Comparison of two ponds at the end of the stream, and how different factors may affect the inhabitancy of the ponds.

AIM

In my investigations I will study two of the four ponds at the end of a stream (the first and last). I will use a wide range of equipment to find out how the two ponds vary and how this could affect its inhabitancy. I will look at various factors such as light intensity, depth; pH, temperature and take into account how these factors might affect the difference between the two ponds including differences in wildlife.

Background information

The ponds that I will study are at the end of a stream. There are four ponds in total each after the other. The ponds that I will study will be the first and last ponds. The first pond, which comes directly from the stream, contains more mud and is more turbid. As you go along the ponds, they come less muddy and turbid as dirt gets filtered out. This is one factor that is of significance in my investigations.

What is a pond?

A pond is a small area of still, fresh water. It is different from a river or a stream because it does not have fast moving water and it differs from a lake because it has a small area and is no more than around 1.8m deep. Some ponds are formed naturally, filled either by an underwater spring, or by rainwater – sometimes known as 'dewponds'; other ponds are man-made. The ponds that I will study are man made ponds.

If a pond is to be a successful habitat it must have plants growing in it. They provide food, oxygen and shelter for most animals. Green plants need sunlight to make their food via photosynthesis. Therefore a plant in the open with lots of sunlight will be more successful than one that's in the shade e.g. covered by a tree.

Pond wildlife

Macro-invertebrates refer to a whole range of different species of 'bugs' that live or spend part of their life cycle in water. They are an ideal way to measure the 'health' of rivers and streams. Different species of invertebrates show various levels of sensitivity to deterioration in water and habitat quality. These types of species are called indicator species. Indicator species are species whose presence, absence, or relative well-being in a given environment is indicative of the health of its ecosystem. Generally, the poorer the quality of the water, the less diversity of invertebrates that will be found. Some of the more sensitive include mayflies, stoneflies, caddisflies, dragon and damsel flies. Beetles, water boatmen and shrimp tend to have moderate tolerance, and the more tolerant (can survive poorer water quality) include snails, worms, chironomids, blackfly and mosquito larvae.

Different forms of pond invertebrates

Water boatman- Water boatmen occur most commonly in ponds and along the edges of lakes. Most water boatmen eat algae, tadpoles and minute aquatic organisms. Some are predaceous and feed on mosquito larvae and other small aquatic animals.

Dragonflies- dragonflies can fly at up to 50 kph and capture other insects in the air, while flying. Dragonflies are preyed upon by fish, reptile's frogs and birds. Female dragonflies lay they eggs in or near water. Eggs hatch into nymphs, commonly known as mudeyes. Dragonflies eat many insects such as fish, frogs, birds, reptiles, mosquitoes, bees, flies and butterflies.

Midge lava- midge larvae have a worm-like body and small antennae. They are often red in colour, and are hence referred to as bloodworms. They may also be white, green or yellow in colour. Larvae develop into pupae, which attach to materials below the water surface. Adult midges are commonly seen in swarms around the edges of wetlands. Midges are also pollution tolerant.

Fly larvae - Fly Larva can tolerate organic pollution as they feed on organic particles. They can live in water with low levels of dissolved oxygen as they often come to the surface to breathe. Some Fly Larvae feed on decaying matter and play a key role in recycling nutrients.

Tadpoles- Tadpoles first develop in the egg, and then they eat the egg case. After this they often seem to disappear, this is because they are so small. Often they will be seen in the warm areas around the edge. They at first eat algae, then they progress on to other plants and then sometimes on to meat - such as worms and daphnia. They will even eat each other. Tadpoles absolutely depend on having fresh, clean water and like warm conditions. They then later metamorphose into frogs.

Pond skaters- Pond skaters are Usually seen skating over the surface of ponds. They have tiny hairs on its feet which repel water and allow it to walk on the surface film. Pond skaters feed on small insects.

Pond plants

Duck weed Duckweed contains very small freshwater plants, which float on the surface or underneath water. When there are many Duckweed plants growing together, they create the effect of a green blanket floating on top of the water. duckweed absorbs lots of sunlight from the sun.

Filamentous algae- Filamentous Algae are primitive aquatic plants which are different from other plants because they don't have any stems, or leaves or roots. Algae have an important role to play in the overall food chain because they convert the solar energy into energy forms that can be used as a food source for other aquatic life. Algae also help to increase dissolved oxygen in water during daylight hours but

over-abundance can be a serious problem at night when they remove oxygen from the pond water.

