Bee mite arrival in Hawaii causes pathogen changes in honeybee predators

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Kevin Loope excavates a yellowjacket nest in Volcano, Hawaii. Credit: Jessica Purcell, UC Riverside.

The reddish-brown varroa mite, a parasite of honeybees and accidentally introduced in the Big Island of Hawaii in 2007-08, is about the size of a

pinhead. Yet, its effects there are concerning to entomologists because the mite is found nearly everywhere honeybees are present.

A team led by entomologists at the University of California, Riverside, performed a study on the Big Island and found viruses associated with the mite have spilled over into the western yellowjacket, a honeybee predator and honey raider. The result is a hidden, yet remarkable, change in the genetic diversity of viruses associated with the larger pathogen community of the mite and wasp, with repercussions yet to be understood.

"Already, we are seeing that the arrival of the varroa mite in honeybee populations in Hawaii has favored a few virulent strains," said Erin E. Wilson Rankin, an assistant professor of entomology and lead investigator of the study published Jan. 9 in the *Proceedings of the Royal Society B*. "We do not know what the effects of these strains will be. What we know is that the effects of the varroa mite have cascaded through entire communities in Hawaii and probably around the world."

In particular, the researchers saw a loss in the diversity of deformed wing virus, or DWV, variants, resulting in new strains whose impact is hard to predict. DWV, widespread in honeybee populations globally and made up of several variants, is thought to be partly responsible for global die-off of honeybee colonies. DWV infects bumblebees and has been detected in other insects. The yellowjacket wasps can acquire this virus directly or indirectly from honeybees.

By a stroke of luck, the researchers had the benefit of studying the honeybee and yellowjacket populations on the Big Island both before and after the varroa mite was introduced there. They saw more association of honeybees with pathogens after the appearance of the mite. Indeed, some pathogens were detected in the honeybee and wasp populations only after the mite was introduced to the island.

"This is one of the first descriptions of pathogens in the western yellowjacket," Wilson Rankin said. "Evidently, pathogens known to be associated with varroa have spread into non-bee species, despite the mite itself being a bee specialist. We suspect the spread in yellowjackets is partly due to the wasp's propensity to prey upon bees, which is one way the wasps may be exposed to the pathogens."

Erin Wilson Rankin examines a western yellowjacket. Credit: I. Pittalwala, UC Riverside.

Wilson Rankin noted the pathogens are often incorrectly called "bee pathogens" because they were first found in bees. The pathogens, however, are found in a wide variety of insects.

"We are seeing entirely different predators being affected," she said. "The mite is not vectoring viruses to the wasps. The viral spread is happening through predation and through flowers. Predators may be passing on pathogens to other species. The yellowjacket, for example, preys on both honeybees and native bees, and may explain why both bee populations are showing the same viruses."

Wilson Rankin explained wasps have been overlooked by researchers because these arthropods do not have "warm, fuzzy, and furry connotations."

"They look scary," she added. "People also get stung by them. People are more afraid of wasps than bees. But our work shows we can examine the health of the arthropod community by using species other than bees. We show for the first time that a predator is being affected by a parasite that does not even infect it."

The researchers sampled 25-45 bees and wasps for one part of the study, and then about 100 individuals, analyzed in groups, for each of the species during the period before and after the mite was introduced to the Big Island. The researchers did not study native bees, focusing instead on honeybees and yellowjacket wasps, neither of which is native to Hawaii.

"Our findings suggest that pathogen transmission from domesticated bees, such as honeybees, may be important even for non-bee insects like the wasps we studied," said Kevin J. Loope, the research paper's first author, who worked as a postdoctoral scholar in the Wilson Rankin lab during the study. "The impacts may be more subtle than previously observed: we found changes in the genetic variation of viruses found in the wasps, but not changes in the amount of virus. These findings suggest we should look more broadly and in greater detail to figure out how moving domesticated bees for agriculture may influence wild populations of insects.

Loope, now a research assistant professor in the Department of Biology at Georgia Southern University, explained that finding overlap in the pathogens of yellowjacket wasps and domesticated bees also means that using pathogens to control undesirable wasp populations is risky.

"Any biological control efforts using pathogens should be carefully evaluated to prevent inadvertent harm to beneficial bees," he said.

He added that the research team was surprised to find a dramatic difference in the viral genetic diversity between the wasp samples from the two periods—before and after the varroa mite was detected on the Big Island.

"We had predicted we would observe a decline in wasp viral diversity matching the decline described in honeybees in Hawaii, but we were still surprised to see this borne out in the data," he said. "It's not so often that you see what you've predicted in biology."

More information: Pathogen shifts in a honey bee predator following arrival of the Varroa mite, *Proceedings of the Royal Society B*, rspb.royalsocietypublishing.or … .1098/rspb.2018.2499

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