

The Busiest of Bees

Pollen bees outwork honey bees as crop pollinators.

The bee had landed on the ground, ready to walk into its nest in the soil, when Suzanne Batra reached for it, gently taking hold of it between her fingers.

"What do you think it smells like?" she asks, holding it up like a freshly picked flower. "Smells like lemon, doesn't it?"

She explains that it's actually a fragrance blend of three chemicals that the bees use to attract each other. "Each kind of bee has its own special odor. Some smell like fruit, flowers, or rubber; others smell like dirty socks or skunks," she says.

Then she puts the bee down, and it ambles away, headed back home to its underground, plastic-lined nest. These native pollen bees are known as polyester bees, because they produce their own transparent, polyester plastic to line their cells and keep them dry.

"They're very gentle," she says of pollen bees. "They rarely sting, and most don't even store honey. They're not what you think of when you think about bees, are they?"

Not at all. They certainly don't fit descriptions of the Africanized honey bees that have captured headlines as "killer bees" because of their aggressive behavior and propensity to sting. And they are not hornets or yellowjacket wasps, which are sometimes mistakenly called bees. Instead, pollen bees go by friendlier names, such as digger, sweat, bumble, hornfaced, carpenter, leafcutter, orchard, and shaggy fuzzyfoot.

"You can tell it's a bee if it's on a flower collecting pollen on its hind legs or under its stomach," Batra says. "Wasps and hornets visit flowers and eat nectar, but they don't collect pollen."

Pollen bees are like family to Batra, who for more than 20 years has studied their behavior and advocated them as nature's hardest-working, most effective crop pollinators. She wants backyard gardeners, commercial fruit growers, and everybody else to treat them like useful pets, making places for them to nest and minimizing the use of pesticides that can harm them.

"I've spent my whole career trying to educate people about pollen bees," she says, surrounded by Styrofoam coolers, adobe, and other materials that she's made into homes for them. "People need to realize there are a lot of valuable bees out there that they are unaware of because they

don't look like honey bees. Without them, crop and wild-flower pollination would really suffer."

Of the more than 20,000 known bee species, only six are honey bees (genus *Apis*). The rest are pollen bees, also called solitary or wild bees.

There are about 3,500 kinds of pollen bees in North America. A good example of the mix of honey and pollen bees in a typical natural habitat is illustrated in a 3-year study that Batra and a cooperator at Georgetown University are conducting in the Fernow Experimental Forest in West Virginia. In 1991—the first year of the study—they randomly trapped 1,701 pollen bees, but only 34 honey bees. They found similar mixes during 1992 and 1993.

"Most of the pollen bees were bumble, sweat, and digger

bees," she says. "People would not realize that the tiny ones are bees." That's partly because they don't act like the familiar honey bee. Pollen bees usually don't sting—and if they do, it's usually mild, something akin to a mosquito bite. "If you disturb a honey bee colony, the bees will attack and sting you," Batra says. "But you can open most pollen bee nests, and they won't defend them."

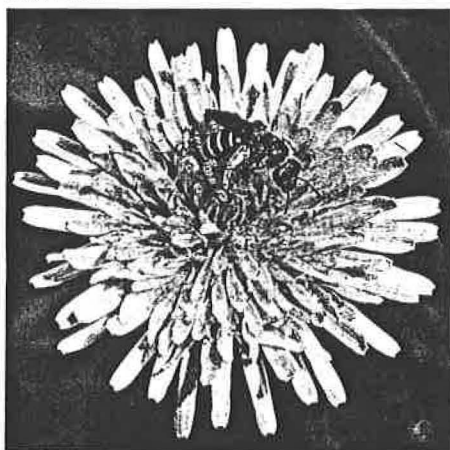
Batra says the differences in behavior are largely evolutionary. Honey bees, as social insects with thousands of residents per colony, store large amounts of honey—an inviting target for sweet-toothed animals like bears.

Consequently, honey-bee stings are potent enough to drive away animal invaders. The social bumblebees and tropical stingless bees also store food and vigorously defend their colonies. Stingless bees bite and release a saliva chemical that irritates the skin.

