Natural Selection and Social Behavior in Panamanian Sweat Bees

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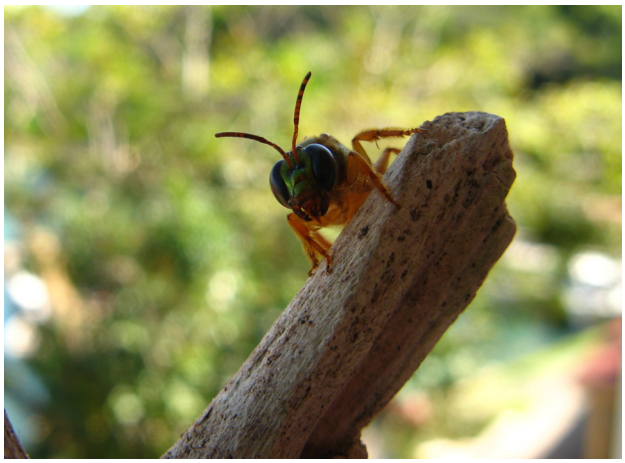
The extreme level of cooperation found among social insects (e.g., ants and bees) has fascinated naturalists, philosophers, and evolutionary biologists for centuries. In these highly organized societies, workers forego reproduction to stay in their natal nests and perform dangerous and costly tasks, such as foraging and brood care, that help others reproduce more effectively. It is difficult to understand how this type of altruistic behavior could have originated through natural selection because the individuals expressing the behavior are not contributing offspring of their own to future generations.

Megalopta genalis *are wood nesters. They excavate tunnels through the pith of dead stems and vines hanging in the forest, then build brood cells along tunnel walls (photo courtesy of Adam Smith).*

While the distribution of work and reproduction among honeybees is well characterized, social organization is actually quite variable across bee species. *Megalopta genalis* is a nocturnal sweat bee from Central America with extremely flexible social behavior. These bees are unique because they can live socially (with some daughters remaining in their natal nest as workers), but have retained the ability to live solitarily (with all offspring dispersing). This makes them especially useful for investigating the selective pressures and molecular and developmental mechanisms responsible for the origins of sociality.



Left: Megalopta genalis *is a nocturnal member of the sweat bee family (*Halictidae) *and is common throughout the Republic of Panama. Right: To observe social interactions and track reproductive strategies, I construct two-dimensional versions of natural nests from balsa wood and plexiglass. I hang these nests in the forest, so the bees are able to mate, forage, and disperse naturally. Bees build brood cells in these nests just as they would in natural wood nests.*

I have recently returned from my second field season on Barro Colorado Island, which is in the Republic of Panama, but is owned and protected for research by the Smithsonian Tropical Research Institute (http://www.stri.org/english/visit_us/barro_colorado/index.php). This island is characterized by primary and secondary lowland tropical forest, and was created when the Chagres River was dammed during construction of the Panama Canal.

Barro Colorado Island is a 1,500 hectare island situated in the middle of the Panama Canal. Scientists from many countries conduct research on the island through the Smithsonian Tropical Research Institute (photo courtesy of Adam Smith).

A primary goal of my fieldwork is to set up observation nests through which to study *M. genalis*. I follow the productivity, social interactions, and reproductive decisions of the bees in each nest over a period of four months. With data from these nests, I am able to test many hypotheses regarding the way in which natural selection may favor social behavior. Specifically, I am investigating whether sociality is spread through selection for altruistic behavior on the daughter's part or through selection for maternal manipulation.

After observing their behavior, I collect the bees for further analyses. I am currently using genetic markers to determine whether some workers lay eggs of their own. I am also in the middle of hormone and protein assays to determine the role of developmental processes in social behavior. In the future, I will explore the role of temporal differences of gene expression in social behavior.