

Study: Mapping people's knowledge of bees may aid in pollinator conservation

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A honey bee visits an apple flower. Managed honey bees and wild native bees provide critical pollination services for agricultural crops in the United States, but researchers say the public's knowledge of wild bee species is low. Credit: Laura Russo

U.S. college students' knowledge of bees focuses primarily on honey bees and pollination services, according to Penn State researchers, who said findings from their recent study could help in designing campaigns to generate support for protecting threatened pollinators.

Wild and managed [bee populations](#) have been in steep decline worldwide in recent years, noted study co-author Christina Grozinger, Publius Vergilius Maro Professor of Entomology and director of the Center for Pollinator Research in the College of Agricultural Sciences.

"In the United States, 30% or more of [honey bee colonies](#) die each winter, and studies suggest that populations of a quarter of all bee species globally, including half of bumble bee species, have fallen significantly," she said. "These declines have serious implications for natural ecosystems, agriculture and human nutrition."

About 80% of flowering plants—and three-fourths of major food crops such as fruits and vegetables—rely on pollination from animals, with [bees](#) being the most important pollinators, Grozinger explained.

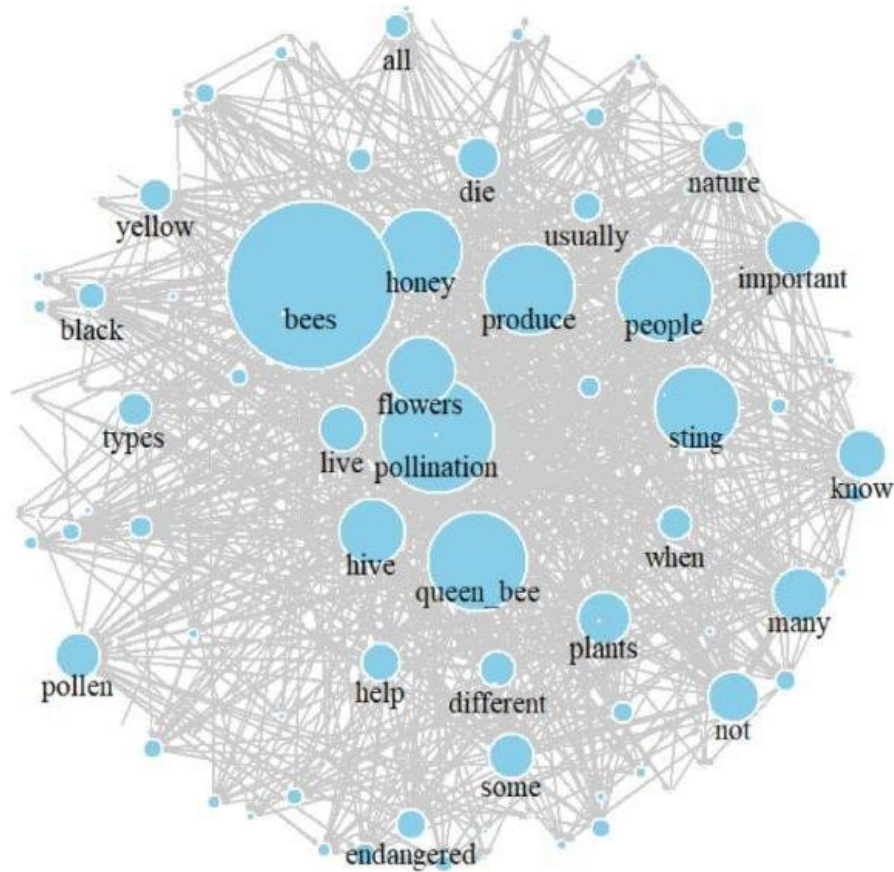
Study lead author Shannon Cruz, assistant professor of communication arts and sciences in the College of the Liberal Arts, contends that to address bee species declines, the public must engage in conservation efforts, but research on how best to promote such behavior is limited.

