An investigation to disprove or support the null hypothesis that there is no correlation between the oxygen content of the water and the number of Stonefly and Mayfly in the water being tested

Apparatus

Fishing net 500 cm in diameter, tape measure, pen, results sheet, bowl, steel pole, 1 ball of string, stopwatch, 3 tree leaves, oxygen meter, universal indicator paper, thermometer, wellington boots.

Method

Go to the nearest river to test the amount of Stonefly and Mayfly in different places. The test should be carried out by holding the fishing net a meter downstream from where the kick sampling is being taken place. The kick sampling should be done by the bottom of the stream being kicked to dislodge the rocks on the riverbed, thus causing the in sects to flow into the net. The kicking during the kick sampling should last for approximately 30 seconds during each sample, as this is one of the variables that should be kept the same. This is because if one kick sample is kicked for longer or shorter than 30 seconds, it may provide the opportunity for more or less insects to be caught in the fishing net. This is due to a longer period time may mean more rocks are dislodged and possibly more insects too, that may drift into the net. The same goes for if one kick sample lasts for less than thirty seconds as less rocks will be dislodged and thus fewer insects moved into the current to fall into the fishing net and be caught.

To test the diversity of the species in the river, the kick sampling should be carried out in different places like upstream and downstream along the river. At least 5 different sites in along the river being tested, upstream and downstream resulting in 10 different sets of results for comparison and analysis. Each of the 10 places b eing tested should be tested 3 times to enable any anomalous results to be spotted and to allow an average to be taken from the 3 sets of results. Once a kick sample has been taken the contents should be emptied into a bowl with some river water, so that the diversity and amount of each species noted down on the results sheet. This should be done in the form of which species are present, how many were present and the place on the river in which they were found. After this information has been recorded the c ontents of the bowl can be emptied back into the river, with some fresh river water put in the bowl for the next kick sample to be emptied into. Each kick sample

should only be examined for 5 minutes for the species diversity, as if this variable is not kept the same some insects may move an be counted twice if a bowl is examined for too long as they could move to different places in the bowl. If different bowls are examined for different periods of time the control of the experiment will be effected, as so me of the bowls will have been inspected for different periods of time. This may cause the experiment to be an unfair test if different bowls have had more attention to the diversity than others have.

The independent variable will be the points on the ri ver that are being tested using the method of kick sampling. The independent variable should be changed by the sites on the river that are being tested being changed with 10 places being tested in total as stated above. The method of kick sampling is to be chosen as it is seen as the most suitable method to obtain the end result of the amount of Stonefly and Mayfly that are present in 10 different sites along the river. Other methods considered were ones where an area of the river 1 meter square was isolate d by using a glass shield and the insects present could be counted in this glass shield. The glass shield was present so that non-of them could escape whilst others were being counted as they would be surrounded by glass. However, as the riverbed would be dark it could be difficult to count the insects using this method. Some of the insects may have also escaped when the glass shield was being deployed due to ripples created by it when being placed in the water. Therefore kick sampling was seen as suitable because as long as the fishing net is of suitable size there is no reason why the majority of insects dislodged into the water should not flow into the net. This is because if the net is held downstream from where the rocks are kicked then most of the inse cts should flow downstream into the net as long as it of suitable size like 500 centre meters in diameter. As this reduces the space that any of the insects flowing downstream have to miss the net, thus there is a bigger chance they will fall in the net and be counted.

The rate of flow of the river should be tested over a distance of 5 meters. This can be done by placing a pole in one side of the river, with some string attached to the top of the pole that is tied to a tree on the opposite side of the river. Ideally a straight line should be created by the string being tied to a tree and the top of the pole on the opposite side of the river to the tree. It is important that the line created is parallel to the width of the river. Once the pole and string i s set up, a leaf should be dropped into the river 5 meters upstream from where the piece of string hangs over the water. The distance it takes for the leaf to travel to the piece of string should be timed using a stopwatch and can be therefore be used to measure the rate of flow at each place in the river. Each place being tested for diversity should be tested for rate of flow 3 times so that

an average can be taken, so that any anomalous results can be spotted. Also so that it is a fair test as each place being tested along the river has had the rate of flow tested the same number of times as everywhere else.

The light intensity for each area being tested should be tested by giving a rating of 1 to 5 depending on how much light is present in certain areas. If a rating of 5 is given it means that the area is as well lit as possible and that the maximum amount of light is present that could be. If a rating of 1 is given this could shown that there is very little or no light focusing on that part of the river area being tested. The ratings 2,3 and 4 should be used for in between 1 and 5 where 2 means there is a little light showing, 3 about a medium amount of light is present and 4 nearly the maximum amount of light possible is present.

