# The Effects of Re-Establishment of Saltwater to Coastal Wetlands


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## ABSTRACT

**Wetlands provide a number of ecosystem services that are vital to the well-being of society. Wetland restoration is critical if a healthy ecosystem function is to be re-established to degraded land. This study was conducted in order to determine the potential implications of tidal flow restoration to wetlands, particularly to understand how restoring saltwater to the area may affect wetland plants and water quality. This study was conducted through the use and analysis of grab samples of water and soil. Water and soil samples were collected to measure salinity (sal.), dissolved oxygen (DO.), temperature (temp.), barometric pressure (barp.), conductivity (cond.), chlorophyll A (ClA), chloride (Cl), sulfate (SO4), and phosphate (PO4). Plant height was measured along with parameters related to plant growth such as air temperature and soil quality. The results showed that the restoration kept the wetland intact, without negatively impacting the quality of the ecosystem.**


**Restored Site**

**Natural Site**


**Fig 1. The aerial map displayed above shows the location of the two testing sites. This map includes the coastlines of the area from 1934 (outlined in blue) and 1965 (outlined in red). This shows how the coastline progressed over time.**

## INTRODUCTION

**Wetlands are vital to the local environment as they provide a number of ecosystem functions and services, such as regulation of water quality, pollution and flooding as well as nutrient transformation of nitrogen and phosphorous (Kentula, 2002). Consequently, disturbance to wetlands can have serious negative impacts on floral and faunal communities, climates, humans, and more.**

**Today, over half of the nation's original 220 million acres of wetlands are significantly disturbed due to sea levels rising and urbanization (Gale, 2003). Wetland biologists have attempted restoration efforts to repair damaged wetland systems. Studies throughout the United States show that wetland restoration has been successful, from the Missouri River to watersheds throughout Cape Cod (Natural Resources Conservation Service, 2008). As such, this experiment was important to examine the effects of wetland restoration on the local environment by comparing a restored saltwater wetland to a natural wetland. This study specifically focuses on how the re-establishment of saltwater to coastal wetlands affects water quality and plant community dynamics.**

**Fig 2. (left) Soil cores being processed and examined onsite.**

**Fig 3. (right) Water samples being filtered for Chlorophyll A and analyzing nutrient concentrations.**

## MATERIAL AND METHODS

### Study Area

- **The sites are located within the Great Meadows Unit of the Stewart B. McKinney National Wildlife Refuge along the border between Stratford and Bridgeport, CT.**
- **The samples were taken from within a ten acre section of the site restored between September 2003 and March 2006. The restored area is located adjacent to industrial buildings and roads.**
- **Identical samples were taken from an unrestored natural wetland area nearby, located further in the woods (Fig. 1).**

### Restoration Process

- ***Phragmites australis,* or Common Reed, an invasive species which had overgrown, was controlled via herbicide application following mulching and cutting of the plant.**
- ***Spartina alterniflora,* commonly known as Smooth Cordgrass, was introduced to the environment when the ground surface level was lowered 4.0 ft. above mean sea level (msl).**
- **Tidal creeks were constructed at 2.0 ft. below msl.**
- **Fill removal lowered the elevation of the area, enhancing tidal flow.**

### Project Sampling

- **Four trips were made to both sites to collect soil, plant, and water samples from August to November of 2015.**
- **3-4 soil cores were collected from different areas of each site and sifted together to homogenize the samples, and large roots and other impurities that would impede the investigation were sifted and extracted onsite (Fig. 2). The contents were later analyzed in a lab for water content, organic matter content, and metal concentrations.**
- **Water samples were taken using a YSI water quality meter, to determine dissolved oxygen, conductivity, temperature, and salinity. Additional grab samples of water were stored in 150 ml. bottles and analyzed for nutrients and metals. These water samples were then filtered using a gf/f glass microfiber filter and analyzed for chlorophyll A (Fig. 3)**
- **Plant height was measured along a 50 meter transect with a 0.25 m² quadrat. Quadrat data were collected at 0, 19.5, and 39.5 meters. The plant height was averaged by collecting the heights of the 5 tallest plants in this square radius. Other observations of plants were made, such as plant species and condition.**
- **Air temperature was also recorded at each sample location using a kestrel meter, along with GPS coordinates that were collected with a Garmin Fortex 401.**