Most pollen bees nest in the ground, where animals have a hard time finding them. The solitary pollen bees only have one female to a nest, meaning there isn't much food on hand for invaders to covet. "Some social sweat bees might have a few dozen bees per colony," she says, "but even then there's not enough food in their small underground nests to make an inviting target. So they really haven't needed to develop potent venom or aggressive stinging behavior."

If you think bears hibernate for long periods, consider pollen bees. Most kinds are dormant for 10 to 11 months a year, living as larvae or pupae inside the nests they build in the ground, in twigs, hollow tree branches, or in the types of artificial nests that Batra builds outside her Beltsville, Maryland, lab and even in her own backyard.

SCOTT BAUER



Sweat bees: Small wild bees such as this one visiting a dandelion are often attracted by salty sweat on hot days. (K5397-14)



Buzz pollinator: Entomologist Steven Buchmann observes a giant carpenter bee, which uses rapid vibrations to release pollen. (K5401-1)

But when the adult pollen bees emerge—many flying for only 4 to 6 weeks in the spring—they go about pollinating with the energy of a salmon swimming upstream to spawn.

Hornfaced and Fuzzyfoot

“There are certain crops, like alfalfa, blueberries, apples, tomatoes, and potatoes, that honey bees just don’t pollinate well,” she says. “Some of the pollen bees are specialized for these.”

Take the hornfaced bee. Used commercially for several decades in Japan, the popularity of the hornfaced among apple growers has grown considerably. By 1990, it was used to pollinate more than 60 percent of the apples grown in a major apple-growing region in northern Japan.

Based on work done, it’s easy to see why it has become so popular. A single hornfaced bee can visit 15 flowers a minute, setting 2,450 apples in a day—compared to the 50 flowers set in a honey bee’s day. Batra says that in Japan, apple growers only need about 500 to 600 hornfaced bees per hectare (2.47 acres). That same grower would need thousands of honey bees to pollinate the same area.

Since an earlier story on wild bees [“Wild Bees Make Money Not Honey,” *Agricultural Research*, August 1987, pp. 10-12.], Batra says she has sent hornfaced bees to beekeepers, orchardists, and others in several states. Most U.S. growers still rent honey bees from beekeepers. However, that could change as beekeeping becomes more difficult and expensive because of new honey bee diseases, mites, and quarantines due to Africanized honey bees, and the phase-out of federal honey subsidies.

“Growers may have to get more and more into raising their own bees. Pollen bees will become more attractive then, because they are efficient pollinators, gentle, and easy to keep,” she says. This has already happened with commercially available alfalfa leafcutter bees.

The newest addition to Batra’s wild bee family is the “shaggy fuzzyfoot” bee. This fat, shaggy, fast-flying bee carries pollen back to the nest on its fuzzy hind legs, she says, and can be heard buzz-pollinating blueberries. In that type of pollination, the bee creates a vibration that releases the pollen from inside tiny, tubelike anthers. It’s a feat that honey bees can’t accomplish,

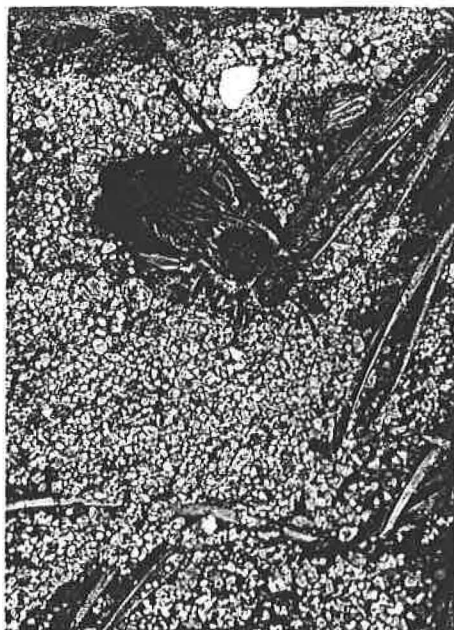
because they don’t vibrate their bodies to shake pollen loose.

Batra has been studying the shaggy fuzzyfoot since 1988, when she received permission to import a few from Japan to study at Beltsville. Batra found the bees in the adobe walls of an old farmhouse in Japan during a research trip there and was impressed with their ability to pollinate in rain and cold, when other kinds of bees would not.

