Bryanne McNamara
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Environmental Health
Final Project Essay

The Disappearance of the Bees

Executive Summary:

In October 2006, U.S. beekeeper David Hackenberg discovered that about 400 of his bees out of his 3,000 hives has completely disappeared. No bees were found dead inside or outside of their hives. They had simply disappeared. Now this was not due to some funny magic trick. But still the questions remained, where did the bees go and what happened to them that caused them to leave? Once 2007 rolled around, more beekeepers were finding that the exact same situation was happening to them. This phenomena was soon called Colony Collapse Disorder. CCD occurred when no bees were found dead outside or inside the hive, there were not mites or parasite inside of the hive, and eventually the queen and her larva are abandoned. CCD is mainly caused by the use of systemic pesticides that once in a bee's system, are persistent and harmful. These pesticides cause bees to lose their navigational abilities causing them to not be able to find their way back to their hive. Some ways to help prevent CCD is to eliminate monoculture agriculture all together. People can buy organic produce at their local markets, or grow their food themselves. This is the only way to keep the bees from going completely extinct.

Essay:

Bees are important to humanity and the world we live in because they provide the most efficient way to pollinate plants. They are especially important because they pollinate our agriculture for free. This paper will discuss how modern agriculture has caused the phenomenon called Colony Collapse Disorder. Together we will look at how this problem will

affect the economy of Washington State and beyond. As a result of the use of pesticides on monocultural agriculture there has been a colony collapse of honey bees.

History

Bees have been held sacred for thousands of years. In the ancient world they were thought to be some sort of prophecy.In ancient Egypt, Greece, and Rome honey was used to treat most any ailment the human body had. It is funny to think that a swarm of bees on a house or temple used to be seen as a blessing. Now we call the exterminator to get rid of them. Bees were the goddess of the ancient world. This is because of the fact that most of a hive is made up of female bees. 95% of bees are female worker bees, with one queen bee as the mother of all the others. The female worker bees have many roles in their hive. They gather pollen and honey, protect the hive, care for the young, and create honey combs. The rest of the population is made up of males called drones. They have the sole job of mating with the queen.

Pollination Process

How a bee pollinates is incredible. A single bee may visit as many as 100,000 flower in one day to collect pollen. Bees were simply made for this. There wings move so quickly that they create static electricity causing the pollen to practically jump onto the bee. They are even fuzzy with small hairs all over their bodies that the pollen clings to. When a bee lands on a flower they start the pollination process. Their feet fall into the crease of the flower where the pollen sacs are held. The pollen sticks to the bee as it flies away. When the bee lands on another flower, while in search for nectar, the pollen falls off and out of the sac, causing pollination to begin.

Ecosystem Services

Honeybees provide an incredible ecosystem service. Ecosystem services are defined as "the benefits provided by ecosystems that contribute to making human life both possible and worth living." (UK NEA) This means that bees provide a service for humans with no charge. It is a natural process that we have ended up benefiting from. Honeybees pollinate many different species of plants that we use for agriculture including tomatoes, oranges, potatoes, onions, celery, broccoli, watermelons, cauliflower, cabbage, and strawberries, just to name a few. Honeybees are most commercialized of the bees and is most prominently seen on television, magazines, and in real life on farms and near flowers.

Beekeeping has even turned into an industry itself. Beekeepers tend to multiple beehives that are for commercial use. These beekeepers are located in a single area where their bees live in bee boxes with pre made frames for each hive. During certain growing seasons, the bees are trucked thousands of miles all over the U.S. to pollinate many different crops. They may travel to California to pollinate almond trees for a couple of weeks, and then are shipped off to New York to pollinate another crop for a few weeks, and then be shipped back home for a while. Wherever the bees are needed to pollinate, that is where they will be shipped to.

