



## Bee Siege

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## Bee Siege

Last November, Penn State insect physiologist and pathologist Diana Cox-Foster received a call from a large commercial migratory beekeeper, who noticed something strange going on with his hives. The bees were disappearing without a trace, leaving healthy brood behind.

It's not unusual for bees to die from infectious agents or parasites. American foulbrood (*Paenibacillus larvae*), a bacterial infection, killed many colonies in the 1940s; tracheal mites (*Acarapis woodi*) first entered the United States in 1984 and remain a minor problem. Varroa mites (*Varroa destructor*), which first appeared in the United States in 1987, are a bigger threat. "There didn't seem to be any particular meaningful level of resistance [to the varroa mite] in the population," says Nicholas Calderone, a Cornell University entomologist. Two pesticides were developed that killed the mites—until the mites became resistant. At present, Calderone notes, "Nothing satisfactory has replaced the first two pesticides that were released." He explains that even with successful pesticide use, baseline losses from varroa mites in overwintering bee colonies have ranged from 10 to 20 percent, with losses as high as 50 to 100 percent of bees in some areas in some years. The winter of 2000–2001 had a large bee die-off. The most recent die-off began just before Cox-Foster was phoned.

Migratory beekeepers make up the bulk of all honeybee keepers, with about two million hives. Their bees are put on tractor-trailers and hauled around the country to pollinate such crops as California almonds, northeastern blueberries, squash, pumpkins, melons, alfalfa, apples, citrus, carrots, and many more fruits and vegetables. Honeybees pollinate about 90 commercial crop species. An often-repeated statistic is that honeybee pollination of US crops is worth about \$15 billion annually. With the increasing

acreage of almonds, the addition of new fruits (such as kiwi), and the cost to rent hives (as much as \$150 to \$200 per hive, up from \$30 to \$40 per hive a few years ago), the total value of bee pollination is much higher. Fully one-third of US agriculture depends on pollinators, and if bees are dying and cannot be replaced easily, then the nation's ability to produce food will suffer. Almonds need so many bee pollinators that last year hives were rented from Australia.

Shortly after the call from the beekeeper in November, Cox-Foster and her colleagues realized that there were a lot more beekeepers whose hives were suffering. What beekeepers are reporting differs from standard die-offs caused by mites, Calderone explains. "When the bees get mites, they're often gone...[but] even if the bees are gone, you tend to find the brood and it tends to be deteriorated." Now, he says, "they're finding colonies with no bees; they're finding brood but it looks fairly healthy." Cox-Foster adds that with varroa mite infection, dead adult bees will be found in the colony. Furthermore, wax moths and small hive beetles will go into the dead colony, and bees from neighboring colonies will enter and maraud, stealing honey and comb. But in the current situation, no dead adult bees are found in or around the colony; the brood appears to be in good health, albeit untended by adults; and no marauders are going into the hives. This phenomenon has been termed "colony collapse disorder" (CCD).

Jerry Bromenshenk, of the University of Montana–Missoula, is studying the epidemiology of CCD. He notes that to date, about 20 to 30 percent of beekeepers' colonies have been affected, with losses ranging from 40 to 100 percent of hives. To a beekeeper with thousands of colonies, that is a huge economic hit—perhaps more than \$1 million—and it is a loss of millions of bees.

Cox-Foster elucidates the three main hypotheses on what is killing the bees: CCD may be caused by one or more emerging pathogens; an environmental chemical or toxin may play a role in development of CCD; or general stresses associated with apicultural practices may be weakening the bees, leaving them open to infection. May Berenbaum, an entomologist from the University of Illinois at Urbana-Champaign, explains that, at present, there is no reason to reject any hypotheses, and she jokingly notes that even alien abduction of bees has been suggested.

Berenbaum points out that Cox-Foster's call came within a month of the release of a report by the National Research Council, *Status of Pollinators in North America*. Referring to the report's warning that we are relying too much on one species—the western honeybee (*Apis mellifera*)—for pollination as "prescient," Berenbaum notes that the rapid loss of honeybees and their hives "may be a reflection of environmental changes that have reduced the availability of free pollination service [from feral bees]."

On 29 March 2007, both Berenbaum and Cox-Foster testified before the House Subcommittee on Horticulture and Organic Agriculture on the plight of the honeybee. The day before, Representative Alcee L. Hastings (D–FL) introduced the Pollinator Protection Act, which would authorize \$5.25 million over five years for research on CCD. The CCD Working Group plans to meet at the end of April with the subcommittee and with other researchers in the hopes of presenting Congress with a list of priorities for bee research.

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