Responses to Environmental Change: Genetic and Phenotypic Variation Among *Littorina obtusata* Populations in the Gulf of Maine's Rocky Intertidal

Graham Bendickson, Class of 2020

This summer, as a Bowdoin Life Sciences fellow, I worked with Professor Sarah Kingston on a project establishing a baseline data set for the genotypic and phenotypic variation among populations of the flat Periwinkle or smooth Periwinkle snail, *Littorina obtusata*. *L. obtusata* live in the rocky intertidal ecosystem, an ecosystem with various physical stress factors such as desiccation—exposure to heat and sun during low tides—and wave energy exposure. As in all marine ecosystems, organisms in the intertidal are also affected by pH, temperature, salinity, and dissolved oxygen concentrations. Ecologically, *L. obtusata* is vulnerable to predators, such as birds or crabs. We considered these to be pressures on the survival of *L. obtusata*, leading us to the research question driving this project: how do varying physical and ecological pressures drive selection and genetic variation among populations of *Littorina obtusata* in the Gulf of Maine? It is our goal to assess differences among different populations so that we can analyze what factors are drivers of variation among populations.

To establish this baseline data set, we collected snails for genetic samples, ecological field data, and physical field data. We are collecting this data from six regions in the Gulf of Maine (see Figure 1). This summer, we successfully completed field work in Harpswell, ME, and Hurricane Island, ME. In each region, we established a wave exposed and protected site to isolate the effect of wave exposure. At each site, we used three existing horizontal transects at a low, medium, and high tidal height to quantify the effect of tidal height. The ecological data we collected was the species abundance using 10 replicates of 0.25 m^2 quadrats, spaced every 10 feet, on each transect. We recorded the abundance of *L. obtusata* and the four common intertidal crab species. Upon arrival, we recorded a bird and crab carapace count, to assess the presence of predators. We recorded shell color of each *L. obtusata* to record color variation related to geographic site or tidal height. Off transect, we collected around 25 samples from each tidal height to assess genetic and shell variation. We also recorded temperature, pH, salinity, and dissolved oxygen concentration at each field site. For quantification of genetic variation among populations, we prepared purified DNA samples of 330 of the snails collected.

This summer's field work was a productive start to establishing this data set, but future work is needed to complete field data sets in the Pemaquid Peninsula, Schoodic Peninsula, Great Waas Island, and Kent Island regions. A larger sample size is needed to accurately analyze the effect of ecological and physical pressures on *L. obtusata* populations. However, in the interim, data sets from field work completed this summer were analyzed. A significant effect of exposure type (exposed or protected) on the proportion of lightly colored shells (defined as light green, yellow, and orange colored shells) to total shells was found ($p < .0000001$), with light shells more common in wave protected areas. No other significant interactions were found in the data collected so far. To assess genetic variation among populations, additional DNA samples must be extracted from collected *L. obtusata* specimens. Genetic variation will be quantified by sequencing DNA samples using Next Generation Sequencing technology. With continued work, a more complete dataset will allow the tracking of evolution in progress among *L. obtusata* populations.

Faculty Mentor: Professor Sarah Kingston

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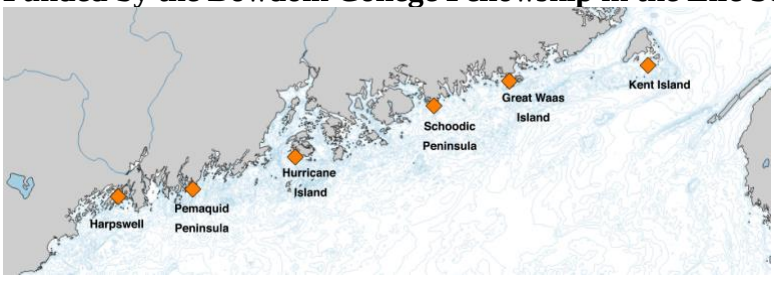

Figure 1. Field sites in the Gulf of Maine