INVASIVE PHRAGMITES AUSTRALIS MAY NOT BE THE BLUE CARBON SOLUTION WE THOUGHT IT IS: A CASE STUDY IN SOUTHERN CONNECTICUT,

AUTHORS

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CONTENT

INTRODUCTION

- Salt marshes- Challenges
- Species of Interest- Invasive Phragmites Australis (Bottom right) and Native Spartina Alterniflora (Bottom left)
- Study Focus - Blue Carbon Sequestration (carbon stored in coastal and marine ecosystems, such as salt marshes)

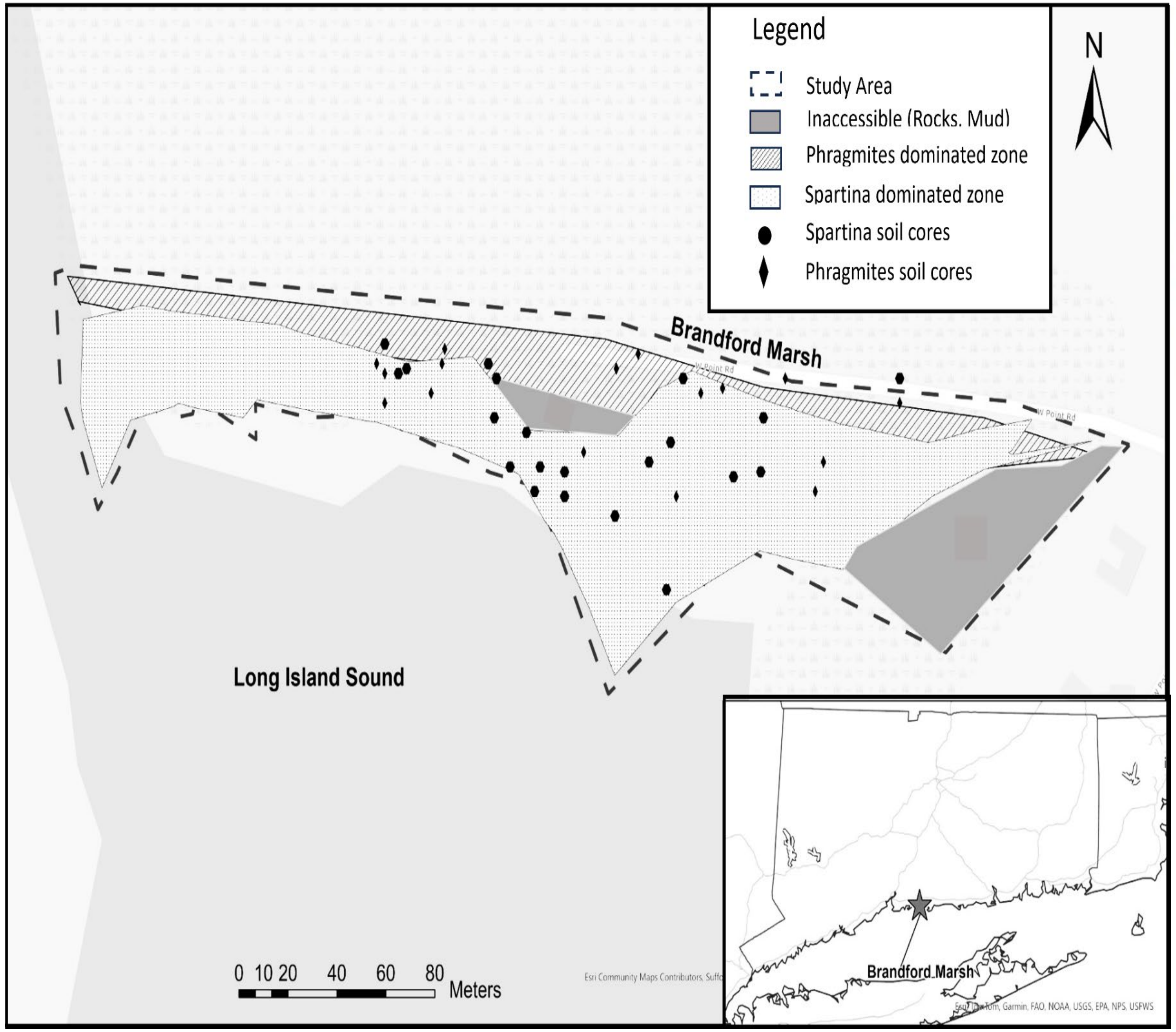
“ To investigate the impact of invasive Phragmites australis on blue carbon sequestration”

