The Effects of Elevation on Grasshoppers' Growth and Development

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Understanding Climate Change

Climate change has caused an increase in temperatures across the globe. As weather patterns have changed and temps grow to more extremes, we see an impact in our local ecosystems. [1]

Why Grasshoppers?

Ectotherms - cold blooded so external temps directly affect internal temps
Seasonal species - live only for one season
Live across different elevations - By transporting them to different elevations, we can essentially mimic the process of climate change.[2][3]

***Melanoplus sanguinipes* MS**
-Low elevation
-Lives across multiple areas
-Emerges later
-Data set not yet complete

***Melanoplus boulderensis* MB**
-High elevation
-Endemic to the Rocky Mountains in Boulder
-Emerges earlier

I hypothesize that the faster they develop the smaller the size (tradeoff),
Males will develop faster - smallest mass at low elevation
Females will develop slower - largest mass at low elevation.

Methods

Catch
Snap cap or net
Date, site caught, and species

ID
Identify with a loupe
- sex is identified by checking genitalia (Figure 3)
- instar is identified by checking wing buds (Figure 4)

Transplant
Take 3rd instar MB from high elevation site to cages at all three sites:
High, Middle, and Low
(Figure 1)
5 females and 3 males per cage
4 cages per site

Weigh
Every 3 days document weight and instar in notebook
Use scale to weigh (Figure 2)

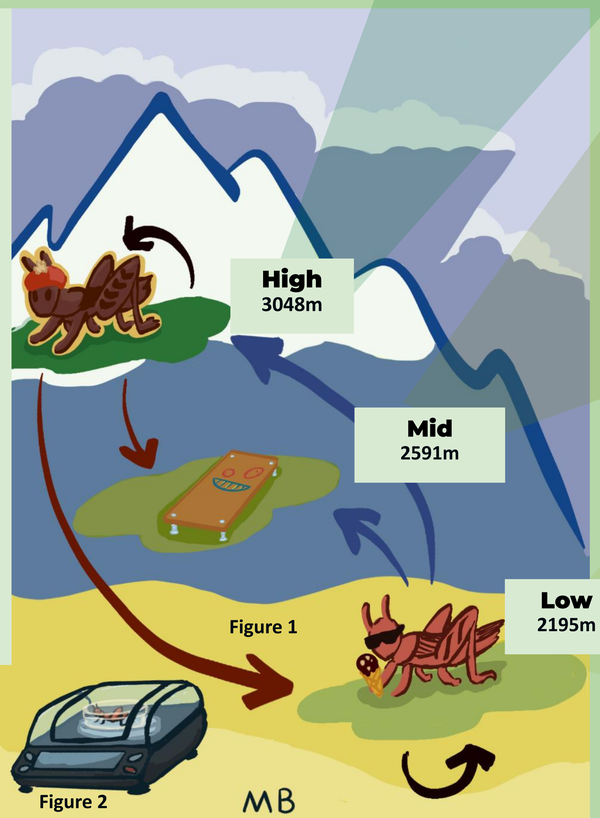


Figure 1

Figure 2

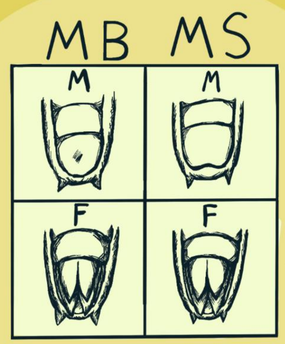


Figure 3

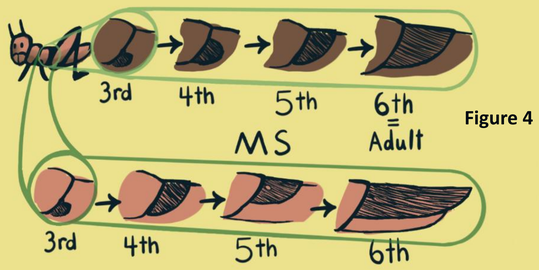
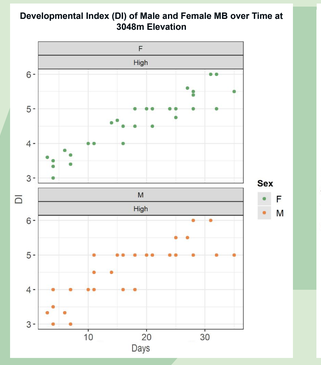


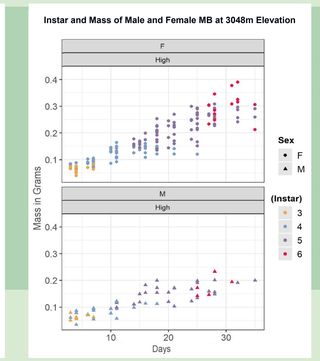
Figure 4

Acknowledgements

NSF (grant number EAR 1950681), RECCS, CIRES CU Boulder, Monica Sheffer, Julia Smith, Ebony Taylor, Simran Bawa, Thomas, Mom, Dad, and all my crazy siblings, Victoria Tonski, Wookie and Maddie and their dogs, Leah, and all those who supported me along this journey!