The ecosystem service of pollination provided by bees saves farmers a lot of money. Although human pollination by hand is possible, it is incredibly hard and expensive. This would mean that farms would have to hire more employees to pollinate their crops. This would be expensive and time consuming. Even then, human placed pollination does not produce very bountiful and flavorful folds of crops. It is hard to place the pollen just right like honeybees do. Honeybees are not the only pollinators on this planet, but they are the most well known.

According to Losey and Vaughan, the Economic Value of Ecological Services Provided by Insects "present(s) a range of possible values based on assumptions of the pollination redundancy of managed honey bees and other bee pollinators, including feral honey bees and other native and nonnative bees. Taking all of this into account, they give a range of $1.6 billion ($2.1 billion when adjusted for inflation to represent 2003 dollars) to $5.2 billion ($6.8 billion in 2003 dollars) for the value of honey-bee pollinators." (Losey, Vaughn, 2006). If bees were to disappear or vastly fall in numbers, we would lose billions of dollars in the ecosystem service that they provide. Bees have saved farmers and consumers billions of dollars and the energy it takes to pollinate crops in the U.S.. Farmers would not be able to simulate what they do. This is especially crazy, because what they do is completely free! We need bees if we want to continue to eat and use the crops that we grow.

Colony Collapse Disorder

As one can see, bees are rather necessary for the healthy lifestyle that we are used to. That is why humanity should be more aware and concerned as to why so many bees are disappearing. Our bee colonies are going through a major collapse which was recently discovered in 2006. Bees have existed on this Earth 100 million years and only recently in the past few decades have they started to decline in numbers.

Near the tail end of 2006, well known commercial beekeeper David Hackenberg stepped outside to tend to his 3,000 bee hives only to find that 400 of his hives were empty. He called up his friend David Mendes, who owns 7,000 hives, to tell him this strange happening. Mendes attempted to console Hackenberg, but not much later the same happened to him. He began to see a large decline of bees in his own hives. Soon after, news reports came out with more

claims of catastrophic bee decline. The presumption that Hackenberg was just a bad beekeeper turned out to be false. Beekeepers around the U.S. started to see a significant decline in bee populations. It is important to note that these declines were reported by those who kept bees, not those who researched and took field notes of wild bees.

To give a better understanding of what Colony Collapse Disorder is let's look at what the signs of it are. When CCD takes place, there are no dead bees around or inside the hives. They have simply flown off to never return again. There are not mites or pathogens to explain why the bees have abandoned their hive. And finally, the queen and her baby bees are soon abandoned by the worker bees. Before further research was accomplished, there were some conspiracy theories about the cause of CCD. Some thought that Russian satellites were sending out wavelengths to kill the bees. Others thought that it was the use of fake honey where beekeepers took the honey from the bees and replaced it with sugar water. They would feed and grow off what was essentially junk food for a bee and the next generations would be weaker than the previous. They would have less healthy immune systems and would not be able to fight off disease. Although sugar water is not healthy for bees to gain nutrients from, neither of these theories were the cause of CCD.

The Causes

Although no one knows for certain, the Colony Collapse Disorder is thought to have been caused by four intermingling issues: Pesticide use, disease carrying parasites, monocultures, and flowerless landscapes. These four problems are not separate from each other. Alone they are all parts of why bees are dying at fast rates, but together they give a

better perspective on what modern agriculture looks like today and how its practices are unsustainable for pollinators, like bees.

Monocultures

Monocultures seem to be where this problem all starts. Monocultures are by definition, the cultivation of a single crop in a given area. This means that only one crop is grown in one field at a time. Growing a single crop in one area is a mistake for many reasons. When one uses monoculture growing techniques, there is no rotation of crops. This means that one plant absorbs all the nutrients it needs from the soil within a certain time period and depletes the soil. This means that things like chemical fertilizers must be used. But this is not the worst part. It eliminates biodiversity therefore pests and other pathogens become accustomed to the soil, since new species are not being introduced**.**

Monocultures are not found in nature. “Mother nature does not put all her eggs in one basket.” (Michael Pollan, Vanishing of the Bees) This kind of agriculture kills off diversity, and allows for disease and other pests to come in and attack a crops weakness. Once a pest discovers a monoculture they have more than enough food to eat, so their population grows larger and larger. Therefore they are harder to get rid of. A lack of diversity means that that crop is rather vulnerable. The plants in a monocultural field all have the same kind of natural defense, and cannot help each other fight off anything that they may be vulnerable to. When one puts multiple crops together, called companion planting, other plants are able to fight off different pests better than others, so they give each other protection and nutrients.

