Mitigating Marshes Against Sea Level Rise: Thin-Layer Placement Experiment
What do we know already know about marshes?
Ecosystem Services of Coastal Marshes

- Buffering wave energy to protect coastlines
- Trapping sediments and filtering runoff to improve water quality
- Reducing impacts of flooding
- Recreational opportunities
- Fish nursery areas and wildlife habitat
Zonation

Image: CCRM at VIMS
Species

**Low Marsh Species**
Smooth cordgrass (Spartina alterniflora/Sporobolus alterniflorus)

**High Marsh Species**
Salt grass (Distichlis spicata)

**High Marsh Species**
Saltmeadow cordgrass (Spartina patens)
Global Sea Level Rise (SLR)

SLR is affecting many coastlines in areas such as the Chesapeake Bay Estuary.
Subsidence

Sinking of the land is a major factor contributing to local sea level rise which varies throughout the Bay.

Possible causes:

► Retreat of glaciers from the previous ice age
► Sediment loading adding too much weight on the wetlands
► Sediment compaction after groundwater removal

Erosion

Shoreline erosion causing loss of the marsh land
CATEGORIES OF MARSH RESILIENCE TO SEA LEVEL RISE

1. Marsh elevation: Are the plants located at the high end of their tolerance to flooding so they are initially protected from inundation by rising seas?

2. Change in elevation: Is the marsh rising fast enough to keep pace with rising seas?

3. Sediment supply: Is there sufficient sediment to help build up the marsh?

4. Tidal range: Does the tidal range allow marsh plants to occupy a broad range of elevations so they are buffered against the effects of sea level rise?

5. Rate of sea level rise: Is the marsh more resilient because it has not yet been exposed to rapid local sea level rise or high water levels?
How do the marshes respond?
1) Vertical Accretion

Marshes build vertically by accumulating sediments and organic matter.
1) Vertical Accretion

This vertical development is referred to as accretion.
2) Horizontal Migration

Salt marshes are able to migrate towards higher elevation and further inland to try and survive, but they may not be able to keep up with the rate of SLR and can drown.

Scientists are trying to improve marsh resilience
Thin-Layer Placement (TLP)

TLP can be defined by the US Army Corps of Engineers as:

“Purposeful placement of thin layers of sediment (e.g., dredged material) in an environmentally acceptable manner to achieve a target elevation or thickness. Thin layer placement projects may include efforts to support infrastructure and/or create, maintain, enhance, or restore ecological function” (Berkowitz et al., 2019, p. 6).

In other words, the goal is to increase marsh elevations for maximum vegetation growth and to keep marshes from eroding away.
TLP in action!

Healthy Degraded

Regrowth

TLP in action!

Image: NERRS Science Collaborative TLP Project
Researchers evaluating different strategies and treatments for TLP across the nation

- NERR System Science Collaborative has funded a two-year experiment at 8 different NERR sites
- One more year of monitoring left!
Core research questions the collaborative aims to answer:

► Is sediment addition an effective adaptation strategy for marshes in the face of sea level rise?
► How does marsh resilience respond to different levels of sediment addition?
► How do low versus high marsh habitats differ in their response to this restoration strategy?
At CBNERR-VA:

- Study design answers a secondary question
- Extra treatment using local dredge material from a recent shoreline enhancement project
- “Win-win” situation
CBNERR-VA Study Site: Goodwin Island, VA
CBNERR-VA Study Site: Goodwin Island, VA

York River

Chesapeake Bay
Experimental Design

- 5 study sites in both high and low marsh habitats
  - Plot treatments within sites include:
    - Control plot with no wooden frame
    - Control plot with wooden frame
    - Thin standard sediment layer
    - Thick standard sediment layer
  - Some reserves, like CBNERR-VA, use dredged material in 5th plot
Goodwin Island, VA
(5 treatment plots)
The Beginning: Transportation
The Beginning: Creation
Researchers at the reserves monitor changes over the two years by evaluating:

- Marsh vegetation
  - Cover, composition, and canopy height
- Elevation
Percent Cover

- Measuring how much of an area is covered with vegetation
- Using quadrats helps visualize the area in grids for easy & fast estimation
Activity Time

Help CBNERR-VA monitor the 1\textsuperscript{st} year of the experiment
High Marsh

**Goal:** maximized growth of native high marsh vegetation and high elevation

Hint: The goal is represented by “Ref” (reference plot)
Individual Plots vs. Average of ALL Sites
Low Marsh

**Goal**: Higher percent cover of low marsh species and high elevation

*Hint: The goal is represented by “Ref” (reference plot)*
Individual Plots vs. Average of ALL Sites
Discussion
What Scientists Say: High Marsh

- Both the 7 cm and 14 cm treatments appear to be responding equally well.
- Slightly more vegetation in the 7 cm treatments, but the 14 cm treatments have a higher percent cover of the more desirable high marsh species.
  - In the 7 cm treatment, there is a presence of low marsh species in the high marsh habitat.
  - This indicates the 7 cm might not be enough sediment to support high marsh conditions.
What Scientists Say: Low Marsh

- 7 cm treatments have slightly better vegetation recovery compared to the 14 cm and dredge treatments.

  - Important to remember:
    - This is only the first year from a 2-year study!!
    - Scientists expect the 14 cm treatments to continue to show recovery over time.
Experimental Design Issues

- Raccoons digging
- Deer stepping
- Crabs burrowing
- ...and hurricanes
Wrap-Up Discussion & Questions
Photo Credits

CBNERR-VA Staff: Slide 2, 3, 5, 8, 17, 18, 19, 20, 23, 24, 26, 27, 28, 31, 34, 38, 39

CBNERR-MD Staff: Slide 26

GBNERR Staff: Slide 25

ESNERR Staff: Slide 25

WBNERR Staff: Slide 24

NCNERR Staff: Slide 24, 40

David Harp: Slide 15 & 41

NBNERR: Slide 40