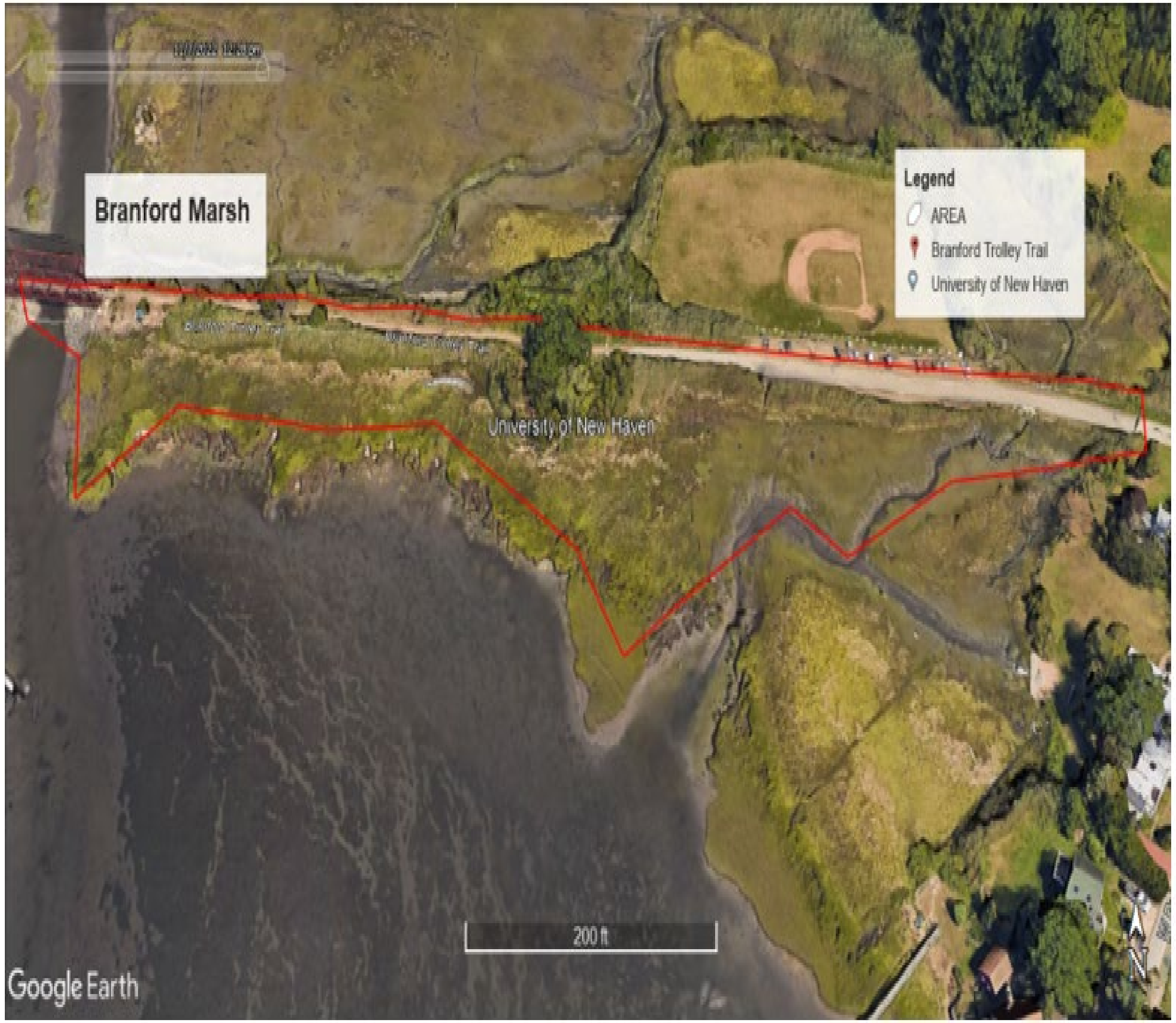
- Relevance to Climate Change
- Hypothesis - "Invasive P. australis enhances salt marsh carbon sequestration."

