

# Honeybees at risk, along with the crops they pollinate: Scientists think the solution lies in the insects' brains

December 29 2022, by Tom Avril, The Philadelphia Inquirer

---



Credit: Pixabay/CC0 Public Domain

The honeybees looked perfectly healthy, buzzing about their boxy wooden hive on a warm autumn day in central Pennsylvania.

Elizabeth Capaldi suspected otherwise.

Clad in a protective white suit and hat, the biologist reached out with a gloved hand to capture one of the insects in a small vial, then took it back to her Bucknell University laboratory to dissect its brain.

Her colleague David Rovnyak later placed a sample of the bee's innards inside a large metal cylinder and pelted it with high-frequency radio waves—a type of scanning technology that revealed the amounts of certain telltale chemicals within.

Their goal: to identify early warning signs that a bee is under stress, so that beekeepers can try to rescue a threatened hive before it's too late.

Honeybees have been in decline for decades, causing headaches and higher costs for farmers who depend on the insects to pollinate their apples, almonds and 130 other fruit, nut and vegetable crops. The issue made headlines in 2006 with the emergence of a mysterious new phenomenon called colony collapse disorder, but the broader downturn in bee health was underway well before that, and it continues to this day.

The causes include climate change, pesticides, and disease, said Capaldi, who studies insect behavior and neuroscience at the liberal arts university in Lewisburg. In bad years, the combination of insults can wipe out more than half of a beekeeper's colonies.

"Honeybees are suffering," she said. "All of these factors have united together to create a stressful environment for honeybee colonies across the country."

She and Rovnyak, a chemistry professor at Bucknell, realized five or six years ago that the problem might lend itself to an interdisciplinary solution. The pair joined forces with colleague Marie Pizzorno, an expert in viruses—as one factor in the insects' decline is a virus that deforms their wings.

They want to identify chemical stress indicators that become elevated in a bee's brain months before the insect displays any outward signs of decline.

The cylindrical device Rovnyak uses to detect these substances, called a spectrometer, would be impractical for any beekeeper or farmer. But once the researchers determine which chemicals are the best predictors of bee health, they want to develop a low-cost test that could be deployed in the real world.

## **Double the cost**

Every spring, just as the apple blossoms are starting to bloom, a flatbed truck rolls up to Hollabaugh Bros. farm in the middle of the night, laden with 100 honeybee hives.

Workers set up the boxy containers across 150 acres that produce more than 50 varieties of apples, said Ellie Hollabaugh Vranich, assistant business manager of the farm in Biglerville, just north of Gettysburg.

"We try to get them spread out while it's still dark, before the bees wake up," she said.

A decade ago, the farm rented the hives for \$50 apiece. A few years ago, the price rose to \$60, and this past spring, it was \$100, for a total of \$10,000, she said.

Beekeepers have cited a variety of reasons for the increases, such as higher fuel costs and disruptions related to the COVID-19 pandemic. But every year, a major factor in [higher costs](#) is that many colonies don't survive the winter, meaning beekeepers must scramble to raise new ones in time for the growing season.

"You can't just manufacture a bee on a processing line in a factory," Vranich said. "They have to be bred and given time to develop new hives."

Experienced beekeepers such as Capaldi, the Bucknell scientist, can often tell when a hive is starting to fail simply by looking at it. Perhaps the insects haven't amassed long-term stores of honey, subsisting instead on liquid nectar. A lack of a brood is another warning sign.

But by that point, it might already be too late.

A year ago, Capaldi judged that her eight hives at Bucknell were under stress, likely because the fall asters and goldenrods had produced less nectar than usual. So throughout the winter, she supplemented the insects' food with sugar.

Even so, just two of the hives survived.

## **Finding the culprits**

The first sign of trouble for the insects came in the 1980s with the introduction of a parasitic mite from overseas, said Pizzorno, the Bucknell virologist.

Relative to the size of the honeybee, these parasites, called Varroa destructor, are enormous.

"It'd be like having a tick on your body that's the size of a dinner plate," she said.

Scientists later would discover that in addition to inflicting harm directly, the parasites also transmitted a virus to the honeybees that deforms their wings.

Researchers also have established that [climate change](#) affects the bees in a variety of ways, Capaldi said. Early warm spells or unusual rain patterns can cause flowers to bloom too early and disappear by the time the insects are looking for nectar.

"When the colony is growing, the flowers may not be available," she said.

Certain pesticides and other practices of large-scale industrial agriculture also can add to the stress, she said. That includes the way the bees are deployed, trucked from farm to farm where they subsist on one crop for days at a time.

Increasingly throughout the 1990s, beekeepers reported that some of their colonies did not survive the winter. Then in 2006, beekeepers discovered that some colonies were dying in an unusual way. Instead of dying in or near the hive, bees were simply vanishing, apparently flying off to die elsewhere.

While beekeepers have reported fewer cases of this colony collapse disorder in recent years—in part because they have developed better management techniques—the causes remain somewhat unclear. Capaldi blames many of the same factors that are behind the bees' overall decline that began in the late 1980s.

## **Telltale chemicals**

The stout silver spectrometer at Bucknell contains a magnet more powerful than the ones used in MRI machines, said Rovnyak, the chemistry professor. To identify telltale metabolic chemicals in a bee brain, he places the tiny clump of material in a small receptacle at the center of the device, then hits it with [radio waves](#), causing the various substances to resonate in such a way that their relative amounts can be measured.

"Each molecule rings with a distinct set of patterns, like a chord," he said.

In one study, he and the others found that an amino acid called proline was elevated in the brains of honeybees that were infected with the deformed-wing virus—well before they showed outward signs of disease.

The scientists have since identified other protein fragments that may be signs of stress—possibly because the insects are changing their eating habits in response to infection—but more work is needed.

Once the Bucknell researchers narrow down the best chemical predictors of a bee's decline, they hope to develop a low-cost rapid test that beekeepers could use.

"If we could come up with something for a few bucks, that might be appealing," Rovnyak said.

He likened the approach to certain blood tests for humans, such as those that can identify metabolic signs of Type 2 diabetes years before the onset of disease. Much like humans with pre-diabetes can ward off disease by changing their diet, [beekeepers](#) could do the same for the insects. Feeding them sugar, for instance, but starting earlier than Capaldi did last year with Bucknell's colonies. Or deploying other tactics

that have shown promise in limiting [colony collapse disorder](#), such as treating for mites, relocating hives, or swapping in a different queen bee.

In the meantime, significant fractions of colonies keep failing every winter—30% one year, 40% or 50% the next, according to surveys by the nonprofit Bee Informed Partnership. For now, breeders have kept up with the demand for new colonies. But at some point, maybe they won't, Rovnyak said.

"It just seems to be getting more and more challenging every few years," he said. "And there's no sign this is stopping."

2022 The Philadelphia Inquirer.

Distributed by Tribune Content Agency, LLC.

Citation: Honeybees at risk, along with the crops they pollinate: Scientists think the solution lies in the insects' brains (2022, December 29) retrieved 27 April 2024 from <https://phys.org/news/2022-12-honeybees-crops-pollinate-scientists-solution.html>

<p>This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.</p>
------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------