Another problem with the use of a monoculture is the fact that a crop only blooms and need to be pollinated at a certain time. This means that for fifty weeks in a year, there is

nothing for the bees to feed on, until those two weeks of pollination come around. What bee would hang around where there is no food for most of the year.

Pesticides

Since monocultures are so vulnerable to disease and pests, many farmers use pesticides to ensure the health and growth of their crops. Yet these pesticides are made of many harmful chemicals that hurt humans and insects as well, including bees. Originally pesticides were used for chemical warfare. During WWI, German scientists created these chemicals that were used to kill their enemies. Once the war was over, these chemists needed a job with the skills that they already had acquired. This is how pesticides came about. The strength of these poisonous chemicals and gases was manipulated to be safe to ingest in small doses. Salt and sugar are not harmful for the body in small doses, but everyone knows that they are not good for you. So isn't it ironic how the same chemicals that are used daily on the foods we consume, were used to kill people about one hundred years ago?

Pesticides are sprayed everyday on crops in the U.S. They were first used uncontrollably with planes flying over large fields just dumping these chemicals onto crops. This technique is still used today, yet it is highly inefficient. The conventional use of pesticides is to spray them onto crops. The crops leaves and stem are coated with pesticides, so then the pest feeds on it and dies. But, in 2003, a more efficient and successful way to kill of pests was invented. These pesticides are called systemic pesticides. Systemic pesticide use is carried out through either feeding the pesticides into the irrigation system, so that the plant takes up the water and grows strong with the pesticide as almost a part of them, or it is put on the seed itself before planting.

This makes it so that the pesticide is incorporated into the plant and moves within the plant itself. Now the defense will be expressed in the leaves, and even the pollen.

What happens to a bee when the systemic pesticides gets into its system is tragic. These pesticides cause a bee's immune system to weaken making it hard to fight off mites and other disease. It also disrupts their digestion and nervous systems. Pesticides impair a bees navigational abilities, making it an impossible journey back home to their hives. This would explain why one of the signs of CCD is no dead bees around the hive. Bees cannot live more than 24 hours without their hives, so a disoriented bee has a slim chance of survival.

While beekeepers and other scientists were discovering the effects of systemic pesticides, they could not prove to the government that the use of these chemicals were harmful, due to the fact there is such a large time lapse between when the bees pollinate infected areas, and when they disappear. Meanwhile, France was keeping up with the whole report, feeling like the story of bee disappearance was an awfully familiar one. In 1994, France began to see a colony collapse themselves similar to CCD. They called it Mad Bee Disease. It was soon discovered that the use of system pesticides called Gaucho and Poncho were to blame. French scientists set an experiment where they used sunflowers and treated one group with Gaucho systemic pesticides and let the other grow organically. They observed how the bees behaved after pollinating each group. It was discovered that the bee on the organic flower collected pollen and nectar in a systematic way, while the other bee on the treated flower was confused. Soon the use of systemic pesticides on corn, wheat, and soy were banned in France.

Hackenberg and Mendes travelled to France to collect this information to prove to the U.S. government that these pesticides were in fact killing off the bees. The pesticide is not

enough to kill a bee when pollen is first collected, but this pollen and nectar is brought back to the hive and is nourishment to larva. This means that future generations of bees are more likely to feel the affects of the pesticides. The systemic pesticides are long-lasting and residual. A specific one may not be the problem. It is when a bee collects pollen from many different plants with many different pesticides from each, that the problem increases. This creates different compounds in the bees system, which will eventually kill the bee. There is significant evidence that the bees do not die right away. Instead, overtime they become confused and cannot find their way back home. It may happen a few weeks after the exposure to the pesticides.

