National Geographic News October 5, 2004 Honey Bee Decline

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Bee Decline May Spell End of Some Fruits, Vegetables

John Roach
for National Geographic News
October 5, 2004

Bees, via pollination, are responsible for 15 to 30 percent of the food U.S. consumers eat. But in the last 50 years the domesticated honeybee population—which most farmers depend on for pollination—has declined by about 50 percent, scientists say.

Unless actions are taken to slow the decline of domesticated honeybees and augment their populations with wild bees, many fruits and vegetables may disappear from the food supply, said Claire Kremen, a conservation biologist at Princeton University in New Jersey.

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Anecdotes of farmers losing their crops owing to the honeybee shortage appear to be on the increase, Kremen said. Last February, for example, there were insufficient honeybees for all the almond blossoms in California. As a result some farmers failed to meet expected yields.

"There are shortages [like this] that pop up from time to time," Kremen said. "Whether there are more [shortages] than there were 20 years ago, one would guess yes, as there are fewer bees to go around, but it's not well documented."

Maryann Frazier, a senior extension associate in the department of entomology with Pennsylvania State University in State College, said honeybee shortages are not yet impacting commercial producers of crops, but that community farmers "are struggling to get bees for pollination."

In fact, Dewey Caron, an entomologist at the University of Delaware in Newark, started to study the problem of the honeybee decline when he noticed that farmers in the northeastern U.S. increasingly lacked sufficient bee colonies to meet their pollination needs.

"Growers didn't have options if they didn't like the quality [of the bees] they got from one fellow," he said. "So, we started to ask, Well, what is affecting the bees? What can we do to keep them healthier?"

Bee Decline

The honeybee decline, which is affecting domesticated and wild bee populations around the world, is mostly the result of diseases spread as a result of mites and other parasites as well as the spraying of crops with pesticides, scientists say.

Among the greatest problems is the varroa mite, a bloodsucking parasite that attacks young and adult honeybees. Attacked bees often have deformed wings and abdomens and a shortened life span.

"The varroa mite is also really effective at transmitting disease, particularly viruses," Frazier said. Left untreated, a varroa mite infestation can wipe out a bee colony within a few months.

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Another major bee pest is the tracheal mite, which gets inside adult bees and clogs their breathing tubes, essentially suffocating the insects. The tracheal mites also impede the bees' ability to fly, making them useless as pollinators, entomologists report.

According to Caron, both the varroa and tracheal mites lead to the death of the bees by puncturing holes in their bodies that serve as pathways for viruses. The viruses are what technically kill most of the bees, he said.

Decades of pesticide use has also taken its toll on honeybees, though farmers are beginning to refrain from pesticide applications while their crops are blooming. "People are definitely smarter than they used to be about how they apply pesticides," Kremen said.

Pest Management

Knowing that the use of pesticides, even those targeted specifically at mites, can be fraught with negative consequences, researchers are devising alternative measures to control the mites.

"Pesticides have a role. They can be very useful, but they should be down [on] the list of things we attempt," Caron said.

Toward the top of the list is the search for so-called biological control agents. One such agent scientists are looking at is a fungus that attacks mites but not the bees. However, research has yet to find a way to effectively deliver this fungus to a bee colony.

Researchers are meeting some mite-control success by increasing the ventilation of managed bee colonies. Most colonies are airtight by design, to protect honeybees from the elements. Caron likens the effect of such systems to traveling on an airplane.

"If anyone on an airplane has a cold, you are exposed to it. If they are sneezing, you have the potential to catch that cold," he said. "Bee colonies, too, are airtight. Once the pathogen is in there, it will have a better chance of spreading."

By opening colonies up to greater ventilation, Caron and his colleagues have found that the mites are less successful at reproducing. The bees can better cope with temperature fluctuations than previously believed.

Researchers are also busy combing the world's bee populations in search of bees that are resistant to—or have reduced susceptibility to—the mites. If the researchers can isolate the genes responsible for such mite-defying qualities, they could breed those genes into domestic honeybees.

