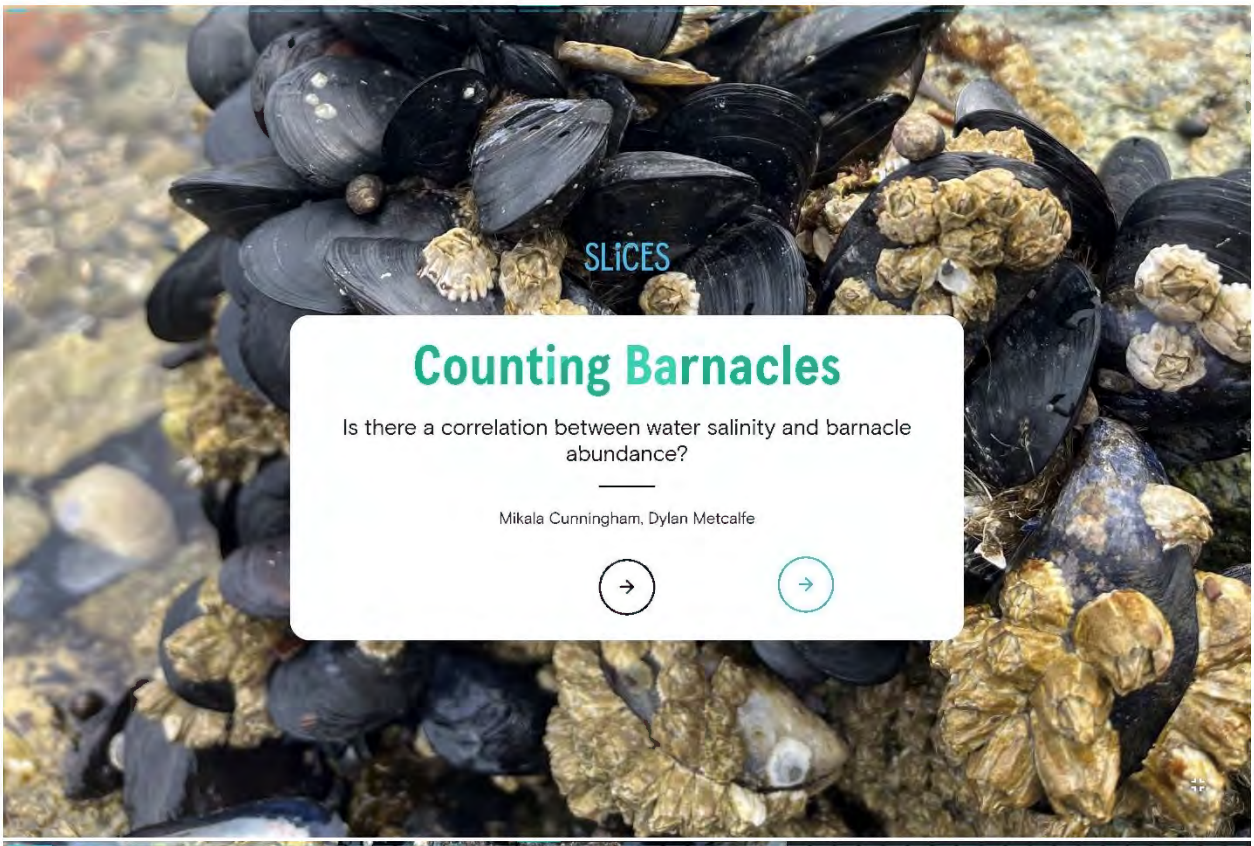
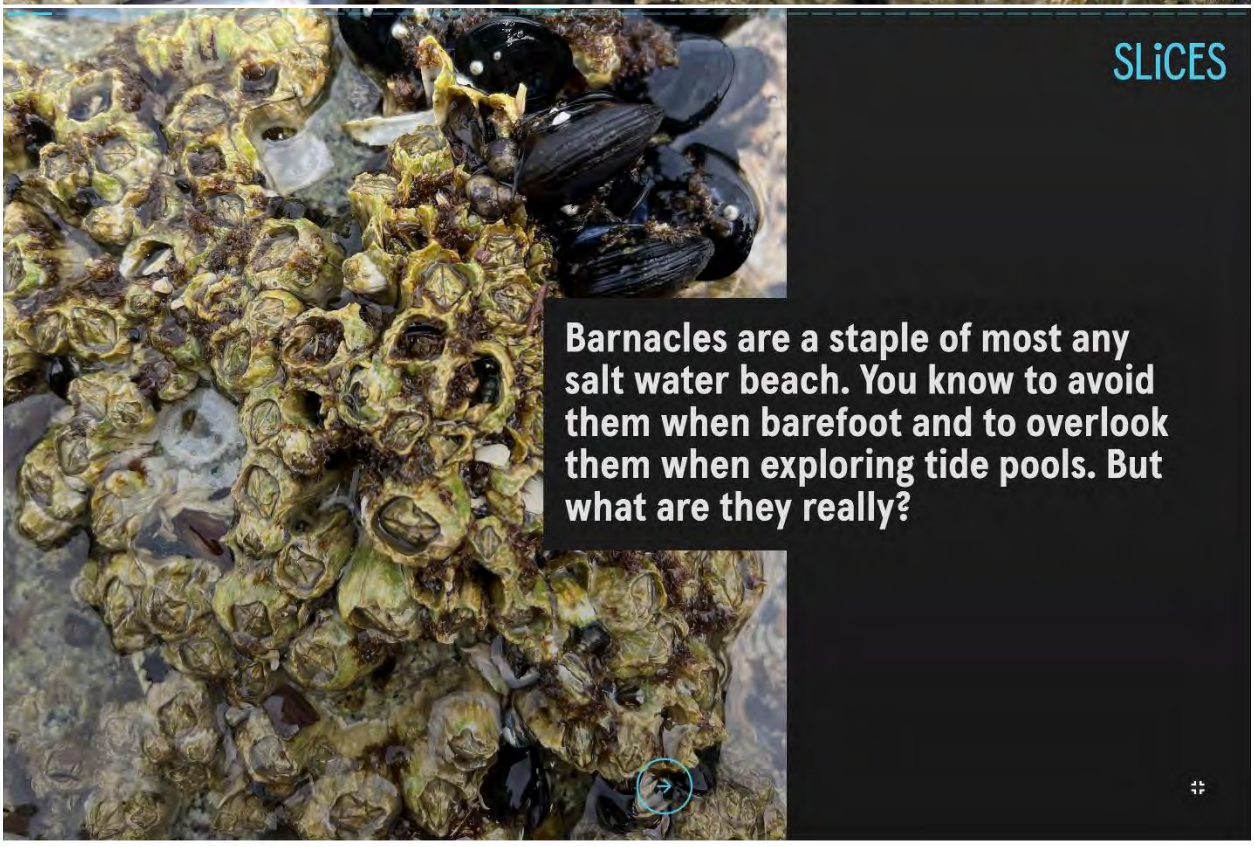
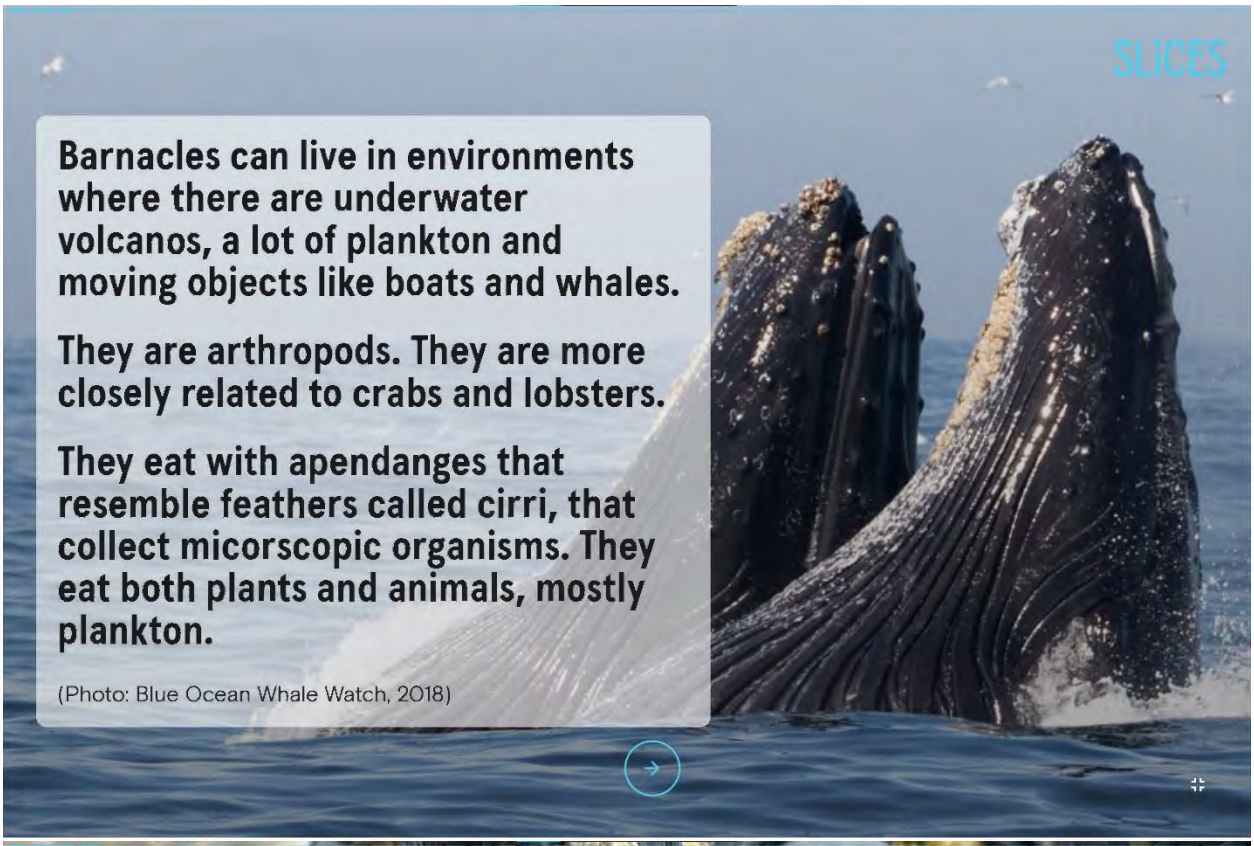
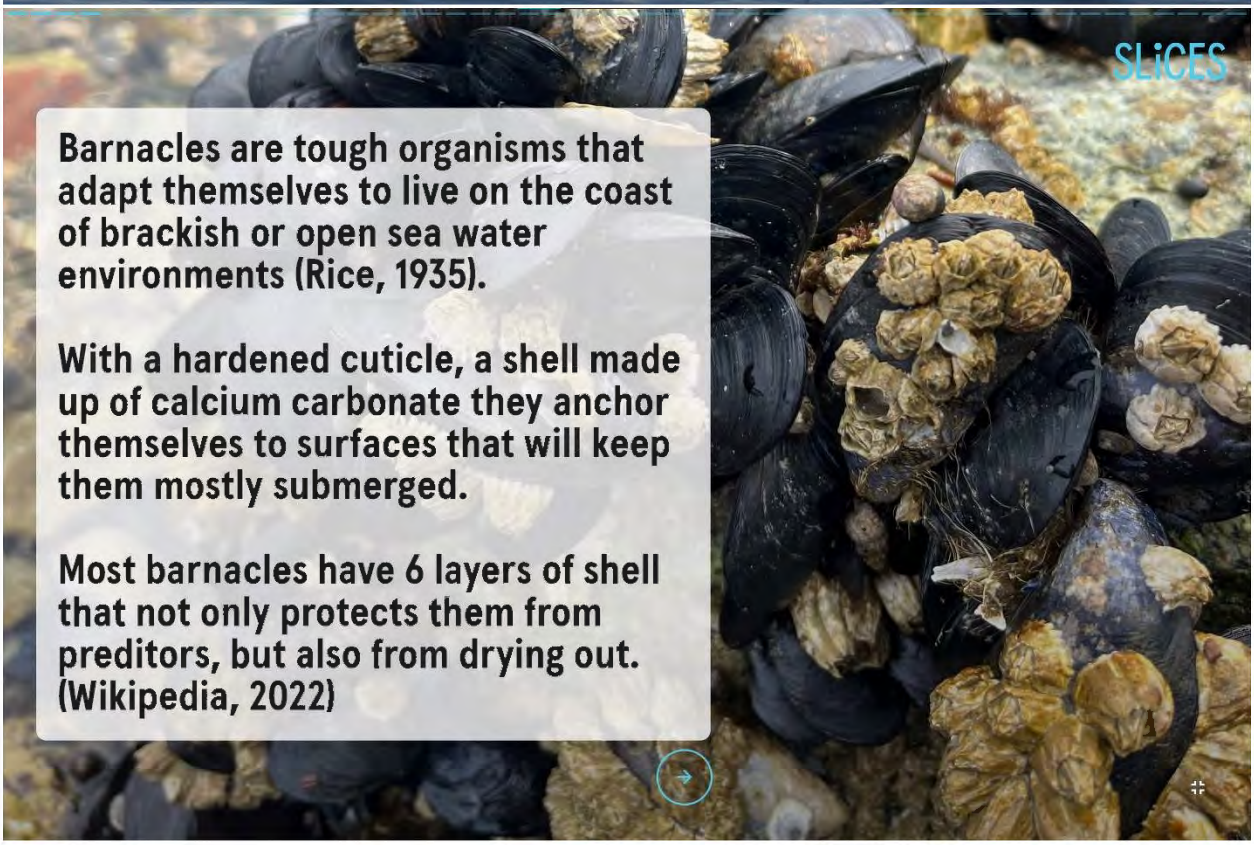

