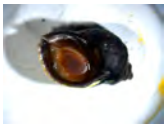
The Role of Non-Consumptive Effects in Structuring West Coast Rocky Intertidal Communities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Abstract

Recent research suggests that the non-consumptive effects of predators (effects a predator has on other organisms due to its simple presence) may be as important as consumptive effects (consumption), but few studies have examined the impact of non-consumptive effects on west coast rocky intertidal communities. In our research, we examined the non-consumptive effects of sea stars (*Pisaster ochraceus*), a keystone predator in intertidal communities, on the behavior, morphology (growth and shape), and feeding patterns of whelks (or sea snails, *Nucella emarginata*), a secondary predator in the communities. Both of these predators preferentially consume competitively-dominant mussels (*Mytilus* sp.), meaning changes in consumption may have an impact and result in community-level consequences. Snail growth, shape, behavior, and feeding patterns (consumption rate and size preference) were measured and analyzed in both the presence and absence of two densities of sea stars. We attempted to mimic natural communities by supplying whelks with mussels of various sizes that had formed clumps similar to natural variation in communities. We hypothesized that in the presence of sea stars, sea snails would grow less, choose smaller prey, and display more avoidance behaviors.

Methodology

• **Species collection:**

- Sea stars, sea snails and mussels all collected at various local beaches in order to preserve locations as well as represent natural variation on the west coast.

• **Experimental design:**

A) Mussels placed into different class sizes, 0-15mm, 15-30mm, 30-45mm, and 45-60 mm. to mimic natural variation in the communities.

B) 20 mussels of each class size were placed into 3 treatments in 48 non toxic plastic containers, totaling 9 containers.

C) In bottom containers, each treatment had mussels and snails . On top of the bottom containers, containers were placed that had : a) no sea stars, b) 1 sea star, or c) 2 sea stars present.

3 variables measured and evaluated :

-Snail growth (measured before and after experiment)

-Snail behavior (snails counted above water line)

-Snail feeding (counted and classified consumed mussels)

*** 3 treatments used to evaluate non-consumptive effects of sea stars on sea snails**

a) **NO** Sea stars

Sea Snails and Mussels

b) **1** Sea star

Sea Snails and Mussels

c) **2** Sea stars

Sea Snails and Mussels

Results

•**Behavior**

- **Marginally significant** (p=.06, binary permutation test) difference among treatments overall

•**Feeding**

- **Significant** difference in number of mussels consumed among treatments (p<.01, binary permutation test)
- **Significant** difference among treatments only present in consumption of 0-15 mm mussels (p<.01, binary permutation test)
- Post-hoc tests showed differences between treatments a and c and treatments b and c
- Multiple tests corrected for using Bonferroni method

•**Growth**

- **Significant** difference among treatments overall (p=.002, ANOVA)
- **Marginally significant** difference among treatments a and b (p=.06, ANOVA)
- **No significance** among treatments b and c (p=.11, ANOVA)
- **Significant** difference among treatments a and c (p=.002, ANOVA)
- As amount of sea stars increased, growth of sea snails decreased

Conclusion

We determined a replicate for treatment b was missing at the end of the experiment. This may have impacted the statistical analysis used for results due to the smaller sample size and different sample sizes among treatments.

We found marginal support for an increase in avoidance behavior due to the presence of sea stars. In the presence of sea stars, sea snails were found to feed less. However, this trend was only apparent for the smallest size when considered for each group. Sea snails also grew less in the presence of sea stars.

Overall, we found that the presence of sea stars has an impact on both their immediate prey (snails) and an indirect effect on a secondary prey (mussels) via changes in snail behavior. This suggests non-consumptive effects may initiate important trophic cascades in west coast intertidal communities.

Future Research

Because the variable snail shape is still being examined and measured, it will be analyzed at a future time. Once the foundational impact of non-consumptive effects from sea stars on sea snails is better understood, the impact of non-consumptive effects and interaction with temperature will be examined. As a result, a conclusion regarding the impact of climate change on west coast rocky intertidal communities may be determined.

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