Comparison in the Attachment Strength of 5-Rayed (*Pisaster ochraceus)* and 6-Rayed (*Leptasterias hexactis) Sea stars*

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Introduction

Pisaster ochraceus and *Leptasterias hexactis* are two carnivorous sea stars that share similar geographical and depth ranges. *P. ochraceus* can be found from Prince William Sound in Alaska south to Point Sal in Santa Barbara County in California. It occurs in the low and middle intertidal zones, and sometimes in the sub tidal zone[1]. *L. hexactis* can be found as far north as the San Juan Islands of Washington south to the Channel Islands of California. They are typically found in the middle intertidal zone[2].

In this study, I would like to determine if the number of rays a sea star has correlates with its attachment strength. I hypothesize that the 5-rayed star will have greater attachment strength than the 6-rayed star. I believe that because *P. ochraceus* has a more rigid body and harder exterior, this will work as an advantage in remaining attached as the amount of force (weight) increases. I also hypothesize that the number of rays attached correlates with the maximum spread of the sea stars rays. I believe the maximum spread will be greatest when the number of rays attached is lowest.

Specimen Collection

The *L. hexactis* specimen used in this experiment was found at Middle Cove, Cape Arago, Charleston, Oregon. The *P. ochraceus* specimen used was found on the south jetty at Bastendorf Beach, Charleston, Oregon.

Methods

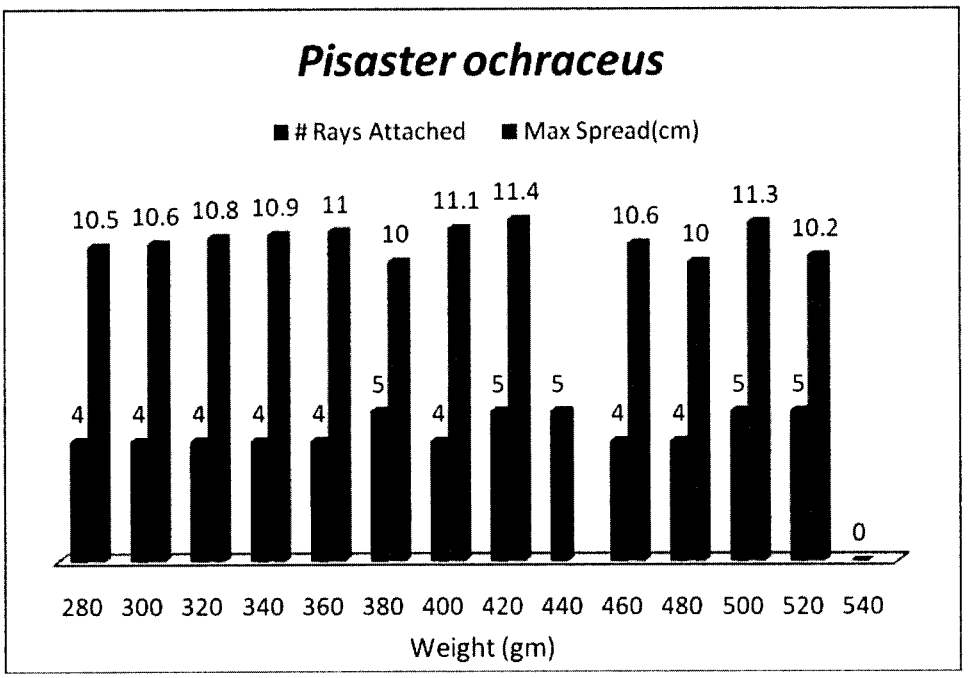
To begin, a harness was constructed using a thin twine. The harness was attached to the sea star by placing the loops around its rays. The harness was attached to a thicker rope that was tied around a Tupperware container that held a plastic sandwich bag. First, the sea star was allowed five minutes to attach itself to the surface of the water table. During this time I weighed the container and plastic bag, adding water until the weight was equal to ten times the weight of the sea star. The weight of the *L. hexactis* specimen was 6.5 grams, so the starting weight of the container/bag was 65 grams. The weight to the *P. ochraceus* specimen was 28 grams, so the starting weight of the container/bag was 280 grams. Once the five minute attachment period was up, the rope was tied around the weighted container and left to hang over the edge of the

water table for five minutes. If the sea star remained attached, a five minute break was given. During this time, twenty grams of water was added to the plastic bag. Once the five minutes was up, the device was reattached and sea star attachment was timed for another five minutes. This series of five minute intervals with the addition of twenty grams of water after each successful interval continued until the sea star became unattached from the wall of the water table.

