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Adaptations/Structural Exploratory 1

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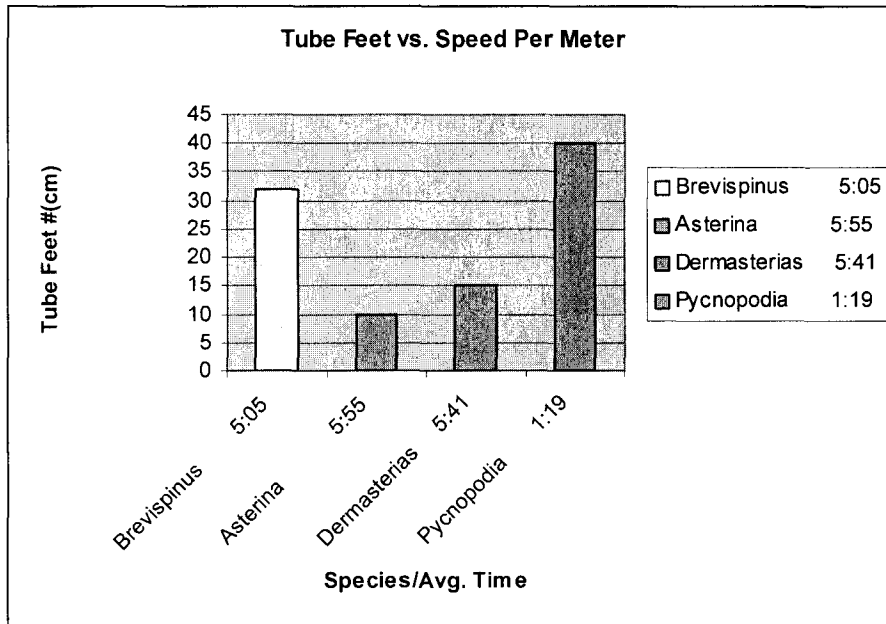
**Introduction:** Sea Stars are one of the most fascinating creatures found in marine environments. Interests in these animals derive from the many different colors, sizes, and physical characteristics found between species. For example, *Pycnopodia helianthoides*, more commonly known as the Sunflower Star, typically has 24 arms or rays compared to the *Asterina miniata* (Bat Star) which only consists of 5 webbed arms (1). Or if comparing the *Pisaster brevispinus* (Giant Pink Star) to the Leather Star (*Dermasterias imbricata*) we can see differences in texture. The *D. imbricata* has a slippery surface contrast to that of the *P. brevispinus* whose dorsal side is covered with short spines (2). Although there are many other distinctions that can be talked about between these four species, there are some common attributes they all share as well. **1)** They have all been located in a range from Alaska to California. **2)** Despite maximum depth variation they all can be found within the low intertidal zone. **3)** Although they have somewhat different diets, they have been observed feeding upon common prey, such as sea anemones and muscles (2). With all of this in mind I began to wonder what factors, if any, contribute to the variation of speed in Sea Stars. My assumption is that the speed of Sea Stars derives from their tube feet. In this paper I propose that a Sea Stars speed is directly correlated with the number of tube feet associated with that Star. However I will examine the length and width of the tube feet to either dispute or confirm my hypothesis.

**Method:** For this experiment I chose to use the four species listed above; *P. brevispinus*, *A. miniata*, *P. helianthoids*, and *D. imbricata*. I had chosen these specimens on the basis of species availability, ability to drive the Sea Stars to their maximized top speed, and as close of a common size as I could within the allot time given for this exploratory.

