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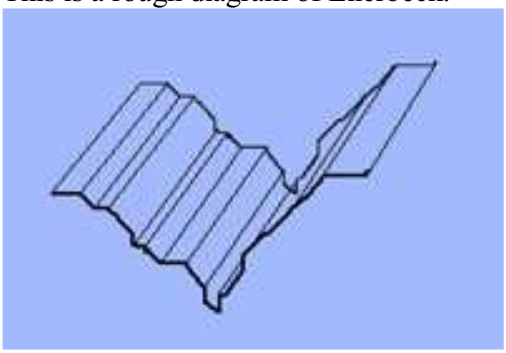
Biology Coursework

To determine if the distribution of flora across Ellerbeck is due to chance.

The valley containing Eller beck possesses a huge variety of different species of plant life, particular species are often found in specific places across the valley, to find out why these particular plants grow in the particular places I mean to investigate where different species of plants are located and what the conditions in those particular places are, investigating the effects of several factors on the distribution of these different species across a specific area of the valley. I believe that the varied distribution of the different species investigated is directly related to, and can be explained by the differences in the factors I will be measuring, that certain plants will grow in certain places in the area because they are more suitably adapted, in whatever way to the conditions in that specific place.

This is a rough diagram of Ellerbeck.



I plan to perform my investigation using two information gathering techniques, after first establishing a straight line across the valley by taking a bearing using a compass from one point at the top of the South side of the valley and following that bearing down the valley, across the beck and up the other side whilst performing both a line transect and an interrupted belt transect.

I also plan to perform an interrupted belt transect along the same bearing. Laying down a quadrat frame on the left side of my tape measure at regular intervals of 10 metres and recording in detail, the distribution of species within the frame. This will give me a general view of the distribution of different species in many areas across the valley allowing me to sample the abundance and frequency of the different species, providing quantitative data and will allow me hopefully to speculate on the distribution of those species in the whole area.

The line transect involves following my bearing with a tape measure, I will stop at specific intervals of 2 metres and record which species of plant is growing at that specific point, I will also measure the pH of the soil, using a pH probe, the Light Intensity at that point using a light meter and the moisture content and temperature of the soil using a moisture probe and a temperature probe respectively. Through these results I will hopefully be able to establish a broad view of the conditions where a specific species grows and due to the many intervals will hopefully be able to come in contact with the same species more than once and see if the conditions were similar. This investigation will provide me with qualitative data regarding the distribution of flora. I predict that this data will show that the distribution of flora is not down to chance but to outside physical and chemical factors.

The input variables in this investigation will be the levels of the different factors I will measure in my line transect, pH level of the soil, Light Intensity, Moisture content of the soil and temperature of the soil. I will now explain how each factor should affect the growth of plants.

The pH scale measures the acidity or alkalinity of a substance, in this case the soil of Eller beck, it ranges from 0 to 14 with 7 indicating pure water, values below 7 indicating acidity and values above indicating alkalinity. I theorise that the pH will effect plant growth in that there will be an increase in growth around or just below the neutral pH level, 7, either neutral pH 7 or acidic to some degree. I believe this for several reasons.

PH has a serious effect on the activity of enzymes, an excessive pH will change the secondary structure of an enzyme because of it's effect on the interactions in which hydrogen takes place, hydrogen being essential in stabilizing the secondary structures in the form of hydrogen bridges, so if the structure of the enzyme changes so does the active site and reactions can no longer take place, and as enzymes are essential in many of the processes that occur in plants, such as photosynthesis this will affect the plants growth negatively.

One of the so-called "major nutrients" required by plants is Phosphorus, this is because of a variety of reasons, Phosphorus is one of the primary structural components of the membranes that surround plant cells. It is essential for photosynthesis and is involved in the synthesis of proteins and vitamins and builds certain essential enzymes. It is widely considered that Phosphorus is commonly more available in soils around a pH value of 6.5 but it has also been noted to have been available in some areas at 7.9. The levels of Phosphorus decrease as the pH value drops or rises from 7. The availability of many other nutrients such as aluminium, iron, manganese, boron, copper and zinc increases more in acidic than in neutral or slightly alkaline soils. My theory on the effect of plant growth is based on these observations and the theory of the "Law of the Minimum," which states that the lack of one essential nutrient will prevent the utilization of one or more of the others resulting in less than adequate growth and development of the plant.

I theorise that temperature will affect a plants growth and that plant growth will be most effective between a temperature of between 10 degrees C and 40 degrees C with plant growth rising as temperature does. Temperature has a large effect on plant growth, it affects the activity of an enzyme and the course of any reaction. An increase in temperature gives the reacting molecules in any reaction more kinetic energy increasing the number of collisions and the rate of reaction, temperature also affects an enzyme in that the enzyme when experiencing an increase in temperature eventually reaches its optimum temperature of approximately 45*C, at this temperature the bonds in the enzyme's tertiary structure break and the active site is denatured so no more reactions can occur. Therefore an increase in soil temperature would affect enzymes involved in planet reactions such as Ribulose Biphosphate Carboxylase which catalyses the CO2 and the five-carbon sugar ribulose biphosphate in the Calvin cycle, in the dark reaction of photosynthesis. An increase in temperature would increase the rate of photosynthesis so increasing the growth rate of the plant.

Nearly all plants slow down their growth below the temperature of about 9^0C and above the temperature of about 50^0 C. This is because the biological processes for

nutrient transformations and nutrient availability are heavily influenced by soil temperature. Soil temperature has a profound influence on seed germination, root and shoot growth, and nutrient uptake and crop growth. Seeds do not germinate below or above a certain range of temperature.

