Q&A: How new honeybee vaccine offers hope for protecting more than just honeybees

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A yellow-fronted bumble bee, Bombus flavifrons, probes a flower for nutrients, picking up pollen as it does so. Credit: Sarah Johnson

In a headline-making move, the U.S. Department of Agriculture recently approved the first honeybee vaccine against American foulbrood disease, a bacterial illness that has partially contributed to dramatic drops

in U.S. honeybee populations. The vaccine will be fed to queen bees, which will then pass immunity to their offspring.

Laura Melissa Guzman, Gabilan Assistant Professor of Biological Sciences and Quantitative and Computational Biology at the USC Dornsife College of Letters, Arts and Sciences, studies pollinator biodiversity, including bee populations. She sees the vaccine as an exciting and important development partly because it may end up protecting more species than just honeybees.

Building on a lifelong fascination with both biology and puzzles, Guzman uses statistical modeling and a form of artificial intelligence called machine learning to understand where and why pollinator populations are declining as well as how we can help protect these crucial species.

She recently answered questions about her work and the implications of the new honeybee vaccine.

What first sparked your interest in science, and what led you to your current research?

I have been interested in science, especially biology, since I was a little kid. I have also always loved solving puzzles, and my family supported this curiosity. I was very fortunate to be able to participate in science camps and university experiences when I was in high school, and very early on I realized that I loved research. Most recently, I began including bees in my research because I wanted to use my skills to help solve conservation problems.

Describe your current research.

I am interested in figuring out whether pollinators are declining, and what could be causing their decline (climate change or pesticide use, for example). Pollinators include birds, bats, butterflies, moths, flies, beetles, wasps, and bees. Currently, my research focuses on bees and butterflies. Most of my work involves re-creating bee and butterfly distributions through time across the North American continent particularly using community science data and data from museums.

Why is pollinator biodiversity important?

Most of our food production—about three-fourths of the crops we eat—depends on pollinators. According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services report on pollinators, $235 billion to $577 billion worth of crop production is attributed to pollinators. Some of our most popular food crops, such as tomatoes, almonds, apples, melons and broccoli, can't produce the fruits and vegetables we eat unless they are pollinated by insects such as bees, butterflies and beetles.

In some cases, this pollination happens through the natural activity of native and wild pollinators. In other cases, crops are pollinated by honeybees that are raised and transported to fields or orchards to pollinate specific trees or plants.

What's something surprising you've learned from your research?

So far it seems that, at least for bumblebees, not every species is declining. There are about 46 species of bumblebees in North America, and while a third of those are very much in trouble, there are some that are still hanging on. I want to continue working on this question to figure out the characteristics of these species or the locations where they live

that allow them to persist.

How can we help protect pollinators?

We can help protect pollinators by transforming our gardens into pollinator habitats, mostly by cultivating native plants that can be a food source for bees and other pollinators.

We should also reduce our use of pesticides in our gardens, as they harm all types of insects, including bees.

There are products that are also "bee-certified," which lets consumers know that the companies are trying to protect pollinators.

Finally, apps like iNaturalist are a great way to record sightings of bees and butterflies. Researchers can use this data to help them with their work.

What is significant about the new honeybee vaccine?

Honeybees are like the pollinator equivalent of chickens; they are a non-native species that were introduced from Europe specifically for agriculture. My research focuses on studying declines of native bees, which are affected by many of the same pressures that affect honeybees, including pesticides, climate change and disease.

The new honeybee vaccine is one of the many methods we need to employ to improve our food security, and any other improvements we make alongside it, such as reducing our pesticide use, are going to help both honeybees and native bees.

For example, neonicotinoids, which are a type of pesticide still allowed

for nonagricultural use in California, are believed to affect bees' brain and reproductive development, make pollen-collecting trips longer and more exhausting, and prevent bees from ridding themselves of parasitic varroa mites. Reducing neonicotinoiduse should have obvious benefits for bees.

Are there other pollinators who could benefit from vaccine protection?

I do think other pollinators can benefit. For example, we also rear bumblebees for agriculture. This type of vaccine could potentially be extended to cover bumblebees.

In addition, wild bees can benefit from the vaccination of cultivated bee species. Most wild bees are solitary, and we do not rear them in the labs, so it would be very difficult to vaccinate them directly. But there is evidence of disease spillover from honeybees to native bees, mostly occurring when native bees interact with honeybees as they're visiting the same flowers. Any decrease in diseases on honeybees—as we are hoping to see with this new vaccine—is going to help wild bees by reducing the amount of disease transmission between species.

What are some future avenues of research to help us protect pollinators?

For many bee species, we need more data to help us understand where they are and how they are responding to all of these human-made pressures. One of the things we need to figure out is which species are resilient, what are the characteristics of the species that make them resilient, and where our protection is most helpful. It's also important to determine the best places to build and protect pollinator habitat, since that can have a significant protective impact.

Provided by University of Southern California

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