Effect of invasive *Typha* on sediment nutrient composition of Great Lakes coastal wetlands across a water depth gradient

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Abstract

The invasive hybrid cattail, *Typha x glauca* (hereafter, *Typha*) forms dense monocultural stands in the shallow waters of Great Lakes coastal wetlands. *Typha* competitively absorbs macronutrients such as nitrogen and phosphorus and outcompetes native wetland plants. When *Typha* dies, its biomass accumulates in nutrient-rich floating mats. I hypothesized that the sediment in wetlands invaded by *Typha* will have significantly higher levels of carbon and nitrogen due to the accumulation of organic litter by *Typha*. I analyzed sediment samples from two *Typha* invaded and two uninvaded coastal wetlands to determine how biodiversity affects sediment nutrient composition paired with water level gradients. I combusted sediment samples in an N-C Analyzer to determine sediment percent carbon and nitrogen. I found that sediment taken from deep water vegetative zones had lower concentrations of carbon and nitrogen due to sparse vegetation and tidal currents. Average flora diversity was significantly different between medium and deep-water plots.

Question

- How does *Typha* invasion affect carbon and nitrogen composition of wetland sediment across a water level gradient?

Figure 1: A colony of hybrid *Typha* in a wetland.

Hypotheses

- Sediment in wetlands invaded by *Typha* will have significantly higher levels of carbon and nitrogen.
- Sediment in shallower water depths will have significantly higher levels of carbon and nitrogen.
- There will be an interaction between water depth and *Typha* invasion.

Introduction

Water level fluctuations have a significant effect on both the biodiversity of wetland vegetation[1] and nutrient export from the wetland.[2] In the past 30 years, average water levels within GL coastal wetlands have varied by as much as 2 meters.[3] *Typha*, propagates in periods of low water. It has superior flood tolerance and nutrient uptake compared to native plant species.

Typha litter deposits carbon and nitrogen into the ecosystem.[4] However, it is unclear what the effects of high water levels have on the stored carbon and nitrogen in *Typha* dominated GL coastal wetlands.

Methods

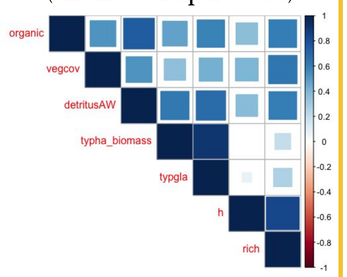
The samples in this study are from the wetlands Cheboygan Marsh, Cecil Bay, Munuscong Bay, and Mackinaw Bay. Two to three transects of 15 replicates were drawn perpendicular to open water through each of the field sites. Diversity measurements and sediment cores were taken for each replicate. Soil samples were ground and sieved. 70 mg of each sample was run through the N-C Analyzer. All results were processed using the software RStudio. All transects were divided Into thirds by replicate (1-5, 6-10, 11-15) with the exception of Cecil Bay's transect, Voss, that had 50 replicates. Voss was divided into thirds based on total water depth.

Figure 2: Shane Lishawa collects field data.

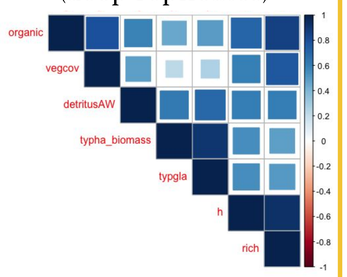
Figure 3: Cassidy Redding prepares soil for combustion.

Results

Upland Division
(shallow replicates)



Open Water Division
(deep replicates)



Mid Division
(mid replicates)

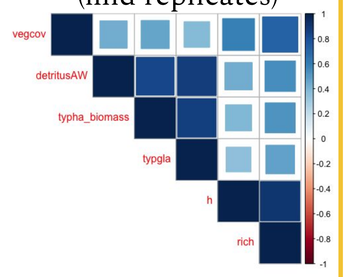
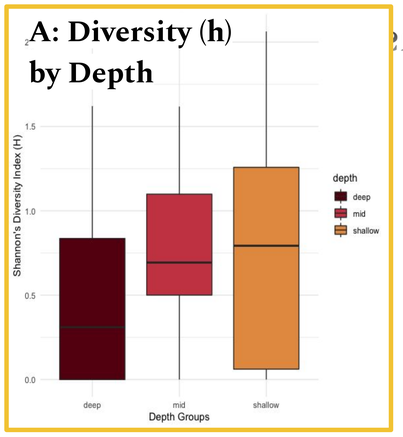


Figure 4: Correlation matrices of each transect divided into thirds by water depth.

Matrices show positive correlation between all variables. Further analysis will explore how carbon and nitrogen are correlated with the variables seen in these matrices.

Results

A: Diversity (h) by Depth



B: Richness by Depth

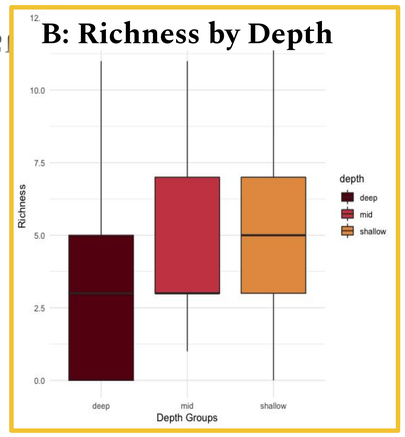


Figure 65a: Boxplot of Shannon's diversity index across the subdivisions of all wetlands. Means are significantly different (ANOVA: p<0.05; shallow-deep Tukey: p<0.05; shallow-medium Tukey: p<0.05). 5b: Boxplot of richness across the subdivisions of all wetlands. Shallow-deep replicates are significantly different (Tukey: p<0.05).

	H Mean	H SD	Rich Mean	Rich SD
Shallow	0.76	0.59	5.01	3.24
Mid	0.74	0.49	4.55	2.88
Deep	0.47	0.51	3.28	3.22

Discussion

- There is significantly less richness and diversity in the deep water replicates. Exposure to lake currents and tides could explain this.
- I have only analyzed 160 of my 224 sediment samples due to lab constraints and safety concerns regarding COVID-19. This poster serves as a preliminary study of the sites that I can use and reference once I have access to the full extent of my data.

References

[1]Raulings, E., Morris, K., Roache, M., & Boon, P. (2010). The importance of water regimes operating at small spatial scales for the diversity and structure of wetland vegetation. *Freshwater Biology, 55*(3), 701-715. [2]Steinman, A., Ogdahl, M., Weinert, M., Thompson, K., Cooper, M., & Uzarski, D. (2012). Water level fluctuation and sediment-water nutrient exchange in Great Lakes coastal wetlands. *Journal Of Great Lakes Research, 38*(4), 766-775. [3]Smith, J.P., Hunter, T.S., Clites, A.H., Stow, C.A., Slawecki, T., Muhr, G.C. and Gronewold, A.D., 2016. An expandable web-based platform for visually analyzing basin-scale hydro-climate time series data. *Environmental Modelling & Software*, *78*, pp.97-105. [4]Lawrence, Beth A, Lishawa, Shane, Tuchman, Nancy, Hurst, Nia, & Castillo, Buck T. (2016). *Wetland Invasion by Typha×glauca Increases Soil Methane Emissions,* Institute of Environmental Sustainability: Faculty Publications and Other Works.

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