SLiCES
Counting Barnacles
Is there a correlation between water salinity and barnacle abundance?
Mikala Cunningham, Dylan Metcalfe


SLiCES
Barnacles are a staple of most any salt water beach. You know to avoid them when barefoot and to overlook them when exploring tide pools. But what are they really?


SLICES
Barnacles can live in environments where there are underwater volcanos, a lot of plankton and moving objects like boats and whales.
They are arthropods. They are more closely related to crabs and lobsters.
They eat with apendanges that resemble feathers called cirri, that collect micorscopic organisms. They eat both plants and animals, mostly plankton.
(Photo: Blue Ocean Whale Watch, 2018)

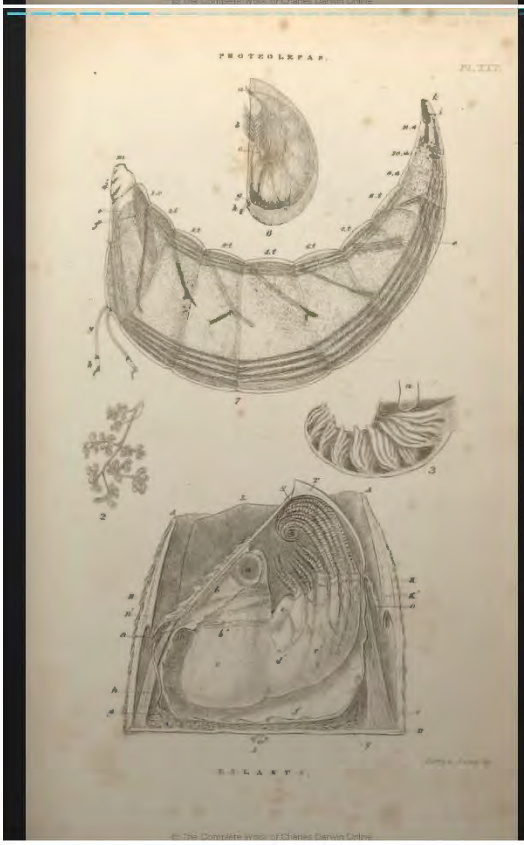

SLICES
Barnacles are tough organisms that adapt themselves to live on the coast of brackish or open sea water environments (Rice, 1935).
With a hardened cuticle, a shell made up of calcium carbonate they anchor themselves to surfaces that will keep them mostly submerged.
Most barnacles have 6 layers of shell that not only protects them from preditors, but also from drying out. (Wikipedia, 2022)

SLiCES

Barnacle Fun Facts:

-Barnacles live between 8 and 20 years.
-The gooseneck species are edible and eaten by many humans.
-They have the largest penis to body ratio of all animals on the planet.
-Barnacles do not have a heart.

(AZAnimials, 2021) (Wiki, 2022)
(Photo: Darwin, 1851)



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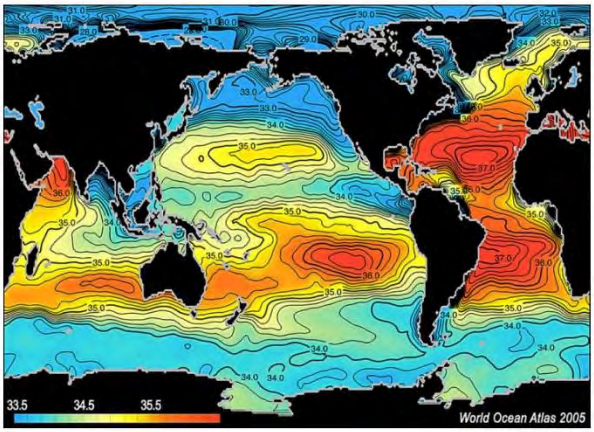
Over 1,400 species of barnacles live in our oceans world wide (NOAA, 2021). 75% of those species live in waters less than 300 feet under water. The other 25% thrive in the intertidal zone (Wiki, 2022).

When considering barnacles and water salinity, you would expect deeper waters to be more salty compared to the intertidal zones. Does this mean barnacles favor more salt since 75% of them are found in deeper waters?



What about water salinity? Why is the salinity of the ocean important?

Let's find out together.

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What is salinity?

Salinity is the number of dissolved salts and other elements including calcium, magnesium, and potassium within a body of water. Some bodies of water, like the Dead Sea for example, are very high in salinity which prevents marine life to thrive (Kennedy, 2020). The amount of salinity in seawater is measured in parts per thousand (ppt).

The attributes of salinity can tell us the density and heat capacity within a given amount of water. Salt is dense which tends to sink below the less salty water (Feldman, 2017). We see this play out in the patterns of our ocean currents, the mixing of fresh water and salt water in relation to density.

(Photo: Ostrovsky, 2018)

Do you think there is a correlation between water salinity and the abundance of barnacles in the Salish Sea?

A. They do not relate.

B. More barnacles = more salt.

C. Fewer barnacles = less salt.

D. More barnacles = less salt.

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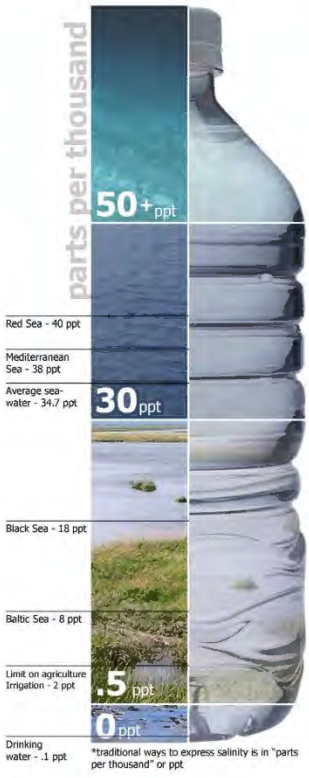
Do you think there is a correlation between water salinity and the abundance of barnacles in the Salish Sea?

A. They do not relate. (0%)

B. More barnacles = more salt. (60%)

C. Fewer barnacles = less salt. (40%)

D. More barnacles = less salt. (0%)



briny water
brine pools
50+ ppt

saline water
seawater, salt lakes
30-50 ppt

brackish water
estuaries, mangrove swamps, brackish seas and lake, brackish swamps
.5-30 ppt

fresh water
ponds, lakes, rivers, streams, aquifers
0-.5 ppt

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A group of biology students from Vancouver asked a similar question in 2014. They tested the salinity of the water in relation to barnacle life of two diffrent species of barnacles (Wordpress, 2014).

Next are their results.

