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Hanna Lloyd
hanna.lloyd@salve.edu

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The Importance of Coastal Wetland Restoration in Old Lyme, CT: The White Sands Beach Salt Marsh Restoration Project

Hanna Lloyd

ENV-350: Natural Resource Management, Salve Regina University

Dr. Jameson Chace

December 10th, 2023

1. Introduction

Coastal wetlands are unique habitats that provide a variety of ecosystem services to the environment and economy of coastal towns. Salt marshes, seagrass beds, freshwater marshes, bogs, and mangrove swamps, are all examples of coastal wetlands (Bilstein et al.,1991). Coastal wetlands are an important natural resource, as they filter toxins from polluted runoff to improve water quality and provide flood protection for coastal communities. Many threatened species of aquatic and terrestrial organisms are endemic to coastal wetlands, making them a biodiverse habitat (Ray, 1991). From an anthropocentric or economic standpoint, coastal wetlands provide endless opportunities for popular recreational activities, such as bird watching, and boating, which provides coastal towns with income from ecotourism (Barbier, 2019). Unfortunately, coastal wetlands are subject to degradation, due to the increasing impact of climate change and industrialization (Narayan et al., 2017).

According to a 2009 study from the US Fish and Wildlife Service, wetlands in coastal watersheds are lost at an average rate of 80,000 acres per year ("National Coastal Wetlands Conservation," 2023). In New England specifically, coastal wetlands are rapidly drying up from widespread droughts, eroding from sea level rise, being overrun by invasive species, or being drained for unsustainable development (Fell et al., 2009). Old Lyme, Connecticut is a New England town that relies heavily on the environmental and economic benefits of wetlands (Ryan & Welchel, 2015). In the last decade however, many of the coastal homes in Old Lyme, such as the summer cottages of White Sands Beach have been threatened by a lack of resilient wetlands surrounding them, and the coastal biodiversity of the town has decreased drastically (Ryan & Welchel, 2015). Multiple successful management plans to restore coastal wetlands in Old Lyme have been implemented with Federal government funding from The National Coastal Wetlands

Conservation Grant Program ("National Coastal Wetlands Conservation Grant Program," 2022). For instance, The White Sands Beach Salt Marsh Restoration Project of 1995 restored over an acre of coastal wetland at White Sands Beach through integrated marsh management strategies, by improving the tidal flow, drainage, water quality, and native biodiversity of the marsh (Kutcher et al., 2018). Thus, the coastal wetlands of Old Lyme must be preserved through integrated marsh management initiatives like the White Sands Beach Salt Marsh Restoration Project because coastal wetlands promote biodiversity and provide regulating services that benefit the environment and coastal economy of Old Lyme.

2. Background

A. Economic Benefits

Healthy wetlands generate billions of dollars annually through coastal tourism and recreational activities such as observing wildlife, hiking, and fishing. More than a third of all U.S. adults hunt, fish, bird watch, or photograph wildlife found in natural wetlands (NOAA Fisheries, 2022). Payments for yearly hunting, fishing, and boating licenses finance wetland maintenance. Photography classes, fishing competitions, and kayak tours, for example, boost the coastal economies as well (NOAA Fisheries, 2022). Visitors to beaches and coastal habitats are a major economic driver for coastal communities, supporting substantial revenue and job growth (NOAA Fisheries, 2022). Additionally, "By providing spawning grounds, food, and refuge for young fish, wetlands support a robust recreational fishing industry. In 2018, anglers generated more than 72 billion dollars in sales impact and supported 470,000 U.S. jobs" (NOAA Fisheries, 2022).

B. Environmental Benefits

Coastal wetlands are some of the most productive ecosystems on Earth as they increase biodiversity by serving as a habitat for juvenile striped bass, crabs, lobsters, oysters, etc., which not only creates a diverse ecosystem but supports commercially harvested seafood for sustainable fisheries (Tiner, 1989). The salt grass that grows in coastal salt marshes on the East Coast provides protection and nesting materials for the endangered saltmarsh sparrow, and freshwater marshes are home to a variety of amphibians and insects, making them a unique habitat that is essential to preserving biodiversity in the environment (Tiner, 1989).

While the physical beauty and aesthetic value of coastal wetlands are hardly overlooked, many people are unaware of the natural benefits and ecosystem services that coastal wetlands are constantly providing. Coastal wetlands support regulating services, which impact our day-to-day lives. A regulating service is the benefit provided by ecosystem processes that moderate natural phenomena (Environmental Protection Agency, 2023). Regulating services include water purification, erosion and flood control, carbon storage, and climate regulation, all of which coastal wetlands do naturally (Costanza et al., 2008).

