

Most Bees Live Alone

No hives, no honey, but maybe help for crops

Susan Milius

Theresa Pitts-Singer and Cory Vorel give us such friendly smiles that it's almost impossible not to believe them. But their advice on getting a close look at their bees seems nuts. They've led a small group of visitors around a back corner of the home of their bee lab. Dark blurs zip past us as the bees settle down for the night. Vorel passes out otoscopes. For prime viewing, she urges us to position our eyes and a bright light just an inch away from the stinging end of a resting bee, as if we're ear doctors gone off the deep end.

At first we're skeptical. But, in the 20 minutes that we shine our otoscopes into the bees' bedrooms, no one is stung. We're impressed, but Pitts-Singer isn't surprised. These are special bees. This lab in Logan, Utah, is the only one of the United States Department of Agriculture's five bee laboratories that doesn't work on honeybees.

Instead, she and her colleagues keep alfalfa leaf-cutting bees (*Megachile rotundata*). These bees and others classified as solitary bees operate independently and don't have hives or honeycombs. Each leaf-cutting bee in the lab lives in a paper drinking straw stuck in one of many holes in a plastic block. Solitary bees, Pitts-Singer tells us, don't sting as readily as honeybees do because they aren't defending a family nest.

Loner bees may seem unusual, but honeybees are actually the oddballs. At least 75 percent of the 4,500 bee species in the United States and Canada live solitary lives.

This unsung majority has attracted new attention as concern rises that populations of honeybees, and perhaps other pollinators, may be declining. In October 2006, a National Research Council report on pollinators called for new attention to solitary bees. They may offer alternatives to honeybees as pollinators for crops. And research is starting to reveal their importance in the wild.



Two female *Megachile pugnata* bees perch at the center of a purple coneflower. This native North American species is one in which each bee has its own, private home. A solitary lifestyle is actually more common among bees than is the better-known social life of the honeybee.

Pitts-Singer

Regardless of what uses people find for them, solitary bees offer a variety of charms. Some gleam like blue pearls; some grow fur tufts; some sleep in flower blossoms. And it's hard not to like a bee that's slow to sting.

Honeybee hiatus

The job market's great for honeybees these days, says James Cane of the Utah lab. Commercial beekeepers rent their hives to farmers, who rely on the bees to pollinate some 100 commercial crops in North America.



HONEYBEE SUBS. The alfalfa leaf-cutting bee, a stowaway from Europe and Asia, has settled into North America. It pollinates these purple alfalfa flowers more efficiently than honeybees do.

Pitts-Singer

The 2-million-plus honeybee colonies traveling the farm circuit represent a shrinking labor force. It's down by a third since 1981, according to the USDA's statistics. Pesticide use, Africanized bees, parasites, and diseases have taken their toll. In 2005, California almond growers became the first U.S. farmers since 1922 to get emergency permission to import honeybees from outside the United States.

The new National Research Council report notes a "demonstrably downward" trend not only for honeybees but also for some wild-living pollinators, such as several bumblebees and bats.

Out of 115 crops worldwide examined in a study that the *Proceedings of the Royal Society B* has [posted online for the Feb. 7 issue](#), 87 rely fully or partly on animals for pollination. That represents a third, by volume, of all crop production, report Cane, Alexandra-Maria Klein of the University of Göttingen in Germany, and their colleagues. For example, cantaloupes, watermelons, and cocoa are almost exclusively dependent on insects.

Alternative farmers

While honeybees pollinate many crops, they shirk that duty for some, such as alfalfa. Pitts-Singer demonstrates the problem by plucking a little pom-pom of flowers from a field of alfalfa.



ALT BEES. The small native bee *Osmia aglaia* could work as an alternative pollinator of red raspberries and blackberries in the Pacific Northwest, according to recent tests. A relative, the blue orchard bee (*Osmia lignaria*), readily moves into holes in nesting blocks (upper right) and does a good job pollinating tree fruits such as cherries.
S. Werblow/Homestead; (inset) Pitts-Singer

When she squeezes the bottom petal of an individual bloom with the tips of her fingers, several yellow, pinhead-size balls pop out. They barely tickle a human fingertip, but they bother honeybees, which "don't like getting smacked in the head," says Pitts-Singer.

Honeybee foragers generally avoid the drubbing. Most of them are looking for nectar rather than the pollen that's on the yellow balls. The bees get what they want by sidling up to alfalfa flowers and sipping slantwise. The blossom's spring doesn't trip to make the balls whop them, so the honeybees don't pick up pollen to transfer to other blossoms.