(Photo: Summerlin, 2011)

briny water
brine pools
50+ ppt

saline water
seawater, salt lakes
30-50 ppt

brackish water
estuaries, mangrove swamps, brackish seas and lake, brackish swamps
.5-30 ppt

fresh water
ponds, lakes, rivers, streams, aquifers
0-.5 ppt

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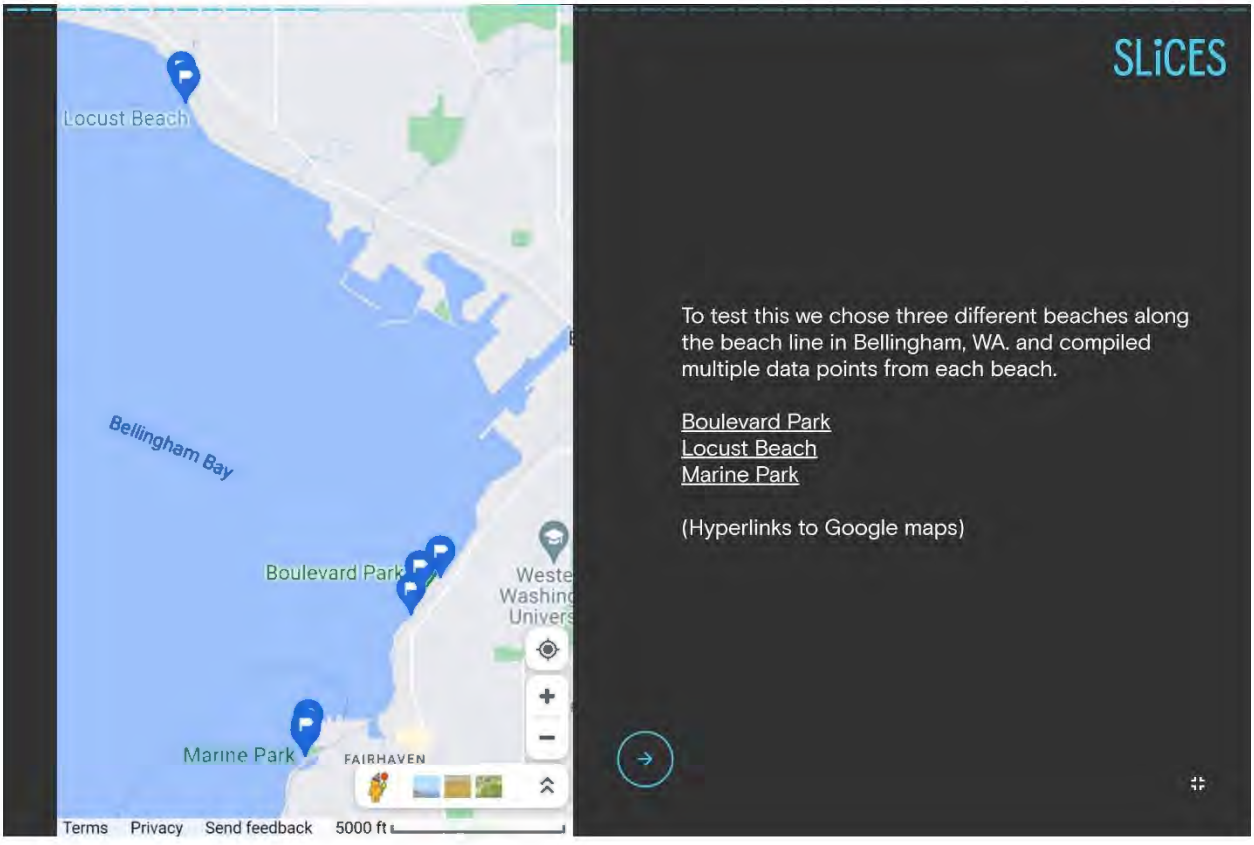
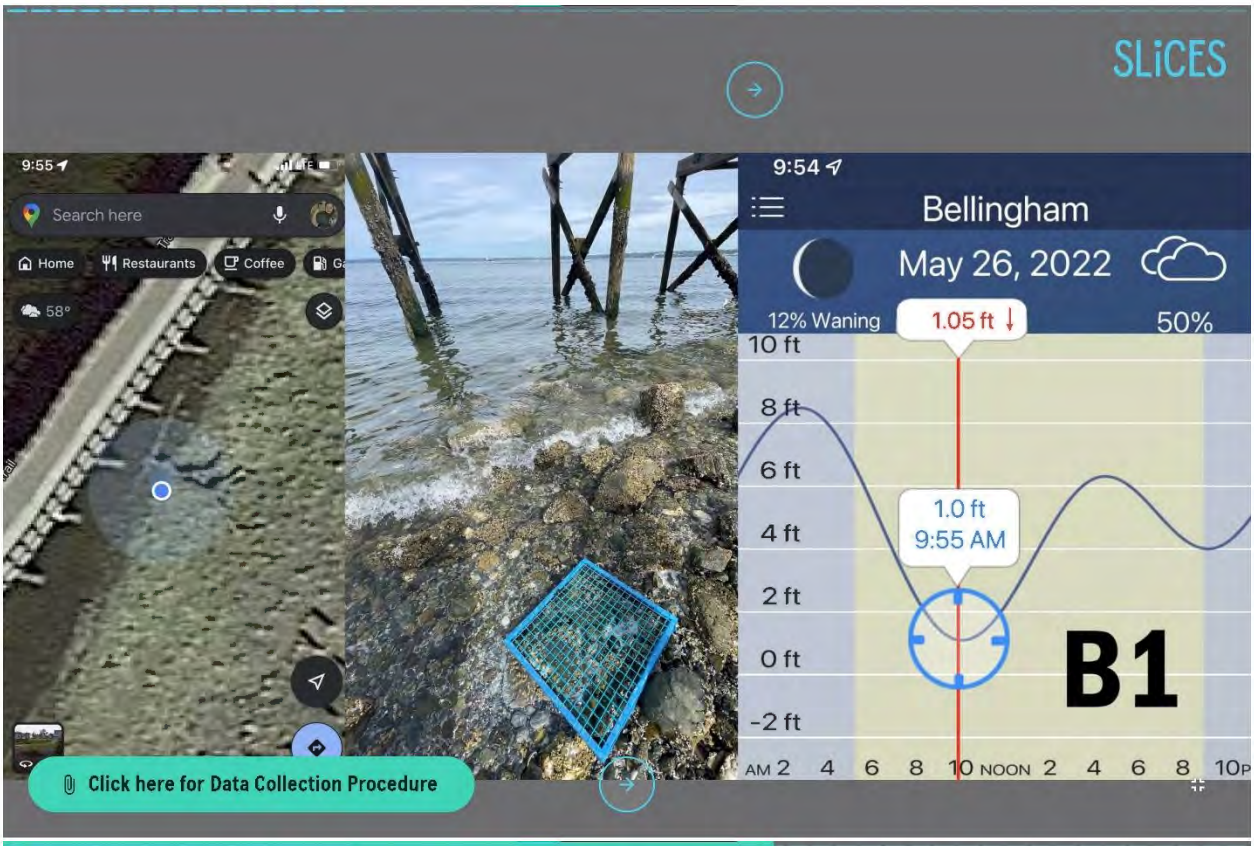
"We found that greater proportion of barnacles from Vancouver were feeding at higher salinities of 20 and 28 ppt, but both Vancouver and Bamfield barnacles were equally dismayed by the low salinity at 12 ppt. [We] see this as potential evidence to support the idea that Vancouver barnacles are better adapted to larger ranges of salinities more so than Bamfield barnacles because of the differences in salinity fluctuations within their natural habitats."

We hypothesize that because salt levels affect how well organisms will survive in the water and barnacles need a healthy balance of salinity to thrive, then we are likely to find more barnacles in water with higher levels of salinity.



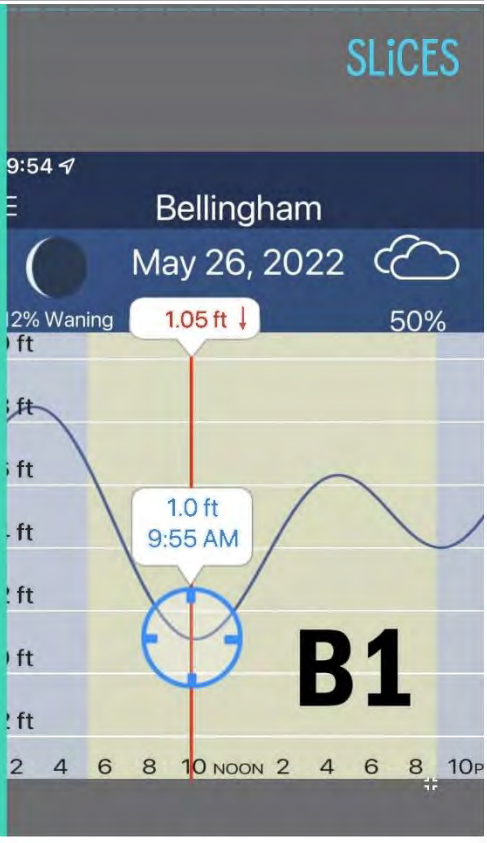


Click here for Data Collection Procedure

Here you can see the relative location where we took our first sample (in this case Sample B1) and a screen shot of the tide level when we collected the water sample as well as a photo of our physical survey set up.

This information was collected at each of the sample sites we visited.

