INTRODUCTION.

Patella Vulgatas, commonly known as limpets, are gill breathing herbivores. They are distributed from the north of Norway to the Mediterranean, therefore they are found on all British and Irish coasts. They live wherever there is suitable hard substratum. Their main habitats are: bedrocks, large boulders, small boulders, cobbles, pebbles, rockpools and overhangs.

They become vagrant after their emergence for the first three years and then they settle down to a homing style. They squat and settle in pools and damp places, although swapping of homes can occur. Adult Patella Vulgatas go home to their 'home scar' after grazing, using the radula, on the micro algae. They form a depression on the rock by abrasion, using the shell, which results in a tighter fit to the rock and reduction to the risk of desiccation. Patellas are also tolerant to low salinity levels.

HYPOTHESIS.

I predict that Patella Vulgatas will be more distributed on the upper eulittoral shore than on the lower eulittoral shore. The reason is that Patellas compete for space. There is much more open space on the upper shore due to the lack of plant domination and less population of creatures. However, the lower shore is hugely dominated by large plants, such as fucus serratus and fucus vesiculosus.

Due to abiotic factors, the sizes of Patella vary between the two areas. Most Patellas have a larger volume on the lower shore in comparison to the upper shore. The main reason is due to the fact that there is less competition for food, an indispensable factor which is important to all limpets. The less competition comes from the fact that there is a lot of food, i.e. plant, available. More food means more growth.

BIOTIC FACTORS.

Patella Vulgatas have many concerns mainly because of competition. Their main competitors are themselves. They compete with each other for space and food, however food can be a rare case. Space is very important to them. They are based in one spot for nearly all their lives, which is their 'home scar'. They constantly grind away at the rock using their powerful and resistant shells to mark out the shape of their shell. Once marked, only then the spot is theirs because no other Patella will fit in the shape, as they are all different in shape and size. Their base, home, is a great advantage, as it makes it easier for the Patella to clamp down and hold down stronger while making it hard for the predators to overturn them. The only time they leave this spot is when they are surrounded by water. They graze on microalgae under the water because it is safe for them to move. It makes it more difficult for the predators to spot them and they don't lose water by dehydration.

Another biotic factor affecting Patellas are the predators. Predators, such as oyster catchers, prey on these herbivorous snails. Oyster catchers, among many more predators, are found on the lower shore. This is one of the reasons why there is less population on the lower shore compared to that of the upper shore. Many predators prey here because there are a lot of preys found here, besides Patella Vulgatas. Patellas have a proverbial grip, enabling the fact that they can only be overturned with a single sharp blow at the base of its shell. The shell is lifted regularly for facilitated respiration. Therefore if the predators aim and hit the base directly with force, using their beaks, the limpets will overturn. However inaccuracy from the predators will result in failure, causing the Patellas to clamp down stronger and creating more problems for the predators, which then have to search for other creatures to eat.

ABIOTIC FACTORS.

LIGHT INTENSITY.

Light doesn't directly affect the limpets but it does have an effect. Light is important for plants, who need it to photosynthesise. The colours of the spectrum have different wavelengths. A normal plant on dry land photosynthesises by absorbing blue and red spectrum lights. In contrast, they reflect the green light, hence their colour being green. But plants under water don't use the red light because it cannot pass through water. It is reflected 90 degrees when shun straight down. Which is why the colour of the plants under water tends to be red (i.e. absorbing green and blue but reflecting red). This shows that the limpets are adapted differently in both areas.

This is a factor which I cannot control. However I can measure the light intensity using a light probe but I cannot measure the amount of light which the microalgae absorb.

SALINITY LEVELS.

The sea contains salt water. It is undiluted and made up of a solution of salts. The common salt found is Sodium Chloride, in the form Chloride, which is responsible for its salty taste. This affects nearly all the plants. Plants inside the sea have very little effect towards osmosis when it rains because there are plenty of solutes present, having little effect on the dilution of salt concentration. Therefore the rate of osmosis is very slightly affected, depending on the amount of rainfall. On shore, however, this is an important factor. There is very little salt water on land, therefore when it rains the salt concentration becomes less negative than the plant's salt concentration. Hence more water is drawn in the plant causing it to become turgid and eventually destroying it. From my preliminary work, I know that water moves from a low negative water potential, less concentrated, to a lower negative water potential, more concentrated. Here is an example where limpets might start to compete for food, as microalgae aren't adapted well enough to withstand any changes from osmosis, due to their very thin cell walls. This explains why the sizes vary. Patellas being larger on the lower shore; where there are more wave actions which result in little effect towards osmosis, hence less microalgae dying. On the upper shore, Patellas are in trouble because there are very little wave actions therefore, by osmosis, the plants die.

