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Fall 12-16-2016

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Why we still need to worry about bees

Honey bee populations have stabilized, but large numbers continue to die each year, especially during winter months.

By Meaghan Lee Callaghan

Like bears, birds and other creatures, bees have their own way of coping with the winter months. No, they don't fly south for the winter, nor do they necessarily hibernate. Instead, they congregate in a swirl inside their hive, twitching their muscles to keep warm. The bees on the outer ring slowly move in toward the middle, and the middle works its way out, so that all share the best warmth.

The bees are vulnerable at this time. They need to rely on what food stores they have holed up in their hives -- the honey. But even if they have enough food saved up for the winter, some bees may not make it. In the United States, beekeepers, or apiculturists, are reporting worsening bee die-offs over the winter months, what scientists call colony decline.

Colony decline is an umbrella term to describe the loss of bees that keepers in western countries have been experiencing for decades. Most scientists believe these losses owe to a variety of causes, such as East Asian mites and viral infections. The infamous colony collapse disorder [CCD], which has been widely reported in the media, is actually just one affliction that has been causing bee populations to plummet. In CCD, female worker bees mysteriously disappear from a seemingly healthy hive, and daily processes in the hive start to break down in their absence. There are no bodies to examine and determine what's caused the bee deaths.

It should be noted that colony collapse and colony decline are not the same thing, though they are related. In colony decline, the hive could be suffering from the mysterious colony collapse, or there could be a number of deceased worker bees, like a miniature crime scene. Colony collapse can be one form of colony decline. So while numbers of pure colony collapse cases seem to be leveling off in the United States, perhaps not being the true bee-pocalypse that was foretold by breathless headlines and primetime news specials, colony decline is a widespread problem across the country, and maybe in more parts of the world.

Colony decline is straining beekeepers, both commercial and hobbyist. Keepers say that they

now have to go to greater lengths to care for their hives over the winter. Some apiculturists condense their hives to focus on the strongest bunch. Others forgo collecting honey, so the bees will have ample resources for the coldest months. Some keepers are even feeding their bee colonies sugar water to supplement their nutrition.

"My dad was keeping bees before colony collapse, and he'd have 90 percent survival rate every winter, with very little effort," says Davin Larson, a hobbyist beekeeper in Brooklyn. Growing up in Kansas City, Larson watched his father do fairly little to keep his bees happy and be rewarded with honey the family would hand out as gifts around the holidays. Larson says that if you want to keep bees today, you have to be passionate about it.

"And now it's like you have to follow every little trick in the book to make them as healthy and happy as possible," he added.

Larson has found unique places to keep bees in a city with eight million people. He first began storing his colonies on rooftops in Fort Greene; now he's placed hives within Green-Wood Cemetery in Greenwood Heights, Brooklyn. The expansive graveyard helps to diversify his bees' diet -- 438 acres of winding paths among thickets and ponds provide a variety of pollen and nectar for the bees.

The bees even venture out to collect their food, as Larson discovered when collecting a batch of honey with a clean mint taste. As he later found out, no mint is grown in the cemetery. And that's not uncommon. Bees will forage on average up to five miles, and the whole group will converge on a really tasty spot.

Although Larson tends to his bees carefully, the specter of colony decline is always on his mind. And it's not just decimating hives in the United States; the problem has recently been recorded in some European countries. Numerous scientists also believe that it may be a more far-reaching event. Several of the known causes of colony decline, like infectious mites, are known to be a global problem. Other causes, like bee viruses, have not been studied enough in countries other than the west, says David Gallbraith, a postdoctoral researcher at Penn State University. "The majority of the studies have been done inside the United States, and very few have looked in other countries," he said.

Between April 2015 and 2016, beekeepers in the U.S. lost an average of 44 percent of hives, compared to a 36-percent loss in 2010-2011, according to surveys by the Bee Informed Partnership, which is supported by the United States Department of Agriculture [USDA] and the National Institute of Food and Agriculture.

But the data on colony decline is as complicated as the phenomena. Beekeepers often will consolidate small hives and buy more bees, which can result in inflated survey numbers. Still, there has been a steady increase of over-winter loss in recent decades. But, there are also missing gaps in statistical data from the U.S. government, as census methods have changed over decades. What records that do exist show that American beehives peaked in 1947 at 5.9 million hives, and have hit a low point at 2.3 million in 2008, according to the USDA National Agricultural Statistical Service.

The consensus among experts is that bees are getting sick and dying for a host of reasons, such as poor nutrition and environmental toxins. The healthiest can fight off infections, but the sickly and young are vulnerable. There are already twenty known viruses, as well as bacteria, fungal infections and parasites like mites that can infect whole hives like a college dorm in cold season. This multitude of threats makes for a perilous time for American bees.

Like pantry moths in a kitchen, or mice in the attic, honeybee hives are prone to their own infestations. Ants can be a problem, though one easy way to keep them from getting in is to place the legs of the hive box in water. (Ants can't swim.)

But there are other pests that aren't so easy to deal with. For instance, the varroa destructor mite, which first came over from East Asia in 1987, is now so widespread in the United States that almost every hive has them, says Diana Cox-Foster, lead researcher at the USDA Agricultural Research Service in Logan, Utah.

The mites spread from country to country though global trade, but they are dependent on honeybee populations. The mites can only reproduce within a honeybee colony, where they latch onto bees and suck the bees' blood-like substance called hemolymph. A bad infestation can lead to death of the entire colony, which almost always happens between the fall and spring when bees stay inside their hives.

