. By helping out around the nest, worker paper wasps are able to stock up on the food they need to eventually leave and lay eggs on their own, and the queen gets some babysitting help in return. "It's a situation of reciprocal exploitation," Hunt said.

Debates over how social behavior comes to be can be notoriously fierce in scientific circles. In recent years, a handful of studies have thrown Hamilton's rule into question, including a 2010 paper in the journal Nature that inspired dozens of scientists to write replies. Hunt's hypothesis says the 2010 study is basically correct, but it overplays the

importance of genes.

Much of the debate stems from a failure to parse out key intermediate steps in the evolutionary transition from solitary to social, Hunt says. Paper wasps, for example, cooperate to care for young, but haven't yet evolved the distinct differences in appearance that characterize castes in the most highly social insects.

At these earliest stages, Hunt says, it doesn't matter whether workers and queens are related or not, or how many genes they share. The workers could be lingering around the nest simply because they're looking out for number one.

"The model that I'm putting forward proposes that at the very beginning of social behavior, the workers and the queens are both acting in their own self-interest," Hunt said.

The study will be published this week in the *Journal of Evolutionary Biology.*

More information: Hunt, J. "A conceptual model for the origin of worker behaviour and adaptation of eusociality." *Journal of Evolutionary Biology.*

Provided by National Evolutionary Synthesis Center (NESCent)

provided for information purposes only.