2022

Beeworks Farm Intern

Delta Kayler
Western Washington University

COLLEGE OF THE ENVIRONMENT

WESTERN WASHINGTON UNIVERSITY
MAKE WAVES.

Internship Title: BeeWorks Farm Intern

Student Name: Delta Kayler

Internship Dates: 3/29/22-6/10/22

Advisor: Manuel Montaño

I grant to Western Washington University the non-exclusive royalty-free right to archive, reproduce, distribute, and display this Internship Report document in any and all forms, including electronic format, via any digital library mechanisms maintained by WWU.

I represent and warrant this is original work, and does not infringe or violate any rights of others. I warrant that I have obtained written permissions from the owner of any third party copyrighted material included in this document.

I acknowledge that I retain ownership rights to the copyright of this work, including but not limited to the right to use all or part of this work in future works, such as articles or books. Library users are granted permission for individual, research and non-commercial reproduction of this work for educational purposes only. Any further digital posting of this document requires specific permission from the author.

Any copying or publication of this document for commercial purposes, or for financial gain, is not allowed without my written permission.

STUDENT SIGNATURE Delta Kayler

DATE: June 7, 2022

The Organization

Figure 1. Jarred honey from BeeWorks Farm.

BeeWorks Farm is a small business in Whatcom County that cares for about 800 beehives throughout the year. Rob Rienstra is the owner and has three outstanding employees that help care for the bees. Honey production is at the center of BeeWorks Farm. The harvested honey is sold at the Bellingham Farmers Market and a few other nearby stores. Moreover, the bees play an essential role as pollinators for our community as they forage for food. BeeWorks Farm transports numerous beehives throughout California and Washington to pollinate various crops during different growing seasons. The bees are mainly used to pollinate almond, blueberry, and raspberry farms. Most of these farms are not organic but follow strict guidelines for the application of pesticides and fertilizers to minimize exposure to the bees.

My Experience

Working with honeybees was a thrilling and fascinating experience. I got to learn about the complex and somewhat fragile lives of honeybees. These small yet sophisticated creatures provide a service for our agriculture system that makes it impossible to sustain without them. Rob Rienstra was a great mentor and was very generous to share his knowledge of beekeeping with me. He has been beekeeping for over 12 years and is very passionate about raising strong and healthy honeybees. Over 10 weeks I learned a lot about the anatomy of a beehive, the different social castes of bees, and the biggest threats that honeybees face. We used smokers to calm the bees while we were moving the frames around, I was told it has no effect on the bees' wellbeing. Our bee suits were effective at keeping the bees out, but I endured many stings and I quickly learned that the pain is minimal.


Figure 2. Employee Baylie, being attacked by bees.

We had to work very efficiently so we had enough time to monitor all the hives, which also meant a few bees were killed as we were opening and closing the hives. But our actions were to ensure the colonies survived, not every individual bee. It was sad to see that a few of the hives did not make it because of the weather and lack of good forage. I learned that a big part of beekeeping is accepting there will be unpreventable and seemingly random colony losses. Although, the process of splitting hives led to an increase in their population overall. Splitting hives is a common practice that is used to sustain a beekeeper's colonies by preventing swarms and growing new colonies quickly. A frame full of honey and a couple frames with brood (bee larvae) at various stages are taken out of a strong hive and put into a new box, called a nuc. The queen stays in the mother hive and the worker bees on the switched frames go into the nuc. Most of the drone brood on the switched frames is scraped off and discarded so that there is enough food for the workers. A new queen is released into the new hives at night, ours were ordered online. Nucs readily accept a new mated queen, but not always. Some beekeepers let nucs requeen themselves, but it takes much longer. Eventually the nucs become strong colonies, as big as the mother colony. Hives can be split up to three times during the spring if the colonies grow rapidly.

Figure 3. Left) The newly split hives. Right) The split hives after growing into second story boxes.