Now she has 400 nests in Beltsville, and is planning to release some shaggy fuzzyfoots to growers who want to use them to pollinate orchards in the southeastern states.

Fuzzyfoots pollinate blueberries, apples, and other crops for only 6 weeks in the spring—but it’s a busy 6 weeks, during which females lay eggs and seal their mud cells inside Batra’s handmade adobe blocks. Bee larvae grow inside during summer, pupate in the fall, become adults, and hibernate in the cells over winter. They’re best adapted for a moist, warm climate and can survive mild winters.

Blueberries aren’t the only crop suited to pollen bees. Tomatoes, chili peppers, eggplants, and cranberries have similar flower structures that require



◀ **Plasticized:** A polyester bee emerges from its burrow in spring. These bees protect their nectar, pollen stores, and delicate broods by lining their cells with waterproof, transparent polyester plastic secreted by two of the female's glands and mixed by her, like an epoxy glue. (K5398-20)

▶ **Ace blueberry pollinator:** *Osmia ribifloris* bees are three times faster than worker honey bees. Here, entomologist Phil Torchio inspects adults as they emerge from cocoons extracted from nests produced the previous year during blueberry pollination studies. (K5399-1)



buzzing bees for effective pollination, says Stephen L. Buchmann, an entomologist at ARS' Carl Hayden Bee Research Center in Tucson, Arizona.

Carpenters, Oxaeids, and Cuckoos

"One bee we're studying for pollinating tomato plants is an Arizona native called a giant carpenter bee. It performs buzz pollination by curling its body around the pollen-bearing anthers," Buchmann says.

Like the fuzzyfoot, the giant carpenter bee "flexes its powerful flight muscles so fast they create sonic energy that causes pollen to shoot out of the tomato flower's hollow anthers. So much pollen is released, it looks like a cloud—enough to pollinate the flower and stick to tiny hairs on the bees.

"We want to develop artificial nests to make mass-rearing of the buzz pollinators possible. The most promising materials seem to be several different kinds of wood and bamboo," says Buchmann.

Buchmann is collecting basic information on wild bees and how the behavior of various species around different crops boosts fruit and vegetable production in fields and in large,

commercial greenhouses. He found in one study that a native bumblebee was 500 times faster than the normally reliable honey bee in pollinating flowers of deadly nightshade. This weed is a relative of the tomato plant and native to Arizona, making it convenient for Buchmann to study. He hopes to find the best bee for each type of crop plant.

Buchmann is also learning the best time to move bees into crops and greenhouses. For example, he observed that an oxaeid bee preferred to pollinate between 5 and 6 in the morning, while the bumblebee was a late riser, beginning work after 7 a.m.

And he is recording how various species of buzz pollinators thrive under different temperatures and humidities.

Three carpenter bee species that are native to Arizona seem very hardy, surviving daytime temperatures in excess of 115°F, low relative humidity, and little moisture. These bees could be kept over winter for use year after year, unlike some pollinators that are reared from eggs each spring.

Batra and Buchmann note that bumblebees are now a big business overseas. There are nearly a half-

dozen commercial bee producers in Europe rearing 80,000 to 100,000 colonies of bumblebees to use in pollinating tomatoes grown in greenhouses. One Dutch company recently opened a 10-acre tomato greenhouse near Wilcox, Arizona, and uses an estimated 20 bumblebee colonies for pollination. Batra says she's been in contact with a company in Pennsylvania that is beginning to use bumblebees in greenhouses to pollinate tomatoes. Bumblebees are also the only pollinators of potato flowers worldwide.

Another potential blueberry pollinator is *Osmia ribifloris*, says Philip Torchio, an entomologist at the ARS Bee Biology and Systematics Laboratory in Logan, Utah. [See "What's a Better Blueberry Pollinator?," *Agricultural Research*, March 1992, p. 19.] He says the bee—collected in California—visits a blueberry blossom about every 3 seconds—three times as fast as a worker honey bee.

