Adaptive management of salt marshes under accelerated SLR

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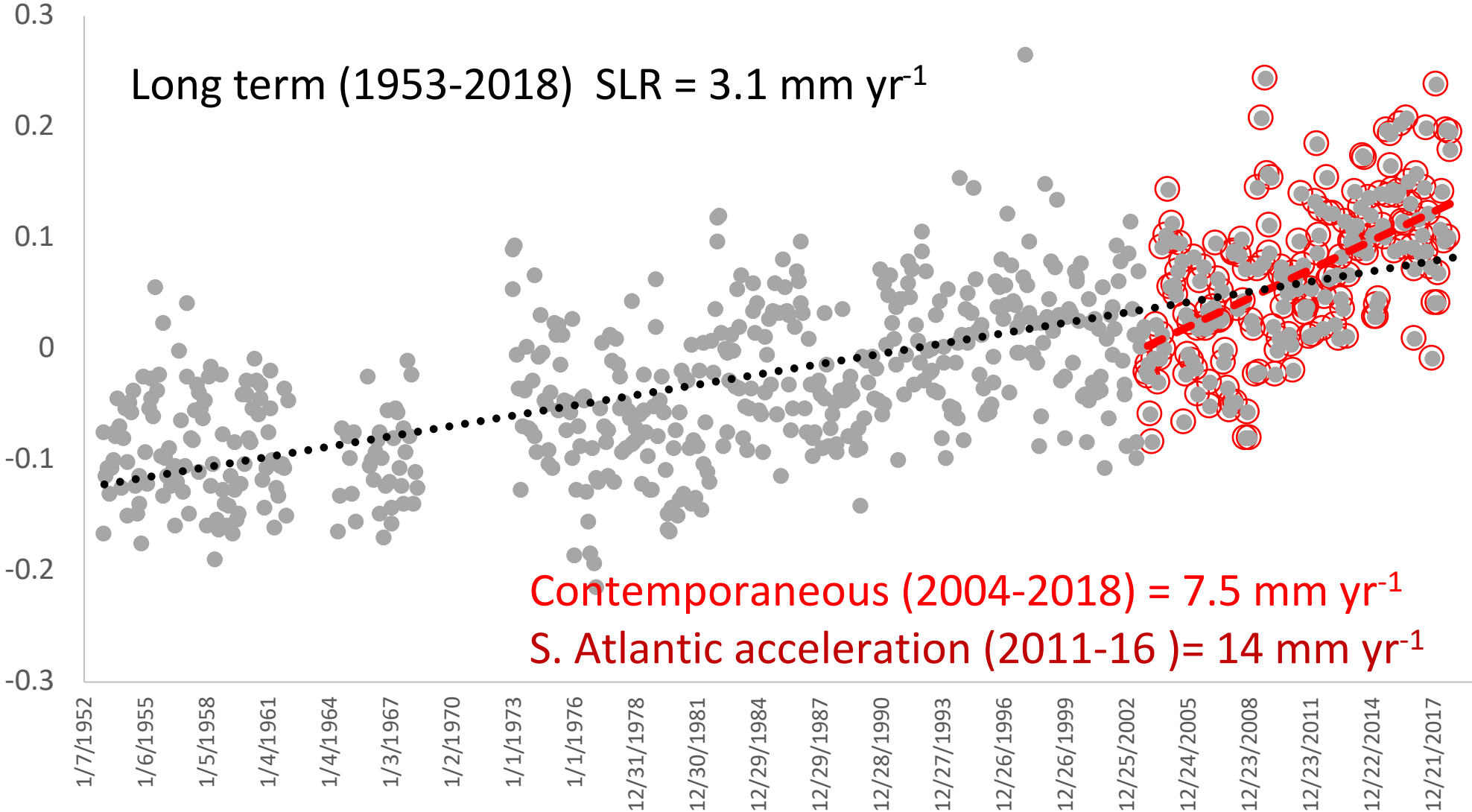
NOAA NCCOS

