Investigating difference in Abiotic Factors and species diversity in too ponds.

Aim- To investigate the distribution of invertebrates in two pond ecosystems.

In this investigation I will be studying the distinction in abiotic factors and species diversity in the two ponds. The two ponds that I will be looking at to achieve my results is meadow pond which was man made in 1994 and Woodland pond which is mad made in 1990 and is surrounded by deciduous trees like oak and ash, which loose their leaves during the season of the year when there is in short water supply.

Several physical factors affect the distribution of organisms in their habitats. These physical factors are often referred to as abiotic. Abiotic is referred to not living. Biotic factors which involve the effects of other living organisms including plant with the type and distribution to feed on also the food availability and the competition of invertebrates.

The Abiotic factors include oxygen concentration, pollution, light intensity, and water temperature and substrate depth.

Other factors comprise of invertebrate diversity, number of detrivores/decomposer compared to herbivores and carnivores and number of Herbivores compared to detrivores and carnivores.

- I predict that light intensity would be higher in the meadow pond as there is no shading from the trees, so more light reaching the pond.
- I predict that water temperature will be greater in the meadow pond than the woodland pond due to fact of no shading of trees so more light reaching the pond so the temperature will be higher due to the heat of the light.
- I predict that the oxygen concentration will be higher in meadow pond because of more sunlight so plants will be photosynthesising more. Also as I am taking the data during the day the oxygen will be higher linked to its production by the photosynthesis of activity of aquatic plants. Also the factor of seasonal changes in temperature and light intensity influences oxygen availability through the photosynthesis activity.
- I predict that the substrate depth will be higher in the woodland pond as there are deciduous trees which loose their leaves which fall in the pond giving a rise in the water.
- I predict the acidity will be more acidic in the meadow pond due to the fact that more rainfall reaching the pond as there is fewer trees which reduce interception which increases surface run-off. As I mentioned I will be taking this data during the day in which carbon dioxide is higher due to the fact photosynthesis activity will be higher. Carbon Dioxide forms carbonic acid which is weak acid so the rain is likely to be mildly acidic. Carbonic acid dissociates into hydrogen ions ($H^+$) and hydrogencarbonate ions ($HCO_3^-$). The $H^+$ ions contribute to the acidity of the water or make the pH lower.
- I predict that there will be a higher invertebrate diversity in meadow pond due to fact there is more light reaching the plant so more photosynthesis is occurring so more species are available to survive.

- I predict that there will be more detrivores/ decompose rs compared to herbivores and carnivores in the woodl and pond as there are more dead organic matter like leaves.
- I predict a number of herbivores will be higher compared to de trivores and carnivores in the Meadow pond because of more sunlight reaching the plant so more photosynthesis so they grow more and more food for the herbivores.

## Methods

Light intensity – Used a light intensity detector,
Place it in the water and read the temperature for different sites in the pond.

Oxygen concentration – Used an oxygen concentration detector, bottle of pond water. First off all we got pond water in the bottle and shacked it for 1minute. Then we turned the meter on and opened the lid of the bottle. Place the meter in the bottle until it reached to 100. After that we put the meter in the pond and read readings at different sites in the pond.

Water temperature – water temperature meter
We placed the meter in the water and read the reading at different sites.

Substrate depth – Used a depth ruler.
First off all we took the depth of the river without the substrate at the bottom. After that we took the depth with the substrate. To achieve the substrate depth – normal depth – substrate.
We took 3 readings.

Acidity – Used universal indicator paper.
Place the small amount of paper in the water and saw what colour it turned into. Took different readings from different sites.

Invertebrate diversity – Used a sieve/net, tray for the insects and an identification key, magnifying glass, small pot and a pipette/spoon.
First off all we put the net in the water and took a figure of 8 for 1 minute. Then we put some pond water in the container and then placed the species in the container. After that we identified them using the species key. The species we identified we placed them in a separate bowl with pond water.