PHRAGMITES. A

SPARTINA. A

STUDY AREA



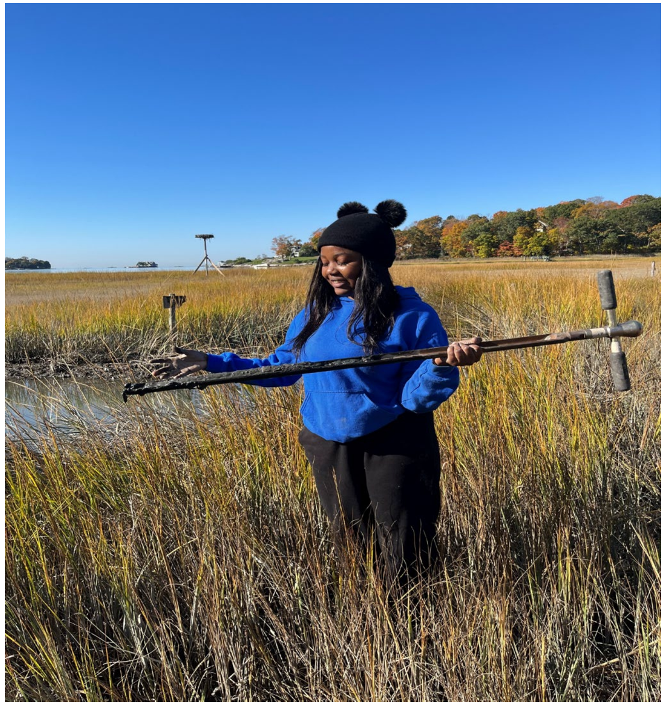


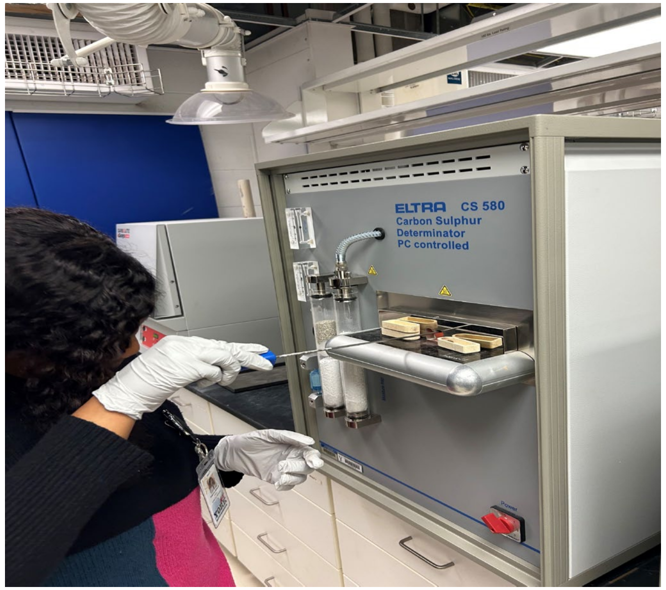
- Caption: The study area located in southern Connecticut (inset) was bounded by moderate human development to the north and the Long Island Sound to the south.