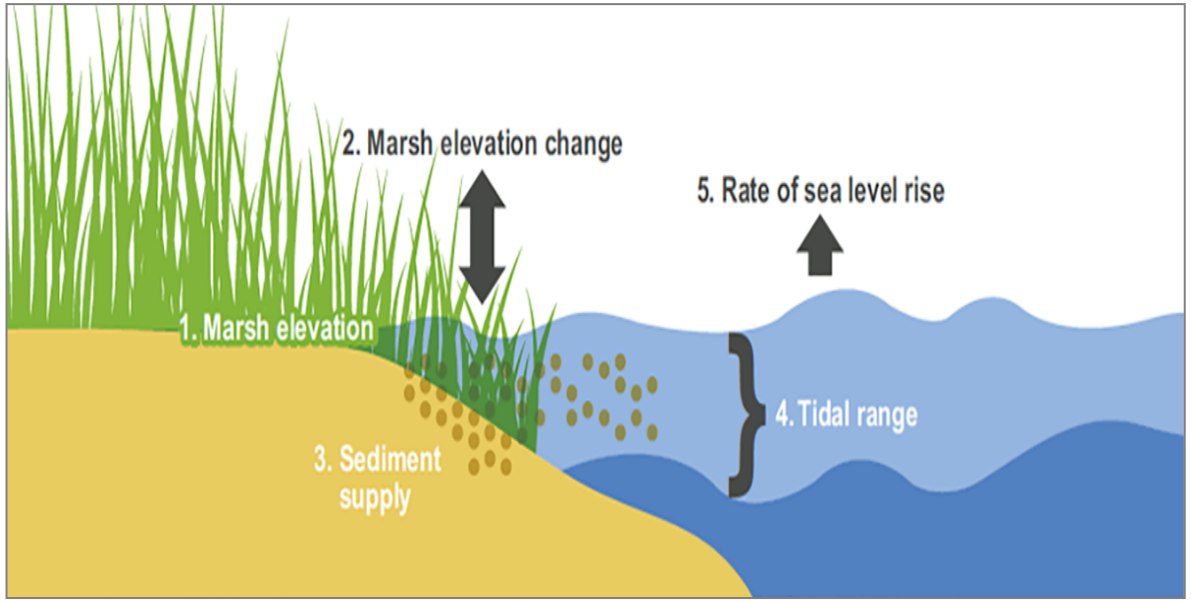
Monthly Mean Sea Level (Beaufort NWLON)



