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Marine Adaptations

Desiccation Rates in *Lottia persona* and *Lottia scutum*

Introduction

Desiccation is the drying out of a living organism. This refers to aquatic animals being taken out of the water, or plants being exposed to sunlight or drought. Desiccation is considered to be an important environmental stress, which directly or indirectly determines the upper distributional limits of many intertidal organisms (Lowell, 1984). One intertidal organism that is influenced by this is the limpet. Limpet shell size is also a likely response to desiccation meaning that when the shell fits tightly to the substratum, the area available for water loss is proportional to aperture circumference (Branch, 1981).

The mask limpet, *Lottia persona*, is blue-gray to brownish in color. It can reach up to 4cm long, and is found in the upper mid littoral from Alaska to central California. The height of its shell is usually over 1/3 the width of the shell (Figure 2), and the aperture is oval shaped (Figure 4). In contrast, the plate limpet, *Lottia scutum*, is gray to greenish in color. It can reach up to 5cm long, and is found in the low intertidal zone, and the subtidal zone from Alaska to Baja California. The height of its shell is usually less than 1/3 the width of the shell (Figure 3) and the aperture is more circular compared to the mask limpet (Figure 5).

I questioned if the desiccation rates of limpets are influenced by the different habitats that they reside. I hypothesized that the desiccation rates are in fact influenced by the different habitats. Therefore, the mask limpet will have a slower desiccation rate than the plate limpet because it is found higher in the intertidal and thus exposed to oxygen more often than the plate limpet.

Methods and Materials

I collected 6 individuals, 3 *L. persona* and 3 *L. scutum*, from Sunset Bay in Charleston, Oregon. I measured, and recorded the aperture circumference of each limpet. I then put them in the water tables for 24 hours so they could acclimate themselves to the new environment. Then I took 1 mask limpet and 1 plate limpet and dried their shells off thoroughly with a paper towel. This was to ensure that the weight I recorded was purely the weight of the limpet and not excess water on the shell. I then weighed each limpet separately on a Scout Pro Balance and recorded the results. The two individuals were then left in a finger bowl without water for one hour. After one hour, I weighed and recorded their individual weight. I then put them back into the water table for 1 to 2 hours so they could re-hydrate themselves. After this, I took them out of the water table, dried them off, weighed them again, and put them back into the finger bowl with no water. I waited another hour and recorded their new weight. I did this one last time with these same individuals. I then repeated this procedure with 2 more individuals (1 of each species), and then again with the last 2 individuals (1 of each species). This created a total of 3 trials, each consisting of 3, 1-hour periods where the desiccation rates of each individual were measured.

After all the data was collected, I averaged the desiccation rates for the 3, 1-hour periods in each trial for each individual. I was then able to graph and compare the different rates between the two different species.

Results

In trial 1, the mask limpet, *L. persona*, had an average weight loss of 0.103g, while the plate limpet, *L. scutum*, had an average weight loss of 0.520g. In trial 2, the mask limpet lost an average of 0.063g, while the plate limpet lost an average of 0.176g. In trial 3, the mask limpet had an average weight loss of 0.100g, while the plate limpet had an average weight loss of 0.320g (Figure 1). The mask limpets lost an average of 0.87% of their weight, and the plate limpets lost an average of 8.34% of their weight for

all three trials. The average aperture circumference of the mask limpet was 10.05cm and the average aperture circumference of the plate limpet was 11.94cm (Table 1).

