

AF5 impact story: bees

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Breeding healthier and stronger honeybees

AlphaFold's insights show how tiny changes in the Vg protein affect resilience in honeybee colonies.



[Alt text tbc]

The world needs bees. These small but mighty insects help to pollinate a third of all crops we grow, from almonds to apples. But they are under threat, caught in a storm of habitat loss, pesticides, disease and a changing climate.

In 2025, US honeybees suffered perhaps the largest colony die-off in the country's history, close to 60% for managed honeybee colonies. If we can learn how to accelerate breeding programs for more resilient honeybees, we can improve our chances of reversing this trend.

Vilde Leipart, a postdoctoral researcher at the Norwegian University of Life Sciences, is among the many scientists racing to protect the planet's bees. Her work focuses on a protein that's central to keeping bee colonies healthy: vitellogenin (Vg).

In honeybees, Vg is a molecular Swiss-army knife that helps bees resist disease, handle stress, feed offspring, and much more. Yet for decades, no one knew what it looked like.

"Just a few years ago, we had a fragmented structural understanding of this protein," says Leipart." In 2021, she was able to [use AlphaFold 2](#) to predict Vg's shape in near-atomic detail, providing a glimpse of how it helps bees pass immunity from queen to offspring.

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It took me two days to do something that could have taken me years.

VILDE LEIPART, LIFE SCIENCES RESEARCHER

In July 2025, those predictions, as well as other predictions from AlphaFold 3, were [experimentally confirmed](#) using a technique called electron microscopy. AlphaFold 3 also enabled Leipart and her colleagues to investigate how vitellogenin binds and reacts with other important molecules inside the bee. These insights show how tiny changes in the protein's shape can ripple out to affect immunity and stress resistance across the colony, for example.

This work also has implications beyond bees. Egg-laying species including fish, poultry, tree frogs, crocodiles and turtles all make Vg and are all vulnerable to a variety of infectious diseases. Understanding Vg's basic functions in honeybees may reveal what it does in other

egg-layers, potentially helping scientists protect vulnerable wild species and key farmed animals from infectious diseases and pesticides.

The honeybee research is already moving from the lab to the hive in the form of AI-assisted honeybee breeding programs in the U.S.

Breeding bees for traits such as parasite resistance is painstakingly slow. Each breeding cycle can take almost a year, as beekeepers raise queens and then test mature colonies to see if offspring develop the desired traits for resilience.

Now, by linking the precise 3D structures of Vg to honeybee genetics, scientists can identify the most resilient bee variants before they become adults. Early trials suggest this could shorten generation times from months to weeks. It's a nimble, data-driven way to help honeybee populations adapt faster to some of the threats driving their decline.

By decoding this critical protein in such detail, Leipart and her collaborators hope to give honeybees a fighting chance and, in doing so, help secure the ecosystems and farms that depend on them.

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