Valle-Levinson et al. 2017 GRL; NOAA NWLON

Possible Marsh Responses to Sea Level Rise

Keep Up

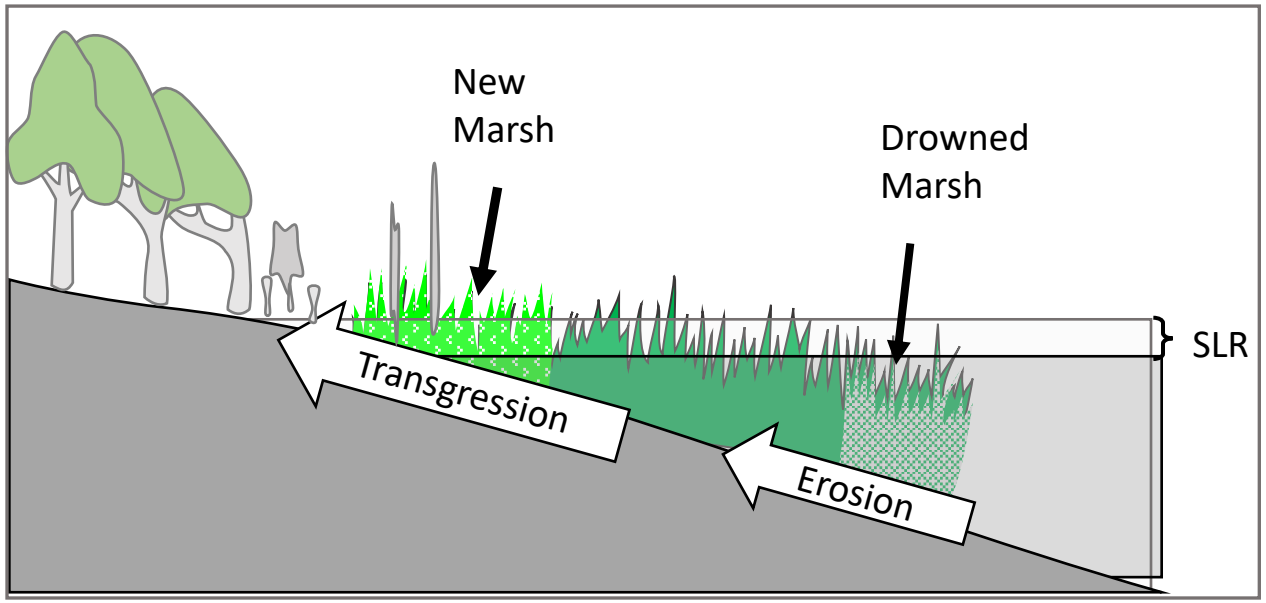


- Requires Adequate Sediment Supply and Plant Biomass

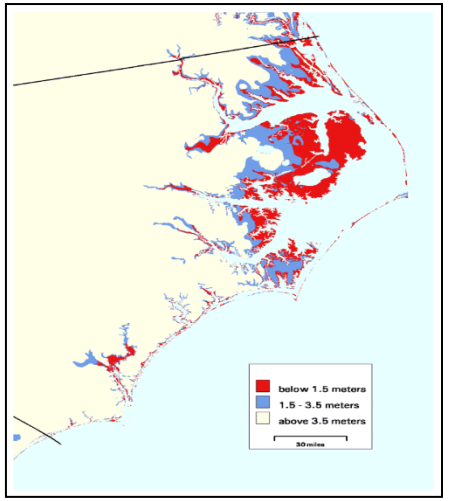
NC salt marshes

- microtidal
- <20 mg/l SSC
- Low end of *Spartina* primary production

Migrate Inland



- Requires undeveloped space to move into and no topographical barriers



< 1.5 m

Living Shorelines

- What are LS design impacts on resilience?
- Does increasing resilience to SLR and erosion alter ecosystem services provided by marsh habitats?