This spring was particularly cold and wet which meant the bees did not leave the hives as much as they usually do. This also meant they consumed their honey supply faster than normal. This is the first year they had to feed the bees at BeeWorks Farm. At first, we fed them cane sugar in the hives, then we switched to giving them sugar dissolved in water in troughs.

To ensure the all the colonies grew consistently we were continuously equalizing the hives. This was done by trading frames between hives so that all the hives had sufficient resources. Some frames contained honey while others contained brood. Switching frames between hives has little to no impact on the hives and it increases their chance of survival. The bees raised the introduced larvae as their own.

Figure 4. A honeycomb frame covered in bees.

We treated the hives with an antibiotic weekly to prevent foulbrood infections. Foulbrood poses a serious threat to honeybees in the PNW and worldwide. It can spread quite rapidly and decimate an entire colony and surrounding colonies. Antibiotic application is halted about two weeks prior to harvesting honey to ensure there is no cross-contamination. As blackberry blooms occur towards the beginning of summer, it is expected honey production will increase with this source of abundant nectar. Supers will be added to the top of the hives, which are long frames specifically designed for the bees to store honey.

Honeybee Structure

The anatomy of a honeybee hive is quite complex. An average honeybee colony consists of several thousand bees, including one queen and a couple thousand drones (male bees). Worker bees (female bees) make up the rest of the colony. Queen bees typically live for 1-3 years and can lay more than 500,000 eggs during their lifetime (Pernal, 2021). The queen produces pheromones to maintain the social order and inhibit other bees from laying eggs. The worker bees live for up to six weeks in the summer and for about 150 days in the winter. The worker bees are responsible for protecting the hive, making honey, and regulating the temperature inside the hive. Worker bees also forage outside the

Figure 5. A queen bee surrounded by worker bees on a frame.

hive, mainly for nectar and pollen. Young adult worker bees are known as “nurse bees” because they feed and care for the developing larva. Drones are roughly twice the size of worker bees with the sole purpose of passing on genetic information. After a drone has mated with a queen, it dies. The unsuccessful drones are ejected from the hive at the end of summer to ensure there is enough food for the queen and worker bees in the winter to repopulate the hive in the spring.

Honeybees are a unique bee species because of their social lives and distinct social castes, most bee species live solitary lives. Some of the benefits of group living include efficient food collection and better defense against predation (Pernal, 2021). Meanwhile, there is increased competition for food among individuals in the colony and increased transmission of pests and diseases.

Figure 6. A frame with pollen, food for the bees.

Honeybees have developed a form of communication that is quite unique. When a bee finds the location of a profitable food source, the bee mimics the flight path in dance to so that the other bees can find it (Pernal, 2021). The bee uses the orientation of the hive and the sun relative to the food source. The dance conveys distance through the speed of the dance and the energy expenditure. The dance also communicates how bountiful the location is by the intensity of its buzzing and the number of times it repeats the route. Honeybees also communicate through pheromones which serve to organize the hive. For example, honeybees will mark the entrance of a hive or send signals to initiate defense mode. If a honeybee stings an attacker, it will mark the location of the sting with a pheromone so that other bees can sting the same spot (Pernal, 2021).

Honeybee colonies in the wild reproduce by swarming, which usually occurs mid spring to early summer when a colony becomes too large to sustain itself (Pernal, 2021). The queen and many younger worker bees leave the hive to find a new home. Before departing the hive, the queen lays about six queen eggs (Pernal, 2021). When the first queen pupa hatches in the original colony, it kills the other queen pupa.

Honeybee Threats

The essential role that bees play in our agriculture system is often overlooked by the average consumer. Thousands of beehives are transported across the country every year to various farms while the crops are in bloom. Almost all fruits, vegetables, and nuts require pollinators for optimal production yield (National Academic Press, 2007), making commercial beekeeping extremely valuable. The beekeeping industry in the U.S. is facing many problems which have impacted honeybee health for the past few decades. Around 2006, beekeepers began reporting significant losses (EPA, 2022). Their hives lost most of the worker bees, leaving behind the queen. This became known as Colony Collapse Disorder. Some beekeepers don’t believe that CCD is real, but it is impossible to deny that bees face numerous threats. There are many theories as to why this is occurring such as habitat loss, food diversity loss, pathogens, and pesticides.