## RESULTS

### Natural Site:

- **The soil in the natural site was 25.54% more moist than the restored site on average, and contained 28.59% more organic matter in the soil.**
- **Throughout the site a fairly wide channel can be seen. The water appeared to be clear, and the channel was simple to spot regardless of tide. The water samples showed that while most parameters tested had similar levels compared to the restored site, chlorophyll A in particular had higher levels (Figs. 4 and 5).**
- **The plants consisted of a large variety of grasses and lush green plants (Fig. 1), such as sea lavender, a coastal flower. The majority of the plant life consisted of short saltwater grasses. There was also abundant wildlife, such as crabs, fish, egrets, swans, and other waterfowl.**

### Restored Site:

- **The soil in this site was fairly low in phosphate compared to the natural site, with 0.1 mg/L compared to the natural 1.3 mg/L. There were low levels of nitrate detected, which could be due to iron interference. Much of the soil was an orange-red color due to high iron levels.**
- **The channel here appeared to be smaller, and was difficult to find the majority of the time. It also appeared fairly murky, and contained low levels of chlorophyll A.**
- **The plant life was different from the natural site, with longer grasses, less diversity, and plants such as *Spartina Alterniflora*, or Saltmeadow Cordgrass. Many of the plants had a browner and sparser appearance in comparison to the lush grasses of the natural site. Much of the area was taken over by the invasive Common Reed as well. This species appears mostly on the outskirts of the marsh, roughly 40 ft. from the channel. The plant heights measured show how both locations have different plants, all with different heights (Fig. 6).**