This is also beyond my control but it can be measured using a pH probe. I can measure the pH of the salt water in the sea and on land to conclude which is stronger and which is weaker, in terms of concentration. This will determine which will have a greater osmotic effect.

DESSICATION.

Patella can move and encrust in water but not on land. The reason is that they get dehydrated easily on land. This is very dangerous for them as they will dry up and lose strength in clamping down hard. Therefore their shells are impermeable to water.

The temperatures vary from the low shore to the upper shore. The low shore is always being exposed to water and therefore maintaining a constant temperature, with slight changes. As I also know, from past experience and knowledge, that water gains or loses heat much more slowly than land. Therefore in the sea, temperatures scarcely change all year around; on the other hand, the land has drastic changes in temperature all year around.

Again, I don't have the ability to control this variable. I can only measure the temperatures on both land and sea using thermometers. On land I will have to push the thermometer into the soil or in a crack on the rocks. The temperatures will verify as to which conditions the limpets prefer to live in, whether it being warm or cold, with drastic changes or without.

CONTROLLING THE VARIABLES.

INDEPENDANT VARIABLES.

As most of the variables are beyond my control, I cannot control them. Temperature, light intensity, water salinity, desiccation and the pH concentrations are all beyond my control. Therefore I have no choice but to measure them and conclude on my results. They can be measured with the availability of thermometers, light probes and pH probes.

DEPENDANT VARIABLES.

I will be measuring the size and population of Patella Vulgata in both areas. I will be specifically measuring the circumference and the height, in millimetres, of random selected Patellas. Having the circumference and the height, it will enable me to work out the volume, in millimetres cubed.

NULL HYPOTHESIS.

The null hypothesis is that the Patella Vulgata will be distributed evenly in both areas

ANTICIPATED METHOD.

Before carrying out the investigation, the safety procedures will be considered and obeyed.

A random page will be used from a phone directory. This will be used for random coordinates. The method will be to choose a phone number randomly, either by pointing at a number when eyes are shut or by turning the page quickly and spotting the first number the eyes see. When the phone number is randomly chosen, the last two digits will be recorded as the coordinates. The first number will be marched after turning 90 degrees anticlockwise when facing the sea, from a fixed point, and then turning 90 degrees clockwise towards the sea and marching out the second number. The quadrat will be placed down where the co-ordinates stop. As in the past, I have discovered that throwing the quadrat anywhere is not random at all. This gives biased results as the thrower is adjusting the throw how he/she wants. Therefore my method will not only give me accurate results but also very reliable results. This is because of the fact that it was randomly carried out.

Once the quadrats have been placed, a random sequence will be used to measure the Patellas. I don't have enough time to measure all the limpets present in the quadrat because my preliminary work corroborates that there can be up to 10-20 limpets in each quadrat, on average. I will need 30 results, 15 from each area. Below is the random sequence I will be using, per quadrat:

1	5	13	8	4
9	21	17	24	12
14	18	25	20	16
10	22	19	23	11
2	6	15	7	3

As you can see each square is numbered. This is the way I will search for the Patella I want to measure. If there are no Patellas in the first ten squares then the first to be measured will be in square eleven. If there are more than one Patella in a square then they will all be measured first. For example, if there are two Patellas in the first square then I will measure both before I move on. I am looking at a total of three measurements per quadrat because then I can find the average and use this average to represent the whole quadrat, as the lack of time doesn't permit me to measure all of them. I will be measuring the height and the circumference, in millimetres.

FAIR TEST.

To make my test fair, I will handle the same apparatus for each result. I will make sure each apparatus is appropriate to what I need, i.e. I will be measuring Patellas in millimetres therefore I will need a millimetre ruler, which is not damaged in any way. For accurate results, I will need suitable and accurate apparatus.

HEALTH AND SAFETY.

I will make sure my experiment is carried out safely. I won't wave any apparatus about and I will take special care towards the environment, not destroying any organisms whether they are limpets or other organisms. If I do use chemicals, for example, universal indicators for measuring the pH, then I will be use it safely and away from the environment. I will only use it on samples, which are taken away. The method of throwing the quadrat for random co ordinates won't be used. As this is dangerous and hazardous to other students and the environment. Precautions will be taken at all times to avoid any accidents.

CONCLUSION.

My results show that there are more Patella Vulgatas on the upper shore than the lower shore. They also show that the sizes vary, being larger on the lower shore when found. However there were small limpets on the lower shore, some smaller than the ones on the upper shore.