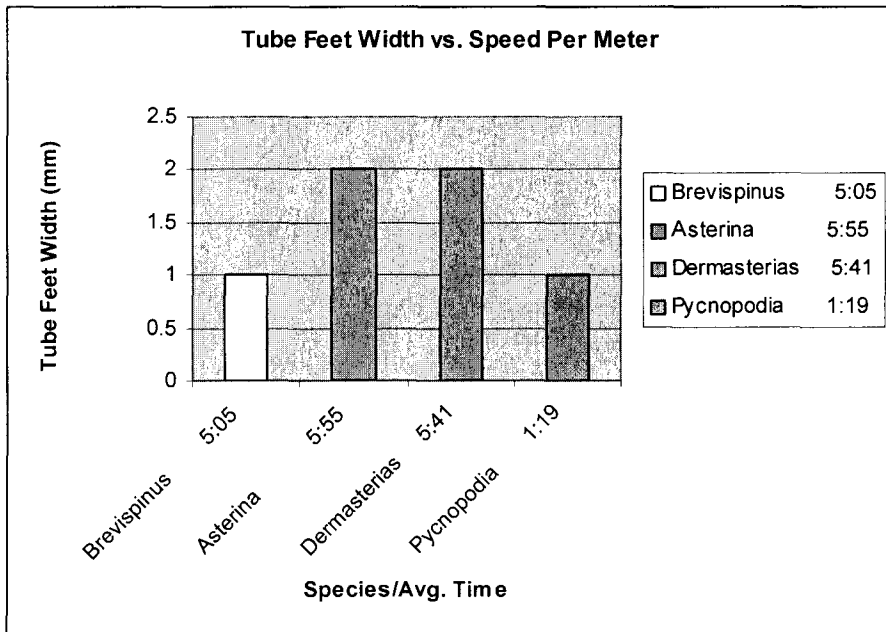
The first step I undertook was measuring the size of my specimens, which I did using a tape measure. The specimens measured between 20 and 25 centimeters. The next step was to put the Stars under the microscope and count the number of tube feet, using a small clear ruler. I measured a space of 1cm at the middle of their arm. Choosing the middle of the arm seemed to be the best option because it is the meatiest part of the arm. I went 2cm down and then counted the number of tube feet in the next centimeter range. The number of feet for each species can be found on the y axis in **figure 1**. After that I decided to measure the width of the tube feet, using the same clear ruler and a microscope, for each species. Those measurements can be found on the y axis of **figure 2**. The last measurements I made were the length of the tube feet. For this I decided to prop the Stars on their backs on the top of a finger bowl. When they tried to stretch and turn themselves back over I made some rough dimensions using the ruler once again. These results can be found on the y axis of **figure 3**.

Finally I was ready to time their speed. For this I used a water tub, stop watch, tape measure, and another Sea Star the *Solaster dawsoni*, otherwise known as the Morning Sun Star. The *S. dawsoni* was used because it is quit known that they tend to prey upon other Sea Stars and using the escape response method seem to work surprisingly well (1). I measured out a 1m distance inside the tub, a start and finish line,

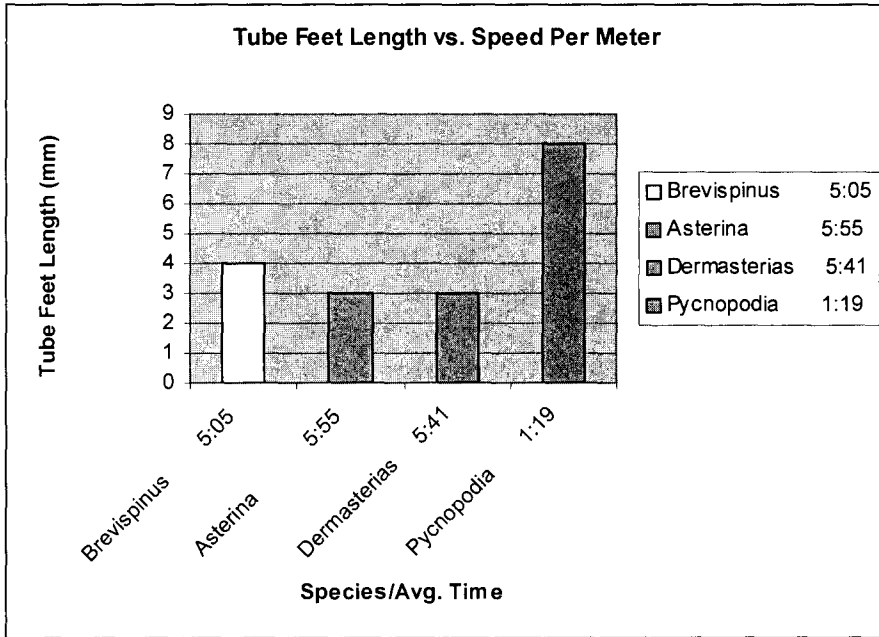
**Figure 1**



**Figure 2**



**Figure 3**



and set the *S. dawsoni* slightly behind the other specimens. Once the Stars crossed the starting line I timed their movement until they reached the finish. I did this five times per species and calculated their average time.

