
Photo credit: Chris Peter

Synthesizing Monitoring Data to Improve Coastal Wetland Management across New England

Project Location

New England

Project Duration

October 2018 to November 2019

Project Lead

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Project Type

Catalyst – Targeted investment for advancing collaborative science

Products

- How to guides to synthesize marsh monitoring data and integrate plant cover data from two common monitoring methods
- Regional salt marsh data packages and data report
- Final workshop presentation

Project Partners

- Great Bay National Estuarine Research Reserve
- Narragansett Bay National Estuarine Research Reserve
- Waquoit Bay National Estuarine Research Reserve
- Wells National Estuarine Research Reserve

Project Webpage

nerrssciencecollaborative.org/project/Burdick18

Overview

Sea level rise and climate change present major threats to salt marshes across the continental United States. A better understanding of their impacts on marsh vegetation and sediment accretion can help coastal managers improve the management, protection, and restoration of these important ecosystems. Since 2011, the National Estuarine Research Reserve System has been monitoring salt marsh vegetation and elevation changes through the Sentinel Site Application Module. This project conducted the first regional synthesis of Sentinel Site data for four New England reserves (Great Bay, Narragansett, Waquoit Bay, and Wells). It developed statistics-ready data packages linking vegetation change with elevation, inundation, tide range, and other factors. The project team provided recommendations to improve sentinel site protocol and established a methodology for analysis of marsh conditions that can be used by other national estuarine research reserves and coastal managers nationwide. The project's analysis revealed trends in New England salt marsh elevation and vegetation changes over time that are being used to inform regional salt marsh management and conservation.

Project Approach

A stakeholder group, including over 30 regional researchers and managers, was engaged from the project's outset to shape research questions and inform approaches to data collection and analysis. With input from this group, the project team designed a statistical analysis focused on understanding changes in marsh elevation and plant communities from year to year, over the long term, and in salt marshes of different tide ranges.

The project team began by combining sentinel site salt marsh monitoring data from the four participating New England National Estuarine Research Reserves collected from 2010 to 2017. The team reformatted data to produce vegetation and surface elevation data that were compatible across the four reserves, with identical formatting, species names, species abundance metrics, and initial marsh zone (habitat) designations. When methodological differences could not be reconciled, data were retained in reserve-specific data sets, but excluded from the regional analysis. The team then analyzed

monitoring data using multiple tiers of increasing complexity: graphical analysis, univariate statistics, inundation modeling, and multivariate statistics. Pie charts were used to show simple visualizations of plant community changes from 2010 to 2017. A univariate statistical analysis using Analysis of Covariance (ANCOVA) looked at plant species and cover type over time. Inundation modeling examined the effect of tidal flooding on salt marsh vegetation distribution across marsh elevations over time. Finally, a multivariate statistical analysis using non-metric multidimensional scaling, analysis of similarity, and contributions to similarity analysis from the Plymouth Routines in Multivariate Ecological Research (PRIMER) statistics package was used to understand vegetation variations and trends with respect to marsh zone (low or high marsh), tide range, and inundation. Each reserve was provided with their data in a common format following quality assurance/quality control suitable for statistical analyses, and the project team developed a guide to synthesize sentinel site data that described the process to check, correct, format, combine, summarize, and analyze data.

Results

The project produced a detailed analysis of changes to salt marsh at each of the four participating New England national estuarine research reserves, as well as a report describing regional trends. A few highlights are discussed here.

The findings indicate that throughout New England, salt marsh is shifting toward wetter plant communities. From 2010 to 2017, low marsh areas lost plant cover and had more bare areas and standing water. High marsh areas increasingly looked like low marsh over time, with less perennial grass cover and an increasing abundance of Sporobolus alterniflora compared to Spartina patens. Marshes with small tidal ranges, such as those in Rhode Island and the southern shore of Cape Cod, experienced the most dramatic vegetation changes. Marshes behaved differently over time as a result of habitat type and plant species. Year-to-year variation in cover of specific or total marsh plants was small enough to allow the identification of long-term trends. At the same time, marsh elevation increased, but many marshes did not build fast enough to keep up with sea level rise. Results from inundation modeling supported these findings, suggesting that inundation due to sea level rise is a key driver of vegetation shifts and losses at lower elevations.

The project team also produced recommendations to guide future data collection and recording at national estuarine research reserves and other salt marsh monitoring sites. These include suggestions for particular methods of assessing plant cover, and frequency of data collection to enable analysis of interannual variation in plant communities.

Benefits

- Reserves gained new information about marsh vegetation changes through project's visual outputs and reports that can be used for planning, management, and education.
- The project compared salt marsh data collection methodologies across reserves, leading to changes in monitoring practices and addition of new types of data being collected at some reserves.
- Data was made more accessible for individual reserve managers and multi-reserve comparisons by helping reserves streamline their marsh vegetation data into a well-designed format complete with metadata.

What's Next

- This project complemented parallel efforts to improve marsh monitoring data within the National Estuarine Research Reserve System and the National Oceanic and Atmospheric Administration's Office for Coastal Management. To continue and expand their work, the project team has joined with colleagues from 17 other reserves to develop a newly funded proposal that will enable a national synthesis of biomonitoring data through the development of R scripts.
- Results from the New England reserves are being synthesized for publications in scientific journals.
- New England reserves are using the new data set templates provided by this project and many have adopted recommended best practices, leading toward better regional collaboration.

About the Science Collaborative

The National Estuarine Research Reserve System's Science Collaborative supports collaborative research that addresses coastal management problems important to the reserves. The Science Collaborative is managed by the University of Michigan's Water Center through a cooperative agreement with the National Oceanic and Atmospheric Administration (NOAA). Funding for the research reserves and this program comes from NOAA. Learn more at nerrssciencecollaborative.org or coast.noaa.gov/nerrs.