METHODS

The study employed the following methods:

- Stratified Random Sampling: Soil cores collected along 10 transects perpendicular to the shoreline. Transects stratified by dominant plant type (P. australis and S. alterniflora).
- Quadrat Sampling: Three quadrats sampled along each transect, starting at the highest elevation.
- Soil Collection and Transportation: Hand auger used to collect soil samples to 30cm depth. Soil cores cut into 10cm sections, stored in Ziploc® bags, and transported with ice.
- Sample Processing: Samples stored at -20°C until analysis. Thawed, homogenized, and weighed for wet weight. Dried at 60°C for stable weight; re-weighed for dry weight.
- Soil Organic Carbon Analysis: Ground fine dust from dried samples; 200mg sub-sample for standard mass. Analyzed for total organic carbon at Yale Analytical and Stable Isotope Center using Eltra CS580 analyzer.
- Data Analysis: Conducted using Microsoft Excel® and program R (R Core Team 2023, Version 4.1.2).





RESULTS OVERVIEW

- **Sampling**: N= 54 soil.
- **Seasonal Collection:** Samples taken in winter when plant growth had stopped (between October 2022 and February 2023)
- **Plant Biomass:** *P. australis* shorter at study site but still twice as tall as *Spartina spp.*
- **Normality Testing:** Shapiro Wilks test (skewed data) (figure 4).
- **Elevation and Disturbance:** Not statistically significant, reference Table 1 (Kruskal-Wallis test) and figure 1 in next slide.
- **Comparison Between Species**: Mann-Whitney U test showed significant differences in mean wet weights ($P<0.01$), dry weight differences not significant ($P=0.056$) (figure 2).
- **SOC Content:** S. alterniflora had significantly > soil organic carbon (SOC) than P. australis ($P<0.001$) (figure 4).

VISUAL ELEMENTS

		High marsh → Low marsh			Kruskal -Wallis test
		Quadrat 1	Quadrat 2	Quadrat 3	
Wet weight (g)	Both	11.12	11.18	10.67	$\chi^2 = 1.85$, df = 2, P = 0.39
	Phragmites	11.89	11.46	11.48	$\chi^2 = 2.09$, df = 2, P = 0.35
	Spartina	10.36	10.91	9.87	$\chi^2 = 3.37$, df = 2, P = 0.18
Dry weight (g)	Both	6.47	6.43	6.27	$\chi^2 = 0.24$, df = 2, P = 0.89
	Phragmites	7.29	7.11	6.82	$\chi^2 = 0.44$, df = 2, P = 0.80
	Spartina	5.66	5.76	5.72	$\chi^2 = 0.09$, df = 2, P = 0.95
Carbon (%)	Both	4.52	4.3	4.86	$\chi^2 = 0.16$, df = 2, P = 0.92
	Phragmites	3.02	3.35	2.69	$\chi^2 = 0.47$, df = 2, P = 0.79
	Spartina	6.01	5.24	7.04	$\chi^2 = 2.99$, df = 2, P = 0.22

Table 1: Statistical comparisons between quadrats were carried out using a Kruskal-Wallis test.

