A Bio-Based Living Shoreline Design for Salt Marsh Erosion Control

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Delaware Department of Natural Resources and Environmental Control
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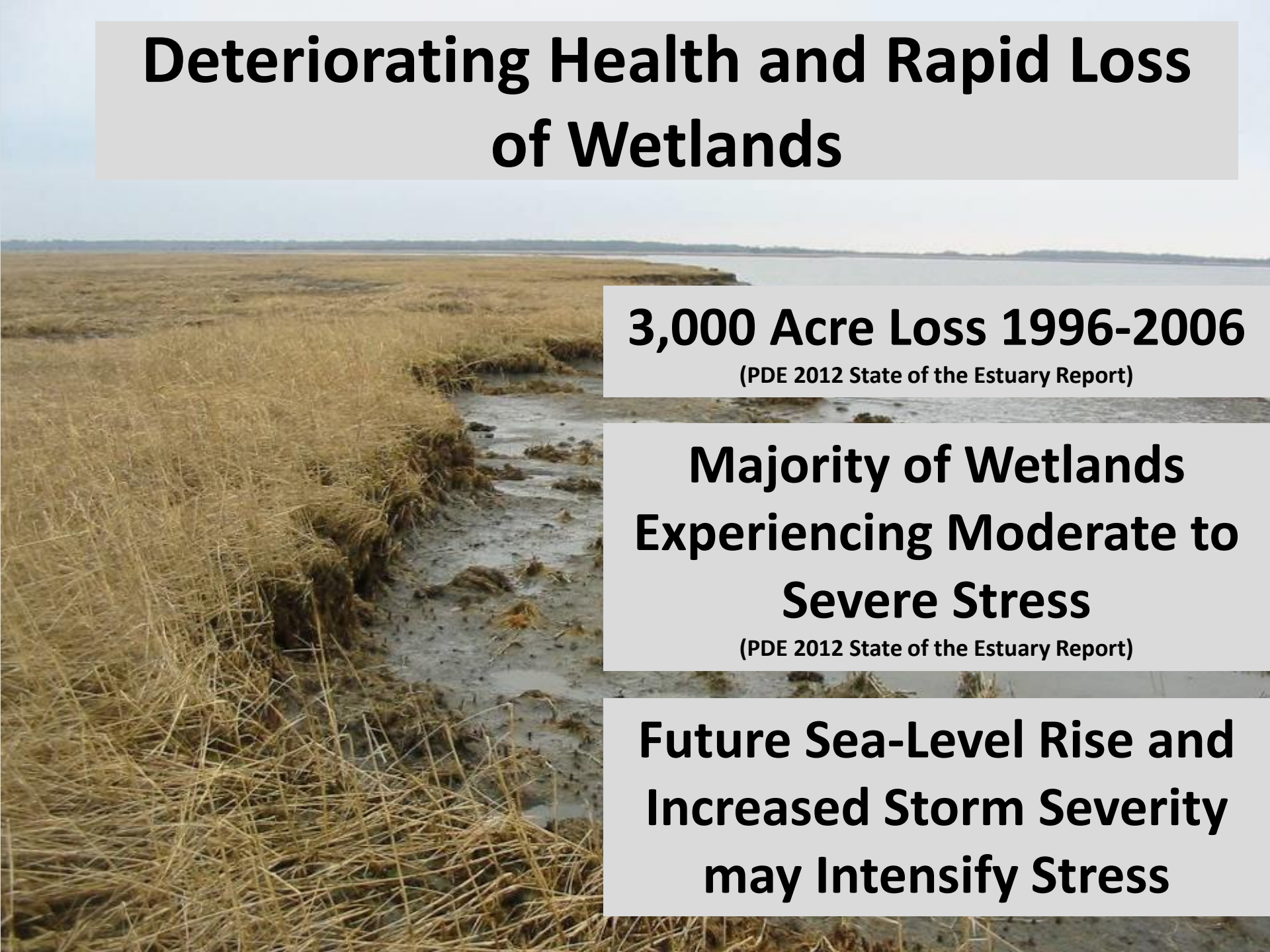
Deteriorating Health and Rapid Loss of Wetlands



3,000 Acre Loss 1996-2006

(PDE 2012 State of the Estuary Report)

Majority of Wetlands Experiencing Moderate to Severe Stress

(PDE 2012 State of the Estuary Report)

