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Resilience of Seagrass and Associated Carbon Stocks to Storms

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Background

Why is seagrass important?

Seagrass beds support healthy estuaries and are among the most efficient carbon sinks. High-salinity seagrass commonly forms behind barrier islands in an area frequently impacted by storms. Storm processes can remove some of the seagrass bed as new inlets form and erode back-barrier areas, or enhance preservation of the seagrass bed as washover sand is deposited on the meadow. The research community mainly assesses seagrass carbon stocks from surface samples and assume loss of seagrass area equates to loss of the carbon stock.

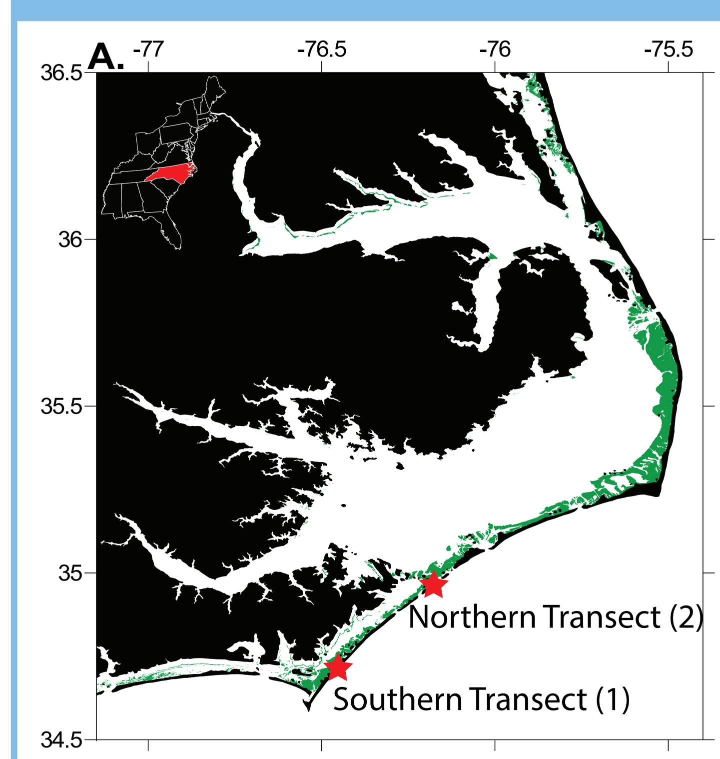
However, the relationship between carbon burial in seagrass beds and the frequently shifting depositional environment of many temperate seagrass meadows has yet to be investigated. **The main goal of this research is to develop a depositional model for high-salinity temperate seagrass meadows that captures changes in carbon storage associated with storms and spatial variability in sediment composition across the meadow.**

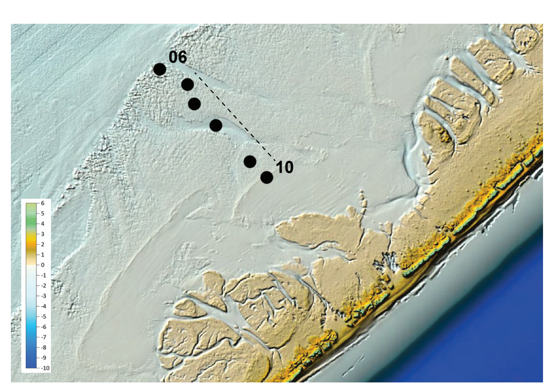
Research Objectives

Research Questions

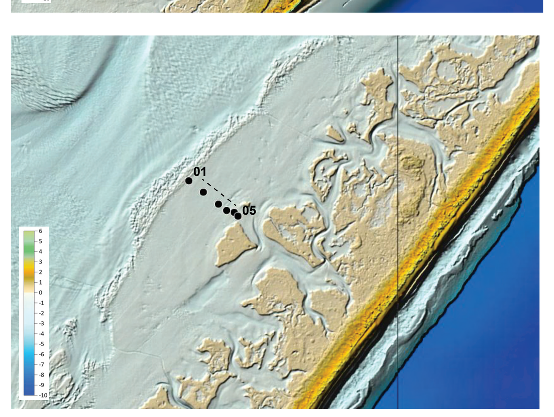
- Are seagrass beds composed of multiple depositional units? How do these beds record storm events?
- How does carbon content of modern seagrass units compare to the carbon content of those buried by storms? How old are these seagrass beds?
- Does composition and geometry vary across the seagrass meadow?