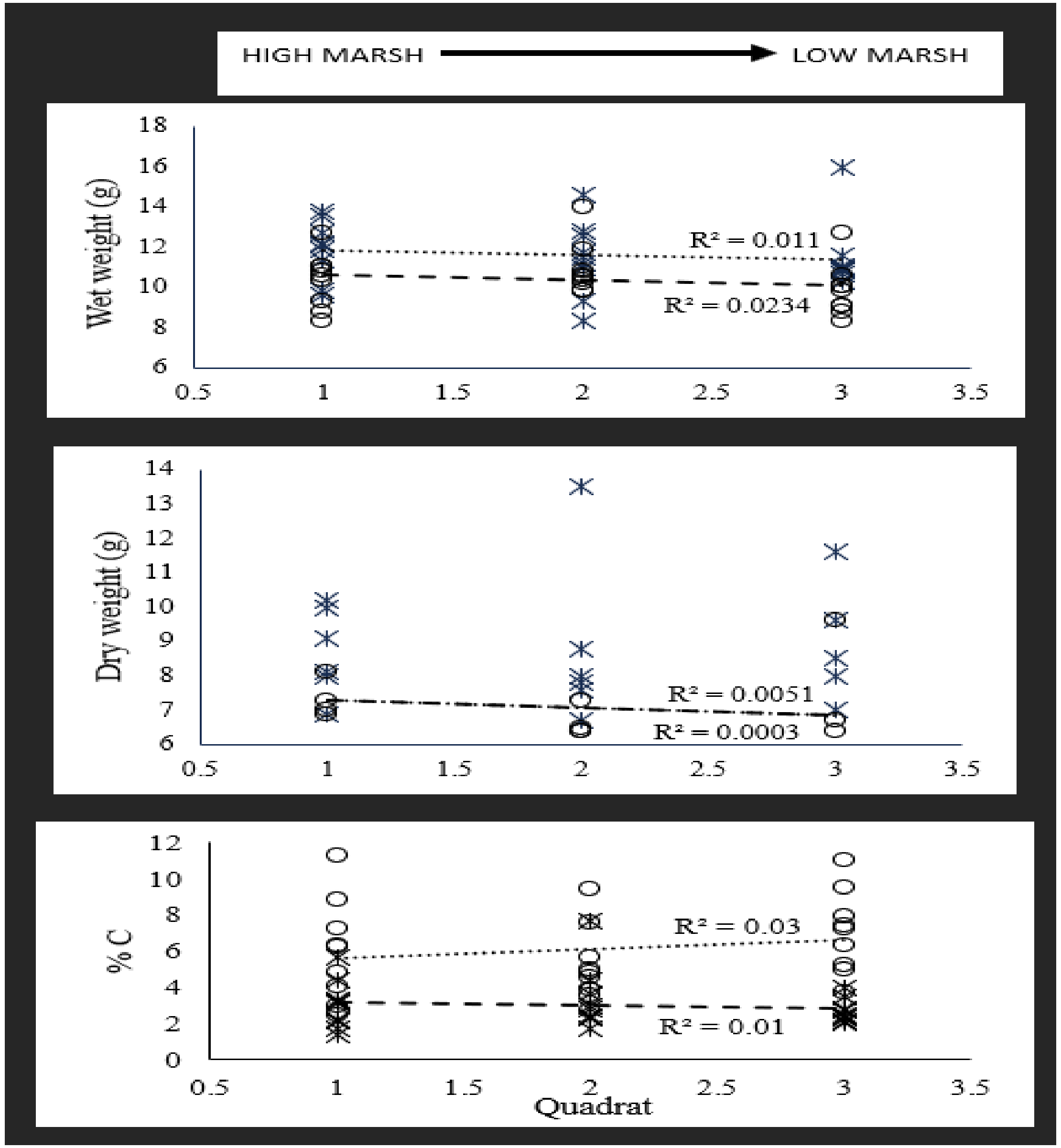


Figure 1: illustrates the trends in wet weight, dry weight, and soil organic carbon along transects from the first to the third plots (Phragmites australis denoted by stars and Spartina alterniflora denoted by open circles). P-values > 0.05