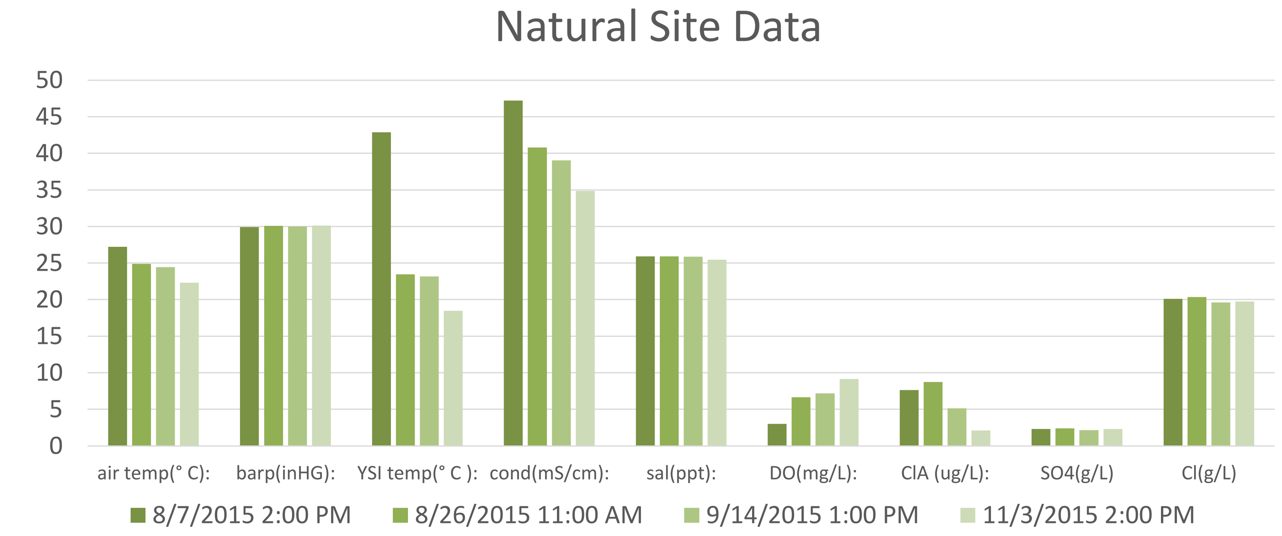


**Fig 4. This graph depicts the data collected from the natural site on all four dates.**

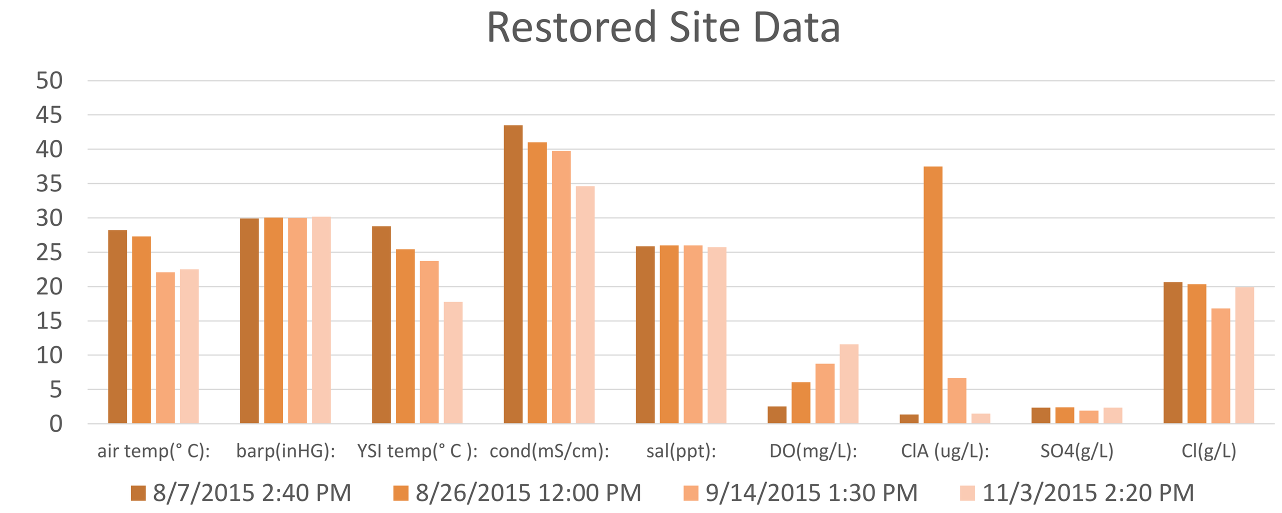


**Fig 5. This graph depicts the data collected from the restored site on all four dates.**

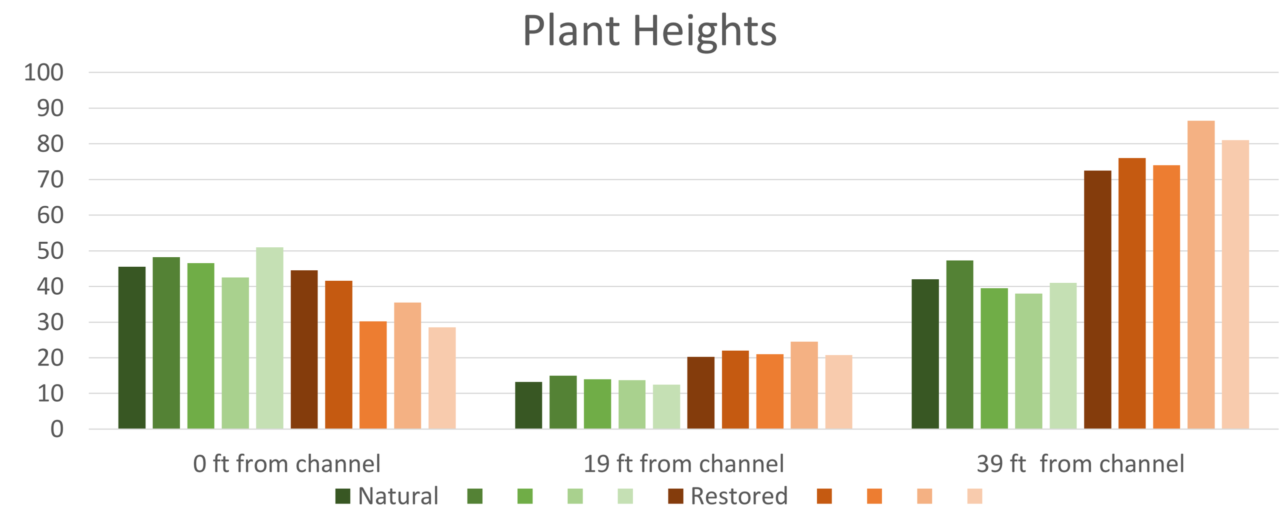


**Fig 6. This graph shows the tallest plant heights in a square meter radius, certain distances from the channel at each sample site.**

## CONCLUSIONS

**This study indicates that in this site, restoration did alter plant community dynamics, as both sites appeared to have entirely different plant life. The natural site contained lush short saltwater grasses and wildflowers. The restored site appeared browner and sparser in plant life. Most of the plants there were tall saltwater and saltmeadow grasses. This would mainly be due to the restoration, which introduced smooth cordgrass to the environment. Another major component of the ecosystem at the restored site is the invasive Common Reed that has taken over some of the site. Despite the differences in the plant community, the water still maintained similar quality, as many nutrients show corresponding trends compared to the natural site (Figs. 4 and 5). Even though at immediate observation the restored site appears more degraded, the data shows that the water and soil quality remain in good condition. The restoration of the Stewart B. McKinney site was a success, according to this study.**


## ACKNOWLEDGEMENTS

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