Changes in Plant Biodiversity Due to Saltwater Intrusion

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INTRODUCTION

As seen with the increased damage from hurricanes, sea water rise is already altering landscapes, which will lead to a change in the future of coastal environments[1]. Ecosystems on the coast such as the Dodge Paddock and Beal Preserve (DPBP) are being biologically transformed before our eyes (Fig. 1 & 2), where new species of plants are appearing[2].

In 2015, a restoration effort was undertaken at DPBP. The ultimate goal was to rebalance the freshwater and tidal wetlands, and invasive ridden coastal grassland systems to enhance wildlife habitat, biologically control mosquito populations, and increase water quality, all by restoring the coastal buffer systems. A planting plan was used to restore native wetland and pollinator attracting species, and also accommodated for an increase in extreme precipitation and saltwater intrusion. Based on the initial planting plan (Fig. 7), 405 plants were planted throughout the wetland areas. The most successful plant was *Spartina alterniflora* (Fig. 1). There was a high mortality rate in the first year of plantings for most of the vegetation. But after years of trial and error, there was significant growth throughout the entire marsh of a handful of species like the *Spartina alterniflora.*

Soil salinity continues to be monitored at DPBP to encourage growth of the vegetation. This project investigated how the intrusion of saltwater in Long Island Sound has changed plant diversity at DPBP. After many years of being a favorite spot for locals to play baseball as a large field, DPBP is on its way to becoming a saltwater marsh.

Fig. 1: Salt water that intrudes during high tides and storms. Spartina grass has thrived in the salty soil after being manually planted.

Fig. 2: Aerial view of the preserve after a storm.

MATERIALS AND METHODS

Soil collection

This project was conducted at DPBP in Stonington Borough, Stonington, CT. Soil collection took place from August to November, 2017.

Each month, a soil corer was used to extract samples of soil from 12 locations (Fig 3 & 4). These samples were then taken back to the Mystic Aquarium to dry for 1-2 weeks. Sampling at DPBP required maneuvering around the dominant plant, *Spartina alterniflora.* Seaweed often made its way into the samples.

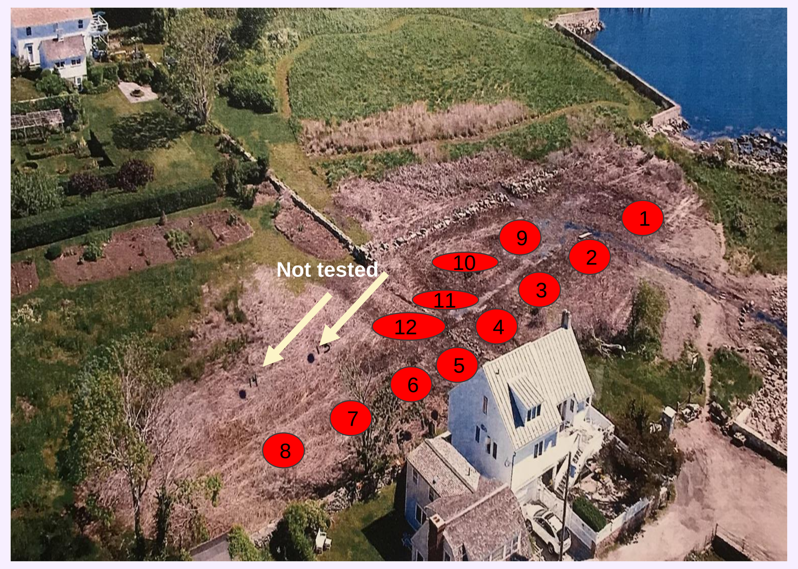


Fig. 3: A map of the preserve showing soil sampling locations

Fig. 4: Kelci (left) and MaryEllen (right) taking a soil sample with the soil corer

Sample Analysis

At the aquarium, salinity tests were conducted on each sample to determine their average salinity. Using a refractometer (Fig. 5 & 6), it measured the change of direction of light as it passed from air to water. Light moves slower in water than air, and the more salt in the water, the slower the light would move.

One part soil was mixed with and five parts water and then filtering to be placed on the refractometer (Fig. 5). The measurements obtained were compiled in a spreadsheet, and the average salinity of each sampling location was calculated and graphed.

Fig. 5 : Soil solution being placed into the refractometer.