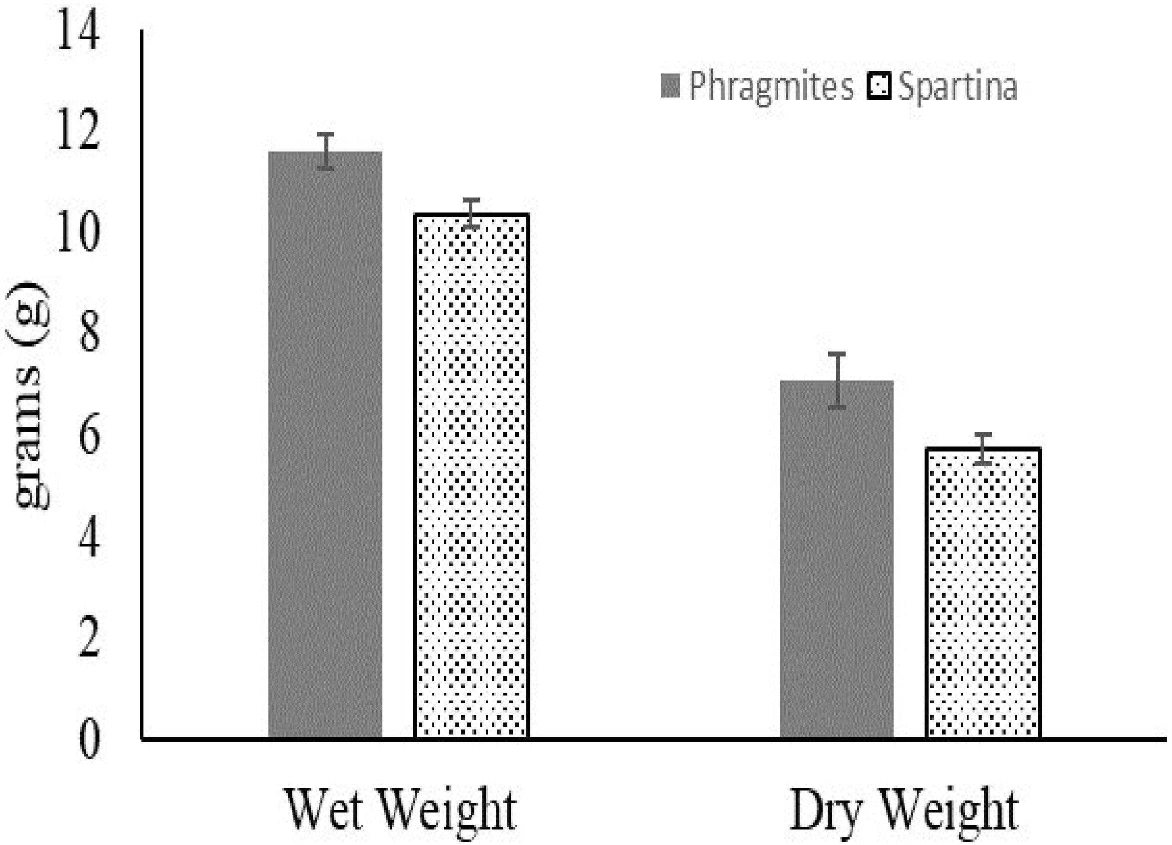


Figure 2 Illustrates the typical wet and dry weights, with standard errors, for soils beneath *Phragmites australis* and *Spartina alterniflora* in a salt marsh in Branford, southern Connecticut, USA. It's noteworthy that there were significant distinctions between the two species (P≤0.05), as determined by the Mann-Whitney U test.

