# Spatial Analysis of the Area Loss of Saltmarshes Located in Barnegat Bay, NJ

Morgan Zylinski, Marine Academy of Technology and Environmental Science

## Abstract

In this study, five saltmarshes located in Barnegat Bay, NJ were analyzed using spatial imagery and ArcGIS editing tools, in order to create estimates on how the saltmarshes have lost area over the years. Environmental and human-induced triggers through climate change, sea level rise, and human development around the Barnegat Bay is causing the further detachment of saltmarshes from mainland sources. The saltmarshes in this research are classified as pocket marshes, which were initially disconnected from the mainland. The goal of this research was to analyze the area loss of the pocket marshes since they are under more stress from the environment compared to regular connected saltmarshes. After digitizing the saltmarshes using four different years of spatial imagery, it was determined that each marsh exhibited area loss over the decades of time, likely due to the increasing environmental pressures from the Barnegat Bay ecosystem. The continued monitoring of our saltmarshes is necessary to examine the effects of climate change, as we need to preserve our tidal wetlands so they can continue to protect the coastal shoreline.

**Figure 1**: Barnegat Bay saltmarsh exhibiting erosion. Credit: Pinelands Preservation Alliance.

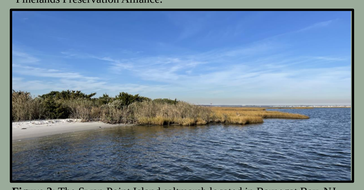

**Figure 2**: The Swan Point Island saltmarsh located in Barnegat Bay, NJ in 2022.

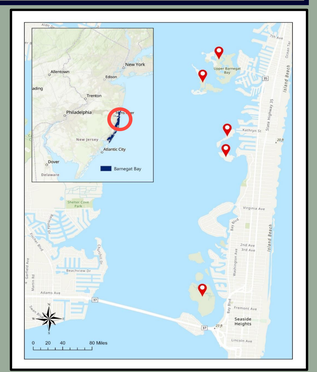


**Figure 3**: Map of the saltmarsh locations in Barnegat Bay, NJ. Locations from north to south include Middle Sedge, Marsh Elder Island, Little Sedge Island, Swan Point Island, and Mikes Island.

## Introduction

Saltmarshes are one of the most productive and diverse ecosystems, providing vital habitat and nurseries for coastal plant, animal, and bird species. Saltmarshes absorb large amounts of greenhouse gas carbon dioxide and have the ability to sequester it for hundreds of thousands of years (NOAA, n.d.). However, environmental and human-induced triggers through climate change, sea level rise, and extreme weather events can degrade saltmarshes, contributing to their loss (Wang et al., 2022). Due to this erosion and development, the area loss of salt marshes is increasing, causing the further detachment of saltmarshes from mainland sources (Golden, 2021). Further loss of saltmarshes also increases the emissions of carbon dioxide, methane, and other pollutants into the atmosphere (Cawdrey and NASA, 2022). An increase of urban development and nutrient runoff also contribute to the loss and further pollution of salt marshes located in fragile watersheds (Spencer, 2020). Pocket marshes, disconnected from tidal flow due to development, could be placed under more stress due to the high levels of development around them.

## Methodology

1. Spatial data layers were downloaded from the NJ GIN site, collecting New Jersey layers from 1930, 1980, 2006, and 2020.
2. All saltmarshes were digitized in each layer using ArcGIS create and modifying tools. New feature classes were made in the geodatabase for each saltmarsh per year.
3. After the saltmarshes were digitized, the area of the polygons were created and accessed though the layer attribute table. Area is recorded in square feet.

**Figure 4:** Selection of the digitized polygon of Mikes Island located in Barnegat Bay, NJ. (1980)

**Figure 5:** Selection of the digitized polygon of Little Sedge Island located in Barnegat Bay, NJ. (1980)

## Objective

The objective of this research is to digitize the areas of saltmarshes within the Barnegat Bay using ArcGIS and spatial imagery, and to determine the rates of their area loss.

