Unicellular algae in Anthopleura Sola
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Introduction to Research in Ecology and Ecological Physiology

Introduction

Anthopleura sola lives in the rocky intertidal zone along the California coast (Ricketts et al. 1985). A. sola host two unicellular algae species, zooxanthellae and zoochlorellae (Verde and McCloskey 2007). These algae live symbiotically within the anemones and often provide the anemone's coloring, with the zooxanthellae providing a golden-brown hue and the zoochlorellae giving a green coloring (Ricketts et al. 1985). Models show that both zooxanthellae and zoochlorellae provide the host anemone with photosynthetic carbon, with the zoochlorellae being able to supply more carbon per unit anemone biomass than the zooxanthellae (Bergschneider and Muller-Parker 2008). Both algae are concentrated within the tissue of the digestive tract, which extends into the core of each tentacle (Kozloff 1973).

The effect of temperature and light intensity on zoochlorellae and zooxanthellae have been observed. Neither the algal densities nor chlorophyll content varied within the tested temperature range (6–24 °C) of anenomes hosting zooxanthellae, whereas anemones with zoochlorellae showed reduced algal densities and chlorophyll content at the highest temperature treatment (24 °C). Zoochlorellae also showed signs of reduced densities and chlorophyll content in the higher temperatures (Verde and McCloskey 2002). According to data from the National Centers for Environmental Information, the highest coastal sea temperature in Monterey Bay throughout the year is 20 ºC, so

anemones would hardly ever be exposed to the highest studied temperature (NOAA 2019).

Verde and McCloskey (2002) showed that the chlorophyll content of zooxanthellae remained constant regardless of irradiance, whereas the chlorophyll content of the zoochlorellae was inversely proportional to light intensity. The effect of both temperature and light intensity seem to suggest that zooxanthellae would be more abundant than zoochlorellae in anemones exposed to direct sunlight.

I propose to examine the abundance of zooxanthellae and zoochlorellae in Anthopleura sola to determine if increased light intensity and temperature result in a greater relative abundance of zooxanthellae. I will collect multiple samples of anemone tentacles from anemones located in the shaded habitat under the Monterey Bay Aquarium and anemones in the exposed pools next to Agassiz to compare the relative abundance of zooxanthellae in each other. I expect a higher abundance of zooxanthellae from the anemones located in the sun exposed areas.

The relative abundance of each algae could be used as an indicator of climate change. Since zoochlorellae are suggested to be less abundant than zooxanthellae in anemones affected by higher temperatures, studying zoochlorellae concentration in anemones over an extended period of time may show changes in ocean and air temperature. Colder ocean and air temperatures would mean higher zoochlorellae abundance over time while warmer ocean and air temperature would mean lower zoochlorellae abundance over time.

Methods

I observed 6 anemones from the shaded location and 6 anemones from the sun exposed location. I removed three tentacles per anemone. I observed each individual tentacle under a microscope, taking note of the presence of zooxanthellae and/or zoochlorellae, and the relative abundance of each alga type.

I found the relative abundance by dissecting the tentacles using scissors in a small petri dish filled with a standardized five drops of water, pipetted the water, and placed a randomly selected drop of water onto a viewing glass. I observed the drop under an optical microscope that is locked in a set position and counted each individual algal cell that is visible. I repeated this process for each anemone tentacle. I then calculated whether there is statistical significance between the size of the anemone and the number of algae they have. To find the size of each observed anemone, I will measure their diameter with a ruler while they are fully or nearly fully opened.

Results:

Based on the initial data, there is a possibility that the abundance of algae is dependant on location of the anemone. Running a pairwise t-test in R resulted in a p-value of 0.6985, meaning we fail to reject the null hypothesis that the average abundance of algae in an anemone would be equal between the shaded location and the sun exposed location.