Methods





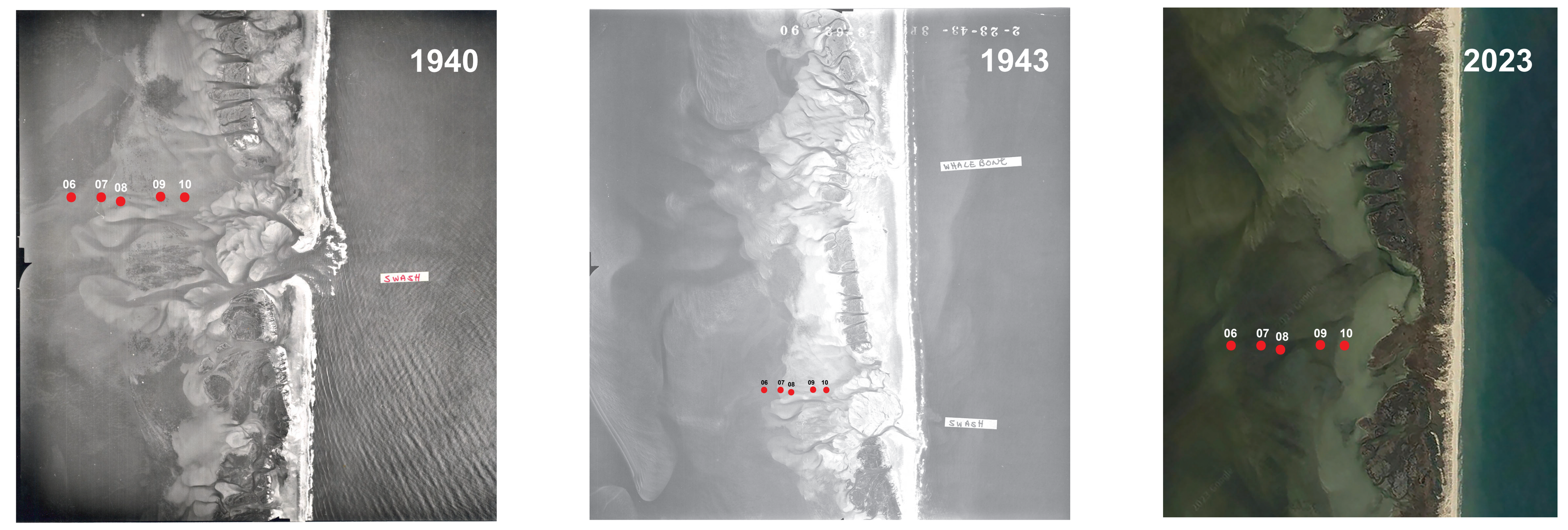
Northern Transect (2) - The northern transect sampled a 1500 m-wide meadow from an area with an active flood-tidal delta in 1942 CE.



Southern Transect (1) - The southern transect sampled a 700 m-wide meadow from an area that shows no evidence of washover or flood tidal delta deposition since 1940 CE.

Seagrass forms on a sandy back-barrier terrace. The flat terrace is fringed by a ridge on the estuarine side and saltmarsh towards the barrier. This area has been frequently impacted by storm washover and inlet formation events from the late-Holocene to present.