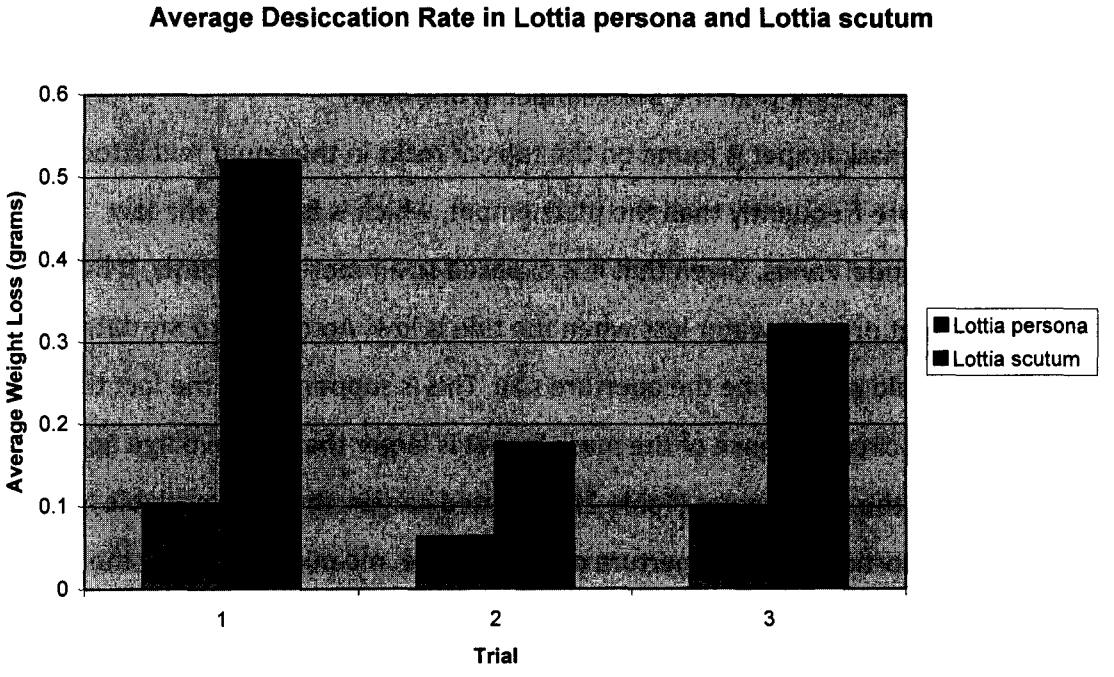


Figure 1: Shows the average weight loss of *Lottia persona* and *Lottia scutum* in all 3 trials.

The Average Percent Weight Loss and Average Aperture Circumference in Both Limpet Species

Species	Average % Weight Loss	Average Aperture Circumference
Lottia persona	0.87%	10.05cm
Lottia scutum	8.34%	11.94cm

Table 1: Shows the average percent weight loss in one hour for *Lottia persona* and *Lottia scutum*. It also shows the average aperture circumference in both limpet species.

Discussion

The results fully support the hypothesis that the desiccation rates of limpets are influenced by the different habitats that they live in. As shown in Figure 1, the plate limpet, *L. scutum*, lost an average of 2 to 5 times the amount of weight than the mask limpet, *L. persona*, in one hour. Also, the plate limpet lost an average of almost 8 times more percent body weight than the mask limpet in one hour.

Since the mask limpet is found on the tops of rocks in the upper mid littoral, it is exposed to air more frequently than the plate limpet, which is found in the low intertidal and subtidal zones. Given that it is exposed to air more frequently, it has adapted traits that prevent water loss when the tide is low. According to my data, one of these traits could possibly be the aperture size. This is supported by the fact that the average aperture circumference of the mask limpet is larger than the average aperture circumference of the plate limpet (Table 1). As stated earlier, the area available for water loss is proportional to the aperture circumference, meaning the larger the aperture, the faster the desiccation rate.

