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ROCKY SHORE LAB REPORT

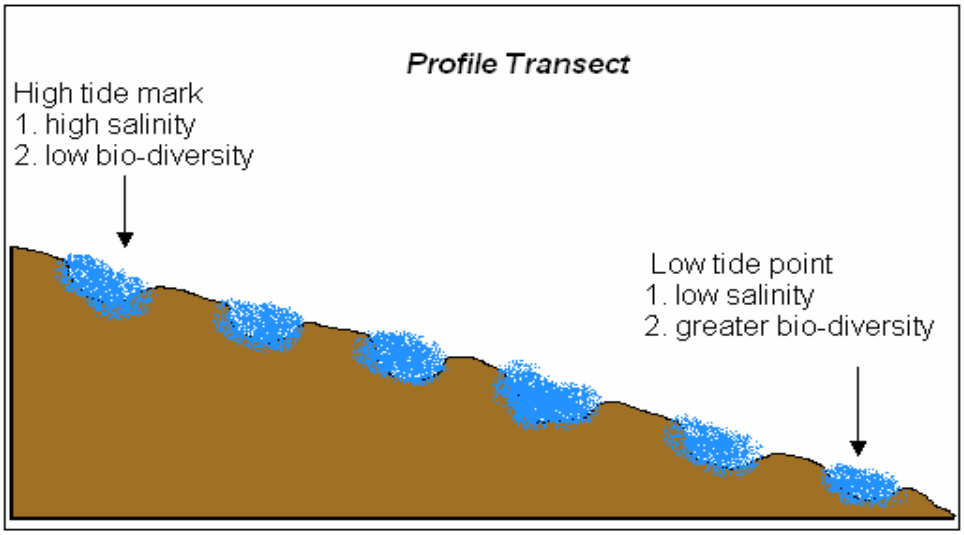
AIM:

To analyze the rocky shore ecosystem and the changes in the bio-diversity in the rock pools along the rocky shore as we move from the high tide mark to the low tide mark.

HYPOTHESIS:

If we move from the high-tide mark to the low-tide mark the bio-diversity will increase. This could be due to the several reasons:

1. The bio-diversity will be more at the low tide mark because, this area being covered in water most of the time has a low saline concentration as compared to the high tide mark. Due to the constant wave action, salt is deposited at the high tide mark and the water close to the low tide mark is continuously replenished.
2. Since the area around the low tide mark is covered in water most of the time, more organisms will be found here because more aquatic animals can thrive in this region.
3. Evaporation of water in the high tide regions will cause the animals to die. This is because, these regions anyways lack water and with evaporation, these animals will dry out. On the other hand, even though evaporation occurs in the low tide regions, there is still enough water present in the rock pools of these regions due to the constant wave action. Therefore, the possibility of the animals drying out decreases.
4. The rock pools present in the high tide mark, will have water with very high salinity. This causes the organisms in such pools to die due to plasmolysis in such a hypertonic solution. On the other hand, rock pools near the low tide mark will have water with low salinity. This is because the water in these pools is constantly replenished due to the wave action, thus making the water more suitable for the aquatic organisms to thrive in.
5. The number, the size and the amount of water in the pools will increase as we approach the low tide mark.



FACTORS AFFECTING THE ROCKY SHORE:

*T*he following are the factors that affect the rocky shore and even could be responsible for the shape of the rocky shore*:*

PHYSICAL FEATURES:

- Salinity
- Wave force (frequency and the power)
- Tides
- Temperature

BIOLOGICAL FEATURES:

- Competition for survival amongst the aquatic organisms in a limited area
- Predation
- Human impact

'Competition and predation play strong roles in the lower, more resource rich zone. This forces some species to live in areas that are sub optimal for their growth and reproduction.'[1]

APPARATUS:

ON SITE (AT ROCKY SHORE):

1. Measuring tape
2. Metre ruler
3. *P*lastic sieve
4. *S*urgical gloves
5. *P*unctured plastic containers for the samples
6. Glass bottles for the water samples

[1] http://is2.dal.ca/~theriaud/ztheriault/xmar/theriaultst.html#introduction

7. Shovels
8. Dry and wet bulb thermometer
9. Clipboard pencils and paper

LABORATORY APPARATUS:

1. Intel digital microscope
2. *L*ight microscope
3. pH meter
4. *T*ongs
5. *P*etri dishes
6. Slides
7. Cover slips

PROCEDURE:

On approaching the site we were divided into six different groups between the high tide mark and the low tide mark and the following procedure was carried out:

AT THE SITE:

1. A rock pool was identified between the high tide and the low tide mark.
2. A rough sketch of the pool was drawn.
3. The approximate dimensions of the rock pool were noted.
4. The pool was divided into four regions.
5. The dimension of each region was measured using the metre scale.
6. The depth of each region was also found using the metre scale.
7. The number of each species of plants and animals present in every region was counted.
8. A sample of each species was collected in the empty punctured containers along with the pool water, ensuring that they received enough oxygen supply.
9. A sample of water was also collected in an empty bottle for further research.
10. The approximate distance from the high tide mark was estimated.

IN THE LABORATORY:

1. The sample of organisms was taken and examined under a light microscope.
2. The pictures and slides of various organisms were also taken in order to have a better study of the adaptations of the species in order to survive.
3. Sketches of the collected species were drawn and the adaptations for organisms surviving on the shore were found.
4. The total number of species in the rock pool was estimated.
5. Using the Simpson's Diversity Index (SDI), the bio- diversity in different pools was found and a comparative study was done.

DATA COLLECTION AND DATA PROCESSING;

OBSERVATIONS:

- It was noticed that the size of the pools and the amount of water in every pool increased as we approached the low tide mark.
- The water was not very clear. It was cloudy and had certain suspended particles in it.

Distance of the rock pool from the High Tide Mark = 130m {Estimate}

PROFILE OF THE ROCK POOL

	Dimensions	*Area*	*Depth*
Region 1	50 x 55*cm*	2750cm^2	7*cm*
Region 2	130 x 80*cm*	10400cm^2	8*cm*
Region 3	105 x 50*cm*	5250cm^2	8*cm*
Region 4	90 x 50*cm*	4500cm^2	5*cm*

TABLE SHOWING THE ANIMAL AND PLANT LIFE IN EACH REGION

Name	*R*1	*R*2	*R*3	*R*4	*R*1+*R*2+*R*3+*R*4
Shrimp	1	0	0	2	3
Lobster	2	2	1	0	5
Black and White Spotted Snails	25	10	19	20	74
Grey Snails	12	18	11	14	55
Black Snails	14	12	0	6	32
Barnacles	32	36	14	28	110
Crabs	0	2	2	1	5
Cockles	0	0	2	1	3
Fish	0	0	3	0	3
Worms	6	7	5	10	28
Sponge	1	4	3	2	10
Sea Anemones	16	21	23	15	75
Seaweed	30	70	35	50	185
				Total (*N*)=	588

Formula for finding the SDI of the number of organisms:

$$SDI = \frac{N(N-1)}{\Sigma n(n-1)}$$

CALCULATION:

Name of the species	*N*	*(n-1)*	*n (n-1)*
Shrimp	3	2	6
Lobster	5	4	20
Black and White Spotted Snails	74	73	5402
Grey Snails	55	54	2970
Black Snails	32	31	992
Barnacles	110	109	11990
Crabs	5	4	20
Cockles	3	2	6
Fish	3	2	6
Worms	28	27	756
Sponge	10	9	90
Sea Anemone	75	74	5550
Seaweed	185	184	34040
		Total =	61848