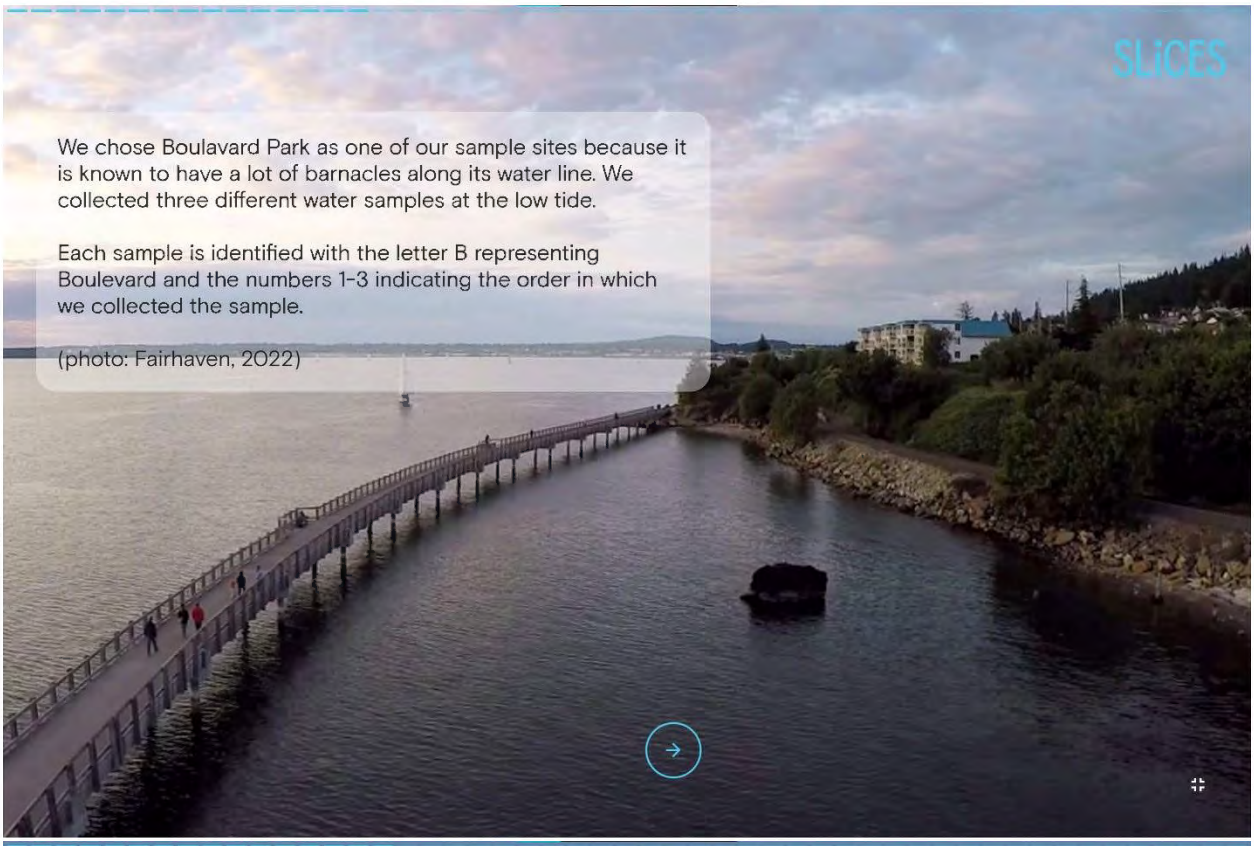
× Click here for Data Collection Procedure



We chose Boulavard Park as one of our sample sites because it is known to have a lot of barnacles along its water line. We collected three different water samples at the low tide.

Each sample is identified with the letter B representing Boulevard and the numbers 1-3 indicating the order in which we collected the sample.

(photo: Fairhaven, 2022)



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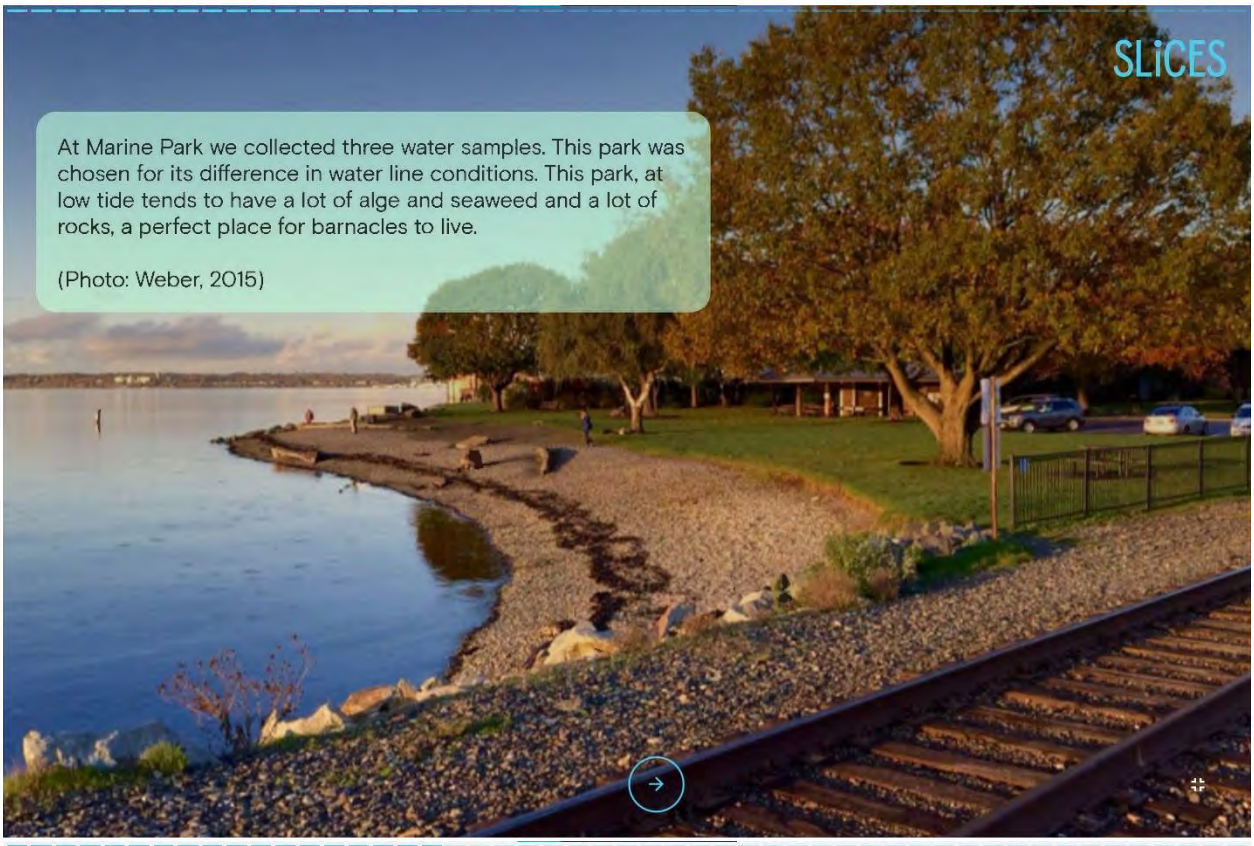
Locust Beach, we collected two water samples here. We chose to collect samples here because this beach is further north than the other two locations. This beach is closer to the Nooksack River inlet, potentially effecting the water salinity.

(Photo: Diehl, 2022)



At Marine Park we collected three water samples. This park was chosen for its difference in water line conditions. This park, at low tide tends to have a lot of alge and seaweed and a lot of rocks, a perfect place for barnacles to live.

(Photo: Weber, 2015)

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To maintain consistency we used the same grid frame and took a photo of each sample location, and counted the barnacles we are able to see in each photo for each location.

We used a standard mathamatical freqency equation to determine the coverage of barnacles.

All of the data was collected on the same day, May 26th 2022 within two hours of eachother.

The next several imagas is a slideshow from our data collection day. Enjoy.


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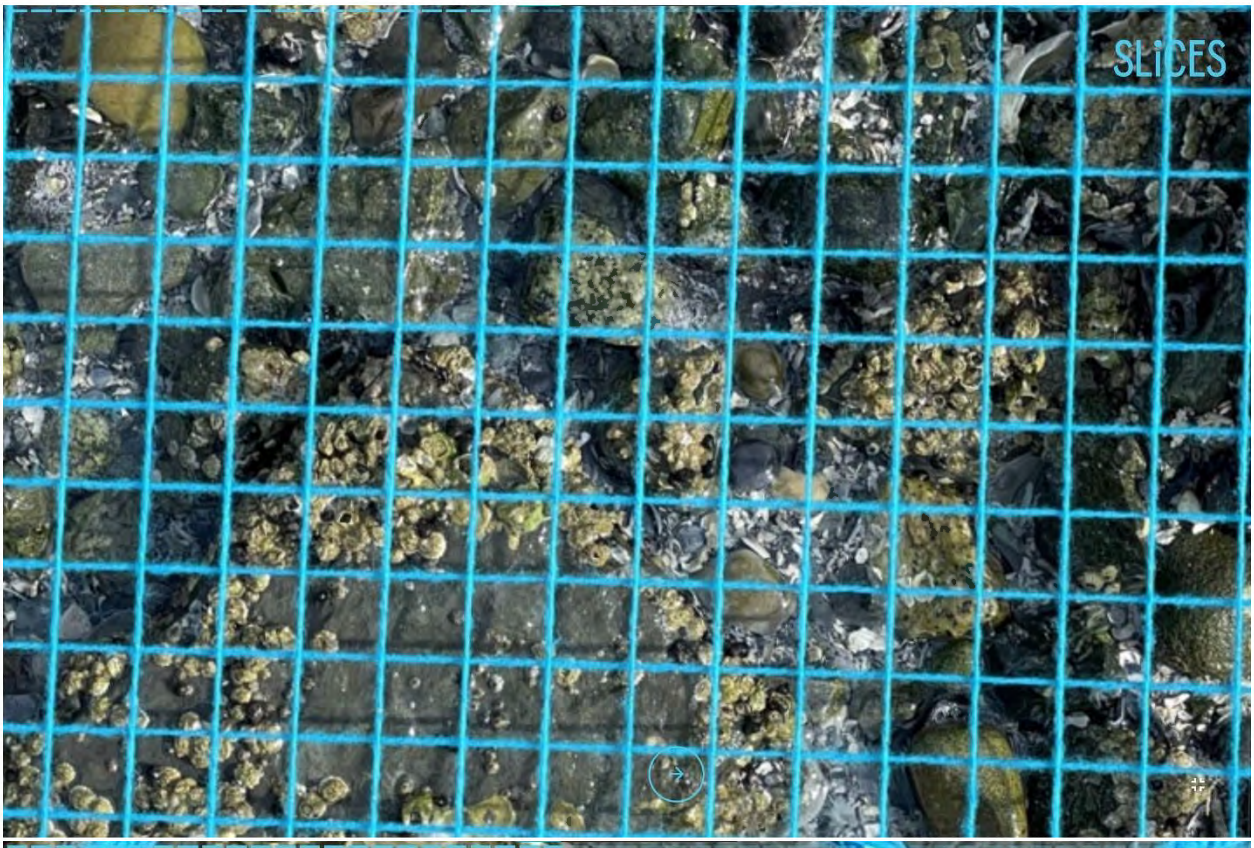
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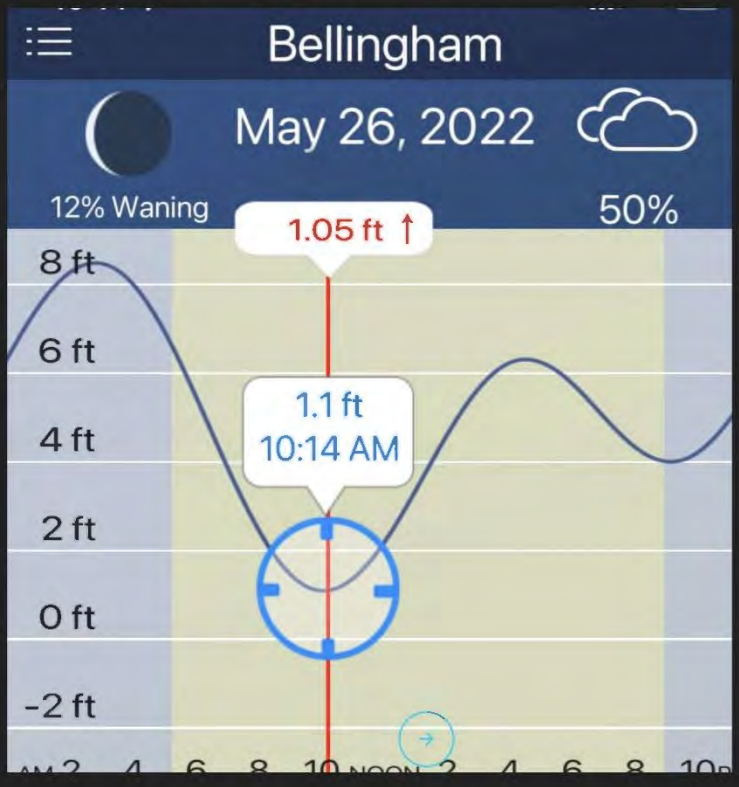

