Tom Owens
Set 5

Biology Sc1

The Plan:

Simple procedure:

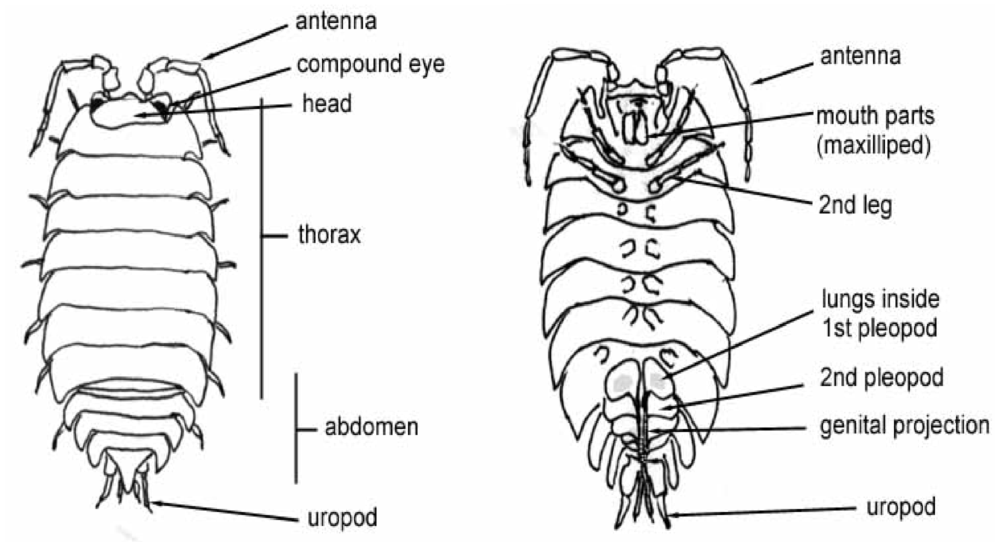
I am doing an investigation in to how humidity effects a woodlouse's movement. To do this I shall measure the amount of time that the woodlice stay still in a petri dish for one minute, while changing the humidity by adding more or less water to the filter paper. I shall investigate how the woodlouse helps to prevent excess water loss and so is able to successfully live in a range of terrestrial habitats.

Secondary sources:

Woodlice can be classed biologically as cr ustaceans because they have a hard outer shell. The woodlouse evolved from sea -based life forms as opposed to insects for example, which evolved from land -based life forms. A woodlouses skin is therefore permeable and it thus lets out a lot of essential fluid (water.) If the woodlouse did not live in damp places it would dry out as the water they had would quickly leave their bodies through their permeable skin.

As they are classed as crustaceans it is possible to think that the woodlouse is related to other terrestrial arthropods, as this would clearly make sense, such as spiders, insects and centipedes. In fact, their closest living relatives are actually crabs, lobsters and water fleas. They belong to an order that is called Isopoda. Isopoda are a large g roup of animals that otherwise live in the sea or in fresh waters and they are of the class Malacostraca. The woodlouse is the only non-extinct example of Isopoda.

Most of the animals in the crustacean class are aquatic, and although the terrestrial species can breath with the aid of primitive 'lungs' they lack the features found in most other land dwelling arthropods. They have no waterproof waxy cuticle on their exoskeleton and are therefore more likely to suffer from 'desiccation' compared with other art hropods such as insects and spiders, which have a well-developed waxy layer. Therefore many of the behavioural responses of woodlice are concerned with water conservation. Also, as woodlice have a relatively high surface to volume ratio they are likely to lose more water, more quickly, than many other species. To respire, they use simple surfaces called psuedo -lungs, which has a pore that allows gases to exchange in and out of the lung. Unfortunately for the woodlouse, this particular pore cannot close whi ch means that the woodlouse loses even more water by diffusion from the inner surfaces of the psuedo -lung out in to the surroundings. What the woodlouse can do however, is to replace the water that it looses from the above methods as they are able to 'take up' water through an organ called a uropod. Uropods are efficient as they are pressed against a moist surface, which in turn enables capillary action to result in water absorption ('or up take.')



