NITROGEN MITIGATION PROJECTS

Martha's Vineyard

Coastal Conference 2018

Sengekontacket Pond

- Northern side of Martha's Vineyard
- 716 acres
- Watershed 4440 acres
- Impaired by excess nitrogen entering pond
- Mostly residential

Mirrored Oyster Mitigation Project

- Both Edgartown and Oak Bluffs have introduced oysters into Sengekontacket
- Both towns have sites in Major's Cove
- Both towns seed out oysters for recreational take.
- Both towns have and are getting rave reviews about the new put and take fishery in the pond

- Each purchase disease resistant strain of 500,000 seed oysters each year

- Photo of upweller

Living Shoreline
Salt Marsh Restoration

1. Town of Oak Bluffs Shellfish Department
2. Town of Edgartown Shellfish Department
3. MA Audubon Felix Neck
4. US EPA Atlantic Ecology Division
5. University of Rhode Island

Background

- 2014/15 hard winter
- Significant erosion
- Oak Bluffs and Edgartown Share Pond
- Pond is impaired
  - Excess nitrogen
- TMDL established

Approach

- Two towns appropriated 10K ea.
  - 5K outreach MA Audubon Felix Neck
  - 5K ribbed mussel seed
- US EPA Atlantic Ecology Division
  - Experimental design
  - Monitoring and installation

Atlantic Ecology Division

- Seized opportunity to quantify nitrogen attenuation of restored marshes
- Permits were in hand
- TMDL for nitrogen already established

Installation labor intensive

ALL MATERIALS USED ARE BIODEGRADABLE

SEWED COIR MATS TO MAKE SHELL BAGS

STAGED MATERIALS AT SITE

SHELL BAGS AND COIR LOGS

Installation

2017

- Some damage from winter nor'easter storms
- Replaced some logs
- Smaller mesh covering
- Redesigned E2 as the EI design held up better

- Sand bags from burlap coffee bags instead of shellbags
- Sand fill
- Plant *Spartina alternoflora*

Monitoring

- Physical
- Chemical
- Biological

Elevation transects

Goal: Measure marsh elevation along transects traversing the intertidal zone

Methods:

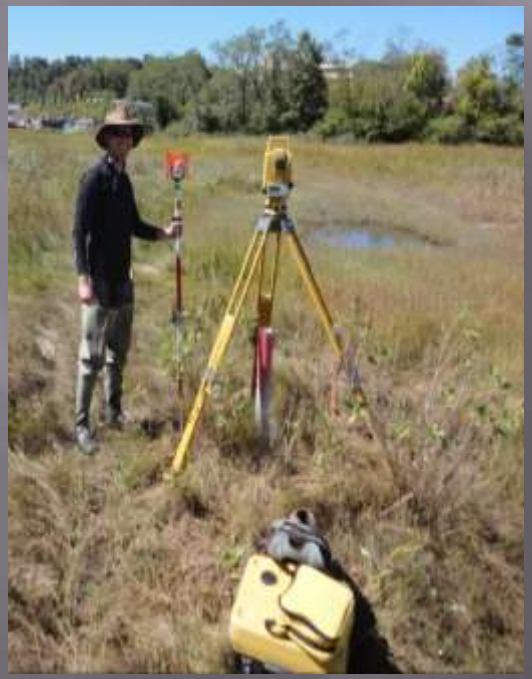
- Low-impact surveying equipment will be used to monitor elevations along 16 transects
- Vegetation at each point will be recorded

Sampling Frequency:

- Surveys will be repeated twice annually, in early fall and early spring

Why it's important:

- Allows us to estimate erosion or expansion at the seaward edge of the marsh
- By also examining the upland edge, we can monitor inland migration of marsh plants



A total station (left) will be used to precisely measure relative elevations. These measurements will be converted to absolute datums

Salinity mapping

Goal: Monitor seasonal changes in porewater salinity

Methods:

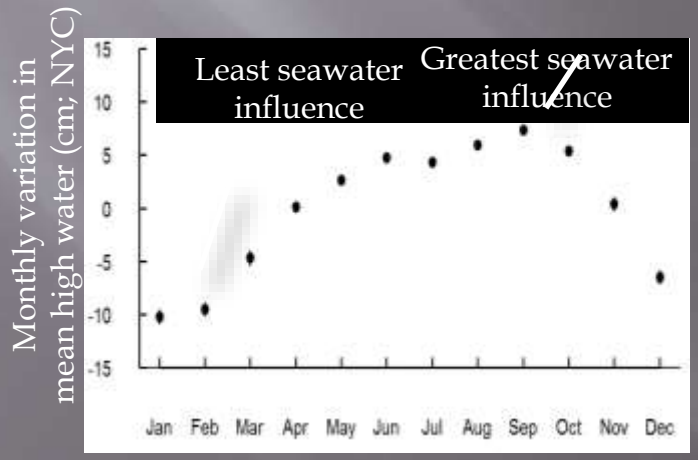
- Non-intrusive salinity mapping will occur along our 16 transects