Future Sea-Level Rise and Increased Storm Severity may Intensify Stress

Unnatural Infrastructure

Bulkheads and Seawalls

Revetments

Rip Rap

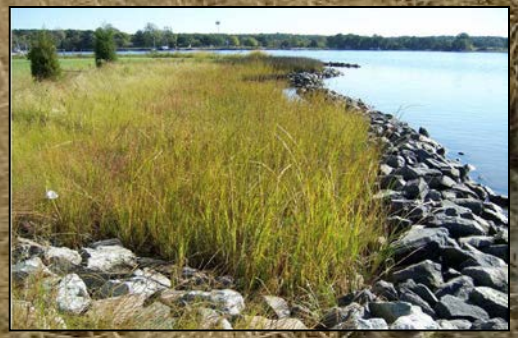
Natural Infrastructure

Oyster Breakwaters

Beneficial Use of Sediment

Living Shorelines

Living Shorelines



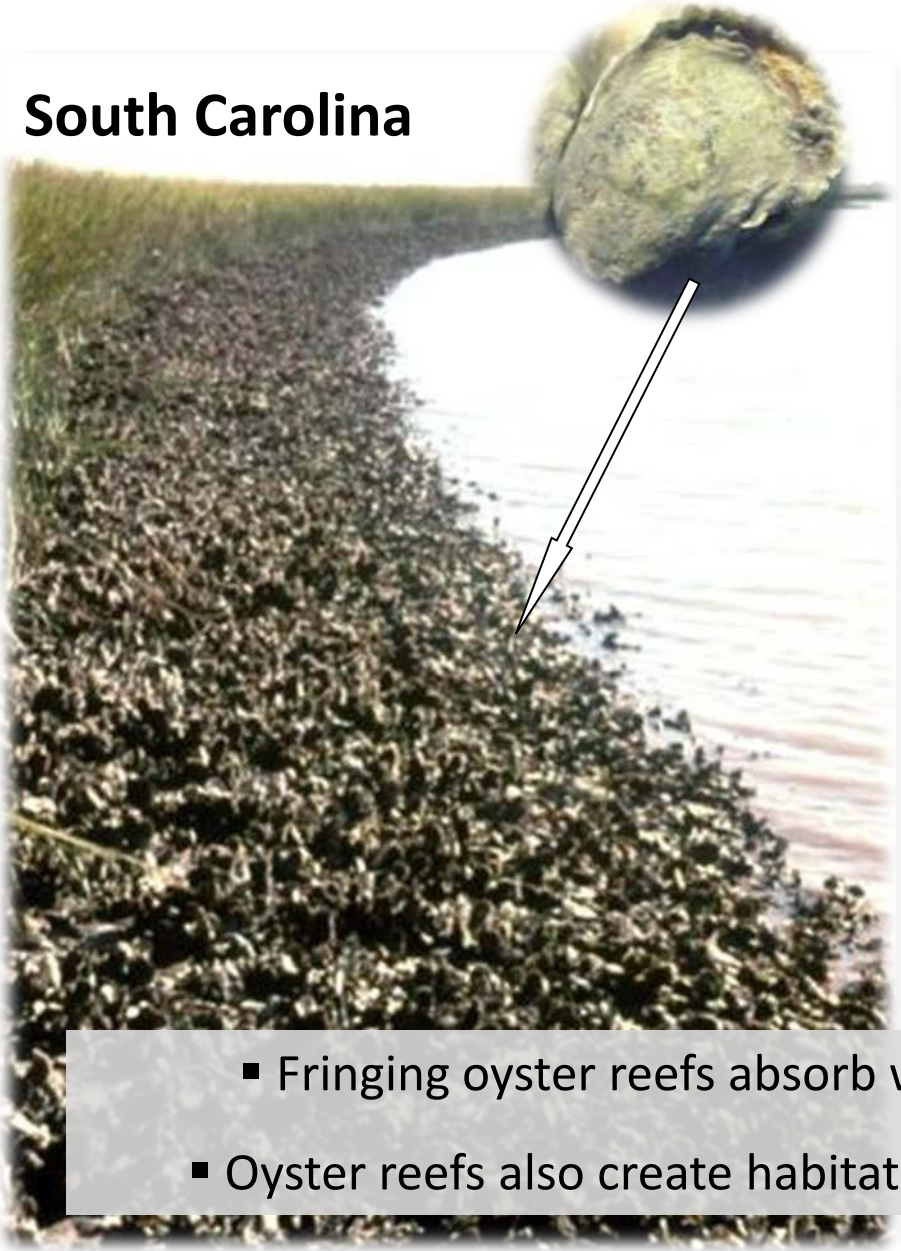
Off-Shore Shellfish Reefs

Hybrid Hard/Soft Tactics

Bio-Based Designs

Shellfish as Natural Erosion Control

South Carolina



New Jersey