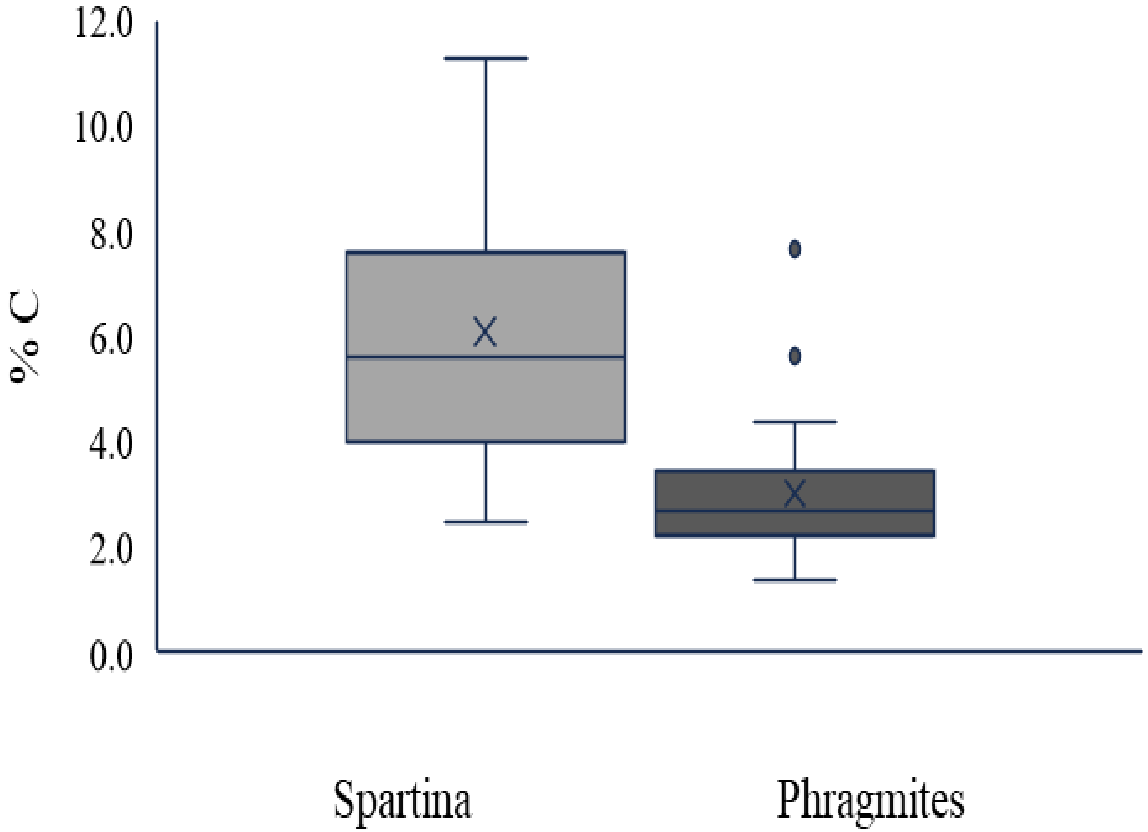


Figure 3 Emphasizes the difference in SOC content between *Spartina alterniflora* and *Phragmites australis.*