A female solitary bee, in contrast, needs pollen to pack away as food with the eggs that she lays in her few weeks of adulthood. If she visits alfalfa flowers, she collects pollen, even though she gets bumped on the head. So, in her short, urgent season of motherhood, she spreads lots of pollen among flowers.

Most U.S. alfalfa is grown for its greenery, to be used as animal forage, so only the suppliers of alfalfa seeds need pollinators. Decades ago, the seed farmers started taking advantage of solitary bees. They had noticed that their crop yielded extra seed when planted near salt flats pockmarked with nesting holes from alkali bees (*Nomia melanderi*).

However, because alkali bees nest in the ground, they couldn't be moved easily and so weren't supplied commercially in the way that honeybees were. Farmers began creating new bee beds by planting blocks of soil riddled with bee nests dug from natural nesting zones. It was a struggle to

mimic those areas' moisture and chemistry. The farmers even had to add salt to the surface, "which seems horrible for agricultural land," Cane says.

When alkali bees find a suitable stretch of barren land, each female excavates a shaft ending in a cluster of nursery chambers about the size of small table grapes. To make a wad of food for hatchlings, the female uses a few drops of nectar to pack together pollen she has collected from about 5,000 alfalfa flowers. She works 11-hour shifts to outfit about one chamber a day.

The pollen wad contains the only nectar a young bee will need. Because they don't feed a large nursery and workforce through the winter, solitary bees don't bother with honey.

In recent decades, an easier-to-handle solitary species has been supplanting the alkali bees. It's the species that Pitts-Singer studies—the alfalfa leaf-cutting bee. It offers a great advantage over alkali bees: It doesn't need ground for nesting.

Female leaf-cutting bees nest in holes that beetles have bored into trees or almost any other small cavity. Pitts-Singer says that the bees lay eggs in the grooves of wooden house siding and even in electrical outlets.

The bee's common name comes from the females' habit of snipping sections of leaves and lugging them home. The swatches can easily measure two-thirds of a bee's body length. The females work leaf pieces into position to line their nest holes. "They're agile little critters," says Vorel.

Commercial bee suppliers set out polystyrene blocks with rows of holes in them to serve as leaf-cutting-bee nests. A female bee moves into a hole and, starting from the rear, creates a line of nursery chambers.

The supplier punches out a string of egg chambers to ship to an alfalfa farmer, who buys a fresh supply of leaf-cutting bees each year. It's convenient, though Pitts-Singer sounds wistful when she says that the species has become a "disposable bee."

Other solitary species also hold promise as crop pollinators, says Cane. He tested the powers of the metallic-green-blue bees *Osmia aglaia* by caging them with raspberry plants. The berries turned out as plump and plentiful as those on bushes left uncaged for honeybees to work, he reported in the October 2005 *HortScience*.

An *O. aglaia* relative, the blue orchard bee (*Osmia lignaria*), has proved energetic in pollinating cherries and some other fruits. Cane says that he's now working with California growers to develop commercial orchard-bee sources for almond orchards.

Vorel describes *O. lignaria*, with its shining-blue body, as "about my favorite bee." The male cuts an especially dashing figure, with its white mustache and a vest of white body fur.

Squash bees also interest Cane. These native bees in the genus *Peponapis* collect pollen only from squash, gourd, and pumpkin plants. Males often spend the night in a closed blossom. They meet females working so early in the morning that they can pollinate the day's blooms before any honeybees show up.

Wild volunteers

Other solitary bees may also be pitching in to pollinate crops, especially the ones honeybees fumble, such as tomatoes, says Sarah Greenleaf of the University of California, Davis.

The tomato plant belongs to a diverse group of species that release pollen only when their little salt shaker-like pollen organs receive intense vibration.

The bee species that do pollinate tomatoes grip the flower and shiver their flight muscles without opening their wings. Although the honeybee may seem the embodiment of buzz, it doesn't show this behavior.

When Greenleaf surveyed fields on 14 organic farms in California, she found that *Anthophora urbana*, a wild, black-and-white solitary bee, accounted for 60 percent of 2,500 tallied visits to tomato plants. Wild bumblebees, which live in groups, logged about a third of the visits.

Both species gave flowers a strong buzz. "Each flower gets just a 'tzzt', a second or two," says Greenleaf.

She reports that flowers left open for bee buzzing grew into tomatoes six times as often as did flowers that researchers covered in bags sewn from wedding-veil material.

Buzz-pollinating bee species shiver at different frequencies, which an aficionado can identify. "It's like birding," Greenleaf says. "You can just stand in the tomato field and close your eyes and do beeing by ear."