Using an oxygen meter the oxygen content of the water should be measured as it is possible to judge the cleanliness of the water by the amount of oxygen that is present and this may affect the amount of Stonefly and Mayfly present in the water. Therefore if the oxygen content of the water is taken it may be possible to analyse the results to see if there is a correlation between the oxygen content and the amount of stonefly and mayfly present in the water. The oxygen meter should be dipped in the water and the reading of the amo unt of oxygen present in water should be noted down. This should be done 3 times so that it is a fair test and if there are any anomalous results they can be spotted.

The width of the river should be measured at the same time the rate of flow is tested. This should be done by measuring the length of the string that is used as a marker for the rate of flow, due to the string spanning across the width of the river. These measurements should be taken three times for each part of the river being tested so tha t if one of the measurements is slightly out the other two may indicate this, as the anomalous result will look out of place. An average can be taken to limit the significance of the anomalous result, or it could be left out the results all together.

The pH level of the water should be tested using universal indicator paper, to see how acidic or alkaline the water is and if this has an effect on the amount of stonefly and mayfly present in certain stretches of the water. The universal indicator paper sh ould be dipped into the water with a number of 1-14 taken depending on how acidic or alkaline the water is, as 1 means the conditions are really acidic, 7 means neutral and 14 indicates it is extremely alkaline. The pH number of how acidic or alkaline the water is should be noted down almost straight away as the colour of the paper may change due to moisture in the air or on the skin where the paper is being held. The pH for each part of the river should be tested at least 3 times so that a fair test is ens ured.

The temperature of both the water and the air surrounding the water should be measured using a standard thermometer. The thermometer should be left stood in the water and air for 5 minutes each time to allow the temperature to settle on the thermom eter. The temperature should be noted down with this being carried out 3 times for each area tested so that it is a fair test and so that any anomalous results can be spotted. If there are any anomalous results they should tend to stick out against the pattern of the other two and they can be dealt with by either being left out of the end results or being included in the average to reduce their significance.

Safety/environmental aspects

When carrying out the investigation near the river, it may be important to consider not to leave any litter or rubbish lying around, as it may damage the environment and habitats of some of the animals like otters that have habitats in or near a river environment. It may also be important to try to leave everything as it was found in the first place, again to avoid changing the habitat and environment of any animals that may harm them in anyway. Waterproof and sturdy footwear may be worth using especially when carrying out the kick sampling, as this could be in relatively deep water so if the foot wear used is waterproof, peoples feet may stay dry as oppose to getting wet. As the kick sampling involves moving rocks using feet having sturdy footwear could be a good idea, due to this causing the feet of people carrying out the investigation to be protected in the case of some of the rocks falling directly onto a persons foot. If standard footwear without any form of protection is used, injuries to people's feet could be incurred were rocks to fall on them, so waterproof strong footwear like wellington boots should be used. Small children should be kept away from near the edge of the water, due to some parts of the river being quite deep and only 2 centre meters of water are needed to drown anyone. Thus it is a good idea to keep children away from the waters edge or not bring them at all. The steal pole used to stab in the side of the river to measure the width of the river, should be taken care with as the end may be sharp and could hurt someone when being stabbed into the ground. When being transported too care must be taken with the steal pole, to avoid hurting pedestrians and any other passers by.

Control

If possible only the independent variable should be changed with all the other possible variables kept the same. However in this investigation it is almost impossible for that to be the case. This is due to the rate of flow that will probably not be the same in every different place along the river that is being tested, due to some parts of the river having more rocks in preventing the water from moving as fast as it might do. The width of the river may also stop the water from moving at as high velocity, as it could do as wider rivers may have more space for the water to be stored in. This is oppose to a river that is narrow which could make the water flow quicker, as the same amount of water molecules could be trying to get in a smaller space. This may cause the stream to flow faster as there could be more of a concentrated force pushing the water molecules in a smaller space, as oppose to a larger river where the water molecules are more spread out. This might result in a less concentrated force pushing the river along, as there is more space for the water to fit into. Subsequently the rate of flow and the width of the river are being tested as well as the diversity of the river, as the rate of flow and the river width could have an effect on the diversity. This is due to some species being able to survive in waters of a higher velocity and possibly of less width, as oppose to waters of a lower velocity and perhaps a higher width.

