Biology Coursework

An investigation into the variables affecting the distribution of plants in a woodland area.

Introduction.

I will be carrying out my investigation in Whomerley wood. Whomerley wood is an ancient wood, created in the 16 th century, 400 years ago. Initially Whomerley wood seems to be largely made up of bramble and the trees consist mainly of Hornbeam, with a number of Oaks, Ash and Silver Birch trees, consequently the woodland looks to be a fairly sheltered and shaded place in the patches where the trees were growing. On the woodland floor though, there were numerous patches of Bluebells, Dog's mercury, Wood millet and Wood melleck. Make note how to identify the different plants.

The woodland is coppiced on a rotation system, where one acre of trees per 15- 25 years are cut, giving them a small trunk remaining. This produces a smaller diameter wood, therefore giving other plants light and space to grow. This can be seen in the wood, and over time, on the trunks a shrub (explain what layers are) layer will start to grow.

The idea of coppicing affects some of the areas factors of distribution of plants because it provides more light and space for smaller plants, i.e. dog's mercury, so they will not be competitively excluded. This also affects when they grow, because bluebells have adapted to their environment in Whomerley wood, and they start to develop in the early spring, where most of the trees surrounding them are bare. This means that the bluebells have light (through the bare tree branches) and less competition for the nutrients in the soil.

Variables/Factors

The factors that will affect the distribution of plants in a wood are:
(information found in "Biology G.C.S.E. edition" and the internet)

- Temperature. Principally speaking, in more extreme temperatures, whether hot or cold, animals and plants find it more difficult to survive. This is because water is very easily lost through evaporation, and is not easily replaced. Only few plants adapt to extreme conditions, which is why places like a desert or the Antarctic is sparsely populated. Plants and animals can adapt to their surroundings, cacti have a small surface area on the plant so water is not evaporated off and polar bears produce a thick layer of fat and a thick coat to insulate them in the freezing cold temperature.
- Food availability. Animals and plants will populate where there is food availability, especially if there are no other competitors in the vicinity of their chosen area. This results in the plants and animals being able to increase in their population and grow into healthy organisms. This is why on areas such as fields, plants like daffodils can grow as there are no trees to take up their nutrients in the soil.

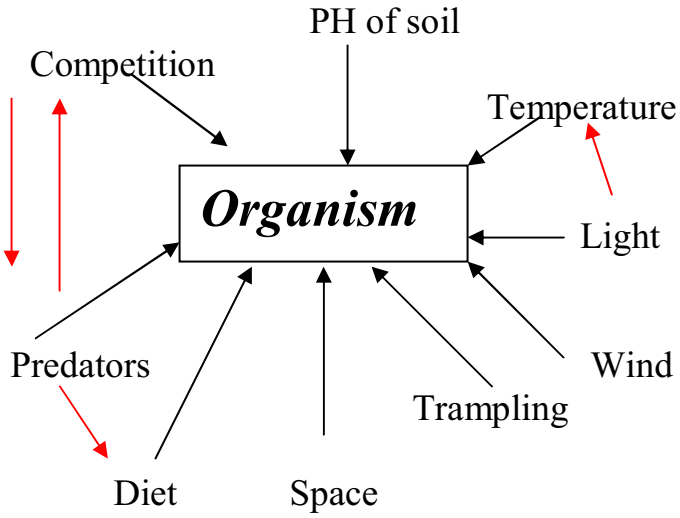
- Shelter. Plants and animals will usually stay in a habitat where there is shelter, but not so much so that they do not have enough light. Plants and animals can adapt to shelter, plants can become shade tolerant, which means either, like the Blue bell they flower early or they reduce the need for light.
- Trampling. Plants will mostly be nonexistent on places with high trampling numbers like a path because the intensity of the forces exerted on to the plant will be very likely to be too much so the plant would die.
- Light. This is an important factor, as it is needed for photosynthesis. If plants become shade tolerant, i.e. Dog's mercury, it is able to grow in shaded areas without the competition for light with other plants. If, however a plant does not become shade tolerant, i.e. poppies, the plant will have to grow in open areas with plenty of light, like fields.
- pH of soil. Only few types of plants live in acidic soil because few bacteria live in acidic conditions so there are few nitrates in the soil, which is a requirement for the growth of plants.
- Space/ competition. Plants need space to grow and so to decrease the competition for nutrients, light and so on. With their own space, plants are free to reproduce and grow into healthy organisms.
- Rainfall/ water. Water is essential for the growth of plants, but too much or too little dangerous to the plant. With too much water, soil becomes wet and bacteria are unable to live there, as they cannot get enough air from the soil. This makes the bacteria unable to decay dead organisms, so the dead organism start to release acid into the soil, which destroys any nitrates in the soil. This makes it very difficult for plants to have their environment there. If there is not enough water, soils become gritty and lack nutrients and its water retentive properties, making it difficult for a plant to have its habitat there.
- Predators. A predator is an animal, which kill another living organism, called prey, for food. If a plant is a prey for an animal in its environment, the plant must adapt to protect itself from being eaten. This may make it very difficult for a plant to produce in that area, so it is likely that plants will produce more in environments with a low number of predators.
- Oxygen. Oxygen is a necessity for plants to live with. Oxygen is available in the air, but aquatic plants can obtain it from the oxygen dissolved in the water. Aquatic plants will usually live along the edges of a river or pond, as oxygen is not easily dissolved so it does not diffuse very quickly, this means that there is a larger oxygen supply in the shallower parts of the water.
- CO2. Carbon dioxide and water are combined using energy from sunlight to give sugars and oxygen to the plant in photosynthesis. The plant then uses the sugars. One of the things that the sugar is used for is growth (it's used in respiration to give the plant energy, and to make cellulose- needed for plant cell walls, it's also converted to other substances needed by the plant to grow). If you increase the concentration of carbon dioxide then

