# Limpet Settlement Distance on *Egregia* vs. Wave Action Exposure

**Annie Walser**

Exploratory 3, Adaptations of Marine Animals, Dr. Charlie Hunter

Oregon Institute of Marine Biology, University of Oregon, Charleston, Oregon

*Introduction*

*Lottia insessa* is a specialist limpet found to exclusively consume the kelp *Egregia menziesii*. This is not a symbiotic relationship, however. The effects of *Lottia insessa* directly lead to *Egregia* death. More specifically, this limpet feeds on the epidermal and cortical cells of the kelp's rachis (Black, Fig. 1). This produces a distinct, visible scar that can be elongated as *L. insessa* eats along the length of the rachis. *Egregia menziesii*, commonly referred to as the "feather boa" because of its appearance and long length, often washes up on shore bearing holes and elongate scars from this grazer.

In a notable paper by Robert Black regarding his studies of *Egregia* and *L. insessa*, he observed that limpets were not found near the meristem of the plants and speculated that this was "because the whiplash effect of the surf on the rachis led to poor survivorship there" (1976). Because he did not elaborate further on this observation, his statement directed me to ask one of two questions in this exploratory: Do *Lottia insessa* settle and feed further from the kelp meristem on shores with higher wave action? My second question in this exploratory stemmed from a study done by J. Arrontes. He also observed that *L. insessa* caused extensive damage to *Egregia* and stated that although the limpets graze on small portions of the kelp, "the weakening of the kelp blade may imply the loss of large portions of plant biomass in situations of increased water motion" (1999). Taking this into consideration, I asked: On two beaches with varying wave action, do the average lengths of washed up *Egregia* differ? From my knowledge on these examined species, I came up with a combined hypothesis predicting that I would find *L. insessa* scars at a larger distance from the meristem of *Egregia* at beaches exposed to greater wave action, resulting in a longer portion of the kelp broken and washed to shore.

### *Materials and Methods*

Washed up *Egregia* was acquired at two locations: North Cove, Cape Arago and Whiskey Run, both in Coos County Oregon. It was observed that Whiskey Run had significantly larger wave action than North Cove. The first date of collection was July 26 and the second collection was done on August 3, 2008. At each site, the shoreline was scanned for freshly washed up kelp and *Egregia* was isolated and gathered if it retained scars from the limpet *Lottia insessa*. The total kelp length was measured in meters and then the distance from the kelp meristem down to the first detectable limpet scar was also measured in meters. Data was recorded for both of these sites. Eleven *Egregia* rachis were examined from Whiskey Run and 26 rachis from North Cove.

### *Results*

The average length of *Egregia* located at North Cove was 2.40 m and at Whiskey Run, the average length was 3.45 m (Fig. 2). The standard deviation for North Cove was $\pm 1.19$ and $\pm 2.52$ for Whiskey Run. The average distance from the meristem of the kelp to the first limpet scar and North Cove was 0.32 m and was 1.27 m at Whiskey Run (Fig. 3). The standard deviations for these data sets were $\pm 0.38$ and $\pm 0.56$ for North Cove and Whiskey Run, respectively.

*Discussion*

The hypothesis predicting that *L. insessa* scars would occur at a larger distance form *Egregia* meristems at beaches with higher wave action, resulting in a larger portion of *Egregia* broken and found on shore seems to be supported. Although the data does not appear significant, there is evidence that upon further investigation and replication, a conclusive pattern may arise. Both the distance from the meristem to the first scar and length of *Egregia* were larger at Whiskey Run, the location assumed to have a greater amount of wave action.

I believe that there was one main reason why the results showed such a pattern. In high wave action communities, marine organisms, kelps, and seaweeds are very streamlined in order to avoid detachment and death. *Egregia* is a long kelp with a hearty rachis, but when an organism such as *L. insessa* is attached to it, water drag is greatly increased and the limpet risks an early death because it is in danger of being ripped off. Dave Duggins investigated this idea and found that "the comparatively small number of grazers on algal stipes, or stipe injuries, in the habitats with frequent strong currents appears to result from the inability of grazers to persist on stipes in strong flows" (2001). To combat this problem, *L. insessa* moves down the rachis of *Egregia* in high wave action sites to feed and attempt to safely settle. In places of lower wave action, detachment from the host would not be a problem and the limpets would feed closer to the meristem, as seen in the data from North Cove.

