What are our sediments in the Damariscotta doing?

Background. Oysters are well known for their ability to filter large amounts of water. In other states with excessive nutrient pollution, coastal landowners are even incentivized to keep bags of oysters off their docks to help clean up the water column. Up here in Maine we are fortunate to not have such issues with water quality. Instead, we are perhaps on the complete opposite end of the spectrum regarding nitrogen levels in the Damariscotta. Years of historical data collected by researchers at the Darling Marine Center, the LOBO buoys more recently deployed by SEANET, and my own prior work confirm that the Damariscotta Estuary generally has very low concentrations of dissolved, inorganic forms of nitrogen (nitrate, nitrite, ammonium; the tiniest of molecules that serve as a food source for the tiniest of organisms, phytoplankton). All living creatures are largely made up of nitrogen, so it is important to study how this estuary processes the organic matter that it receives from oyster farms and other inputs.

Knowing that our water column never has had very much dissolved nitrogen in it, how is it that we have all these farms successfully producing oysters? And how are the sediments underneath these farms handling the oyster feces produced? Is there a connection between these two questions? That is what I aim to find out. The purpose of my research is to determine how the sediments under and surrounding oyster farms metabolize the resulting feces.

The marine nitrogen cycle is composed of several pathways that are influenced by many different microbes. Depending on which processes are most prevalent in a system, nitrogen is either going to end up leaving the system as nitrogen gas (N_2) or get recycled back into an inorganic form that is readily accessible by phytoplankton. In order for me to investigate how the sediments around the oyster farms are handling nitrogen, I must first understand what nutrients and gasses are being produced and consumed by the microbes in the sediment.

Experimental Plan. I will collect sediment cores using acrylic chambers during summer months when oysters are doing the bulk of their feeding. These cores are brought back to the lab, equilibrated in a chamber kept at site temperature, and then incubated with airtight caps so we can mimic the sediment/water interface. These caps have valves that allow for the collection of water samples from atop the sediment core while filling with replacement seawater, preventing the introduction of air. Since one of the possible pathways we are trying to quantify involves the production of nitrogen gas, which makes up 78% of our atmosphere, we must be maintain an air-free environment in these chambers during experiments.

2017 marks the first year that I will be diving for sediment cores with the help of my colleagues here at the Darling Marine Center. My intent is to collect cores from directly underneath several oyster farms over this summer. Since I will be

SCUBA diving for these cores I have decided to focus on the growing area South of Hog's Island. These sediment samples should provide me with a means of obtaining valuable information on sediment nutrient consumption and production, contributing to our understanding of how sediments metabolize oyster feces here in the Damariscotta Estuary. This project is funded by SEANET, a NSF EPSCoR grant that was awarded to the University of Maine in an effort to support and protect the livelihood of those who make a living on the water in Maine.

Contact me with any questions or comments.

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Here is a video of my project that provides a nice overview of how my flux chambers work around 1:50, though it should be noted the depth and scope of my project has narrowed significantly since this was made.

https://vimeo.com/162853405

A more recent overview of this project can be heard in this recorded Coastal Conversation show that aired on WERU March 24, 2017.

https://www.seagrant.umaine.edu/coastalconversations/SEANET