Honeybee Colony Collapse Disorder

By a Skagit County Master Gardener
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Colony Collapse Disorder threatens U.S. honeybee hives, damaging beekeepers and the agriculture industry.

Colony Collapse Disorder (CCD) is a sudden disappearance of all bees in a hive. It is characterized not by piles of dead bees, as in most hive misfortunes, but by an empty hive. The queen, who is not affected by the disease ravishing her workers, can be found wandering about the hive alone or with a few attendants, which are younger bees. The older bees, who are responsible for foraging and hive defense, are absent. In most CCD-stricken hives, honey stores appear plentiful, ruling out starvation as the cause for decline. Disappearing hives, however, is not a new phenomenon. This particular syndrome has been noted anecdotally, but infrequently from the late 19th century. However, in recent years this beekeepers' worst nightmare has become widespread, virulent and devastating. It is ruining not only beehives and beekeepers' livelihoods, but also the livelihood of agriculture and food security.

Rest assured, scientists are working on this one. Laboratories at many universities across the United States, including our own Washington State University, research apiaries in Pullman and here in Mount Vernon. Haagen-Dazs is even offering a $250,000 research grant for universities in Pennsylvania and California to probe the causes of CCD.

As far as we know, honeybee cultivation originated in Egypt, where ancient beekeeping is demonstrated in hieroglyphics. In the scientific names that grew from this starting point lies the story of what living things are and how they came to be. Here is a mini-glossary of scientific names to help you read on:

Latin word	**English meaning**
Apis	Bee
melifera	Bearer of honey
cerana	Wax maker
Scutella	Armed!
Nosema	Infectious, single-cell agent
Varroa	Named for Marcus Terentius Varro Lucullus, a very busy politico of ancient Rome—Like Varroa, he must have been into everything!
microsporidium	Fungal, single-celled parasite

Since ancient times, two strains of honeybee, initially from Africa, became favorites for cultivation in Eurasia: *Apis melifera,* which was favored in Europe, and *Apis cerana,* which was favored from the Middle East to East Asia. Both strains of bee make wax and honey.

Europeans brought *Apis melifera melifera* with them to the New World in the 17th century. By this time, *"melifera"* appeared twice in this bee's name, which means: "this bee really makes a lot of honey!" It is

a super-honeybee.
Before its arrival in the new world, culture of *Apis melifera* had developed to a new level. Bees were bred to be gentle (more tolerant to human intervention), hygienic (only the most fastidious hivekeepers would be allowed to breed), and productive; i.e., providing copious amounts of honey, filling every available container with precious liquid gold. The winning bees became *Apis melifera melifera* or super-honeybee. In fact, a variant of this bee, called the "Italian bee" became so beautiful and successful, that now beekeepers prefer to purchase colonies of these magnificent bees to replace their stocks of plainer, more primitive, and less productive but more robust *Apis cerana*, the traditional honeybee of the East.

The perfection of the super-honeybee, however, has come at a price. The gains of gentleness, hygiene, and productivity were purchased at the expense of genetic diversity and defenses, be they internal, like immune system function, or external, like a plain old cantankerous nature. Whereas this prize-winning bee must have survived many bee plagues in the past, she has little immunity to the new generation of parasites descending on her now.

U.S. honeybees face the continuing threat of Colony Collapse Disorder (CCD). So far, the best guess for what causes CCD—a sudden disappearance of all bees in a hive—is a "perfect storm," a combination of biological and cultural factors, such as diseases and stress. Photo by Jason Miller.

Nosema Ceranae
As if losing one's position as favorite bee weren't enough, the over-shadowed *Apis cerana* seems to be more resistant to icky pests affecting her prettier, but more delicate sisters. Because of this, *Apis cerana* is blamed for passing maladies to the super-honeybee in shipments either of *Apis cerana* themselves or of Super-honeybees kept in *Apis cerana* territory. Everything from varroa mite to deadly *Nosema ceranae*, are attributed to contact with *Apis cerana* (thus the name). Some of these fears may be supported. It is risky to introduce new bees (or any other new form of life, for that matter) into an area where they have never been before.

Although *Nosema ceranae*, carried by *varroa* mite, is heavily implicated in Colony Collapse Disorder (CCD), we must await results of testing healthy hives in which mites are nonetheless present (an easy task, since all human-tended beehives seem to have mites) for the proportion of absence to presence of *Nosema ceranae*. If the absence far exceeds the presence, this is a strong indication that *Nosema ceranae* should be removed from beehives as quickly as possible. Research also must focus on how this is best accomplished.