Sampling Frequency:

- Surveys will be repeated twice annually, in early spring (May) and early fall (Sept), to capture seasonal variation

Why it's important:

- Helps us non-destructively measure groundwater and subsurface dynamics
- Salinity is a master variable driving plant dynamics and biogeochemical processes



Salinity mapping is done with a handheld electromagnetic conductivity sensor (red device in right image). Mapping will be timed to capture extreme high and low periods (left).

Measuring Nutrients

Goal: monitor the water quality/nutrient levels in the water from the landward side of the living shoreline

Methods/ Equipment:

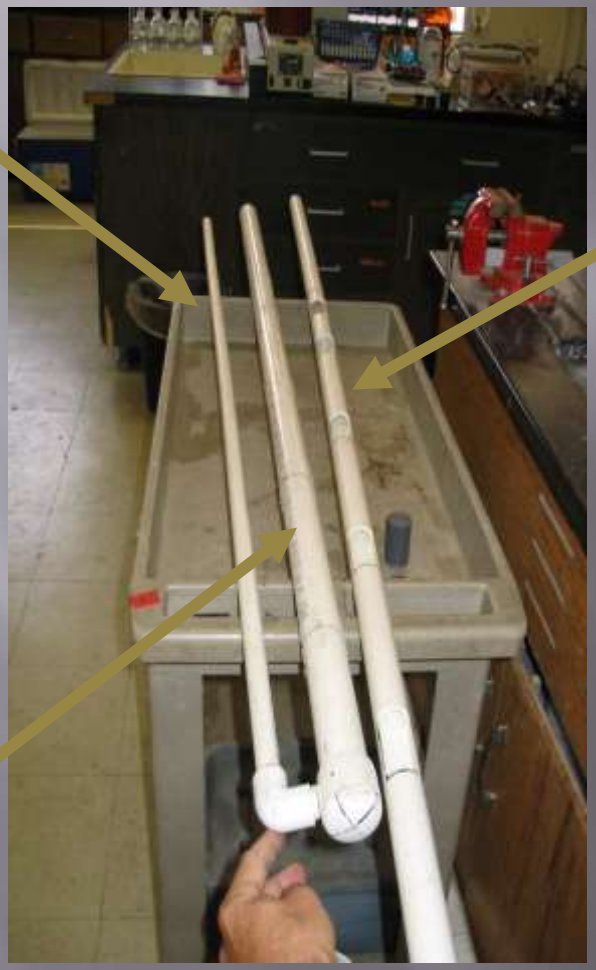
Porewater Samplers: collect water samples from porewater (subsurface water between sediment particles) to test for nutrients

Sampling Frequency:

- Water samples from the samplers will be collected 1 day/month, beginning right before installation (May) → Oct/Nov
- Porewater samplers would be installed and left in the field for the duration of the sampling season

Measuring Nutrients

Breather tube: ¾”



Inner tube: 1”, goes inside outer tube and holds vials

Outer tube: 1 ¼”

- Only about ~3-4” of the sampler will be exposed
- Samplers will be installed 50 cm deep

Why it’s important:

Obtaining porewater samples will help us better understand the level of nutrients that the living shoreline is receiving from the upland side of the log.

Nutrient Removal

Goal: to examine the living shoreline's potential for reducing nitrogen

Methods:

- Direct measure: denitrification
- Indirect measures:
  - DEA (Denitrification Enzyme Activity)
  - N removal from mussels
  - Plant matter

Sampling Frequency:

- Seasonally

Vegetation Surveys

Sampling Frequency:

- 1 day/season
  - Once in spring (right before installation): May
  - Once in late summer/early fall (end of growing season): August/Sept

Why it's important:

By monitoring vegetation type, abundance and above ground and below ground biomass over time, we can determine the potential ecological benefits of a living shoreline in the nutrient removal and C sequestration.