photosynthesis will work faster, and more sugars will be produced. The growth rate will also increase so the plants will grow more quickly.

- Nitrates Nitrogen is usually very important to plants, so soils low in dissolved nitrates will not support growth well. Again, some plants deal better with low levels or absence of some nutrients better than others. E.g. Legumes (Peas, beans, clover) have symbiotic nitrogen-fixing bacteria growing in nodules in their roots, enabling them to flourish in soils poor in nitrogen.
- Pathogens. If pathogens are present in the plants environment the plants habitat can be destroyed if not damaged. This can affect the reproduction and growth of the plants, as pathogens are organisms that cause disease.

These factors can be divided into two groups: biotic and abiotic. Biotic means living and abiotic (sometimes referred as edaphic) means not living. So, Food availability, shelter, space/ competition, Trampling, predators and pathogens (diseases) all come into the biotic side. Temperature, light, rainfall/ water, pH of soil, wind, oxygen, CO_2 and Nitrates all come into the abiotic side. However, food availability, shelter and pathogens also come into the abiotic side as well, so these factors are exceptions.

Sometimes, there are factor complexes, where factors affect an organism, but also each other.



Important factors are the factors, which override all, or most of, the other factors. I consider the overriding factor in this woodland to be light because it affects the temperature, which is a large issue of habitats because .not all plants are shade resistant.

Light is needed for photosynthesis, and without it or lack of it would cause a deficiency in growth and reproduction so plants would not be able to survive there, therefore their distribution would be low unless the plant was shade resistant.

I am going to investigate the distribution of bluebells and bramble in the wood because they are two different plants. Bramble is quite an overpowering plant and the bluebell has had to adapt to this. I will be comparing the results to the light intensity as well.

Prediction

I think that the higher the light intensity, the more bramble coverage in the quadrat. I think this because with more light available, photosynthesis can happen quicker so more glucose will be produced which means bramble will have more sugars to use for growing compared to if it was in a shaded area.

I think that because the season I am investigating in is summer, there will be little bluebell coverage. I think this because in summer the trees leaves are thick and close together and so little light are let onto the floor. I think that if the bramble is lifted slightly, we will be able to see the remains of the bluebell as it grows in the spring time when the trees have none or little leaves so light is let out onto the woodland floor. Because in spring it is lighter on the floor than in the summer under the shade of the trees, there is less competition for light between the Bramble and the Bluebell in spring, so this is when the Bluebells have their chance to grow.

The hypothesis I will use is “the higher the bramble cover values the lower the bluebell cover values” and I will see how the light connects in this hypothesis.

Fair Testing

It is difficult to make this investigation a fair test, as it is not under a laboratory condition. Seeing that the investigation was carried out all day the light intensities would of changed throughout, it would be highest at mid day, then lowest as the afternoon went on.

I tried my best to keep the factors I could the same, the pH of the soil did not change dramatically in the area I was testing (the average was 4.5 pH, so it was slightly acidic). I will check my results with other groups so I can compare them, which will show me if I was right because I will have access to a lot more results.

I will be very accurate in my measurements so I will be able to get a clearer idea of a conclusion and I will carry out my investigation in an area of the same amounts of shelter and to the best of my knowledge with no pathogens.

Safety

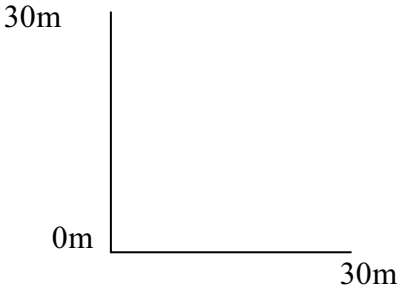
I will make this investigation a safe investigation by wearing sensible shoes, as I will be in woodland, which has uneven ground, and I will wear long trousers because it is likely I will be walking through thick brambles to get my recordings.

I will also carry a first aid kit including plasters and treatment for bites, stings and rashes because it is probable for someone to get stung in a wood.

Method

The apparatus I will be using are a quadrat, 2 30-metre tapes, and a light reader.

