Climate Change, Seasonal Heterothermy, and Mason Bee Body Mass: An Empirical Review

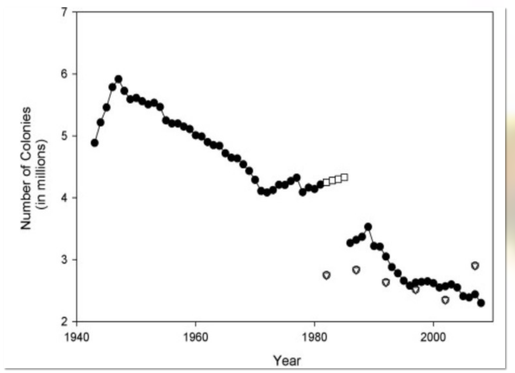
Amanda Cunningham
Comparative Behavior (PSY 324), Prof. Heide Island
Dept. of Psychology | Pacific University | 2043 College Way | Forest Grove, OR 97116

Background

Pollinators are an important part of the world's ecosystem in aiding crop production. Without these essential pollinators aiding commercial farming, humans would not be able to produce fruits, vegetables, and nuts that are essential to not only our diets but also many other species in the ecosystem. Global climate change has brought on a problematic change to the seasons in which the pollenating bees rely on to hibernate (i.e., seasonal heterothermy). Bee colony population has been on the decline since 1947 when there were approximately 5.9 million hives whereas in 2008 that number has dropped to only 2.3 million, a 61% decrease in population (See Table 1, vanEngelsdorp et al., 2010).

Table 1

Source: VanEngelsdorp et al., 2010



Mason bees are found all over the world but are popular in the Pacific Northwest as hard-working pollinator bees for agricultural purposes. The Pacific Northwest boasts a mild climate with heavy rainfall that creates a lush environment for crops such as apples, berries, and a variety of vegetables. Osmia, as well as other pollinator species, are necessary to keep the produce in abundance by pollinating all the crops in the spring during their work period. Climate change has threatened the overall fitness level of mason bees emerging from their state of hibernation which negatively impacts their level of work.

Mason bee hibernation period lasts around 9-10 months with the greatest period of activity in the early spring (March to May) – much earlier than other varieties of bees (Roof et al., 2016). They have a short life cycle of only about 6 weeks where they pollinate and create their mud like structures to house their eggs (Roof et al., 2016). These bees are said to work harder than the more popularly known honeybee because, they are willing to work through rain and poor weather since they are so acclimated to the Pacific Northwest weather. The problem lies where climate change comes in. With mason bee hibernation schedule, hotter or colder climates can affect when they come out to pollinate as well as their overall fitness and ability to pollinate.

Thesis

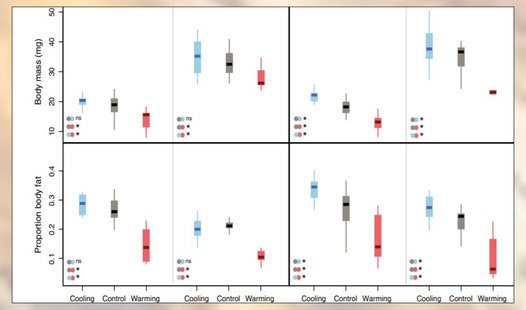
Climate change, specifically increases in global temperature and longer summer season moderate hibernation through body mass. Lower body mass, as predicated by less pre-hibernation caloric consumption, resulting in poorer fitness and survivability.

Image Source: www.beekeepclub.com

Mason bees' ability to pollenate is moderated by hibernation. During colder winters, the mason bees body mass increases to keep themselves warm, which in turn increases their fitness ability during the pollinating season (Schenk et al., 2018). When winter temperatures are warmer during the Osmia's hibernation period, their body mass is typically lower because they do not require as much bodyweight to keep warm. This lower bodyweight can affect the bee's energy levels, making them less productive and more lethargic during their work (Schenk et al., 2018).

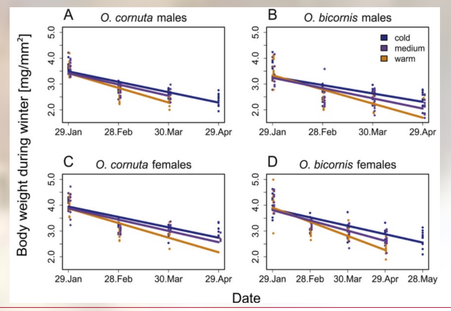
CaraDonna et al., (2013) recorded Osmia body mass and proportional body fat in different temperature environments over 3 years. These temperatures were controlled by painting the larvae boxes with black (warm), transparent (control), and white (cool) to evaluate the effects of temperature on body mass (See Table 2, CaraDonna et al., 2018). In each of the conditions, mason bees had higher body mass and body fat proportion in the cooler conditions for every year both male and female. This shows that Osmia have better fitness when able to hibernate in cooler temperatures rather than warm temperatures.

Table 2, Source: CaraDonna et al., 2018



Body mass was further evaluated in a study of mason bees in Germany (Schenk et al., 2018) in a cool, control, and warm temperature as well as differing emergence times. Schenk et al., (2018) similarly found that Osmia's body mass is affected by hibernation temperature as well as emergence times (see Table 3). The warmer condition bees were consistently a lower body mass than the bees in the control temperature and the cool temperature.

Table 3 , Source: Schenk et al., 2018



Conclusions

Climate change, the rise of global temperatures, will continue to have a negative effect on Mason bee's pollination abilities by increasing length of summers and lowering body mass of bees during hibernation. Osmia body mass will continue to decline with warm hibernation temperatures which will decrease their overall fitness when pollinating crops. Without Mason bees as heavy pollinators crop production will slowly decline if there is not a solution made available for decreasing temperatures or finding alternate ways to pollinate crops.

Future Directions

It is important to consider the effect of climate on bee hibernation and the potential for reduced body mass. Mason bees could be studied individually by their specific species of Osmia, or the same could be done with other species of bee like honeybees, or bumblebees. Comparative continental monitoring of bee body mass and hibernation is important relative to habitat variables like temperature, pesticide-use, and atmospheric change, so we might better anticipate and protect the health of our pollinators.

Select References

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Complete reference list available upon request,
cunn4262@pacific.edu