"The work is very, very slow to develop those techniques," Frazier said. "And, of course, the beekeepers are desperate. If they don't use pesticides to protect their colonies, they are out of business. So, it is a real difficult situation."

Kremen's efforts are focused on augmenting the declining domesticated honeybee populations with wild bees. We'll learn more about her research in a future story.

For more bee stories, scroll to bottom.

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The National Geographic October 28, 2004

Powerful Pollinators, Wild Bees May Favor Eco-Farms

Ben Harder
for National Geographic News
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Organic farming is not only friendlier to the soil and the environment than conventional farming, it's also friendlier to an underappreciated agricultural workforce—wild bees. So indicates research on how well bees distribute pollen across different types of cropland.

The finding has economic implications for farmers, many of whom currently rely heavily on domesticated bees to perform crop pollination, Princeton University conservation biologist Claire Kremen told *National Geographic News*.

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If farmers restored natural habitats near their lands and used more organic cultivating techniques, resulting growth of wild bee communities might reduce growers' dependence on European honeybees, the domesticated variety, and ultimately pay financial dividends, she said.

Kremen added that such farming methods would also offer insurance against the possibility of further declines among European honeybees, which have suffered setbacks in recent years. Pesticides, diseases, and other deadly agents have taken their toll over the past decade.

Furthermore, domesticated colonies that have crossbred with Africanized "killer" bees have been rendered too aggressive for beekeepers to manage, further depleting their availability to farmers, said bee researcher Robbin W. Thorp of the University of California–Davis.

"Pollination is an incredibly important ecological function," Kremen said. Bees function as pollinators because, as they feed on flower after flower, they unintentionally shuttle grains of pollen from one plant to the next. Without bees to do that lifting, many common North American plants—including numerous economically important crops—would go unfertilized and would be unable to reproduce, she said.

For more than a century, the most popular pollinators among North American farmers have been domesticated descendants of imported European honeybees, said Thorp. He estimated that 3,500 to 4,000 species of non-domesticated bees that are native to North America can also pollinate crops—when they can survive on or near croplands.

But modern intensive farming practices often don't provide all the resources bees need to stay alive. Beekeepers take care of domesticated bees, while the wild bees are left to subsist on shrinking wild habitats.

Homegrown Labor Movement

"We don't necessarily need to rely on honeybees," said Kremen. In fact, she said, farms with sufficient numbers and types of wild native bees theoretically don't require the domesticated honeybees at all. "But the caveat is that we only find sufficient numbers of native bees in areas that are near native habitat."

Kremen reached that conclusion after she, Thorp, and Neal Williams of Princeton Unversity conducted experiments on watermelon plots in California. The research trio considered two important factors about each plot: How much natural habitat existed near the farm, and whether the farm relied on organic or conventional cultivating techniques.

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Powerful Pollinators, Wild Bees May Favor Eco-Farms

The researchers measured the abundance and diversity of wild bees on all three types of farms during the 2001 growing season. They also measured how rapidly pollen accumulated on flowers living on each farm type. Domesticated bees

A Beeline for the Bottom Line

Kremen said that farming techniques that appear friendly to native bees include avoiding herbicide and pesticide use; growing a diversity of crops on each plot of land, rather than a single crop; and cultivating some plants that don't have economic value on their own but that help provide a continual supply of food for native bees. In some cases, she said, it may even be advantageous to allow weeds to grown along the borders of fields.

"We couldn't do away with honeybees all together," said Kremen. But, she said, farmers could "reduce the [number of] honeybees that they rent and plow that money into these small restoration efforts," which could help native bee populations grow and might ultimately pay dividends.

The resulting diversity of bee species would also offer an insurance policy against, for example, attacks by parasites that pray mainly on honeybees.

"If honeybees continue to decline, [these farmers] will be better off, because they'll have these natural pollinators," said Kremen.

"As we destroy natural habitats, we are reducing our options," she said. "We are destroying an insurance policy."