Methods

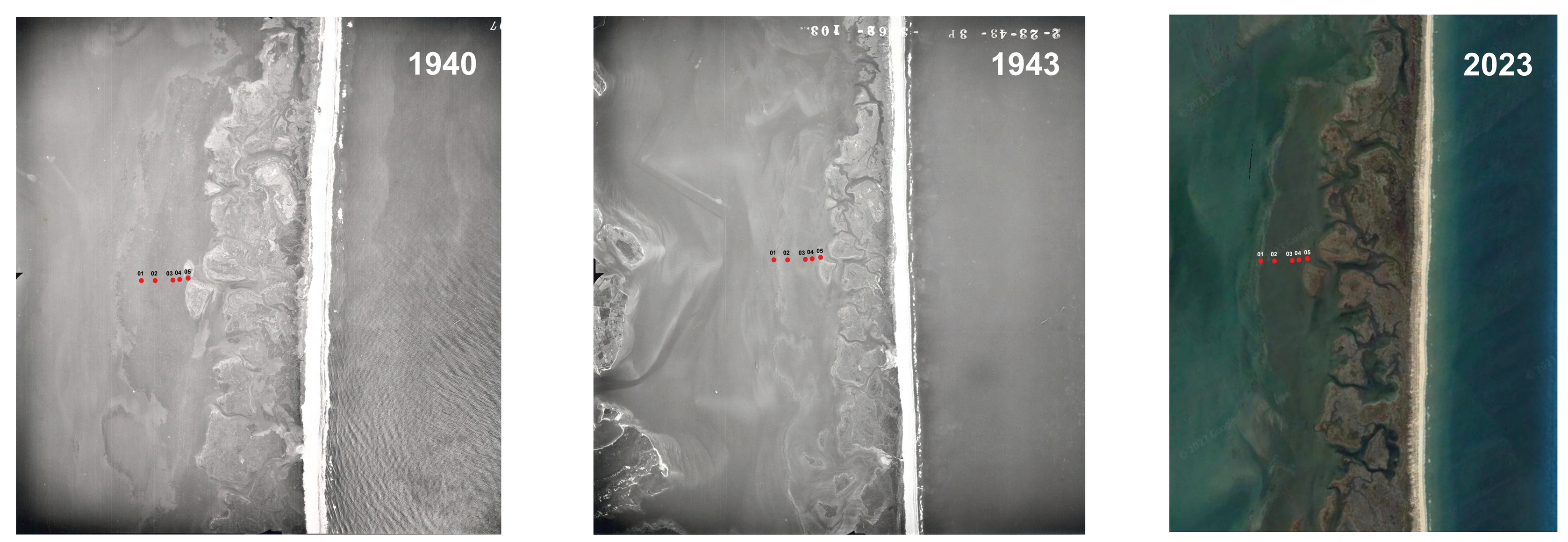


Left, Northern Transect (2) site, 1940 CE. Center, Northern Transect (2) site, 1943 CE. Right, Northern Transect (2) site, present day.

Core Collection - Ten cores (average depth of 277.7cm) were taken from Core Banks, NC (June and July 2023). Five from the northern end and five from the southern end. Both transects were collected perpendicular from the back barrier into the estuary. The northern transect was collected from a paleoinlet that was filled in between 1940 and 1943 CE. The southern transect was collected from an area that has been relatively unchanged since 1940 CE.

Core processing - Cores were subsampled to the 2nd seagrass bed's basal contact with the underlying sandflat (~1 m). Analyses included:

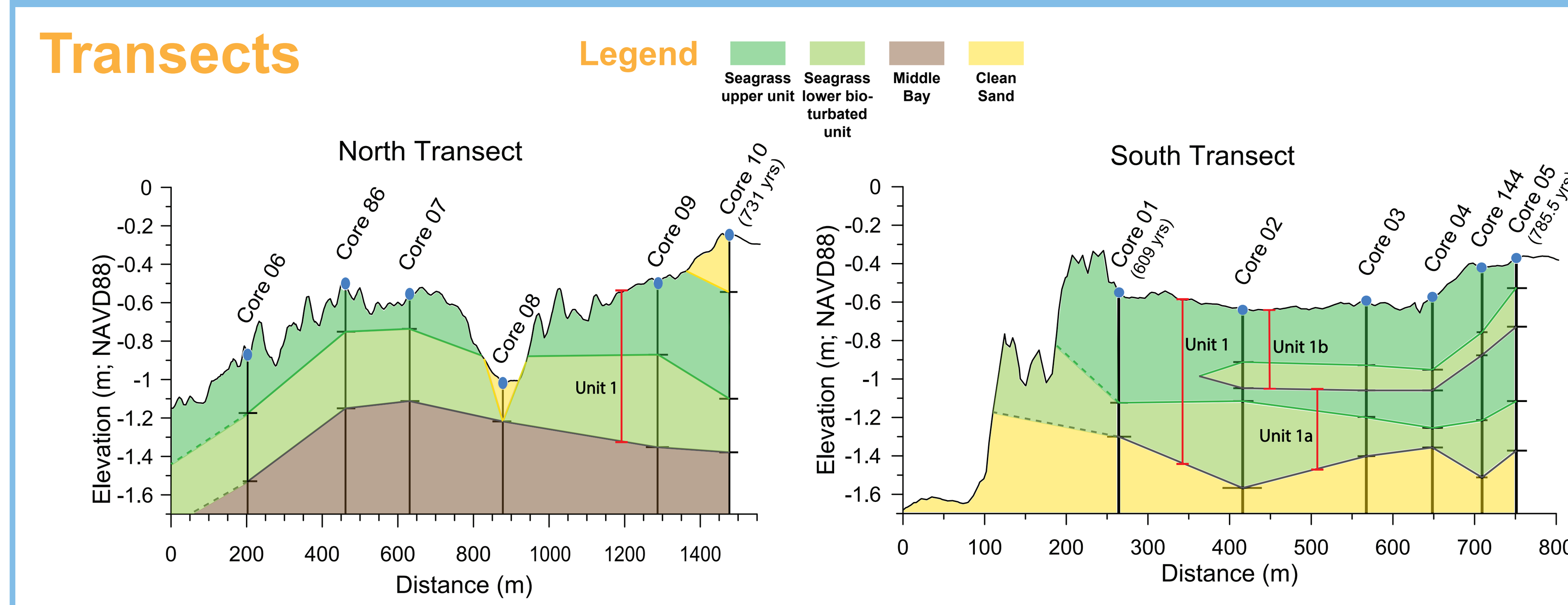
- Percent loss-on-ignition
- Grainsize
- Radiocarbon dating (01, 05, 10)



