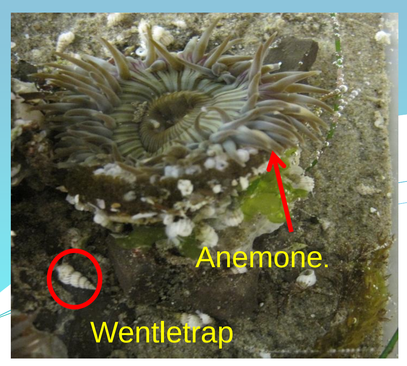


The Impacts of Temperature on Wentletraps and Anemones

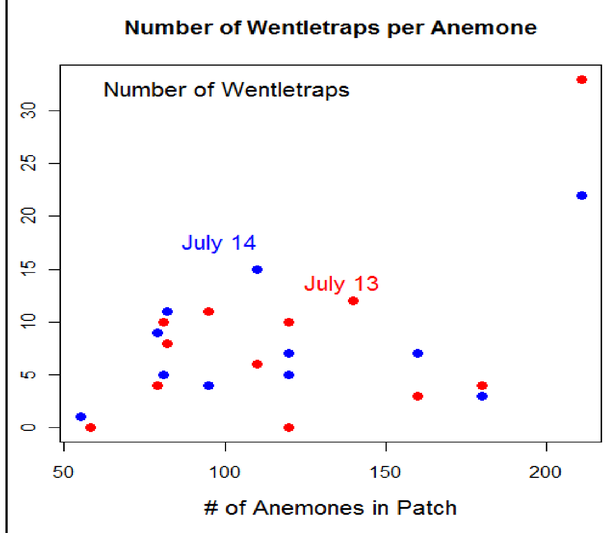
Angelica Trujillo eatrujillo@pipeline.sbcc.edu, Santa Barbara City College;
Mentor: Stephen Gosnell gosnell@lifesci.ucsb.edu, UCSB
Advisor: Dr. Steve Gaines gaines@bren.ucsb.edu, UCSB

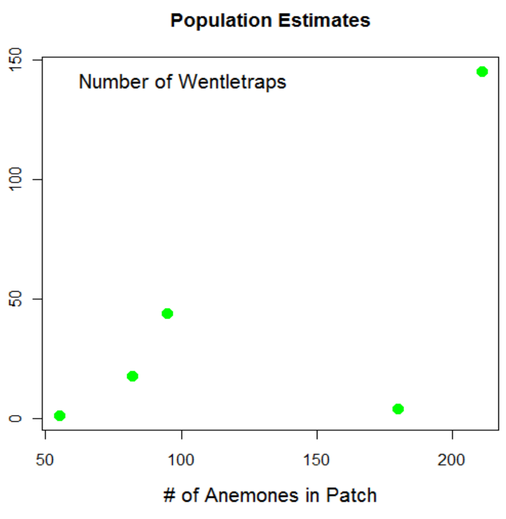
Introduction

Changes in temperature have been shown to impact both individual organisms as well as species interactions. Combination of multiple stressors such as temperature and predation, however, have received less attention. I examined how temperature impacted sea anemones (*Anthopleura elegantissima*) and their specialist micro-predator, wentletraps (*Epitonium tinctum*). Sea anemone's derive a large amount of energy from a mutualistic relationship with zooxanthellae; this relationship has been shown to be impacted by temperature. The impacts of wentletraps on temperature-stressed anemones has not been explored, nor have the direct impacts of temperature on wentletraps. Due to the small size of wentletraps (< 15 mm) and their tendency to conceal themselves, previous survey methods may have underestimated the number of wentletraps at intertidal sites. Overall, the community impacts of this interaction have also received little attention. For this reason, multiple experiments were carried out. Field surveys were conducted to determine wentletrap population size and density. Lab experiments were conducted to asses the impact of multiple stressors on anemones and the impact of temperature on wentletraps.

Determining Wentletrap Population Size & Density

Field experiments were conducted in mid-June at Alegria Beach in Santa Barbara, CA. Experiments consisted of developing a wentletrap search protocol and using mark-recapture methods to gather information on wentletrap population size. Wentletraps were collected from various anemone patches for 10 minutes and then marked. The same sites were re-sampled 24 hours later. Density was estimated by determining the proportion of marked specimens that were recaptured. Patch size (# of anemones) was also recorded. Specimens for lab experiments were also collected.

