Jess Eberle
Exploratory Project I
Adaptations for Marine Animals
Professor Charlie Hunter

Introduction

A structural element is very important in understanding any organism. An animal's morphological make-up helps us get a grasp on how it is able to function in its environment. In this exploratory I looked at locomotion in asteroids. My question in this experiment was is there a trait or combination of traits that contributes to the speed in which they move. My hypothesis was that the more tube feet the sea star had on the ventral or oral side the faster it would be. I tested this mainly on three different species of sea stars; *Pisaster ochraceus, Asterina miniata,* and *Pycnopodia helianthoedes* (the common Pacific star, the bat star, and the sunflower star respectively) (Kozloff 1973). All sea stars are able to move by a process involving the water vascular system (Nichols 1962). The stars have a concentration on the dorsal side of very small pores near the lateral center of the animal that intakes water, in which the water can be forced to appropriate regions of the animal's body, especially the arms, to process movement and locomotion (Nichols 1962). The concentration of many small pores top is called the madreporite (Nichols 1962). While the madreporite is responsible for regulating pressures to different areas of the sea stars body, the tube feet adhere to substrates and move the animals along by detaching and attaching different tube feet to exhibit movement. The tube feet are located ventrally on the animal between two spines that create a groove. The number of tube feet varies from one species to another. *Pycnopodia* has many tube feet as opposed to *Asterina* and this was thought to be the deciding factor for the animal's speed.

Methods

The processes in which I used were very exploratory. I tested the speed of the three species. With *Asterina miniata* and *Pisaster ochraceus* I did a test to see how much each animal would move at a given amount of time which was thirty minutes for each organism. For the *Pycnopodia* I didn't get a good quantifiable estimate of its speed but I did get an idea by placing it among the other sea stars and comparing by just watching. This is obviously a very poor way of collecting data. I also tested the animals flexibility which could attribute to the animals overall speed. I did so by putting them on a rectangular container that was placed with the bottom side up. The container was plastic and it was open on the sides with square holes allowing it to submerge easier. The dimensions of the container were twenty-four cm. long, five point seven cm. wide, and six and a half cm. tall. I put each sea star on the edge of the container with a little less than half of its body suspended. I timed the point of which I let go until the sea star folding closely to a ninety degree angle. The stars couldn't fully fold into a ninety degree angle because the bottom of the container, which was used as the top of the container to set the star fish upon, was tapered outwards. To test the hypothesis of tube feet being the deciding factor of the sea stars speed I flipped the starfish over and counted the individual tube feet for one centimeter, starting at the base of the arm. I had to take into consideration that size would play a big role in the number of tube feet each individual had for every cm. so I counted individuals of each species that were within three cm. of each other.

Results

The results that I got from this were a little inconclusive put they were helpful. The most flexible of the three was the *Pycnopodia*, followed by *Asterina*, and lastly by *Pisaster*. The sea star that exhibited the greatest traveling distance was the *Pycnopodia*, followed by *Pisaster*, and the star that showed the least amount of distance traveled was *Asterina*. The traveling time was not well defined. The *Pynopodia* had the most tube feet per centimeter, followed by *Pisaster*, and *Asterina*.

Discussion

The hypothesis of the number of tube feet alone being the ultimate decider of speed for each sea star was proven wrong. I now see that it is a combination of things instead of one attribute alone. The *Pycnopodia helianthoedes* was the fastest with the greatest flexibility and speed. *Pisaster ochraceus* was the least flexible but was still faster than *Asterina* which had less tube feet. This might show in this case that tube feet play a more critical role in speed than flexibility but I can't speculate that a star with very limited flexibility and with great numbers of tube feet is faster than a star that is very flexible but has very little numbers of tube feet because there is no way to correctly quantify the which is more important. To see a pattern evolve from this one would have to use more examples and with many more species. The exploratory, as I said, was a little inconclusive and that can be attributed to the lack of thoroughness and consistent testing on my part. Next time there should be more data collecting and testing to quantifiable results.

Literature Cited

Karl P. Mauzy, Charles Birkland, Paul K. Dayton. 1968.
Ecology, Vol. 49, No. 4, pp. 603-619. Feeding Behavior of Asteroids and Escaped Responses of their Prey in the Puget Sound Region
Ecological Society of America.

Linda A. Thomas, Colin O. Hermans. 1985.
Biological Bulletin 169. pp.675-688. Adhesive Interactions Between the Tube Feet of a Starfish *Leptasterias hexactis*, and Substrata
Biological Bulletin.

David Nichols. 1962.
Echinoderms. Great Britain.
Hutchinson & Co. 39p.

Eugene N. Kozloff. 1973.
Seashore Life of the Northern Pacific. Washington.
University of Washington Press. 120p. (plate25)