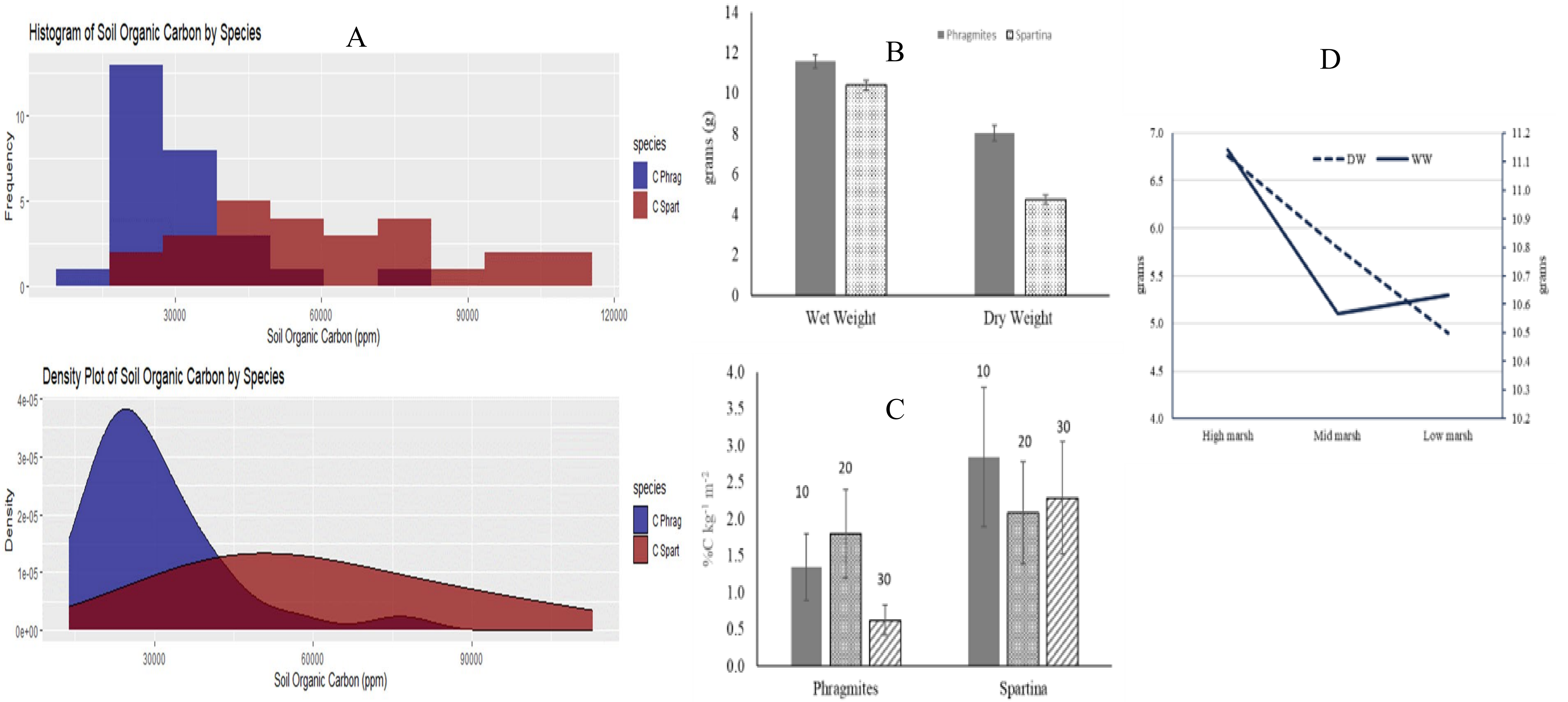


Figure 4. A)The density plot shows how frequently different values of soil organic carbon concentration occur in the dataset,
B)Replica of Figure 2
C) % carbon with depth along the transect between both species
D)Elevation and disturbance: Illustrates the trends in wet weight, dry weight, and soil organic carbon along transects

DISCUSSION POINTS

- **Vegetation Impact on SOC:**

Our findings reveal that *Spartina alterniflora* stores over twice as much carbon in soils compared to *Phragmites australis*. (figure 3).

- **Microbial Decomposition and Soil Carbon Conversion:**

Role of *Phragmites australis* in mineralization of soil carbon (Bernal et al. 2023).

Inverse relationship between plant biomass and soil organic carbon (Terrer et al. (2021)

- **Below-Ground Biomass and Carbon Ratio:**

Spartina alterniflora, despite allocating less biomass to shoots than P. australis, may have greater below-ground biomass, contributing to higher SOC stocks (Ravit et al. 2007).

Carbon ratio in soils under S. alterniflora is greater than under *Phragmites australis*, potentially contributing to increased SOC stocks (Yang et al. 2013).

- **Nutrient Enrichment Impact on SOC:**

Phragmites australis ability to extract deep nitrogen stores due to greater nitrogen demand fuels its invasiveness (Mozder et al. 2023).

Long island sound nutrient enrichment.

- **Ecosystem Management:**

Spartina alterniflora may play a role in protecting regional carbon stocks.

CONCLUSION

- Surprising Findings
- Ecosystem Complexity
- Need for Exploration
- Management Insights
- Scientific Contribution

ACKNOWLEDGEMENT

We express our gratitude to the Connecticut Association of Wetland Scientists for their generous funding support, which made this project possible. Special appreciation goes to J. Ofili, J. Yalamati, J. Aseperi, and I. Otuomagie for their invaluable assistance in field data collection and sample analysis. Lastly, our sincere thanks to D. Mays for providing the initial review and edits for this manuscript.