Tables and Figures

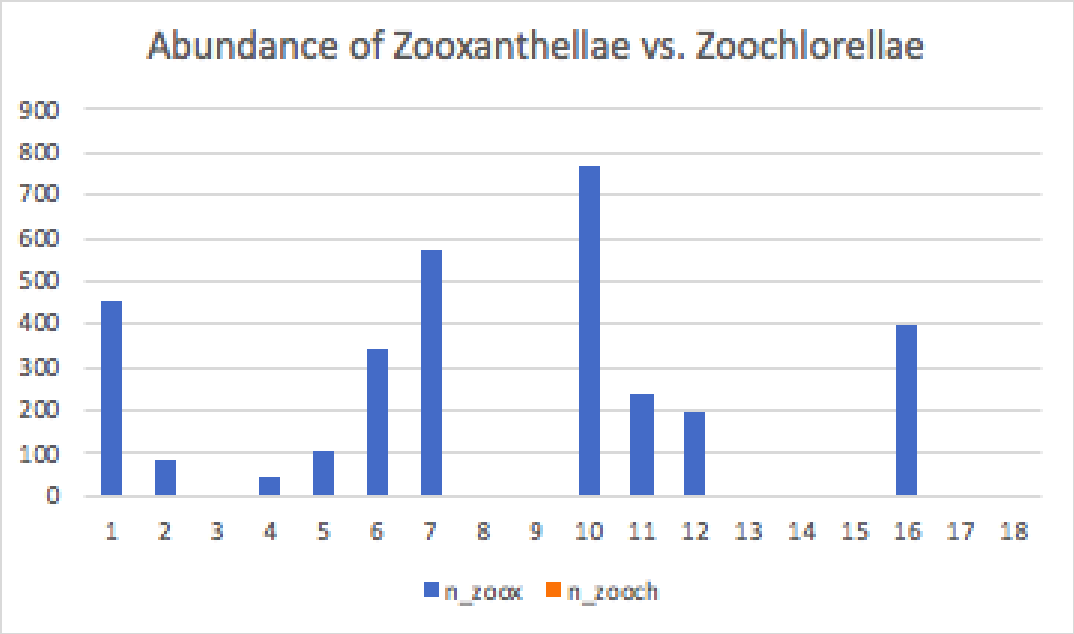

Figure 1a: Results of algal cell count in sun exposed anemones. n_zoox indicates the abundance of zooxanthellae. n_zooch indicates the abundance of zoochlorellae.

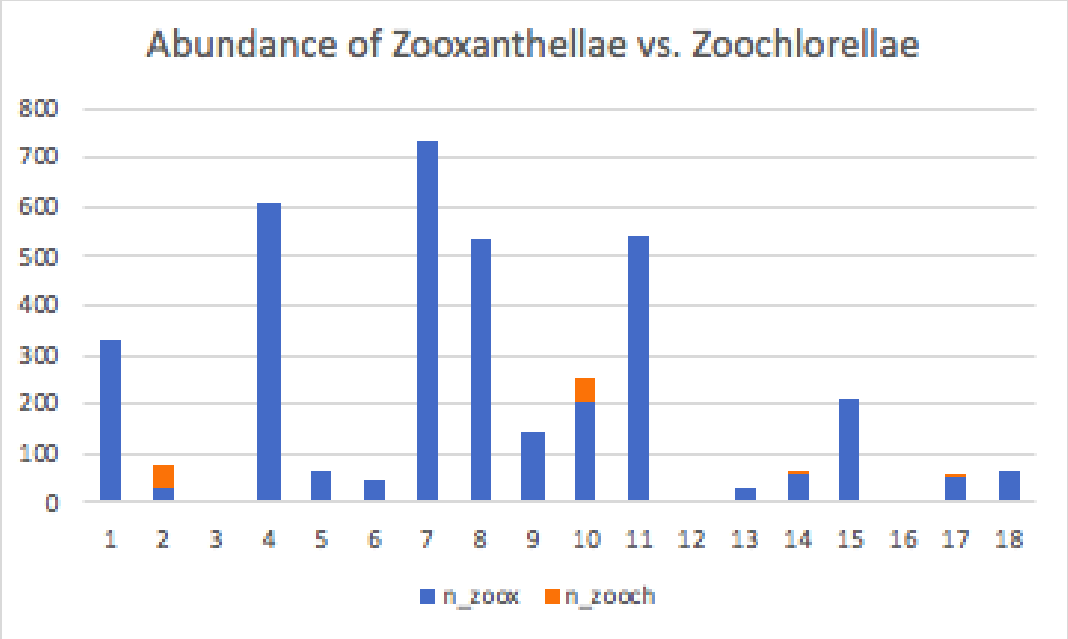

Figure 1b: Results of algal cell count in shaded anemones.

Proposed Work:

Based on my preliminary data, it is possible that there is a difference in abundance of symbiotic algae in anemones in sun exposed areas and shaded areas. The methods I used to count abundance of each algal type, however, was inaccurate. I propose to utilize a hemocytometer to measure abundance of the single-celled algae, as well as work with a larger sample size. This would provide a more accurate count of both the zoochlorellae and the zooxanthellae in each observed anemone. I would also take sea and air temperature measurements and compare those values with the abundance of zoochlorellae, expecting higher abundance over time if water and air temperature decreases over time.

I also propose to analyze how large of a nutritional effect the algae have on the anemones. With more testing and data, I expect more accurate results in terms of the significance of amount of microalgae in an anemone and the size of the anemone. Changes in amount of algae within the anemone could result in a change of size of the anemone, meaning the competitiveness of A. sola could shift, ultimately resulting in a change of the trophic landscape in the rocky intertidal.

Finally, a study has been previously conducted showed that ethanolic extract from Anthopleura displayed some antitumor activities towards mouse tumors (Quinn 1974). If further studies show that anemones are negatively impacted by increased temperatures, this may hinder possible research in to cancer treatment.

References

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