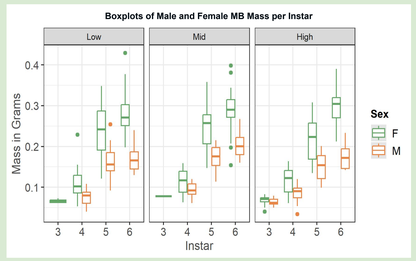
Results



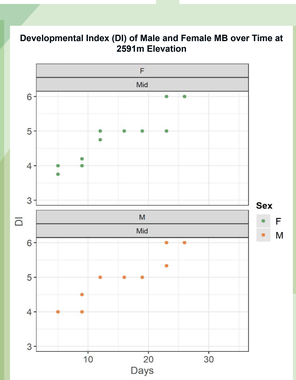


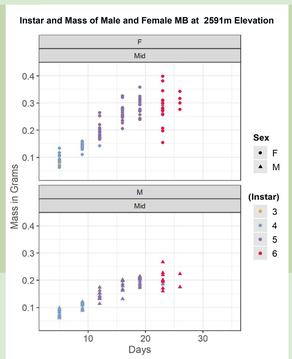
High Elevation Mass and Development Rate

At high elevation it should be noted that there are more measurements of 5th instar taken, showing that the grasshoppers stayed at 5th instar longer.
28 days after transplant till first adult.
Both male and female development rate appears to be similar in the first graph.



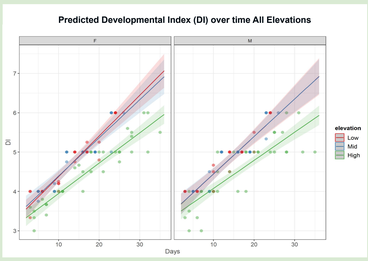
These boxplots represent the general mass size the instars have for both M and F at the different elevations.
At high elevation adult F are seen to be bigger overall than from the lower elevation.
Adult M are smaller overall at the lowest elevation.



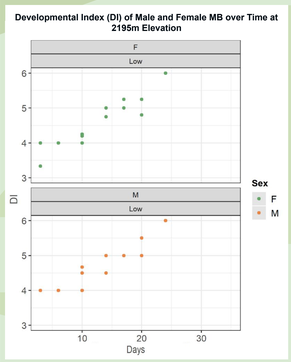


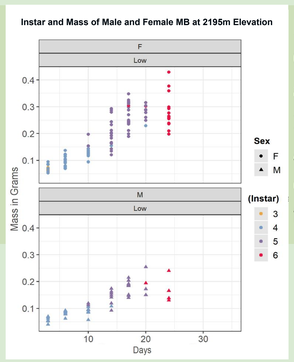
Mid Elevation Mass and Developmental Rate

Grasshoppers developed more quickly at this elevation and at a rather steady pace.
23 days after transplant till first adult.
Both male and female development appeared to be similar as well.



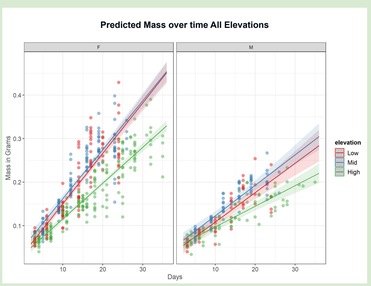
Both M and F develop at the same rate at both Low and Mid elevation sites, while in general they developed slower at high elevation, but overall we can clearly see that they both develop around the same rate. (P-value < 0.01)





Low Elevation Mass and Instar

Grasshoppers developed almost just as fast as the middle elevation.
17 days after transplant till first adult.
Appear to be almost the same as mid elevation with just a bit of fluctuation for the DI.



In general F are larger than the M, but we see that F exceed their mass at lower elevations than at the high elevation and much more dramatic than the males. (P-value < 0.01)

Discussion

In general males are smaller than females, as to be expected for these grasshoppers as their sexual size dimorphism (SSD) is female biased. [4]
Interestingly, there was hardly any difference between Developmental Index, the rate at which the grasshoppers developed, between sexes.
So compared to my hypothesis that males would develop faster than females, this does not seem to be the case in this experiment.
Also, the adult females appear to be largest the highest elevation compared to what I thought that they would be largest at low elevation.
We do see that males ended up being smaller at the lowest elevation from the boxplot graph.
From DI we see that MB developed faster by 11-5 days and were larger overall at the lower elevations than the high elevation.

Conclusion

This shows that the effects climate change increasing temperatures will impact grasshoppers to grow larger and faster. So we may start to see larger grasshoppers across the Front Range. Thus, as a result, can lead to an imbalance in seasonal species development within our ecology.

Citations QR Code