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Biologists study mosquito and bird behavior at Archbold

By ARCHBOLD BIOLOGICAL STATION
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Oberlin College Researchers at Archbold Biological Station. From left; Keith Tarvin, Eli Haines-Eitzen, Madeleine Gefke, Ma Garvin, Natasha Radic, Abby Parker and Katherine Karson.

KATHERINE KARSON PHOTO

During their winter January term, faculty and students from Oberlin College visited Archbold Biological Station to research mosquito and bird behavior. Biology Professors Mary Garvin and Keith Tarvin established a base at Red Hill and were joined by Oberlin students Katherine Karson, Madeleine Gefke, Natasha Radic, Eli Haines-Eitzen and Abby Parker. Having returned to chilly Ohio in early February for their spring semester, the students are grateful for the opportunity to have experienced Archbold and the amazing Florida scrub. Below, we describe the Garvin team research, and next week we will report on the Tarvin team research.

As a graduate student at the University of Florida in the 1990s, Garvin found that blue jays and Florida scrub-jays harbored eastern equine encephalitis virus (EEE), a mosquito-borne virus that also afflicts humans, as well as horses, which rarely survive an infection. This discovery was not surprising, as many birds serve as reservoirs of the virus. However, certain avian species may be more important reservoirs in the virus cycle than others. Garvin observed that the closely related blue jays and Florida scrub-jays differed in the frequency of EEE infection, with blue jays more often infected than scrub-jays. This January, Garvin, along with undergraduate research students Karson and Gefke, undertook research at Archbold in an attempt to understand the basis for this difference.

One possible explanation is that the species of mosquito believed to transmit the virus, Culex nigripalpus, is more attracted to blue jays than scrub-jays. While both male and female mosquitoes feed on plant juices to maintain their basic daily activities, only females feed on blood, which provides nutrients for egg production. Female mosquitoes use chemical cues to locate an animal host on which to feed. For example, carbon dioxide, exhaled by all animals, is one important chemical cue.

In avian species, the preen gland, which is located at the base of the tail, produces secretions that birds spread over their feathers to protect and condition them. Since 2011, the Garvin lab has been exploring the hypothesis that mosquitoes cue in on certain chemicals in the preen gland secretions. As an initial step in the current study, Garvin compared the chemical composition of the preen gland secretions of the two jay species at Archbold and discovered that they are quite different. Mosquitoes may be more attracted to, or repulsed by, the chemicals produced by one of the jay species over the other. Such a result would provide a potential explanation for the observed difference in the level of EEE virus infections.

To conduct this study, we used a machine called an olfactometer to test mosquito feeding preferences. On one end of the device is a large flight chamber into which the mosquitoes are released. The other end has two side-by-side cylindrical chambers. One chamber holds a blue jay, and the other holds a scrub-jay. The birds are protected from the foraging mosquitoes by a screen. During a thirty-minute trial, filtered air that flows over the birds carries the chemical signatures of each species to the mosquitoes in the flight chamber. When the mosquitoes fly toward the species to which they are attracted, they are trapped in a small port. Following each trial, we count the number of mosquitoes in each port to assess whether the mosquitoes show a preference for either jay species.

Most of January was spent preparing for the actual olfactometer experiments. We caught thousands of mosquitoes on warm nights and held them in small cages. We also trained wild blue jays and scrub-jays to become more familiar with visiting the areas where we played recorded jay alarm calls and placed tasty peanuts in walk-in cage traps. On the day of the experiments, we captured blue jays in mist nets and scrub-jays in cage traps, put the birds in the olfactometer chambers, and allowed the mosquitoes to make their choice.

After each trial, we released the birds in the same places we caught them. Several government scientific permits that protect the birds and ensure the merit of the study, were required for us to capture and handle birds. In February, we will analyze the data. If we observe mosquito preference for one avian species, we will use the same experimental design to determine whether mosquitoes are attracted to, or repelled by, isolated preen gland secretions collected from each jay during the aforementioned study.

A third experiment also is being planned to determine whether mosquito sensory cells are stimulated by different jay species' preen gland secretions.