The two diagrams above show the dorsal view and the ventral view of Porcellio scaber. The body of the woodlouse is closely fused together and so it is almost impossible to tell where one section begins and the next one ends. From these diagrams we can see the uropod and the pleopods. A pleopod is a very specialised leg that is adapted for b reathing in the woodlouse. These pleopods contain a pseudotrachea, which is a branching system of tubes. The pseudotrachea is covered with a layer of moisture that is very thin. The layer of moisture allows gas exchange and also allows water to evaporate. The water can transpire out of the pleopods through a pore like opening. It is due to the fact that the woodlice have a permeable exoskeleton and can thus lose water from their respiratory pleopods, that their preferred surroundings are places of high humi dity and cooler temperatures, where less water can be lost. These preferences are behavioural adaptations that have occurred over a long period of time to help reduce 'desiccation.'

There are three common species of woodlice. The first is Oniscus, which is the 'standard' woodlouse. They appear shiny and reflect light, in order to prevent more water loss. The second common species found is called Porcellio scaber which are shaped like a torpedo, presumably to reduce there surface area slightly, thus sligh tly reducing water loos as greater surface areas have a tendency to lose more water as they are more open to bright light and hot temperatures. They are also dull in colour, which may be an act of camouflage as ironically, most animals like nothing more th an a tasty woodlouse! Finally, the third type of common woodlouse found is called Armadillium. It is so called as it unsurprisingly curls up in to a little ball like an armadillo. It is dull and torpedo shaped, similar to Porcellio scaber, but it is because this species curl up in to their little ball shape that they are perhaps the most efficient at retaining water as the ball shape helps to reduce water loss as it has a small surface area that is also dull in colour.

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Hypothesis:

From my background knowledge I hypothesise that the woodlice will show an increase in speed of movement away from the drier (less humid) and more 'dangerous' conditions, and will be strongly attracted towards the more damp conditions. I also believe that in more humid conditions the woodlouse will move less as it will have no urge to move, as it will enjoy its humid surroundings. Whereas in the less humid conditions the woodlouse will have a much greater sense of urgency to move as it can be life threatening for a woodlouse to remain in dry conditions for too long.

From this information about the woodlouse I believe that humidity is directly proportional to the amount of movement, and the speed of which the woodlouse moves. I also believe that my results are going to be quantitativ e. By this I mean that when the humidity is doubled, the amount of movement will halve and when the humidity is halved, the amount of movement will double (for example).

I thus think that the woodlouses life is going to be governed by the need for damp conditions, wherever it can find them.

The variables and a fair test as a result:

There are many dependent variables in this experiment. All of them I must try to keep the same, or constant throughout the experiment. Otherwise, a fair test would not be planned and my relevant readings would be false, and thus of no particular use to me.

Firstly, I must try keeping the species of woodlouse the same throughout the experiment. This is because each of the three common species of woodlouse reacts slightly differently to each other. For example, Armadillium is the most efficient at retaining water and so is going to be least effected by a change in humidity. Whereas Oniscus or Porcellis scaber will be more affected by the change in humidity, and will move faster t o a more humid place than Armadillium will. If I hope to plan a fair test it is crucial to keep the species the same so that one woodlouse does not have an 'advantage' over another.

Secondly, I must try to keep the woodlice that I use the same size. This i s because smaller woodlice will be more agile than larger ones and thus be able to move quicker. Also, they will have a smaller surface area than a larger woodlouse and be thus be able to retain more water as they will be in less contact with direct sunlig ht, and consequently, there will not be such an urgency for it to want to move to a more humid condition, although it will still want to. To keep this variable constant will be quite hard as they all appear to me to be small. I think a way to get around th is problem is to use a magnifying glass to identify their size, and even to weigh them, thus seeing which is heavier and thus bigger.

Thirdly, I must try to keep the age of the woodlouse constant. This is because a young woodlouse will be far more active and fast than an old one. This means that older woodlice will try just as hard to get away from the dry conditions, but will be unable to do so as fast as the younger ones. So younger ones will find their preferred conditions first, and then stop moving. Older ones will take longer to reach their desired conditions and so will stay still for a shorter period of time.