1. Set out the two 30- metre tapes at right angle to each other. (As shown)



2. Using the co-ordinates produced from the computer (from the computer because it is selected at random so there is no biases in the selection of co- ordinates) put down the quadrat and record the percentage coverage of Bluebells.

3. Using the ACFOR scale (A= abundant= 76-100%, C= common= 51-75%, F= frequent= 26-50%, O= occasional= 6-25% and R= rare= 1-5%) record results in a data collection table.

4. Again, using the ACFOR scale record the amount of Bramble coverage and record in the data collection table.

5. Record any comments of the area

6. Record the light intensity (in lux) four times and take the average.

7. Do (2)-(6) for the next 19 co-ordinates

Co-ordinates= 21,12 27,14 17,9 5,12 3,15 25,3 4,25 20,9 1,25 6,26 26,9 21,4 28,19 13,15 8,23 24,26 14,10 21,10 30,20 21,11

Results

	Quadrat number									
Species	1	2	3	4	5	6	7	8	9	10
Bluebell	R	R	-	R	-	-	R	-	F	-
Bramble	F	A	-	-	A	F	F	-	-	-
Comments?								Foot path		Foot path
Light intensity (lux)	600	500	620	450	200	475	1700	400	600	560
	Quadrat number									
Species	11	12	13	14	15	16	17	18	19	20
Bluebell	F	R	O	C	A	-	R	O	-	A
Bramble	C	A	F	F	F	-	F	F	C	-
Comments?										
Light intensity (lux)	630	210	450	350	400	390	160	310	285	300

I also put the results on two different graphs. The first graph I plotted the results against each other. I was able to do this by taking the first co- ordinates of my results and then using that as the “metres along in forest”. I did this because my first 30-metre tape

went deep into the forest and as the environment is the same in my area I sectioned off, it was fair that I used the results in that way.

My second graph is a replica of the area I sectioned off but on graph paper, which shows the distribution of bramble and bluebells in the different quadrats.

I can compare my results with the other groups to confirm our conclusions and I can also compare some of my results with the rest of my results and seeing if they look accurate.

Conclusion

Looking at my graphs and my table, I can see that where the light intensity is high, the bramble coverage is also high, however even when the light intensity is at its lowest, bramble has still the highest percentage of coverage.

Bluebells emerge when there is even a little light, but little or no bramble coverage. This is because as the bramble is a larger plant than the bluebell and over powers it in distribution, Bluebell can only appear where there is little Bramble. I can also see from my graph that both the Bramble and the Bluebell plants appear in patches on the woodland floor.

When looking at the graph more closely, I can see that the Bramble appears in larger patches than the bluebell. This shows that there is inter specific competition between the Bramble and the Bluebell and the Bluebells are slowly being what is known as competitively excluded. This also proves that when the Brambles take in more light, like when the have a larger surface area, photosynthesis can happen quicker, so the bramble patches have more of the glucose to grow and over power the competition.

As Bluebells are in such small patches anyway they do not have as much light for photosynthesis (due to the competition from the Bramble) so they can not get enough sugars to use for growth and overpowering the Bramble. This turns into a vicious circle and because of this the population of the Bluebells will decrease while the population of Bramble will increase.

It is when the inter competition starts to happen that the weaker plant (in this case the bluebell) has to adapt to its environment so it will not become extinct. This proves that the Bluebells will thrive in the springtime where there is little competition as most plants are still bare from the winter. This shows that my prediction was correct.

Evaluation

The procedure our group used for this investigation was not entirely fair for numerous reasons. There was a footpath running through our area of investigation which made it look like we had a few ominous results because it showed that where bramble was extinct, so was the Bluebell and according to my hypothesis the bramble should be abundant where Bramble is absent.

Because our area of investigation had a huge Bramble patch in it, it made it impossible to walk through, so we had to guess where the co- ordinates would be if they happened to be in the large bramble bush or just outside it. This made the co ordinates not entirely random, as they were not carried out accurately.

Once the quadrat was on the woodland floor, there was no accurate way available to us to record the percentages of coverage, so we had to estimate, which was inaccurate,

but we did use the same person to estimate the percentage all the way through so at least we had some continuity.

As the investigation was carried out outside, it was difficult to keep all of the factors the same like the temperature, the light intensity (we found there would be a few minutes where the sun would go behind a cloud so the light intensity would drop) and the shelter (the wood was mostly covered by trees, but sometimes there was a small gap in the trees from time to time). But as the results were accurate when comparing theories in other resources, these inaccuracies must have been very small and therefore would not have affected the investigation.

The investigation is fairly reliable, but it could be more reliable if a more accurate way of measuring the percentage of plants per quadrat was available and the investigation was done in laboratory conditions (e.g. if an area was created in a greenhouse where all other the factors could be controlled).

I could extend the investigation by taking into account the tree density in the surrounding area and how its shade affects the light density and therefore the distribution of both the Bramble and the Bluebell.

I could also carry out the investigation in different acres of the wood to see if the pattern is consistent and reliable. I could see whether the coppicing makes a difference and I could see whether the pattern would be the same in different plants like the Oak trees and Dog's mercury.