Nosema is not a new blight. *Nosema apis* is now, like *Nosema ceranae*, recognized as a *microsporidium*. *Nosema apis* has been lurking in honeybee colonies for decades, causing diarrhea in bees, and presenting unsightly brown splats all over the hive, inside and out. Over time *Nosema apis* seems to have weakened into a status of minor annoyance, easily rectified by a standard microbiological treatment applied to hives every spring. So did *Nosema ceranae* arrive in a shipment of alien bees? Or did it actually evolve from *Nosema apis* under pressure from regularly applied but identical treatments over long periods of time? Firm evidence for either origin remains elusive.

IAPV

Another beast, called Israeli Acute Paralysis Virus, or IAPV, which affects bees as the name implies, has also joined other "usual suspects" as a cause of CCD. The origin of this affliction is thought to have come from China (*Apis cerana* territory) by way of Australia. This disease is thought to have made landfall in the U.S. in 2002.

Varroa mite

Varroa is a little red-brown mite, visible to the naked eye, which attaches itself to a bee while it is pupating. During this time, the mite gets plump gorging itself on the pupa's body fluids. The mite lives a life of leisure: eating, defecating and making babies. When the bee is ready to emerge, mite offspring born in the cell climb out with their mom and the stunted and maimed host. Then the baby mites, at this stage tiny, yellowish, and transparent blobs, hitch a ride on the first nurse bee (one of the younger bees) to find, as the nurse bee does her job, another unwitting larva being capped for pupation by other nurse bees. If the mommy mite has *Apis ceranae, Nosema apis*, IAPV or anything else smaller than itself that preys on honeybees, the colony becomes ill. Like human AIDS, *Varroa* mite attacks the immune system of the host bee.

Skagit County Master Gardener Mary Pat Larsen pulls out a piece of white sign board, placed below the bottom board of one of her hives three days prior, to determine the extent of *Varroa* mite infestation. Fortunately, the sign board revealed few mites. Photo by Mary Pat Larsen

.So far, the best guess for what causes CCD is a "perfect storm," a combination of biological and cultural factors, such as diseases and stress. Suspected biological causes are *Nosema ceranae*, IAPV, and the mites that carry them; cultural causes can be blamed on any of the following stressors (some of these are under a beekeeper's control; others are not):

- Lack of biodiversity in genetic make-up of American honeybees
- Frequent disturbance of bees by excessive or clumsy rummaging through hives to look for queens, brood, etc.
- Pollution: any undesirable substances affecting air and water quality in or near the apiary
- Lack of good forage habitat due to urbanization, suburbanization, or putting lawns and cement where flowering plants had been before, even if they were weeds.
- The practice of hauling bees long distances for pollination and single-source honey crops, such as oranges, raspberries, etc., which risks exposure to undesirable elements and agents from colonies other than the beekeeper's own; this is in addition to the bouncing on rough roads and confinement of bees during the day when they want to fly
- Incorrect feeding of bees, possibly exposing bees to contaminants, malnutrition; beekeeper forgetfulness to feed at all, and unnatural sugars, such as high-fructose corn syrup (HFS); a colony's own honey is the best food for bees anywhere and at any time of the year
- Hive conditions: dampness is fungus heaven. No matter how cold it gets, ventilation within the hive must be adequate.
- Prolonged confinement in hive due to cold, wet weather, especially during the time when bees' favorite forage flowers are blooming.

Bees in the Pacific Northwest also may be at greater risk of CCD because of unused land being covered by berries, from native huckleberries to Himalayan blackberry—the latter of which provides the most important honey-flow in the Pacific Northwest. Yet such a field of plenty will attract bees from a circle of five miles. This also allows mites and diseases hiding in the anthers to jump on the next bee that comes along.

Rays of Hope?

Remember Africanized honeybees (killer bees), which we view with dread? That's *Apis melifera scutella*. Western Washingtonians, however, needn't be overly worried. While fungi may love our wet climate, *Apis melifera scutella* does not. However these nasty tempered attack bees seem not to have mites and don't seem to be suffering as much from *Nosema ceranae* and/or IAPV. Is this because humans don't go near them or try to manage or breed them? Or is it because their genetics give them immunity? If you don't like the solution of trying to use Africanized bees for honey, wax and pollination, like beekeepers do in Brazil, maybe we should just do the best with what we have, our super-honeybees, and wait it out.

As CCD ravages our apiaries, the damage has seldom been total. A few colonies either escape infection altogether, or fight it off successfully. Perhaps this means that, in remaining functional colonies, our precious Super-honeybee is slowly developing resistance to CCD. We can always hope.