How deep the site on the river is could effect the diversity too as deeper sites can harbour more water, which could cause the river to have a lower velocity. A reason for this may be that the force behind the river current is less concentrated, due to there being more space for the water to flow into making the current a little slower. As it is highly unlikely that all the sites on the river tested for diversity will have the same river width, depth and thus rate of flow, the river width and rate of flow should be taken into account when testing the diversity. This is because the rate of flow, width and depth of the river could have an effect on the results of the diversity, due to different species being able to survive in waters of different speed, depth and width. Consequently if one site has a much faster current than another site, it might be likely that different species will be found in the two sites because of the speed of the current. Not because there is more oxygen in the water which is what this investigation was designed to do, to see if there is a correlation between the oxygen content in the water and the amount of Stonefly and Mayfly present. Thus other factors like the river depth, width and the rate of flow have to be consider, as it is out of our control that they have an effect on the diversity of insects present at different sites along the river.

As water with a higher velocity increases the contact with the air on the surface of the water, this may have the result of altering the temperature of the water and the air surrounding the water. This could be

because if the water comes into more contact with the cooler air surrounding it, the temperature of the water may lower due to the air molecules being cooler than the water. As when a hotter medium is near or directly touching a cooler medium than itself, the heat tends to be evened out thus if the cooler air is next to the hotter water the water may become cooler. This could be due to the heat making the water hotter than the air may transfer to the air to even the heat out. This can also work the other way if the water is cooler than the air as some heat from the air could be transferred to even out the heat distribution subsequently resulting in the temperature of the water being increased. Consequently this can have an effect on the diversity of the insects in certain patches of water as different types of insect can survive and thrive in different temperatures of water. If the temperature of the river water can be effected by the temperature of the air and the river water by the heat distribution of the two levelling out, it can therefore effect the diversity of the insects. This is because if the temperature of the river water is altered by the air either being hotter or colder than the river water, then the type of insect inhabiting the water may alter because of this. Subsequently this is a factor that cannot be controlled in the experiment as different places along the river may have different temperatures of the air and river water causing the temperature of the river water and the insects living in certain stretches of the water to alter.

The temperature of the water can have an effect on the amount of oxygen that is present in between the water molecules. This is because if water is relatively cold more oxygen can be dissolved and held in between the water molecules than hot water, as the molecules have less kinetic energy present in them therefore have less movement. This may make the water more efficient at holding oxygen gas as there may be less space in between the water molecules for the oxygen gas to escape into the atmosphere from. This is as oppose to warmer water where as there is more kinetic energy present in the particles the water moves more and more gaps in between the water molecules are created. Subsequently these extra gaps between the water molecules created by the movement caused by the extra kinetic energy not in the colder water, allow more of the oxygen gas particles to escape through the gaps between the water molecules. Subsequently colder water holds more oxygen gas particles as there may be less air space between the water molecules for oxygen to escape into the atmosphere, due to there being less kinetic energy in colder molecules for these air spaces to be created by random movement. This can have an effect on the diversity of insects in certain areas of the river. This is because as the alternative hypothesis to this experiment states, there is a correlation between the amount of oxygen present in the water and the amount of stonefly and mayfly, that are present in these

certain areas of water. This could be due to the parts of a river with more oxygen in being cleaner than other parts and allowing clean indicator species like Stonefly and Mayfly to live here.

If there is an increased amount of Oxygen in certain stretches of the water, it may allow species that need more oxygen to respire to live and inhabit certain areas. There could be more oxygen in certain areas due to the temperature of the water and the air as explained in the above paragraph. Some species of insects could need more oxygen to respire as they need more ATP to operate mechanisms such as active transport and movement as ATP is produced using energy released during the process of respiration. Subsequently an increased amount of oxygen allows certain species to thrive more, as they can produce more ATP that can be broken down to release energy. Consequently if one species thrives more in more oxygenated parts of the river this chemical factor could have an effect on the diversity in this part of the river. Due to the amount of oxygen present could effect the biotic factors of the environment that Stonefly, Mayfly and other species live in. This could be because if a certain species thrives more than other species, the food present in the particular environment where the Stonefly for example are thriving could decrease dramatically. This could cause the inter specific competition to increase as well as the intra specific competition of the insects in a certain environment as more nutrients may be used up by the thriving species due to the increased oxygen content in the water, which is a factor that may not be able to be controlled due to certain areas having warmer water and air surrounding them.

Repetition

Any results taken in this experiment should be repeated 3 times for each result taken. This is so that if any anomalous results are present it may show up against the trend of the other two results. For example the width of the river was being measured and results one and two were 322 cm and the third result was 343 cm. It may become apparent that the third result was anomalous because it was 23cm of off results one and two. Once an anomalous result has been identified by this method it is possible to use all three results gathered to take an average and reduce the significance of the anomalous result. Or the anomalous result could be left out of the average if it is so far adrift from the other two results gained, as may be apparent in this case due to 23cm being 7.14% of 322cm. It can be said that this is quite a large difference and could have too significant an effect on the average were it to be included.