**Results:** After I tallied up all the information, the speed averages and measurements, there were some interesting findings. First of all in **figure 1** there does seem to be some relationship between tube feet number and generalized speed. However you can also notice that the *P. brevispinus* has 32 feet per centimeter while *pycnopodia* has 40, and yet their speed time is close to four minutes apart. On the same token they have the same width as shown in **figure 2**. As for the *Asterina* and the *Dermasterias* it seems that they are clearly at a disadvantage with wider and fewer tube feet. But the most conclusive evidence I was able to obtain is that tube feet length is definitely a contributor in a Stars speed. As **figure 3** shows, the *pycnopodia* has a 50% longer reach than the one with the 2<sup>nd</sup> longest reach, which is the *brevispinus*; and the *brevispinus* has a 25% longer reach than the other two specimens which seems to conclude that tube feet length is the major factor in relevance to Sea Star speed.

**Discussion:** As this paper shows tube feet length is definitely a factor responsible for the speed in Sea Stars. However I also have to look at the unintentional bias brought about in this paper. For example there was only four different species used and three of the four specimens had five rays while the *pycnopodia*, with the fastest speed time, has twenty-four arms. So my next question would have to be “Does arm numbers determine Sea Star speed?”. This would be a great secondary question and I would predict that it

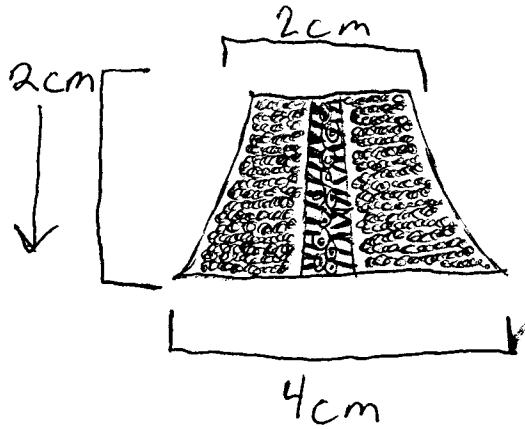
does play an important role. Although this question might put some controversy around the findings of this paper, I believe this paper gives a good stepping stone towards and a generalized understanding about Sea Star speed. There is plenty of room for further research and I implore others to do just that.

## References

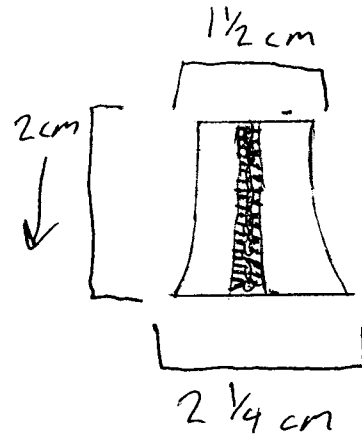
1. Sept J, Duane. *The Beachcomber's Guide To Seashore Life In The Pacific Northwest*. 1999
2. Niesen M, Thomas. *Beachcomber's Guide To California Marine Life*. 1994

Life Size

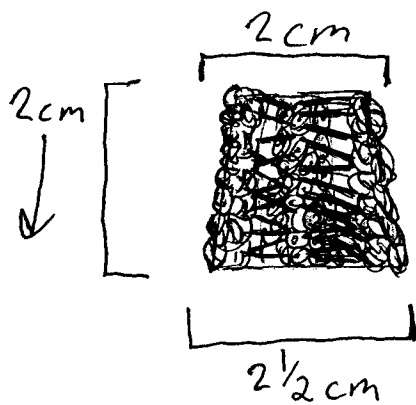
*Asterina miniata*



*Dermasterias imbricata*



*Pisaster brevispinus*



*Pycnopodia helianthoides*

