Of bees, mites, and viruses

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Honeybee colonies are dying at alarming rates worldwide. A variety of factors have been proposed to explain their decline, but the exact cause—and how bees can be saved—remains unclear. An article published on August 21st in *PLOS Pathogens* examines the viral landscape in honeybee colonies in New Zealand after the recent arrival of the parasitic *Varroa* destructor mite.

Varroa is thought to be one of the main stressors that reduce bee fitness. As they feed on the blood of pupae and adult bees, the mites can transmit several honeybee viruses with high efficiency. Uncontrolled *Varroa* infestation can thereby cause an accelerating virus epidemic and so kill a bee colony within two to three years. Interested in the complex interplay between bees, mites, and viruses, Fanny Mondet, from the University of Otago, Dunedin, New Zealand, and INRA, Avignon, France, and colleagues took advantage of a unique situation in New Zealand: The country was only recently invaded by *Varroa*, which was first detected on the North Island in 2001, and still had an active infestation expansion front traveling southward into *Varroa*-free areas of the country when the study took place.

The researchers' aim was to monitor the first stages of the *Varroa* infestation and its consequences for bees and bee viruses. As they report, the arrival of *Varroa* dramatically changed the viral landscape within the honeybee colonies of New Zealand. Each of seven different virus species examined in detail responded in a unique way to the arrival, establishment, and persistence of the mite.

Consistent with the observations in other countries, Deformed Wing Virus (DWV) is the virus most strongly affected by the spread of *Varroa* throughout New Zealand. DWV, which can multiply in the mites and is thought to be a direct cause of *Varroa*-induced colony collapse, was almost never seen in New Zealand bee colonies before the arrival of *Varroa* or ahead of the expansion zone after 2001. Thereafter, DWV abundance gradually increased with *Varroa* infestation history, even when *Varroa* infestation rates declined. Another highly virulent *Varroa*-transmitted virus, Kashmir Bee Virus (KBV), also showed a close association with *Varroa*. However, in contrast to DWV, KBV abundance peaks two years after an initial *Varroa* infestation and subsequently disappears from the colonies entirely, leaving DWV as the dominant honeybee virus in long-term *Varroa*-infested areas.

The researchers say that the results of their study "strengthen the idea that the multiple virus infestations in honeybees interact to create a dynamic and turbulent pathological landscape, and that the viruses play an important part in the survival or collapse of the bee colonies infested by *Varroa*. For example, KBV could play a key role in the dramatic honeybee colony weakening observed during the first years of *Varroa* infestation". They hope that their results to date will be "useful for the beekeeping industry by highlighting the importance of beekeeper awareness, of mite monitoring, and the timing and efficiency of *Varroa* control". "Future work", they state, "will focus on the mechanisms that form the evolutionary basis for the bee-*Varroa*-virus interaction".

More information: Mondet F, de Miranda JR, Kretzschmar A, Le Conte Y, Mercer AR (2014) On the Front Line: Quantitative Virus Dynamics in Honeybee (Apis mellifera L.) Colonies along a New Expansion Front of the Parasite Varroa destructor. *PLoS Pathog* 10(8): e1004323. DOI: 10.1371/journal.ppat.1004323

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