Vegetation Surveys

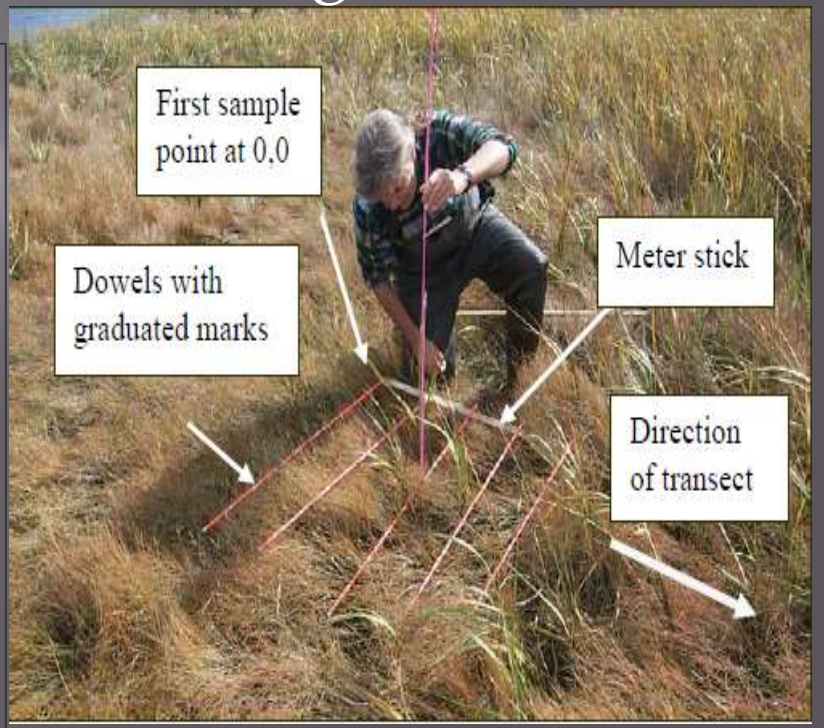
Goals: 1) Better understand the vegetative community composition & abundance of the site, and to 2) examine whether vegetation is enhanced over time, by the presence of the living shoreline

Methods:

- Stem count- % abundance
- Stem length
- Plant ID- diversity

Equipment:

- 1m^2 Quadrat (wooden dowels)
  - Non-destructive, non permanent structure
  - discreet markings/flags will be placed on marsh to denote an established sample point (so that same area can be identified and visited seasonally)



An example of the quadrat in the field (USFWS 2002).

Sediment Characteristics

Goal: Assess sediment characteristics of the site and to monitor their changes over time

Methods:

- Grain Size
- Sediment Organic Content
- Sediment Chlorophyll

Equipment:

- small cores- 6 cm x 2 cm (using a simple 60 ml syringe)
  - Cores will be taken along marsh edge (landward side) and in front of coir logs (water side)

Sampling Frequency:

- Grain Size: 1x/year
- Sediment Organic Matter and Chlorophyll: 1 day/season

Why it's important:

Knowing the type and distribution of sediment on the site can help us understand belowground water movement. Monitoring sediment organic content explains changes in sediment physical and chemical properties over time (changes in soil fertility, structure, biodiversity, etc.)

Sediment Accretion

Goal: to measure the amount of sediment accretion (or erosion) due to the presence of coir logs.

Methods/Equipment:

- Professional grade GPS to precisely examine accretion
- Feldspar marker horizons
  - 50 x 50 cm plots
  - measure the naturally accreting material deposits on top of feldspar
- Sediment traps

Sampling Frequency:

- Once a year

(USGS)

Bivalve Surveys

Goal: Describe the shellfish density on the marsh over time to 1) understand the nutrient removal capability of the mussels and to 2) determine whether the living shoreline helps to increase mussel density.

Methods:

- Set quadrats along marsh edge and marsh face to survey density
- Collect a small number of mussels to examine condition index (bivalve health)

Sampling frequency:

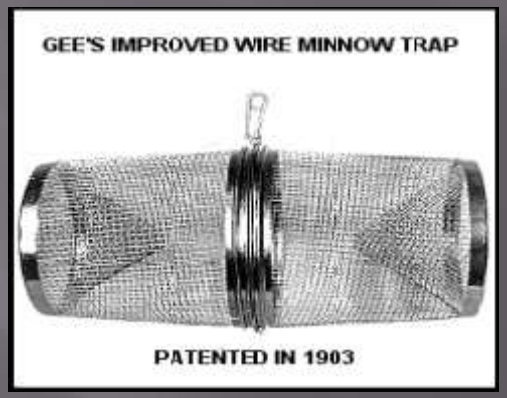
- Quadrat surveys and the condition index would be calculated seasonally.

Nekton Surveys

Goal: Describe the ecosystem service benefit of increase in habitat availability through living shoreline by surveying fish and macroinvertebrate use of the site.

Method:

- Collect oyster shell bags and 'shake' them into bins to make observational comments.
- Set minnow and shrimp traps at each site. Remove organisms, if possible sort in the field.
- Seine net hauls at each site.



Contact Information

While there are several researchers who will be working on this project; the points of contact are:

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