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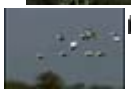
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Pulse of the Planet

NATURE (P.B.S.) 2007 http://www.pbs.org/wnet/nature/bees/impact.html

In the winter of 2006/2007, more than a quarter of the country's 2.4 million bee colonies -- accounting for tens of billions of bees -- were lost to CCD, Colony Collapse Disorder. This loss is projected have an $8 billion to $12 billion effect on America's agricultural economy, but the consequences of CCD could be far more disastrous.

The role honeybees play in our diet goes beyond honey production. These seemingly tireless creatures pollinate about one-third of crop species in the U.S. Honeybees pollinate about 100 flowering food crops including apples, nuts, broccoli, avocados, soybeans, asparagus, celery, squash and cucumbers, citrus fruit, peaches, kiwi, cherries, blueberries, cranberries, strawberries, cantaloupe, melons, as well as animal-feed crops, such as the clover that's fed to dairy cows. Essentially all flowering plants need bees to survive.

A daunting question is: If honeybee colonies were so severely affected by CCD that pollination stopped, could we lose these crops from our markets and our diets forever?

Bees conserving warmth after long-haul to Maine to pollinate wild blueberries

"We're not there yet," says Jeff Pettis of the USDA. Pettis says there are steps researchers and beekeepers can take to ensure that the bee population doesn't plummet to catastrophic levels. "One measure beekeepers have been taking is to keep bees as healthy as possible -- improve nutrition and reduce stress," says Pettis. Consumers have become more demanding and expect to have fruits and vegetables available to us all year round. In order to achieve this, commercial beekeepers haul colonies of honeybees across the country so their pollination services can serve all growing seasons. The season may start with almonds in California, then move on to apples in the Northwest, cranberries in New Jersey and Maine blueberries. The constant moving about places stress on the bees. In addition, certain crops that may be in the pollination circuit, like cranberries and cucumbers, are not very nutritious for bees. To keep the bees healthy, beekeepers may need to ease up on their schedules. It may be necessary for them to retire bees for a particular season or skip some less nutritious crops entirely.

Of course, nature has its own safeguards to keep crops pollinated. Honeybees aren't our only pollinators. Other insects and birds pollinate fruits and vegetables as well. The problem with other natural pollinators picking up the bees' slack is that today's agricultural industry has simply grown too large for them to keep up. The leviathan that is U.S. agriculture creates a huge demand for pollination. Because honeybees are relatively mobile and can pollinate a generous number of crops, they have been the ideal recruits to meet our crop needs. But honeybees don't perform such feats naturally without help -- lots of it. Commercial beekeepers keep colonies nourished and healthy and move their hives from state to state in semis, selling their pollination services to farmers at a premium.

With the threat of CCD looming, researchers are starting to study how other pollinators like the larger bumble bees could step in for honeybees. "The Dutch have figured out how to use bumblebees," says Pettis. Bumblebees share many similarities with honeybees. Both are social nesters, although the bumblebees' society is not as highly ordered as that of honeybees. Also, bumblebees make a new nest each spring by solitary queens, who hibernate through the winter. Honeybees remain in the old nest.

Perhaps the biggest consideration is an economic one. Bumblebees last just 2 months and cost $200 per colony, whereas honeybees can last several months in the summer with colony rentals running only $100 to $140. As a

result, the use of bumblebee pollination is usually confined to high-value crops like tomatoes. Clearly, the use of bumblebees is a step in the right direction, but not a final solution.

"There's nothing waiting in the wings that can replace honeybees at this time," says Pettis, "but we can solve the problem in honeybee health." Pettis says that by focusing on reducing stress and improving nutrition, beekeepers can limit some of the factors that potentially lead to disastrous conditions like CCD, thereby keeping bees -- and our diets -- healthy.

http://www.pbs.org/wnet/nature/bees/update.html

It was a mystery that left scientists around the world buzzing for answers. Last year a mysterious and deadly plague silently worked its way through bee colonies, leaving millions of dead bees in its wake. The killer was coined as CCD or Colony Collapse Disorder. It had moved in suddenly and unexpectedly, and left so few clues, experts could not crack the case.