## Results

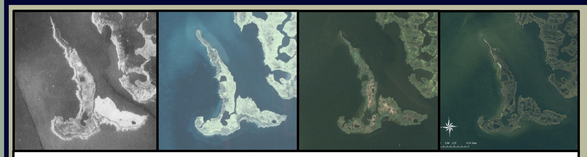

**Figure 6:** Spatial comparison of the Marsh Elder Island saltmarsh in Barnegat Bay, NJ from (left to right) 1930, 1980, 2006, and 2020. The map visually displays the area loss over time.

**Figure 7:** Spatial comparison of the Mikes Island saltmarsh in Barnegat Bay, NJ from (left to right) 1930, 1980, 2006, and 2020. The map visually displays the area loss over time.

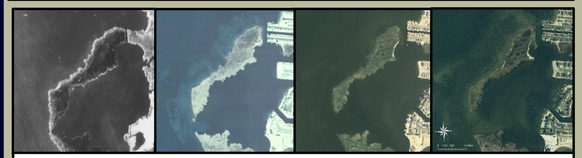

**Figure 8:** Spatial comparison of the Little Sedge Island saltmarsh from (left to right) 1930, 1980, 2006, and 2020. The map visually displays the area loss over time.

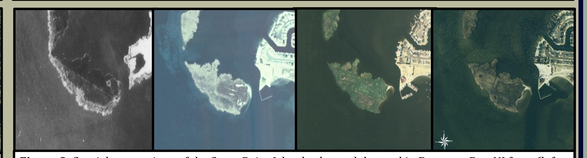

**Figure 9:** Spatial comparison of the Swan Point Island saltmarsh located in Barnegat Bay, NJ from (left to right) 1930, 1980, 2006, and 2020. The map visually displays the area loss over time.

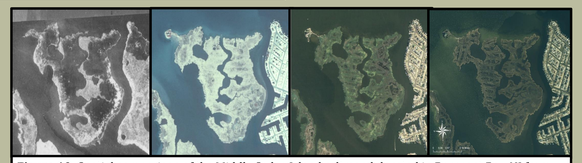

**Figure 10:** Spatial comparison of the Middle Sedge Island saltmarsh located in Barnegat Bay, NJ from (left to right) 1930, 1980, 2006, and 2020. The map visually displays the area loss over time.

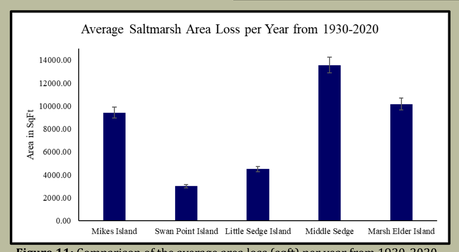


**Figure 11:** Comparison of the average area loss (sqft) per year from 1930-2020 in all analyzed saltmarshes.

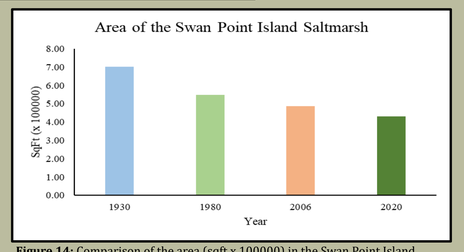


**Figure 14:** Comparison of the area (sqft x 100000) in the Swan Point Island saltmarsh from 1930, 1980, 2006, and 2020.

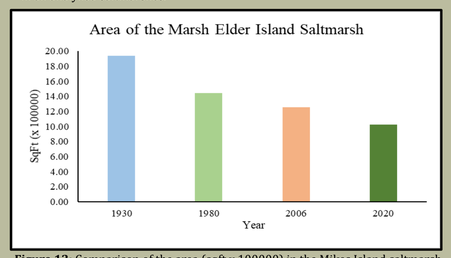


**Figure 12:** Comparison of the area (sqft x 100000) in the Mikes Island saltmarsh from 1930, 1980, 2006, and 2020.

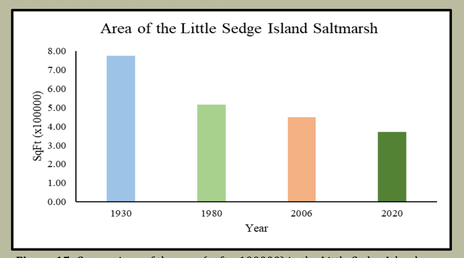


**Figure 15:** Comparison of the area (sqft x 100000) in the Little Sedge Island saltmarsh from 1930, 1980, 2006, and 2020.