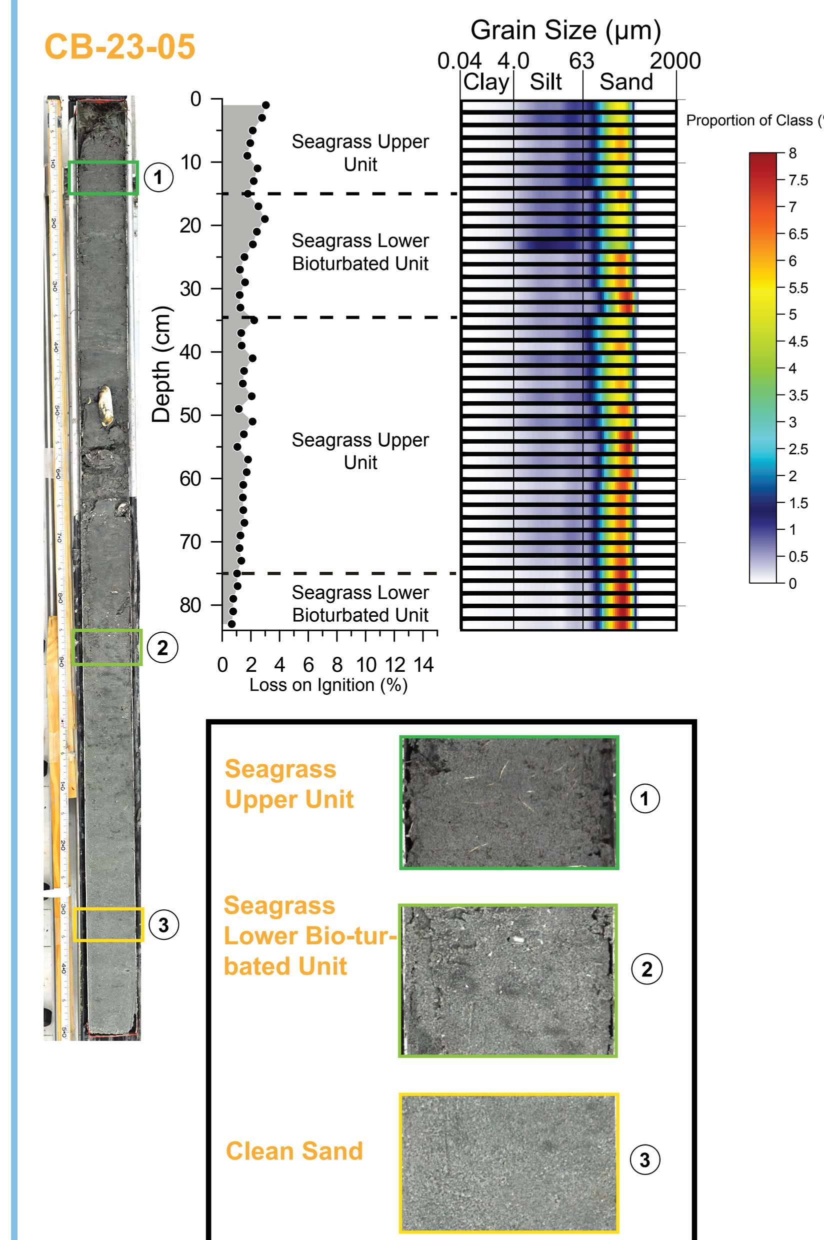
Left, Southern Transect (2) site, 1940 CE. Center, Southern Transect (2) site, 1943 CE. Right, Southern Transect (2) site, present day.

