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 exposure to wave action. Average floral 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.

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 Great Lakes coastal wetlands (GLCWs) 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 GLCWs.

Methods

The plots in this study are from the wetlands Cheboygan Marsh, Cecil Bay, Munuscong Bay, and Mackinaw Bay. Three transects of 15 replicates were drawn perpendicular to open water through each of the field sites. Plant diversity (calculated by taking aerial percent cover) 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 a Cecil Bay transect that had 50 replicates. It was divided into thirds based on total water depth.

Figure 2: Shane Lishawa collects field data.

Results

Correlation Matrix

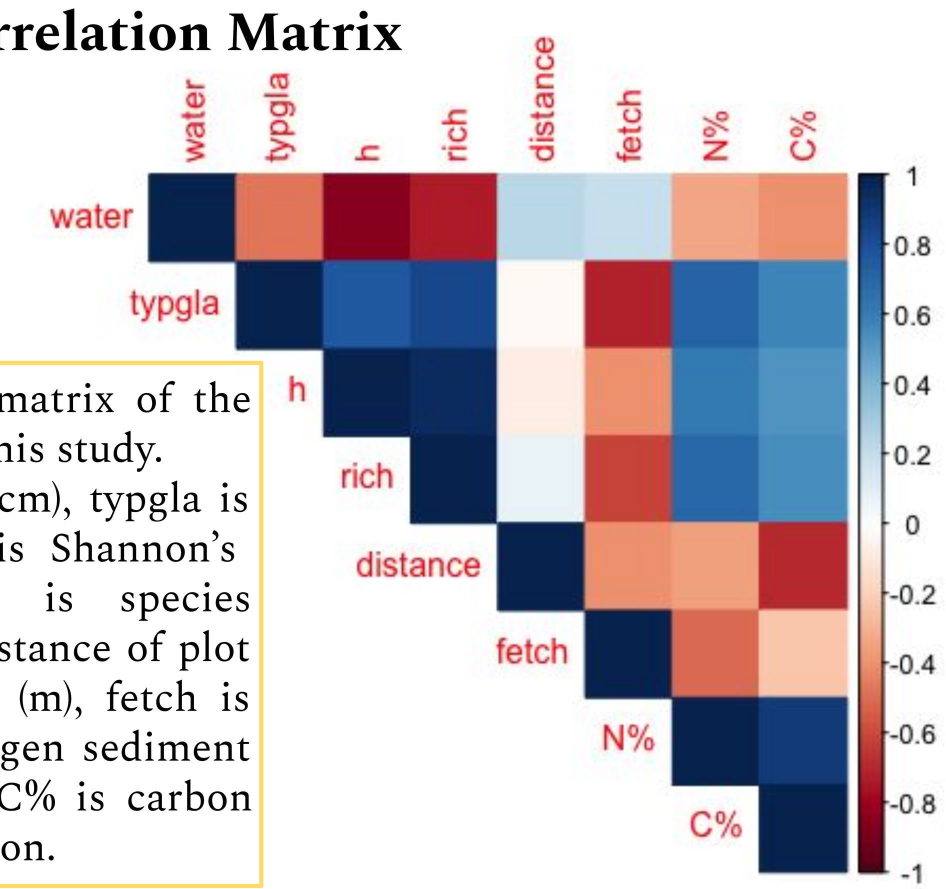
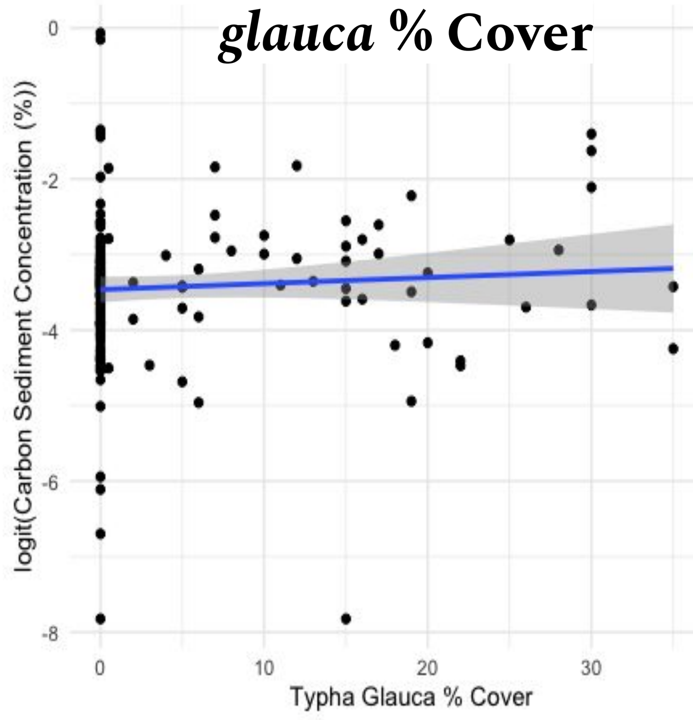