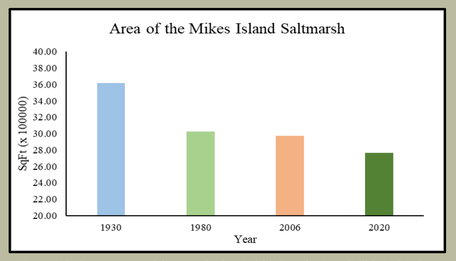


**Figure 13:** Comparison of the area (sqft x 100000) in the Marsh Elder Island from 1930, 1980, 2006, and 2020.

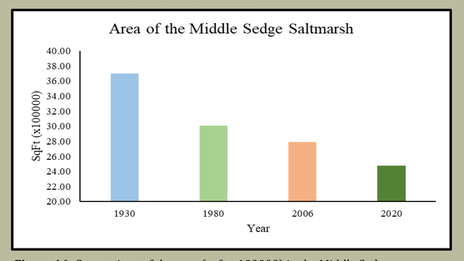


**Figure 16:** Comparison of the area (sqft x 100000) in the Middle Sedge saltmarsh from 1930, 1980, 2006, and 2020.

## Discussion

In the results (**Figure 11**), it is determined that all saltmarshes had experienced severe area loss from 1930 to 2022. Mikes Island decreased a total of 9,400 sqft, Swan Point Island decreased a total of 3,000 sqft, Little Sedge island decreased 4500 sqft, Middle Sedge decreased 13500 sqft, and Marsh Elder Island decreased 10,000 sqft. These increasing rates of saltmarsh area loss are a product of our weakening saltmarshes, as they are constantly placed under stress due to storms, wind/wave energy, human pollution, and well as environmental stresses. Additional factors which led to the loss include excavations for mosquito control, edge erosion, and ponding (Krause et al., 2023). Current observations of the Barnegat Bay has shown sea levels are rising at the rate of 16 inches per century, 4mm per year (Barnegat Bay Partnership, n.d. ). This rise in sea level is transforming the biogeochemical properties of the saltmarshes and creating large-scale tidal wetland loss. Harmful pollution from impervious surface runoff, are also directly affecting the health of Barnegat Bay and its watershed, contributing to the loss of wetlands. As saltmarshes serve as buffers for our coastlines, its necessary to stop developing into the marsh area, and to work to conserve our coastal wetlands.

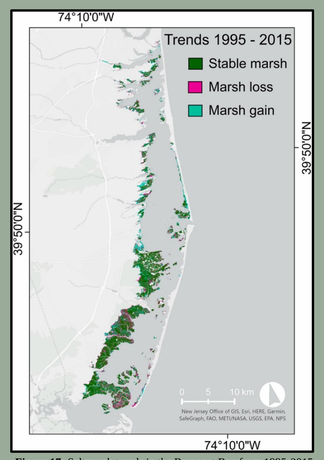


**Figure 17:** Saltmarsh trends in the Barnegat Bay from 1995-2015. (Credit: Krause et al., 2023).

**Figure 18:** Top: mosquito ditches within a saltmarsh in Barnegat Bay, NJ (Credit: Bonnie Delaney). Bottom: Example of storm and wind energy in Barnegat Bay, NJ (Credit: Flickr, "Shore Bound").

## Conclusion

In conclusion, its important to continue to monitor the area loss of saltmarshes in the Barnegat Bay because they serve as important coastal buffers, and the increasing effects of climate change and human development will increase the effects of sea level rise and loss of our tidal wetlands

## Acknowledgements

I would most importantly like to thank Mr. Kelsey and MATES for providing me with the resources and ability to use ArcGIS, and to apply its functions and resources within my environment.

## Selected References

Cawdrey, K., & NASA. (2022, December 22). *NASA scientists map global salt marsh losses and their carbon impact*. Phys.org. https://phys.org/news/2022-12-nasa-scientists-global-salt-marsh.html

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Wang, J.-J., Li, X.-Z., Lin, S.-W., & Ma, Y.-X. (2022). Economic Evaluation and Systematic Review of Salt Marsh Restoration Projects at a Global Scale. *Frontiers in Ecology and Evolution*, *10*. https://doi.org/10.3389/fevo.2022.865516