For instance, wetlands act as natural water purifiers, filtering sediment and absorbing toxins. The roots of wetland plants filter runoff from developed areas or farms by absorbing nitrogen and phosphorus (Environmental Protection Agency, 2023). This natural water filtration helps maintain healthy water bodies that make up the surrounding watershed. Wetlands also provide flood and storm protection as part of a regulating service. Coastal wetlands absorb and temporarily hold back floodwaters, which slows the rate of that water entering rivers or streams, and in turn, reduces the severity of downstream flooding and erosion. Consequently, coastal wetlands can lower overall flood levels, protecting people and infrastructure from devastating flood damages and saving vulnerable coastal communities 23 billion dollars in repair costs each

year (Blankespoor et al., 2014). Furthermore, salt marshes, seagrass beds, and mangroves specifically, are vital to reducing the impacts of climate change by removing greenhouse gases like carbon dioxide from the atmosphere and storing them in plants and the soils (NOAA Fisheries, 2022). These natural carbon sinks are known collectively as "blue carbon" ecosystems, as they store roughly 50% of all carbon known to be buried in global ocean sediments (NOAA Fisheries, 2022).

3. Methods/Study

The natural, economic, and environmental benefits of coastal wetlands are numerous, and yet, coastal wetlands are rapidly degrading due to a variety of factors. In Connecticut specifically, the town of Old Lyme and the Connecticut Department of Environmental Protection have been working to restore and protect the White Sands Beach Salt marsh from degradation (CT DEP, 2000). White Sands Beach is located in southeastern Connecticut on the Long Island Sound coastline and borders the Connecticut River estuary. This neighborhood and beach are man-made and sit atop a partially filled salt marsh. The five-acre marsh is separated from Long Island Sound by a 200-300-yard-wide barrier beach and was connected to the Sound's salt water by a tidal creek and an underground culvert (CT DEP, 2000). Like many salt marshes in this area, the White Sands Beach marsh is surrounded by summer cottages, which were built on a barrier beach that isolates the marsh from the sound (CT DEP, 2000).

While this marsh may be small, it still provides many of the beneficial ecosystem functions associated with tidal wetlands for Old Lyme, such as a refuge area for the endangered shorebird, the Piping Plover (*Charadrius melodus*), and shoreline stabilization through buffering wave energy, making it an important resource to protect (Haig, 1983). Unfortunately, the residential development on White Sands Beach disconnected the salt marsh from Long Island

Sound, by blocking off the natural tidal creek where salt water entered, and freshwater exited the marsh system (CT DEP, 2000). The development also led to the wetlands being filled, and the natural creek was altered to pass through a culvert and tide gate, which was used to drain the marsh during the summer to prevent mosquito breeding (CT DEP, 2000). These construction projects altered the natural processes of the salt marsh as reduced tidal flow lowered the salt content of the soil and the water table (CT DEP, 2000). The lower water table caused accelerated soil decomposition, and the release of dilute sulfuric acid, causing the salt marsh waters to be inhospitable for aquatic organisms (CT DEP, 2000). Additionally, the reduced salinity allowed for the marsh vegetation to become dominated by the non-native, invasive *Phragmites australis* or the common reed (CT DEP, 2000). Phragmites can outcompete native plant species, which reduces wildlife diversity, and dead shoots of Phragmites are considered fire hazards during warmer months. "Other problems associated with the restricted flow of freshwater out of the marsh system included reduced access to the marsh by fish that feed on mosquito larvae, and periodic backwater flooding of several neighboring properties" (CT DEP, 2000).

4. Results & Solutions

The solution in response to the quickly degrading salt marsh was the creation of the White Sands Beach Salt Marsh Restoration Project in 1995, which implemented integrated marsh management strategies. The goal of this restoration project was to increase the flow of saltwater into the marsh from Long Island Sound and allow freshwater to flow out of the marsh, increasing the salinity levels, and as a result, reducing Phragmites growth (CT DEP, 2000). To increase this flow, the CT DEP Wildlife Division's Wetland Habitat and Mosquito Management Program (WHAMM) implemented a restoration plan in which the altered tidal creek and the existing 18-inch diameter, 70-foot-long culvert and broken tide gate that connected the marsh

with Long Island Sound were replaced with a 24-inch diameter, 120-foot long culvert (CT DEP, 2000). In addition, the tidal creek channels were cleared of debris and excess sediment (CT DEP, 2000). This plan was designed based on the previous usage of mosquito ditches/runnels to increase water flow and prevent mosquito breeding in stagnant marsh water. The restoration project was completed after two years in 1997 and the integrated marsh management techniques proved to be a success, as native plants were able to re-colonize the area, the pollutant-removal capacity of the marsh was improved, and flooding of the neighboring residences was stopped entirely (CT DEP, 2000).

Today, the White Sands Beach salt marsh remains healthy and resilient and serves as a "living classroom" for local elementary schools, with signage and photos describing the environmental benefits of the project (CT DEP, 2000). In the end, the White Sands Beach Salt Marsh Restoration Project restored over an acre of open saltwater wetlands in Old Lyme and improved the resiliency and natural functioning of the White Sands Beach salt marsh, preserving the biodiversity and encouraging the Long Island Sound Habitat Restoration Strategy goal which restored 2,000 acres of coastal wetland habitat in 2010 (CT DEP, 2000). The project cost a total of $15,000 including a $9,000 grant from the EPA Clean Water Act, and $6,000 from the CT DEP (CT DEP, 2000).