- Fringing oyster reefs absorb wave energy and trap sediments.
- Oyster reefs also create habitat, filter water, and recycle nutrients.

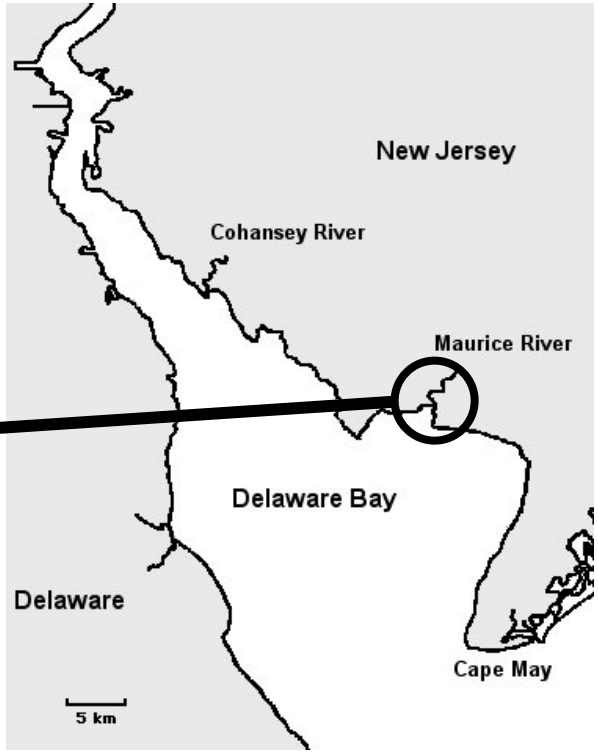
Ribbed Mussels (*Geukensia demissa*)

PDE and Rutgers
Bio-Based Living Shorelines

- Utilizes natural synergistic relationship between shellfish and native vegetation
- Enhances ecological functions of habitat
- Can help to Control Erosion

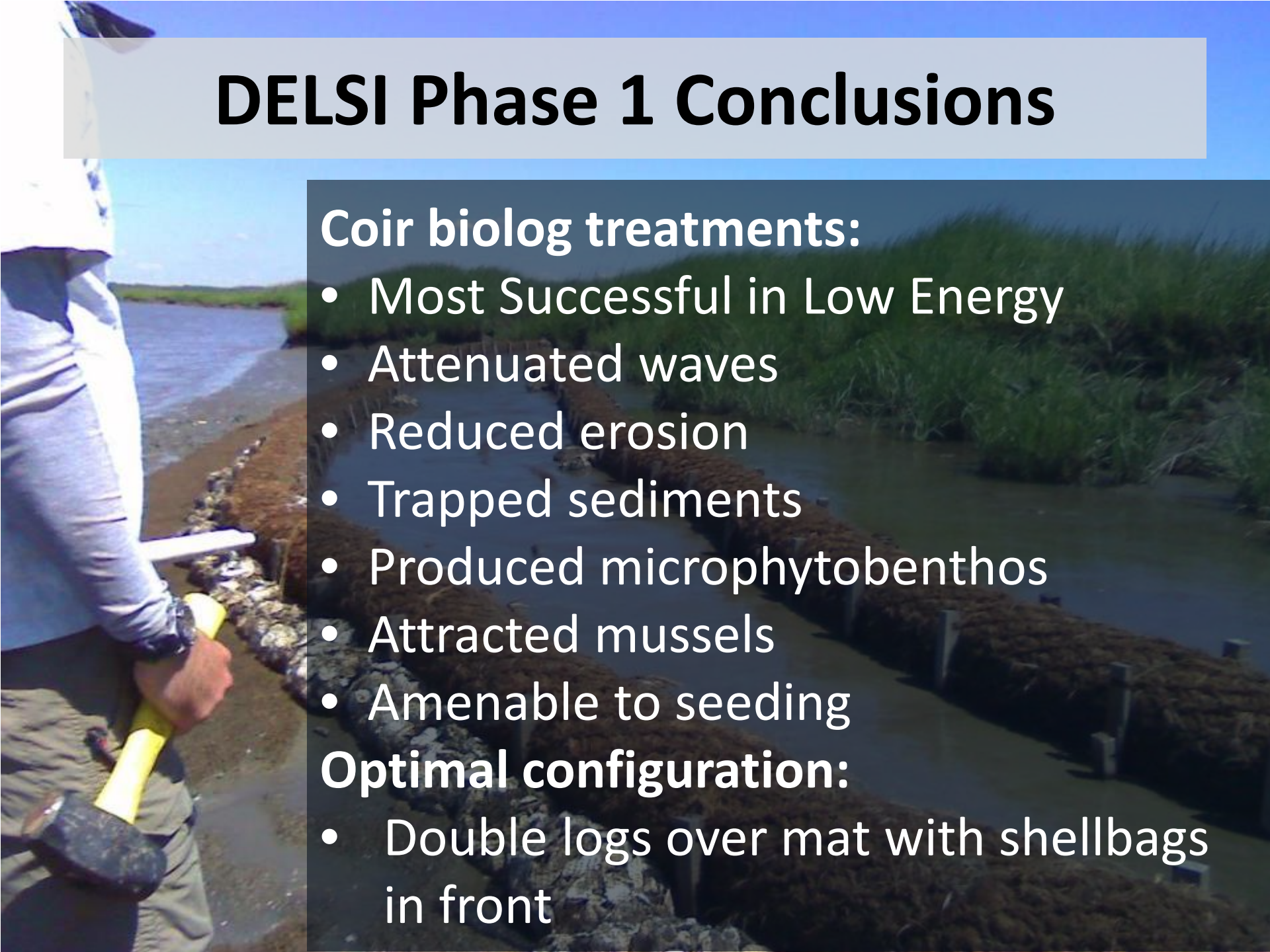
DELSI: The Delaware Estuary Living Shoreline Initiative