Figure 3: Correlation matrix of the variables examined in this study. Water is water depth (cm), typgla is *T. glauca* % cover, h is Shannon's diversity index, rich is species richness, distance is distance of plot from inland-most plot (m), fetch is lake fetch, N% is nitrogen sediment % concentration, and C% is carbon sediment % concentration.

C Concentrations by *T. glauca* % Cover



N Concentrations by *T. glauca* % Cover

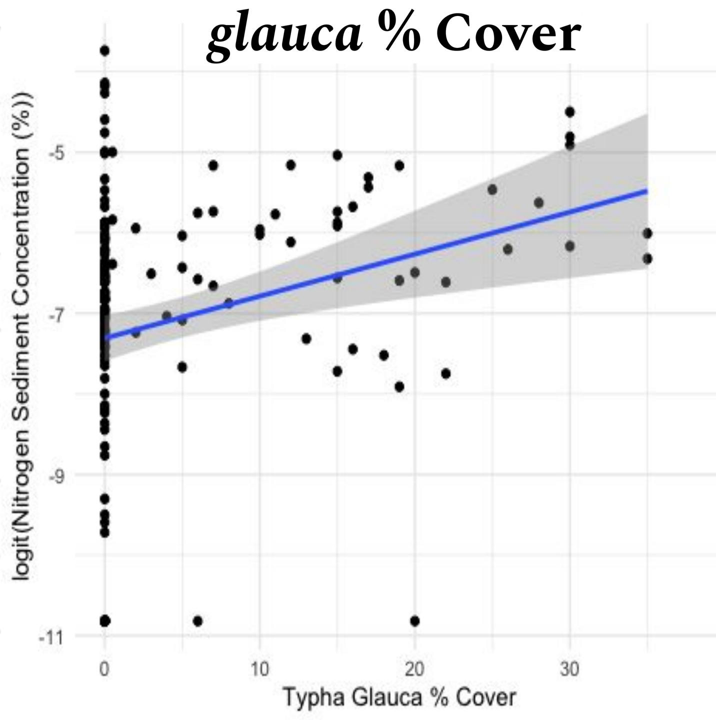
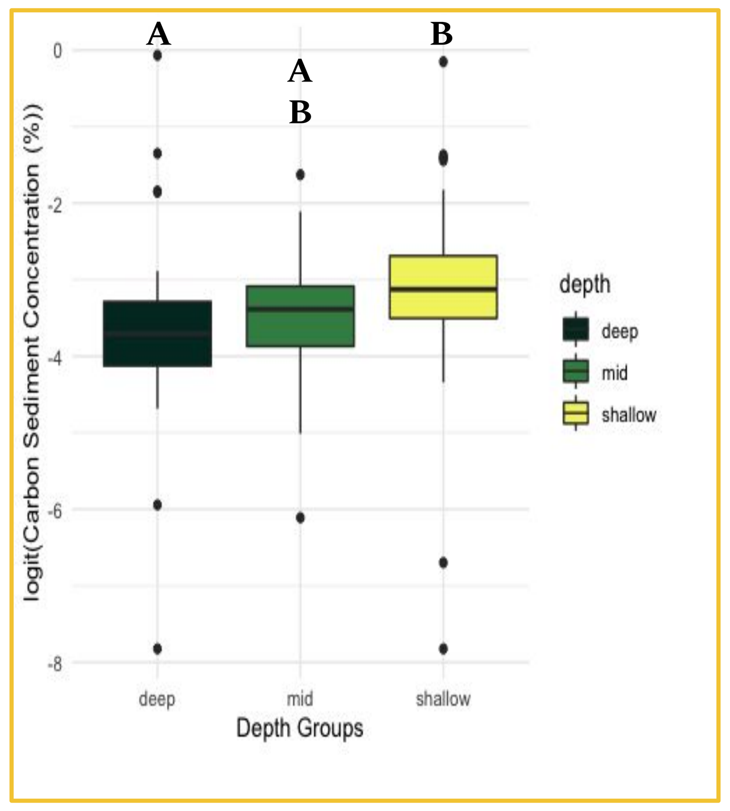