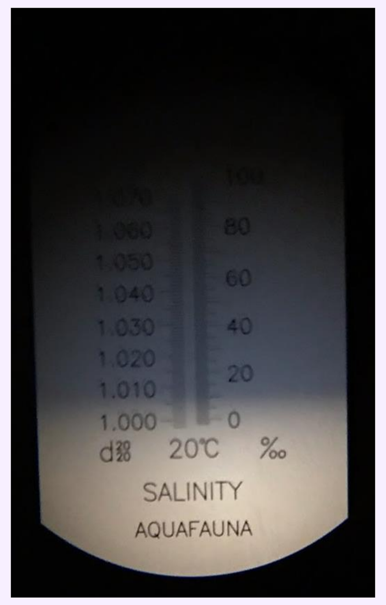
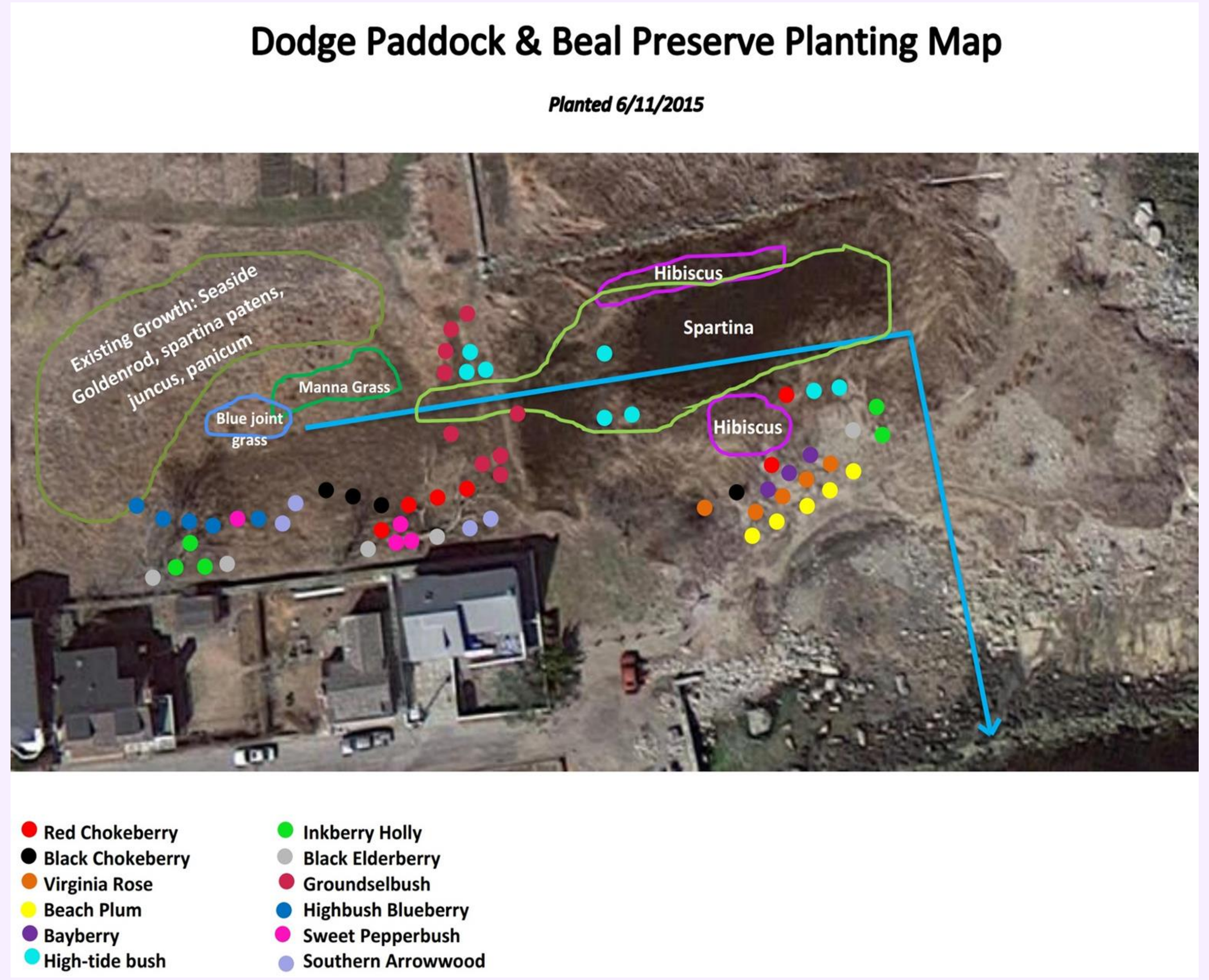


Fig. 6: View through a refractometer.

2015 Planting Map



Restoration efforts in 2015 included a planting plan. All plants were carefully selected, and purposefully placed. By the time this NRCA project began, most of the vegetation originally planted in 2015 had died. There are currently many dead spots, and the amount of still and brackish water present on the preserve increases every year.

Fig. 7: 2015 planting map.

RESULTS

Although not abundant, there is salt present in the soil at DPBP. The areas closer to the channel that flood water flows through are seen to have the highest salinities. Locations 2 and 9 are nearer to the standing water that resides on the preserve, and therefore are the most salty of all the locations. Locations like 7 don't see as much salt water directly, but rather it spreads over the preserve through groundwater.

During my time sampling there were no significantly high tides or storms that would have influenced by data.