Flowerless landscapes

Along with these monocultures that are doused with pesticides comes a flowerless landscape that bees are not attracted to. Bees thrive off of flowering plants and are attracted to the bright colors. So when a monoculture is created, there being only one crop that may not even be a flowering one, bees are less attracted to it. Before the days of monocultures, there used to be multiple crops in a field with bushes and flowering plants on the sides and intermixed. These plants were not seen as weeds until the farmer became greedy and started to pull all things other than the crop they were trying to sell. These “weeds” were actually very useful. They attracted bees to the land and they also helped to protect and encourage other crops to grow because of defense and soil diversity. Fields without monocultures create their own defense mechanisms. They also attract less pests, making it so that farmers don’t have to use as many pesticides to keep their crops alive.

Parasites

Along with flowerless monocultures with pesticides another factor that has contributed to the colony collapse are disease carrying parasites such as the varroa. “The varroa mite was

not seen in Europe until the 1970s and in America until the 1980s, but since its introduction it has caused massive bee deaths, as the Western honey bee has no defense against the parasite." (The Bee Gate, 2013)

The Varroa "Kills the bee slowly " with deformed wing virus (DWV) and by causing acute paralysis virus (APV), vectored by the mite, on the host colony." (Martin, 2002) These mites are attracted to drone bees, or male bees. They suck the blood from the bee, causing the bee to become weak and unhealthy. The attack starts early in the bee brood, or the cell in which the queen lays her eggs. They feed on the maturing larva to better strengthen their numbers so as to produce more offspring and feed on drones.

Now there does not seem to be any simple solutions to stop a varroa infestation other than using other pesticides that have some bad side affects on the bees themselves. For house kept bees there has recently been a better solution to this problem. The Bee Institute and Bayer have created a device called the "varroa gate." This gate is placed at the entrance of a hive and when the bees come or go they must go through it. The holes in which they crawl through have small holes on the edge that is coated with a mite poison called acaricide. This coats the bee and kills off any mites that is might be carrying. This idea is very similar to a household pet wearing a collar that prevents fleas. This does not solve the mite infestation in wild hives, but it is a start in the right direction.

The combination of flowerless monocultures that use pesticides and the varroa mite have been the leading causes of the bee colony collapse. One cannot be blamed more than the other. To have a monoculture, you must have a flowerless landscape, and since your monocultures are so vulnerable without any natural defenses, you must spray them with

pesticides to prevent pest infestations. The bees soon become less attracted to the monoculture without flowers, and the ones that are become poisoned by the sprayed pesticides. Then comes the mites that feed on the already sick bees. It is improbable to think that bees can go on living like this. In fact, they will not live if this continues to happen.

Monocultures are easy to blame for all the is happening, but the true root of the problem is the fact the people want cheap subsidized food. This want for cheap food that is to be purchased by a population far past its possible carrying capacity is what is causing monocultural agriculture. Farmers have to find the most efficient way to mass produce their crops in the cheapest way possible. What they do not think about is the long term effects of this. Like most problems with society, the short term gain is seen as more important that the long term negative effects. In this case it is bees coming close to extinction, which would inturn lead to no crops at all.

A Call to Action

This is why I support a change in the way that we grow our food. If a change is not made, we will not have any food to eat at all. ⅓ of the food that we consumed is produced by some sort of process of pollination. I believe that we ought to start to use agricultural practices like crop rotation and companion planting. Take the Three Sisters for example. They are made up of squash, corn, and climbing beans. Each crop benefits from the other. The corn stalks give the beans something to climb on, so no extra poles are needed. The beans give nitrogen to the soil for the other plants to absorb. Then the squash grows outwards on the ground, blocking out sunlight and keeping moisture in. The squash also helps to fight off room for weeds and it's sharp hairs deter pests. This example of companion planting shows that plants are diverse

enough to each have a different strength to help each other grow, without the use of pesticides.

