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Bees Vanish, and Scientists Race for Reasons

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Beltsville, Maryland - What is happening to the bees?

More than a quarter of the country's 2.4 million bee colonies have been lost - tens of billions of bees, according to an estimate from the Apiary Inspectors of America, a national group that tracks beekeeping. So far, no one can say what is causing the bees to become disoriented and fail to return to their hives.

As with any great mystery, a number of theories have been posed, and many seem to researchers to be more science fiction than science. People have blamed genetically modified crops, cellular phone towers and high-voltage transmission lines for the disappearances. Or was it a secret plot by Russia or Osama bin Laden to bring down American agriculture? Or, as some blogs have asserted, the rapture of the bees, in which God recalled them to heaven? Researchers have heard it all.

The volume of theories "is totally mind-boggling," said Diana Cox-Foster, an entomologist at Pennsylvania State University. With Jeffrey S. Pettis, an entomologist from the United States Department of Agriculture, Dr. Cox-Foster is leading a team of researchers who are trying to find answers to explain "colony collapse disorder," the name given for the disappearing bee syndrome.

"Clearly there is an urgency to solve this," Dr. Cox-Foster said. "We are trying to move as quickly as we can."

Dr. Cox-Foster and fellow scientists who are here at a two-day meeting to discuss early findings and future plans with government officials have been focusing on the most likely suspects: a virus, a fungus or a pesticide.

About 60 researchers from North America sifted the possibilities at the meeting today. Some expressed concern about the speed at which adult bees are disappearing from their hives; some colonies have collapsed in as little as two days. Others noted that countries in Europe, as well as Guatemala and parts of Brazil, are also struggling for answers.

"There are losses around the world that may or not be linked," Dr. Pettis said.

The investigation is now entering a critical phase. The researchers have collected samples in several states and have begun doing bee autopsies and genetic analysis.

So far, known enemies of the bee world, like the varroa mite, on their own at least, do not appear to be responsible for the unusually high losses.

Genetic testing at Columbia University has revealed the presence of multiple micro-organisms in bees from hives or colonies that are in decline, suggesting that something is weakening their immune system. The researchers have found some fungi in the affected bees that are found in humans whose immune systems have been suppressed by the Acquired Immune Deficiency Syndrome or cancer.

"That is extremely unusual," Dr. Cox-Foster said.

Meanwhile, samples were sent to an Agriculture Department laboratory in North Carolina this month to screen for 117 chemicals. Particular suspicion falls on a pesticide that France banned out of concern that it may have been decimating bee colonies. Concern has also mounted among public officials.

"There are so many of our crops that require pollinators," said Representative Dennis Cardoza, a California Democrat whose district includes that state's central agricultural valley, and who presided last month at a Congressional hearing on the bee issue. "We need an urgent call to arms to try to ascertain what is really going on here with the bees, and bring as much science as we possibly can to bear on the problem."

So far, colony collapse disorder has been found in 27 states, according to Bee Alert Technology Inc., a company monitoring the problem. A recent survey of 13 states by the Apiary Inspectors of America showed that 26 percent of beekeepers had lost half of their bee colonies between September and March.

Honeybees are arguably the insects that are most important to the human food chain. They are the principal pollinators of hundreds of fruits, vegetables, flowers and nuts. The number of bee colonies has been declining since the 1940s, even as the crops that rely on them, such as California almonds, have grown. In October, at about the time that beekeepers were experiencing huge bee losses, a study by the National Academy of Sciences questioned whether American agriculture was relying too heavily on one type of pollinator, the honeybee.

Bee colonies have been under stress in recent years as more beekeepers have resorted to crisscrossing the country with 18-wheel trucks full of bees in search of pollination work. These bees may suffer from a diet that includes artificial supplements, concoctions akin to energy drinks and power bars. In several states, suburban sprawl has limited the bees' natural forage areas.

So far, the researchers have discounted the possibility that poor diet alone could be responsible for the widespread losses. They have also set aside for now the possibility that the cause could be bees feeding from a commonly used genetically modified crop, Bt corn, because the symptoms typically associated with toxins, such as blood poisoning, are not showing up in the affected bees. But researchers emphasized today that feeding supplements produced from genetically modified crops, such as high-fructose corn syrup, need to be studied.

The scientists say that definitive answers for the colony collapses could be months away. But recent advances in biology and genetic sequencing are speeding the search.

Computers can decipher information from DNA and match pieces of genetic code with particular organisms. Luckily, a project to sequence some 11,000 genes of the honeybee was completed late last year at Baylor University, giving scientists a huge head start on identifying any unknown pathogens in the bee tissue.

