Bumblebees do best where there is less pavement, more floral diversity

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This image shows *Bombus vosnesenskii*, the yellow-faced bumblebee studied by University of Texas at Austin's Shalene Jha and University of California, Berkeley's Claire Kremen. The researchers found that the ground-nesting bumblebees are negatively impacted by impervious cover and will forage long distances for diverse patches of flowers. Credit: Shalene Jha, University of Texas at Austin

Landscapes with large amounts of paved roads and impervious construction have lower numbers of ground-nesting bumblebees, which are important native pollinators, a study from The University of Texas at Austin and the University of California, Berkeley shows.

The study suggests that management strategies that reduce the local use of pavement and increase natural habitat within the landscape could improve nesting opportunities for wild bees and help protect food supplies around the word.

The study also suggests that increasing the number of species-rich flowering patches in suburban and urban gardens, farms and restored habitats could provide pathways for bees to forage and improve pollination services over larger areas.

The findings have major implications for global pollinator conservation on a rapidly urbanizing planet.

"We are potentially in a pollinator crisis," said Shalene Jha, lead author and assistant professor of biology at The University of Texas at Austin. "Honey bees are declining precipitously, and wild bees have also been exhibiting population declines across the globe. Native bees provide critical pollination services for fruit, nut, fiber and forage crops. Understanding how bees move around the landscape can help us both preserve biodiversity and improve crop yields."

Animal pollination is estimated to be worth over $200 billion in global crop yields.

For the research, published in the journal *PNAS*, Jha and senior author Claire Kremen, a professor at UC Berkeley's Department of Environmental Science, Policy and Management, studied a native California bumblebee, *Bombus vosnesenskii*, in habitats across exurban areas, farms and nature reserves.

In addition to finding that pavement negatively affects the bees, the scientists discovered that:

- Bees will move longer distances to find patches of flowers that are rich in species; it's not floral density that determines how far a bumblebee will fly, but floral diversity.
- Bees will also forage further away from their home nest if the surrounding landscape is less heterogeneous. "In some ways, it's a bet-hedging strategy," said Jha. "If the landscape is composed of consistently dense flowering patches, bees take a risk and forage farther afield to find species-rich patches."

"In combination with earlier work showing that bumblebees have become rare in agricultural landscapes, our study suggests that farmers could promote these valuable pollinators by diversifying crop types and by planting cover crops and flowering hedgerows to enhance floral diversity," said Kremen.

Though it may seem obvious that pavement and ground nesting don't mix, Jha said that our understanding of the effects of pavement and urban growth on native bees has been largely anecdotal.

"Using genetic tools, we can now estimate the number of colonies in an area," said Jha, who began this work as a postdoctoral researcher at UC Berkeley. "This is helping us better understand how wild pollinators live and move across large, diverse landscapes."

Bumblebees nest in the ground, and each colony contains a queen and a force of workers. As with honeybees, all of the bumblebee workers are sisters who spend some of their time flying around searching for flowers from which to collect pollen and nectar to feed the larvae back in the hive.

Unlike honeybees, which are not native, bumblebees do not make harvestable honey. They do, however, provide important pollination services to plants.

"Bumblebees are among the most effective native pollinators," said Jha. "They are large and can carry a lot of pollen. They also vibrate or 'buzz' flowers with their bodies and thus are excellent at extracting pollen and moving it from plant to plant."

To study the bumblebees, Jha did not scour the landscape for nests in the ground, which has proved in the past to be very difficult, especially over large areas. Instead, she analyzed the genetic relatedness of bees foraging in the landscape.

If bees collected in an area were genetically identified as sisters, they came from the same colony. Unrelated bees came from different colonies. Jha used this information, plus the bees' locations, to estimate the number of bee colonies in an area and determine how far afield the individual bees were foraging.

Provided by University of Texas at Austin