Fourthly, I must have a bank of woodlice as if I use the same woodlouse a lot of times, it will become increasingly angry and stressed! It will become tired more quickly and will act differently to a 'fresh' woodlouse. It will become slower and far more reluctant to move due to obstinacy. This means that a stressed woodlouse will find its desired conditions much slower than a woodlouse that is used for the first time. It will be easy to make sure only to use a woodlouse once, and then exchange it for a new one.

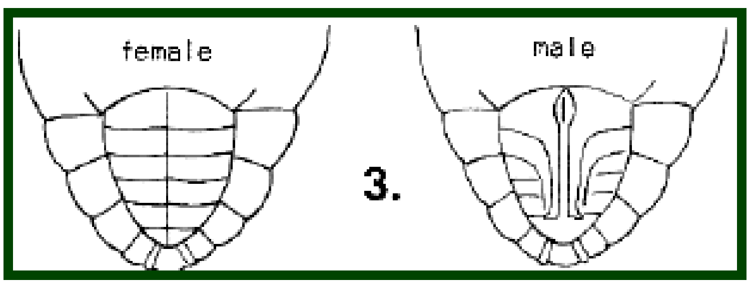
Fifthly, depending on what time of year I conduct the experiment will greatly change the temperature and thus the woodlouse's desire to move. In January, it is often very cold and so the woodlice will not have a great desire to move around, as the cold weather will reduce the loss of water through their permeable exoskeletons. In July however, the temperature can often be very hot and this means that the woodlice will move around a lot, desperately trying to find more suitable conditions. So as we can see, depending on the temperature and the weather conditions will greatly vary the woodlouse's desire to move. I believe though that I will be able to keep the temperature constant as my experiment shall only last for the duration of about an hour and during this hour I would be highly surprised, if the temperature varied enough to make the woodlouse want to stay still or move around more.

Sixthly, I must try keeping the light around the woodlice very consistent as light changes temperature. This means that when there is a lot of light shone on to a woodlouse, the humidity will rise and so the woodlice will be more inclined to try to move away from the light. If there is little or no light, then the humidity will not be artificially increased and so the woodlice will not have the same urgent desire to move. This means that when there is a lot of light, the woodlice will move around for longer, and when there is less light, the woodlice will remain still for longer. I think that it will be easy to control the light because during the hour period I conduct the experiment, I will either have the classroom lights on or off (not both), and like I said above, I doubt that the weather conditions will change enough in the hour to increase or decrease the light, and subsequently increase or decrease the amount of movement in the fixed period of time. In any case, I can always shut the laboratory curtains for an hour, so as to ensure a constant amount of light on the woodlice.

Seventhly, I shall make sure that I do all my readings at one time of the day. I shall not do some of them, leave my experiment, and then go back and do some more later. This is because if I do some of my readings at noon, when the sun is directly over head and thus at its brightest, there will be an increase of humidity and so the woodlice will be inclined to move more than if I do my results at six a clock when in the winter it is dark a nd there is no sunlight to increase the humidity and thus the woodlice will not be so inclined to move. It shall be easy to control this variable and make sure I just do my results at one time of day.

Eighthly, I must try making sure that the feeding state of my woodlice is kept constant. This is because if one woodlouse has just eaten a big meal and one hasn't eaten for ages then the one that has eaten will have more energy to get away from the unpleasant conditions and will also have more fluid (water) in its body and will move slower as it will not be so urgent for it to move away from the dry conditions. This means that a 'full' woodlouse will move for less time as it will have a smaller need to move and a hungry woodlouse will move for more time in a fixed period because it will have a greater urgency to do so. I think that it will be easy to control the amount that the woodlouse has eaten because when they are stored they will all be give the same amount of food and so should all react the same to the c hange in humidity.

Ninthly, I must try keeping the sex of the woodlouse the same. This is because the males will react differently to a change in humidity to the females. I think that it should be easy to keep the gender of the woodlouse the same because I have found this diagram on the Internet:



Shown above is the way to differentiate between the two sexes, thus always being able to choose the preferred sex and in so doing keeping the 'sex' variable constant.

The last dependent variable that I must try to keep constant is the size of the container (or petri dish) that they are kept in. This is because in a larger container, they will tire themselves out more by moving away from the drier conditions and thus be more inclined not to move, wherever possible. It will be very easy to control this variable as I shall just chose the same size of container throughout the experiment.