NNBF

NOAA Defined LS

NWP 54-compliant LS

Living Shoreline

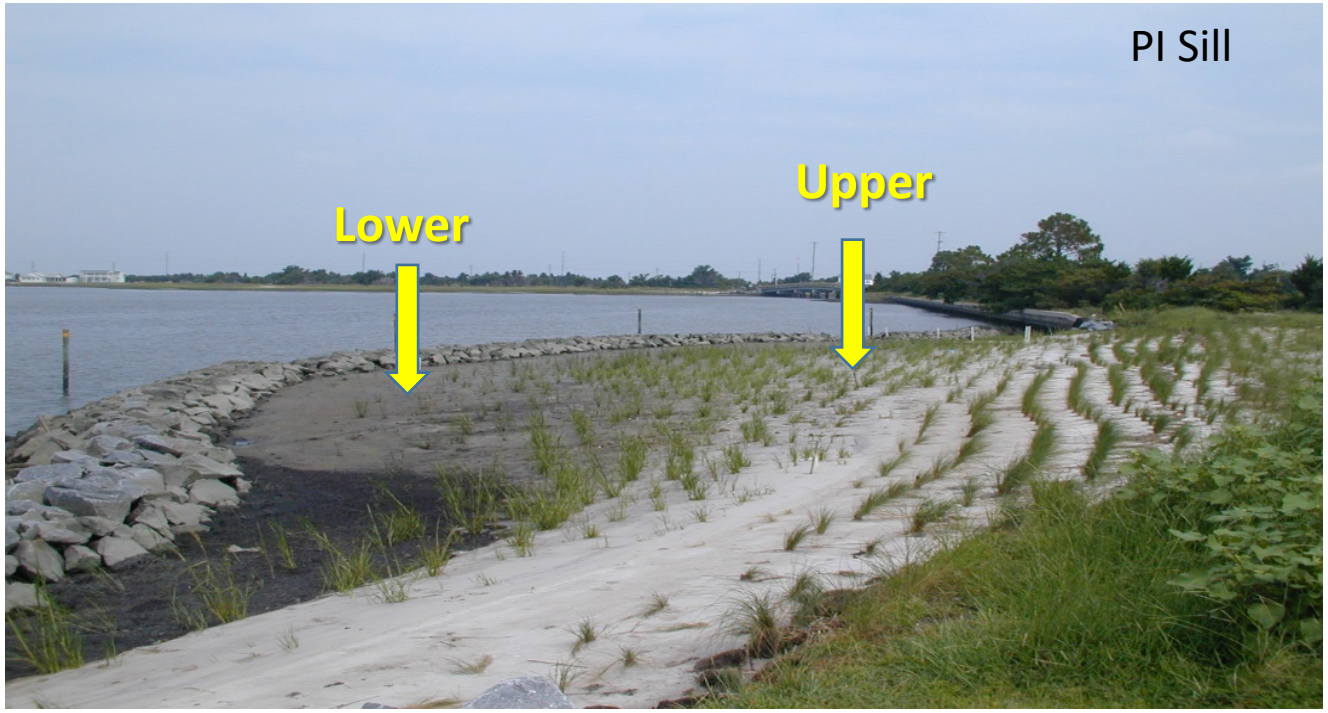
Hardening

Wave Energy, Cost, Permitting Time

Living Shoreline Marsh Monitoring 2004-2019

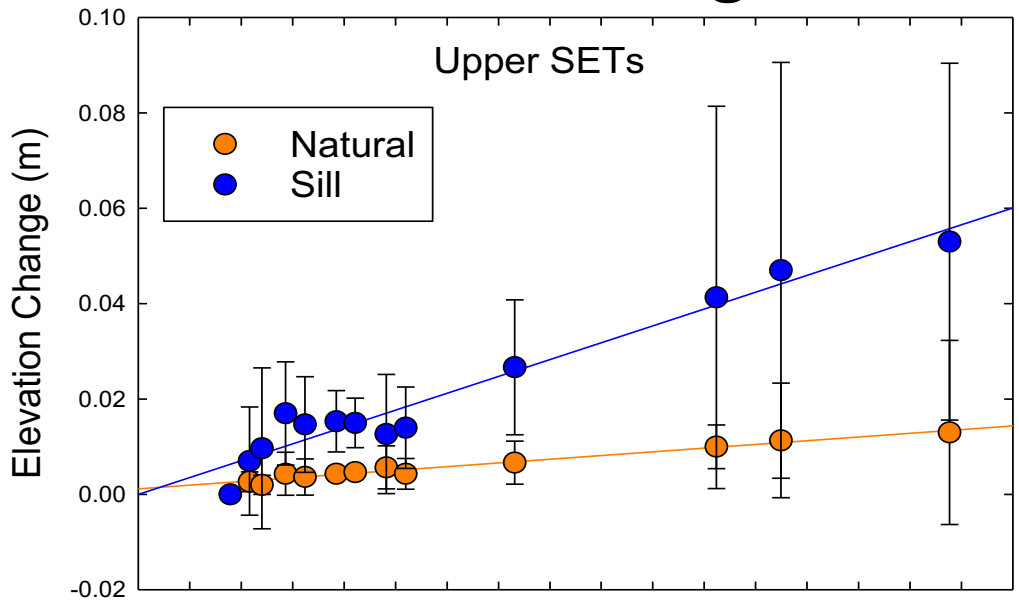
- **15 years of monitoring data (veg and SETs)**
- **3 paired sites (natural and sill)**
- **NOAA NCCOS and NC NERRS collaboration**

