

A more natural location improves the microbial health of beehives, shows study

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The researchers of the Applied Genomics and Bioinformatics group Andone Estonba and Iratxe Zarraonaindia on the Unije island preparing the hives for the study together with their Croatian colleagues (UPV/EHU). Credit: Marin Kovačić / Universidad de Osijek

According to a study published by the journal *Scientific Reports*, when

the anthropization of beehives decreases, the relative abundance of their beneficial bacteria increases

In an international study, the Applied Genomics and Bioinformatics group of the University of the Basque Country (UPV/EHU) explores the situation of bees in areas of intensive agriculture, semi-[natural areas](#) and natural areas, taking the beehive as a unit. The bees' microorganism pool was found to vary considerably depending on the degree of anthropization. After the hives had been kept in a semi-natural habitat for 16 days, their microbial imbalance resulting from agriculture was reduced.

The western honey bee (*Apis mellifera*) is endangered as a result of many of the stress factors it suffers in human-dependent areas, such as poor nutrition, pesticides and pathogens.

"It has become apparent over the last few years that bee mortality has increased significantly; that is why about 6 years ago we started to look at which factors influence the bee microbiota and what relationship this has with bee diseases or health," explained Iratxe Zarraonaindia, Ikerbasque research fellow of Applied Genomics and Bioinformatics. "The researchers attach great importance to the anthropization of the areas, in other words, "intensive agriculture, chemicals used, etc."

"In collaboration with three Croatian universities, we have had the opportunity to study some beehives located on the Croatian island of Unije, far from [human influence](#). These hives have not been subject to any treatment for ten years; their bees were known to survive for a long time despite the presence of the Varroa mite, responsible for a disease that causes bees to sicken and die. We wanted to investigate how anthropization influences the microbiota or microorganism community of bees. To do this, we compared the hives on the island of Unije with the microbiota of two hives located in rural areas," said Zarraonaindia.

To be able to compare the two hives in the [agricultural area](#), "genetic siblings" (hives comprising bees containing the same genetic material as those in the agricultural area) were used, and one of them was moved to a semi-natural area.

"Anthropization was clearly seen to exert a significant impact, since only 16 days later we detected that the microbial imbalance due to agricultural stress had lessened in the hive moved to the semi-natural area," explained Dr. Zarraonaindia. This shows that the honey bee microbiota has a great capacity to adapt. "We didn't think that the composition of the microbiota was going to change so rapidly," she said.

The researchers found a clear gradient related to the degree of anthropization and the microbial community of the hive. "The microbiota of the Unije Island hive is more balanced, its proportion of beneficial microorganisms is higher and in a semi-natural environment the proportion gradually decreases, whereas in the agricultural environment the composition of the hive is highly imbalanced, more opportunistic bacteria are found and it is more sensitive to diseases," explained Zarraonaindia. According to the researcher, "the stress factors in agricultural areas are highly activated."

Apibioma research

These findings have enabled the research group to determine biomarkers that will provide information on bee health. For example, the researchers have detected that a particular bacterium, *Arsenophonus*, is highly prevalent in agricultural areas, less present in semi-natural areas, and hardly present at all in natural areas.

They studied the hive as a whole, not just the bees. This is one of the most significant keys in this research. "This approach is innovative. We studied the apibiome: the set of microorganisms in the niches present in

the hive. We studied the gut of the bees, the hive entrance, bee bread (the substance the bees feed on) and the air inside the hive."

Arsenophonus bacteria are the most prevalent bacteria in the agricultural area, and this is a trend that has been found in all the niches. So it is a very appropriate biomarker for measuring the impact of agriculture on [hives](#) and measuring their health; what is more, "this method is not invasive, since it can be implemented by taking a sample from the entrance to the hive."

The researchers have published this study in the journal *Scientific Reports*. The research reported in the paper represents only one year's work. And the research will go on. "We have now moved the hive from the semi-natural area to a natural area to see whether the microbiota becomes balanced and ends up the same as that of the bees in the natural area. This will tell us the extent of the genetic contribution as well as that of the environmental contribution."

More information: June Gorrochategui-Ortega et al, A short exposure to a semi-natural habitat alleviates the honey bee hive microbial imbalance caused by agricultural stress, *Scientific Reports* (2022). [DOI: 10.1038/s41598-022-23287-6](https://doi.org/10.1038/s41598-022-23287-6)

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