The Manipulated variable / replicate measurements / suitable range and number of measurements:

The manipulated variable that I shall change in this experiment is going to be the humidity. I shall do 8 readings at each level of humidity, e.g. 8 readings with one drop of water, 8 readings wit h two drops of water etc. I shall use 5 drops of water as a maximum amount of humidity and thus will be able to obtain 8 readings at 5 different levels of humidity. The unit for humidity is obviously ‘number of drops,’ and the unit for behaviour is obvious ly ‘the number of seconds in a minute that the woodlouse remains still.’ In this way I shall be able to obtain a good range of results as I shall replicate my measurements 8 times and use 5 different levels of humidity. This gives me a good number of measu rements in order to obtain a good average and easily identify any anomalies that I could leave out of my final conclusions. Hopefully though, as I plan to take only relevant readings, I shall not encounter any anomalies although as there are ten variables to control in order to plan a fair test it is likely I shall obtain the odd anomaly that I shall leave out of the final conclusion as it will not help to prove my hypothesis correct.

Method:

- A piece of filter paper shall be placed in a plastic container or petri dish
- A varied amount of water is then placed on the filter paper to vary the humidity
- A woodlouse is placed in the container, on the wet (ish) filter paper
- The container is then left to stabilise for about 30 seconds
- Then a timer is started and the amount of time that the woodlice stays still is recorded in a table
- The results are repeated ten times for each of the five concentrations and are then recorded in a pre -prepared table
- This gives a suitable number and good range of relevant results t hat allows anomalies to be easily identified and left out of the final conclusion

List of appropriate equipment:

- A number of woodlice
- A petri dish with filter paper
- A pipette with drops of water
- A stop clock to measure amount of time spent s till

Risk assessment:

- There are few risks in the experiment as it is so simple, but he following things I must be careful not to do:
- The woodlice may carry infection and so we must take care not to put our hands in our mouths or near our face w hile we are in contact with the woodlice. This of course would be very unhygienic and would spread infection. We should therefore wash our hands before and after being in contact with the woodlice. It shall be unnecessary to wear gloves, as the chances of infection are minimal, and are even more reduced if we wash our hands thoroughly.
- Under no circumstances will I try to put the woodlice under any unnecessary stress. As a biologist I am interested in life and not death! I wish very much not to be cruel and hope that the woodlice undergo no pain or stress whatsoever throughout the experiment.

(Word count: 2890)

References – Internet – Goggle - Woodlice

Analysis:

Identifying trends and patterns and explaining what has been found out:

From my graphs I have ascertained and identified some patterns and trends. From the average graph we can clearly see that in general, when I increased the number of drops, the time that the woodlice remained still increased. But by looking at my graph we can also see that a nice curve would have formed through four out of the five points which suggests to me that there is a maximum amount of time that a woodlouse will remain still, regardless of the humidity. Although unfortunately my line of best fit does not back this statement, or my hypothesis up. This is because the correlation is very bad as the points are along way away from the line of best fit. This reflects in my very poor R^2 value of 0.1355. However, we cannot rely upon an average graph for an accurate representatio n of all of my results because often, a few anomalies can make a good set of results look poor as the average can be brought down considerably, thus affecting the entire shape of the graph and I rounded up or down the averages accordingly, thus making each one in turn slightly less accurate. We can obtain a much more accurate and fairer representation of my results by looking at each result individually which is what my other graph shows. This graph gives a great range of results (0 -59 seconds for 1 drop of water added), especially when only one or two drops of water were added. This was because the change in humidity was not great enough to make the woodlouse definitely decide to stay where there were slightly more favourable conditions, especially as it ha d just been placed in a new environment and was thus scared and anxious to find out its new perimeters. I subsequently found that while taking my results, the woodlice tended to walk around the edges of the petri dishes in circles. What is noticeable about this graph is that the range decreases with every drop of water added, with the exception of when five drops of water were added, which is a very good thing. This is good because it means that more woodlice tended to stay still for a longer period of time when I increased the humidity by a distinct amount. The range when four drops of water was added only varied between 50 and 60 seconds, thus showing that woodlice tended to stay still when they found more humid conditions. This backs up my hypothesis thor oughly although only for when three or four drops of water were added. When one or two drops of water were added some results were far higher than expected (59 seconds) and (60 seconds.) This is because when dealing with animals the amount of variables one has to control to get perfect results are unimaginable. Furthermore animals are very complex and you have no control over them. They will simply do what they want to and thus anomalies are always found. In a similar fashion, when five drops of water were added I expected the range to be between (50 and 60 seconds,) thus to record a reading when a woodlouse only stayed still for 29 seconds was clearly a great surprise but in a biological experiment, not unlikely.

