Using Temperature as a Predictor to Calculate Emergence Date of *Parnassius smintheus*

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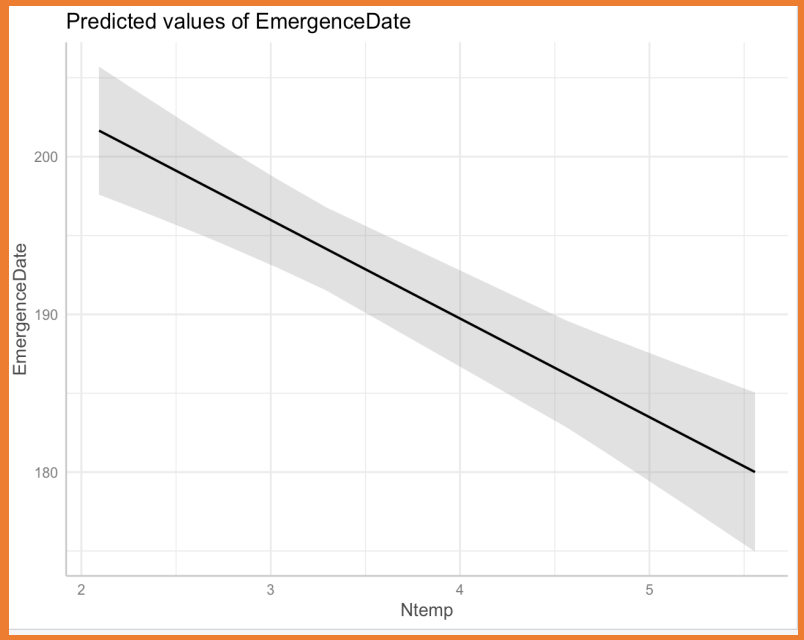
Introduction

As climate change continuously threatens our world, it is important to understand how temperature-dependent species will be affected (Bale et al 2002). By studying insects and other *'r'* selected species, we can observe how organisms adapt on a relatively-short time scale. Insects are exothermic so we can see how temperature directly affects their growth. By studying these organisms, we can see how the natural world may change in the coming years.

Methods

Using field data on the emergence date of *Parnassius smintheus* and temperature from the Nakiska Ridgetop weather station, I was able to create a bootstrap methodology for predicting the emergence date for a given temperature range of any year in R Studio. After testing many different temperature windows, it has become apparent that using the average temperature between May and June return the best results, most likely probably because the butterflies usually start to emerge in early to mid July.

Results



Ntemp: Average temperature in Celsius between May and June collected from the Nakiska Ridgetop Weather Station, Kananaskis, Canada

EmergenceDate: The first day that *Parnassius smintheus* butterflies are observed in the field, reported in Julian Date

Conclusion

As the average temperature increases, it takes less time for a temperature-dependent organism like the rocky mountain butterfly, *Parnassius smintheus,* which can force them to emerge as butterflies too soon, which can lead to starvation if their food sources have not grown yet. In insects that are pollinators, this can also result in decoupling between the insects and their host plant, which would lead to a decrease in plant reproduction (Bale et al 2002). Understanding the short-term effects of an increase in variability in temperature on a small insect group may allow us to predict how a larger population of organisms could be affected.

Sources

Bale, Jeffery et al. "Herbivory in Global Climate Change Research: Direct Effects of Rising Temperature on Insect Herbivores", *Global Change Biology*, Jan. 2002: 1-16.