Carbon and Sediment Dynamics of the James Bay Coastline

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Introduction

Background

- The James Bay coast is a critical area for carbon accumulation and blue carbon (Riley, 2011) which requires further study
- Under consideration for a National Marine Conservation Area
- This region is undergoing postglacial uplift; the shoreline grades from mudflat to salt marsh to fen (Riley, 2011)
- Emerging land accumulates organic matter from inland peatlands and situ biomass - critical carbon sink (Riley, 2011)
- Further, this region is important for migratory birds, marine mammals, and other species of concern (Abraham et al., 2011)

Objectives

1) Determining the relationship between habitat type (flat, marsh, etc.), organic matter, and soil texture
2) Using these observations and comparisons other works to determine what threats the James Bay Coastline may be facing
3) Investigating whether shorebirds tend to be found in areas with certain soil properties

Figure 1: James Bay Intertidal Flat. Image: A. Anderson

Methods

Figure 2: James Bay Intertidal Marsh. Image: A. Anderson

James Bay Field Data

- 185 soil samples were taken from the flats & marshes,
- Organic Matter content, bulk density, and sand/silt/clay content, presence of shorebirds, and submergence class were recorded, as were the sampling time and location

Analysis

- Differences in OM content and BD between habitat types were analyzed using ANOVA in R
- PCA was performed using the vegan package in R with the factors of bulk density, organic matter content, & sand/silt/clay content
- James Bay sites were also compared to data from the Bay of Bothnia (Finland) and American tidal wetlands

Results

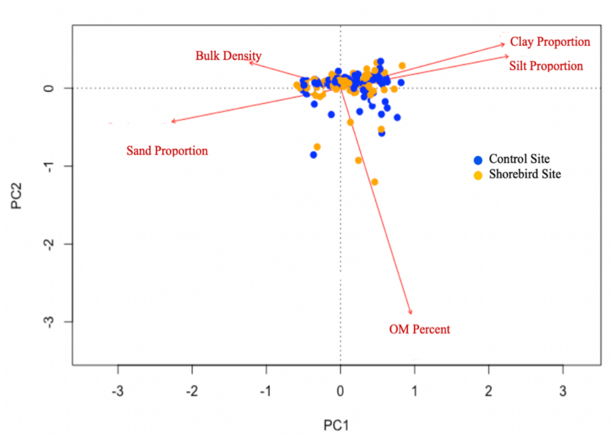

Figure 4: PCA Plot of James Bay sample sites coloured by shorebird presence. Shorebirds did not show any obvious preference for particular sites based on the five displayed soil properties

James Bay Coastline Data

- Organic matter and soil texture both significantly differed with habitat type (ANOVA); the PCA biplot differentiates the flats from the intertidal marsh sites based on higher bulk density and greater sand content
- Shorebirds clustered around submerged sites but not organic rich or fine-grained ones (χ^2 contingency test & PCA plot)

Comparisons

- US tidal wetland sites had significantly more organic matter than James Bay ones (t-test)

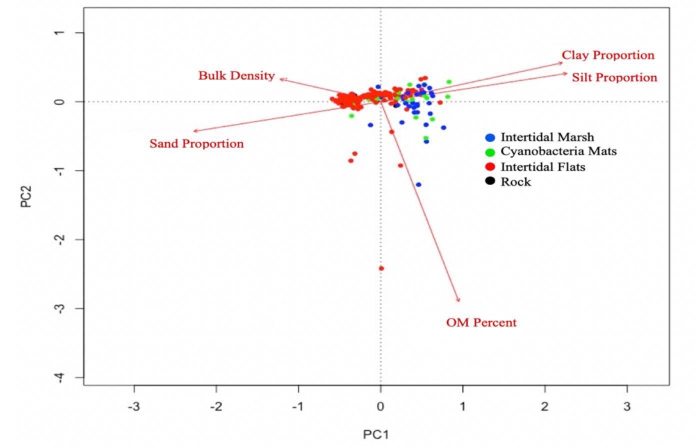

Figure 3: PCA Plot of James Bay sample sites coloured by habitat type. The more inland intertidal marsh was mainly differentiated from the intertidal flats by texture (higher sand content) instead of OM content

Discussion

Explanations For Observed Trends

- Organic matter is significantly lower on the James Bay (JBL) coasts compared to US wetlands – likely due to uplift
- Low OM, but over a large coastal area, and will increase with more uplift (Pendea & Chmura, 2012)
- Similarly low OM at Bothnia Bay in the intertidal zone – has similar rates of uplift (Tuittila et al., 2012)
- Finer texture on the marsh due to wave action (Stewart & Lockhart, 2005)

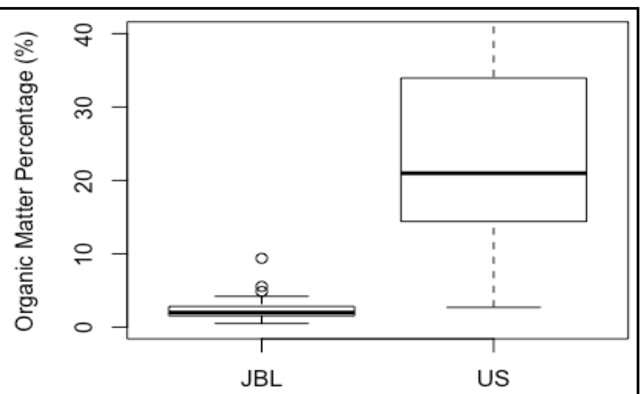

Figure 4: OM % for James Bay and US tidal wetlands

Threats to the James Bay Coastline

- Grubbing and erosion on the coastline by geese continues to be a concern (Abraham et al., 2011)
- Pollution on similar coastlines has had detrimental effects in the Bay of Bothnia (Manzetti, 2020)
- Climate change will "slow" uplift through rising seas, potentially narrowing or altering the ecologically indispensable marshes and flats (Abraham et al., 2011)

Conclusions

- Collected organic matter content data the shoreline, big first step for blue carbon study of this region
- OM low, likely due to rebound – but still relevant over a large area, and will increase with further uplift
- Different habitat types on the coastline are mainly differentiated by texture – OM and fine grained content are both higher in the intertidal marsh
- Climate change and development pose continuing threats – climate change may disrupt coastal marsh expansion through sea level rise
- Shorebirds mainly cluster around submerged sites

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