"Many initiatives have focused on education as the solution to this problem, but education alone often isn't enough to produce attitude and behavior change," Cruz said. "Such change also may require communication campaigns that not only explain how to protect pollinators, but persuade people they should protect them. Research indicates that this type of persuasive messaging is likely to be most effective if it's designed based on what people already know about an issue."

The researchers said previous studies suggest that public awareness of the breadth and diversity of bee species—which number more than 400 in Pennsylvania, 4,000 in the U.S., and 20,000 globally—is low and that people tend to have better knowledge of [honey](#) bees than of other bee species, even though honey bees are not representative of most species.

To craft persuasive messages that are effective even among people with low awareness, more in-depth studies are needed, the researchers noted. So, they set out to develop a novel approach to examining knowledge using semantic network analysis and content coding.

This type of analysis enables researchers to gauge the content of subjects' knowledge of a topic based on their expression of words and concepts. By mapping the relationships between these words and concepts, researchers can better understand not just what the subjects know, but how they connect concepts to one another and organize this knowledge cognitively.



This illustration depicts the semantic network that represents the knowledge of bees expressed by the low-interest group of students. The larger the node, the more central the concept was to the subjects' understanding. Only words with at least 20 connections to other words are labeled. Credit: Penn State

"Recent communication research suggests that arguments that incorporate more central concepts in a semantic network will be stronger and more persuasive than arguments that incorporate more peripheral concepts," Cruz said. "The implication is that if we understand which concepts are most central to public knowledge of bees, we can also determine which concepts to focus on when developing persuasive messages to promote bee conservation."

As their subjects, the researchers chose undergraduate students, with an eye toward examining the content and structure of their self-reported knowledge of bees and identifying the central concepts that might form the most promising basis for persuasive messages on bee conservation. They also looked at whether central concepts and the accuracy of bee knowledge differed in two audiences—a high-interest group enrolled in a course specifically on honey bees, and a low-interest group enrolled in psychology classes.

Participants completed a survey that asked questions such as "What do you know about bees? Please write down anything that comes to mind." The researchers analyzed responses word by word using a software program, which tabulated how often each word appeared and how often two words occurred together (within three words of each other) in the text.

Researchers also coded responses manually to evaluate the accuracy of students' knowledge on a scale of 1 (completely false) to 5 (completely true). In addition, they separated statements based on whether they focused on bees in general or on honey bees only.

Their findings, published recently in *Conservation Science and Practice*, indicated that the concepts most central to students' understanding of bees—such as produce, honey, hive and queen bee—tended to be specific to honey bees. The words "people" and "pollination" also were central, which suggests that participants' understanding focused mainly on the value bees provide to humans through honey production and pollination of crops and flowers.

These patterns also held true when looking at the low- and high-interest students separately. The main difference between the two groups was that "sting" was among the most central concepts for the low-interest students but not for the high-interest students. These findings suggest

that students in general have a honey bee-centered, utilitarian understanding of bees and that the fear of being stung is more prominent among those with low interest in bees.

Both groups' knowledge of bees was relatively accurate but shallow, the researchers said. Students' understanding of honey bees was much more accurate than their knowledge of bees in general, and they frequently assumed that facts about honey bees were true of all bees.

"Because honey bees typically are managed and not representative of most wild bee species, some researchers have argued that focusing [conservation efforts](#) on honey bees is counterproductive," Grozinger said. "But our findings show that because concepts like 'honey' were central to how students organized their knowledge, honey bees may still be among the best ambassadors for bee and pollinator conservation."

Cruz noted that the findings do not mean that focusing solely on honey bees will be effective in promoting the conservation of other species.

"Instead, honey bees can serve as a familiar place to start, before transitioning into a discussion of other bees and [pollinators](#)," she said. "By drawing connections between other bee species and honey bees, we can help tap into existing knowledge structures, making behaviors like native bee conservation more familiar and appealing than they might be otherwise."

More information: Shannon M. Cruz et al, Mapping student understanding of bees: Implications for pollinator conservation, *Conservation Science and Practice* (2023). [DOI: 10.1111/csp2.12902](https://doi.org/10.1111/csp2.12902)

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