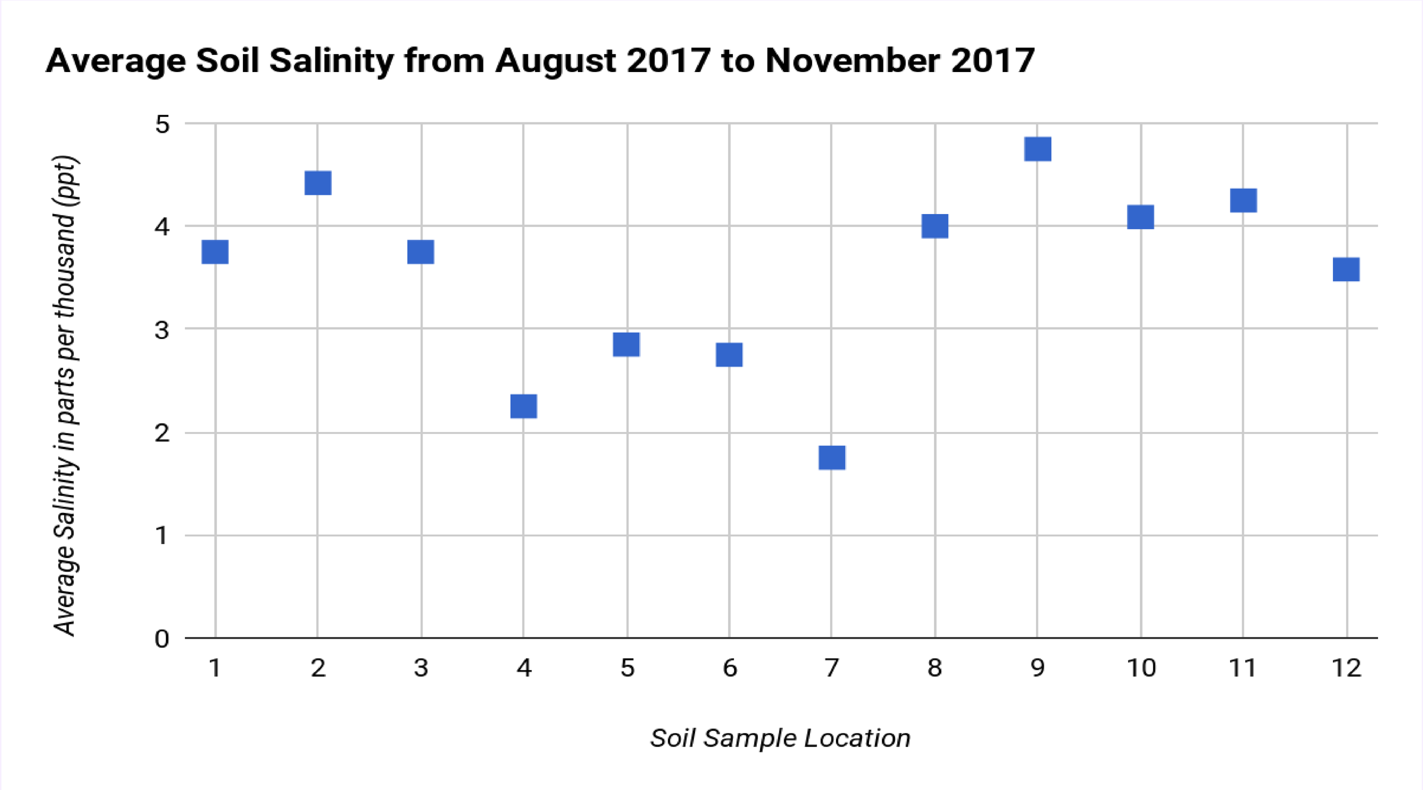


Fig. 8: Average soil salinity at each soil sample location at DPBP.

CONCLUSIONS

The locations with the highest salinities are rightfully those that are closer to the water, and where the water travels into the preserve after a storm or high tide. At these locations there is currently very little existing vegetation. One exception is site 8. Samples may have been improperly collected or mislabeled at this location. Across the preserve, plant biodiversity is lacking, with the most abundant being *Spartina alterniflora* and other plants like the sea pickle *(Salicornia* spp.*)*, which is commonly among the first plants to emerge when a saltwater marsh begins to form[3].

The intrusion of saltwater in DPBP has altered the ecosystem so much, it has changed the vegetation that thrives in it. The salt is creeping further and further inland, and likely will continue.

Studies such as this one helps illustrate the impact of sea level rise on coastal environments. Taking note of these changes is the first step in determining how to preserve coastal vegetation. The creation of salt water marshes also poses human health risks, as the still water can become breeding grounds for mosquitoes which can vector diseases. While there is currently no discernable way to stop the sea level from rising, there are ways to mitigate dramatic coastal changes, beginning with identifying the problem areas and investigating them.

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REFERENCES

[1] Bilskie, M. V., et al. (2014) "Dynamics of Sea Level Rise and Coastal Flooding on a Changing Landscape", Geophysical Research Letters 41, 927-934. http://onlinelibrary.wiley.com/doi/10.1002/2013GL058759/pdf

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