Greenleaf and Claire Kremen of the University of California, Berkeley have also found that wild bees boost pollination in hybrid sunflowers, but in an indirect way. Although 30 or so wild bee species work sunflower fields, commercially supplied honeybees perform most of the pollination.

In the course of a survey, "I noticed some bizarre interactions going on. Bees were colliding with each other a lot," says Greenleaf. She also saw bees landing on each other as if objecting to a competitor's reaching the pollen first. All this mayhem stirred up the honeybees to switch flowers frequently, often by moving between rows of the hybrid's parent varieties.

Overall, the wild bees doubled the effectiveness of the honeybee pollination, she and Kremen reported in the Sept. 12, 2006 *Proceedings of the National Academy of Sciences*.

Wildflower specialists

It's not just crops that need pollination help. Bees visit wild plants too, pollinating some 40,000 flowering plants, or nearly 17 percent of the known worldwide total, according to a 1996 estimate from ecologists Stephen Buchmann and Gary Nabhan in *The Forgotten Pollinators* (Island Press: 1996). That's twice the total number of species serviced by butterflies and moths and more than 40 times the number pollinated by birds. Only beetles do more pollinating.

Major declines in wild pollinators could have "substantial" ecological consequences, but they could be "difficult to detect," says the National Research Council report on pollinators. Outside laboratories and crop fields, pollination turns into a complex business.

Most common, the report notes, are networks of pollinators and flowers, only some of which are specialized to rely on a few partner species. However, biologists have documented a few dramatic tales of plants nearing extinction after their specialized pollinator died off. Some wildflower communities depend on communities of specialist pollinators, says bee researcher Robbin Thorp of the University of California, Davis.

His favorite solitary bees are specialists, little, dark species that are often mistaken for flies by a casual observer. These bees, in the genera *Andrena* and *Panurginus*, nest near so-called vernal pools of accumulated winter rains. Adults emerge just for the 2 to 3 weeks of wildflower bloom: the goldfields, yellow carpets, meadow foams, and sky blues that provide some of the West Coast's most scenic, but also most endangered ecosystems.

Solitary bees have sometimes surprised biologists looking at bee-flower relationships. Margrit McIntosh of Tucson studies bees that collect pollen only from certain cactus species, which don't seem complex enough to require a specialist bee.

The flowers of *Ferocactus* barrel cacti look like kindergarten drawings: tufts with rows of petals around them. Pollination doesn't require a long hummingbird bill or a buzz-pollinator's muscles. A kindergartner trailing a coat sleeve could do the job.

Yet although both solitary cactus bees and sweat bees visited two species of the flowers in the Sonoran desert during McIntosh's tests, only a cactus-bee visit transferred enough pollen from one flower to pollinate the next. McIntosh reported this result in the August 2005 *Functional Ecology*.

Another oddity about the barrel cactus flowers: "Honeybees don't like them," she says. "I don't know why, but they don't."

In contrast, a study of the first orchid bee to invade the United States documents flexibility in a pollinator despite a tough challenge. Since 2003, the metallic-green, solitary *Euglossa viridissima* from Mexico and Central America has been turning up around Fort Lauderdale, Fla., report Robert Pemberton and Gregory Wheeler of a USDA lab there. Male orchid bees depend on fragrances that they collect from orchids or other sources to



DESERT OASIS. One of the solitary bees of the Southwest, this *Diadasia* specializes in visiting cactus flowers.

McIntosh



PERFUME BEE. *Euglossa viridissima* bees collect flower scents that males deploy during courtship. This species, native to Mexico and Central America, is moving into Florida and apparently finding the local odors attractive.

Pemberton

supply just the right aroma for attracting a female.

Out of 55 scent ingredients identified in bees living in Florida, 27 scents matched those from nine orchids collected in the native range. The Florida bees had picked up the scents from different local plants. For example, the common garden basil holds 14 of those 27 compounds. Allspice and the leaves of the melaleuca trees offer bees other ingredients in the faux-orchid scent, the researchers reported in the August 2006 *Ecology*.

This tropical orchid bee hasn't moved north of Florida, but there's plenty of good solitary-bee viewing available elsewhere, even in built-up landscapes, says Thorp. He's been participating in a survey of solitary bees just within Berkeley, Calif.

"Eighty-two species and counting," says Thorp.

Of course, city people may mistake solitary bees for flies. Or honeybees.

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Further Readings:

For further information about solitary bees, go to <http://www.sacsplash.org/critters/solitarybee.htm>.

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