From Hydrography to Hydrologic Regime

Understanding Salt Marsh Survival

NERRS-COOPS-NGS-Collaboration
The NERRS purpose in life:

to support science-based coastal management through education, training, and original short-term research and long-term monitoring
NERRS VEG HABITAT MONITORING
New England High Marsh
Low Tide Profile
Sea Level Rise Happens
Coastal Habitat Impacts and Response driven by Acute Storm Events and Chronic Sea Level Rise
Tides Rule Coastal Habitats and Coastal Habitats Protect Coastal Property

- Salt marsh sediment supply, accretion, erosion, elevation
- Salt marsh plant vigor
- Formation of drainage network
- Movement of fish and their food
- Marsh horizontal migration
Tides, Sea Level, Upland Topography, and Built Infrastructure
direct salt marsh horizontal migration
NERRS Climate Change Sentinel Sites

Goal 1. Contribute to scientific understanding of climate change and monitor ecosystem changes

Goal 2. Assess climate change impacts on human and estuarine ecosystem communities, vulnerability of these communities, and their capacity for adaptation and mitigation.
National Water Level Monitoring Network and National Spatial Reference System Essential to NERRS Sentinel Site Goal

to establish:
*a long-term ecosystem-based climate change impacts monitoring program utilizing NERRS capabilities and serving NERRS priorities for addressing sea level rise and other climate-related changes.*
Questions Needing Answers

1) What is happening to the tidal range at a given site? What is happening to the marsh surface relative to the water level?
2) Can we detect a vegetation response to changes in these factors?
3) How does the response of vegetation at a given site compare to, or reflect, other site specific, relevant factors – i.e. temperature change, invasive species, etc?
As Sea Level Rises, Marshes can Drown
Or, they can Migrate
To Predict Habitat Response/Change

Process-based model inputs driven by Inundation Regime:

- Surface sediment deposition, accretion/loss
- Plant growth, density, biomass production
- Surface elevation change
§III-4 Sediment Deposition Drives Marsh Accretion

The pattern observed for the H1 sediment traps were consistent for the H2 and H3 traps, but the amount of sedimentation increased progressively with the slight decline in elevation, further support for a quantitative link between inundation and sedimentation.

Example of variation in sediment deposition across sampling sites, with each row representing a different elevation (H1, H2, H3, L1 from top to bottom), and each column a different station. The far right column is for the impounded and subsided Drakes Island marsh, which has no real high marsh, and retained wrack due to poor drainage through an undersized culvert.

Daily average sediment deposition in relation to the percent of time submerged, over the course of the survey, with sampling stations arranged in approximate order from north to south along the estuary's main axis. Deposition and tidal inundation (i.e. % submerged) are closely matched except for the Drakes Island sites (DI-1 to DI-3), where a culvert restricts sediment input and retards drainage.
Measuring Change in Elevation and Accretion
GPS Surveying Network
Elevation Change Varies over Time

Sediment elevation (Maroon Bars)

Overall change (11 stns)
- 4.2 mm/year pre dredge
- -2.5 mm/year post dredge
Mean change of 1.2 mm/yr

Bay front Stations (4)
- 3.4 mm/year pre dredge
- -3.9 mm/year post dredge

Interior Stations (5)
- 3.3 mm/year pre dredge
- -2.9 mm/year post dredge
So Far Maine Marshes are Surviving

**Total Marsh mean**: 5.0 mm/yr  
* (n = 57)*

**High marsh**: 2.2 mm/yr  
(n = 8)

**Low marsh**: 5.6 mm/yr  
(n = 15)

**Fluvial-tidal marsh**: 6.9 mm/yr  
(n = 13)
Vegetation Survey

- % Cover all species
- Stem Counts for dominant species
Big Horsepower on Small Rivers
another Driver of Coastal Erosion
With no Tides, Marshes Subside

5 square foot connection
To 20 square feet
Drakes Island Marsh, Wells Maine
Peat Decay causes Marshes to Sink
Invasive Plants always at the Ready
Inundation Regime is the Master Control
Reference Marsh Inundation
Self Regulated Tide Gate
Flooded Marsh
Modeling Tides to Design Restoration
Application of Sentinel Site Monitoring and Modeling

- Identify marshes that would benefit from living shoreline management practices
- Identify marsh migration zones for protection through marine spatial planning
- Identify restricted marshes for restoration to allow marsh migration
Sentinel Site Projected Outcomes

1) Contribute to scientific understanding of climate change and effects of climate change on coastal ecosystems.

2) Develop a consensus definition and protocols for an ecosystem-based sentinel site.

3) Expand “pilot” sentinel site network and enhance capacity and infrastructure within NERRS.

4) Implement SWMP Priorities (e.g. SWMP Phase II and Phase III). Develop data management strategy (with CDMO) for data dissemination to research community.

5) Use Coastal Training Program to define target audiences and develop products for coastal management end-users.

6) Enhance integration within NERRS as well as between NERRS and other NOAA partners.
One More Reason to Manage for Salt Marsh Survival
All You Can Eat Salt Marsh Buffet

Percent of Striped Bass, *Morone saxatilis*, with each prey type in stomach
(Little River creek channel, 1995)

Dietary Preferences

- Pisces eggs: 3.96%
- larval Pisces: 8.91%
- Astacura (Homarus americanus): 4.95%
- Leptostraca (Nebalia bipes): 2.97%
- Caridea: 15.8%
- larval Brachyura: 58.4%
- Brachyura: 4.95%
- Amphipoda: 2.97%
- Gammarus mucronatus: 4.95%
- Corophium volutator: 15.8%
- Isopoda: 8.91%
- Mysidacea: 4.95%
- Copepoda: 8.91%
- Ostracoda: 4.95%
- Argulidae: 8.91%
- Insecta: 4.95%
- Nereidae: 8.91%
- Bivalvia: 58.4%
- Nematoda: 4.95%

Frequency of Occurrence (%)
Save a Salt Marsh and give a Fish a Chance