



HAULIN' POLLEN.  
RESEARCH THAT WORKS  
TO PROTECT HONEYBEES IS  
CRITICAL: THEY POLLINATE  
U.S. CROPS WORTH \$15  
BILLION EACH YEAR,  
ENSURING FOOD SECURITY  
AND BIODIVERSITY.






# H I V E M I N D S

BY

MEREDITH

GUINNESS

Two SHU undergrads join the community  
of scientists racing to save the world's bees



THE VARROA DESTRUCTOR mite lives up to its name. The talk of beekeepers around the globe, the omnipresent pest is the world's deadliest threat to honeybee health and sustainability. Only 1.1 millimeters long, the mites burrow into honeycomb nurseries, latching onto the backs of the growing pupae. Once attached, they hinder wing development and spread viral infections that ultimately collapse entire bee colonies.

It is difficult to overstate the importance of pollinators to Earth's agricultural and ecological systems. About 90% of flowering species—crops like almonds, berries, melons and squash—rely on insect pollination. Animal pollinators ensure food security, biodiversity and sustainability. According to the U.S. Department of Agriculture, honeybees pollinate \$15 billion worth of U.S. crops each year, including more than 130 types of fruits, nuts and vegetables. They also produced more than 125 million pounds of honey in 2022 alone.

So it was that Alexander Besnilian '25 found himself brushing hundreds of live bees off a cumbersome hive frame in Uppsala, Sweden, late one summer night, recording the progress of the bees' honeycombs and using tweezers to remove tiny pupae from their wax-capped cells for future study.

Since he was 15, Besnilian, of Waltham, MA, has wanted to become a doctor. The biology major spent much of the last three years bugging one of his mentors, Assistant Professor Alyssa Woronik, to find an engaging internship befitting a future M.D.

The monthslong immersion into bee genetics she found opened his eyes to more than just jobs requiring a stethoscope.

"We were on the bees' schedule, not our own schedule," said Besnilian. "I got there knowing I wanted to be a doctor, but I left with a good backup plan. Having experience in genetic





**WELL-SUITED.**  
KEVIN CULLINAN '25 AND  
ALEXANDER BESNILIAN '25  
STAY SAFE NEAR  
THEIR SUMMER  
COMPANIONS IN  
UPPSALA, SWEDEN,  
DURING THEIR  
IMMERSION INTO  
BEE GENETICS.







ON THE FARM, UNDER THE SUPERVISION OF EVOLUTIONARY BIOLOGIST NAOMI KEEHNEN, THE TWO SHU UNDERGRADUATES CONDUCTED PROFESSIONAL FIELD WORK ON AN INTERNATIONAL RESEARCH VENTURE.

research is different than just seeing it or reading about it. Working in a professional setting was really rewarding.

"I felt like an undergraduate student for, like, three days," he added. "Then I was a researcher."

Fellow junior Kevin Cullinan '25, who is considering the physician assistant program, joined Besnilian on the new international research venture, which came about thanks to Woronik's own professional network. Woronik worked on her Ph.D. in the same Stockholm lab as Naomi Keehnen, now a postdoctoral researcher at the Swedish University of Agricultural Sciences (SLU); Woronik was studying wing color in butterflies, and Keehnen was looking at the genetics of immunity in the delicate insects. The two have kept in touch over the years,

and Keehnen asked if SHU undergraduates would like to work with her in Uppsala, opening the door to a real-world research opportunity.

Woronik knew Cullinan and Besnilian, diligent students with a strong interest in genetics and evolution, would jump at the chance. "Of course, I asked them if they were allergic to bees," she said. "They weren't."

The quarter quickly mobilized; soon the students had housing on the Swedish campus and a stipend for their stay. Mark Beekey, dean of the College of Arts & Sciences and a biologist himself, secured insurance and funds to cover the students' airfare for their two-month odyssey.

Once in Sweden, the students joined a research project that began before they were born. In 1999, a group of scientists put 200 West-



ern honeybee hives on the remote island of Gotland, 56 miles east of the Swedish mainland in the Baltic Sea. This population developed a natural resistance to the Varroa destructor mite, and today the researchers' aim is to discover the mechanism that gives the island bee population resistance. In addition to feeding on the bees themselves, the mites are vectors for about 18 bee viruses, the most prevalent being Deformed Wing Virus (DWV).

