Dr. Rueppell and two undergraduates assess a queen's egg-laying pattern, for a project comparing virus resistance in different bee strains.

Buzzworthy

Social Insect Lab zeroes in on honey bee health

Dozens of young honey bees buzzed through the air on the warm June day. The two undergraduates, though, weren't sure how to proceed. Collecting bees for research isn't covered in most classes.

The students, visiting UNC Greensboro for a National Science Foundation research experience program, asked Dr. Olav Rueppell for help. The Social Insect Lab director was happy to demonstrate.

He eschewed the beekeeper's hood and seemed oblivious to bees swirling around him. Young bees, it turns out, rarely sting.

As the students observed from several feet away, Rueppell briskly collected bees for them to take to the lab.

The bees were headed inside to be sedated and studied — all part of the Social Insect Lab's research to better understand how honey bee genetics, behavior and health fit together.

A sticky problem

Rueppell believes research on how genetics and the environment interact in honey bees will help beekeepers keep hives healthier, and therefore help us all.

In the last few decades, bee populations have declined. Colony collapse disorder, where most worker bees disappear from a hive, is just one well known but poorly understood cause.

"Colony collapse is the tip of the iceberg," Rueppell says. He ticks off a range of problems: less diverse food sources, pesticides, diseases, mites and lifestyle-related stress.

Researchers aren't the only ones concerned. Beekeepers are losing 20 to 40 percent of their bees yearly — millions of bees per commercial beekeeper.

These losses threaten businesses and our food supply. That's because bees do much more than make honey: they pollinate billions of dollars of produce each year.

"Most wild pollinators can't survive in our modified agricultural landscape," Rueppell explains. "We rely on honey bees for a lot."

Without them, many fruits and vegetables you see in the grocery store simply wouldn't be there. By some estimates, honey bees pollinate $15 billion in crops annually — crops accounting for one-third of the American diet.

Commercial beekeepers transport hives across the country to pollinate crops like broccoli, peppers and almond groves.

This brings us to bee lifestyle. "Commercial bees get shipped everywhere," Rueppell says. "Usually in high density conditions, with 20 or 30 colonies right next to each other."

Imagine growing up in a rural town and being relocated to a crowded, noisy high-rise. You'd be stressed, too.

In addition, agriculture use means many hives get nutrition from one or a few crops, rather than the diversity of plants they'd encounter in the wild. And they can be exposed to pesticides. It's tough to be a honey bee.

"Beekeepers are trying to split colonies and manage as best as they can," Rueppell says. "But they're running out of tools."

As colonies struggle, pollination costs increase for food and forage crops, raising prices in the fruit, vegetable, nut, beef and dairy industries in turn.

"We need long-term, sustainable solutions for improving honey bee health."

Cleaning up mites

Work by Social Insect Lab postdoc Kaira Wagoner may turn into one of those tools. To understand Wagoner's research, you must understand one of the biggest threats honey bees face: varroa mites.

These tiny, rust-colored arachnids prey on bee larvae, sucking their blood when larvae are defenseless in the cells of honeycombs. Not only do varroa harm and sometimes kill bees, they also transmit deadly viruses.

Treatments protect bees from the mites, but some, like pesticides, can hurt bees. Wagoner discovered something that may be better.

She studies bee hygienic behavior. Worker bees sometimes open honeycomb cells containing larvae and, if they find mites, remove the parasitized larvae, leaving healthy ones to continue growing. This behavior allows bees to police their own hives against varroa.

But how do bees know when to do this?

Wagoner is identifying biochemical alarms that trigger bees to start hygienic behavior. Her discoveries may give beekeepers a new weapon against varroa: Spray those natural chemicals in infested hives, and bees could ramp up hygienic behaviors, eliminating mites themselves.

Researchers might also breed bees more responsive to those biochemical alarms.

The USDA recently awarded the Social Insect Lab $999k to continue its varroa research, previously funded by NC Biotechnology Center and Project Apis m. The lab is collaborating with three other universities, extension specialists and beekeepers to test and share innovations.

To breed better bees

The idea of breeding healthier bees is an important one Rueppell approaches from multiple angles.

His lab is studying the impact of stress on honey bee gene expression with U.S. Department of Defense funding. It's examining the effect of major viruses on different bee strains from across the country. And it's planning a collaboration with Israeli researchers to develop a new line of hygienic bees.

"There's a lot of talk about breeding disease-resistant bees," Rueppell says. "But you have to understand the genetic architecture and system constraints. There's a lot to know to be successful."

His lab, part of UNC Greensboro's newly established Plant and Pollinator Center, is here to help.

See the full version of this article in the Fall 2017 issue of UNCG Research Magazine.

Social Insect Lab graduate student Taylor Reams examines a worker bee, as part of her research on varroa mites.

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