Researchers believe ants can lead to human-disease insights

April 30 2014, by Chuck Gill

A more than $1.8 million grant from the National Science Foundation will enable researchers to study ants as a model system for how diseases are transmitted among populations. Credit: Joseph Berger, Bugwood.org

What can ants teach us about the transmission and spread of human disease? Perhaps a lot, according to a team of researchers who recently received a grant of more than $1.8 million from the National Science Foundation to explore this question.

David Hughes, assistant professor of entomology and biology in the College of Agricultural Sciences at Penn State, is the lead on the five-year project, which is funded under the Ecology and Evolution of Infectious Diseases research initiative, a joint program of NSF and the National Institutes of Health. The project was one of only a handful funded from among about 100 proposals.

"Living in societies affects how diseases transmit," said Hughes, who also is a faculty affiliate of Penn State's Center for Infectious Disease Dynamics. "We need to understand the role of group size, group complexity and connectedness in driving infectious disease transmission so that we can reduce the heavy burden that infectious diseases impose."

The ant model presents an ideal system to study disease transmission, Hughes explained. "They live in high-density groups, they are ecologically dominant and they have evolved mechanisms to mitigate the spread of infectious disease that humans can only marvel at."

To accomplish its objectives, the team will expose groups of ants to a variety of agents, both beneficial and virulent, Hughes noted. "We first will establish baseline patterns for scaling of transmission as a generic process," he said. "We want to determine the basic rules that govern the mathematical biology of disease transmission."

The researchers then will experiment with changing the background conditions in which the ants live. "Does transmission of these diverse agents happen at the same rate when there are 100 ants compared to 10,000?" Hughes said. "Or does it happen when all are crowded in one space compared to being spread across 20 or 30 compartments?"

Understanding the mathematical biology of transmission will give researchers insights that are applicable to humans, Hughes contends. "We can't introduce pathogens to a building full of school children or to

endangered wolves in Yellowstone National Park to see how disease spreads," he said. "By using ants, we can manipulate colony size and structure and repeat experiments over and over to confirm our results.

"We believe what we learn will have great significance for understanding how diseases are transmitted in schools, hospitals, farm fields and other settings."

In addition to the implications for humans, the study could lead to strategies for managing crop damage caused by ants and other pests. Various species of ants are serious pests around the globe, causing losses in crops such as cocoa and cassava in Ghana, for instance, where Hughes conducts some of his research.

"Typically, we treat for ants by placing pesticide baits in a house or a field, but the bait sometimes dissipates and doesn't get back to the nest to kill the queen," he said. "But the sugars and nutrients that foragers collect from crop plants do get back to the nest to nourish the colony.

"If we understand how the nutrients are transmitted back to the nest without breaking down, we may be able to devise tactics to ensure that insecticidal agents in baits also reach the nest."

Hughes said other agricultural applications for the knowledge gained could include better strategies for managing diseases of livestock and crops.

"Transmission is transmission, regardless of where it occurs," he said. "Using novel dynamic network models and spatial movement models, we will identify the important components of social living that both promote disease and, importantly, reduce its spread.

"Our results should provide specific insights into controlling destructive

ant colonies and general insights into the mechanisms behind social immunity in humans and other social species."

Provided by Pennsylvania State University