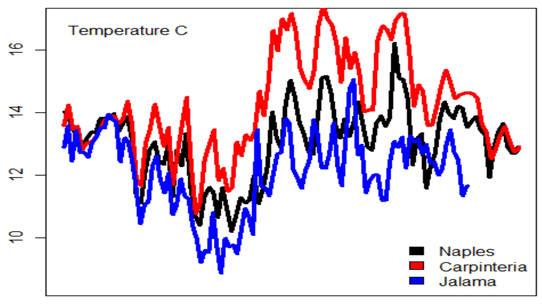




Larger number of wentletraps were collected in patches with larger number of anemones. Although similar numbers were collected from patches on both days, few marked wentletraps were recovered. Given the ability of wentletraps to survive marking that we observed in lab, this suggest large population sizes of wentletraps may exist.

Assessing Impacts on Wentletraps

Wentletraps were divided into wells on a heat block and exposed to temperatures ranging between 12.1˚C - 31.5˚C for 90 minutes. Survival rate was acquired just after the acute temperate exposure and 12 hours later. All of the wentletraps survived. We decided not to expose the wentletraps to any higher temperatures or for any longer periods of time because local water do not exceed 20˚C.



Heat Block

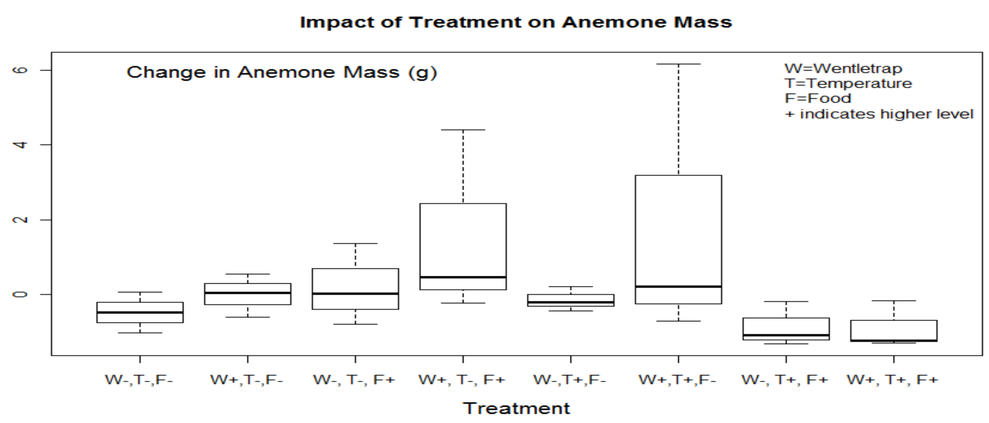
Analyzing the Impact of Multiple Stressors on Anemones

A factorial experiment was set up in a sea water room equipped with fresh, filtered sea water. We explored the combined impacts of multiple stressors (temperature, food availability, and presence of a predator). We used a factorial table to determine what combination of stressors we would apply in each of the treatments.

Food/No Food		
	Low Temp 12˚C	High Temp 20˚C
Predator	12˚C, Predator	20˚C, Predator
No Predator	12˚C, No Predator	20˚C, No Predator

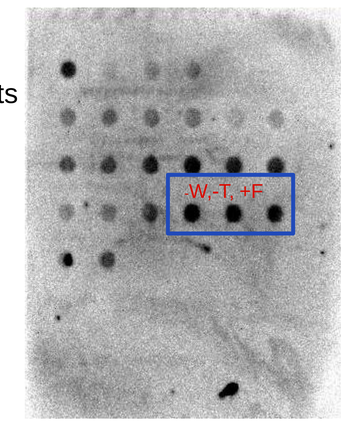
Temperature
Presence of predator
Food availability

Impact on anemones was assessed using morphological measures (mass, color, death rate) and molecular methods (protein degeneration).



The weight of sea anemones was taken before and after the five day factorial experiment. The results were inconsistent with what we thought would occur. There was a large increase of mass in treatments that had all three stressors (temp, food, and predator). No statistically significant impacts of treatments on mass were founds. Similarly, changes in color and death rate showed no trends.

Ubiquitin dot blots where used to asses protein degradation. Protein was extracted from sea anemone tentacles. Darker blots suggest more protein degradation. While no trends were found, the results suggest extraction of proteins using this method is possible.



Ubiquitin Dot Blot

Discussion

Our experiments suggest that wentletraps are common members of some intertidal communities. Given their abundance and ability to tolerate higher temperatures, this interaction may be important in communities that experience warming since previous work has demonstrated increased temperatures reduce energy available to anemones. Although our experiments did not demonstrate an impact of temperature on the interaction between anemones and wentletraps, our results may have been impacted by the duration of our trials. We recommend further work be carried out for longer periods. Establishing the impacts that temperature has on the interaction between the wentletrap and sea anemone can offer insight on community dynamics in intertidal sites and illustrate how multiple stressor can interact. These results may be particularly valuable for similar anthozoan-gastropods relationships found in coral reefs around the world.

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