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Exploratory 1

Structural Comparison
Purple Sea Urchin

Introduction:

The Purple Sea Urchin or otherwise known as Strongylocentrotus purpuratus is part of the Echinodermata phylum. They are most commonly a purple or purplish-green hue, spherical in shape and covered with short spines. The purpuratus is an example of pentamerous radial symmetry. Pentamerous radial symmetry implies that the outer skeleton can be divided equally into five parts originating from the center point. The purple Sea Urchins can be found all throughout the Pacific Ocean, ranging from Alaska to Baja, California. Most are found in large groups in the lower intertidal zone but can be found in waters up to 525 ft. deep. Their primary food source is microalgae that they scrape off rocks but they also consistently eat macroalgae and some animal matter.

All echinoderms have calcareous internal skeletons but sea urchins fuse their bones together to form the test or shell. Purple Sea Urchins live all throughout the Oregon coastal area, inhabiting areas with high and low wave action. Marine animals are known to adapt their physiological features to help suit themselves to their unique environment. A question arises whether the Strongylocentrotus purpuratus adjusts it's test shape and thickness in order to help it survive in high wave action locals compared to low wave action areas. Researchers could hypothesize that urchins living in a high wave action habitat would exhibit a squat-like, flattened test. In addition to this, one could hypothesize that the urchin's test would be thicker in areas of high wave action so as to protect the individual.

Methods/Materials:

This experiment is designed to determine if the Purple Sea Urchin modifies its test in high wave action habitats. To test this, 20 sample urchins were collected from a location with high wave action (Middle Cove, Cape Arago, OR) and another 20 were collected from an area known for low wave turbulence (South Cove, Cape Arago, OR). Each urchin test was measured with a caliper for the height and radius, which would quantify test shape. Values with a higher height/radius ratio would be more bulbous. The caliper was also used to measure the thickness of the test. To keep the data accurate, the thickness sample was taken at a constant radius of 1 cm from the central point on the dorsal side of the test, which is the thickest part. Care was taken to ensure that the thickness was not measured on the base of a spine which would skew results.

Results:

High Wave Action

Location: Middle Cove, Cape Arago

Test #	Height/Radius (cm)	Thickness (mm)
1	1.083	1.9
2	1.062	2.2
3	1.086	1.7
4	1.059	1.9
5	1.129	1.3
6	1.026	1.9
7	1.233	1.7
8	1.077	1.5
9	1.056	2.1
10	1.061	2.1
11	1.175	2.1
12	1.162	2
13	1.103	1.9
14	1.15	1.5
15	1.129	2.2
16	0.969	1.8
17	0.806	1.6
18	1.088	1.7
19	1.19	2
20	1	2