"Otherwise, we would be looking for the needle in the haystack," Dr. Cox-Foster said.

Large bee losses are not unheard of. They have been reported at several points in the past century. But researchers think they are dealing with something new - or at least with something previously unidentified.

"There could be a number of factors that are weakening the bees or speeding up things that shorten their lives," said Dr. W. Steve Sheppard, a professor of entomology at Washington State University. "The answer may already be with us."

Scientists first learned of the bee disappearances in November, when David Hackenberg, a Pennsylvania beekeeper, told Dr. Cox-Foster that more than 50 percent of his bee colonies had collapsed in Florida, where he had taken them for the winter.

Dr. Cox-Foster, a 20-year veteran of studying bees, soon teamed with Dennis vanEngelsdorp, the Pennsylvania apiary inspector, to look into the losses.

In December, she approached W. Ian Lipkin, director of the Greene Infectious Disease Laboratory at Columbia University, about doing genetic sequencing of tissue from bees in the colonies that experienced losses. The laboratory uses a recently developed technique for reading and amplifying short sequences of DNA that has revolutionized the science. Dr. Lipkin, who typically works on human diseases, agreed to do the analysis, despite

not knowing who would ultimately pay for it. His laboratory is known for its work in finding the West Nile disease in the United States.

Dr. Cox-Foster ultimately sent samples of bee tissue to researchers at Columbia, to the Agriculture Department laboratory in Maryland, and to Gene Robinson, an entomologist at the University of Illinois. Fortuitously, she had frozen bee samples from healthy colonies dating to 2004 to use for comparison.

After receiving the first bee samples from Dr. Cox-Foster on March 6, Dr. Lipkin's team amplified the genetic material and started sequencing to separate virus, fungus and parasite DNA from bee DNA.

"This is like C.S.I. for agriculture," Dr. Lipkin said. "It is painstaking, gumshoe detective work."

Dr. Lipkin sent his first set of results to Dr. Cox-Foster, showing that several unknown micro-organisms were present in the bees from collapsing colonies. Meanwhile, Mr. vanEngelsdorp and researchers at the Agriculture Department lab here began an autopsy of bees from collapsing colonies in California, Florida, Georgia and Pennsylvania to search for any known bee pathogens.

At the University of Illinois, using knowledge gained from the sequencing of the bee genome, Dr. Robinson's team will try to find which genes in the collapsing colonies are particularly active, perhaps indicating stress from exposure to a toxin or pathogen.

The national research team also quietly began a parallel study in January, financed in part by the National Honey Board, to further determine if something pathogenic could be causing colonies to collapse.

Mr. Hackenberg, the beekeeper, agreed to take his empty bee boxes and other equipment to Food Technology Service, a company in Mulberry, Fla., that uses gamma rays to kill bacteria on medical equipment and some fruits. In early results, the irradiated bee boxes seem to have shown a return to health for colonies repopulated with Australian bees.

"This supports the idea that there is a pathogen there," Dr. Cox-Foster said. "It would be hard to explain the irradiation getting rid of a chemical."

Still, some environmental substances remain suspicious.

Chris Mullin, a Pennsylvania State University professor and insect toxicologist, recently sent a set of samples to a federal laboratory in Raleigh, N.C., that will screen for 117 chemicals. Of greatest interest are the "systemic" chemicals that are able to pass through a plant's circulatory system and move to the new leaves or the flowers, where they would come in contact with bees.


One such group of compounds is called neonicotinoids, commonly used pesticides that are used to treat corn and other seeds against pests. One of the neonicotinoids, imidacloprid, is commonly used in Europe and the United States to treat seeds, to protect residential foundations against termites and to help keep golf courses and home lawns green.

In the late 1990s, French beekeepers reported large losses of their bees and complained about the use of imidacloprid, sold under the brand name Gaucho. The chemical, while not killing the bees outright, was causing them to be disoriented and stay away from their hives, leading them to die of exposure to the cold, French researchers later found. The beekeepers labeled the syndrome "mad bee disease."

The French government banned the pesticide in 1999 for use on sunflowers, and later for corn, despite protests by the German chemical giant Bayer, which has said its internal research showed the pesticide was not toxic to bees. Subsequent studies by independent French researchers have disagreed with Bayer. Alison Chalmers, an eco-toxicologist for Bayer CropScience, said at the meeting today that bee colonies had not recovered in France as beekeepers had expected. "These chemicals are not being used anymore," she said of imidacloprid, "so they certainly were not the only cause."

Among the pesticides being tested in the American bee investigation, the neonicotinoids group "is the number-one suspect," Dr. Mullin said. He hoped results of the toxicology screening will be ready within a month.

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