NITROGEN MITIGATION PROJECTS

Martha’s Vineyard Coastal Conference 2018
Northern side of Martha’s Vineyard
- 716 acres
- Watershed 4440 acres
- Impaired by excess nitrogen entering pond
- Mostly residential
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
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
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 BIORANGE
SEWED COIR MATS TO MAKE SHELL BAGS
STAGED MATERIALS AT SITE

SHELL BAGS AND COIR LOGS
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
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 measurement s will be converted to absolute datums.
**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).
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
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.

Breather tube: ¾”

Outer tube: 1 ¼”

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

• Only about ~3-4” of the sampler will be exposed
• Samplers will be installed 50 cm deep
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:**
- 1m² 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)
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.
While there are several researchers who will be working on this project; the points of contact are:

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