Water helps plants in transpiration where 99% of the water entering the plant through the roots leaves as water vapour via the stomata on the leaves, this allows the plant to lose the heat that its reactions produce. Water is needed for photosynthesis, (the essential process in which plants convert light energy into chemical energy in the form of organic molecules, some of which also serve as building blocks for plant structure) the photolysis of water in the light dependent reaction of photosynthesis provides electrons to replace those that have left the chlorophyll of a plant cell due to them having gained energy from light, it also releases H+ ions which are used at the end of the carrier chain where they are reunited with electrons which reduce the coenzyme NADP to form NADPH.
Water is essential to the growth of a plant; it is used in a variety of different functions throughout plant growth and in many of the different processes that occur inside a plant. All chemical reactions require water as a solvent. A water solution is required for the transport of nutrients from the root through the plant.

Water can even be referred to as an essential structural agent in plants, plant cells containing an abundance of water are turgid and the plant stands erect. When there is a water deficit the cells are flaccid and the plant droops or wilts, thereby reducing the effectiveness of the plant to absorb light through its leaves, slowing the rate of photosynthesis and so the rate of plant growth. I therefore make a prediction that the higher the moisture content of the soil the higher the growth rate of a plant and so the greater the number of plants.

Light affects essentially all aspects of growth and development of a plant, it is required essentially for photosynthesis which ultimately is the basis of all plant growth and activity. The light dependent reaction of photosynthesis, as its name suggests depends on light energy, light is absorbed by the antenna pigments of photosystems one and two, the absorbed energy is then transferred to the pigments of both photosystems, activating the pigment of photosystem 2 and removing an electron from it. This makes the pigment of photosystem 2 (Chlorophyll P680) positively charged and as a result it can remove electrons from water. These electrons are then used to provide energy for the process to continue. Products of the light dependent reaction are then used in the light independent reaction. Without light none of the reactions involved in photosynthesis could occur. I will be measuring the effect of light intensity on the distribution of plants in this investigation; light intensity positively influences the manufacture of plant food, stem length, leaf colour and flowering. Generally speaking, plants grown in low light tend to be spindly with light green leaves, whereas a similar plant grown in very bright light tends to be shorter, better branches, and have larger, dark green leaves, this reveals that the increased light intensity is responsible for the more lush structure of the plant compared to its relative grown in low light intensity indicating an improvement in plant growth and efficiency while under increased light intensity. I therefore predict that under higher light intensities plant growth will be significantly increased.

The outcome variables being measured will be the distribution of the specific species and of plants in general, as in some areas of the quadrat or at some intervals on the line transect there may be no plants growing. The quadrat will show the number of different species of plants in a specific area and the line transect will show how the general plant species change as I move across the valley.

The equipment I will be using will be ranging poles, tape and a compass for taking the bearing on which I will travel down the valley, and the tape will also serve to measure the different intervals where my different techniques will be performed. I will use a pH probe to measure the pH of the soil, the probe is perfect for using considering I will be measuring the pH of soil which is quite likely to wet and so other pH measuring methods such at Litmus paper would be impractical. I will be using a temperature probe and a moisture probe to measure the temperature and the moisture content of the soil respectively, both of which are ideal for the same reasons as the pH probe, that soil is an unusual medium to be measuring and these probes are specialized for dealing with substances like it. I will be using a quadrat frame for performing my interrupted belt transect, with a ruler for measuring inside the frames and knowing where to put the pin, which I will use to I can pinpoint exactly where the measurement should be taken from to ensure fair testing.

Firstly I will choose a specific point on the South side of the valley and take a bearing using a compass (I will keep checking this bearing at intervals as I move across the valley to ensure I am travelling in a straight line.) I will then mark the point at which I start with a ranging pole to which I will attach my measuring tape, I will then place another ranging pole a specific distance (30 metres) away using my compass to make certain it is on the same bearing. I will then pull the measuring tape taught between the two ranging poles and move down it, performing a line transect every two metres and an interrupted belt transect with a quadrat frame every 10 metres. For the Line Transect I will use my equipment previously specified, the light meter, temperature, pH and moisture probes to measure their respective factors. To ensure a fair test, at each interval, each time I repeat the testing I will obviously use the same equipment but will also press all the probes into the same depth of soil, on the same side (left) of my measuring tape and will repeat the testing 3 times to ensure that my first result was not accidental and that I am in the right range. I will record my results in a normal table.
For the Interrupted Belt transect I will be using the quadrat frame, ruler and pin because this allows me to accurately quantify a certain patch of land. I will lay the quadrat frame on the ground, to ensure a fair test I will always lay it on the same side of the tape and with the same corner, ie. Bottom right touching the same value ie. 10m, 20m to ensure each quadrat is the same distance away from the last exactly. I will then measure a certain distance down one side then lay the ruler straight across the quadrat, placing the pin into the ground at 10 centimetre intervals along the ruler recording which species of plant the pin touches. It is likely that in the quadrat frame there may be different species of plant on top of each other, therefore to ensure each quadrat receives the same treatment I will decide now to record the first plant the pin touches. I will record the results in a suitable diagram that will also illustrate the distribution of different species visually.

I will perform a statistical analysis such as the Chi squared test on my results to test the statistical significance of results reported in my tables of results.

While I am following my bearing across the valley I will also be making a height profile of the area using a clinometer at each ranging pole and measuring from a specific point on one, to the next along to see by how many degrees the valley slopes down, and up on the other side.