Science Societies

Abundant food but nowhere to live

Researchers Test soils, lipids in ground-dwelling bee nests

By DJ McCauley

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This sweat bee in the genus Dufourea is emerging from its nest in the sand. This bee is a specialist forager on snowberry. Photo by L.R. Best, Taxonomist, Oregon Bee Atlas, OSU.

- Ground-dwelling bees make up 70% of all native pollinator species in the United States.
- New *Soil Science Society of America Journal* research characterized the soil and lipid content in agricultural sites where ground-dwelling bee nests were found.
- This research adds to the sparse literature on the soil habitats containing the nests of ground-dwelling pollinators in agricultural settings who serve a vital role in the lifecycle of many commercial crops.

When it comes to your home, you might be a bit picky. Wood floors or carpet? Vinyl siding or stucco? Modern furniture or classic silhouettes?

The odds are good that you haven't considered a home in the soil. Unlike the domesticated bumblebee, which so often lives in wood-sided boxes provided by a doting beekeeper, more than 70% of pollinators in the United States make their homes in the ground (**https://bit.ly/3faEPWw**). Of those species, most are solitary; a single mom tends to her brood.

It turns out ground-dwelling bees have very specific requirements for housing. They've been spotted in the areas next to agricultural fields—the unvegetated bits that often

go unnoticed, like the sloped shoulders of a dirt road, or bare patches where a tractor might turn around.

A team at Oregon State University (OSU) recently documented the dwelling places of ground-nesting bees in the Willamette Valley, publishing their research in the *Soil Science Society of America Journal* (**https://doi.org/10.1002/saj2.20085**).

Despite their prevalence across the landscape, there is a dearth of research characterizing the soil habitats that support native pollinator nests near agricultural sites. As domesticated bee populations decline, understanding how to provide both food and shelter for native pollinators is paramount.

The study began when Sujaya Rao, then a Professor of Entomology at OSU (she has since taken over as the Head of the Department of Entomology at the University of Minnesota), approached Rebecca Lybrand, an Assistant Professor in the Crop and Soil Department.

The two wanted to characterize the soil types where ground-dwelling bees are found in the agricultural fields of the wet, fertile climate of western Oregon. Lybrand's graduate student, Jennifer Fedenko, played a key role in finding and monitoring nests. Together, the three documented the presence of bees and sand wasps (who are also pollinators) at 17 different sites.

Waterproof Nests

After analyzing the soil samples, they found that the bees preferred soil composed mostly of clay and silt. From a subset of sites, the team scraped a small sample of the lining of the nest.



The ground-dwelling mining bee, of the genus Andrena, snacks on a plant in the genus Senecio. Photo by L.R. Best, Taxonomist, Oregon Bee Atlas, OSU.

Rao and Lybrand then partnered with Malak Tfaily. At the time, Tfaily was a scientist at the Pacific Northwest National laboratory but is now in a faculty position at the University of Arizona. Tfaily analyzed the lipids using mass spectrometry. She characterized the distinct biochemical composition of the lipids the bees were using to line their nests.

“We need to do more research and analyze more samples,” Lybrand says, “but we think the bees are secreting the lipids as a way of waterproofing their nests. The nests don't swell shut in the winter, which is something we didn't initially expect.”

Lipid linings are common in bee nests—just think of the wax in the honeycomb of a domesticated honeybee hive. So far, this is the first study characterizing its exact composition.

“This [lipid analysis] is something I've never seen before,” says Alexandra Harmon-Threatt, an Associate Professor of Entomology at the University of Illinois who was not involved with the study. “It would be really amazing if we could monitor for the presence of ground-dwelling bees in agricultural sites using just soil cores and these lipid profiles.”

Further research is needed to validate just *how* the wax keeps water out. Does the hydrophobic nest entrance lining prevent water from entering? Is the top of the nest preferentially lined, like a little wax roof within the soil? Does the long vertical shaft of the nest prevent water from running into the side chambers?

Healthy Habitat

Scientists know a great deal about the benefits that bee populations provide for crops—as one meta-analysis demonstrates, pollinators benefit production of 39 of the 57 leading crops grown worldwide (**https://bit.ly/33nfkyY**).

But as Harmon-Threatt puts it, “What good is providing bees with all this food if you don't also give them somewhere to live?”

Researchers have advice for the farmers, growers, and backyard enthusiasts that find ground-dwelling bees in their green space.

“If you spot a nest, and you can keep the site intact, the odds are good that more solitary bees will aggregate as time goes on,” Lybrand says.

Harmon-Threatt recommends planting native flowers. “There's something about the way they grow that ground-dwelling bees really like. I think it's because they tend to grow in dense clumps, and they leave patches of bare, unvegetated ground between them,” she says.

Rao also mentioned that simply integrating crops that attract pollinators benefits bee populations. Though most research focuses on how bees can benefit crops, agricultural crops can benefit bee populations, as well. It could be as simple as integrating cover crops that require pollination like meadowfoam, clover, or vetch.

“We have to find ways to work with farmers, to make conservation fit in with their schedules and their work,” Rao says. “No matter how much they want to help the bees, it has to be practical for them, too.”

And that's the thread binding the team's research together: collaboration. For research endeavors and broad-scale conservation, we need cooperation between soil scientists and entomologists, biochemists and biologists, farmers and researchers, bees and bare soil. Working to foster these connections is the way forward, for the health of our crops, our bees, and our environment.

Dig deeper

Check out the *Soil Science Society of America Journal* article, “Soil Properties and Biochemical Composition of Ground-Dwelling Bee Nests in Agricultural Settings,” at **https://doi.org/10.1002/saj2.20085**. Photos of ground-dwelling bees in this article provided by the Oregon Bee Atlas. The Oregon Bee Atlas enlists volunteers across the state of Oregon in a concerted effort to survey the state's bees to create a checklist of species to monitor populations and pollinator health. You can read more about the project here: **www.oregonbeeproject.org/bee-atlas**.

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