Phase I: Testing the DELSI Design



Test installation methods across a gradient of energy and erosion.

DELSI Phase 1 Conclusions



Coir biolog treatments:

- Most Successful in Low Energy
- Attenuated waves
- Reduced erosion
- Trapped sediments
- Produced microphytobenthos
- Attracted mussels
- Amenable to seeding

Optimal configuration:

- Double logs over mat with shellbags in front

DELSI Phase 2

- Replicate Successful Treatment Method
- Plant with *Spartina alterniflora*
- Plant Ribbed Mussels
- Quantify Faunal Use

Example: Conversion of Rip Rap to Salt Marsh Habitat




Apply Mussels





Post-Planting


June 2011


Sept. 2011 Post Irene and Lee


November 2012 Post Sandy

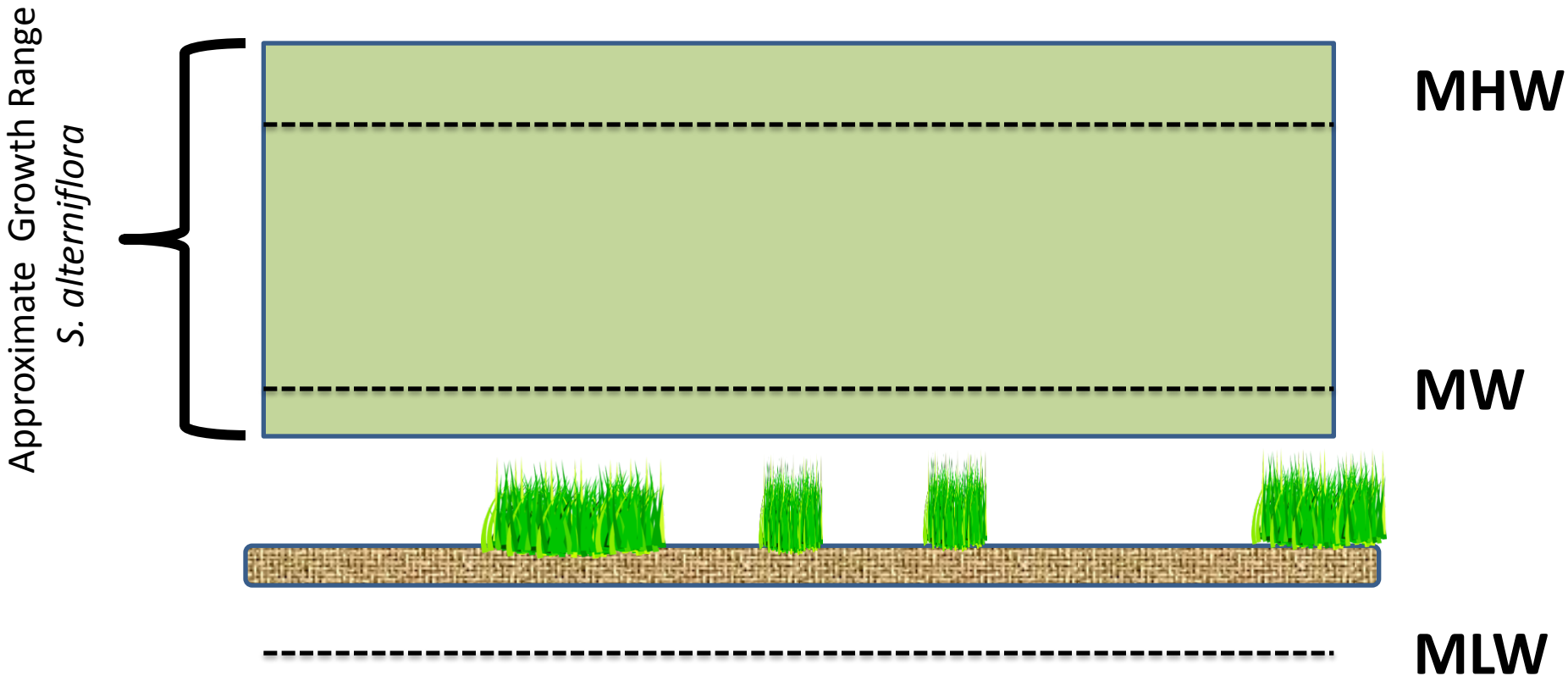
Post Hurricane Sandy

Survey Before and After

Elevation is key

Optimum Growing Range for *Spartina alterniflora*

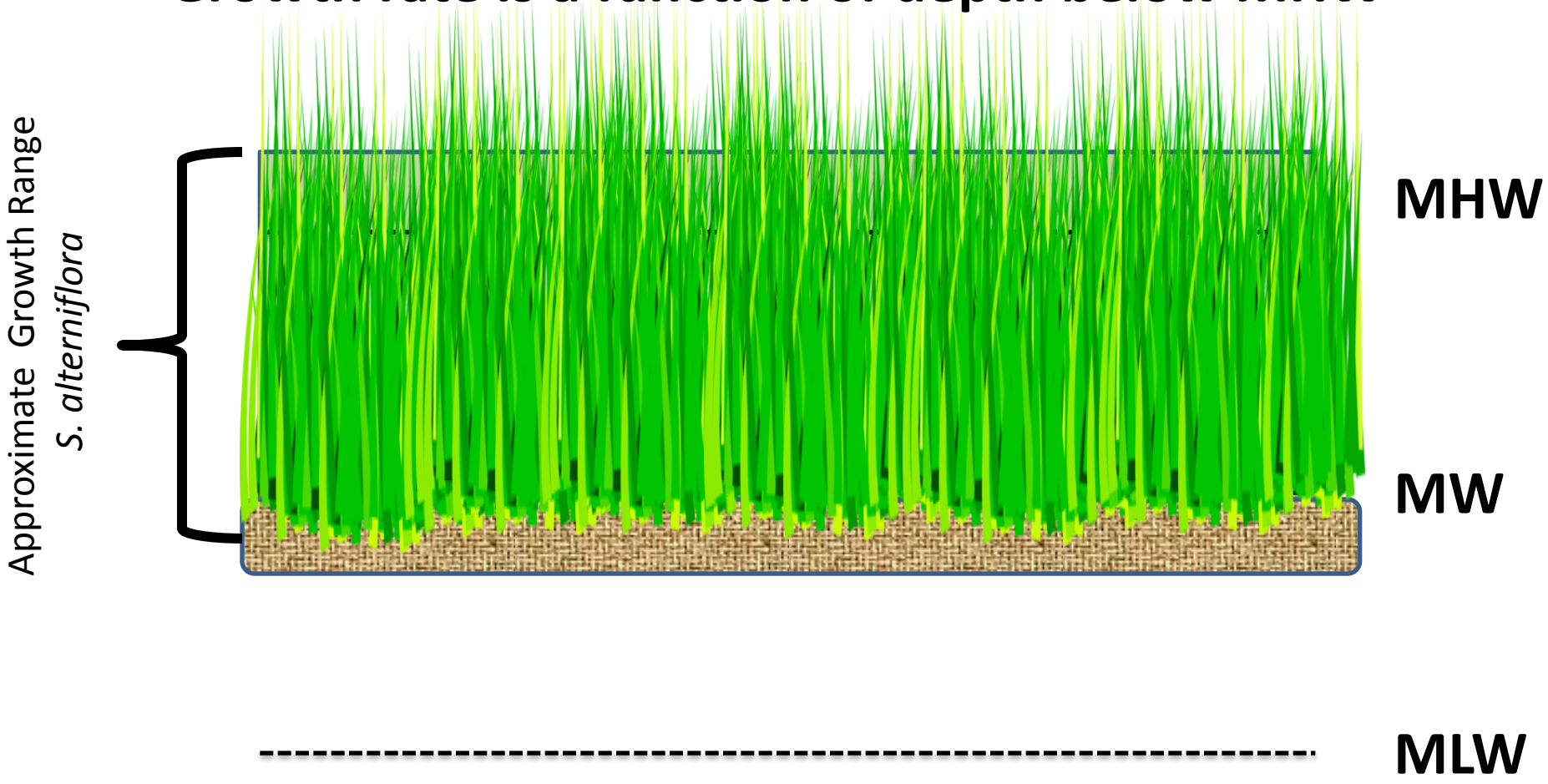
Growth rate is a function of depth below MHW