Cox-Foster says that at one time, pesticides were used to control this mite, but the species has quickly gained resistance over generations, making certain treatments useless. While there still are some options left, such as naturally-occurring chemicals like formic acid from the stinging nettle plant, the mites are not just a problem on their own. They've been found to spread disease while sucking hemolymph within the hive, viruses like the deformed wing virus, which is as debilitating as it sounds.

Viruses can infect hives just as they infect humans. For most viral infections, many of the population are carriers that don't show symptoms, but the few that do can be born with congenital malformations, like in deformed wing virus, where bees develop with shriveled, crippled wings.

And while there have been advancements in research for bee viruses and infections, there's no bee vaccines to prevent the spread. But there are researchers mapping the RNA sequences, the coding of the virus, to better identify sick bees, and even researchers looking for unknown bee viruses, such as David Gallbraith at Penn State University.

He says that bee viruses are more studied than other insect illnesses, because we use bees for pollinators in agriculture and honey production. Still, there are wide knowledge gaps. Scientists know a lot about American and European honeybees, he says, but have been "neglecting most of the [other] bee populations from around the world."

Gaining insight into unstudied populations in Africa and Asia, he adds, would help researchers

better understand the breadth and scope of bee colony decline.

The threat to honey bees was first recognized in 2006, when Penn State researchers, who had been tracking honey bee health, began to notice mass disappearances. Shortly after, the media jumped on the story. In 2009, PBS's Nature ran one of the first documentaries, *Silence of the Bees*. Four years later, the cover of Time magazine lamented, "A World Without Bees."

The sickness was colony collapse disorder, and the predictions were dire: all of our bees would disappear. But numbers from the USDA are now showing a plateauing of sorts, and experts agree that while still a prevalent problem, CCD is not ushering in an ecological doomsday, as some feared. Moreover, experts believe we should focus on all the forms of colony decline; that is, colony collapse is only one type of colony decline. It's a very specific circumstance in which worker bees leave the colony and never return, leaving the queen and some nurse bees unaided. There are no dead bee bodies. And maybe part of that mystery is what so captivated the public and the press.

Cox-Foster was one of the first to identify colony collapse when working at Penn State University in the mid-2000s. Her lab is currently working on research that would present a blueprint for distinguishing between colony collapse and colony decline. The new work will trace out specific pathways that colony collapse manifests, so scientists can better diagnosis problems with hives.

Despite the media's over-hyping of colony collapse, the future of bees still looks precarious to Cox-Foster, who has spent her professional life studying bee health in the United States. In addition to the variety of bee pests, viruses and other ills, Cox-Foster says the overuse of pesticides presents another major challenge.

While the U.S. Environmental Protection Agency (EPA) recently declared that certain types of pesticides, specifically neonicotinoids, are harmful to bees, not all bee researchers are convinced. But Cox-Foster insists the evidence is mounting that pesticides are one of the culprits. It has been theorized for a while that what works as a neurotoxin or mixes up the hormones of one insect may do the same for various types of bees.

Cox-Foster says that in a typical sample of pollen, weighing around three grams, researchers on average find six different pesticides. "You can still find DDT circulating out there" in the environment, she says. Dichlorodiphenyltrichloroethane, or DDT, though sparingly used today, was at one time one of the most prolific pesticides, used to kill mosquitos and other insects. Trucks filled with DDT use to chug along city streets in the United States, spraying directly into neighborhoods. American troops were doused in it before fighting in the tropics in World War Two.

But scientists eventually began to understand that the pesticide was a hormone disrupter, which was leading to precipitous declines in bird populations. Bald eagles and other birds of prey would sit on their nests to incubate and crush their own brood with DDT-weakened eggshells. Partially due to Rachel Carson's famous 1963 work *Silent Spring*, DDT use was reduced or

banned in many parts of the world. But fifty years later, you can still find the pesticide in local pollen.

And when bees are already exposed to so many toxins throughout the lifespans, they're also not always getting the best mix of pollen, like Larson's bees in New York City. Americans love their lawns, and suburbs that are weed-free may actually be worse than concrete slabs of the city. All green spaces are not the same; the bees need a mix of flowers, the diet diversity, to be the healthiest they can be.

"If you look at a golf course, that's maintained the old way, making sure it's absolutely free of weeds, it looks beautiful to us, it's nice and bright and green," says Cox-Foster. "But to a bee that's basically like a desert, there's nothing there. You might as well be looking at a sandstone wall for that bee species."

So what can be done to help the bees? For starters, Cox-Foster recommends using fewer pesticides and allowing some weeds grow. Scientists also need to better understand how long-standing pathogens and parasites are affecting bees. What we know now is just a drop in the bucket.

Meanwhile, commercial apiculturists and hobbyist beekeepers like Davin Larson in Brooklyn are doing everything they can do to keep their hives intact. But it can be costly. It's more time consuming and expensive, to keep bee hives surviving over the coldest months. There's also an emotional toll. To Larson, it's sad to lose out on honey or to lose a free pollinator for a beautiful garden. But what's worse for him is the loss of a living thing.

"I actually get kind of attached to them and every hive has kind of a personality, how aggressive they are or what kind of things they bring into the hive," Larson says.

Every spring, Larson fears the worst, now that it's virtually certain that he'll lose a substantial number of bees every winter. "How many of them are going to die?" he wonders.

This winter, he's wrapped his hives in layers of special roofing paper and insulation to keep the bees warm. To supplement their diet, he's feeding them extra sugar syrup.

After a December snowstorm that quickly melted away, Larson went to check on his hives. "I opened one hive, and they were definitely alive," he said in an email. "So that's encouraging."

"I'm just hoping for minimal losses," he continued. "We'll see what happens around March or April. Fingers crossed."