SDI = $\frac{N\,(N-1)}{\Sigma n\,(n-1)}$

= $\frac{588 \times 587}{61848}$

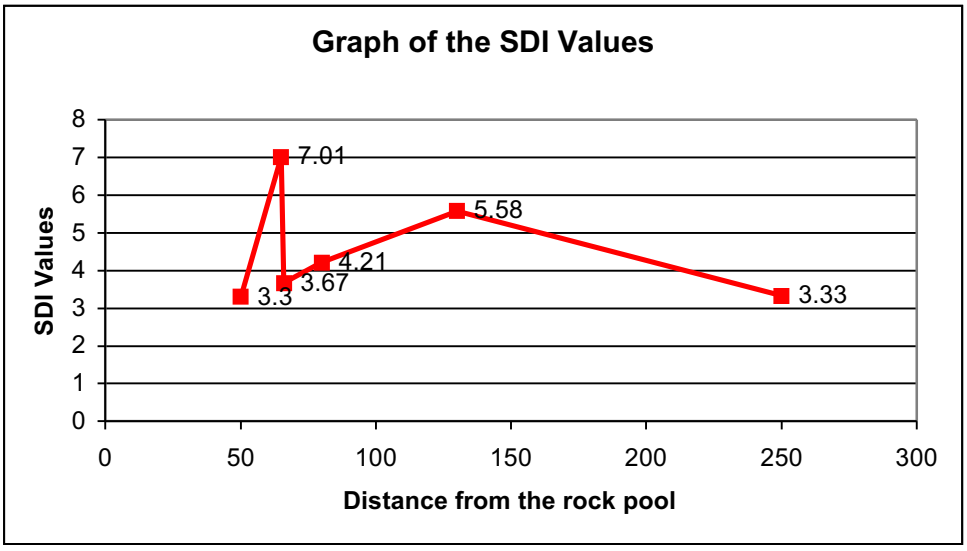
= $\frac{345156}{61848}$

= 5.580714009

SDI = 5.58 *(approx)*

Distance From The High Tide Mark And The SDI Of Each Of The 6 Pools Examined By The Students

	Distance from the High Tide Mark	Simpson's Diversity Index
Pool 1	50 m	3.3
Pool 2	65m	7.01
Pool 3	66m	3.67
Pool 4	80m	4.21
Pool 5	130m	5.58
Pool 6	250m	3.33



INFORMATION ON SOME OF THE ORGANISMS FOUND

1. **SHRIMPS***:* Shrimps are small, marine decapod crustaceans. Shrimps have 10 jointed legs on the thorax, well-developed swimmerets on the abdominal segments, and a body that is compressed laterally. They are mostly grey or transparent and can grow as long as 9 inches (23cm), but most of them are smaller. Shrimps are well distributed in the temperate and tropical salt and freshwaters. Although they are very tolerant of salinity and pH ranges (down to 6.0), they are very sensitive to ammonia and heavy metal concentrations, as most of them are freshwater shrimps. They live in temperatures around 30ºC or below.

2. **LOBSTERS:** Clawed lobsters comprise a family of large marine arthropods. Lobster has a tough exoskeleton, which protects it, and it is an invertebrate organism. Like all arthropods, lobsters are bilaterally symmetrical. The anatomy of the lobster includes cephalothoraxes, which is the head fused with the thorax, and the abdomen. The lobster's head consists of two pairs of antennae, eyes, and a mouth. The abdomen of the lobster includes its 10 legs and swimmerets. The environmental conditions of the lobsters can vary from ocean to ocean, but the lobster's temperature environment does not fluctuate much, since its home is basically the ocean. Because a lobster lives at the bottom of the ocean, vision is poor and instead, the lobster uses its antennae as sensors.

3. **SNAILS:** Snails are terrestrial molluscs belonging to the phylum Mollusca and class Gastropoda, characterized by the animal's foot being attached to its abdomen. The snail's soft and wet body is coated in a layer of mucous and consists of a bilaterally symmetrical foot and head, and a coiled, asymmetrical hump that fits into the spire of the shell. Snails have an external shell large enough to enclose the entire animal, enabling them to survive severe conditions of drought, heat and predators. They have a soft, unsegmented body measuring 2 to 4cm in length with a bearing one to two pairs of tentacles. While the front tentacles are sensitive to odours and sometimes taste, the larger back tentacles have an eye at the end. The foot, located in the abdomen, is the organ of locomotion. They can live for 5 to 10 years, and rarely 15 years.

4. **BARNACLES:** Barnacles are a type of Arthropod and are distantly related to crabs and lobsters. Emerging more than 520 million years ago, there are around 1,220 barnacle species currently known. Barnacles spend their early life as part of the plankton, floating wherever the wind, waves and tides send them, surrounded in a bivalve shell. They then settle down in an area where environmental signals indicate, is a safe and productive region. They stick their legs in the air, and develop six hard plates to surround their body and for the rest of their lives, they are cemented to the ground, using the feathery legs called cirri, to capture passing planktons.

