MURAJ In-Focus: Ian Lane, Cariveau Bee Lab

By Austin Kraft

Ian Lane slides a wooden case out of a tall metal cabinet. He lowers the case to eye level: bees, dozens of specimens, of myriad shapes, sizes and colors. Each bee is meticulously labeled and accompanied by an individualized QR code. "These little organisms turn into data that we use to ask questions," Ian explains. Nearby, Ian displays a pressed plant that was taken with a bee discovered on it. In monitoring bee populations, maintaining precise records is a necessity. Though small in size, bees provide profound insight into the past, present and future of Minnesota's ecological landscape. And that's all not to mention their vital ecological service as pollinators.

It is a quiet Friday morning at the Cariveau Bee Lab in St. Paul. On the lab bench are microscopes, petri dishes and incubator shakers. Ian Lane, a Ph.D. student in the Department of Entomology at the University of Minnesota, sat down with the Minnesota Undergraduate Research & Academic Journal (MURAJ) to discuss his research experiences and offer some advice to students interested in getting involved in research.

Figure 1: *Ian Lane, a Ph.D. student in the Cariveau Bee Lab. Source: Cariveau Lab Team webpage.*

Ian studies native bee populations in Minnesota, particularly how prairie habitat affects indigenous bee communities. By community, we use the definition from ecology: a group of interacting species residing in a shared place. Much remains to be learned about indigenous bees. As opposed to honeybees, these bees do not belong to managed or domesticated species. There are approximately 20,000 species worldwide, with 4,000 in the United States and more than 400 estimated to be in Minnesota. Ian's research investigates how human restoration actions affect indigenous bee communities. There is a complex interplay between plants and bees, each helping the other. Development of prairieland for agricultural use affects indigenous bee communities, which have historically inhabited prairie regions. Adverse effects on the bees jeopardizes pollination, and poor pollination leads to less biodiversity. "How do we protect diversity?" Ian asks. "That's an important, critical question of humankind." It's a big question, and Ian, alongside the rest of the Cariveau Lab team, is up for the task.

In the spring of 2016, Ian was completing a master's degree at the University of Minnesota - Twin Cities under Dr. Marla Spivak, examining

pollination patterns in urban settings. With an itch to get outside of the city, Ian turned his research attention toward wild habitat conservation. Minnesota is in a unique ecological position, where deciduous, boreal, and prairie communities come together. Thousands of years old and in decline, prairie remnants serve as a reference point when researching bee abundance across the spectrum of agricultural development. At the confluence of natural patterns and rapid human agriculture development, Ian studies bee ecology in relation to the intensity of surrounding agricultural practices.

To evaluate indigenous bee abundance across a gradient of crop intensity requires dedication and teamwork. With restoration sites and prairie remnants scattered across the western part of Minnesota, Ian and his colleagues delegate regions for data collection to each other. Ian focuses on west-central and northwest areas. On location, Ian and his crew employ a variety of techniques to measure bee abundance while minimizing bias in their methodology. One method, called hand-netting, involves a researcher walking along a predetermined path, or transect; the researcher sweeps a net across the plants to catch bees, which are then placed in kill jars. Killing bees may seem diametrically opposed to any conservation effort, but Ian explains that this destructive sampling is necessary and ultimately the most informative for conservation. Bees cannot be thoroughly identified in the field, and full measurements of bee body parts require a dead specimen. The pollen on each specimen is also examined to see what types of plants the insect visited. That degree of understanding allows researchers like Ian to determine which plants support these critical populations of bees.

Figure 2: *Ian Lane stores hundreds of bee specimens in this cabinet.*

Data collection is resource-intensive. In visiting all sixteen sites across the state within a three-week interval, the team cannot afford to lose precious days in the field to inclement weather. Handling the logistics of transportation and lodging (Ian and his collaborators rented a house last summer) is a challenge all its own. The fun of

the science work, Ian says, drives them to manage resources efficiently throughout the process.

With the help of collaborators with local knowledge, Ian captures snapshots of the sites; like any photograph, each snapshot represents an instant in time, the blink of an eye on an ecological scale. As the data accumulates, however, an album of precise snapshots becomes a compelling description of community ecology over time.

Figure 3. *Bee specimens in the Cariveau Bee Lab.*

"We capture different stages of the communities to get a good picture of diversity for the year," Ian says. The specimens gathered are then moved into an insect museum in Hodson Hall on the St. Paul campus. This is a special museum, a repository for history and biodiversity. "For all life, these historical collections are extremely important for what Minnesota looks like [at any given time]," Ian says, with a quiet but contagious enthusiasm for his work and its impact on Minnesota.

Prairies used to make up one-third of the original Minnesota landscape, and it is the original landscape that Ian and other researchers in the Cariveau Lab are thinking about: what were bees like before human influence? What can we learn about biodiversity and extinction? Given the threat to bees by the Holocene (aka Sixth) Extinction, time is of the essence for bees as well as the rest of the biosphere, ourselves included. On a more humble scale, Ian's work informs smart decisions about planning for prairie restoration efforts across the state.

With the data collected, the time comes for analysis and number-crunching. But just how much data are we dealing with? Through 2018, "it would be about 18,000 individuals," Ian says. Each bee individual translates to numbers in a spreadsheet: body dimensions, location sampled, pollen present. Ian and the rest of the team are just getting to programmatic analysis and are reaching stability in the abundance numbers. Ian acknowledges that the analysis phase is a tricky one. "It's a story that we're trying to craft. It takes a long time to put together these elements to tell a story. We use data and the scientific method to get as close to the truth as we can."

As a nontraditional student, Ian worked in retail and maintenance prior to starting his undergraduate career. Having seen his fair share of jobs, he recognized research as an opportunity to gain more creative freedom, to be appreciated for his intelligence and independence, and to be entrusted with projects that advance human knowledge. "It's very liberating to have that trust."

The University of Minnesota Bee Research Facilities is home to the labs of Dr. Marla Spivak and Dr. Dan Cariveau. There are science support staff, undergraduate support, an extension professor, research scientists, master's students, undergraduate students, and Ph.D. students like Ian. The Cariveau Lab is a relatively young group, with year-round research opportunities in the lab and the field. Ian remarks, "We would love to get serious undergraduates who want to help for long periods of time." Some undergraduates start in the fall to help in processing data; others work in the summer data collection months. Ian is eager to support undergraduates in their work through activities like the Undergraduate Research Opportunities Program.

Ian's research is deeply connected to the ecological well-being of Minnesota. It is a rewarding endeavor and not without its occasional frustrations. Not counted among the challenges, though, are bee stings. Compared to honeybees, indigenous species are much more docile. In generating new knowledge, Ian finds joy and pride in the challenge. "In science, there's a lot of room to be creative. It's stressful, but it's mine; sink or swim, I've had the chance to show the world what I've got."

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