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An Assessment of pH and the Effects of Ocean Acidification in a Phippsburg, ME Clam Flat

Lloyd Anderson, Class of 2016

Increased atmospheric CO_2 due to the combustion of fossil fuels and subsequent oceanic uptake has led to a phenomenon known as ocean acidification: CO_2 gas dissolved in the ocean lowers surface ocean pH and acidifies ocean waters, a process which has raised global concern. The purpose of my research was to investigate why a particular clam flat in Phippsburg, ME is not as productive as it used to be. This clam flat, located on "The Branch" in Phippsburg adjacent to Head Beach, has decreased to approximately a sixth of its former productivity in just over a decade. A possible explanation for this drop in clam bed productivity is acidification. I worked in a partnership with Bailey Moritz '16, with the goal to measure indicators of ocean acidification in the clam flat and see if there was a difference in those indicators between productive and unproductive areas of the flat. Bailey's focus was alkalinity, a quantification of the buffering capacity of seawater, where my specific research focus was on the effective collection of pH measurements. We were ultimately able to combine our alkalinity and pH measurements to calculate saturation state, an indicator of the susceptibility of clam shells to dissolution. I measured pH, a direct indicator of water acidity, from the top centimeter of the mudflat, the region where clam spat (juvenile clams) are seeded. The first few weeks of my fellowship time I spent researching the most accurate and precise way to measure pH in the field, and ultimately decided to measure pH on site using glass electrode probes. Sites 1 and 2 were located in a productive region of the flat, sites 4 and 5 were located in an unproductive region, and site 3 was located on the boundary between the two zones.

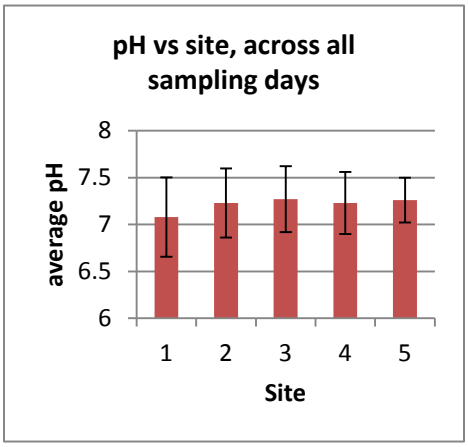

Figure 1: average pH at each site, with standard deviation error bars. Large error bars show no significant differences in pH between productive (sites 1-2) and unproductive (sites 4-5) areas within the flat.

Average pH values within the clam flat ranged from 6.9-7.5, and there was no significant difference in pH between productive and unproductive sites across the flat (Figure 1). The wide variations in pH across this clam flat could potentially be attributed to daily shifts in temperature, freshwater input, and biological productivity in the sediments. Low average pH values seen across all sites contribute to a low saturation state across the flat: our average calculated saturation state was 0.47, lower than similar data measured by Green et al. on a clam flat in South Portland in 2013, where average saturation state was 0.9. Our data indicate that the soft-shell clams at the productive sites in this particular Phippsburg clam flat are managing to survive in undersaturated (saturation state < 1) conditions. Since saturation state was low across both productive and unproductive sites, ocean acidification seems not to be the cause for the clams' decline. However, other factors such as dissolved oxygen or sediment type may have combined with low saturation states to create a difference in productivity across the flat. In further research I would be interested to see how average pH at these same sites varies over a year-long period, which would give a better representation of the environment that the soft-shell clams are exposed to through yearly cycles.

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