As the Mann-Whitney U Test proves that the results are relatively 95% correct, I can state that on my results are accurate and very reliable. The u value in my investigation was 40, lower than the critical value of 64. This confirms that my investigation was done accurately. With this succession, I can reject my null hypothesis which expected that there will be the same inhabitants in each area.

The graphs show big differences between the populations. There are many factors behind the reason as to why the populations fluctuate. The main one being the existence of predators on the lower shore. There weren't many predators on the upper shore but there were a lot of antagonism. There were the barnacles that competed with the Patella for space; Patellas themselves were competitive towards each other for space and food and there were the Littorina Littorea who competed for food. But they have an advantage over limpets of travelling and searching for food instead of being situated in one place most of the whole time. Barnacles also competed for food with the limpets. In comparison, on the lower shore there wasn't much of a competition as there were plenty of resources available. There are plenty of minerals for micro algae to grow successively and in great quantity. There is plenty of space for limpets as not a lot of creatures are adapted to survive on the coast, for example the wave actions can cause major exertion force, killing any organisms present. Conversely, Patellas with their proverbial grip can withstand extreme cases. But sometimes they do get nudged off by extreme waves.

The sizes of the limpets are influenced by the surroundings, mainly because of the abiotic factors. This is shown in the graph which represents the size in volume. The fact that little Patellas were found on the lower shore makes the results slightly biased. But the fact that the limpets are taller in height but smaller in circumference on the upper shore compared with the shorter but wider limpets on the lower shore prove that there is significance between them due to their circumstances. The limpets are well adapted on the upper shore because by having smaller circumference, they also have a smaller surface area. According to my preliminary experience, I have come to know that this is an adaptation to conserve water. Having less surface area means less water is lost through dehydration. It is important that limpets stay moist where there is less wave action and therefore it makes it harder for them to recover any water loss. This is also why limpets do not graze on land as it would take up too much water. On the other hand, the Patellas on the lower shore are smaller in height but larger in circumference. The reason for being shorter is that when the waves come crashing in, they smooth off the shell. Therefore they stay short. It also prevents it being hit by large stones or other large creatures present in the sea. Another reason for this adaptation is that it helps it from the predators. The predators would spot them easily if they were taller; therefore being shorter maximises its chance of survival. Their main reason for being wide is that they have a lot of food available. Therefore they just graze and grow. Being larger in size gives them more advantage over land and gives them more strength when it comes to its magnificently powerful grip.

EVALUATION.

Despite the success of the Mann-Whitney U Test, I reckon my experiment could have been more accurate. There were two limitations which could have affected my results.

The first being the apparatus. There was lack of apparatus available, such as the absence of thermometers, light probes and pH probes. Because of this, I couldn't take any measurements of the environment therefore I couldn't reflect my conclusions based on the abiotic factors. This would have been great help as I would have been able to conclude my results appropriately and proved my hypothesis evidently. This could have been prevented with the presence of the equipment. Another problem was the lack of accurate apparatus. A string was used to measure the circumference then placed onto the ruler to the take the measurements, was very inaccurate. As this has an effect of shifting the measurements back and forth. Therefore this has affected the whole of my results but ever so slightly. A tape measure could have been used or instead a string with measurements marked on it.

There was also lack of time which prohibited us from obtaining more results. Fewer measurements were taken, having an effect on the averages. The more results accessible, the more evidence there is to prove the conclusion. However I did have an average measurement but I would have preferred to take an average of at least four to five limpets in each quadrat because there were a considerable number of Patellas found.

APPARATUS.

- Quadrat (x 1)
- 30 Centimetres Ruler (in mm) (x 1)
- Piece of String (x 1)
- Pencil (x 1)
- Clipboard (x 1)
- Piece of Rock (x 1)
- A Page from Phone Directory (x 1)

METHOD.

The equipment was collected. Random phone numbers were chosen on the directory page. Last two numbers were recorded on a chart for the results. A rock was placed to mark the fixed point. The coordinates were marched out, the first co ordinate being marched by turning 90 degrees anticlockwise when facing the sea, and the second turning 90 degrees clockwise after stopping at the first co ordinate, i.e. now facing towards the sea and marching the second coordinate. Once the destination is reached, the quadrat is placed and the number of Patella are counted and recorded. Then the measurements are taken of the random Patellas chosen. First the circumference is measured, using a string to go around the shell and marking the point where it meets itself. Then straightening the string and placing it on the ruler for the size in millimetres. The ruler is then placed in a crack or slight hole to measure the height. The reason for the ruler being placed in a hole or a crack is that rulers have an extra space before the measurements start. Therefore to start on 0mm, it has to be slightly lower.

This experiment is repeated thirty times, fifteen in each area.

DIAGRAM.