

Honey Bee Decline Factors

Colony Collapse Disorder (CCD)

The mysterious syndrome that is killing off honey bees, called Colony Collapse Disorder (CCD), continues with commercial beekeepers reporting the biggest losses of honey bee hives. University of Illinois entomologist and Carl R. Woese Institute for Genomic Biology director Gene Robinson, an expert on honey bee behavior, genomics and biology, describes the advances scientists have made in understanding the causes of CCD. He spoke to University of Illinois News Bureau life sciences editor Diana Yates for an April 19, 2013 press release, and updated by Dr. Robinson on January 5, 2018.



Honey bee on crabapple

Is there an effort to get a geographic sense of which bees are most affected?

Surveys have been done that report on the severity of bee losses by location, by state. The U.S. Department of Agriculture generates maps of how big the losses have been in different parts of the country. There's no strong geographic pattern. This is because CCD losses occur in places where the most commercial beekeeping occurs and commercial beekeeping in general is on wheels – beehives are trucked throughout the country for pollination purposes.

There are several migratory routes that these hives follow. As many as two-thirds of the commercial honey bee colonies in America are moved to northern California for a period of two to three weeks just for almond pollination. CCD losses are greater in commercial beekeeping operations areas.

We've been observing declines for many years now. Are we any closer to understanding what's going on?

Yes, we are closer, but progress is slower than we'd like because multiple factors are contributing to CCD. Moreover, there is pretty good evidence that there are synergies between these factors. This explanation is reasonable, but it doesn't mean that solutions will come quickly. It's reasonable because we have a general intuition that many organisms in the environment are under increasing stress, that it's harder for them to survive and thrive in the environment these days than in the past because of anthropogenic changes. Whether one considers introduced pests or pathogens, degraded habitats or more extreme climate, it's just more difficult out there. And so the notion that we are putting species closer to a tipping point is easy to grasp. What this means is that when an already stressed beehive is exposed to yet another factor, the bottom falls out and we see CCD, a complete colony collapse.

What factors do scientists think contribute to CCD?

First of all the varroa mite, a parasite of honey bees, has been the real game changer. It is not the cause of Colony Collapse Disorder but it is a huge factor. It has weakened bees by the pathogens that it harbors that it passes along to the bees and perhaps also by damage that it does directly to the bees.

There are also nutritional stresses associated with migratory beekeeping. When you use bees for pollination your objective is to benefit the plants, not the bees. Sometimes for a major crop like almonds, which blooms early in the spring, the fate of the whole crop depends on whether the temperature gets above bee-flight weather for just a few hours during the two-week bloom period. Sometimes it's gorgeous and sunny every single day, and then there are many more bees than needed. But sometimes it's touch-and-go for an entire bloom period, and farmers are willing to pay to ship in extra colonies as a kind of insurance, so that if there are a few windows of time of favorable weather, there will be enough bees to take care of the pollination, even in a very short time period.



Almond trees blooming. Photo: M. Wiesbrook

The high density of bees is good for the plants and good for the farmers, but not good for the bees. The bees are often nutritionally stressed as a result of their pollination activities because their densities are too high. In addition, foraging in one homogenous agro-ecosystem for weeks at a time may not provide the optimal mix of nutrients for good bee health.

In addition to pathogens, parasites and poor nutrition, pesticides are also implicated. The newer pesticides are much safer for humans. They also are being applied in ways that make them safer to humans. But they also have negative effects on beneficial insects.

One topic that's just starting to be examined is the synergy between the sublethal effects of pesticides and the effects of a pathogen, or a parasite, or poor nutrition. The effect of pesticides on bee health is a controversial topic. Some studies show strong damage to bees, and others do not. The situation right here in East Central Illinois illustrates this. Here, corn and soybean agriculture use one of the most controversial classes of insecticides, the neonicotinoids. But there are relatively few problems in this area with Colony Collapse Disorder. We're ground zero for neonicotinoid use but there have been few cases of Colony Collapse Disorder.

Is this for the migratory, commercial bees?

No, this area is not a big commercial beekeeping area; this is an area dominated by hobbyists, so that's a good point. There's no question that insecticides kill bees, but as to the question of whether they are involved in CCD, they are a factor, but not the only factor.

Would it be possible to enhance the overall health of the honey bees with more home-grown, localized bee operations that stay in place and therefore stress the bees less?

Right now there is a renaissance in beekeeping; there are many new beekeepers, and many have been stimulated to get involved primarily by the bee crisis, coupled with increased interest in local food production. These two separate trends have combined to lead to a strong surge in interest in hobby beekeeping. We have a number of new beekeepers here in this area, even some rooftop beekeepers in our urban areas, and many urban beekeepers in Chicago, New York City,

San Francisco and so forth. But these are largely hobbyists or sideline beekeepers, as opposed to large commercial beekeepers. So while their local impact can be huge, they cannot affect large-scale agriculture. In modern agriculture, huge numbers of plants come into bloom at the same time and they need to be pollinated at the same time. Only large-scale commercial beekeepers can provide the millions of bees needed to get the job done.

Is there any overlap between declines in honey bees and declines in wild bees?

Yes. Bumble bees, the next best studied bees after honey bees, have experienced serious population declines. There is a feeling that honey bees are like the canary in the coal mine – and we're all watching anxiously.

January 2018: Phil Nixon, Entomologist, University of Illinois at Urbana-Champaign