5. **CRABS:** Crabs, also known as decapods, are in the Crustacean family, characterized by the crab's hard shell (carapace). Crabs have 4 antennae, 2 claws, 4 visible ambulatory legs, and 4 small legs kept inside the shell. The antennae are used for sensing. The crab's larger claw is mainly used for defense, and the smaller claw is used for climbing and carrying food in the mouth. The 4 visible legs are used for walking and climbing, and the other 4 legs are kept inside the shell and are used to hold on to and maneuver the shell and for removing sand and waste. If any of the crab's legs have broken off, they will regenerate when the crab molts. Smaller crabs live in the pools on the lower shore and the larger ones are found out in deeper water. Aquatic crabs can live out of water for a little while (which explains why they are sometimes found washed up on the sand), but they need an aquatic environment to survive.

6. **SPONGE:** Sponges are a diverse group of organisms, with about 5000 species known across the world. They are primarily marine, but around 150 species live in fresh water. Sponges have cellular-level organization i.e. their cells are specialized such that different cells perform different functions, but similar cells are not organized into tissues, and the body of the sponge is a sort of loose aggregation of different kinds of cells. Sponges have a system of pores and canals, through which water passes. Water movement is driven by the beating of the flagellae, which are located on specialized cells called Choanocytes (collar cells). Sponges can be both symmetrical and asymmetrical and are supported by a skeleton made up of protein collagen.

7. **SEA ANEMONES:** Primitive animals, sea anemones belong to the phylum variously known as Cnidaria or Coelenterata and are closely related to jellyfish. They are predatory and tend to be pervasive in marine ecosystems. They live in a wide variety of habitat and coexist closely with other marine life. Anemones are invertebrates, surrounded by few or many tentacles, which are in the form of finger-like projections. These projections are active in capturing food and transferring it to the mouth, and may be used defensively too. Anemones are seen mostly in the deeper pools. They move around a little but are usually stationary, waving their tentacles to attract prey within the range of their tentacles.

8. **SEAWEED***:* Seaweeds are diverse group of organisms living in the earth's ocean. They are either attached to rocks in the intertidal zone, washed up on the beach or floating on the ocean's surface. They can be tiny, but mostly grow up to 30 m in length. Although they have many plant-like features, seaweeds are not true vascular plants; they are algae i.e. they belong to the Protista kingdom (neither plants nor animals). Because all the parts of a seaweed are in contact with the water, they are able to take up fluids, nutrients and gases directly from the water, and do not need an internal conducting system. Seaweeds are photosynthetic; they convert energy from sunlight into the materials needed for growth. Instead of roots, seaweeds have holdfasts, which attach them to the seafloor. Holdfasts act as an anchor, thereby providing support to the weeds. The stem or the stalk of the seaweed is called Stipe, which provides support to the rest of the plant. The leaves of the seaweed are called blades and their main function is to provide a large surface for the absorption of the sunlight.

Picture Identifications for Animals Found

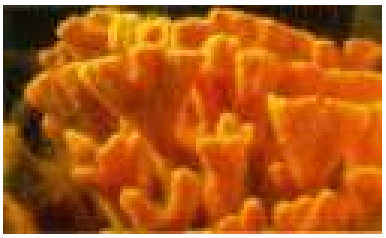
1) Shrimps

2) Lobster

3) Snails

4) Barnacles

5) Crabs



6) Sponges

7) Sea Anemones

8) Sea Weeds

CONCLUSION AND EVALUATION:

In this experiment, a Rock Pool Analysis of our pool (Group 5) was carried out, the result of which is as follows:

REGION 1:

This was the smallest region with a depth of 7cm and was relatively shallow. It mainly had snails and barnacles and the snails found, were mostly on the rocks in the water. It had the highest number of 'Black and White Spotted' snails and Black snails, with the largest population of snails compared to all the other regions. This is because the snails found could live in water only for some time and therefore lived in the shallow parts of the rock pool.

REGION 2:

Region 2 was the largest region with a depth of 8cm and was very deep compared to the other regions. It had the most number of barnacles, grey snails, crabs, lobsters and seaweed. This region had the most number of aquatic animals with a population of 182 animals. This indicates that animal and plant life thrived in this region. Region 2 also had the most number of sponges because sponges are normally found in the deeper regions. The sponges were found attached to a rock surface, which was immersed in water.
The crabs and barnacles were found in the shallow parts of region 2 since they couldn't survive in deep waters for a long time.

