European Honey Bee and Varroa Mite Population Interactions

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Background/Motivation

Varroa mites are parasites that are extremely harmful to European Honey Bee (*Apis mellifera)* populations. The parasites resemble ticks. Varroa mites feed on the hemolymph of immature and adult honey bees (see Figure 2). Varroa mites are a natural parasite to the Asian honey bee but they were accidentally introduced to the United States in the mid 1980's (Honey Bee Parasites, 2020). Varroa mites can destroy an entire honey bee colony in 1 to 2 years. We would like to know how honey bee population size will effect Varroa mite population. Honey bees are extremely important to the ecosystem and are crucial pollinators. Honey bees also provide major products such as honey, beeswax, and royal jelly used for medicinal and nutritional purposes (Helping Agriculture's Helpful Honey Bees, 2018). As honey bee populations decrease across the U.S, it is important to better understand the ecological interactions between honeybee and varroa mite populations.

Hypothesis

Honey bees are a crucial pollinator in the ecosystem and stimulate local food economies but ecological parasites wreak havoc on honey bee colonies, therefore, we would like to further understand the relationship between ecological parasites and honey bee populations. We hypothesize that there is a positive relationship between honey bee parasites and honey bee colony size.

Fig. 1 (Honey Bee Box, indiamart.com)

Prediction

One can predict that that as the honey bee population size increases, there will also be an increase in Varroa mites because there will be more honeybees to feed off which will support larger parasite colonies.

Study design

To test the relationship between colony size and mite populations, an observational study of 100 randomly selected hives across the United States, that did not use anti-mite treatment, were selected. Most of these hives were privately owned (Occurrence of honey bee *(apis mellifera* L.) pathogens in commercial and traditional hives, 2018), with regular inspections for mite populations, which was used for data reporting on population of mites in the colony. This was then complied, along with average sizes of the colony, to generate a representative sample of all hives, and how the honeybee colony size affects mite populations. The data was complied into two variables; hive size, based off cluster counts (Journal of Economic Entomology, 1900), and mite populations, based off a random sample of honey bees within the hive observed to have/not have an attached mite. This data was then analyzed for trends within the different species population sizes.

Fig. 2 (Varroa & Treatment Options, Freeiraapiary.com)

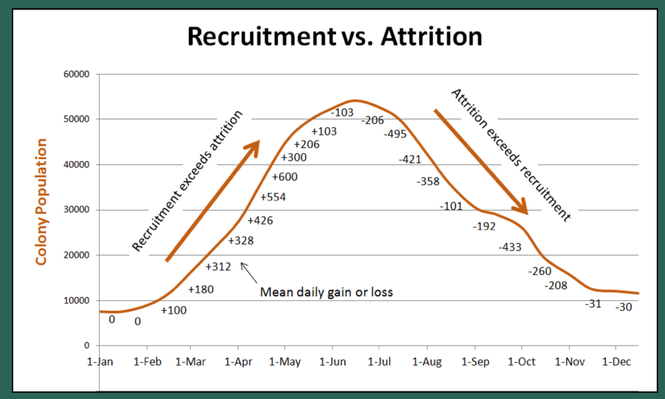

Fig .3 (Understanding Colony Buildup and Decline, scientific beekeeping.com)

Intended Analysis

The response variable within this study is the population rate of the Varroa mites in each hive. The predictor variable is the honey bee population within each hive. Both the independent and dependent variables are continuous data, therefore this data will be analyzed through regression testing. A regression test will create a a visual description of the relationship between bee and mite population. Our intended analysis is the corresponding relationships between honey bee and varroa mite populations in the greater ecosystem. The scope of our inference extends to larger populations of honey bees where Varroa mites are a threat (SpringerLink, 2009). The population of honey bees was sampled through random selection therefore we are able to make an inference back to the whole population.

Literature citations: (Nasr, M. E., et al. "Estimating Honey Bee (Hymenoptera: Apidae) Colony Strength by a Simple Method: Measuring Cluster Size." *Journal of Economic Entomology*, vol. 83, no. 3, 1990, pp. 748–754., doi:10.1093/jee/83.3.748.), (Center for Veterinary Medicine. (2018, July 30). *Helping Agriculture's Helpful Honey Bees*. U.S. Food and Drug Administration. https://www.fda.gov/animal-veterinary/animal-health-literacy/helping-agricultures-helpful-honey-bees), (Guzmán-Novoa, E., Eccles, L., Calvete, Y. *et al. Varroa destructor* is the main culprit for the death and reduced populations of overwintered honey bee (*Apis mellifera*) colonies in Ontario, Canada. *Apidologie* **41,** 443–450 (2010). https://doi.org/10.1051/apido/2009076), (Honey Bee Parasites. (n.d.). Retrieved November 29, 2020, from https://bees.caes.uga.edu/bees-beekeeping-pollination/honey-bee-disorders/honey-bee-disorders-honey-bee-parasites.html), (Taric, Elmin, et al. "Occurrence of Honey Bee (Apis Mellifera L.) Pathogens in Commercial and Traditional Hives." *Journal of Apicultural Research*, vol. 58, no. 3, 2019, pp. 433–443., doi:10.1080/00218839.2018.1554231.), (Guzmán-Novoa, Ernesto, et al. "Varroa Destructoris the Main Culprit for the Death and Reduced Populations of Overwintered Honey Bee (Apis Mellifera) Colonies in Ontario, Canada." *Apidologie*, vol. 41, no. 4, 2010, pp. 443–450., doi:10.1051/apido/2009076.)