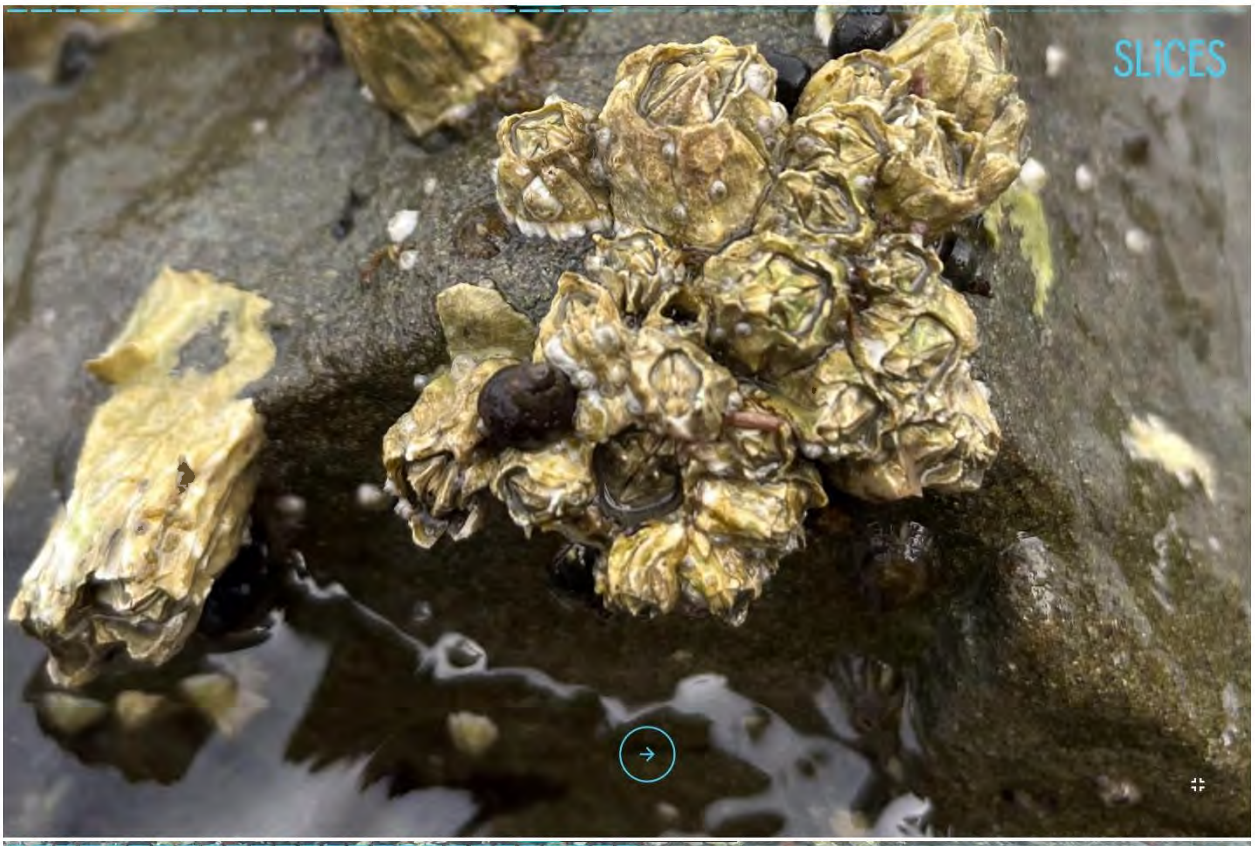
SLICES


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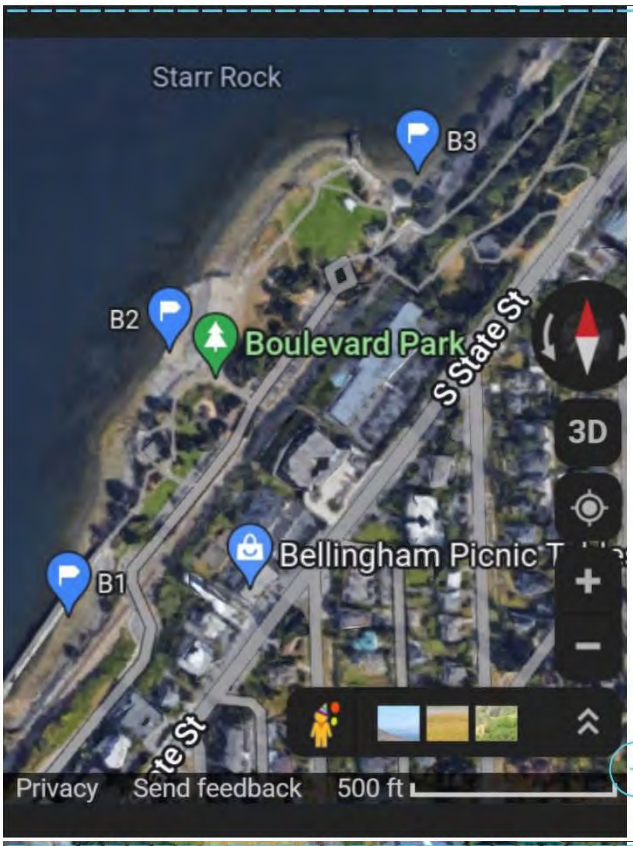

Boulevard Park Data

B1 : 52.8%
B2: 22.2%
B3: 13.3%

*These percentages along with the percentages at the other locations where determined by counting the number of squares that barnacles appeared and dividing it by the total number of squares in our quadrat (255) and then multiplying that number by 100.

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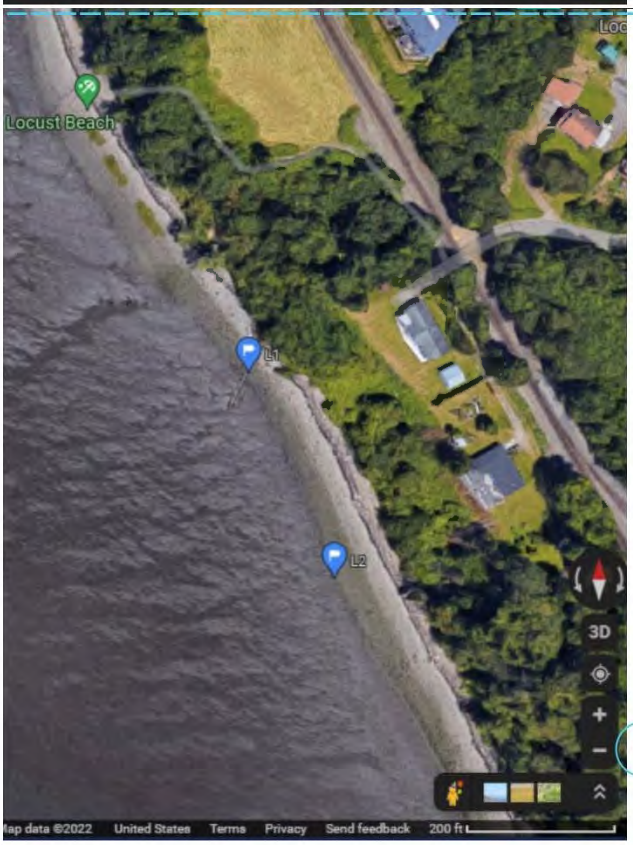

Locust Beach Data

L1 : 1.3%
L2 : 0%

*Very few barnacles here in the mud flats as there where not a lot of places for barnacles to attatch as well as the water line was several hundred feet out from where the rock line ended.