Slide adapted from James Morris

Optimum Growing Range for *Spartina alterniflora*

Growth rate is a function of depth below MHW

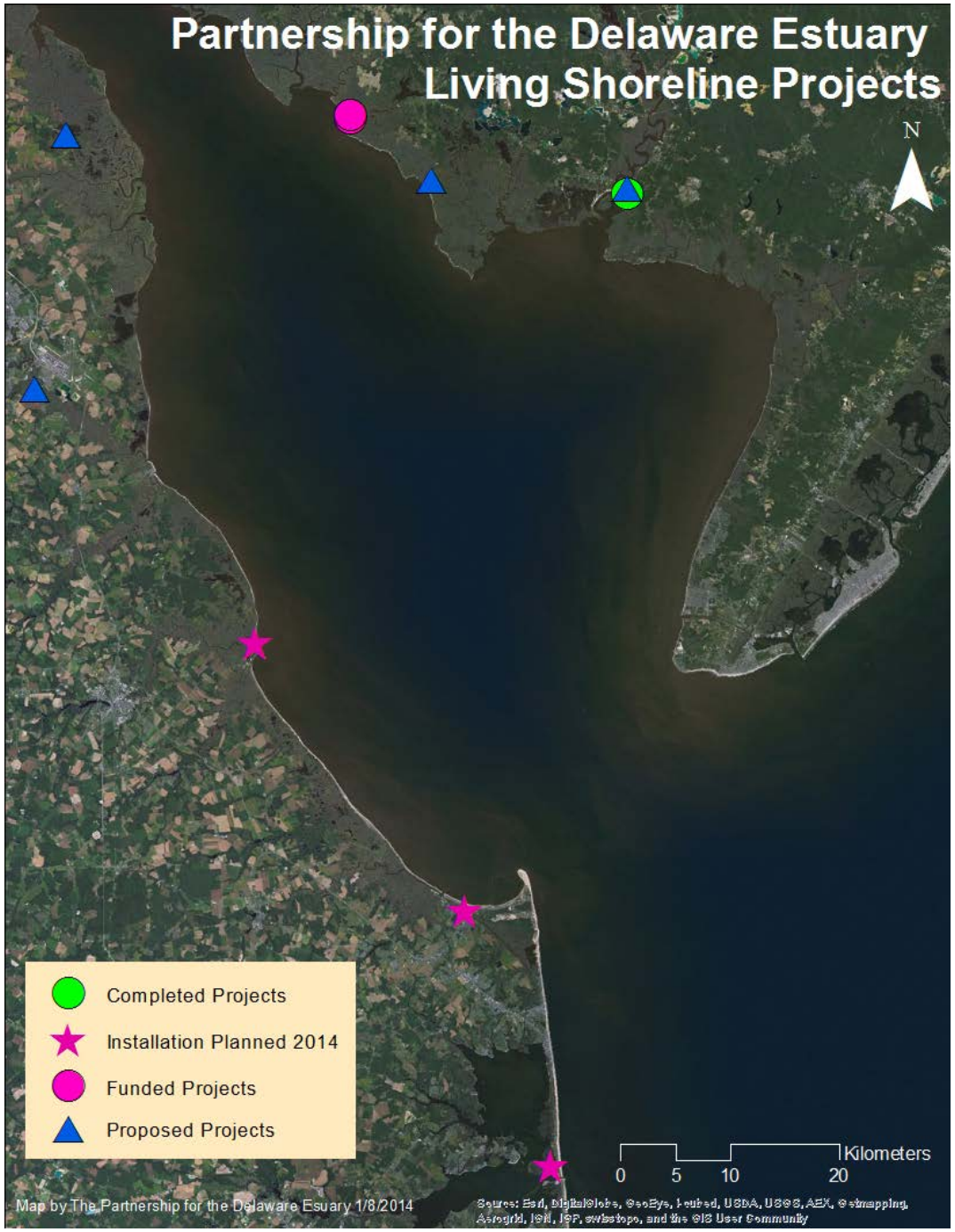


Slide adapted from James Morris

Seine Species	Control	Treatment
Grass Shrimp	1037	1536
Blue Crab	647	501
Mummichog	221	229
Bay Anchovy	251	26
White Perch	89	52
Silverside	50	38
Silver Perch	9	26
Weakfish	16	15
Striped bass	14	8
Black drum	12	6
Window pane flounder	12	
Atlantic menhaden	1	4
Hogchoker	5	
American eel	2	1
Spot	2	1
Unidentified	2	1
Summer Flounder	1	1
Naked Gobi	1	
Toadfish		1

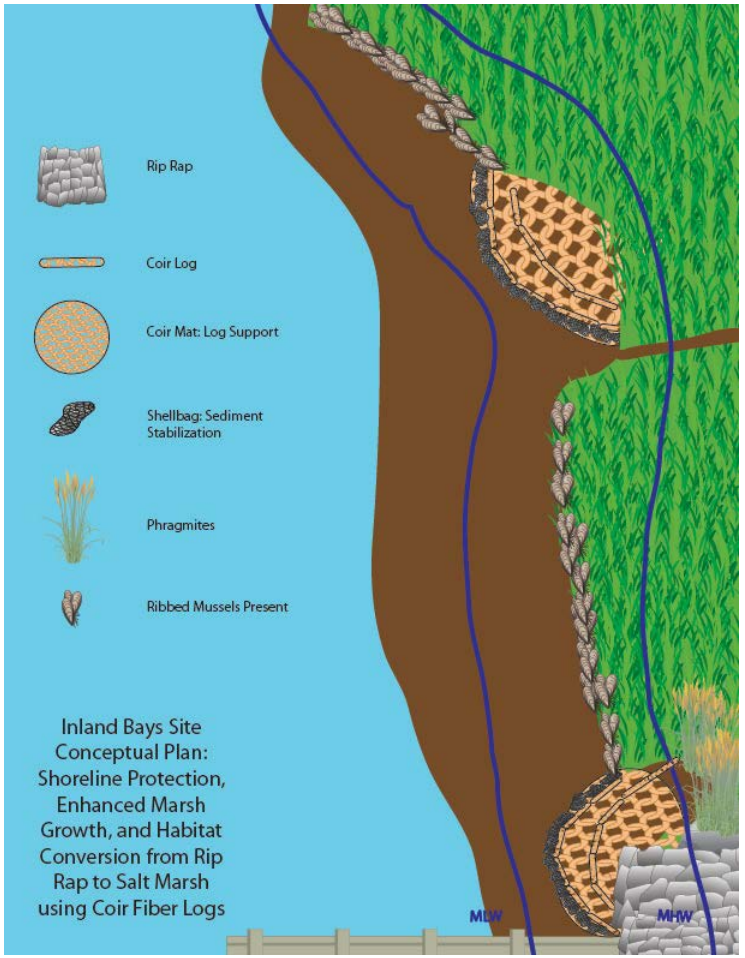
Minnow Pot Species	Control	Treatment
Mummichog	544	1564
Grass Shrimp	458	424
American eel	14	6
White Perch	1	9
Blue Crab	6	2
Silver Perch	3	3
Spotfin mojarra	1	2
Bunker	2	
Striped Bass	1	

- Completed
  - Matt's Landing, NJ
- Installation Planned 2014
  - Inland Bays, DE
  - Lewes Canal, DE
  - Mispillion, DE
- Funded
  - Money Island, NJ
- Proposed
  - Fortescue, NJ
  - Heislerville, NJ
  - Lebanon Landing, St. Jones, DE
  - Bombay Hook NWR, DE