Some of the factors that can affect plants and organisms in ponds are...

pH- pH is a measure of the acidity or alkalinity of a solution. Low pH (acidic conditions) affects aquatic environments. Also most plants grow well at a pH of 6.5. However some plants prefer acidic conditions and others prefer alkaline conditions.

Light- Light is an important factor in most ecosystems, because it influences primary productivity and, therefore, the rest of the ecosystem.

Temperature- Temperature is important because it can affect the metabolism of any organisms. The solubility of oxygen in water is affected by the temperature: as the temperature increases, oxygen solubility decreases. A low solubility of oxygen is harmful for most aquatic plants and animals.

Oxygen Level- One of the important elements in water quality is the concentration. Oxygen levels in aquatic ecosystems can change very considerably and can have a big impact as most organisms require oxygen (aerobic). If organic waste gets into aquatic environments the concentration of oxygen will fall. This is because the bacteria that break down the waste will need a higher demand of oxygen. The consequent low level of dissolved of oxygen can have a harmful effect on aquatic plant and animal life.

Hypothesis

My hypothesis is that there is a significant difference between pond 1 and pond 4. I predict that the first pond would have less diverse number of wildlife and plants growing in or around the pond than the fourth pond and therefore pond 4 will have a higher diversity index than pond 1. The reason for this is because as I mentioned earlier, the first pond, which comes directly from the stream, contains more mud and is more turbid. This reduces the light intensity and has a negative effect on plants. As you go along the ponds, they come less muddy and dirtier as the mud and dirt gets filtered out. One of the reasons why I believe the fourth pond would have a more diverse number of plants and invertebrates is because it appears to be much cleaner than the first pond. Another reason why I believe this is because the fourth pond has more light coming to it than the first pond and is not shaded by trees unlike the first pond. Light is one of the most important parts in all life cycles and so this is why I believe pond four would have more plants and invertebrates.

Null hypothesis

My null hypothesis is that there isn't a significant difference between the two ponds that I will investigate and that the species diversity does not differ between the two ponds.

Apparatus-

- **pH metre-** one of the factors that I will look at in both ponds is the pH. I will use a pH metre to look at the pH in both ponds. The reason why I chose a pH metre to find out the pH of the ponds and not another method such universal indictor is because a pH metre is very accurate and reliable piece of apparatus. Another reason for this is because a universal indicator is difficult to use at different depths.
- **Light meter-** light intensity is another factor that I will look at and a light metre is a safe and accurate way of finding out the light intensity of the ponds.
- **Digital Thermometer-** this will be used to take the temperatures of the ponds. A thermometer will be used, as it is a safe, accurate and reliable piece of equipment to use. An ordinary glass thermometer can be used but it is too fragile for fieldwork so it is better to use the digital thermometer. The digital thermometer can be used to measure water at different depths which makes it greatly efficient for my investigation.
- **1 metre ruler-** this will be used to look at the depths of the ponds. A ruler will be used as it easy and safe to use and will provide accurate data.
- **Net-** I will use a net to capture invertebrates from the ponds as part of my investigations. A net will be used, as it is an ideal piece of equipment to use to capture invertebrates, as it allows no invertebrates to be lost whilst collecting them. A net also prevents any damage to be done to the invertebrates and so can be safely put back into the ponds without ay harm being done to them.
- **Container with white bottom-** this will be used to collect samples that I take using the net. A white bottom is ideal, as it would allow me to identify things easily.
- **Small magnifying glass-** this will be used to look at anything from my samples that is too small to see and will help me greatly in identifying what it is that I am looking at.

Method

The method I will use will be used for both ponds.

1. Begin by investigating the first pond first and then the fourth last. Start by looking at the **depth** of the pond and use the 1 metre ruler to record the depth of the pond at the deepest point.
2. Then look at the **light intensity** of the pond. Place the metal probe connected to the light metre on the surface of the pond and record the light intensity. If the light intensity is 0 at the pond bed work out how far down the sunlight reaches the pond. In order to do this, firstly use a Serles disc and slowly push it down the pond until it becomes invisible. Then measure how far down the container is using a ruler and this will tell you the depth of the sunlight in the pond. Whilst looking at the light intensity, make sure you walk slowly through the pond so that any dust or mud from the bottom of the pond will not affect the recordings you take. It is important that the probe is always facing the same direction in order to achieve fair results. It is also important that the

sunlight's affect is reduced. To ensure this, readings should be taken quickly. Make sure you measure the light intensity of the fourth pond straight after measuring the light intensity of the first pond so that light sources affect is again reduced.