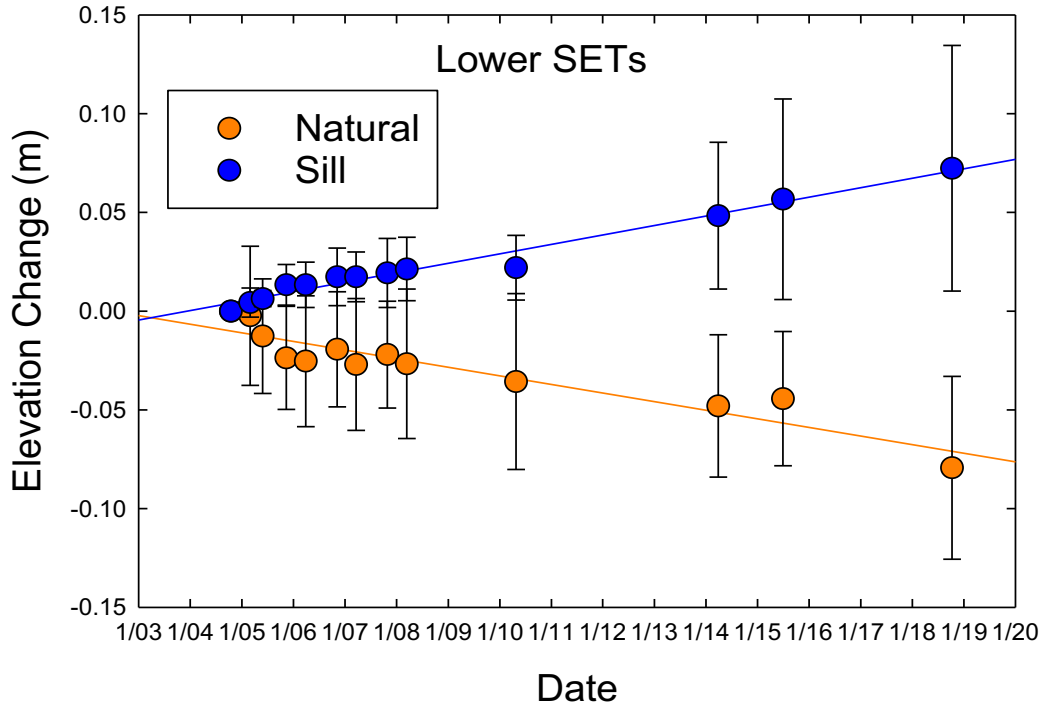
Carteret County, NC sites



SETs established within 1 m of lower and upper extent of *S. alterniflora*

Average Elevation Change Over Time

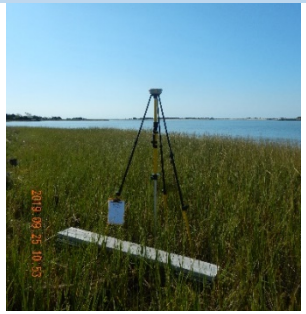




Measuring marsh elevation change in NC Living Shoreline Sites

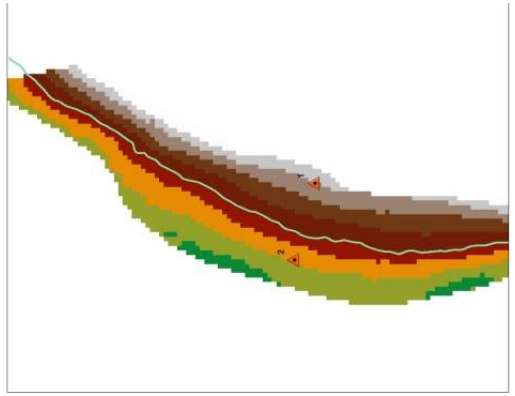
Paired Marsh-Sill and Natural Fringing Marsh Sites 2004-2018

