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*From the Los Angeles Times*

# Suddenly, the bees are simply vanishing

**Scientists are at a loss to pinpoint the cause. The die-off in 35 states has crippled beekeepers and threatened many crops.**

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The dead bees under Dennis vanEngelsdorp's microscope were like none he had ever seen.

He had expected to see mites or amoebas, perennial pests of bees. Instead, he found internal organs swollen with debris and strangely blackened. The bees' intestinal tracts were scarred, and their rectums were abnormally full of what appeared to be partly digested pollen. Dark marks on the sting glands were telltale signs of infection.

"The more you looked, the more you found," said VanEngelsdorp, the acting apiarist for the state of Pennsylvania. "Each thing was a surprise."

VanEngelsdorp's examination of the bees in November was one of the first scientific glimpses of a mysterious honeybee die-off that has launched an intense search for a cure.

The puzzling phenomenon, known as Colony Collapse Disorder, or CCD, has been reported in 35 states, five Canadian provinces and several European countries. The die-off has cost U.S. beekeepers about $150 million in losses and an uncertain amount for farmers scrambling to find bees to pollinate their crops.

Scientists have scoured the country, finding eerily abandoned hives in which the bees seem to have simply left their honey and broods of baby bees.

"We've never experienced bees going off and leaving brood behind," said Pennsylvania-based beekeeper Dave Hackenberg. "It was like a mother going off and leaving her kids."

Researchers have picked through the abandoned hives, dissected thousands of bees, and tested for viruses, bacteria, pesticides and mites.

So far, they are stumped.

According to the Apiary Inspectors of America, 24% of 384 beekeeping operations across the country lost more than 50% of their colonies from September to March. Some have lost 90%.

"I'm worried about the bees," said Dan Boyer, 52, owner of Ridgetop Orchards in Fishertown, Pa., which grows apples. "The more I learn about it, the more I think it is a national tragedy."

At Boyer's orchard, 400 acres of apple trees -- McIntosh, Honey Crisp, Red Delicious and 11 other varieties -- have just begun to bud white flowers.

Boyer's trees need to be pollinated. Incompletely pollinated blooms would still grow apples, he said, but the fruit would be small and misshapen, suitable only for low-profit juice.

This year, he will pay dearly for the precious bees -- $13,000 for 200 hives, the same price that 300 hives cost him last year.

The scene is being repeated throughout the country, where honeybees, scientifically known as Apis mellifera, are required to pollinate a third of the nation's food crops, including almonds, cherries, blueberries, pears, strawberries and pumpkins.

Vanishing colonies

One of the earliest alarms was sounded by Hackenberg, who used to keep about 3,000 hives in dandelion-covered fields near the Susquehanna River in Pennsylvania.

In November, Hackenberg, 58, was at his winter base in Florida. He peeked in on a group of 400 beehives he had driven down from his home in West Milton, Pa., a month before. He went from empty box to empty box. Only about 40 had bees in them.

"It was just the most phenomenal thing I thought I'd ever seen," he said.

The next morning, Hackenberg called Jerry Hayes, the chief of apiary inspection at the Florida Department of Agriculture and Consumer Services and president of the Apiary Inspectors of America.

Hayes mentioned some bee die-offs in Georgia that, until then, hadn't seemed significant.

Hackenberg drove back to West Milton with a couple of dead beehives and live colonies that had survived. He handed them over to researchers at Pennsylvania State University.

With amazing speed, the bees vanished from his other hives, more than 70% of which were abandoned by February.

Hackenberg, a talkative, wiry man with a deeply lined face, figured he lost more than $460,000 this winter for replacement bees, lost honey and missed pollination opportunities.

"If that happens again, we're out of business," he said.

It didn't take researchers long to figure out they were dealing with something new.

VanEngelsdorp, 37, quickly eliminated the most obvious suspects: Varroa and tracheal mites, which have occasionally wrought damage on hives since the 1980s.

At the state lab in Harrisburg, Pa., VanEngelsdorp checked bee samples from Pennsylvania and Georgia. He washed bees with soapy water to dislodge Varroa mites and cut the thorax of the bees to look for tracheal mites; he found that the number of mites was not unusually high.

His next guess was amoebic infection. He scanned the bees' kidneys for cysts and found a handful, but not enough to explain the population decline.

VanEngelsdorp dug through scientific literature looking for other mass disappearances.

He found the first reference in a 1869 federal report, detailing a mysterious bee disappearance. There was only speculation as to the cause -- possibly poisonous honey or maybe a hot summer.

A 1923 handbook on bee culture noted that a "disappearing disease" went away in a short time without treatment. There was a reference to "fall dwindle" in a 1965 scientific article to describe sudden disappearances in Texas and Louisiana.

He found other references but no explanations.

VanEngelsdorp traveled to Florida and California at the beginning of the year to collect adult bees, brood, nectar, pollen and comb for a more systematic study. He went to 11 apiaries, both sick and healthy, and collected 102 colonies.