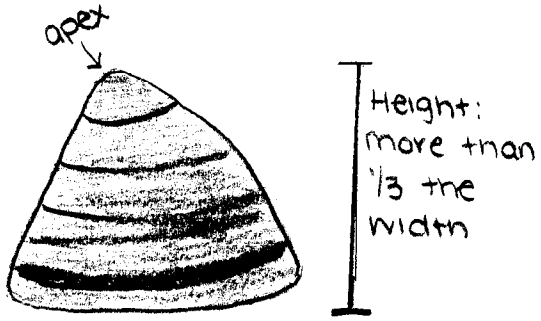
Although these results are very clear, I could still expand this experiment to better test my hypothesis. I could perform the same experiment, but with a variety of species of limpets. This way I could test my hypothesis on a range of species of limpets, rather than just two, and this could further support or negate my hypothesis. I could also explore different areas of this topic to determine what other traits have been adapted for water loss. For example, testing the height of limpet shells or the thickness of the shells compared to the desiccation rates and also, comparing different gill structures to the average desiccation rates in different limpets (Innes, 1984).

Lottia persona

Mask Limpet

FIGURE 2:

Side view



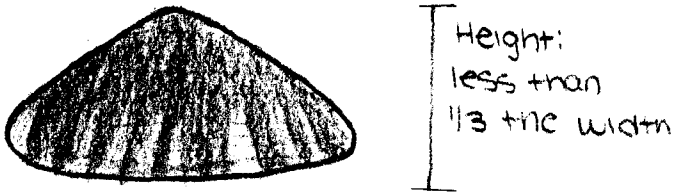
Magnification: 2X

Lottia scutum

Plate Limpet

FIGURE 3:

Side view



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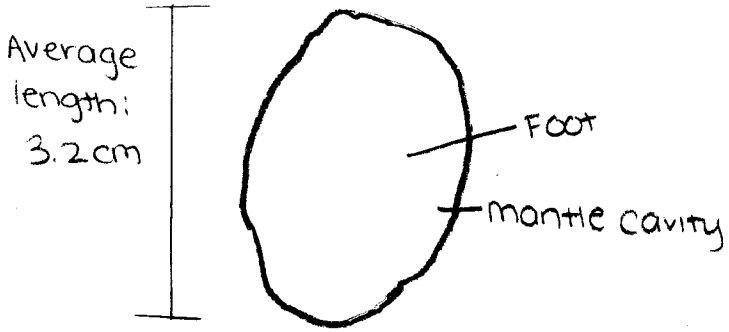
Lottia persona

FIGURE 4:

Ventral view



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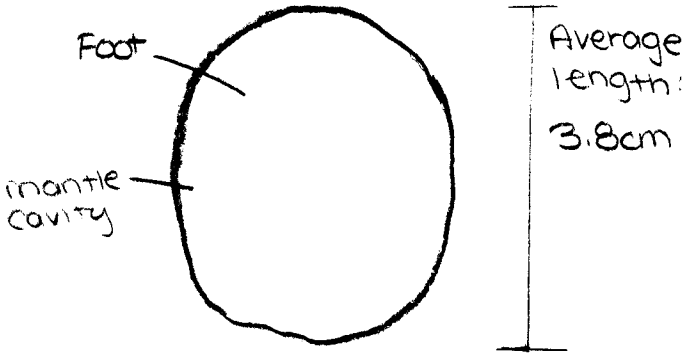
Lottia scutum

FIGURE 5:

Ventral view



Magnification: 1.2X

References

1) Branch, G.M. (1981). The biology of limpets: physical factors, energy flow, and ecological interactions. *Oceanography and Marine Biology* 19:235-380.
2) Brusca, Richard C., Brusca Gary J. (2003). Invertebrates. Sinauer Associates, Inc., Publishers. Sunderland, Massachusetts. Pg 709.
3) Innes, Alastair J. (1984). The Effects of Aerial Exposure and Desiccation on the Oxygen Consumption of Intertidal Limpets. *The Verliger* 27:134-139.
4) Lowell, R.B. (1984). Desiccation of intertidal limpets: Effects of shell size, fit to substratum, and shape. *Journal of Experimental and Marine Biology and Ecology* 77:197-207.
5) Sept, J. (2002). The Beachcomber's Guide to Seashore Life in the Pacific Northwest. Harbour Publishing. BC Canada. Pg 64 & 66.