Figure 4a: Linear regression model of C% based on *T. glauca* % cover ($p<0.05$, R^2 = 0.08). Figure 4b: Linear regression model of N% based on *T. glauca* % cover ($p<0.05$, R^2 = 0.06).

C Concentrations Across Water Level Gradient



N Concentrations Across Water Level Gradient

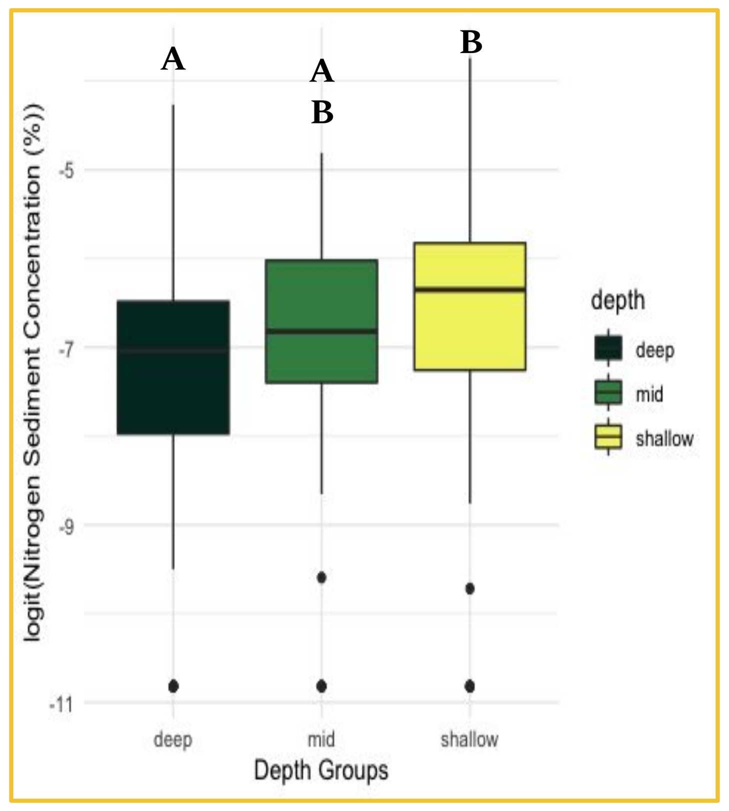


Figure 5a: Boxplot of % carbon concentrations in sediment across the subdivisions of all wetlands. Means are significantly different (ANOVA: $p<0.05$) Significant differences between means denoted with letters (Tukey: $p<0.05$).. 5b: Boxplot of % nitrogen concentrations in sediment across the subdivisions of all wetlands. Significant differences between means denoted with letters (Tukey: $p<0.05$)..

Discussion

Despite the correlation matrix showing a strong positive correlation between *T. glauca* % cover and sediment carbon and nitrogen concentrations, the linear regression models show very weak relationships between the variables. I found that increased *T. glauca* % cover leads to a slight increase in sediment carbon and nitrogen concentrations. Nitrogen concentration seems to be slightly more impacted by an increase in *T. glauca* % cover.

Both sediment carbon and nitrogen concentrations are also significantly lower in deep water replicates than in shallow water replicates.

These results show that sediment carbon and nitrogen concentrations are impacted by both water depth and *T. glauca* invasion.

References

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