A number of the pollen samples went to Maryann Frazier, a honeybee specialist at Penn State who has been coordinating the pesticide investigation. Her group has been testing for 106 chemicals used to kill mites, funguses or other pests.

Scientists have focused on a new group of pesticides known as neonicotinoids, which have spiked in popularity because they are safe for people, Frazier said. Studies have shown that these pesticides can kill bees and throw off their ability to learn and navigate, she said.

Researchers have yet to collect enough data to come to any conclusions, but the experience of French beekeepers casts doubt on the theory. France banned the most commonly used neonicotinoid in 1999 after complaints from beekeepers that it was killing their colonies. French hives, however, are doing no better now, experts said.

Sniffing out the culprit

Entomologist Jerry J. Bromenshenk of the University of Montana launched his own search for poisons, relying on the enhanced odor sensitivity of bees -- about 40 times better than that of humans.

When a colony is exposed to a new chemical odor, he said, its sound changes in volume and frequency, producing a unique audio signature.

Bromenshenk has been visiting beekeepers across the country, recording hive sounds and taking them back to his lab for analysis. To date, no good candidates have surfaced.

If the cause is not a poison, it is most likely a parasite.

UC San Francisco researchers announced in April that they had found a single-celled protozoan called Nosema ceranae in bees from colonies with the collapse disorder.

Unfortunately, Bromenshenk said, "we see equal levels of Nosema in CCD colonies and healthy colonies."

Infected swarms?

Several researchers, including entomologist Diana Cox-Foster of Penn State and Dr. W. Ian Lipkin, a virologist at Columbia University, have been sifting through bees that have been ground up, looking for viruses and bacteria.

"We were shocked by the huge number of pathogens present in each adult bee," Cox-Foster said at a recent meeting of bee researchers convened by the U.S. Department of Agriculture.

The large number of pathogens suggested, she said, that the bees' immune systems had been suppressed, allowing the proliferation of infections.

The idea that a pathogen is involved is supported by recent experiments conducted by VanEngelsdorp and USDA entomologist Jeffrey S. Pettis.

One of the unusual features of the disorder is that the predators of abandoned beehives, such as hive beetles and wax moths, refuse to venture into infected hives for weeks or longer.

"It's as if there is something repellent or toxic about the colony," said Hayes, the Florida inspector.

To test this idea, VanEngelsdorp and Pettis set up 200 beehive boxes with new, healthy bees from Australia and placed them in the care of

Hackenberg.

Fifty of the hives were irradiated to kill potential pathogens. Fifty were fumigated with concentrated acetic acid, a hive cleanser commonly used in Canada. Fifty were filled with honey frames that had been taken from Hackenberg's colonies before the collapse, and the last 50 were hives that had been abandoned that winter.

When VanEngelsdorp visited the colonies at the beginning of May, bees in the untouched hive were clearly struggling, filling only about a quarter of a frame. Bees living on the reused honeycomb were alive but not thriving. A hive that had been fumigated with acetic acid was better.

When he popped open an irradiated hive, bees were crawling everywhere. "This does imply there is something biological," he said.

If it is a pathogen or a parasite, honeybees are poorly equipped to deal with it, said entomologist May Berenbaum of the University of Illinois at Urbana-Champaign.

The honeybee genome has only half as many genes to detoxify poisons and to fight off infections as do other insects.

"There is something about the life of the honeybee that has led to the loss of a lot of genes associated with detoxification, associated with the immune system," she said.

In the absence of knowledge, theories have proliferated, including one that Osama bin Laden has engineered the die-off to disrupt American agriculture.

One of the most pervasive theories is that cellphone transmissions are causing the disappearances -- an idea that originated with a recent German study. Berenbaum called the theory "a complete figment of the imagination."

The German physicist who conducted the tiny study "disclaimed the connection to cellphones," she said. "What they put in the colony was a cordless phone. Whoever translated the story didn't know the difference."

Another popular theory is that the bees have been harmed by corn genetically engineered to contain the pesticide B.t.

Berenbaum shot down the idea: "Here in Illinois, we're surrounded by an ocean of B.t. pollen, and the bees are not afflicted."

And so the search continues.

Many beekeepers have few options but to start rebuilding. Gene Brandi, a veteran beekeeper based in Los Banos, Calif., lost 40% of his 2,000 colonies this winter.

Brandi knows plenty of beekeepers who sold their equipment at bargain prices.

Scurrying around a blackberry farm near Watsonville, Brandi, 55, was restocking his bees. In a white jumpsuit and yellow bee veil, he pulled out a frame of honeycomb from a hive that had so many bees they were spilling out the front entrance.

"When it's going good like this, you forget CCD," he said.

Hackenberg, who has spent his whole life in the business, isn't giving up either. He borrowed money and restocked with bees from Australia.

In April, the normally hale Hackenberg started feeling short of breath. His doctor said he was suffering from stress and suggested he slow down.

Not now, Hackenberg thought. "I'm going to go down fighting."

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