How the Gotland bees resist the mite is a mystery, but some researchers believe the compounds produced in the outer layer of the pupae's exoskeleton may hold the key, Keehn said. To test the hypothesis, researchers in the Barbara Locke Grandér lab at SLU have artificially caused a mite infestation in some hives from the resistant Gotland population and in those found on the mainland. Here's where the SHU Pioneers' work began. Gingerly, the student researchers sampled pupae from both populations six, 12, 18 and 24 hours after infection to test what compounds were present and gauge differences that might contribute to mite resistance.

"What is happening exactly?" Keehn asked, explaining the project. "Did the mites not find the newly wax-capped cells they need to get at just at the right time to infect the babies? The island bees are more tolerant, so we're looking at their immune system."

In addition, the students assisted in extracting DNA from the bees, allowing researchers to investigate genetic differences that potentially underlie the mite resistance. The hope is that this research will protect honeybees around the globe, Keehn said.

"Insects are so important," she said. "They're very overlooked and so vital for humans."

The message isn't lost on Cullinan and Besnilian. Each time they checked the beehive frames, they drew replicas of the cells to show how many of the tiny rooms in the bee nursery were covered with the wax cap at each of the prescribed intervals in the day, Cullinan said. They extracted samples of the baby bees, marking and storing them in microcentrifuge tubes of liquid nitrogen for future investigation.

Mistakes and challenges were instructive.



**VÄLKOMMEN.**  
AFTER PARASITE-RESISTANT BEES WERE DISCOVERED ON THE ISLAND OF GOTLAND, BESNILIAN AND CULLINAN CONDUCTED THEIR RESEARCH ON A TEST COLONY IN UPPSALA, NORTH OF STOCKHOLM.



The undergrads mastered the art of using smoke to calm the bees, Cullinan said. Because bees naturally seek warmth, night visits meant the pair routinely brushed dozens of insects from their clothing and looked for creative ways to work both carefully and efficiently.

As part of their duties, Cullinan and Besnilian did a "12-hour check," which meant recording the state of one frame of a hive in the morning and again at night. To their frustration, the



**NEW FRAME OF MIND.** BESNILIAN AND CULLINAN, WHO ASPIRE TO CAREERS IN MEDICINE, LEARNED TO MAKE BEESWAX CANDLES DURING THEIR TWO-MONTH ODYSSEY IN SWEDEN.



frame didn't always produce usable data. They decided that they could record activity in multiple frames from a hive in the morning, improving their chances of finding results to record at the nighttime check, Besnilian said.

"There's science in troubleshooting," said Cullinan, who hails from New Hyde Park, NY. "We were really on our own doing things every step of the way. We were literally going back to the drawing board. We actually had a board! I think it's a better experience because of that."

There were several fringe benefits to the mundane, repetitive work. Both students learned to make candles from the wax they scraped from the hives, and they became adept at honey extraction.

"I brought home four jars," said Besnilian.

More importantly, they gained a rare immersion into the life of a researcher, working side-by-side with graduate students and postdoctoral researchers from around the world. "Students often dream of being a doctor or PA because they've seen them work and can envision the job," Woronik said. "Our students aren't regularly exposed to the 'community of scientists'; therefore, it can be challenging for them to envision themselves in these careers. In Uppsala, they learned how it is to work in a lab, what it is to be a professional scientist. They were held to

a really high standard, and you can see a shift in them. There's a real confidence."

At press time, Cullinan and Besnilian planned to present their research at the Eastern Colleges Science Conference at Niagara University, as well as at SHU's 2024 Academic Festival. The biology department plans to send another pair of budding international researchers to Keehn and the team in Uppsala this summer. Additionally, the department is looking to expand the program, potentially including collaborators in Germany and the United Kingdom.

The experience left Woronik thrilled to see that her students had grown personally and professionally.

"They grabbed the opportunity and made it happen," she said. **SHU**

#### ● ● ● SAVE THE POLLINATORS

Want to help SHU students join the international community of scientists in Uppsala, Sweden and around the globe? Such internships require funding for student room and board, air travel, insurance and more. Contact Professor Alyssa Woronik at [woronika@sacredheart.edu](mailto:woronika@sacredheart.edu) to learn more about how you can support these life-changing research opportunities.



