Paula Hood
Exploratory on Limpet Movement
Due: 08/0107

An Exploratory on the Movement of Limpets

INTRODUCTION:

Background:

Limpets are in the Phylum Mollusca, and the class Gastropoda. The limpets *Tectura persona* (the masked limpet) and *Lottia digitalis* (the finger limpet) are both high intertidal mollusks that live on rocky shores and feed on algae using their rasping, tongue-like radula. They tend towards similar habitats, however, *Tectura persona* tends to be shyer of the sun, feeding at night and hiding under rock ledges or in crevices in the daytime. (Sept, 1999, pp 65- 66.) Both are well adapted to experiencing long periods of time without water immersion. All limpets have a large muscular foot, which they use for movement and for tight attachment to their substrate. (Sept, 1999, pp. 65-66; Hunter, Caitlin. 2005. p. 1)

Tectura persona can grow up to two inches long. Its apex is off center and slightly hooked at the tip. Its range is from Alaska to central California. They are often found aggregating together on boulders and vertical surfaces in the shade. (Adams, 2006) Masked limpets have window-like thinner shells near their apex, possibly allowing them to sense light and avoid desiccation by moving to a shaded area. (Hunter, Caitlin. 2005. p. 2)

Lottia digitalis is somewhat smaller, growing up to one inch long (also much flatter and less inflated than *T. persona*). The shell is very oval-shaped, with definite ridges radiating from its apex. The apex is hooked, and has a slightly concave area below the hook. Its range is from Alaska to Mexico. (Sept, 1999. p 66; Adams, 2006) They tend to prefer vertical surfaces, overhanging rock surfaces, and barnacle/muscle beds. When they settle on the barnacle/muscle beds, the light colored juvenile limpets settle on the light colored barnacle skeletons. (Muercurio, 1989. p. 1; Hahn and Denny, 1989, p. 1)

Both finger limpets and masked limpets are capable of regularly going long periods of time, roughly 2 weeks, without being covered by the high tide. (Hunter, Charlie. 2007. Lecture) Such long exposures to non-marine environments could potentially pose serious problems in terms of water loss and desiccation, but these limpets have developed different strategies for dealing with these prolonged exposures, and so are capable of colonizing territories that many other limpet species cannot. *Tectura persona* seems to avoid desiccation primarily by avoiding the sun, and also by clamping down with its large foot. (Hahn and Denny, 1989. pp. 1-3; Hunter, Caitlin. 2005. p.1-2.; Hunter, Charlie, 2007) Predation, particularly birds and fish, can also be strong influences on selective pressures for limpet populations and distributions. Limpets are an important part of the food chain, providing prey for shorebirds (such as oyster catchers), crabs, fish, sea stars, and other organisms. (NOAA, online source; Hahn and Denny, 1989. p1; Mercurio, K. et al, 1985. p. 1) Another interesting selection pressure is possibly competition with larger limpets by smaller limpets of the same or different species. Limpets with smaller radulae have a competitive grazing advantage, forcing larger limpets to forage in the upper areas of the tidal zone, past the limits of desiccation by smaller individuals. The larger sized finger and

masked limpets are generally found higher within the vertical zone. (Hunter, Caitlin. 2005, p3; Hobday, A., 1995. p. 29)

Lottia digitalis employs a number of tactics in order to be successful in the upper limits of the high intertidal zone. One of these is simply the ability to withstand a tremendous amount of body water loss. *L. digitalis* can tolerate large percentages of body water loss, up to 30-35%. Another mechanism is to minimize how much water is lost whenever possible. One way to do this is by sealing the shell against the rock as tightly as possible. Sealing the shell is done by use of their large muscular foot to tightly suction them to the rock, and also by secretion of a mucus layer between the rock and the shell, which helps to keep the moisture sealed inside. (Hahn and Denny, 1989. p2; Hunter, Caitlin. 2005. pp. 1-3) Another method that finger limpets employ for success in the intertidal zone is the use of 'home scars', or areas in the rocky substrate with indentations that closely match the shape of the limpet's shell. Finger limpets show very strong homing for these fitted indentations; in fact they always come back to them. These home scars may help with slowing water loss as well as deterring predators, as a fitted indentation would make it very difficult for a predator to pick the limpet off of its substrate. (Sept, 1999. p65; Hahn and Denny, 1989. p.2)

The exploratory:
This exploratory was conducted in order to learn more about the movements of limpets on the OIMB Wildlife Refuge Beach in Charleston, Oregon. The local populations of limpets on this beach are somewhat unique in markings and morphology. Also unique is the near-constant stream of fresh water run-off near some of the limpet populations. The presence of copious numbers of large amphipods, or 'sea roaches' that overlap with the limpet population near the fresh-water run-off was also interesting. I was curious to compare different populations with different circumstances in the OIMB Wildlife refuge beach area, and see if different patterns of movement emerged among them.

