Will Warming Atlantic Ocean Temperatures Effect the Growth of Asterias Ruben?

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Background

Northern Sea Star (Asterias Ruben) are native to New England where water temperatures are typically cooler, however, water temperature is rising due to global climate change. It is already known that warmer water temperatures lead to higher rates of growth of the Asterias Ruben, with growth up to 2x the rate in the summer months as compared to winter months-- 10 mm in summer and autumn and <5 during the winter (Vevers, 1949). This study seeks to determine if longer periods of increased water temperatures related to global ocean warming will relate to longer periods of sustained increased growth in Asterias Ruben.

Motivation

- Warming Ocean temperatures are a clear indicator of anthropogenic climate change. according to a report by the International Pannel on Climate Change the ocean has absorbed more than 93% of the excess heat from greenhouse gas emissions since the 1970s resaulting in a predicted 1-4 degeree C increase by 2100 (Laffoley, D. & Baxter, J. M., 2016).
- Asterias Ruben are a key species to costal ecosystems and their growth rate appears to be contigent on seasonal temperature change
- **We propose to evaluate growth rates of Asterias Ruben in a controlled temperature in order to predict implications for costal ecosystems.**

Fig 1. Shows Asterias Rubes population distribution along the northeast Atlantic coast of the US (OBIS).
https://mapper.obis.org/?taxonid=123776

Hypothesis

We hypothesize that there is a relationship between water temperature and rates of growth in the Asterias Rubens.

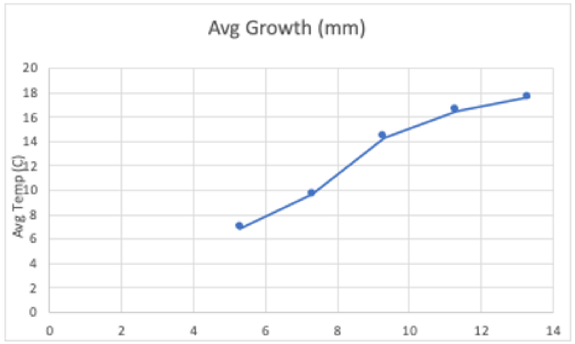


Fig. 2 shows the predicted growth rate for Asterias Ruben based on seasonal observations of changes in growth rate. Average temperature is based off the average for the duration of the study.

Month	Temp (C)
Jan	3.33
Feb	2.2
March	3.33
April	6.39
May	9.44
June	12.78
July	15
Aug	15
Sept	14.17
Oct	12.22
Nov	11.11
Dec	6.67

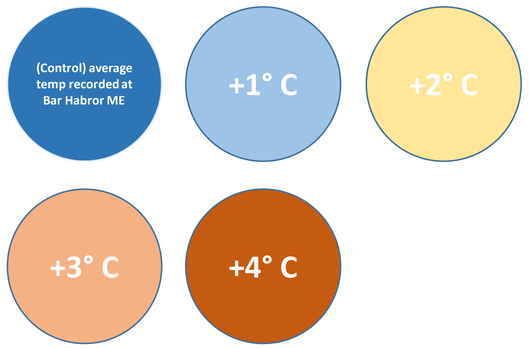
Fig. 3 lists average Atlantic Ocean temperatures recorded in Bar Harbor ME (NCEI). https://www.ncei.noaa.gov/access/data/coastal-water-temperature-guide/natl.html

Predictions

We predict that our increased water temperature treatment will result in increased growth rates (as compared to the control)
amongst Asterias Rubens, measured by body diameter.

Study Design

- We will conduct a lab experiment replicating ocean conditions in which Asterias Ruben live, manipulating temperatures over a 12-month period
- Juevenile Starfish will be selected to best rerespent differnces in growth between treatments as juveniles illustrate the clearest evidence of growth.
- **Control Group:** Starfish serving as the control will be treated with water temperatures reflecting the average ocean temps measured at Bar Harbor, Maine, a location with a high concentration of Asterias Ruben
- **Treatments 1-4:** We will include 4 treated groups which will be treated with water temperatures representative of the 1-4 degree C increase predicted by the IPCC (Laffoley, D. & Baxter, J. M., 2016).
    - Ie group 1 being 1 degree C above each average temp for the 12-month period, group 2 being 2 degree C above, ect. (see fig 3 for average temps)
- Starfish will be randomly assigned to a water treatment and housed in a tank with the corresponding temperature



Visual Repersentation of the control tank and 4 treatments relative to the temperature of the control

- Starfish will be regularly fed with musccles to best replicate their natural feeding
- Growth will be measured using changes in diameter of starfish

Intended Analysis

- Given that our response variable (egg mass count) is continuous, and our independent variable (water temperature) is continuous with > 2 groups, we will analyze the data collected using a t-test.
- The results of our T-test will help us determine the statistical significance of our findings and help us evaluate whether there is a significant relationship between water temperature and rate of growth in Asterias Ruben

Expected Benefits

- Asterias Ruben are a dominant indigenous predator in eastern coastal ecosystems. Asterias Ruben influence community structure through sustained consumption of bivalve prey, mainly blue mussel, Mytilus edulis Linneaus (St-Pierre, A. P., 2018).
- Evidence from research in the Atlantic ocean at large suggests Asterias Ruben along with other benthic consumers exert a top-down control over prey species such as muscles (Mytilus edulis). When Asterias Ruben are absent from the ecosystem, the muscles tend to dominate, “reducing and sometimes excluding other sessile species” (Enderlein, P., & Wahl, M., 2004).
- **Our study will provide important insight into the potential changes to costal ecosystem structure and serve as evidence for future management.**

References

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