Another way to help bees from becoming extinct is to keep your own bees. They could be used for honey and for pollination of your home grown garden. If you do not have the time or money to keep bees, you can support your local beekeepers by buying produce and honey from them. This keeps the industry for healthy beekeeping going. Many honeys that are sold in stores come from across seas from China. They have sweeteners added in like high fructose corn syrup. This is not pure honey that you are getting. This kind of "honey" is terrible for you. When you purchase it, you are not getting all the nutrients that honey can provide. You are also killing the beekeeping industry. If these small beekeepers cannot make money off of their honey, they will go out of business. These beekeepers are the ones doing a lot of work to keep the bees from going extinct.

I find it important to argue that we must change the way this country grows its food. But how much say do we really have over these large entities that run the agriculture industry? We don't all have the time to write letter to our politicians to ban things like the use of systemic pesticides. And who is to say that they will listen anyway? The government makes a large profit off of cheap foods produced by pesticide infested monocultures. It is quite the daunting task to try and make policy changes, so what can we do as individuals to see a change? Well we can all start by changing where our food comes from. Everyday, three times a day, we choose what we eat and where it comes fro, We can choose to each organic local produce, or purchase something at the store that says "Product of Mexico." We also choose to grow or not grow our own food in gardens right in our backyards. If organic foods are too expensive, then grow your

own. Not all of us have a lawn, but crops will even grow in apartment windows. A great way to encourage others to create their own gardens and to build community is by starting a community garden in your neighborhood. Growing your own garden is fun, inexpensive, and healthy! Another way people can help encourage bee health is by planting flowers in your yard or outside our your window. Bees needs flowers to live and who doesn't like the look of a flower garden? They smell great and look beautiful. Just remember not to spray your flowers and gardens with pesticides or use harmful fertilizers.

Washington State

Currently in Washington State around Thurston County, there are many bee organizations including Clark County Beekeepers, Cowlitz County Beekeepers, Lewis County Beekeepers, Pierce County Beekeepers, Olympia Beekeepers Association, and the Pacific Northwest Queen Rearing Club. All of these organizations are part of the Washington State Beekeepers Association. The WSBA's goal is to "keep the bee in business." Their mission is to "help local beekeeping organizations, assist the agricultural community, promote beekeeping and bee products and more." This association is put in place to help bring beekeepers around Washington together.. Together they set new goals for sustainable ways to keep bees. They send out propositions to the WSDA to limit its use of pesticides. They encourage growers who use the pollinations services provided by these Washington State beekeepers to adopt practices that protect honeybees. They have meetings and monthly newsletters that help to inform bee keepers of the recent issues that are occurring around Washington and how they can help or what to look out for. This association is a great place to start if one is looking to become a

beekeeper themselves. Their websites has many useful resources to help people get started and keep updated.

Colony Collapse Disorder is largely caused by the demand for cheap foods which drives farmers to use efficient monocultures. However, these monocultures are only efficient for so long. Monocultures create a need for pesticides to protect crops from unwanted insects. These pesticides, especially systemic pesticides, are affect the livelihood of bees. If farmers continue to dowse their fields with systemic pesticides, the U.S. will see a mass decline in bee population numbers. There are many actions we can take to prevent CCD from continuing. People can start by buying organic and planting their own gardens full of vegetables and flowers. They can also support their local beekeepers by buying their produce and honey. People can even keep their own bees or donate to local bee organizations. We must support local farms that use sustainable growing techniques like companion planting and crop rotation. If people continue to support cheap foods and do not demand a change in modern agriculture techniques, we are likely to see bees go extinct.

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