Using a Community Physiology Approach to Understand Vulnerability to Climate Warming on New England Rocky Shores

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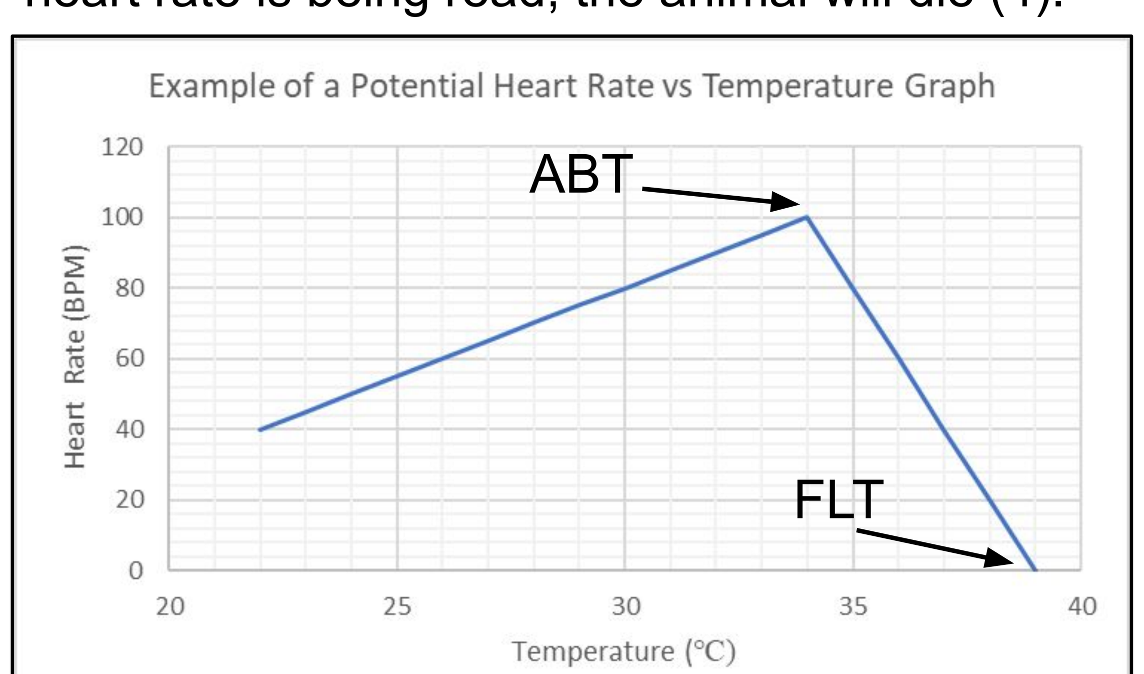
Overview:

Anthropogenic climate change is one of the biggest problems nature is facing right now. As temperatures warm, many living animals are threatened with extinction. While we can predict how climate will change, how do we predict how this change will affect certain animal populations? A lot of our current understanding on species vulnerability to climate change is largely derived from physiological studies that focus on single taxa. A primary belief of ecology is that there are species interactions within a community, so a community perspective is critical in understanding how climate change will affect biota (1, 2, 3). The aim of this study is to find a method that would allow us to predict population decline due to climate change among different animal populations. Our objective is to use heart rate to determine thermal performance of 4 different marine invertebrates species and evaluate if there are physiological differences in these interacting species.

Heart rate Example:

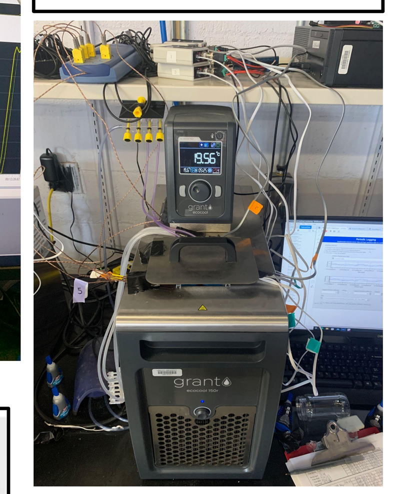
In general, as temperature increases, so does heart rate until it reaches the arrhenius breakpoint temperature (ABT). After ABT is reached, the heart rate declines rapidly. At this point, it's possible for the animal to recover; however, should temperature continue to increase to the flatline temperature (FLT), the point where no heart rate is being read, the animal will die (4).