Inland Bays

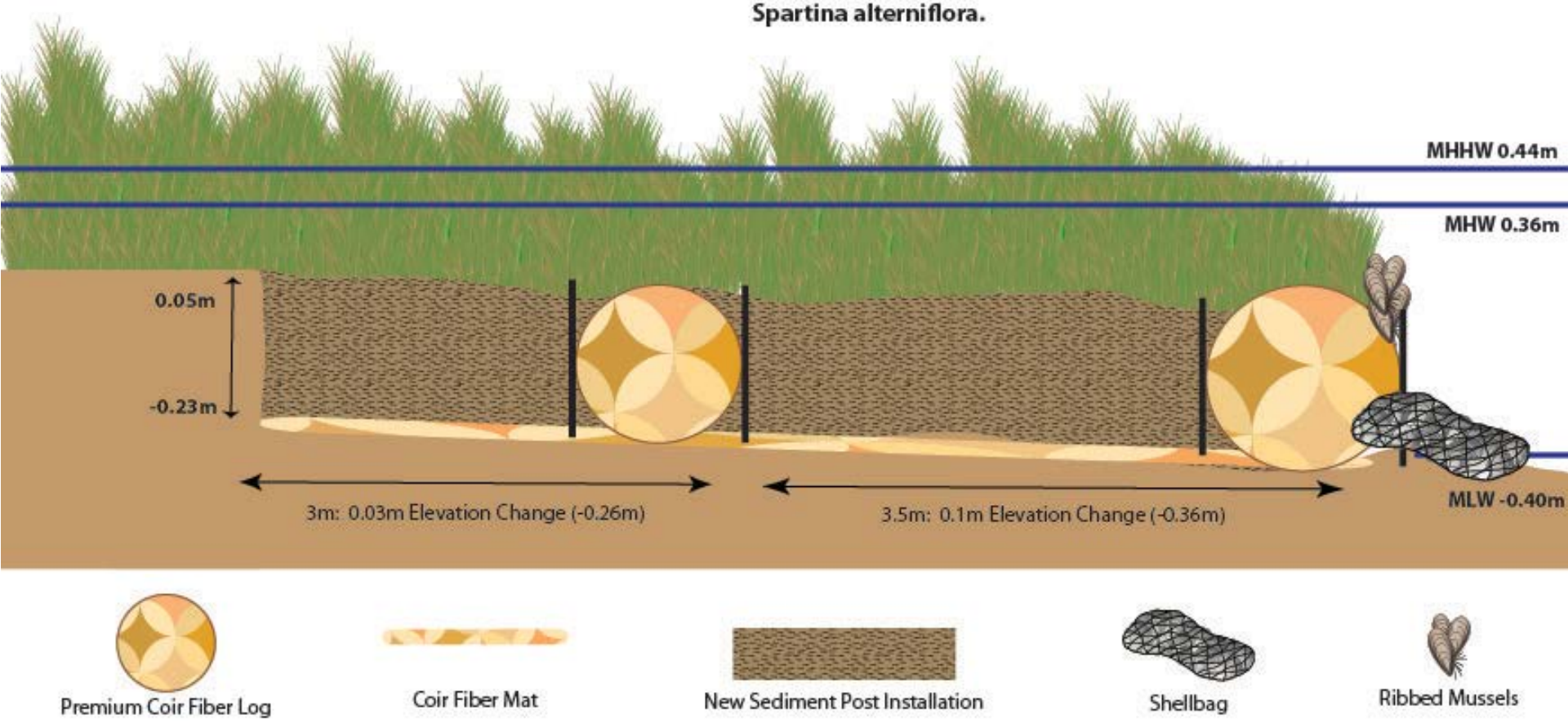

Inland Bays, DE
Water Levels
MHHW 0.44m
MHW 0.36m
MW 0.0m
MLW -0.40m
MLLW -0.45m


Rip Rap
Coir Log
Coir Mat: Log Support
Shellbag: Sediment Stabilization
Phragmites
Ribbed Mussels Present
Inland Bays Site Conceptual Plan: Shoreline Protection, Enhanced Marsh Growth, and Habitat Conversion from Rip Rap to Salt Marsh using Coir Fiber Logs
MLW
MHW

Inland Bays Conceptual Plan Profile

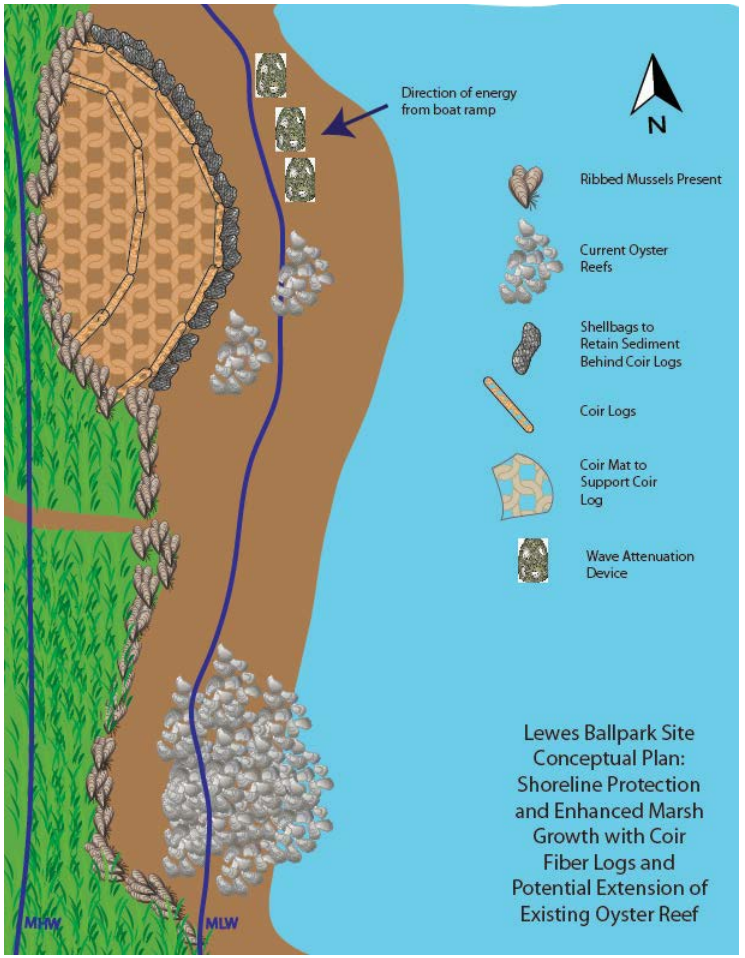
Salt Marsh Habitat Enhancement using Coir Fiber Logs and Natural Existing Ribbed Mussel Populations

An installtion of two rows of coir fiber logs will be installed along an eroding section of salt marsh. The water-ward row will be comprised of 16" coir logs, and the landward row will be conprised of 12" coir logs. This combination of log diameters will elevat the mudflat behind the installation to between MW and MHW, an optimum growing range for Spartina alterniflora.