Low Wave Action

Location: South Cove, Cape Arago

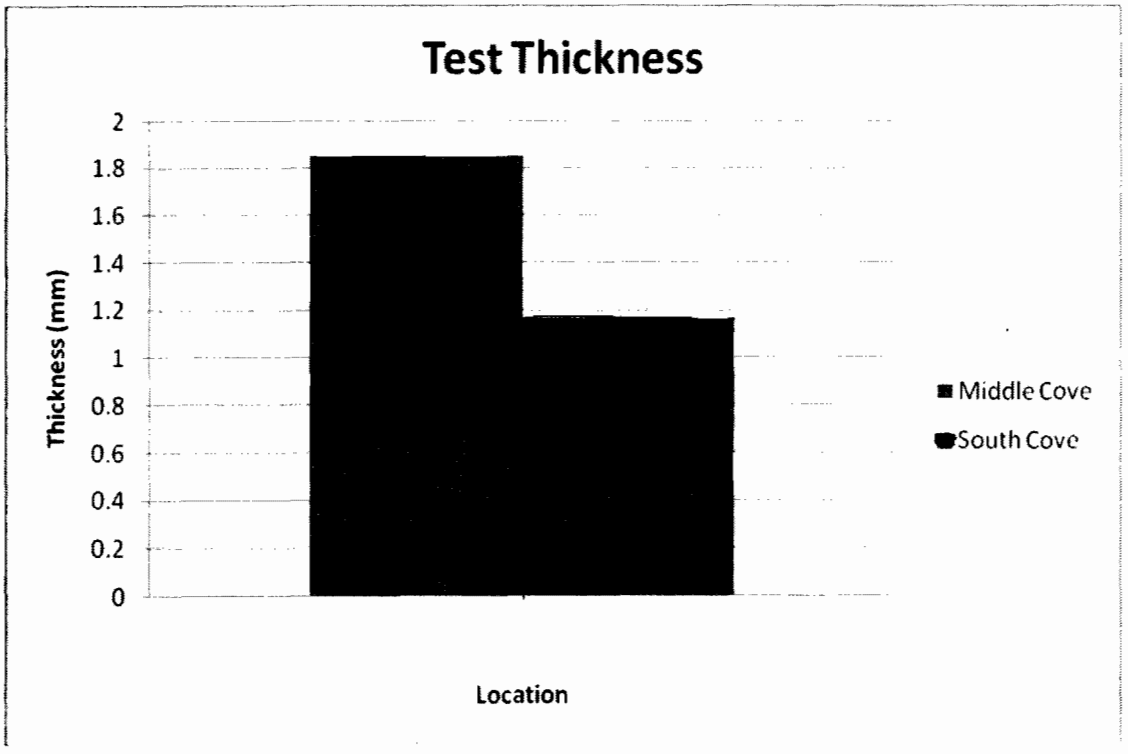
Test #	Height/Radius (cm)	Thickness (mm)
1	1.096774194	1.1
2	1	0.8
3	1.08	1.2
4	0.952380952	0.9
5	1.25	0.8
6	1	1
7	1.038461538	1.2
8	1	1.2
9	1.03125	1.5
10	1.212121212	1.5
11	1.060606061	1.3
12	1.333333333	1.5
13	1.193548387	1.1
14	0.9375	1.4
15	1.115384615	1.8
16	1.033333333	1.2
17	1.32	0.8
18	1	1.4
19	1.391304348	0.7
20	0.9375	1

