What's wrong with our bees:

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Imagine standing in an orchard with trees blooming as far as you can see. There is an almost deafening buzz as millions of bees travel from flower to flower. It seems like the perfect setting for the bees, right? So how is it that 30-40 percent of these colonies will die within a year?

To truly understand what's going on, you need to understand the complexity behind the honey bee. They are fascinating creatures that can adapt to a multitude of environments. These social insects live in a hive that is so organized and so interrelated that the colony is referred to as a superorganism. A healthy hive is in equilibrium. But the equilibrium has a tipping point; too much stress on the system and it collapses. Imagine, seeing a hive full of bees and coming back a couple weeks later to an empty colony. It's heart wrenching and is happening a lot lately.

This complex society exists because bees of different ages do different roles in the colony. Most of the honeybees in the hive are female and live only 6 weeks. The first 3 weeks of the bee's life is spent mainly in the hive doing household chores. She starts off cleaning out the hexagonal cells within the comb so the queen can lay eggs in them. This insures that there are always new bees being developed. After a few days, her glands develop so she can produce "baby" food. Her new role is to be a nurse bee and feed the developing larvae, also called brood. As the larvae age, their food requirements change and the glandular secretions are diluted with pollen and nectar. The bees remain nurse bees for a couple of weeks. At this point, her glands start to decline and her flight muscles become more developed. She starts transitioning to a forager bee. During this transition, she will take on roles of cleaning debris from the hive, receiving and storing nectar from forager bees, and guarding the hive.

Once a bee becomes a forager, she spends the rest of her life searching for water, pollen, or nectar. She can travel 3 miles away for her bounty. What she searches for is dictated by the needs of the hive. Water is not only used for hydration, but is critical to regulating the temperature of the hive. The brood nest (where the larvae develop) is kept between 32-35C (about 93 degrees) regardless of outside temperature. The bees either cluster in winter and shiver to generate heat or they fan the hive and evaporate water during the heat of the summer. Pollen is the main source of protein, fats, and micronutrients, and is vital to the development of the larvae. No pollen, no brood. Too much pollen, and space is wasted. The bees keep track of the brood:pollen ratio and adjust their foraging behaviors accordingly. Nectar is the carbohydrate source; the stuff honey is made from. A colony needs more nectar than pollen because foragers need the carbohydrates to fly and the overwintering colony needs them to generate heat. A forager will bring back nectar in her honey stomach, pass it off to a receptor bee, and the receptor bee either feeds other bees or stores it for later use.

In a healthy hive, the population is in a homeostasis. The queen, who can lay up to 2000 eggs a day, lays only enough eggs that the hive can support. This is dependent on the number of nurse bees who can feed the larvae, the number of foragers that can bring in food, AND the environment. If there is no food to forage, then the hive is dependent on their stores, the queen will shut down, and the population will

decrease. If they are in the middle of a blooming clover field, then everyone is in full swing and the population will increase.

What happens when the equilibrium is disrupted? Let's pretend a major storm hits and wipes out half the foraging force. Suddenly, the hive has all this brood it's rearing but not enough food coming in. They need more foragers. The hive senses this and nurse bees react by prematurely turning into foragers. Their flight machinery isn't completely developed yet, so they have a higher mortality rate during their flights. The hive recovers, but they go through a rough spot. Now add in another disaster. The hive responds the same way, but this time the balance is tipped too far. Too many foragers die, which causes too many housekeeping bees to prematurely become foragers, which leaves too few bees to feed the brood and regulate the temperature. The hive is dead but doesn't know it yet.

Since 2006, this scenario has propagated itself much more frequently. Beekeepers are losing 30-40% of their hives annually. Thanks to good beekeepers, honeybees are NOT going extinct. There are as many hives in the US now as there was 20 years ago. Good beekeepers have altered their management practices to control and make up for these losses. It's expensive, labor intensive, and has placed a strain on the beekeeping industry. Many commercial beekeepers have gone out of business. There are a lot of parallels between the beekeeping industry and farming. It's harder to succeed now than in the past and there has been a shift to larger operations.

Let's go back to the scene described at the beginning of this article. California produces 80% of the world's almonds on almost a million acres. Almond trees don't fruit unless they are insect-pollinated. Each year nearly 2 million honey bee hives are shipped to the state for a one month stint of pollinating. That number is staggering when you consider that there are only 2.5 million hives in the US. Seventy five percent of all the hives in the US are shipped to CA for almond pollination. It's the perfect example to illustrate why declining honey bee health is in the news so much.

The almonds bloom in mid February, but the bees move to CA in mid January. What feeds the bees when the almonds aren't in bloom? Nothing. It is a virtual wasteland for bee forage. Poor nutrition is the first of the 4 "Ps" that are working to undermine the health of our honey bees. Without adequate nutrition, bees become more susceptible to disease and can't rear the brood they need to maintain their population. Meadows, hedgerows, and other sources of wildflowers are being replaced with manicured lawns, monocultural agriculture, and roadways. Beekeepers feed their bees with protein supplements and sugar syrup but the supplements are not nutritionally complete.

The other 3 "Ps"? Poor management, pests/pathogens, and pesticides. Bees have been dealing with these factors for decades but something has pushed them over the edge. The back-breaking straw has been the introduction of the varroa mite into the US in the late 1980s. Today, there isn't a single hive that doesn't have or will have a varroa infestation. The feeding of the mite on developing and adult bees causes a reduced life expectancy and a weakened immune system. They also vector viruses throughout the hive. Weakened immune systems combined with viral infection spells disaster. The beekeepers have limited tools to fight these critters. There are currently one synthetic chemistry and a couple organic acids at their disposal. None of these are harmless to bees. Not only are the bees exposed to fungicides and insecticides sprayed on the crops they are pollinating, but also to the compounds used to protect them from the mites that wreak havoc in their hives. Most the pesticides found within a hive are compounds used to fight varroa mites. These exposures can cause brood loss,

failing queens, and susceptibility to disease. Thus, many colonies lose homeostasis and enter the downward spiral that ends up in death.

Right out of winter, when the bees are low on food stores, most of the nation's bees are shipped to CA to prepare for pollination. The almonds aren't yet in bloom, so the beekeepers need to feed the bees suboptimal nutrition. With so many bees intermingled in a relatively small space, well managed bees encounter poorly managed bees that have high mite levels and carry disease. It's like sending your child to kindergarten. When the pollinations are over, the bees move throughout the country to pollinate the rest of the 30% of our food that depends on pollination and to produce the honey that we all love on our biscuits. Now, instead of having regional outbreaks of disease, every hive is exposed to pests and pathogens. It's been said that bees can easily deal with a single stress. It's when you have two or more that you run into trouble. Now, every hive is starting with a single stress (varroa mites) so it takes less to send the bees into that downward spiral.