Lewes Canal

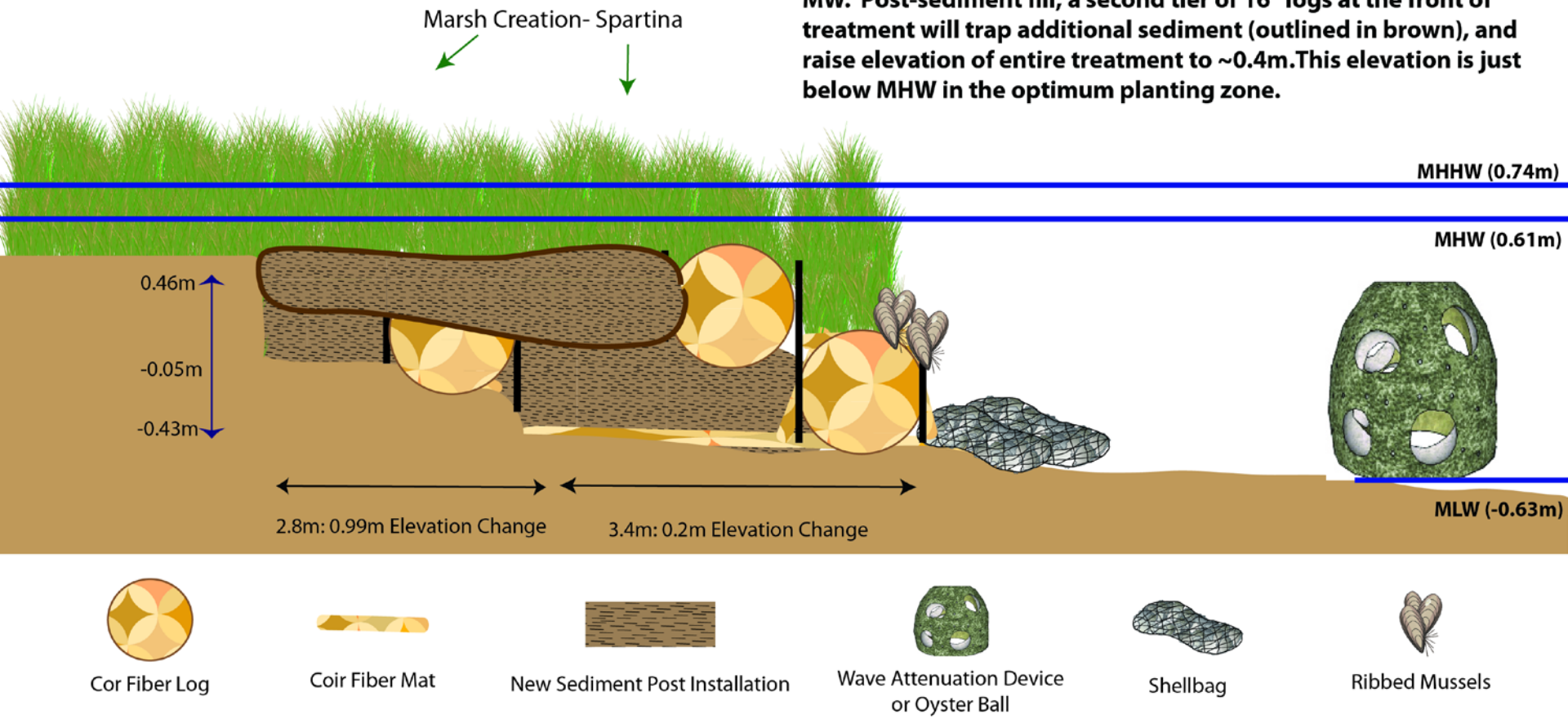

Lewes Canal Ballfield
Water Levels
MHHW 0.74m
MHW 0.61m
MW 0.0m
MLW -0.63m
MLLW -0.68m
N
0
10
20
Meters


Direction of energy from boat ramp
N
Ribbed Mussels Present
Current Oyster Reefs
Shellbags to Retain Sediment Behind Coir Logs
Coir Logs
Coir Mat to Support Coir Log
Wave Attenuation Device
MHW
MLW
Lewes Ballpark Site Conceptual Plan: Shoreline Protection and Enhanced Marsh Growth with Coir Fiber Logs and Potential Extension of Existing Oyster Reef

Lewes Ballfield Conceptual Plan Profile -

Salt Marsh Habitat Enhancement using Coir Fiber Logs and Natural Existing Ribbed Mussel Populations and Oyster Reefs

An initial installation of 16" coir logs in a terraced formation will trap sediment increasing the elevation at the front of the treatment to MW. Post-sediment fill, a second tier of 16" logs at the front of treatment will trap additional sediment (outlined in brown), and raise elevation of entire treatment to ~0.4m.This elevation is just below MHW in the optimum planting zone.



