Carbonate Chemistry and Oyster Recruitment at Oyster Reef Restoration Sites

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As the Gulf of Maine continues to warm, oyster aquaculture and wild oyster populations in the region have been increasing, sparking community-driven interest in local restoration projects due to the potential of oysters to provide positive ecosystem effects (Hale & Westhead 2012). The Basin Oyster Project in Phippsburg, Maine is an oyster reef restoration project created by community stakeholders to explore the potential of reefs to enhance biodiversity and water quality. However, the suitability of this and other potential sites for restored reefs depends on many different aspects of the local water conditions. Because of the vulnerability of oyster shells, particularly larval oysters, to corrosion in acidic waters, carbonate chemistry conditions can be an important factor in successful oyster reef development (Boulais et al. 2017). Food availability from phytoplankton is also closely related to both the recruitment and growth dynamics of oysters (Stasse et al. 2022) and could influence the carbonate chemistry through photosynthesis and respiration. In the Gulf of Maine, biological processes are thought to be the main driver of seasonal changes in carbonate chemistry in some locations (Wang et al. 2016). However, the controls on these processes are highly localized and are likely to vary over small spatial scales (Wang et al. 2016), making the study of specific reef sites important in determining the feasibility of reef growth.

This summer, we analyzed the seasonal dynamics of and relationship between oyster recruitment, food supply, carbonate chemistry and composition of suspended solids at the Basin Oyster Project's reef restoration sites. We sampled biweekly from June through August 2024 at four sites in the Basin Preserve in Phippsburg. At each site, we collected discrete water samples and a depth profile of temperature, salinity, pH, chlorophyll, turbidity, and dissolved oxygen using a YSI EXO2 Sonde. The water samples were analyzed in the lab for total alkalinity, dissolved inorganic carbon, nutrient concentrations, and composition of total suspended solids. From these data, the saturation state of aragonite, the mineral that larval oysters build their shells from, was calculated using the seacarb package in R. Additionally, oyster larvae settlement was assessed using mesh bags of oyster shells that were deployed and periodically collected to look for settled oysters, and through surveys of the shoreline surrounding the sites.

This project is ongoing and will continue into the academic year as an Honors project that will also be presented at the AGU 2024 Annual Meeting. Preliminary data suggest significant differences in water conditions throughout the season and potentially between the different sites. Data from later in the summer has yet to be processed, but preliminary data suggest strong seasonal trends as Total alkalinity at the surface increased from 2050 to 2100 µmol/kg from early June to mid-July. Temperature, salinity, and dissolved oxygen levels have become more different between the sites as the summer progresses. Data on settlement and other biological indicators of oyster success will continue to be recorded throughout the summer and early fall. By helping to identify the primary factors dictating ecological feasibility of reefs, these results could help inform future reef restoration at coastal sites of local importance.

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