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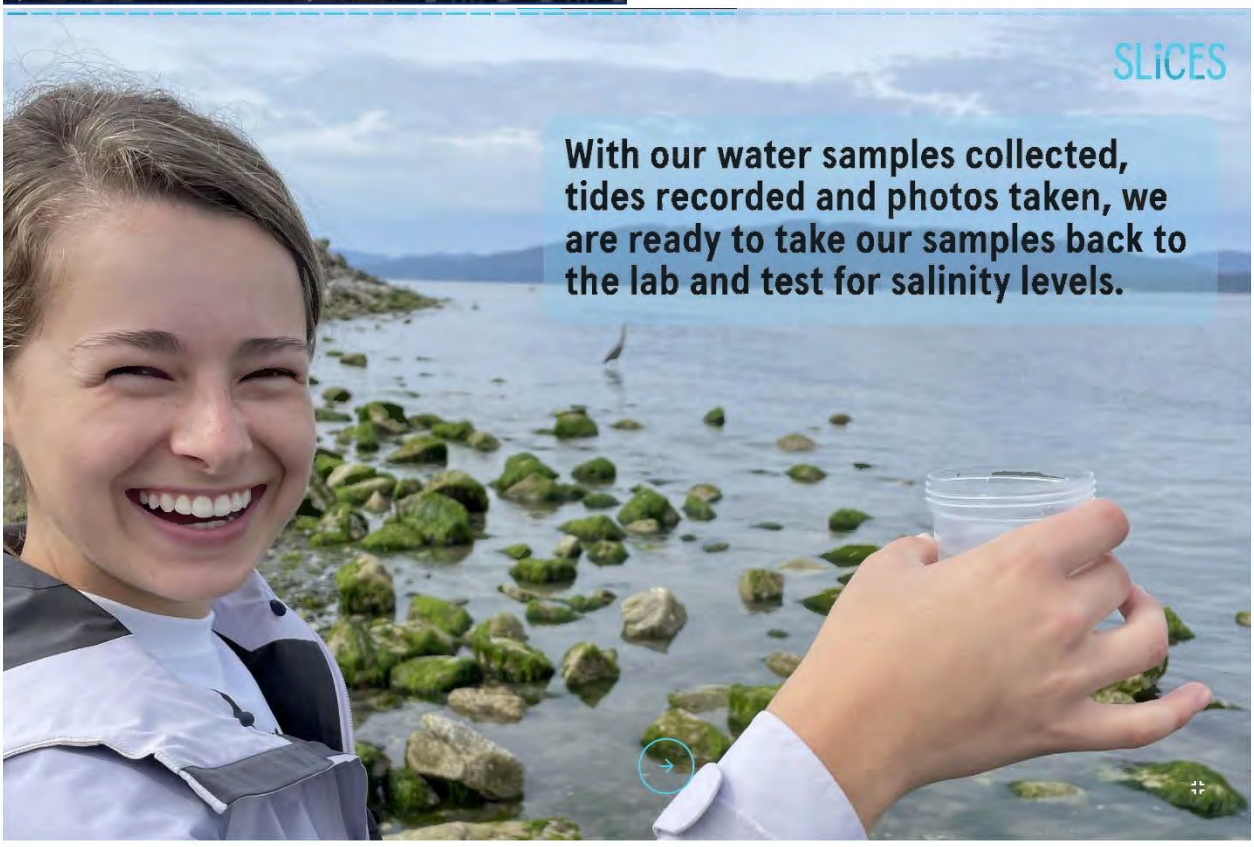
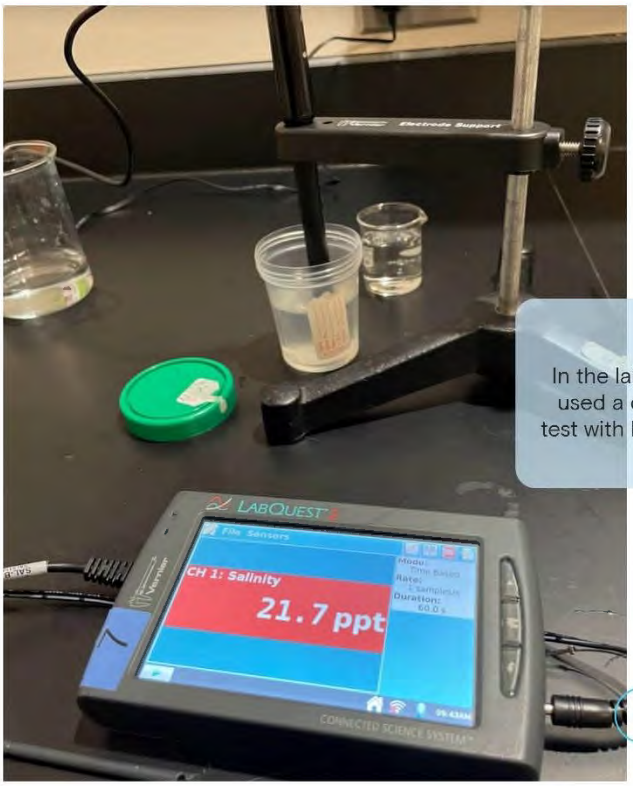
Marine Park Data

M1 : 43.6%
M2 : 10.7%
M3 : 37.8%

*We suspect that M2 has lower amount of barnacles because it has a higher human foot traffic compared to the other two locations. M1 is heavily covered in algae and seaweed, while M3 is past a bank of large boulders making the terrain more difficult to access.





LAB TESTING

In the lab we used two methods to test the water salinity. We used a digital hydrometer and a refractometer. We chose to test with both tools to see if there was a difference in numbers, and to attempt to get more accuracy.

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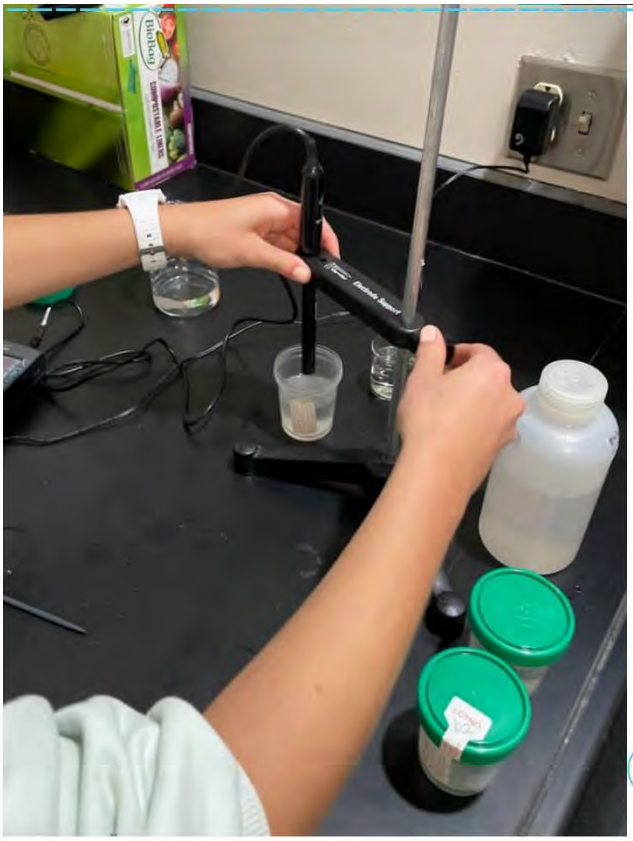

Testing water Salinity with a Hydrometer:

Ensuring that the hydrometer probe was rinsed with distilled water and patted dry with a cloth, we would lower the probe into the sample and swirl the liquid. Swirling the liquid allows for any settled salt molucules to rise and properly be counted.

After a few seconds, the hydrometer screen would display a number, that number is the level of salinity of the water mesured in ppt.

Hydrometer Salinity results

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Boulevard Park

B1: 21.7 ppt

B2: 20.2 ppt

B3: 21.9 ppt

Marine Park

M1: 25.2 ppt

M2: 24.4 ppt

M3: 24.5 ppt

Locust beach

L1: 10.9 ppt

L2: 10.8 ppt

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Procedure for using a Refractometer:

We ensured that the refractometer was properly calabrated to zero and the glass plate was clean and dry from any debris or water. We placed a few drops of the sample using a clean pipette. Then closing the plastic cover over the glass plate, we held the refactometer up towards the natural light and veiwed through the veiw finder to determine the sample's salinity.

Where the blue and white sections meet is the salinity level of the sample.

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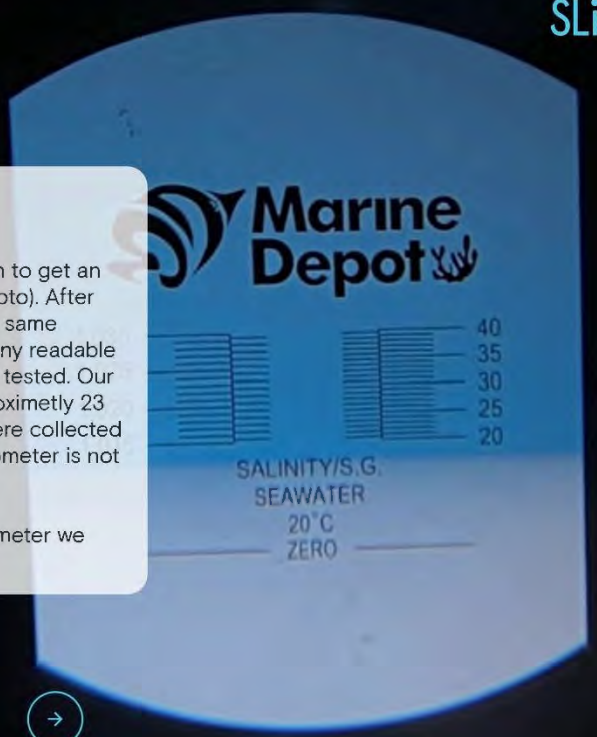
Results of the refractometer:

All of our sample's results did not read high enough to get an accurate reading with this tool (as shown in the photo). After using two different refractomerters and getting the same results, we suspect that this method did not yield any readable results is due to ideal tempature of the water when tested. Our samples had been resting at room temperture, aproximetly 23 degrees Celcius. Also considering our samples where collected from an estuary opposed to ocean water a refractometer is not the appropreate tool for our samples.

Continuing with the data collected from the Hydrometer we compliled all of our results together to compare.