Cor Fiber Log

Coir Fiber Mat

New Sediment Post Installation

Wave Attenuation Device or Oyster Ball

Shellbag

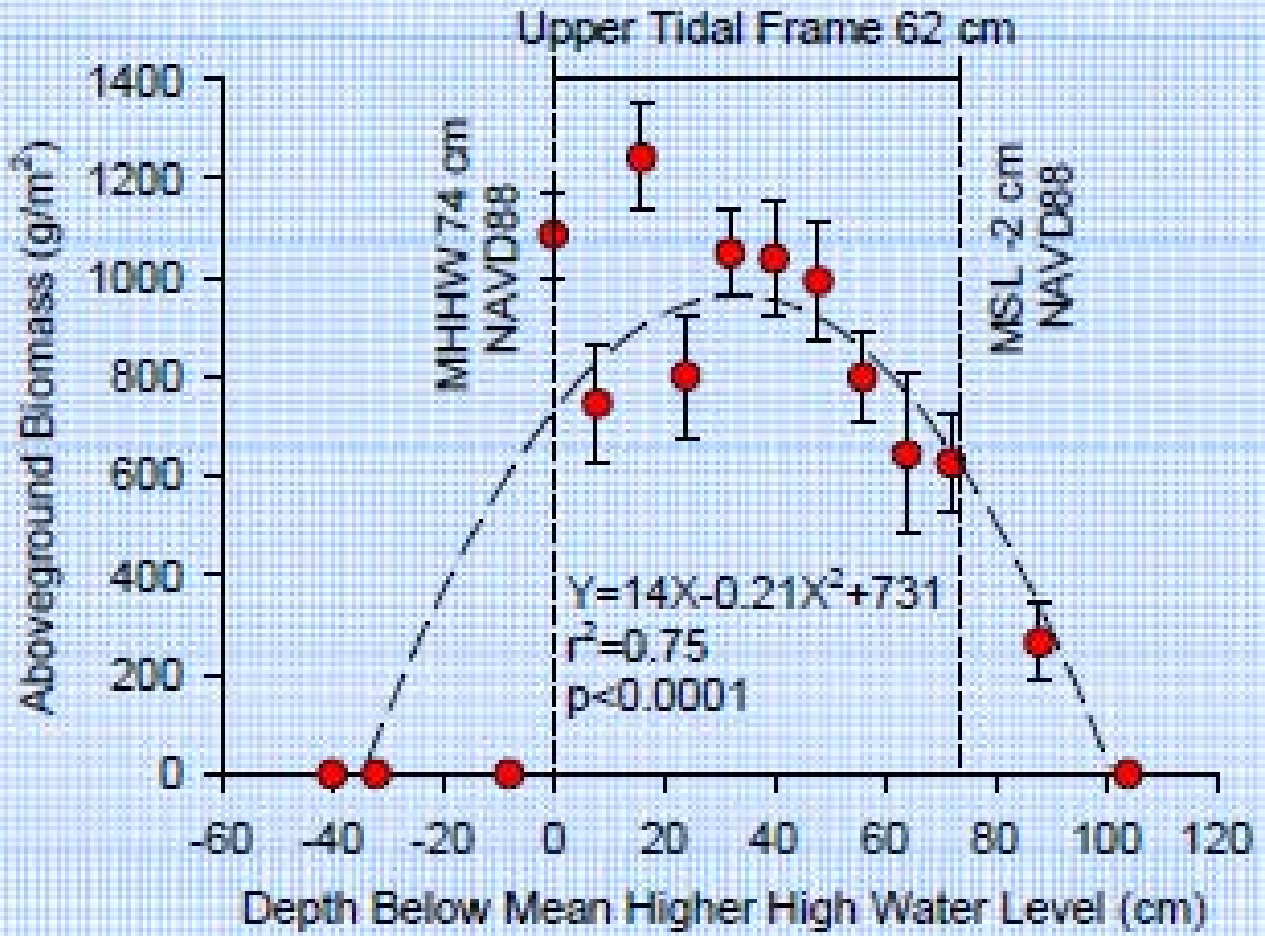
Ribbed Mussels

Acknowledgements

THE ACADEMY
OF NATURAL SCIENCES
of DREXEL UNIVERSITY

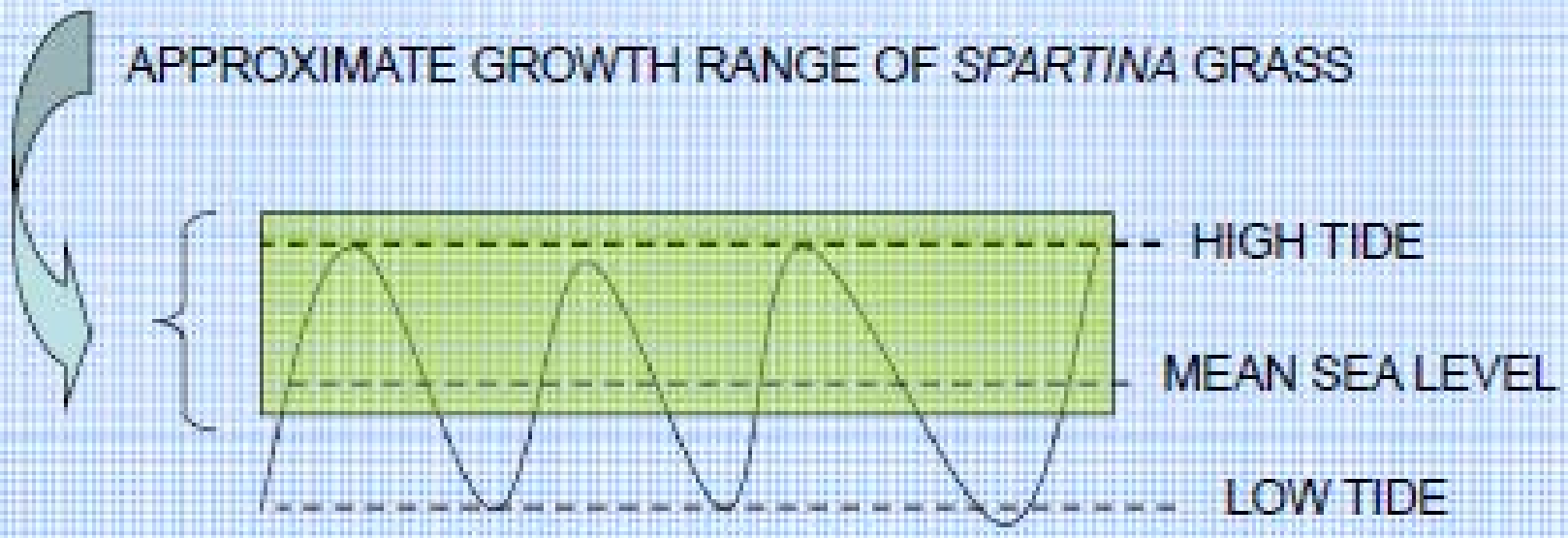
Questions

Vertical Growth Range of *Spartina alterniflora* at North Inlet



James Morris

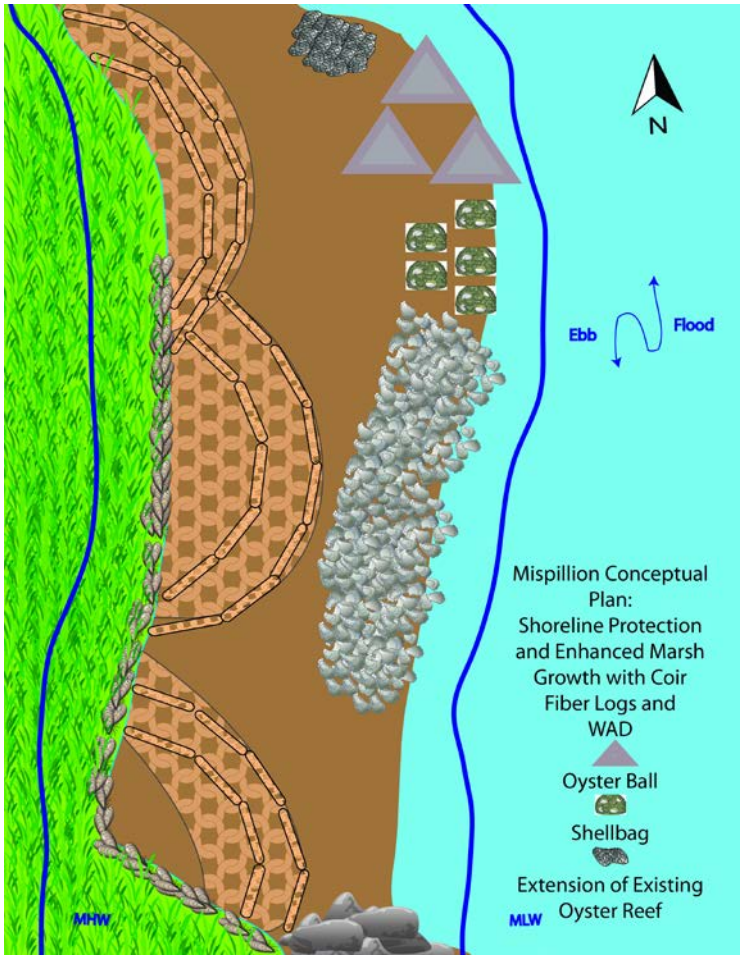
Growth rate = function of depth below MHW
Inundation time = function of depth below MHW



The sensitivity (and sign) of the vegetation to a change in MSL or amplitude will depend on where within this range the marsh surface lies.

James Morris

Mispillion Harbor



Mispillion Conceptual Plan Profile

Salt Marsh Habitat Enhancemnt with Coir Fiber Logs and Natural Existing Oyster Reef Extension Using Wave Attenuation Devices (WADS)

16" (40cm) coir logs will be installed to raise elevation of the mud flat water-ward of marsh between MW and MHW, the optimum rowing range for Spartina alterniflora.