Spatial analyses of aragonite saturation between potential oyster reef building sites in the Basin Preserve, Phippsburg, Maine

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The shellfish industry in the Gulf of Maine (GoM) region has produced both economic benefits through the creation of jobs and marketable shellfish and environmental benefits. A new, collaborative research effort between Bowdoin College, Colby College, The University of Maine, and The Basin Oyster Project aims to address questions raised by community members, oyster farmers, and conservation groups in Phippsburg, Maine about the viability of building and sustaining oyster reefs in the Basin Preserve, a local preserve in coastal Maine. Oysters build their shells from minerals contained in seawater and because the shells of calcifying organisms are sensitive to ocean acidity, the content of shell building minerals in the water can be an important factor in determining the success of sustaining an oyster reef. Aragonite saturation state (Ωa) of seawater is an indicator of the shell building mineral, calcium carbonate's, tendency to dissolve or precipitate at a given location and, Ωa ≥1.5 is considered optimal for calcifying organism shell growth. As seawater absorbs atmospheric carbon, it acidifies and lowers Ωa. Additionally, changes to salinity, temperature, and biological respiration can locally alter Ωa.

In this study, we investigated spatial and depth trends in Ωa, throughout the Basin Preserve and the New Meadows River, a tidal embayment which acts as the coastal water source for the Basin. We calculated Ωa from fortnightly dissolved inorganic carbon (DIC) and total alkalinity (TA) measurements alongside oyster spawning and settlement study sites from June through August 2024. Samples were carefully collected on research cruises and were then taken to a lab in Roux Center for the Environment where they were titrated for TA and analyzed for DIC. The TA and DIC data were used to calculate the Ωa values with the SeaCarb package in R.

Our results show Ωa values of ~1.6 – 2.3 in the Basin, and ~1.03 – 2.3 in the New Meadows River, which indicates that the Basin is above the optimal 1.5 Ωa threshold for shellfish, and lower than offshore Ωa values of ~1.9 - 2.5. This variability in the Basin could be caused by biogeochemical processes such as increased biological respiration, tidal cycles, or influenced by the unique enclosed nature of the location. The New Meadows River features a much deeper water column and thus has significantly higher values at the surface than at depth. These results are promising for future reef development in the Basin Preserve and highlight the suitability of the New Meadows River for surface oyster aquaculture in terms of carbonate chemistry and have prompted continued efforts to monitor and research the area.

What started as a community effort to assess the viability of oyster reef building has grown into a years-long effort to collect data, assess community concerns that could inform oyster reef siting in other communities, and build a better knowledge base for oyster reef building and aquaculture in and around the Basin Preserve. Our research has allowed us to address questions raised by the community and highlights the valuable opportunity at Bowdoin College to explore community raised scientific questions. My position in this research has allowed me the opportunity to further my independent skills in the lab, out in the field, as well as helped me work collaboratively in a group. Research into the feasibility of the Basin Preserve will continue through the academic year as new data is generated and new trends arise.

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Funded by the Rusack Coastal Studies Fellowship