REGION 3:

This was the second largest region, also with a depth of 8cm. This was the only region where fish was found and had the least number of snails. Region 3 has the largest number of sea anemones because they are found in the deeper regions of the rock pool (this is why Region 2 and 3 had the most number of sea anemones). This region also had the largest number of cockles and a considerable amount of seaweed.

REGION 4:

This was the second smallest region with a depth of 5cm. Region 4 had the most number of shrimps because shrimps are normally found in the shallow regions (this is why Region 1 and 4 have shrimps because they are the shallowest). This region also had the largest population of worms, but very few numbers of snails. Also, seaweed was found in abundant quantities in this region.

The results of the experiment showed that Group 2 and 6 had anomalous readings for their SDI values. The SDI values were expected were to increase as one kept getting closer to the low tide mark. This is because in pools close to the low tide mark, the saline concentration was low enabling aquatic organisms to live in that environment compared to the pools in the high tide mark. But group 2 had the highest SDI value of 7.01(which should have been group 6's SDI value) compared to the other groups probably because their rock pool was very small and they managed to find most of their organisms because of its small size while on the other hand, group 6 had a relatively larger pool and they couldn't into it and find all the organisms easily.

From this experiment, it was evident that rock pools act as Microhabitats.

A microhabitat is a small area, which is home to a community of organisms[2] and is formed when after a tide, the water does not flow back into the sea and stays behind to form a pool of seawater.

They act as natural aquariums that are left behind after a tide, because along with the water, some marine animals are also left behind after the tide has gone out. This isn't a protective environment for these aquatic animals because when the water evaporates during warm temperatures, there is an increase in the salinity of the water, which may result into the organisms' death due to plasmolysis or the organisms may just die due to the lack of water and vice versa, when there is excess water, the organisms may die of turgidity. Zonation was another very obvious feature of life on the rocky shore. Organisms that lived in the low tide mark weren't present in the high tide mark because no organism can successfully inhabit every level of the shore due to the fact that their requirements in life for air and water are so different. The reasons for 'zonation' include physiological adaptation and competition for food and living space in the face of a gradient of physical environment factors between marine and terrestrial ecosystems[3].

Limitations to the experiment:

- Due to lack of equipments, it wasn't possible to test the water in the pool but it was visible that the water contained salts because the water collected was very unclear.
- Since the rocky shore was situated next to a fishing village, a chemical industry and a hotel, waste was dumped in the rocky shore and there could have been a possibility of people urinating in this region adding to the salt concentrations.
- The hypothesis was not aptly proved because of the fault in the results and due to the several other limitations as mentioned below:

{Limitations faced at the site}

1. Due to the time constraint, it wasn't possible to observe their pools in greater depth, thereby not being able to count some organisms.
2. The pools allotted to each group weren't of the same size, as the result of which some hidden organisms mustn't have been counted accurately e.g. due to the big size of the pool, group 6 couldn't get into their pools and count some of the organisms.
3. It is possible that due to the agile nature of some of the organisms, some of them must have been counted more than once.
4. Some species were well hidden underneath the rocks and in order not to harm their habitat they couldn't be counted.
5. Some species being hidden in the sand couldn't be counted.
6. Due to the presence of salts and wastes, the saline concentration of the pools was high, resulting in the death of some of the organisms due to plasmolysis and hence they couldn't be counted.

Possible solutions to the limitations: {to minimize the errors}

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[2] http://www.saburchill.com/ans02/chapters/chap022.html

[3] http://www.le.ac.uk/biology/gat/virtualfc/346/zonation.html

1. More time could have spent in observing the pools so that a more conclusive result could have been found. Also the rocky shore could have been analyzed in a different season so that the results could be compared and a better analysis could be obtained.
2. By choosing a rock pool of more or less the same size, uniform results would have been obtained because people working on the bigger pools would be able to work on the smaller pools and obtain a better result.
3. Measures should have been taken to count the animals hiding beneath the rocks without harming them, so that our findings would be more conclusive.
4. Measures should have been taken so that the species wouldn't have been counted again. This could have been done by marking them, so that if they were caught again, they could have marked out.
5. The defect in the apparatus should have been as minimal as possible, so that a more accurate result was obtained

BIBLIOGRAPHY AND REFERENCES:

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- http://www.le.ac.uk/biology/gat/virtualfc/346/zonation.html
- http://www.saburchill.com/ans02/chapters/chap022.html
- www.google.com for the description of the organisms