

The Effects of Food Availability on Predation and Cannibalism in Sea Stars



Bobbi Dennison

Biology Department, Bowdoin College, Brunswick ME

Background Information:

-The Maine coast is dominated by two species of sea stars: *Asterias rubens* (formally known as *vulgaris*) and *Asterias forbesi*.

-*A. rubens* has typically been thought of as the northern of the two species, having been seen in abundance from Labrador, Canada to North Carolina.

-*A. forbesi* is often thought of as the southern species, dominating the region from Cape Cod to Virginia (Loosanoff, 1961).

-However, recent research has shown the abundance of *A. forbesi* greatly increasing in northern regions (Harris, 1998).



Orange Madreporite

Asterias forbesi



White Madreporite

Asterias rubens

Cannibalism and Predation:

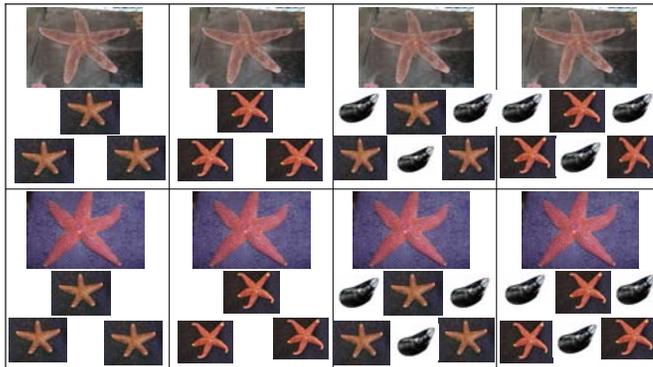
-Both *A. forbesi* and *A. rubens* prefer to eat *Mytilus edulis*, however, cases of sea stars eating other sea stars have been noted extensively.

-This has been reported both in the form of cannibalism, where sea stars eat other sea stars of their own species, and in the form of predation, where sea stars eat sea stars of other species.

-In *Asterias* there have not been many studies on predation and cannibalism, but observations in nature and laboratories have almost all shown cannibalism in *A. rubens* and predation of *A. forbesi* upon *A. rubens* (Holanda, 1995 and Witman et al., 2003).

-A study by Menge in 1979 did report *A. rubens* preying upon *A. forbesi*, however, it has been suggested that this information was reported incorrectly (L. Harris, personal communication).

Tank Layout:



Experimental Design:

-During trial 1 the sea stars were placed in cages each had a volume of approximately 0.02 cubic meters, and in trial 2 were placed in cages of half that volume.

-Each cage contained 1 large sea star and 3 small sea stars (defined by weights).

-All sea stars were starved 3 days prior to the beginning of the experiment.

-Half the sea stars were fed mussels throughout the experiment, while the other half were starved.

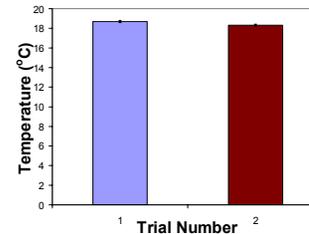


Figure 1: Comparison of the mean temperatures in the tank for trial 1 and trial 2. The tank was significantly warmer during trial 1 (t-test, $p=0.001$). The error bars represent standard error.

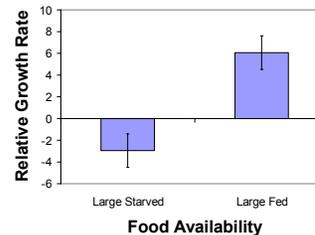


Figure 2: A comparison of the mean relative growth rate of all large sea stars in different feeding conditions. The large sea stars receiving a steady food supply grew significantly more than the large sea stars that were being starved (t-test, $p=0.001$). Error bars represent standard error.

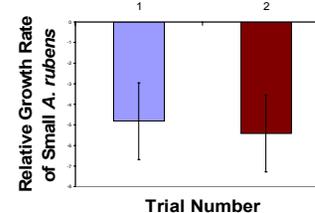


Figure 3: A comparison of the mean relative growth rates for small *A. rubens* that were in cages with a large *A. forbesi* between the two trials. There was no significant difference in RGR between trials (t-test, $p=0.894$). Error bars represent standard error.

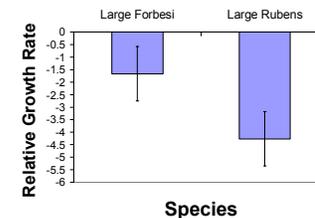


Figure 4: The combined mean relative growth rates of both trials for large *A. forbesi* and large *A. rubens*. There was no significant differences in the RGR between species (t-test, $p=0.264$). Error bars represent standard error.

Questions of focus and hypotheses:

1.) Does the presence of food affect cannibalism and/or predation?

Hypothesis: In tanks with a constant supply of mussels there will be no cannibalism or predation, but in tanks without mussels cannibalism and predation will occur.

2.) Does species affect cannibalism and/or predation?

Hypothesis: *A. rubens* will cannibalize but will not prey upon *A. forbesi*.

A. forbesi will prey upon *A. rubens* but will not cannibalize.

3.) Does crowding affect cannibalism and/or predation?

Hypothesis: An increase in crowding in the cages will lead to an increase in cannibalism and predation.

Results and Discussion:

-Not surprisingly, the presence of continuous food supply had an effect on the relative growth rate of sea stars. As seen in Figure 2, the sea stars that received a supply of mussels had a positive growth rate whereas the sea stars receiving no mussels had a negative growth rate.

-No cannibalism occurred during the two trial periods and very little predation occurred. During trial 1 there was a loss of 1 arm from a small *A. rubens* in a cage with a large *A. forbesi*. There were white skeletal remains in the cage, and despite not seeing the arm consumed, the most likely cause of the disappearance was consumption by the *A. forbesi*.

-During the second trial there was a loss of three arms. All arms were lost from small *A. rubens* in the cage with large *A. forbesi*. Despite more arm loss in trial 2, there was no significant difference in the overall RGR of small *A. rubens* between trials (Figure 3). This is probably due to the small number of predation events that occurred overall.

-Based on the results presented in Figure 3, crowding did not seem to have a significant result. However, arm loss occurred earlier on in trial 2, at day 11, as opposed to day 15 in trial 1. More studies should be done concerning the affects of crowding on cannibalism and predation to see if this factor does play a role if crowding was made even more extreme.

-There was no significant difference in weight loss between large *A. forbesi* and large *A. rubens* that were not being fed mussels (Figure 4). However, it is important to note that both species lost weight over the two trial periods, despite being able to consume other sea stars. This suggests that it takes extreme conditions for sea stars to prey upon each other.



References:

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- Menge, Bruce A. 1979. Coexistence Between the Seastars *Asterias vulgaris* and *Asterias forbesi* in a Heterogeneous Environment: A Non-Equilibrium Explanation. *Oecologia* 41: 245-272.
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