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Draw conclusion consistent with evidence/relate to scientific knowledge and understanding/use detailed scientific knowledge to explain valid conclusion:

The woodlouse evolved from sea-based life forms as opposed to insects for example, which evolved from land-based life forms. A woodlouses skin is therefore permeable and it thus lets out a lot of essential fluid (water.) If the woodlouse did not live in damp places it would dry out as the water they had would quickly leave their bodies through their permeable skin. Woodlice have no waterproof waxy cuticle on their exoskeleton and are therefore more likely to suffer from 'desiccation' compared with other arthropods such as insects and spiders, which have a well-developed waxy layer. Therefore many of the behavioural responses of woodlice are concerne d with water conservation. Also, as woodlice have a relatively high surface to volume ratio they are likely to lose more water, more quickly, than many other species. Unfortunately for the woodlouse, the particular pore that it uses to respire cannot close which means that the woodlouse loses even more water by diffusion from the inner surfaces of the psuedo-lung out in to the surroundings. To combat this though the woodlouse can replace the water that it looses from the above methods as they are able to 'take up' water through an organ called a uropod. Uropods are efficient as they are pressed against a moist surface, which in turn enables capillary action to result in water absorption ('or up take.') I believe that while I took my results I witnessed a num ber of woodlice adopting this method of replacing water. From this background information I thus expected the woodlice to rush quickly from the dry filter paper and remain on the spot that I placed the water on for most of the minute and in 28 cases out of 40 (70%) the woodlice remained still in the more humid area for over 40 seconds. But the other 30% of woodlice did not remain still for over 40 seconds and indeed 12.5% of the woodlice I recorded remained still for less than 20 seconds. The only obvious e xplanation for this is that there were many variables that I was unable to control, e.g. I do not know if the water droplets evaporated in proportion and droplets often hit the filter paper in different sizes and so five drops of water on two different pie ces of filter paper was almost certainly a different amount. When I took the lid off I almost certainly lost varying amounts of humidity, depending on how long I took the lid off for.

I therefore conclude that in general my results were positive, even thou gh many were not. This is because if all the variables were to be eliminated, I am sure that I would find my hypothesis to be completely correct and my graphs and results to back this up as it is essential for the woodlouse to remain in humid conditions so as to avoid the certain possibility of death and I am quite sure that the woodlouses life would be governed by the need for damp conditions, wherever it can find them provided that the conditions were right and there were not artificial.

Explain how results support or undermine original prediction:

Unfortunately though only 18 out of the 40 results really show any signs of thoroughly supporting my prediction, which is only 45%, and my graphs do not reflect the quantitative results that I predicted as I sta ted that as humidity is doubled, movement would halve and as humidity is halved, movement would double. An example of this incorrect statement was when my humidity was two drops of water and the woodlouse stayed still for 41 seconds, and when my woodlouse had four drops of water added, the woodlouse stayed still for 55 seconds. According to my prediction, if the woodlouse stayed still for 41 seconds with two drops of water added, it should have stayed still for 82 seconds with four drops of water added, whi ch wasn't even possible as I was timing for only one minute. I thus believe that my results do not support my prediction thoroughly enough to claim woodlice will always move in to humid conditions wherever possible because there were just too many uncontrollable variables which gave me far too many anomalies to support or back up my hypothesis sufficiently.

Evaluation:

As we all worked with woodlice, but many of us did different experiments, my results do not agree or compare with those of my friends becaus e woodlice react differently to each person individually and thus it would be almost impossible for two or more people to obtain similar results. Technically however, my results should have been very similar to those of my friends because I now know that woodlice tend to move from unpleasant and dry conditions to more humid and thus more favourable conditions. It is essential for them to do this so as to ensure their survival, especially as they lose more water than they gain through their permeable exoskel eton and subsequently one would expect them to take every opportunity they had to move to these more humid and thus more favourable conditions. In practice unfortunately there are just too many variables to control that prevents them from doing what you think they ought.

