

## Evolution & Behavior

# Viruses are spilling over from managed honey bees to wild bumble bees

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### ABSTRACT

*Viruses, once thought specific to managed honey bees, have now been detected in wild bee species, including bumble bees. Our study tested whether virus infection in wild bees was directly related to the presence of managed honey bees. We found that viruses are spilling over from honey bees into wild bumble bees, and this is likely occurring through shared flowers.*



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If you are a concerned environmentalist, or even a food-lover (bees produce every three bites of food you eat), you might have considered becoming a beekeeper to help ‘save the bees’. For most, ‘bees’ conjure up an image of a striped yellow and black insect, producing waxy combs and the honey we all love. The reality is: managed honey bees (*Apis mellifera*), the bees that live in wooden boxes and make honey for your tea, are not native to the US, *and* they may be a source of disease to wild bees. There are over 20,000 species of wild bees in the world, and new research suggests that becoming a beekeeper might be the last thing you should do to save those bees.

Pests and pathogens are among the top threats to both wild and managed pollinators. The introduction and spread of new pests and pathogens have led to catastrophic losses for wild and managed bees. Many bee-harming pests and pathogens are generalists, shared by a wide range of species. However, one question that has puzzled researchers for decades is this: “are the patterns of disease we observe in wild bees, linked to the presence of managed bees?” In other words: are pathogens spilling over from managed bees into wild bees? It seems likely. Considered the tight evolutionary relationship and shared forage habits of managed and wild bees, it’s easier for pathogens to ‘host jump’

across species that are similar and species that share the same figurative ‘watering hole’.

Additionally, the way honey bees are managed, densely placed hives in a field, each consisting of tens of thousands of individuals, may make them a likely source of pathogens as diseases are likely to spread between individuals sharing close quarters. This concept is similar to the way diseases are more likely to spread between humans in cities versus rural areas where folks are more spread out. When our research group began researching this phenomenon in bees in 2015, we set out to [test this largely stated yet widely untested hypothesis](#): Are viruses spilling over from managed honey bees into wild bees? And if so, is virus transmission occurring through the shared use of flowers?

To investigate the spillover hypothesis, we selected 19 sites across Vermont. Sites either had a managed honey bee apiary present or no nearby apiary within at least 1 km. From each site, we collected bumble bees, and when present, we collected honey bees. To investigate whether flowers can serve as platforms for virus transmission, we collected samples of the most highly visited flowers from each field site. We brought all the bees and flowers back to the lab and tested them for two well-known RNA viruses: deformed wing virus (DWV) and black queen cell virus (BQCV).

The presence of honey bees had a significant impact on viruses in both bumble bees and on flowers. For both viruses, we found bumble bees were significantly more likely to host viruses when they were collected near apiaries. At sites completely absent of honey bees, all bumble bees were negative for DWV. Virus results on flowers followed a similar pattern: 19% of flowers we collected from apiary sites harbored bee viruses. Most surprisingly, we did

not detect viruses on any flowers collected from sites without apiaries. Taken together, our results strongly suggest that honey bee apiaries are hot spots for viruses to wild bees and that flowers could play a role in how viruses are transmitted between species.

If honey bees are spreading viruses to wild bees, should we quit beekeeping? The short answer is: no. Honey bees are agricultural livestock animals and are currently the most important *managed* pollinator for our food crops [grown in vast monocultures without habitat to support wild bees and their pollination services]. However, the *way* we manage bees could have implications for the health of wild bees. Although there is no medication or vaccine available for beekeepers to treat viruses, there are many options available to treat the mites which vector viruses to honey bees. Beekeepers who keep mite levels low will keep virus levels low and reduce the likelihood of spillover to wild bees. Secondly, we should be mindful of where apiaries are placed on the landscape. For example, we should avoid placing new apiaries where honey bees are currently absent, particularly in habitats shared by vulnerable bee species, such as the US federally endangered rusty patched bumble bee.

What should you do to ‘save the bees’? Plant a high diversity and abundance of native plants to provide food for bees throughout the growing season. [Our latest research](#) suggests that the plants you choose and/or level of diversity could help reduce the likelihood of virus deposition and spillover. If you are a beekeeper (and perhaps feeling a bit conflicted now about your hobby or work), let us give you our biggest piece of advice. Be a good steward for your bees: monitor your mite levels and treat when necessary to keep your bees and the wild bees healthy!