Luckily this past September, there was a big break in the case. A team of scientists led by the U.S. Department of Agriculture (USDA), Pennsylvania State University, The Pennsylvanis State Department of Agriculture and Columbia University linked CCD with a virus imported from Australia, IAPV or Israeli Acute Paralysis Virus. Over the past three years, genetic tests on bees collected from stricken colonies around the U.S. found the virus in 96 percent of bees from hives affected by Colony Collapse Disorder.

IAPV had not historically been present in U.S. bees. In fact, it was only discovered in Israel in 2004, the same year American beekeepers started importing packaged bees from Australia. "Before that, nobody knew to look for it," says Jeff Pettis of the United States Department of Agriculture's Bee Research Laboratory. "As people began to look for it, it was found in China, Australia and the U.S."

CCD-affected hive

Though the discovery of IAPV was indeed a big break, the case of CCD was not closed. Scientists have much to learn about how IAPV affects colonies and how it may have brought on CCD. Future studies will tell researchers if they are dealing with just one strain of the virus or if there are other strains to look for. "Discovering the IAPV was a lead but not the end of the story. We're looking at IAPV as a marker. It's there. It's present in colonies but viruses by themselves are not known to be that dangerous," says Pettis. Pettis and other scientists believe that CCD is not caused by one single factor, but by a whole host of forces including pesticides, parasites, poor nutrition, and stress. Any of these may leave bees vulnerable to infection and make IAPV lethal. "We know all of those things have affected bees in the past," says Pettis. "We have to look at combinations of factors."

Researchers at Penn State University and the USDA are planning a complicated set of experiments where they stress bees in certain ways and evaluate the effect on their health. The tests will hopefully indicate whether IAPV causes CCD by itself or if it is triggered by other pathogens and stresses.

Some studies on IAPV have already brought positive news. Israeli researchers say there is a possibility that IAPV-resistant bees can be bred. A third of bees sampled in Israel have incorporated the virus into their genome. In experiments, almost 20% of these bees survived when injected with IAPV.

While the work is ongoing and answers are sought, until the government declares otherwise, the nation's borders remain open for bees. Packaged bees are being brought in from Australia, which has yet to report cases of CCD colonies. Though researchers are still searching for answers, they are considering whether stressors that disproportionately affect U.S. bees such as pesticides, poor nutrition or pests like varroa mites might trigger the virus, making it virulent.

Last year, imports from Australia and New Zealand made up only 5 percent of the bees needed just for almond pollination (though almond pollination represents half of our need for honeybee pollination services).

Case closed? Not yet; but at least the prime suspect is now in custody. In the meantime, beekeepers must take measures to keep bees as healthy as possible. The goal now is improved nutrition, reduced stress, and better overall health for bees. Many beekeepers have been able to achieve just that. Over the summer, many experienced beekeepers had been able to build up the number of bees in the colonies over the summer. However, Diana Cox-Foster of Penn State University and a lead researcher on the team that discovered IAPV in U.S. bees says there are some reports now of CCD making a reappearance, though mainly in the colonies of less experienced beekeepers. If CDD continues, researchers like Cox-Foster are concerned that we could see major problems in honeybee numbers next Spring. She explains that beekeepers were able to restore colony numbers this year, but the weather was in our favor. Next time, we may not be that fortunate. If it strikes again, CCD could have disastrous impacts on U.S. agriculture -- causing prices to soar and threatening the availability of some crops. Among the most vulnerable crops are almonds -- a crop that completely depends on honeybee pollination. But foods like apples, berries and alfalfa seeds, which is fed to dairy cows and livestock, will be in peril as well. "It's still fairly early," says Cox-Foster. "It's still a concern that some people will continue to have problems with CCD but the verdict is out."