Hypothesis:
My hypothesis was that the limpets will move around at similar times of the day, and then come back to the same general area, unless they have a home scar, in which case they will come back to the same exact area. I predicted that they would move similar amounts each day, and not travel particularly far.

Methods:
This study took place on in Charleston, Oregon, on the OIMB Wildlife Refuge, and also on the dock for the historic Coast Guard Boathouse immediately adjacent to the refuge. The study was conducted from 07.25.07 to 7.29.07. For this exploratory, I marked several individual limpets with fingernail polish of different colors. I did this in 4 separate areas of the beach. Not all limpets were marked on the same days. On 07.25.07, at 11.00 PST, I marked individuals in three of the four separate areas. The fourth set of individuals was not marked until 07.27.07, at 5.30 PST. Also, in one of the sets of individuals, the fingernail polish came off of all but one limpet with in 2 days. I remarked these on 07.28.07 at approximately 9.00 PST. On this same day, I also added a total of 4 individuals, in 2 separate areas. In an attempt to keep the limpets distinguished from each other, I used separate nail polish colors. I applied nail polish to the shell of the limpet, generally one small line about .5mm long, and a slightly larger nail polish line of

the same color, immediately adjacent to the shell on the rock, in order to mark its place. In order to further help me keep track of the limpets, I drew a sketch of all the marked individuals and their placement, and the rough area they were located in. Some were masked limpets and some were finger limpets. I then went back and checked the limpets as often as possible during low tides (this was the only time I could get to the limpets). Data was collected a total of 6 separate times. I measured and recorded how many millimeters from the original nail polish marked spot the limpet had moved.

- The first group (marked 07.25.07) was on the jetty, about halfway down the west side, below and under the cracked part of the ledge of the jetty, and above the highest point of a rocky surface. All of these were finger limpets. This was 'population A'.
- The next group was located on a pillar under the dock near the boathouse, facing in. This was 'population B' (marked on the same day and shortly after population a, with the exception of one individual, who was added two days later on 07.28.07 at approximately 8.30 PST) These were all masked limpets.
- 'Population C' was to the west of these two, along the cliff bottom, just to the right of the small cave entrance. This population was marked on 07.27.07 at 5.30 PST, with 3 individuals added on 07.28.07 at approx 8.30 PST.
- The last group, 'population D', was the group almost under the fresh water runoff area, just east of the cave entrance and along the cliff. These were marked on 07.25.07 at 12.00 PST, but I remarked again on 07.28.07 at 9.30 PST, because most of the nail polish had come off. Three of these were masked limpets. I numbered each of the group, i.e. A1, A2, B1, B2, etc.

I tallied the millimeters of each movement for the group, and then averaged the movement for each group.

Results:

Population A consisted of 11 individuals. They moved an average of 0 mm during the study. They did not move at all on their own volition, for the entire study. I did move two of them (A1 and A11) approx 3 inches on 07.28.07 in order to see what they would do. Both returned to their original spot with in 12 hours. However, A1 did not have as distinct of a home scar, and continued to shift around a little for the rest of the study, about .5mm left and right of its original spot. A11, however, had a very distinctive home scar, to which it promptly and exactly returned to within 12 hours, and did not move again.

Population B consisted of 3 individuals. During the study, they moved an average of 3.98mm. For the first 3 days, they did not move at all, then they started to move and finally they took off. One suddenly moved 52mm (a masked limpet).

Population C moved an average of 13.3mm. A couple of these individuals moved very far very quickly, over 100 mm with in 12 hours. Both of these fast and far movers were finger limpets.

Population D consisted of 7 individuals, and moved an average of 7.25 mm over the time of the study. Most of them seemed to move short distances but often.