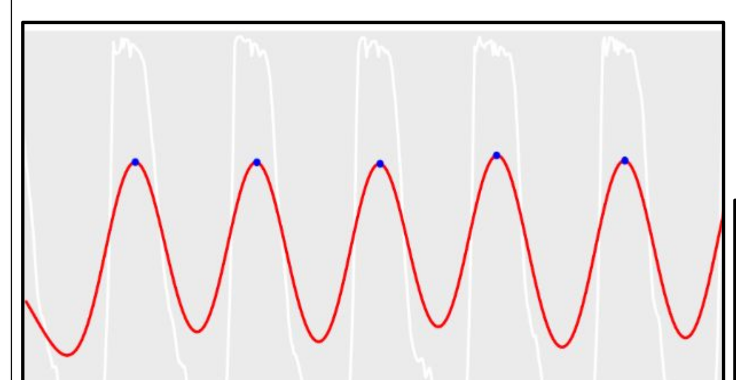


1) Animals were weighed and measured

2) Signals were found and glued to sensor

3) After animals had rested overnight, trials were ran in either air or water





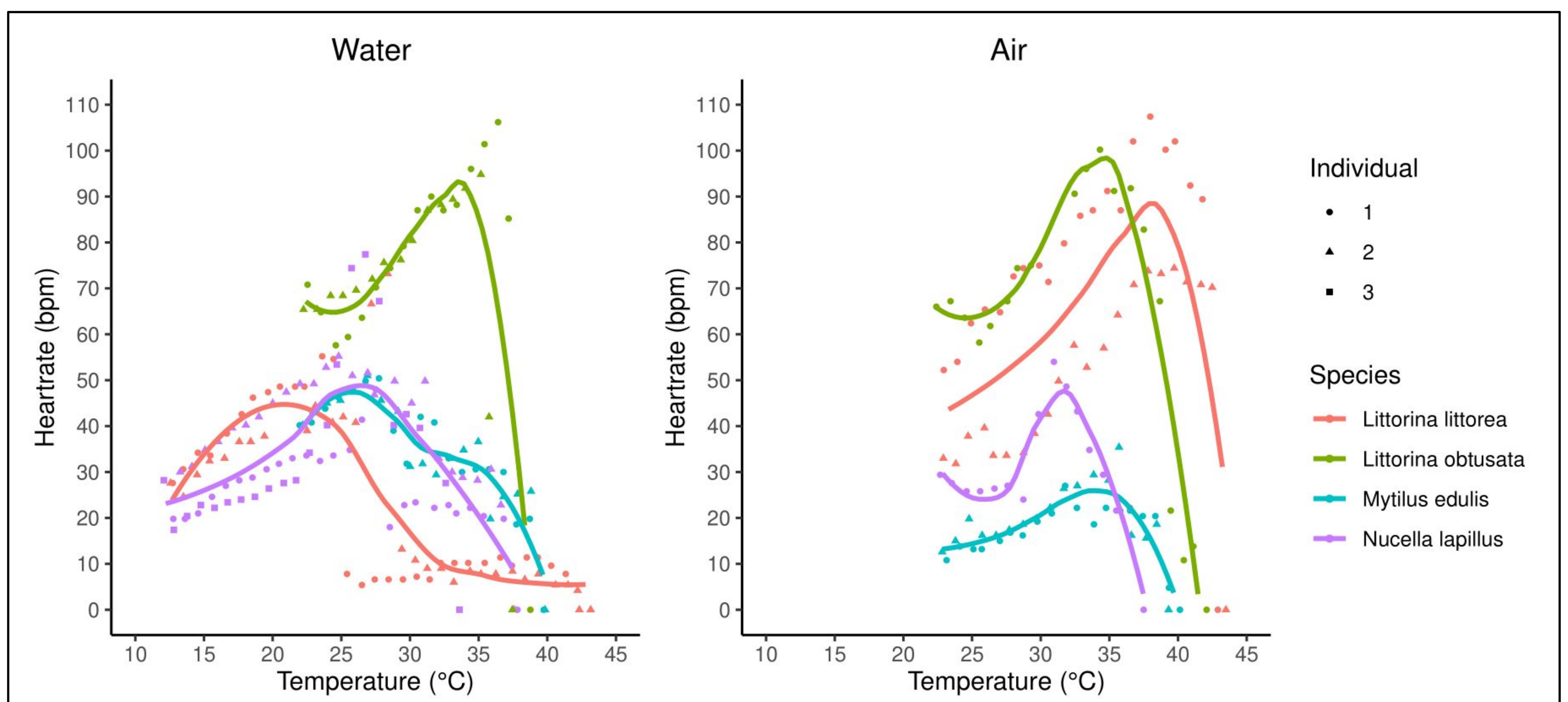
4) Trial data was analyzed with R script to determine heart rate

Nucella lapillus

Littorina obtusata

Mytilus edulis

Littorina littorea



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Discussion:

- Field data have shown that all the species used in this study are in population declines (5).
- *Littorina littorea* has the highest FLT in both air and water trials which suggests it is the least susceptible to heat stress. *Littorina littorea* high thermal tolerance allows it to occupy higher microhabitats along the shore which is what we observed in the field..
- *Littorina obtusata* have a very high heart rate in both air and water trials which may be because they remain feeding even during low tide and stressful conditions. *Littorina obtusata* are able to do so because they remain on seaweed during low tide.
- *Nucella lapillus* has a slower heart rate and lower FLT compared to other species which might indicate that it is more susceptible to heat stress. *Nucella lapillus* are also mostly found lower and in cracks/caves which might explain why it has a lower FLT and heart rate.
- To fully understand *Mytilus edulis* heart rate we would need a much larger sample size because they tend to have multiple heart rate patterns. The data only shows one, but they can have multiple breakpoints and recovery points (6).

Future Directions:

To further this study, we could add a larger sample size to refine the results. Knowing a species ABT and FLT isn't enough to view the full picture.We can calculate warming tolerance, the difference between FLT and environment temperature, which could give us a better understanding of which species are more susceptible to climate change (7).

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