The standard deviation values in this exploratory were bigger than expected and can largely be attributed to human error. *Egregia* blades found were often dense and covered the rachis from view. It is possible that the "first" limpet scar I encountered when moving away from the meristem was actually the second or third, which would have skewed the data. Also, what I assumed to be an *Egregia* meristem may not have been one at all. Most of the time, I could tell where the kelp was ripped from the substratum, but there may have been errors on meristem direction with the especially leafy kelp. Finally, my small sample size, especially from Whiskey Run, may have led to a large standard deviation.

This is a really interesting topic and I would enjoy exploring it further. For future work, I would like to visit more sites with varying wave action and collect more samples in an effort to eliminate error. It would also be interesting to analyze the defensive chemical dispersal throughout *Egregia* to find out if more chemicals are concentrated in the meristem or if chemical dispersal is sporadic. This could have a distinguishing effect on *L. insessa* grazing behavior.

Figure 1:
A picture of Egregia kelp with the rachis and description highlighted.



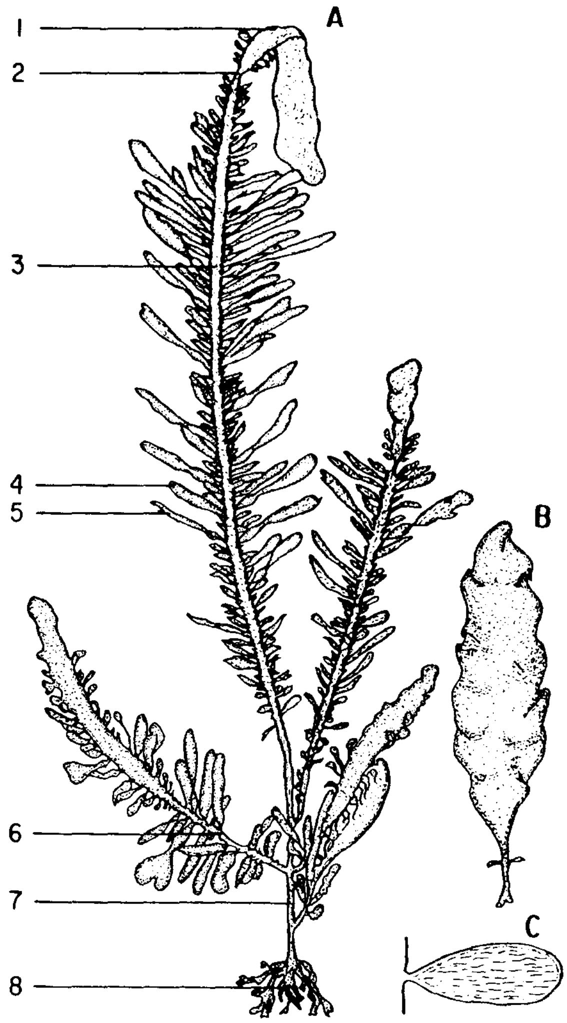


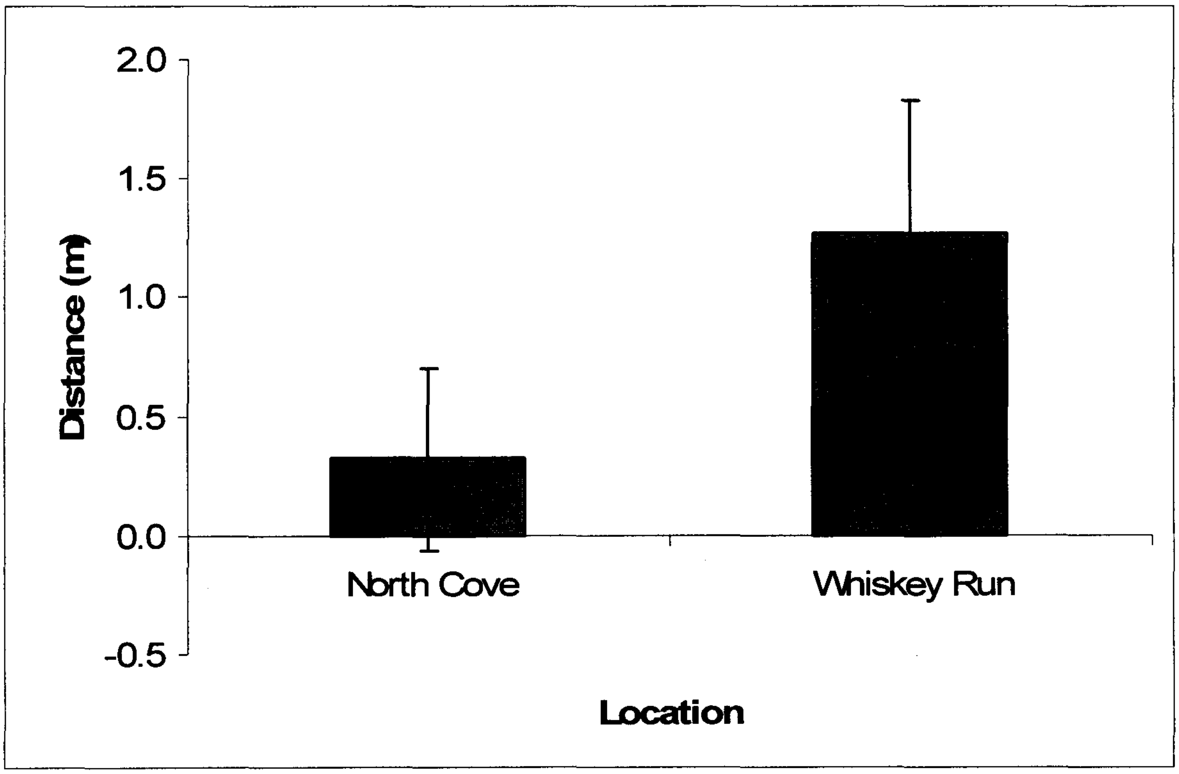