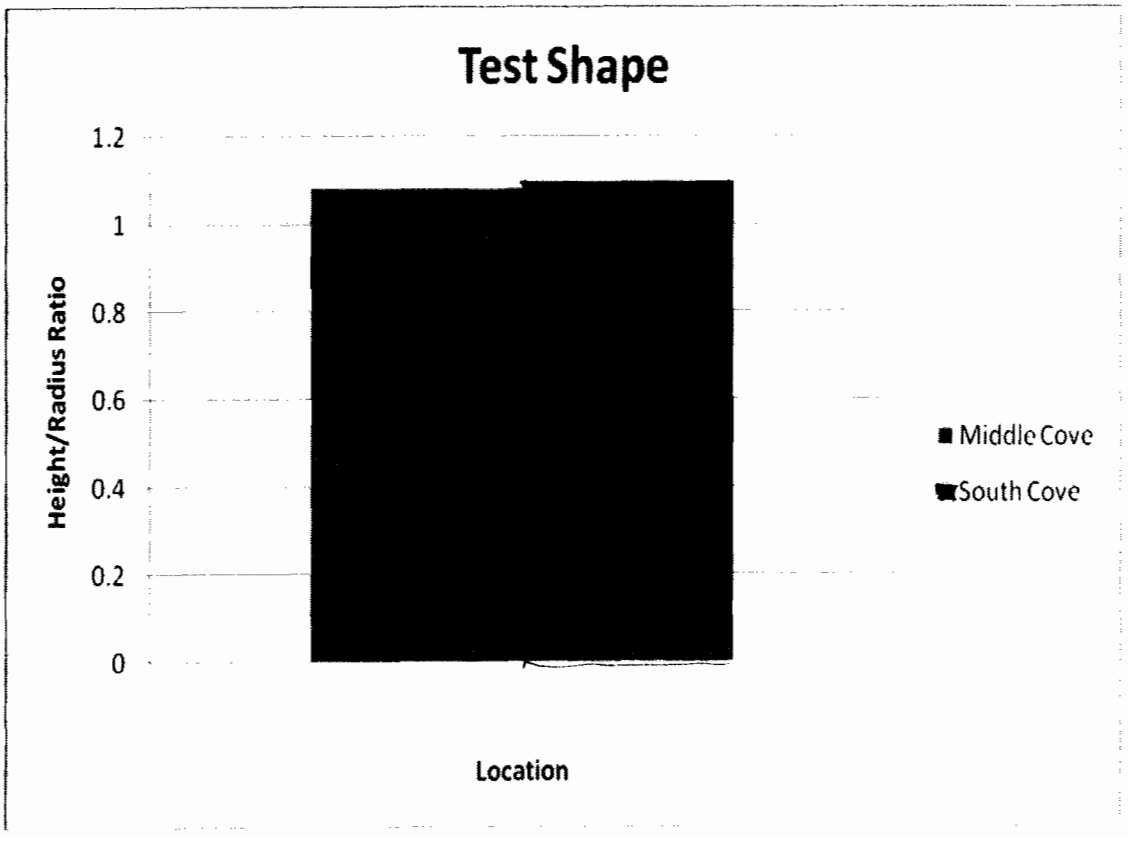
t-Test: Paired Two Sample for Means

Height/Radius Ratio	***Variable 1***	***Variable 2***
Mean	1.0822	1.099174899
Variance	0.008417116	0.019014335
Observations	20	20
Pearson Correlation	0.025984314	
Hypothesized Mean Difference	0	
df	19	
t Stat	-0.463944	
P(T<=t) one-tail	**0.323979607**	
t Critical one-tail	**1.729132792**	
P(T<=t) two-tail	0.647959214	
t Critical two-tail	2.09302405	

t-Test: Paired Two Sample for Means

Thickness	***Variable 1***	***Variable 2***
Mean	1.855	1.17
Variance	0.062605263	0.085368421
Observations	20	20
Pearson Correlation	0.268535176	
Hypothesized Mean Difference	0	
df	19	
t Stat	9.291156388	
P(T<=t) one-tail	**8.48509E-09**	
t Critical one-tail	**1.729132792**	
P(T<=t) two-tail	1.69702E-08	
t Critical two-tail	2.09302405	


Test Thickness
Thickness (mm)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Location
Middle Cove
South Cove


Test Shape
Height/Radius Ratio
1.2
1
0.8
0.6
0.4
0.2
0
Location
Middle Cove
South Cove

Conclusion:

After analyzing the data collected on test shape, one can conclude that there is no significant difference between individuals gathered in areas of high wave action and low wave action. This is evidenced by several analyses. The mean height/radius ratio in Middle Cove was 1.0822 as compared to South Cove with 1.09917. The differences in these two values are not significant enough to correlate test shape with wave activity. This is proved using a T-Test. The P value of the T-Test is great enough to exclude the possibility that the two were linked. Ther variability observed in test shape could possibly be due to microhabitat differences. Live individuals on flat surfaces tended to be more flattened in shape, whereas individuals living in protected creveses were more rounded.

There was, however, a trend observed in the shell thickness in relation with wave action. Individuals in areas with high wave action did exhibit thicker tests when compared with individuals exposed to low wave action. The mean test thickness for Middle Cove was 1.855 (mm), while South Cove had a mean thickness of 1.170 (mm). This constituted a significant difference between sites as evidenced by the t-test values.

Due to the number of samples collected, the data can be considered fairly reliable. The large sample set helped eliminate variability from influencing mean values significantly. One major source of error could be that fully intact specimins were not always available. This might have influenced measurements of height and/or radius. The measurement instrucments did not have a high degree of precision, which would result in less accurate data.

Two hypotheses were proposed; one was supported and one was refuted.

Observations showed that test shape was not influecned by wave action, therin supporting the null hypothesis that shape is unimpacted by wave action Test thickness was positively correlated with wave action as supported by observations.

Work Cited

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