CAN MYCELIUM MUSHROOM EXTRACT DEFEND SOLITARY BEES AGAINST INFECTIOUS BEE VIRUSES?

Claire MacQueen, Ivy Manner, Bailey Weinhold, Rubenstein School of Environment and Natural Resources, University of Vermont

Background & Motivation

Native, solitary bees that make up over 90% of the bee population are key pollinators (Kumar-Rao, 2021).

An increase in infectious bee viruses like Deformed Wing Virus and Lake Sinai virus are decimating wild bee populations (McMenamin & Flenniken, 2018).

Studies have shown that extract from Polypore Mushroom Mycelia can reduce the prevalence of these viruses in honey bees.

Though it is pretty commonly accepted that bee populations are diminishing in part as a result of these viruses, Fig. 1 (Kopec, K., Burd. L., 2017) below shows that nearly 93% of native bee species have not been assessed or were judged undeterminable for conservation status.

Fig 2: The Blue Mason Orchard Bee (*Osmia lignaria*)

Fig 3: A type of housing for this species. Though solitary, they will nest nearby other members of the same species

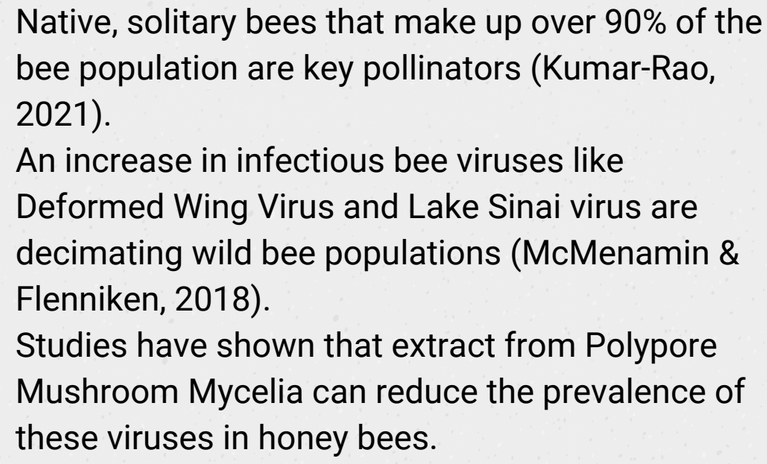


Fig 1: Conservation Status of 4,337 North American and Hawiian Native Bees as Reported by Prior Studies (Kopec, K., Burd. L., 2017)

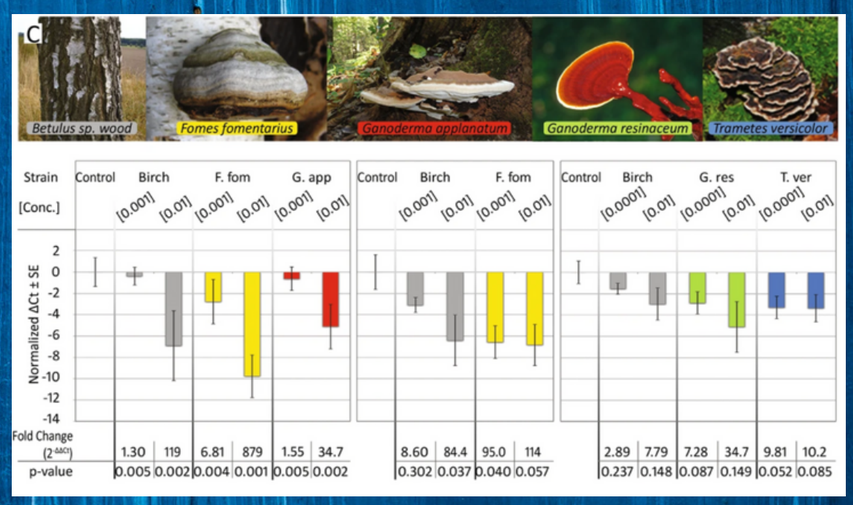


Fig 5: Extracts from different fungi on deformed wing virus (DWV) in honeybee colonies, showing a notable reduction in DWV when mycelium extracts are applied to bee populations (Stamets, P., et.al)

Hypothesis

The introduction of mycelium mushroom extract aid to native solitary bee species will have an impact on the prevalence of bee viruses within these populations. More specifically, introducing mycelium mushroom extract aid will cause the prevalence off viruses to decrease.

Objectives

- See the connection, if present, between the health of solitary native bee population Osmia lignaria, or Blue Mason Orchard Bees, and mycelium mushroom extract
- Provide more literature to the study of solitary native bees

Study Design

We will conduct a manipulative field experiment at Shelburne Orchards during the springtime when there are apple blossoms (McFredrick, 2020) that native solitary bees are attracted to.

Our control group will be a group of Blue Mason bees that nest together. Their nest (like the ones in Fig. 3) will not be treated with Mycelium extract, there will be two of theses nests in our study which will be a mile apart from the treatment population.