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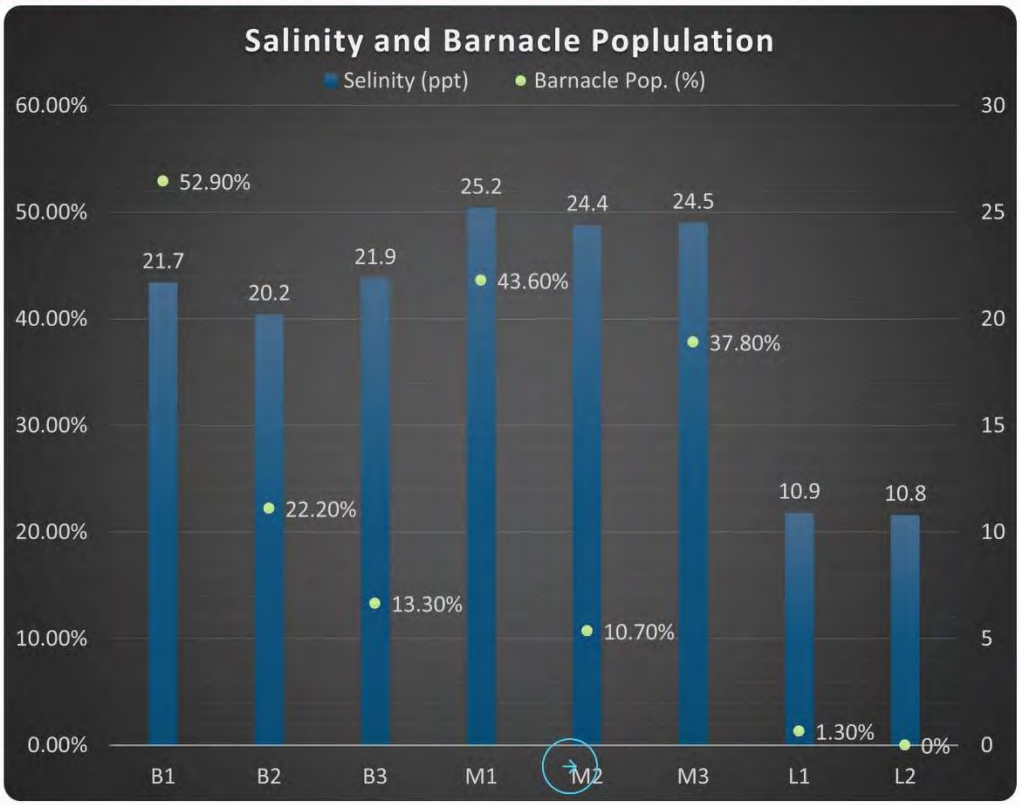
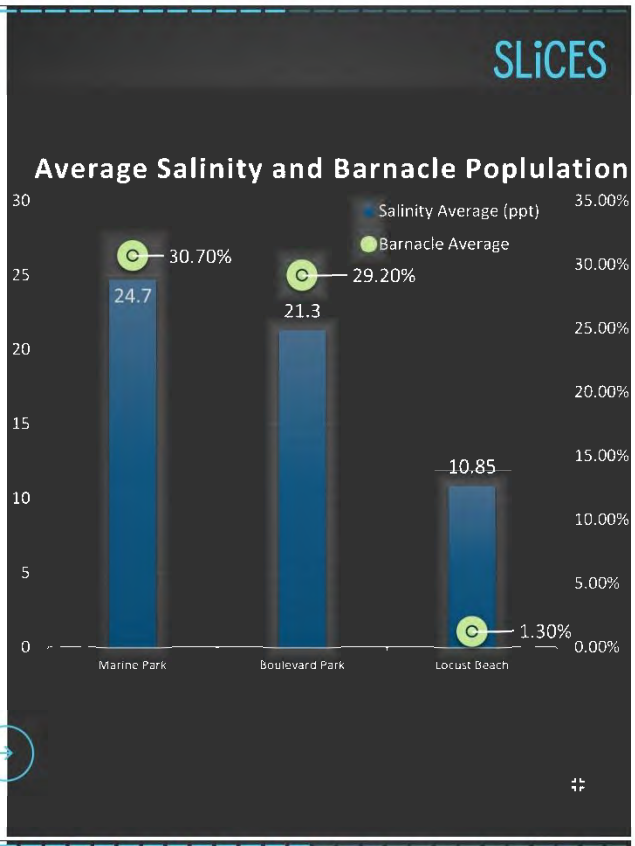


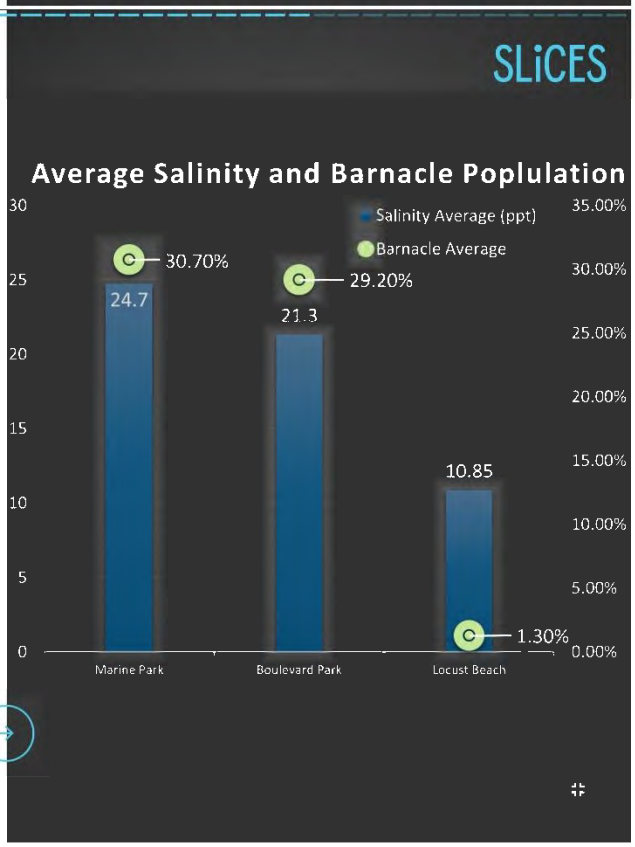
Our results show that at Marine Park the salinity levels on average is highest of the three locations.

The amount of barnacle coverage on average at Marine Park is the also highest of all three locations.

This supports our hypothisis that higher salinity levels will produce a higher barnacle population.



Boulevard Park has a lower level of salinity and slightly lower coverage of barnacles compared to Marine park.



Result Discussion

The fact that we found few barnacles at Locust Beach is likely due to the low salinty levels. The fresh water being distributed into Bellingham Bay from the Nooksack River lowers that salinity level so much that it makes for an unideal environment for barnacles.

That in combination of the tide receding out past the mud flats exposing the barnacles to the sun for longer periods of time, risking being dried out by the sun or eatten by birds may also contribute to the lack of barnacles at Locust Beach.

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Result Discussion

Our hypothosis of barnacles needing higher levels of salinty in order to thrive is supported with our collected data.

Although, when considering how close the data values are between Boulavard and Marine Park, this may suggest that the "moderate" level of salinity at Boulavard could be just as favarable as the slightly higher levels.

Result Discussion

The results of our data suggest that the ideal salinity range for barnacles to thrive in the Bellingham Bay is bettween 20-25 ppt. Between Boulavard and Marine Park salinity values.

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Where you surprised with our findings?

A. Completely unexpected!

B. Your results are about what I expected.

C. I had no expectations.

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Where you surprised with our findings?

A. Completely unexpected! (67%)

B. Your results are about what I expected. (0%)

C. I had no expectations. (33%)

Does our work inspire more questions for you about barnacles and their habitats?

A. What other conditions effect barnacles?

B. This presentation satisfies my interest.

C. How do barnacles effect others?

D. I want to learn more about barnacles and salinity!

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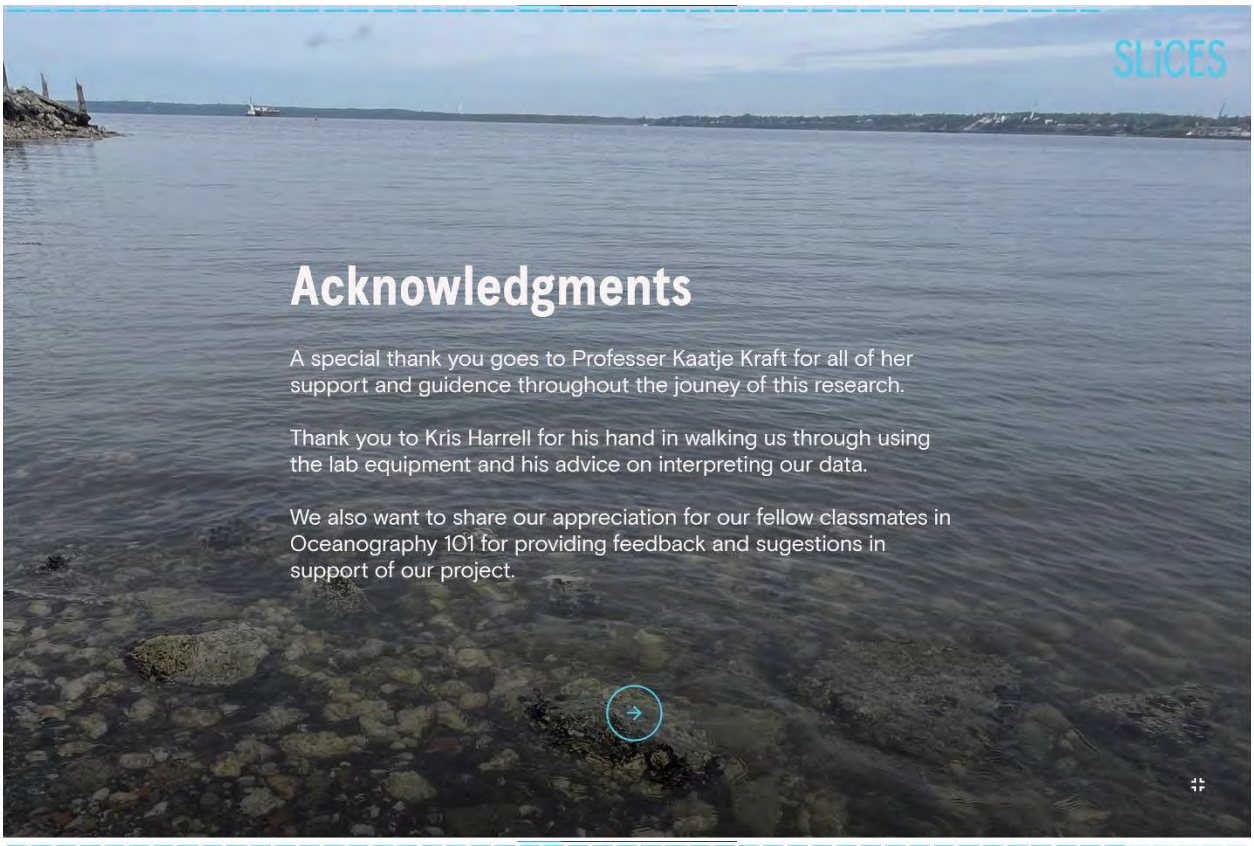
Does our work inspire more questions for you about barnacles and their habitats?