FIG. 1. (*A*) Adult *Egregia laevigata* 150 cm long. 1 = Terminal lamina, 2 = Intercalary meristem, 3 = **Main rachis which is flattened in cross-section**, 4 = Blade, 5 = Blade with pneumatocyst at base, 6 = Branch rachis, 7 = Stipe which is rounded in cross-section, and 8 = Holdfast. (*B*) Young plant before extensive growth at the meristem between stipe and terminal lamina. Total length is ≈ 20 cm. (*C*) A sporophyll which is about 2 cm long and therefore too small to show on drawing *A*. The surface of the sporophyll is ridged. Blades are never ridged and are usually much longer than sporophylls.

**Figure 2:**

The average length of *Egregia* rachis found at North Cove and Whiskey Run over two collection dates. The standard deviations are indicated with black lines.

**Figure 3:**

The average distance from the *Egregia* meristem to the first *L. incessa* scar over two collection dates. The standard deviations are indicated with black lines.



## Works Cited


Arrontes, J., 1999. On the Evolution of Interactions between Marine Mesoherbivores and Algae. Botanica Marina. 42:137-155.

Black, Robert, 1976. The Effects of Grazing by the Limpet, *Acmaea insessa*, on the kelp, *Egregia laevigata*, in the Intertidal Zone. Ecology. 57:265-277.

Duggins, Dave, James E. Eckman, Christopher E. Siddon, and Terrie Klinger, 2001. Interactive Roles of Mesograzers and Current Flow in Survival of Kelps. Marine Ecology Progress Series. 223:143-155.