5. Discussion

Successful restoration projects like the White Sands Beach Salt Marsh Restoration Project are important because they aid in restoring and preserving one of the most beneficial natural resources. Encouraging tidal flow in coastal wetlands maintains the health of the ecosystem, which increases the biodiversity and ecosystem services in towns such as Old Lyme. The positive results of these projects also promote funding for future coastal wetland restoration

initiatives in the area. Currently, the White Sands Beach salt marsh and other coastal wetlands in Old Lyme are being protected by the Old Lyme Inland Wetlands and Watercourses Commission, and funding for wetland restoration in Long Island Sound is actively granted by the EPA Clean Water Act, The National Coastal Wetlands Conservation Grant Program, and by the CT DEP Coves and Embayment Programs (Inland Wetlands Commission, 2023).

A. Drawbacks of Integrated Marsh Management

While the White Sands Beach Salt Marsh Restoration Project integrated marsh management techniques are actively being applied to degrading wetlands in Old Lyme, there are still information gaps and a lack of resources impeding restoration plans from reaching their goal of systematically maintaining or restoring the ecosystem functions and services of coastal wetlands in Connecticut. Furthermore, many of the aforementioned techniques of integrated marsh management can have negative impacts on the health of the wetlands if the restoration site is not properly studied, such as increasing nutrient levels in marsh water due to herbicide treatment on Phragmites, resulting in harmful algal blooms (Anderson, et al., 2002). Thus, the main coastal wetland restoration strategies in Old Lyme are still experimental, and their possible, detrimental effects have not been outweighed.

B. Restoration Knowledge Gaps

Understanding the benefits and drawbacks of wetland restoration is crucial to forming new strategies that are more effective in managing this natural resource. In the case of Old Lyme coastal wetland management, knowledge gaps about the resiliency of coastal wetlands are a major concern to future actions in restoration. In an effort to close these knowledge gaps and maintain and enhance the remaining wetlands in Old Lyme, many opportunities are available in both the government and private sectors.

Government management options include increasing wetland acquisition in vulnerable areas, increasing public awareness of wetland values and the status of wetlands through various media and environmental education programs, removing government subsidies for wetland drainage, improving surveillance and enforcement programs, providing tax incentives to private landowners to encourage wetland preservation, etc. (Tiner, 1989). Conversely, private management options include, rather than draining or filling wetlands, seeking environmentally compatible alternatives for those areas such as timber harvest, constructing ponds in upland areas, and managing them for wetland aquatic species, encouraging the purchasing of Federal and State duck stamps which support wetland acquisition, etc. (Tiner, 1989). Implementing these strategies for vulnerable coastal wetlands in Old Lyme, Connecticut would yield more effective and efficient results in natural resource management. Additionally, despite its success in restoring the resiliency of the salt marsh, the strategies of the White Sands Beach Salt Marsh Restoration Project must be personalized to the needs of other degrading coastal wetlands in Old Lyme and are not universally applicable. Overall, public, and private cooperation is needed to secure a promising future for the remaining wetlands of Connecticut. As competition for wetlands between development and environmental interests increases, methods of achieving economic growth while minimizing adverse environmental impacts are key to preserving the biodiversity of wetlands for future generations to enjoy.

6. Conclusion

In conclusion, the coastal wetlands of Old Lyme, Connecticut, such as the White Sands Beach salt marsh are unique habitats that help sustain the biodiversity and economy of these towns. Coastal wetlands, like the White Sands Beach Salt Marsh provide regulating services that benefit our daily lives and the environment around us, including flood and wave protection.

Coastal wetlands also attract ecotourists, serving as a form of recreation which in turn boosts coastal economies. Yet, the threats of climate change, residential development, and invasive species are not only actively degrading wetlands, but also the biodiversity and economy of coastal towns like Old Lyme. Wetland restoration plans in the last decade have been effective at protecting said wetlands using integrated marsh management strategies such as digging runnels and fill/sediment removal. The success of the White Sands Beach Salt Marsh Restoration Project serves as a resource for future integrated marsh management projects that can be applied throughout New England. However, knowledge gaps on the impact of these restoration strategies still lessen their effectiveness. Encouraging management options through the government and private sector can remove knowledge gaps, aid in spreading awareness about disappearing coastal wetlands, and provide increased funding and regulations. The protection of coastal wetlands in New England, specifically at White Sands Beach, does not only concern coastal property owners and beachgoers, but any resident of Connecticut who interacts with Long Island Sound and the Connecticut River. Coastal wetland degradation is an ongoing issue that impacts all New England residents. If coastal wetland protection does not continue to increase, the valuable natural resources of Old Lyme and many other regions will be permanently lost.

Peer Reviewed and Edited by:
Savannah Szamborski
Grady Provost
Ashley Caputo
Salve Regina University, Natural Resource Management, 2023

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