A. What other conditions effect barnacles? (33%)

B. This presentation satisfies my interest. (0%)

C. How do barnacles effect others? (67%)

D. I want to learn more about barnacles and salinity! (0%)



Acknowledgments

A special thank you goes to Professer Kaatje Kraft for all of her support and guidence throughout the jouney of this research.

Thank you to Kris Harrell for his hand in walking us through using the lab equipment and his advice on interpreting our data.

We also want to share our appreciation for our fellow classmates in Oceanography 101 for providing feedback and sugestions in support of our project.

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Oceanagraphy 101
Whatcom Community College
Spring Quarter 2022

Professor and Supervising Scientist
Kaatje Kraft
Teaching Assistant
Kris Harrell
Student Scientists and Authors
Dylan Metcalfe, Mikala Cunningham

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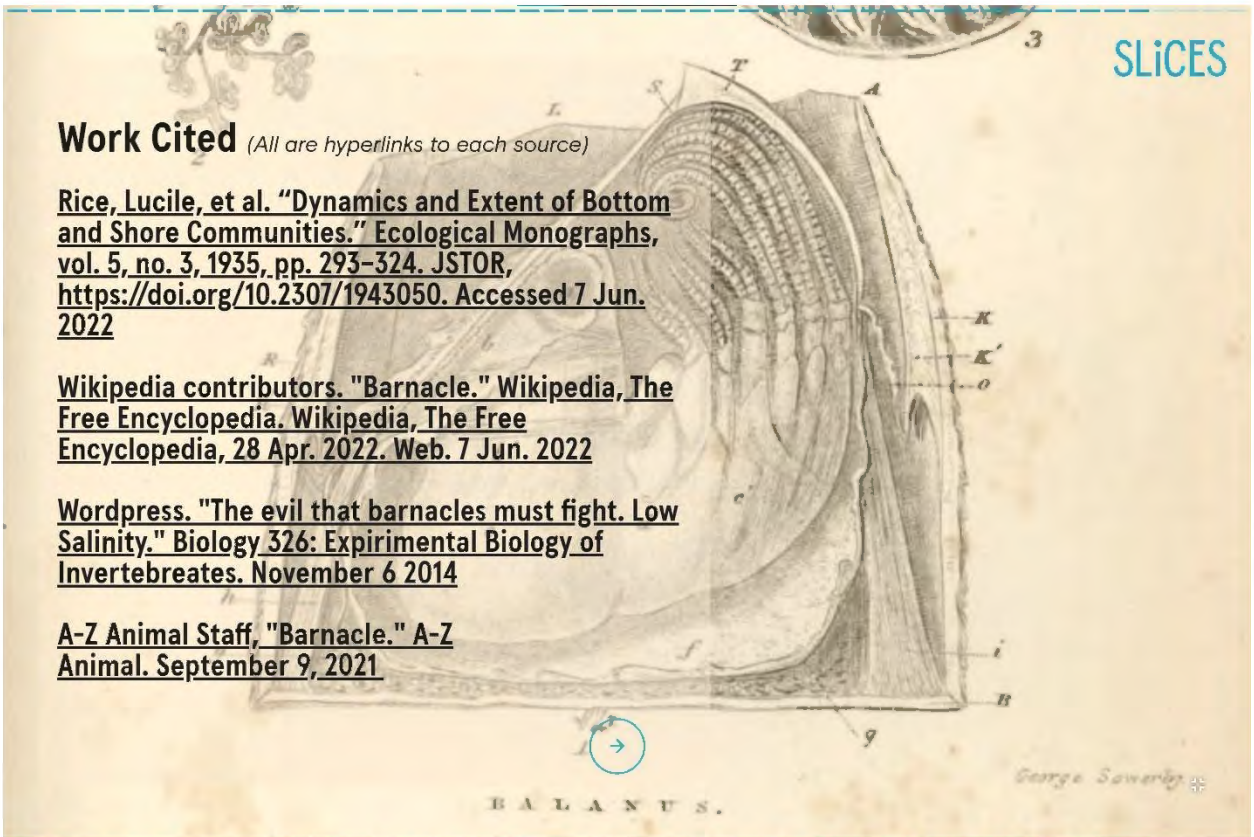

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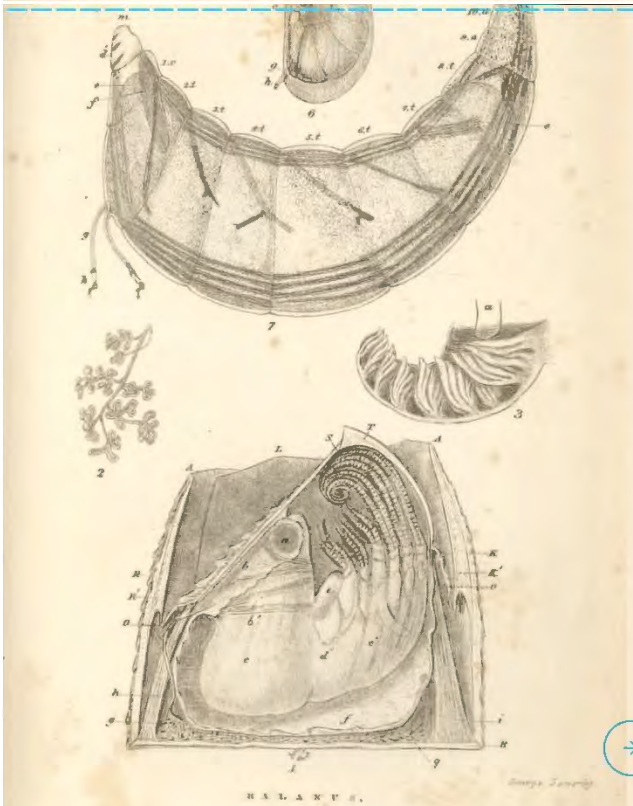

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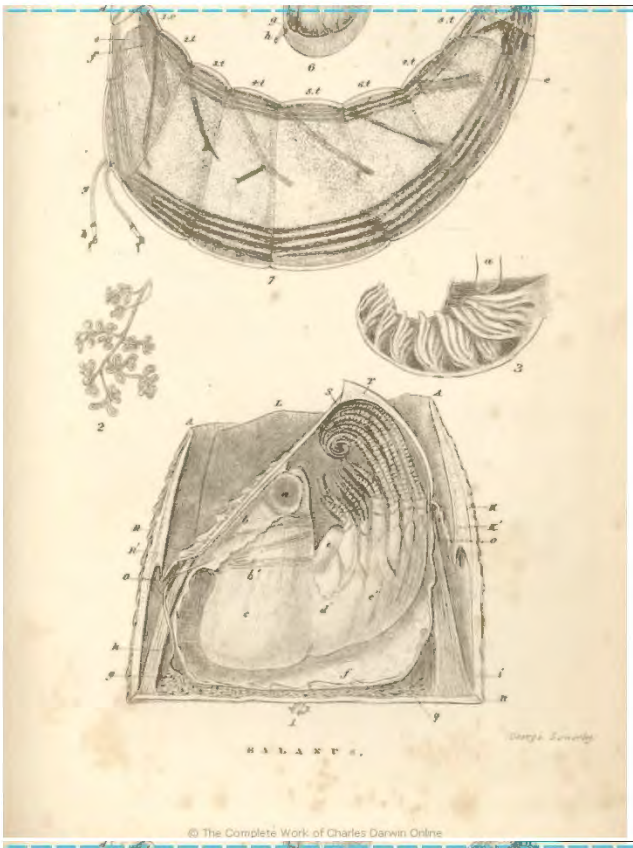

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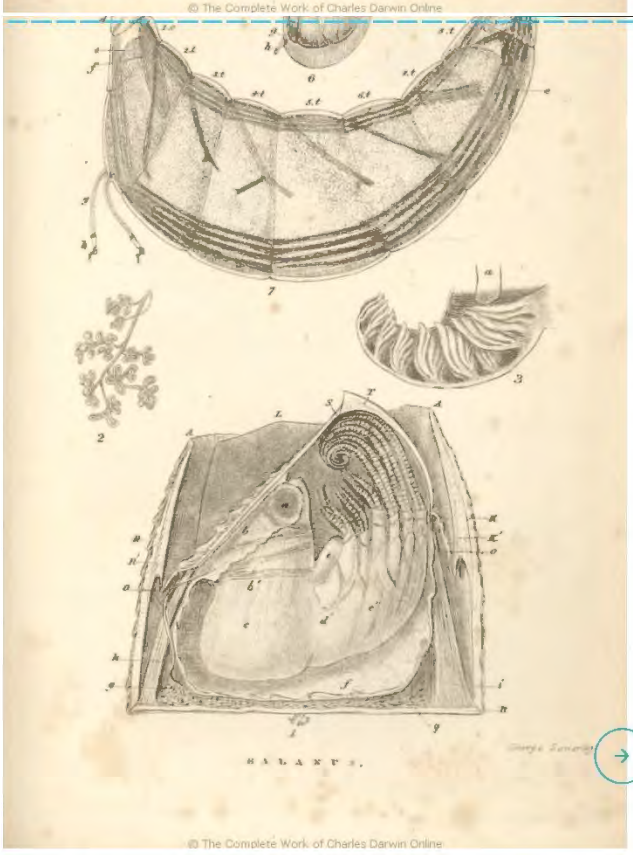

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Uncited photographs and graphs where created by the authors.