The Role of Non-Consumptive Effects in Structuring West Coast Rocky Intertidal Communities

Jillian Davenport
Allan Hancock College
Molecular Biology
Laboratory Mentor: Stephen Gosnell
Faculty Advisor: Professor Steven Gaines
Department of Ecology, Evolution and Marine Biology, UCSB
Funding: National Science Foundation and UCSB Coastal Fund

Importance of Research Objectives

- Ecology has often focused on the importance of predators to community regulation (**Paine 1969**)
  - most work focused on consumptive effects

- Recent studies have suggested non-consumptive effects may be as important (**Preisser 2005**)

- Also suggested that temperature may impact predator consumption (**Sanford 1999**), but relationship to non-consumptive effects unknown

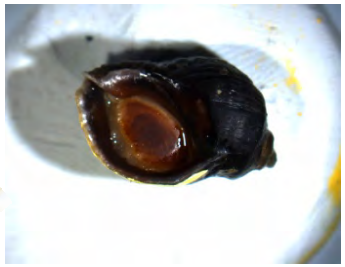
- Understanding total predator impact and potential influence of climate on communities requires evaluating all predator effects

- **Goal:** Determine total impacts of predators (consumptive and non consumptive effects) and interaction with temperature
  - draw conclusion regarding impact of ***climate change*** on west coast intertidal communities

Basic Understanding of the System

- **What species and why?**
  - Critical to intertidal food chain

Pisaster ochraceus, ochre sea stars; keystone predator



Nucella emarginata, sea snails

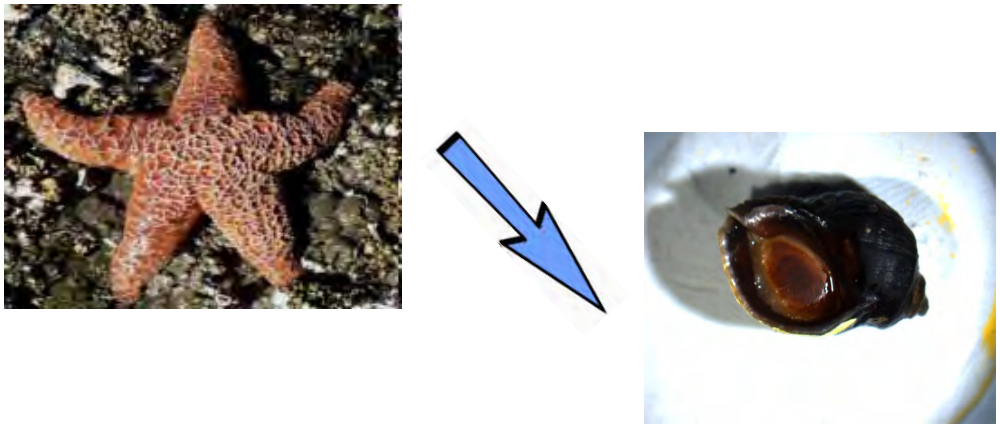
Mytilus californianus, mussels; foundational competitive dominator

Courtesy: google.com

My Research Focus

- **What *ARE* "non-consumptive effects?"**

  - Effects predator has on another organism other than strictly consumptive effects (consuming=death); effects of predator simply due to presence



- **<u>Goal:</u>** Determine non-consumptive effects of *Pisaster ochraceus* (Sea stars) on *Nucella emarginata* (Sea snails) in "normal" ocean temperature(12 degrees Celsius/54 degrees Fahrenheit)

Experimental Methods

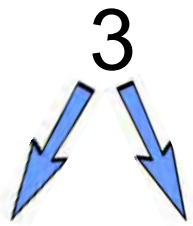
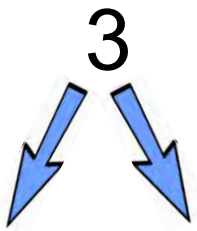
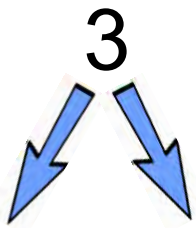
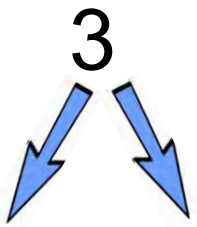
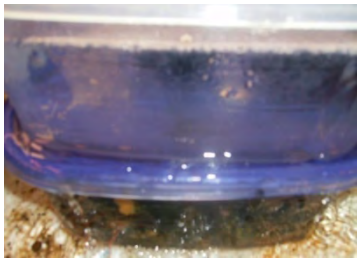
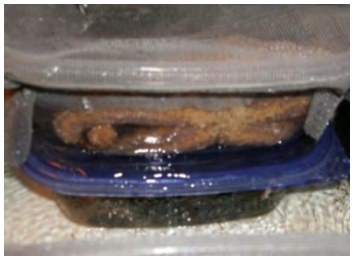
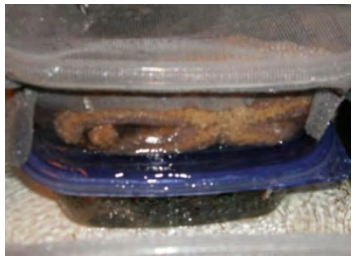
Collection of species:

- *Mytilus californianus* (MUSSELS)-collected @ Campus Point
  - different class sizes (0-15, 15-30, 30-45, 45-60 mm) to mimic natural variation
- *Pisaster ochraceus* (SEA STARS)- collected @ Jalama, Carpenteria, & Campus Point
- *Nucella emarginata* (SEA SNAILS)-collected @ Campus Point

Experimental design:

- Prey (Mussels), 20 of each class size placed in 48 ounce non-toxic plastic containers with holes to allow circulation and water
- Predators marked and measured prior to experiment and randomly assigned to treatments(6 sea snails and 1-2 sea stars)

Experimental Treatments

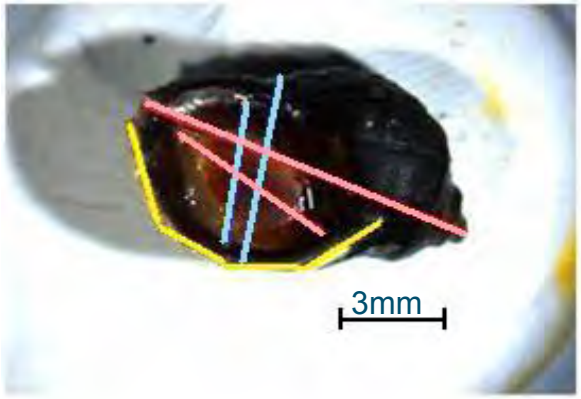
* A)	B)	C)	D)
			
NO Sea stars	**NO** Sea stars	**1** Sea star	**2** Sea Stars
			
Mussels	Mussels & Sea snails	Mussels & Sea snails	Mussels & Sea snails

* **“control” group**

Measurements

- **Snail growth (measured every 4 weeks)**: before and after measurements taken with calipers- width and length of mouth and shell and snail mass

  * long pink line= shell length
  * short pink line snail= opening (mouth) length
  * long blue line= shell width
  * short blue line= opening (mouth) width



- **Snail shape (measured every 4 weeks)**: before and after digital images taken using landmark based geometric morphometrics

  * yellow line= landmark

- **Snail behavior (measured every 3 days)**: location in container measured

- **Snail feeding (measured every 4 weeks)**:
  - **consumption**- counting alive vs. dead
  - **food preference**- counting alive vs. dead with "size" of mussels

Statistical Analysis

- **Snail growth & shape**: *The Analysis of Variance (ANOVA)*

  - used to evaluate impact of treatments on continuous variables(i.e.: 1.2543, 4.5678)
  - statistical technique used to predict how many times by chance (randomly) particular measured averaged values will be the same and come to pass

- **Snail behavior & feeding**: *Binary PermutationTest*

  - used to evaluate impact of treatments on discrete variables(i.e: 1,2,3)
  - statistical technique used to predict how many times by chance (randomly) particular measured averaged values will be the same and come to pass

- **Scientific numerical significance (generally):**
  - p value ≤ .05 = hypothesis is supported
  - p value > .05 = hypothesis is not supported

Results

- **Snail behavior:**
  - Treatment has a significant effect on snail position (**p=.01741,100,000 iterations)**
    - Implies at least 1 treatment is different than others
  - Post hoc tests
    - Bonferroni method: examines all different combinations of treatments (have 3)
      - Significant p-value is: .**05/3(# of tests)=.0167**

C)

1 Sea star

Mussels & Sea snails

B)

NO Sea stars

Mussels & Sea snails

D)

2 Sea stars

Mussels & Sea snails

p=.00995

p=.00995

p=1.0

Future Work

- Continue measuring and recording variables: snail growth, snail feeding, snail behavior and snail shape

- "After" measurements taken for:
  - snail feeding
  - snail growth
  - snail shape

- ***Next step is to study how non-consumptive effects of sea stars on sea snails interact with temperature**
  - **conclusion regarding impact of *climate change* on communities can be determined**

Summary

- Different field, live organisms main focus- cannot manipulate to yield results

- Hands on experience doing various types of field work/collecting data
  - sea stars, sea snails and mussels collecting
  - surf grass community surveys

- Hands on experience with aquariums

- Hands on experience soldering and producing circuit sensors

Acknowledgements

*THANK YOU….

***Mr. Stephen Gosnell**
Prof. Steven Gaines
The Gaines Research Lab Group
Parternship for the Interdisciplinary Studies of Coastal Ocean
California Nano Systems Institute
Internships in Nanosystems,Science,Engineering and Technology
UCSB Coastal Fund
National Science Foundation
Mrs. Irene Wong
Allan Hancock College

QUESTIONS?