Macroalgal Blooms Do Not Affect Restored Salt Marsh Function

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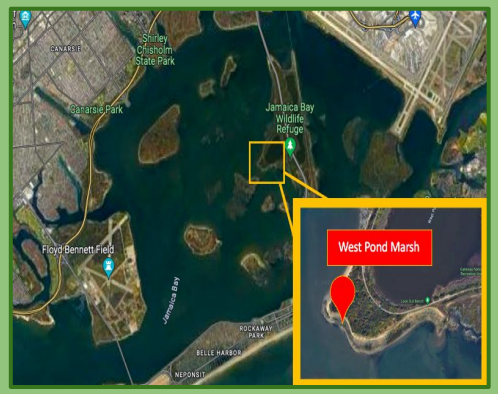
Introduction:

Algal blooms blossom because of an influx of nitrogen from wastewater.[1] In particular, macroalgae can cause a multitude of issues for coastal habitats such as salt marshes. Decomposing macroalgae causes an increase in hydrogen sulfide in sediments, which can reduce marsh plant growth, as well as contribute ammonium to seawater.[2] Macroalgae has also been observed to increase erosion, since faster decomposition of algae may lead to rapid decomposition of sediment organic matter (OM).[3] Salt marshes in Jamaica Bay, New York, experience heavy macroalgal blooms each year.[4] However, the effects of macroalgae on recently restored marshes are not known. With this project, we used caging treatments to test the effect of macroalgae on *Spartina alterniflora* grass growth, nutrient cycling, and changes to OM in West Pond marsh, a recently restored (~2 years) Jamaica Bay salt marsh. We hypothesized that macroalgal mats would create reduced sediment conditions that would lead to lower *Spartina* growth and higher nutrient (phosphate) release than areas without algae. We also hypothesized that OM would be lower in macroalgae cages because of increased decomposition.

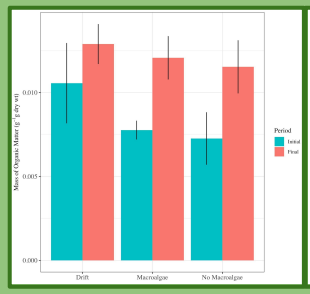
Methods:

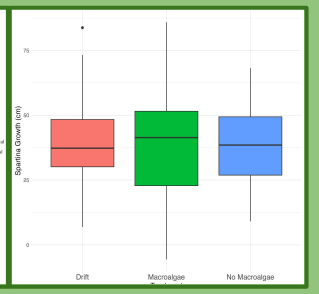
- Fifteen 0.25m^2 plots (three treatments: cages with macroalgae added, cages with no macroalgae, and open Drift treatments to account for caging effects) at West Pond, Jamaica Bay
- In Baruch College, we sampled and weighed out sediments from our cages (one sampling at the start of the experiment, and one sampling at the end)
- Ashed sediment samples into a furnace at 500 degrees Celsius to burn off organic matter (OM)
- A week after the original setup, we filled up specific cages with more algae because some of the algae washed away and back into the bay
- Then we collected pore water samples to measure the sediment phosphate (PO_4) levels
- Using pH meter to measure millivolts to infer oxidation/reduction status of sediment
- Measured the height and density of the Spartina grasses before and after cage treatments, left cages out for 5 weeks

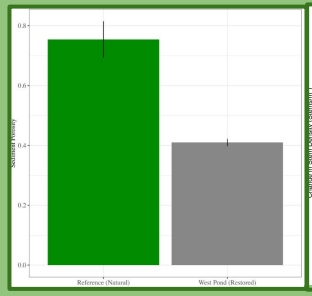


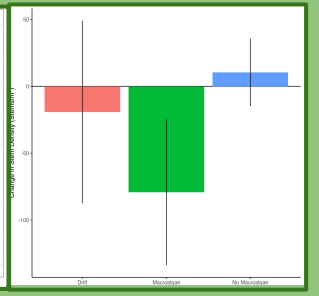
Results:

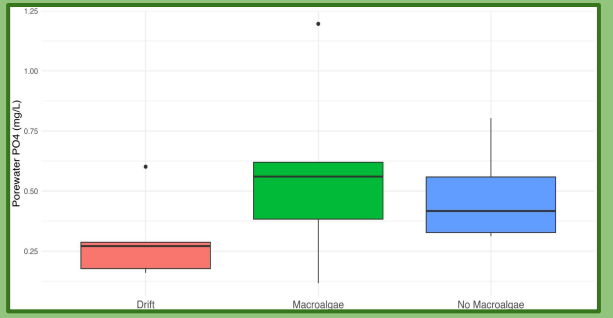
- Macroalgae and macroalgae-free treatments showed a significant increase in OM (p = 0.011 and 0.057 respectively), while drift cages did not
- The macroalgae blooms do not significantly lead to decreased *Spartina* growth/stem density
- Negative changes to stem density may get worse over time (decrease in stem density in Macroalgae treatments, but not significant)
- Sediment porewater PO_4 release did not differ between cage treatments.











References
[1]Hallegraeff, G. M. "A Review of Harmful Algal Blooms and Their Apparent Global Increase." *Phycologia*,1993. [2]Wasson, K. et al."Eutrophication Decreases Salt Marsh Resilience through Proliferation of Algal Mats." *Biological Conservation*, 2017. [3]Liu, S. et al. "Macroalgal Blooms Trigger the Breakdown of Seagrass Blue Carbon." *Environmental Science & Technology*, 2020. [4]Wallace, R.B. and C.J. Gobler. "Factors Controlling Blooms of Microalgae and Macroalgae (Ulva Rigida) in a Eutrophic, Urban Estuary: Jamaica Bay, NY, USA." *Estuaries and Coasts*, 2015. [5]Alldred, M. et al. "Marsh Plants Enhance Coastal Marsh Resilience by Changing Sediment Oxygen and Sulfide Concentrations in an Urban, Eutrophic Estuary." *Estuaries and Coasts*, 2020.

Discussion/Conclusion:

The lack of a significant change in *Spartina* growth/density, or in sediment nutrient release (which would suggest reduced conditions) shows that the macroalgae that grows in Jamaica Bay isn't negatively affecting the restored marsh. Restored marsh sediments may be better drained than those in natural marshes (less porous)[5], which may prevent negative effects of macroalgae blooms (hydrogen sulfide buildup, decreased *Spartina* growth, rapid decomposition). Over time, however, it may be possible that as the restored marsh ages, macroalgae may start to cause these issues.