THE WAVE DISSIPATION POTENTIAL OF *SPARTINA ALTERNIFLORA* IN THE BAY OF FUNDY

NSERC RESNET

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BACKGROUND

Coastal systems and low-lying areas are vulnerable to climate change impacts and sea-level rise. These vulnerable coastal areas are under threat of flooding and erosion which requires sustainable measures to adapt to these impacts. Increasingly, nature-based solutions are being implemented as a response to such events. Coastal ecosystems such as salt marshes can reduce flood risk by attenuating wave energy, but how much was unclear. With more research and field studies on coastal protection, we can learn how to build climate-resilient communities and ecosystems through nature-based adaptation and natural infrastructure solutions.

RESEARCH

This research aimed to determine the wave dissipation potential of salt marsh vegetation in a temperate, hypertidal estuary and learn how plants can reduce wave height as vegetation height increases over time. The research was conducted at Clifton Marsh situated in the Minas Basin, Bay of Fundy, Nova Scotia. This site was selected partly because it is only colonized with *Spartina alterniflora*. We looked at how effective *Spartina alterniflora* is at attenuating wave energy over Neap/Spring tidal cycles and how its wave attenuation capacity varies with varying canopy heights and water depth. Wave characteristics were measured at 5 stations along a transect starting on the unvegetated mudflat and extending 50 m into the marsh.

RESULT

The results of our study show that vegetation height and water depth play an important role in dissipating wave energy and attenuating significant wave heights. When water depths are below 1 meter, vegetation is even more effective in reducing wave heights and energy. For water depths less than 1 m, over 60% of wave energy is dissipated within the first 10 m of the marsh, whereas for water depths greater than 1 m, between 50 and 72 % of the wave energy is dissipated at a much further distance of 50 m. These effects were consistent regardless of what time of year the sampling was done.

Fig 1. Makadunyiswe programming the RBR wave loggers for redeployment; data download at Clifton Marsh, NS.

The presence of vegetation plays a vital role in wave dissipation. Vegetation provides a barrier or supplies bottom friction that dissipates wave energy; however, in some cases, as wave height increases, stem breakage can occur, which reduces wave dissipation. Differences in vegetation density or species composition can also affect wave attenuation. The effectiveness of *Spartina alterniflora* canopy in dissipating wave energy differs depending on relative roughness, which is the proportion of the water column that is occupied by vegetation.

The research outputs show that vegetation affects the wave energy and wave height and affects the attenuation capacity of salt marshes. This research demonstrates that the presence of vegetation on salt marshes plays a vital role in wave dissipation and attenuation. Consequently, our results showed that tall and dense vegetation more effectively dissipates wave energy than shorter or less dense vegetation.

To benefit from the presence of vegetation on salt marshes, it is recommended to promote salt marsh restoration and further investigate the effectiveness of *Spartina alterniflora* in attenuating wave energy under storm conditions or other extreme weather scenarios. The knowledge of the wave dissipation potential of salt marshes presents an opportunity for a cost-effective element of coastal protection schemes. As salt marshes can vertically adapt as the sea level rises, they will continue to play a vital role in coastal defense.

APPLICATION & CONCLUSION

Our research presents an opportunity for salt marshes to be included in quantitative flood risk assessments and adaptive coastal management. When investigating nature-based solutions to flooding, salt marshes can also be incorporated as a component. However, prior to considering them as full alternatives for conventional flood defenses, there is a need to test their probability of failure according to engineering standards. Understanding the wave dissipation potential of salt marshes is essential to help inform designs for marsh restorations and management plans. This study provides a step towards closing the knowledge gap in studies on coastal protection and how to build climate-resilient communities and ecosystems through nature-based adaptation and implementation of natural infrastructure solutions, specifically within the Bay of Fundy.

In the future, there needs to be a better understanding of vegetated intertidal environments and incoming waves to achieve sustainable coastal management and planning.

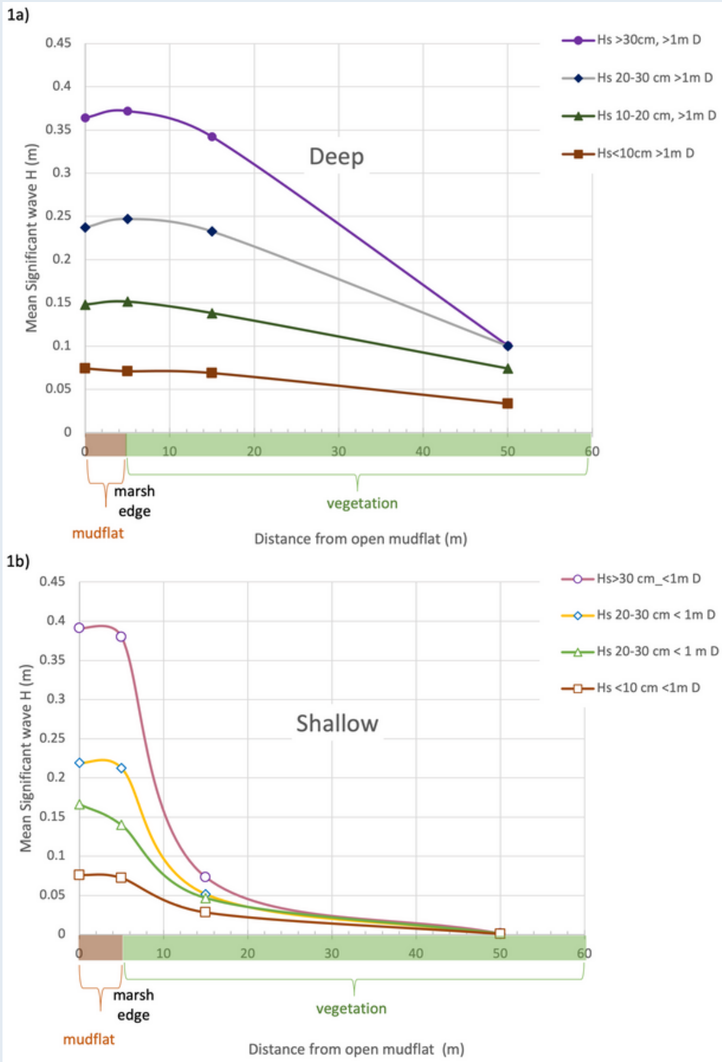

Fig 2. Change in mean significant wave height (Hs) at high tide from RBR1 to RBR4 50 m into the marsh for tides with a) high tide (HT) water depth greater than 1 m and b) HT less than 1 m. (From Figure 4.5 in Honours Thesis, Ngulube 2021)

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