The use of pesticides is thought to be one of the biggest reasons bee populations have been declining over the years. Honeybee exposure to pesticides is difficult to analyze because many chemicals are involved and it likely that bees are exposed to multiple pesticides (Ostiguy

et al., 2019). Previously, honeybee losses were attributed to exposure to organochlorine, carbamate, organophosphorus, and pyrethroid pesticides (Johnson et at., 2010). Efforts to reduce honeybee exposure to these chemicals by pausing applications while crops are in bloom, were moderately successful in reducing bee population losses (Johnson et at., 2010). However, their lethal effects on bees, in addition to human health concerns, have led to their phasing out and the development of alternative pesticides like neonicotinoids and phenylpyrazole (Johnson et at., 2010; Karami-Mohajeri & Abdollahi, 2011). These pesticides were approved for use in the U.S. and have become extensively used. They have been found to cause less acute effects than the previous pesticides, but the effect of chronic exposure is speculated to be harmful (National Academic Press, 2007; Henry et al., 2012). The biggest difference between the older pesticides and the newer ones is that the new ones become systemic within plants (Johnson R.M. et at, 2010). This makes it impossible to prevent bee exposure by adjusting the application regime.

Pests and pathogens are additional stressors that threaten bee populations. American Foulbrood and European Foulbrood are diseases that affect honeybees and have been found worldwide. The first reported cases were in the early 1900s (National Academic Press, 2007). American Foulbrood is caused by the spore-forming bacterium *Paenibacillus larvae* while European Foulbrood is caused by the non-spore-forming bacterium *Melissococcus plutonius*. Both diseases affect and kill honeybee larva when the bacteria are accidentally fed to them by nurse bees. Observable symptoms include unhealthy larva and a distinct foul smell. If a colony becomes infected ultimately it will die and colonies within a few miles' radius may become infected as well. Beekeepers can use antibiotics to prevent the growth of European foulbrood (National Academic Press, 2007). The optimal prevention technique for American Foulbrood is to utilize good beekeeping practices to prevent it from spreading. If a colony becomes infected the best option is to destroy the colony and infected frames via incineration (National Academic Press, 2007).

The *Varroa* mite is the most common honeybee pest in the PNW and can be found across the country. It was introduced to the U.S. about fifty years ago and has had a big impact on honeybee colony losses (National Academic Press, 2007). *Varroa* mites exclusively affect honeybees and are notorious for spreading quickly within a hive and between hives. They affect larva and adults by attaching to the body of the bee and using it for sustenance until the bee dies. There are various methods for monitoring and preventing *Varroa* mite infestations. In other parts of the country other pests endanger honeybees, like the small hive beetle commonly found in the southeast.

The decline of good forage for honeybees and wild bees poses a serious threat to their survival. Habitat and forage loss is corelated with development and urbanization, which is corelated with honeybee colony losses (Naug, 2009). This is because roads, buildings, lawns, etc. all exist in places where wild plants and bee food sources once existed. Because of honeybees' social life their food requirement is quite high, and they struggle to adapt to cities which lack adequate forage area (Naug, 2009). Additionally, our modern agriculture system revolves around monocropping which replaces areas of native vegetation and reduces the food diversity available for bees (Bianco et al., 2014). Wild bees have experienced the biggest population declines, although their populations are not as extensively monitored (National Academic Press, 2007). Because they do not produce honey, they are not seen as valuable as honeybees (Bogusch et al., 2020). Beekeepers have managed so sustain honeybee populations; the same efforts have not been made for other bee species. Out of the thousands of bee species, several are considered endangered by apiarists (Requier et al., 2019). Different bee species have adapted to serve

different roles in the ecosystem and extinctions of certain species may lead to the extinction of the plants that are pollinated by them (Bogusch et al., 2020).