To ensure we made a fair test we did many things such as:

- Taking 3 readings for different variables at different sites from each pond.
- For the species diversity we did figure of 8 in a minute at different site s for each pond.
- Used equipment accurately.
- For the species diversity we used a key to give a more accurate variety.
- We used different sites in each pond for example open water, grassland, mud, and plant life.
- We done same number of times for the differ ent variables at each pond.

- To make the diversity of species fair test we did it once from each site but then there were 5 groups (including mine) which took their results from the same site. After we took an average to make it more reliable.

## *R*esults and analysis

Summary of Aboitic results

| Variables | Meadow pond | Woodland pond | Hypothesis |
|---|---|---|---|
| Water temp | 10.66 | 9.68 | *R*ight |
| Light intensity | 3186 | 666 | *R*ight |
| Oxygen concentration | 50.67 | 36.25 | *R*ight |
| pH | 6 | 7 | *R*ight |
| Substrate Depth | 4.6 | 13.7 | *R*ight |

Meadow pond - Simpson's diversity index

| Species | No. of individual (n). | (n-1) | n(n-1) |
|---|---|---|---|
| Alderfly larvae | 20 | 19 | 380 |
| Beetle larvae | 10 | 9 | 90 |
| Biting midge larvae | 2 | 1 | 2 |
| Black fly larvae | 1 | 0 | 0 |
| Bloodworm | 91 | 90 | 8190 |
| Damselfly larvae | 6 | 5 | 30 |
| Flatworm | 35 | 34 | 1190 |

| | | | |
|---|---|---|---|
| Freshwater hoglouse | 123 | 122 | 15006 |
| Freshwater shrimp | 54 | 53 | 28620 |
| Greater water boatman | 1 | 0 | 0 |
| Leech | 9 | 8 | 72 |
| Lesser water boatman | 2 | 1 | 2 |
| Mayfly nymphs | 288 | 287 | 82656 |
| Phantom midge larvae | 78 | 77 | 6006 |
| Water beetle | 1 | 0 | 0 |
| Pond snail | 40 | 39 | 1560 |
| Ram shorn snail | 4 | 3 | 12 |
| Water flea | 1457 | 1456 | 2121392 |
| Water spider | 2 | 1 | 2 |
| Bivalves molluscs | 4 | 3 | 12 |
| Whirligig beetle | 1 | 0 | 0 |
| Water mites | 10 | 9 | 90 |
| N | 2239 | n(n-1) | 2241114 |

Simpson's Diversity index= N (N-1)

-------- = 2239 times 2238= 5010882

n (n-1)

---------- = 2.24

2241114

| Species | No. of individuals | (n-1) | n(n-1) |
|---|---|---|---|
| Biting midge larvae | 7 | 6 | 42 |

| | | | |
|---|---|---|---|
| Blackfly larvae | 9 | 8 | 72 |
| Bloodworm | 84 | 83 | 6972 |
| Ceaseless caddis fly larvae | 2 | 1 | 2 |
| Damselfly nymph | 28 | 27 | 756 |
| Dragonfly nymph | 5 | 4 | 20 |
| Flat worm | 14 | 13 | 182 |
| Freshwater hoglouse | 13 | 12 | 156 |
| Freshwater shrimp | 47 | 46 | 2162 |
| Greater water boatman | 2 | 1 | 2 |
| Leech | 8 | 7 | 56 |
| Mayfly nymph | 9 | 8 | 72 |
| Non biting midge larvae | 32 | 31 | 1054 |
| Phantom midge larva | 31 | 30 | 930 |
| Ram shorn snail | 1 | 0 | 0 |
| Stonefly nymph | 1 | 0 | 0 |
| Water beetles | 1 | 0 | 0 |
| Water flea | 684 | 683 | 467172 |
| Water spider | 2 | 1 | 2 |
| | 980 | | 479652 |

Simpson's diversity index - 980 times 979 = 959420

----------= 2.00

479652

# *Conclusion*

Both habitat diversity and pond type have affected species diversity. As I predicted that meadow pond will have the higher species diversity in which I was correct.

I predicted that if there is more sunlight reaching the plant there would be a large number of plants growing in which there will be more herbivores which feed on the autotrophs resulting in a greater number of diversity.