Torchio is planning field studies this spring with *O. ribifloris* on 14 acres of highbush blueberries in Oregon. He says about 300 females are all that's needed to pollinate an acre of blueberries. "We want to demonstrate that it's feasible for growers to raise large

enough numbers of *O. ribifloris* to pollinate their blueberry crop," he says.

Over the last 5 years, lab scientists have also studied 25 endangered plant species and wild bee pollinators in 7 western states. [See "Protecting Endangered Plants," *Agricultural Research*, May 1990, pp. 16-18.] The main objective: to determine how the plants—including rare cacti, wild daisies, and wild snapdragons—are pollinated and which wild bees pollinate each plant. ARS entomologist Vincent Tepedino says researchers found that rangeland spraying to control grasshoppers could further imperil the wild plants by killing their pollinators.

Now Tepedino and cooperators at Utah State University are using molecular genetic techniques to "establish buffer zones to protect these plants and their wild pollinators from grasshopper spraying," Tepedino says.

Aside from development, pollen bees have other enemies, including parasitic "cuckoo bees," which make up about 15 percent of all known bee species. These replace host eggs with their own eggs—like cuckoo birds. They can reduce populations of pollinators, just as cuckoo birds deplete songbird populations.

Batra and cooperators at the Smithsonian and the state universities of California and Florida have also discovered a nematode worm, *Bursaphelenchus abruptus*, that lives inside the glands of a solitary bee called the digger bee. But the nematode may be beneficial to the bee, Batra says.

"In lab studies, the nematode fed on fungi similar to those that infest bee nests and destroy food supplies," she says. "So we think the nematode may act as a natural protector of the bee's food by leaving the glands and destroying the fungus."

But the most important protectors of bees, she stresses, are people. "People

SCOTT BAUER



Yellow-dot special: A male carpenter bee, identified by a yellow facial spot, drinks wisteria nectar. The females chew neat, circular holes in wood, where they nest. Territorial males chase each other away from flowers and nests but have no stingers. (K5395-16)

need to realize that pollen bees are not a threat, but a wildlife resource—a fascinating, valuable part of our environment."—By **Sean Adams and Dennis Senft**, ARS.

Suzanne Batra is at the USDA-ARS Bee Research Laboratory, Bldg. 476, BARC-East, 10300 Baltimore Ave., Beltsville, MD 20705-2350; phone (301) 504-8205, fax (301) 504-8736.

Stephen L. Buchmann is at the USDA-ARS Carl Hayden Bee Research Center, 2000 E. Allen Road, Tucson, AZ 85719; phone (602) 670-6481, fax (602) 670-6493.

Philip F. Torchio and Vincent J. Tepedino are in the USDA-ARS Pollinating Insect Biology Research Unit, Natural Resources Biology Bldg., Utah State University, Logan, UT 84322; phone (801) 750-2520/2559, fax (801) 750-1575. ♦

Quick Guide to Pollen Bees

Blueberry bee—*Osmia ribifloris*

Native to the coastal mountains of Southern California, this solitary bee normally gathers pollen from manzanita, but will pollinate blueberries.

Giant carpenter bee—family Xylocopidae

Create so much sonic energy with their buzzing that pollen shoots out of tomato flowers' hollow anthers in a cloud. These native solitary bees nest in bamboo and wood.

Hornfaced bee—*Osmia cornifrons*

Used commercially for several decades in Japan to pollinate apples, it's now in the United States. A single hornfaced bee can visit 15 flowers a minute. This solitary bee nests in reeds, tubes, and holes in wood.

Native bumblebee—*Bombus sonorus*

It's 500 times faster at pollinating than the honey bee. Bumblebees live socially, usually in abandoned underground field mouse nests.

Oxaeid bee—*Ptiloglossa arizonensis*

Prefers to pollinate between 5 and 6 in the morning. This native solitary bee nests underground.

Polyester bees—*colletes* species

Native solitary bees, they build plastic-lined cells in underground nests.

Shaggy fuzzyfoot bee—*Anthophora pilipes villosula*

Fat, shaggy, and fast-flying, it can pollinate in rainy, cool weather. This Japanese solitary bee nests in dry adobe. It was recently imported to the United States.

Sweat bees—family Halictidae

Nesting underground, some kinds form social units with queens and workers.