

# Ecology Design IA

An investigation  
into the ecology of  
low-energy rocky  
shores

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## RESEARCH QUESTION:

How does the amount of sunlight exposure alter the amount of gastropods that are stuck to rocks on the lower intertidal low-energy rocky shore?

## BACKGROUND INFORMATION

Rocky intertidal shores contain a variety of organisms many of which are gastropods, organisms whose main feature is their muscular foot, which is their only source of transport. A number of gastropods that can be included in the investigation may be:

- Constricted top snail
- Hercules mudwink
- Striped mouth periwinkle

These species, and many more may be present at the experimental site and can be recorded for results.

Snails, as well as many other gastropods produce a sticky mucus through their muscular leg that allows them to travel seamlessly over sharp surfaces. This mucus also allows the organisms to adhere themselves to the surface in order to ingest food or to excrete. The substance that sticks to the surface is known as an epiphragm, "a closing membrane or septum (as of a snail shell or a moss capsule)" (Mariam-Webster, 2011) which is essentially dried mucus. The epiphragm also allows the organism to abstain from water loss and to retain as much moisture as possible, which would be useful when in a area of high heat or low water content.

Many epiphragms are calcareous, or contain high calcium -carbonate content. This aids in the strength of the bond between the organism and the surface it wishes to attach itself to. "Gastropods can also create a calcareous epiphragm, prior to annual hibernation ." (Wikipedia, 2010) An epiphragm is not to be confused with an operculum, which is a physical attachment to the muscular foot which allows the organism to retain its moisture.

While any epiphragm does essentially allow the organism to stick to the surface indefinitely, the organism can be removed from the surface with a certain amount of force.

Intensity of sunlight changes as the day goes by, so therefore if the independent variable is Sun exposure, it means that the variable is also time as well. So therefore the experiment will be conducted over a period of time where the Sun's intensity changes as time goes by.

Throughout the year, the amount of sunlight (and essentially UV radiation) fluctuates according to the seasons and the Earth's orientation to the Sun. Furthermore, cloud cover as well as weather conditions on the rocky shore may influence an organism's inclination to be exposed to sunlight.

During summer, sunlight and UV radiation are at their highest, which also increases the rate of photosynthesis in plants and phytoplankton. These organisms are also potential food sources for organisms that inhabit the rocky shores, so food availability is also a factor which may influence any organism's inclination to reveal itself to open areas.

This design describes the method to use to determine the effect of sunlight intensity on the amount of organisms that are stuck to rocks on a low energy rocky shore in the lower intertidal zone.

## VARIABLES

Variable	Changing	How it will be changed	Values of the variable
Independent	The amount of Sun exposure on the experimental site	By recording data at different times of the day	<ul style="list-style-type: none"> <li>- Sunrise* (varies from day to day, however a standard of 0600 hours may be used)</li> <li>- 0700 hours</li> <li>- 0800 hours</li> <li>- 0900 hours</li> <li>- 1000 hours</li> <li>- 1100 hours</li> <li>- 1200 hours</li> <li>- 1300 hours</li> <li>- 1400 hours</li> <li>- 1500 hours</li> <li>- 1600 hours</li> <li>- 1700 hours</li> <li>- 1800 hours</li> <li>- Sunset* (varies from day to day, however a standard of 18:30 may be used)</li> <li>- 19:00 hours</li> </ul>
Dependent	Amount of gastropod organisms attached to the rocky shore at the experimental site	- Counting the number of organisms attached to the rocky shore	- Number of organisms measured in discrete values (#)

(Data is not needed for a full 24 hours as amount of sunlight generally doesn't change after the Sun has set, unless conducting experiment at one of the poles of the Earth, when times of sunrise and sunset should regularly be checked )

\*Sunrise and sunset are defined by the point at which the Sun has just touched the horizon prior to rising or setting

### Control of Constant Variables

<u>Variable</u>	<u>Effect</u>	<u>How it will be controlled</u>
Temperature of environment	<ul style="list-style-type: none"> <li>- Whether the temperature of the environment is favourable or not, determines organisms' inclination to be exposed to the outside world, so therefore this variable is highly significant</li> </ul>	<ul style="list-style-type: none"> <li>- Data to be recorded in the same season, and also in between the same solstices at each trial</li> <li>- Data to be recorded under same to similar weather conditions (therefore, a day forecast for scattered showers is not suitable as data recorded when raining will be different to data recorded when not)</li> <li>- Cannot be controlled, so therefore will be measured</li> </ul>
Food availability	<ul style="list-style-type: none"> <li>- Food (phytoplankton, algae) availability affects an organisms inclination to expose itself to the outside world, so therefore this variable is highly significant</li> </ul>	<ul style="list-style-type: none"> <li>- Experiment to be conducted in the same area, so as to keep food supplies around the same</li> <li>- Cannot be controlled, or measured, so the experiment must be conducted in the same area.</li> </ul>

