Study suggests theory for insect colonies as 'superorganisms'

January 19 2010

New A team of researchers including scientists from the University of Florida has shown insect colonies follow some of the same biological "rules" as individuals, a finding that suggests insect societies operate like a single "superorganism" in terms of their physiology and life cycle.

For more than a century, biologists have marveled at the highly cooperative nature of ants, bees and other social insects that work together to determine the survival and growth of a colony.

The social interactions are much like cells working together in a single body, hence the term "superorganism" — an organism comprised of many organisms, according to James Gillooly, Ph.D., an assistant professor in the department of biology at UF's College of Liberal Arts and Sciences.

Now, researchers from UF, the University of Oklahoma and the Albert Einstein College of Medicine have taken the same mathematical models that predict lifespan, growth and reproduction in individual organisms and used them to predict these features in whole colonies.

By analyzing data from 168 different social insect species including ants, termites, bees and wasps, the authors found that the lifespan, growth rates and rates of reproduction of whole colonies when considered as superorganisms were nearly indistinguishable from individual organisms.

The findings will be published online this week in the Proceedings of the

National Academy of Sciences Early Edition.

"This PNAS paper regarding the energetic basis of colonial living in social insects is notable for its originality and also for its importance," said Edward O. Wilson, a professor of biology at Harvard University and co-author of the book "The Super-Organism," who was not involved in the research. "The research certainly adds a new perspective to our study of how insect societies are organized and to what degree they are organized."

The study may also help scientists understand how social systems have arisen through natural selection — the process by which evolution occurs. The evolution of social systems of insects in particular, where sterile workers live only to help the queen reproduce, has long been a mystery, Gillooly said.

"In life, two of the major evolutionary innovations have been how cells came together to function as a single organism, and how individuals joined together to function as a society," said Gillooly, who is a member of the UF Genetics Institute. "Relatively speaking, we understand a considerable amount about how the size of multicellular organisms affects the life cycle of individuals based on metabolic theory, but now we are showing this same theoretical framework helps predict the life cycle of whole societies of organisms."

Researchers note that insect societies make up a large fraction of the total biomass on Earth, and say the finding may have implications for human societies.

"Certainly one of the reasons folks have been interested in social insects and the consequences of living in groups is that it tells us about our own species," said study co-author Michael Kaspari, Ph.D., a presidential professor of zoology, ecology and evolutionary biology at the University

of Oklahoma and the Smithsonian Tropical Research Institute. "There is currently a vigorous debate on how sociality evolved. We suggest that any theory of sociality be consistent with the amazing convergence in the way nonsocial and social organisms use energy."

Provided by University of Florida