Looking at both results there was a big difference in specie abundance but a small difference in species diversity of only 24. Also looking from the meadow pond results the species assemblage patterns were influenced by the environment. The species diversity was positively correlated with the abiotic factors such as high levels of light meaning more plants to feed on, great amounts of oxygen and warmer water.

The things could affected our result was the seasonal differences in the population of aquatic species, movement of invertebrates into or out of the study area, small changes in pond characteristics or other things I did not measure.

Therefore the higher value of Simpson's diversity, the higher the diversity of the community and the greater the intrinsic value.

Pyramid of number – Meadow pond

Looking at the graph for the pyramid of number of the meadow pond it shows is going in a pyramid shape. The hypothesis was correct because I predicted the meadow pond will have more herbivores compared to detrivores and carnivores because the meadow pond has more plants to feed from.

however it can also be expected for the m.p to have more carnivores as there are more herbivores to feed on this may not be evident due to human error.

This maybe because I did not get readings from the middle of the pond as

sampling was only done on the edge so there wasn't an accurate data for the carnivores.
However there is a significant amount of decomposers which was not expected due to the conditions of the pond.

Pyramid of Biomass –meadow pond

From looking at pyramid it shows the hypotheses is wrong as there are more 2nd carnivores compared to 1st carnivores and herbivores. This is maybe because there's more food from the carnivores and herbivores.
Also as you can see there are more decomposers due to the fact of bad weather and seasonal changes so they're dying out.
Looking at these herbivores there is less then the 2nd carnivores. This maybe a human error as the herbivores are so small

Pyramid of number: woodland pond

Looking at this pyramid it shows the hypothesis was incorrect because there is less decomposers then herbivores which should be the other way round. This is because a lot of dead leaves from the surrounding trees fall into the pond. Also there should be less herbivore because there's shading by the trees which gives less light for the producers so less food for herbivores.

Pyramid of biomass- woodland pond

Looking at this pyramid it shows the hypothesis is wrong. It can be seen that there are less decomposers, 1st carnivores and herbivores But more 2nd carnivores. This is a human error as larger carnivores are more seen than the smaller carnivores and herbivores. Another is, plants dying in the winter so life cycle of herbivores changes.

Conclusion of abiotic factors

Water temperature

From the summary table you can clearly see that the temperature is higher in the meadow pond with a reading of 10.66 then in the woodland pond with a reading of 9.68. This is because more light is reaching the water due to no shading of trees.

Light intensity

From the summary table it shows there's more light reaching the meadow pond with a reading of 3186 then woodland pond with a reading of 666. This is because the pond receives more direct sunlight.

Oxygen concentration

From the table it shows there's more oxygen in the meadow pond with a reading of 50.67 then the woodland pond with a reading of 36.25. In meadow pond there isn't shading of trees so more photosynthesis is occurring so more oxygen produced.

pH

Our hypothesis on the pH was correct. The pH in the meadow was more acidic than the woodland. However it was not meant to be because there are decomposers in the wood land pond as they work best in acidic conditions. This is maybe because we measured the pH at the edge of both ponds. The centre of the woodland pond maybe more acidic.

Substrate data

From the data it can be seen then the woodland pond has a higher level of substrate with a reading of 13.7 than meadow pond with a reading of 4.6. This is a result from deciduous trees which loose their leaves and then fall into pond.

## *E*valuation

Limitations

1. Some species are not accurately counted, for example water flea which are very small which disrupts biomass. Also some species may escape from the net as they are very tiny. Also decomposers such as micro organisms may escape from the net which disrupts the biomass.

2. Less visibility in mud areas so not reliable in the number of species found.

3. Different people have different techniques as so their sampling is not the same.

4. Substrate depth not accurate due to the metre rule not placed correctly on the pond bed-obstacles and also no access to middle pond

5. Temperature – might vary at different times as we only took the readings on 1 day. As the result might vary on another day.

6. Ph inaccuracy – only did it on the edge of the pond