Native bees also facing novel pandemic

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A major threat for native bees is pathogen spillover. Infected bees can leave the fungus on flowers where other bees then feed and contract it. Credit: Unsplash

Move over, murder hornets. There's a new bee killer in town.

CU Boulder researchers have found there is growing evidence that another "pandemic," as they call it, has been infecting bees around the

world for the past two decades and is spreading: a fungal pathogen known as Nosema.

Yet while it's been documented across Europe, Canada and even in Kenya, this infection has almost exclusively been recorded in the European honeybee, the recognizable commercial pollinator. Their findings, published in *PLOS Pathogens*, reveal that almost nothing is known about the impact of this pathogen on native, solitary bees, which make up the majority of the approximately 20,000 bee species on the planet.

"More work needs to be done to understand Nosema infections in native bee species and the potential consequences to native ecosystems, if native bees suffer a similar fate as honeybees when infected," said Arthur Grupe II, lead author and postdoctoral researcher in the Department of Ecology and Evolutionary Biology.

Not only are native bees incredibly important as pollinators in their local ecosystems, as honeybees are not generally found in these places, but they also contribute to pollination of agricultural crops.

"One out of every three bites of the food we eat is due to a pollinator," said Grupe.

Bee populations, and specifically honeybee hives, around the world have been declining in the past two decades due to colony collapse disorder. While there is no singular cause behind this phenomenon, bees and their colonies' health are affected by what's known as the four P's: pests, pathogens, poor nutrition and pesticides.

Nosema is a fungal pathogen, a type of Microsporidia, or spore-forming single-celled parasite.

It survives by infecting the guts of bees, where it germinates, infects the host's cell, reproduces, and ruptures the host cell to release its spores. While being passed through the digestive tract, these spores can infect other cells in the bee's body, sickening the bee and contaminating flowers, pollen, and hives along the way. Some strains of Nosema even lower sperm count and mutilate the male genitalia of bumblebees, reducing their reproductive success.

Different strains, mainly Nosema apis and Nosema ceranae, are now also appearing in new places, with some strains, specifically N. ceranae, causing year-round infections in hives where previously the bees could fight it off seasonally.

So far only Nosema bombi, which infects bumblebees, has been documented in Colorado. However, the more detrimental N. ceranae is probably not far behind, according to Grupe.

A few treatments exist, including plant extracts, breeding methods for resistance and microbial supplements. But most research in native bee populations has been limited to DNA-based methods which test for the pathogen in a bee, rather than looking more holistically at how it effects the bee and the broader population.

The study authors say it's crucial for scientists to better understand how these Nosema strains are traveling the globe and affecting native, solitary bees, as they could lead to further bee pandemics and contribute to colony collapse.

A cascade of effects

Some flowers, like the snapdragon (Penstemon), can only be pollinated by a bee or insect with the right size and weight, triggering the flower to open as the bee lands on it. If that type of bee is wiped out by an

infection, that plant could also disappear—and with it, other animals that ate its fruit or leaves.

Flowers are also almost exclusively where solitary bees—the majority of all bee species—meet their mates, since otherwise females nest alone in the ground or in structures built from plant materials. If these flowers die off, so too do the places where bees find their reproductive partners.

Another major threat for native bees is pathogen spillover, when infected bees from commercial hives leave the fungus on flowers and native bees pick it up. These native bees, having never encountered this pathogen before, could be much more susceptible to its negative effects.

The same thing could happen in reverse: If a novel strain of Nosema develops in native bees, that more aggressive strain could then find its way back into commercial honeybee populations—who wouldn't have resistance to that particular version of it.

Without knowing how Nosema is affecting native, solitary bees, a whole pandemic and its ecological consequences could be going on unnoticed.

"We know so little about the biology of what's happening," said Alisha Quandt, co-author and assistant professor of ecology and evolutionary biology. "That's one of the reasons why we think it's so important for people to start doing this kind of surveillance work, going out there and sampling more native bees."

More information: Arthur C. Grupe et al, A growing pandemic: A review of Nosema parasites in globally distributed domesticated and native bees, *PLOS Pathogens* (2020). DOI: 10.1371/journal.ppat.1008580

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