In terms of my hypothesis, this exploratory was inconclusive. Population A apparently never left their home scars. Population B did not appear to go anywhere for days, and when they did then

they did not return to their original spot. Limpets in population C either did not go far, or went surprisingly far from their spots. They did seem to hang around their original spot the most, except for the ones that went clear off the map. Individuals in population D did not seem to return to their original spots, but only continued to shift around after small daily movements.

Discussion:

The study had a number of limitations, and I learned a lot about how I would do things different next time. For example, I would mark the limpets in a group even more distinctively. Some of them went far enough, and mixed together enough, that I did start to loose track of who was who, as I had repeated some colors. I would have liked a longer study time. And, lastly (and probably most importantly), I would include nighttime observations in my next study, as I am beginning to suspect that the limpets that supposedly did not move at all were moving at night, and just coming back so perfectly to their home scars that I could not tell that they had moved. I would also like to further study what may be some of the causes for the different movement in the different areas, as there were clearly differences. Differences in movement seemed more related to differences in location than differences in species, which I found surprising.

References:

Adams, Mary Jo. 2006. Washington State University Extension Information Site. Accessed on line 07.31.07.
http://www.beachwatchers.wsu.edu/ezidweb/animals/LottiadigitalispeltaTecturapersonascutum.htm

Hahn, Thomas; Denny, Mark. 1989. Tenacity-mediated selective predation by oystercatchers on intertidal limpets and its role in maintaining habit partitioning by *Collisella scabra and Lottia digitalis*. Marine Ecological Press Series vol. 53: 1-10. Published April 4.

Hobday, A. 1995. Body-size variation exhibited by an intertidal limpet: Influence of wave exposure, tidal height and migratory hehavior. Journal of Experimental Marine Biology and Ecology, vol. 189, no 1-2, pp. 29-45. Accessed online 07/31/07 through ASFA.

Hunter, Caitlin. 2005. A Structural comparison of Zonation within Two Limpet Species: *Lottia digitalis* and *Tectura persona.* Student Reports, OIMB Library.

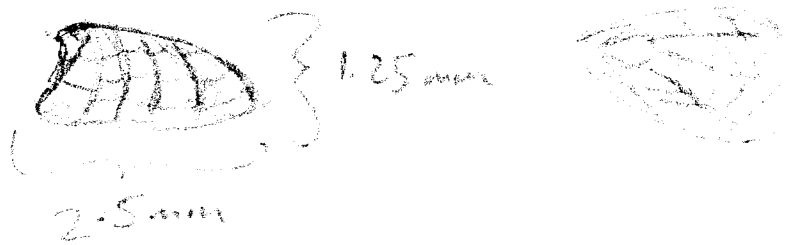
Hunter, Charlie. 2007. OIMB Marine Animal Adaptations lectures and personal interviews.

Mercurio, K.; Palmer, Richard A.; Lowell, Richard B. 1985. Ecology Journal: vol. 66, No.5, p. 1417. accessed online through JSTOR.

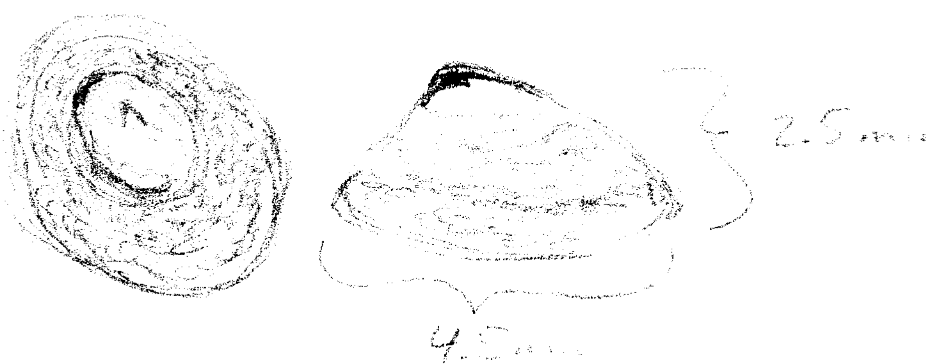
NOAA, online information source. Accessed 07/31/07.
http://limpets.noaa.gov/naturalHistory/species/animalspecies.html#mollusca

Sept, Duane J. 1999. A Beachcomber's Guide to Seashore Life in the Pacific Northwest. Merida Park, BC. Harbour Publishing.

Lottia digitalis :



Tectura persona :



both are
life sized