MSU economist's research on colony collapse disorder published in national journal

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The work of a Montana State University professor examining the economic impacts of colony collapse disorder among commercial honeybees was published in the *Journal of the Association of Environmental and Resource Economists* last month.

Randy Rucker, a professor in the Department of Agricultural Economics and Economics in the MSU College of Agriculture, began looking into colony collapse disorder several years ago with colleagues from North Carolina State University and Oregon State University, for the purpose of estimating its economic impacts. The onset of the disorder was an unexpected shock to commercial beekeeping and pollination markets that first received national attention in the winter of 2006-07 when mortality rates were estimated to be almost 30%.

Colony collapse disorder is still a poorly understood phenomenon, wrote Rucker and his co-authors in the paper's introduction. Since its onset, along with other pollinator health issues such as the Varrona mite, which feeds on developing bees, it has caused significant concern among beekeepers and the public.

"With colony collapse disorder, a beekeeper goes out and virtually all the worker bees are gone," said Rucker. "Twenty thousand, 30,000, 40,000 worker bees, just gone. There are very few dead worker bees on the ground near the colony, and the queen, the brood and all the food are still there. But the bees are just gone."

With so little known about what causes colony collapse disorder, Rucker and his team set out to identify its economic ripple effects by examining trends in four categories: number of commercial honeybee colonies nationwide, honey production, prices of queens and packaged bees and pollination fees charged by commercial beekeepers to growers. The team found some surprising results.

Bee population is known to fall during the winter, said Rucker. Prior to the onset of colony collapse disorder, the average winter mortality rate was about 15%. Beekeepers have long known how to replace dead hives and are prepared to deal with losses, typically in one of two ways.

The first method of offsetting winter losses is called splitting, where a beekeeper takes half the bees in a healthy colony, moves them to a struggling colony and adds a newly fertilized queen, purchased for $18-25 and received through the mail. After about six weeks, there are once again two healthy hives.

The other way to increase colony numbers after winter losses is to simply buy a package of bees, also through the mail, which includes a fertilized queen and several thousand worker bees. Beekeepers place the bees in the dead hive and then watch as a healthy hive develops. Both methods are relatively easy and inexpensive for beekeepers—and have remained so after the onset of colony collapse disorder, the study found.

"Beekeepers know how to replace dead hives," said Rucker. "As winter mortality increased after CCD appeared and beekeepers worried about having enough hives to meet their pollination contracts in the spring, they responded by splitting more hives in mid- to late summer and would then end up with the number they needed."

Even with more hives split and more bees purchased, the prices of queens and packaged bees have not increased dramatically, the study

found. From this result, the authors infer that "the supply of queens and packaged bees is sufficiently elastic that any increases in demand associated with CCD have not resulted in measurable increases in price."

The team found similar results when they examined trends in colony numbers and honey production. While there were pre-existing downward trends in both metrics before the onset of colony collapse disorder, the rate of decline has not increased, said Rucker. In fact, colony numbers in 2018 were higher than they had been over the last 20 years.

The sole instance of a pronounced negative impact came when the team studied trends in pollination fees for commercial crops. Even there, however, only one commercially important crop showed a significant increase in price: almonds.

"Almonds get pollinated in February or March, and it's really the only major crop that requires pollination during that time of year," said Rucker. With about a million acres of almonds in need of pollination each year, it takes about 70% of U.S. managed honeybee colonies to get the job done.

Pollination fees for almonds rose from roughly $70 to almost $160—adjusted for inflation—over the winters of 2004-05 and 2005-06, but Rucker and his co-authors noticed something unusual about the timing. Those increases happened before colony collapse disorder appeared on the scene over the winter of 2006-07.

"Almond pollination fees did go up substantially, but they went up before CCD hit," said Rucker. "You can't attribute those increases to colony collapse disorder."

The bottom line, he said, is that while there have been changes in the commercial pollinator markets, few can be directly linked to colony

collapse disorder or any other recent pollinator health concerns. This is good news for beekeepers and consumers alike, he added.

"When we started this project, we expected to find huge effects, but we found very small ones," said Rucker. "The only effects we found on consumers, for example, is that they probably pay about 10 cents more for a $7, one-pound can of almonds at the grocery store."

The reason the disorder's impacts are so small, said Rucker, is directly linked to the fact that most beekeepers know that bees and honeybee colonies are going to die over the course of the year, and they have developed methods of dealing with those fluctuations. As a result, they have been able to react quickly to disruptions like CCD. But there are still a lot of unknowns about the disorder, and the paper focused on the particular overlap of colony collapse disorder and economics.

"The bottom line is that beekeepers are savvy [businesspeople]," he said. "Our research provides reason for optimism about the future ability of commercial beekeepers to adapt to environmental or biological shocks to their operations and to pollination markets. It says nothing, however, about non-managed pollinators. Data on those pollinators' populations are sparse, and the impacts of maladies like CCD on their populations are not well understood. There is definitely much more work to be done to grasp the effects of CCD and other threats to bee health."

More information: Randal R. Rucker et al. Colony Collapse and the Consequences of Bee Disease: Market Adaptation to Environmental Change, *Journal of the Association of Environmental and Resource Economists* (2019). DOI: 10.1086/704360

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