3. The third factor that to look at is the **pH**. Record the pH after every 10cm of the pond starting from the bottom. This will be done to look at the difference in pH at the bottom and top of the pond and how this could affect the wildlife of the pond. Record the pH, by placing the meal probe attached to the pH metre in the pond, and then records the results.
4. The fourth factor that to look at is the **temperature**. Like the pH, record the temperature after every 10cm of the pond from the bottom. This will be done to look at the difference in temperature at the bottom and top of the pond and how this could affect the wildlife of the pond. The same method will be used, by placing the metal prod in the pond and recording the temperature at the specific depth and then record the results. Just like the light intensity, make sure you measure the temperature of the fourth pond straight after measuring the temperature of the first pond so that the temperature remains constant.
5. After looking at the factors concerning the ponds move on to looking at the plants and invertebrates living in the ponds. Firstly observe the pond closely and record any invertebrates or plants you see. Then take three samples randomly from any part of the pond using a net and a frame quadrat. Do this, by looking away from the pond and throwing the quadrat into the pond. Then take a sample from where the quadrat is. Firstly take samples from the bottom of the pond and place them in a container. Do the same for the surface of the pond and place the samples in a different container. Leave the container for about 10 minutes in order for any mud or dirt to settle in order for you to observe any wildlife easily. Use a key and a magnifying glass in order to identify any wildlife. After finishing with your samples ensure that you place them back into the pond without harming any of the invertebrates.

After finishing your investigations ensure that all equipment is washed and put away and nothing is left to damage or harm any wildlife at the site you will work in. Also ensure that you put back anything you used from the site and leave the site how it was before your investigations for e.g. Stones turned over in the pond to examine invertebrates should be replaced carefully afterwards.

I will use Simpson's diversity index to analyse the inhabitancy of the two ponds. Simpson's diversity index is an accurate measure of the number and abundance of species found in a particular habitat by sampling in a random way. Generally a higher diversity index means a better quality of water. Therefore this statistical test will be used to support my hypothesis which is being tested.

I will also do a Mann -Whitney U-test. This test is used to see whether there is significant difference between two sets of data. If the "U" in the test is less than or equal to the critical value then there is a significant difference between the two sets of data. So therefore the null Hypothesis is rejected.

Below are empty results tables that I will use to record my results into, the same tables will be used for both ponds.

Depth

Light intensity-

Surface (lux)	Bed (lux)	Maximum Depth Of Sunlight (cm)

Temperature-

Distance from pond bed (cm)	Temperature (°c)
Pond bed	
10cm	
20cm	
30cm	
40cm	
50cm	
Pond surface	

pH-

Distance from pond bed (cm)	pH
Pond bed	
10cm	
20cm	

30cm	
40cm	
50cm	
Pond surface	

Inhabitancy-

Species Name	**Number caught**

Health and safety

- First and foremost there are diseases and dangerous organisms that can be picked up either from handling water or by accidental ingestion. Therefore make sure you use protective gloves and essentially if you have cuts or grazes on your arms or hands. Also carry disinfectant wipes and use them to clean your hands after handling water or before eating.
- Wear sensible clothing, in particular shoes such as Wellingtons whilst working in the ponds to ensure that you don't slip or fall.
- Make sure you work sensibly and carefully in the ponds as the ponds are deep enough to drown in.
- The pond surface is also slippery, so make sure you work carefully and cautiously.
- Have access to a first aid kit so that if any incident such as cuts or grazes occurs you can cover them up immediately.
- Make sure you work closely with a classmate so that if any incident does occur, they can call for help.
- Make sure you have phone numbers of friends or any other students, so that if any emergency occurs, you can get in contact with them.

Results for Pond 1

Depth 49cm

Light intensity-

Surface (lux)	Bed (lux)	Maximum Depth Of Sunlight (cm)
5.67	0	31cm

Temperature-

Distance from pond bed (cm)	Temperature (°c)
Pond bed	9
10cm	10
20cm	13
30cm	15
40cm	16
Pond surface	18

pH-

Distance from pond bed (cm)	pH
Pond bed	6.1
10cm	6.2
20cm	6.2
30cm	6.2
40cm	6.3
Pond surface	6.4

Inhabitancy-

Species Name	Number caught
Fly lava	13
Tadpoles	10
Midge lava	5
Segmented worms	7
Leeches	30

Results for pond 4

Depth- 60cm

Light intensity-

Surface (lux)	Bed (lux)	Maximum Depth Of Sunlight (cm)
8.0	8.0	60cm

Temperature-

Distance from pond bed (cm)	Temperature (°c)
Pond bed	16
10cm	17
20cm	18
30cm	18
40cm	19
50cm	20
Pond surface	22

pH-

Distance from pond bed (cm)	pH
Pond bed	6.4
10cm	6.6
20cm	6.6
30cm	6.6
40cm	6.6
50cm	6.6
Pond surface	6.7

Inhabitancy-

Species Name	Number caught
Pond Skaters	25
Blue dragon Fly	3
Water Boatmen	30
Red Dragon Fly	2
Duck weed	7
Filamentous Algae	4
Fly lava	10

Below are two line graphs comparing the temperature and pH of pond 1 and pond 2….