Final Remarks

This internship deepened my desire to work in the environmental science field as I learned about the adversities that bees face due to urbanization. When working with the bees I came to appreciate their beauty and uniquely complex function in the environment. I hope to have my own beehives one day and this hands-on-experience has prepared me well. I will continue to pay attention to bees and do my best to advocate for the bees. I am excited to begin my career using the knowledge I have gained at Western to make a positive impact on the planet.

References

Bianco, M., Cooper, J., & Fournier, M. (2014). Honey bee population decline in Michigan: causes, consequences, and responses to protect the state's agriculture and food system. *Michigan J. Public Aff*, *11*, 4-26.

Bogusch, P., Bláhová, E., & Horák, J. (2020). Pollen specialists are more endangered than non-specialised bees even though they collect pollen on flowers of non-endangered plants. *Arthropod-Plant Interactions*, *14*(6), 759-769.

Environmental Protection Agency. (2022). Colony Collapse Disorder. https://www.epa.gov/pollinator-protection/colony-collapse-disorder.

Henry, M., Beguin, M., Requier, F., Rollin, O., Odoux, J. F., Aupinel, P., ... & Decourtye, A. (2012). A common pesticide decreases foraging success and survival in honey bees. *Science*, *336*(6079), 348-350.

Johnson, R. M., Ellis, M. D., Mullin, C. A., & Frazier, M. (2010). Pesticides and honey bee toxicity–USA. *Apidologie*, *41*(3), 312-331.

Karami-Mohajeri, S., & Abdollahi, M. (2011). Toxic influence of organophosphate, carbamate, and organochlorine pesticides on cellular metabolism of lipids, proteins, and carbohydrates: a systematic review. *Human & experimental toxicology*, *30*(9), 1119-1140.

National Research Council. (2007). *Status of pollinators in North America*. National Academies Press, Washington, D.C.

Naug, D. (2009). Nutritional stress due to habitat loss may explain recent honeybee colony collapses. *Biological Conservation*, *142*(10), 2369-2372.

Ostiguy, N., Drummond, F. A., Aronstein, K., Eitzer, B., Ellis, J. D., Spivak, M., & Sheppard, W. S. (2019). Honey bee exposure to pesticides: A four-year nationwide study. *Insects*, *10*(1), 13.

Pernal, S. F. (2021). The Social Life of Honey Bees. *Veterinary Clinics: Food Animal Practice*, *37*(3), 387-400.

Requier, F., Garnery, L., Kohl, P. L., Njovu, H. K., Pirk, C. W., Crewe, R. M., & Steffan-Dewenter, I. (2019). The conservation of native honey bees is crucial. *Trends in ecology & evolution*, *34*(9), 789-798.

Weekly Log

Week	Task	Hours
Week 1: 03/29-4/2	I met all the employees at BeeWorks Farm. I observed while they checked on the hives. They treated the hives with antibiotics to prevent foulbrood.	15
Week 2: 4/3-4/9	I learned how to create nucs by splitting a beehive into two hives. At night we re-queened the new hives.	16
Week 3: 4/10-4/16	We continued to split hives and requeen them. I learned about the structure of the hive.	16
Week 4: 4/17-4/23	We continued to split hives and requeen them. I learned about each bee's role in the hive.	16
Week 5: 4/24-4/30	We fed the bees sugar as their honey supply was running low. We also treated the hives.	15
Week 6: 5/1-5/7	We monitored the hives, mainly looking at the eggs and honey production. We equalized the hives, by trading honey frames and brood frames among hives.	15
Week 7: 5/8-5/14	We continued to monitor, equalize, and feed the hives.	14
Week 8: 5/15-5/21	We continued to monitor, equalize, and feed the hives.	18
Week 9: 5/22-5/28	We continued to monitor, equalize, and feed the hives.	15
Week 10: 5/29-6/4	We continued to monitor, equalize, and feed the hives. I learned about honey collection.	14