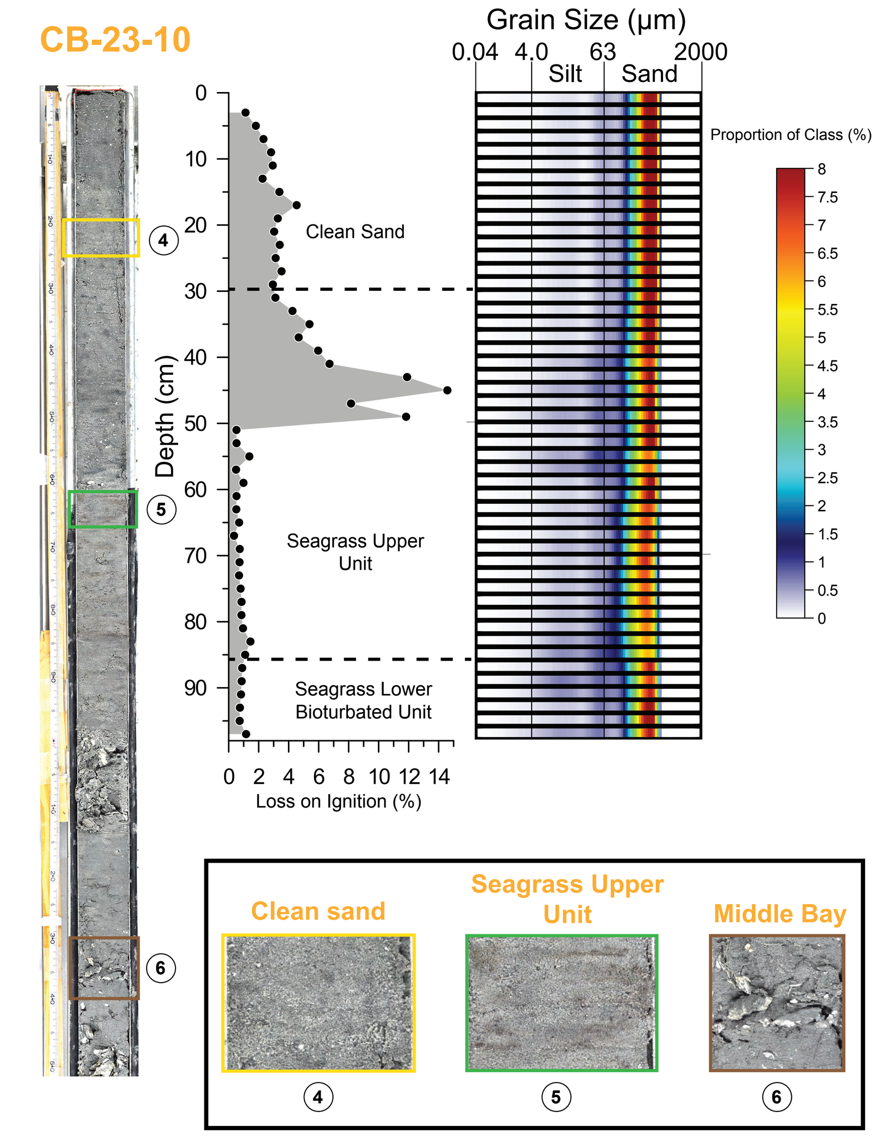
Results - Facies & Successions

Transects



Results - Facies & Carbon Content





Both transects sampled older fining-upward seagrass beds below the modern meadow near the island margin that pinch out into one thicker seagrass bed towards the estuary. The older beds were thinner than the surface bed; however, some had similar carbon content.

Conclusions

1. **Seagrass beds are composed of multiple depostional units which include the upper organic rich seagrass unit with visible plant matter, and a lower bioturbated unit.** Seagrass colonizes overwash and/or flood tidal delta deposits. The beds in Core Banks exhibit stacking, which is indicative of some burial event and re-establishment. As storm associated burial events occur, the seagrass beds of Core Sound have been able to recolonize the substrate that buried them.

2. **The loss on ignition (LOI) values between the modern seagrass units (2.06% +/- 0.59%) and those of older buried units (1.50% +/- 0.39%) are similar, indicating high levels of carbon preservation.** Seagrass has been accumulating in Core Sound since as early as 1237 CE at our sites.

Core	Age (yrs)
CB-23-01	609
CB-23-05	785.5
CB-23-10	731

3. **Composition and geometry varies with distance from the barrier island.** Stacked beds sampled directly behind the barrier island amalgamate towards Core Sound. This indicates burial events are the product of storms washing over the barrier island and transporting sand onto seagrass beds. Cores samples further from the barrier exhibit continual seagrass units due to reduced storm influence.