Tides	<ul style="list-style-type: none"> <li>- Whether the tide is high or not, the rocky shore may be inundated, gastropod organisms cannot swim, so therefore if the experiment is conducted when the shore is inundated, it will affect the gastropods' inclination to expose itself</li> </ul>	<ul style="list-style-type: none"> <li>- Experiment to be conducted in an area not totally inundated with water</li> <li>- Cannot be controlled, so therefore will be measured</li> </ul>
Water salinity	<ul style="list-style-type: none"> <li>- Organisms may be adapted to one certain saline level, so therefore changes in water salinity may affect an organism's ability to function correctly and therefore its inclination to expose itself</li> </ul>	<ul style="list-style-type: none"> <li>- Experiment to be conducted in the same area</li> <li>- Cannot be controlled, so therefore will be measured</li> </ul>
pH	<ul style="list-style-type: none"> <li>- Organisms may be adapted to one certain pH level, so therefore changes in water pH may affect an organism's ability to function correctly</li> </ul>	<ul style="list-style-type: none"> <li>- Experiment to be conducted in the same area</li> <li>- Cannot be controlled, so therefore will be measured</li> </ul>
Weather of site	<ul style="list-style-type: none"> <li>- Whether the weather conditions are favourable to an organism's adaptations may affect its inclination to come out</li> </ul>	<ul style="list-style-type: none"> <li>- Data to be recorded under same to similar weather conditions (therefore, a day forecast for scattered showers is not suitable as data recorded when raining will be different to data recorded when not)</li> <li>- Cannot be controlled, so therefore will be measured</li> </ul>
Placement	<ul style="list-style-type: none"> <li>- May affect the variety of organisms that are experimented on</li> </ul>	<ul style="list-style-type: none"> <li>- Experiment to be conducted in the lower intertidal zone</li> </ul>
Material which the quadrat is made of	<ul style="list-style-type: none"> <li>- May affect an organism's inclination to come out if the quadrat is not made of a favourable substance</li> </ul>	<ul style="list-style-type: none"> <li>- The same quadrat is to be used, so the material of plastic will remain throughout the experiment</li> </ul>
Dimensions of quadrat	<ul style="list-style-type: none"> <li>- Affects the number of organism's in the experimented area, so therefore the counting would not be correct for the area</li> </ul>	<ul style="list-style-type: none"> <li>- The same 1.00m x 1.00m (<math>\pm</math> 0.10m) will be used</li> </ul>
Number of quadrats	<ul style="list-style-type: none"> <li>- Organisms may find a quadrat intimidating, so therefore a large number may affect their inclination to come out</li> </ul>	<ul style="list-style-type: none"> <li>- Only 1 quadrat is to be used, so the number will remain constant</li> </ul>

(Experiment is to be repeated 5 times so as to reduce random error)

## MATERIALS

### Experiment

- 1 x 1m quadrat
- Clock (Analogue or digital) displaying the correct time according to the time -zone of the site ( $\pm 0.5\text{sec}$  [analogue]  $\pm 0.5\text{min}$  [digital])
- 1 metre ruler (increments of 1 cm) ( $\pm 0.5\text{cm}$ )

### Controlling of Variables

- Xplorer GLX
- Salinity meter attachment to Xplorer GLX
- pH meter attachment to Xplorer GLX
- Thermometer

## METHOD

### Prior to recording of data (Approx. 5:30am, however must be before sunrise)

1. The area within the rocky shore in the lower intertidal zone was determined and the 1 x 1m quadrat was placed on the area to be studied
2. The temperature of the environment, tide height, water salinity, pH of the water and the weather of the site were all measured and recorded using the thermometer, tide recordings for that specific day, the Xplorer GLX as well as the salinity meter attachment and the pH meter attachment, respectively.

### Recording of data

1. At sunrise, the number of gastropod organisms that were adhered to the rocky shore were counted and recorded
2. Step 1 was repeated at: (The clock was used to determine the times to count)
  - 0700 hours
  - 0800 hours
  - 0900 hours
  - 1000 hours
  - 1100 hours
  - 1200 hours
  - 1300 hours
  - 1400 hours
  - 1500 hours
  - 1600 hours
  - 1700 hours
  - 1800 hours
  - Sunset
  - 1900 hours (or when sun has completely gone over horizon and no natural light is available )
3. Conduct steps 1 and 2 on a day with similar temperature of the environment, tide height, water salinity, pH of the water and the weather of the site, however at the same site

## RISK ASSESSMENT

<b>Risk</b>	<b>Steps to avoid</b>	<b>Action to take if occurs</b>
Oyster cuts	Remain cautious when recording data on the rocky shore, and watch footing	Administer antiseptic and apply band-aid to absorb bleeding
Being pulled out to sea by high tide	Don't conduct experiment near or during a time where there is a rip in the sea	Continue waving until a person of authority comes and assists.

## POSSIBLE METHODS OF STATISTICAL ANALYSIS

Due to the data being continuous, a trend according to the number of gastropods counted verses the time of day may be presented . Due to conducting the experiment five times, an average for each time may be found. As well as providing a trend on how many gastropods are found, this also gives an indication as to if gastropods prefer sunlight to shade, which immediately gives indications of their adaptations to that environment.

## RAW DATA TABLE

	<b>Number of Gastropods found (#)</b>				
<b>Time (hours)</b>	<b>Trial 1</b>	<b>Trial 2</b>	<b>Trial 3</b>	<b>Trial 4</b>	<b>Trial 5</b>
Sunrise					
0700					
0800					
0900					
1000					
1100					
1200					
1300					
1400					
1500					
1600					
1700					
1800					
Sunset					
1900					

## BIBLIOGRAPHY

Epiphragm (2010) (Internet)Wikipedia (Accessed 7/03/2011) Available from:

<http://en.wikipedia.org/wiki/Epiphragm>

Epiphragm – Definition (2011) (Internet) Mariam-Webster Dictionary (Accessed 7/03/2010)

Available from: <http://www.merriam-webster.com/dictionary/epiphragms>