Conclusion

By analysing the data obtained from my experiments it is clear that my hypothesis was correct. My hypothesis was that there would be a significant difference between the two ponds. I also predicted that the first pond would have a less diverse number of wildlife and plants growing in or around the pond than the fourth pond and that pond 4 would have a higher diversity index than pond 1. This is shown by my statistical analysis of the ponds.

My Simpson's Diversity index shows that Pond 1 has a diversity index of "3.53" and pond 4 has a diversity index of "4.00". This therefore shows that there is a more diverse number of plant and invertebrates in pond 4 than in pond 1. Because, pond 4 has a higher diversity index than pond 1 it suggests that pond 4 has a better quality of water than pond 1.

My Mann-Whitney U-test also supports my hypothesis. The critical value for my Mann-Whitney U-test is "5" and is less than my smallest U value which is "35". This therefore means that there is a significant difference between the two sets of data and so a significant difference between the two ponds.

My results clearly show that pond 4 has a much higher light intensity than pond one. My results also show that light reached right down to the bed of pond 4 whereas in pond 1 the light only reached 31cm down. This was due to two things. Firstly, the first pond was shaded by a tree and received less sunlight, whereas pond 4 was not. Secondly, the first pond contained much more mud and dirt than pond 4 because it came directly from the stream. Therefore pond1 light intensity was low and the light did not reach down to the pond bed. Because there was a low light intensity in pond 1, there were no plants growing in the pond. A plants main energy source is light and this is why there were plants such as filamentous algae and duck weed growing in pond 4 where the light intensity was quite high.

My results also show that the temperature of pond 4 was slightly higher than pond 1. This could be due to the fact that the 1st pond was shaded by a tree and that the 4th pond was in direct contact with the sun.

The line graph shows that the pH of the 1st pond was lower than the pH of the 4th pond and the pH of the 4th pond was closer to pH7 (pure water). This therefore means that the 4th pond has a better quality of water than pond 1. This is on of the reasons why the diversity index of pond 4 was higher than pond 1. Most aquatic plants grow well at around pH 6.5. This is why the fourth pond had plants such as filamentous algae and duckweed growing in it and the first pond had none.

Evaluation

I believe my investigations were successful as I proved my hypothesis correct. I also believe that I carried my investigations out to the best of my ability and achieved reliable results as I followed my method precisely. I also made sure that anything that could affect my results which are mentioned in my method was avoided. For example I made sure that I reduced the effect of the suns light and the temperature of the pond by taking the readings straight after each other.

I made certain that I used all equipment with care and in the correct manner and made sure I followed all my health and safety precautions precisely. I also made sure that whilst carrying out my investigation I avoided anything that could affect the wildlife or habitat of the area I worked in. Any invertebrates I caught for my investigations I made sure I put them straight back where I caught them from. I also ensured that the site I carried my investigations on was left how it was at first.

A problem I faced whilst carrying out my investigations was that the net being used to capture the invertebrates has some larger holes in it and may have let some smaller species through. Also the removal of weeds from the net to get a clear viewing of the organisms in pond 4, may have lead to the removal of some organisms and both of which could have an affect on my results.

Whilst measuring the light intensity of pond 1, I ensured that I walked slowly and carefully through the pond to avoid any mud from the bottom of the pond from affecting my readings. However, it was impossible to avoid moving any mud at all and so this also might have affected my readings.

The accuracy of measurements taken could be taken to a higher degree of accuracy such that the temperature being measure to 0.01 degrees. This would improve the accuracy of my results. The limit of time affected the number of readings I could take, thus affecting the accuracy of my results. To improve the accuracy I would have taken more readings of the temperature, pH and light intensity and would have done more repeats. If I had more time I would also taken more samples with a quadrat so that the samples of invertebrates I take represent the whole of the site.

After evaluating my work I am aware that there were many factors that affected my results all of which are mentioned above. Nevertheless this does not mean my hypothesis was incorrect. My hypothesis was clearly correct as proven in my conclusion. My results were also parallel with my research; therefore I consider my results as being reliable but not accurate.