I have collected a lot of results, 40 in total, because I naturally came to expect some anomalies. I believed that 40 readings would be enough to show a clear pattern that woodlice preferred humid conditions and thus would prove my hypothesis correct, but unfortunately not all of my results agreed with each other and 55% of them do not help to back up my hypothesis. On my average graph, my points do not lie on a smooth line and are scattered about quite considerably, thus my R^2 value is so poor. The results that I have recorded that don't 'fit' with the others can only be explained by the fact that we cannot control the woodlice and often the sudden change in environment forces them to move for an extended period of time as they are anxious t o explore their new environment. I let the woodlice settle on dry filter paper for 30 seconds before I added my water droplets so I could tell whether the woodlice were moving in reaction to the change in humidity or whether they were just moving because they were scared in their new environment. I hoped that by leaving the woodlice to settle, they would only be moving in reaction to the change in humidity although I think now that this was not the case. 30 seconds clearly was not a long enough period of ti me to satisfy the woodlouse that he was not in potentially dangerous conditions.

My conclusion does refer to all of my results because if I left out the anomalies, then I would be leaving out just over half of my results that do not completely fit my hypothesis. I thus included all of my results in my conclusion and stated that only 45% reflected my hypothesis and that the other 55% were not entirely what I expected, but I had to include them in my conclusion because otherwise the test would have been made unfair and I would have 'programmed' my results and in so doing making the experiment pointless.

I never repeated the actual experiment again because I felt that 40 results would be enough to show a clear pattern, but I was wrong. When I repeated my readings I found that I got a great range of results that is shown clearly on my graph and thus no clear trends and patterns could be identified. I encountered too many anomalies and thus was unable to spot the patterns to prove my hypothesis correct due to the great difference and broadness of my results. Ironically however, I am sure that my results should have covered a big enough range to ensure that one theory fitted better than any other as I repeated each reading for each concentration eight times. Unfortu nately due to the abnormal amount of anomalies that I came in to contact with, I was unable to make sure that one theory, that of my hypothesis, fitted better than any other.

A major factor for a cause of all my anomalies was my equipment. I am sure that my equipment was not at all reliable as it was so simple that most of the work had to be done by me. I had to be as accurate as I could, just by measuring and taking readings with my eyes. It was impossible to ensure that all of my water droplets were the same size and that I opened the petri dish for the same amount of time when I was putting in a woodlouse so as to ensure that I only lost the same amount of humidity each time. My measurements were not precise or by any means accurate, as I had to round up or down the averages accordingly and do the same for the amount of seconds that the woodlouse remained still for in one minute. The obvious problem with using more high-tech equipment, such as a humidity measurer to ensure that I kept the humidity constant with the same amount of water droplets added, and thus eliminate a variable, is that it would be far too complicated, expensive and time consuming.

On top of that I had no control over the other factors such as temperature, even though I tried to keep it constant. The light also varied dramatically in my experiments as my piers were constantly pulling up and down blinds. I could hardly control all ten of my variables, let alone any other factors that were sure to have arisen at some stage during the exper iment. My petri dishes were constantly being moved which I am sure made the woodlice more distraught and under more stress than they already were which subsequently led to my results being unreliable as woodlice behave in a different fashion when stressed or placed in a 'life threatening' situation.

I am sure that further work could be done to improve my investigation and help to give more evidence and thus prove my hypothesis correct and back up the reliability of my results and my graphs. Without excepti on, in any biological experiment hundreds of readings are needed in order to prove that one theory stands above the rest and 40 readings are clearly not enough to prove my hypothesis correct, especially in recognition of all my anomalies. My experiment had too many possible faults that led to many anomalies and eventually led to my hypothesis being eventually disproved by my poor graph correlation, poor results and lack of decent and reliable equipment. If this experiment were to be repeated it would have t o be done under such conditions that would give my hypothesis a chance of being proved correct, thus making sure that there were sufficiently more reliable results than anomalies.

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