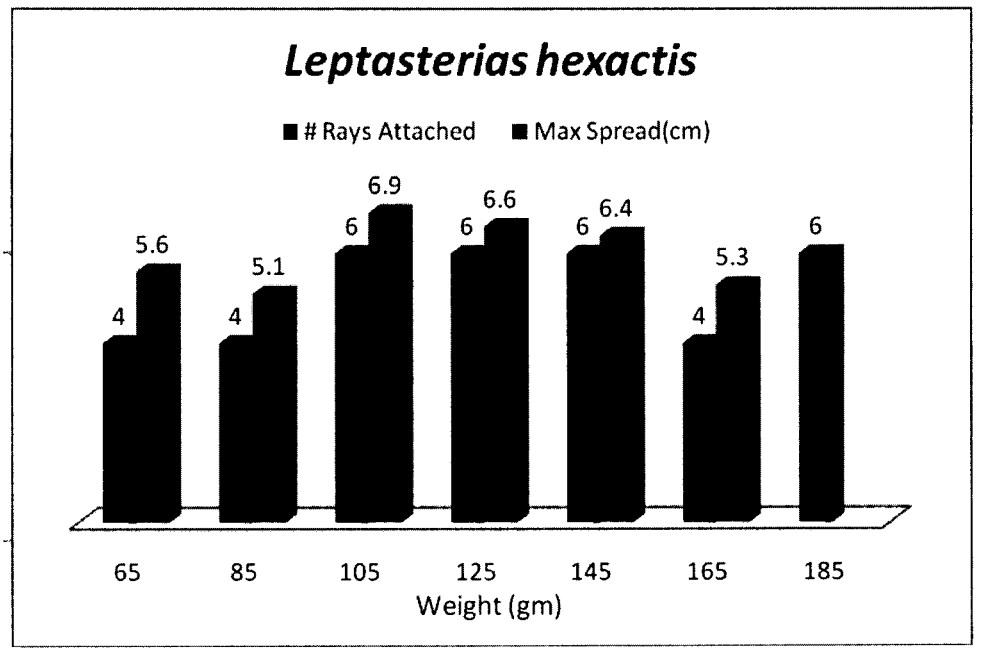
During the intervals when the sea star was bearing the weight of the container/bag, the maximum spread of the sea star's rays was measured using a small plastic ruler.

Results

The *P. ochraceus* went through fourteen intervals, starting at 280 grams and releasing at 540 grams. In eight of the intervals the sea star was attached by four rays, and in the remaining intervals, attached by five rays. The maximum spread of its rays ranged from 10 cm to 11.4 cm. The *P. ochraceus* was able to hold 18.6 times its body weight.



The *L. hexactis* went through seven intervals, starting at 65 grams and releasing at 185 grams. In four of the intervals the sea star was attached by six rays, and in the remaining intervals, attached by four rays. The maximum spread of its rays ranged from 5.1 cm to 6.9 cm. The *L. hexactis* was able to hold 25.4 times its body weight.



Discussion

In the end, I was unable to validate my hypotheses. The six rayed star was able to hold 25.4 times its body weight and the five rayed star able to hold only 18.6 times its body weight. This came as a surprise because the body of *L. hexactis* seemed so much more fragile. This fragility was shown in a study conducted by Bingham et al, in which 30-46% of specimens found were damaged. This damage was caused by either physical disturbances or predators (1999). I believe the extra ray gave *L. hexactis* an improved ability to attach itself to the water table wall, but to also maneuver itself into more efficient positions. During the experiment there were two occasions when *L. hexactis* was able to alternate which rays were attached. It typically kept four rays attached while using the other two rays to maneuver its way out of the harness. On both occasions, *L. hexactis* was able to free itself of the harness. In the case of *P. ochraceus,* the sea star went through a greater number of intervals, but was not able to match the strength of *L. hexactis.*

The relationship between maximum spread and number of rays attached was not proven. In both species the greatest maximum spread was achieved when a higher number of rays were attached. This is the opposite of what I hypothesized would occur.

Overall, there are a few changes I would make to improve this experiment. First, I would increase the number of specimens of each species. Second, the amount of weight added should be determined by the weight of each specimen. Had the amount of water added to *L. hexactis'* weight load been determined by its lower body weight, it would have probably went through a greater number of increments. Last, the weight of the harness and attached rope should have been taken into consideration.

References

1. Melissa McFadden (2002)

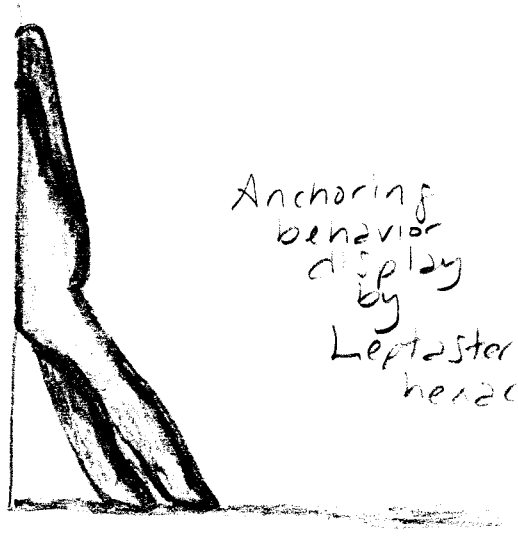
   http://www.rosario.wwc.edu/inverts/Echinodermata/Class%20Asteroidea/Pisaster_ochraceus.html

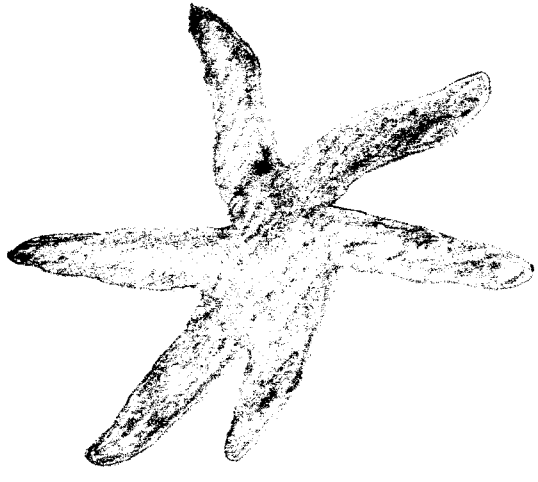
2. Melissa McFadden (2002)

   http://www.rosario.wwc.edu/inverts/Echinodermata/Class%20Asteroidea/Leptasterias_hexactis.html

3. Bingham, Brian L., Burr, Jennifer, and Wounded Head, Herb. 1999. Causes and consequences of arm damage in the sea star *Leptasterias hexactis.* Canadian Journal of Zoology. 78 No. 4-6: 596-605

Pisaster ochraceus





Leptasterias hexactis