We will use small tracking transmitters that will be attached 30 random bees in this study to track their nesting patterns. This tracking information will bes used to see if each bee returns to their original nests and note if these bees survive or die.

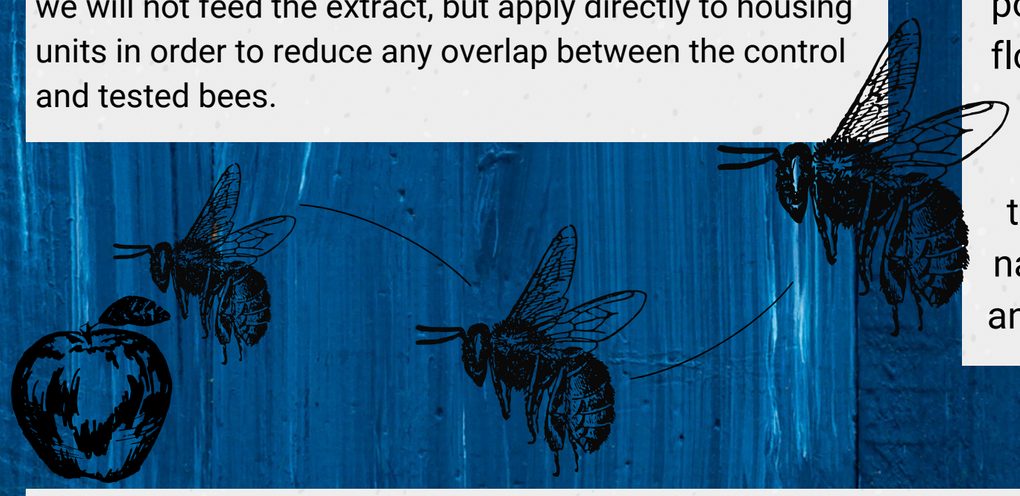
Bees in the treatment group will have their nest sprayed with Mycelium mushroom extract, there will be two nests.

We will then examine the treatment and control groups after three months The four nests will be examined to see which bees were infected with colony collapse viruses such as the Sinai Lake Virus.

With the data collected, we would then perform a T-test to determine if there is a significant difference between the two groups.

Fig 4: Shelburne Orchard. Bees like the *osima lignaria* are vital pollinators to orchards.

The data shown in the above figure, Fig 5, will serve as the background behind the motivation for our experiment. We will only use one type of extract, though: the fomes fomentarius extract tested here, visible in yellow. We will also differ from this experiment in that we will not feed the extract, but apply directly to housing units in order to reduce any overlap between the control and tested bees.



Expected Benefits

Native bees are critically important to the pollination of native plants (GoodLiving, 2017) because they provide “buzzing pollination” which is required by most native flora in New England. Viruses like Lake Sinai virus have infected individuals and could cause colony collapse disorder. With the treatment of Mycelium mushroom extract, native bees could stabilize their populations and in turn promote native plant biodiversity.

Management Implications

Supporting these native pollinator species is important for places like Shelburne Orchards that rely on this ecosystem service. If a connection can be found between mycelium mushroom extract and the health of this Blue Mason Orchard Bee species, this can be a way to support native pollinators.

- Kopec, K., Burd, L. (2017) Pollinators in Peril: A systematic status review of North American and Hawiian native bees. Center for Biological Diversity. Retrieved April 23, 2021, from https://www.biologicaldiversity.org/campaigns/native_pollinators/pdfs/Pollinators_in_Peril.pdf
- McFrederick, C. H. (2020, June 22). Environment Shapes the Microbiome of the Blue Orchard Bee. Springer Link. Retrieved March 31, 2021, from https://link.springer.com/article/10.1007/s00248-020-01549-y
- McMenamin, A., Flenniken, M. (2018.) Recently identified bee viruses and their impact on bee pollinators. Current Opinion in Insect Science, Volume 26, Pages 120-129. https://doi.org/10.
- Sedivy, C., Dorn, S. (2014). Towards a sustainable management of bees of the subgenus Osmia (Megachilidae; Osmia) as fruit tree pollinators. Apidologie 45, 88–105 . https://doi-org.ezproxy.uvm.edu/10.1007/s13592-013-0231-8
- Stamets, P.E., Naeger, N.L., Evans, J.D. et al. (2018) Extracts of Polypore Mushroom Mycelia Reduce Viruses in Honey Bees. Sci Rep 8, 13936 https://doi.org/10.1038/s41598-018-32194-8
- Walker, M. (2018.) Beyond the Honey Bee: How Pesticides affect Solitary, Cavity-Nesting Bees. Entomology Today. Retrieved March 31, 2021, from https://entomologytoday.org/2018/04/12/beyond-honey-bee-pesticides-solitary-bees/