Beaufort NCBE CORS
VZ = -2.5 mm/yr
Upward = 3.3 mm/yr

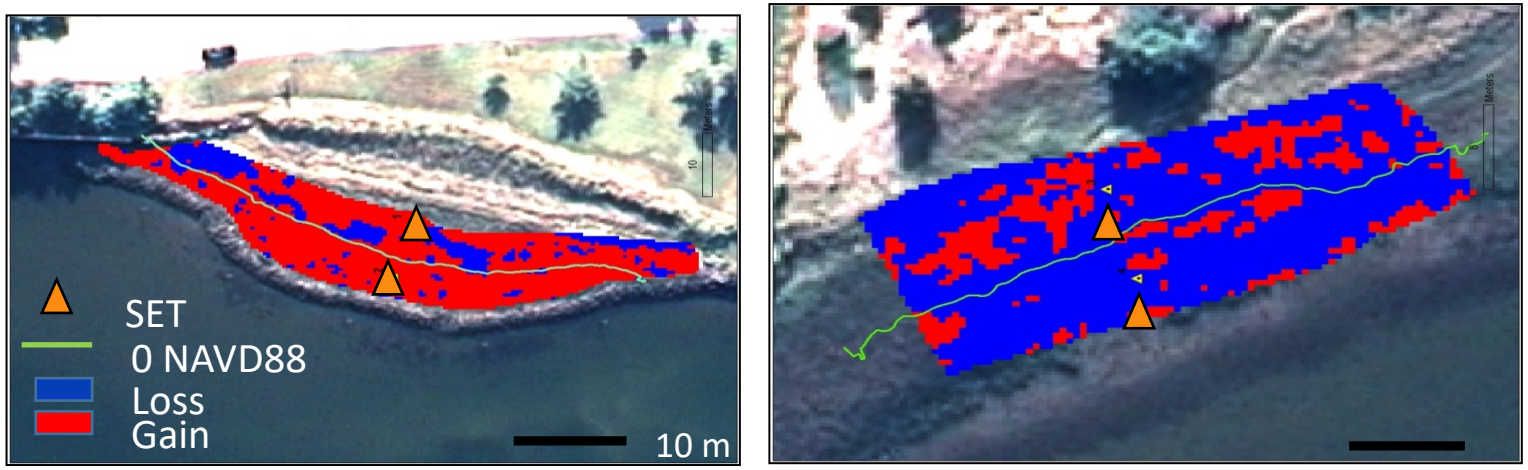


Surface Elevation Table

RTK GPS



Digital Elevation Models

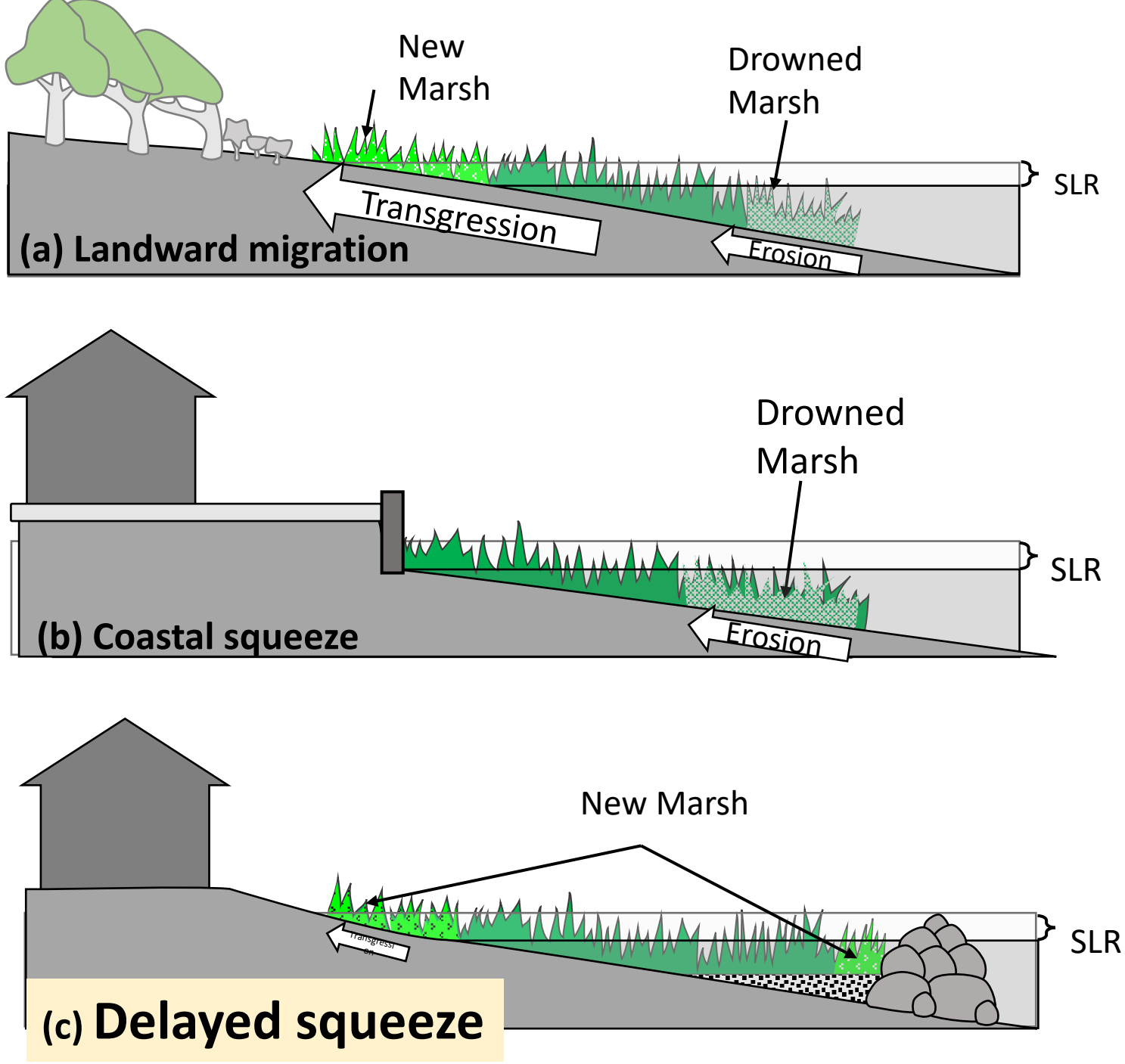


Change in Marsh Surface Elevation

- Site DEMs reveal similar elevation change as SETs
- SETs resurveyed in 2019 have 3 mm y^{-1} elevation loss, consistent with CORS
- Sill marshes are increasing surface elevation near the long term RSLR rate of 3.1 y^{-1}
- BUT only 2 Sill SETs increasing >7 mm y^{-1}
- **Regional analysis of 37 SETs in natural marsh show only 2 increasing at >7 mm y^{-1} over last 12 yrs**

Using Living Shorelines to protect property and Infrastructure

A longer view…

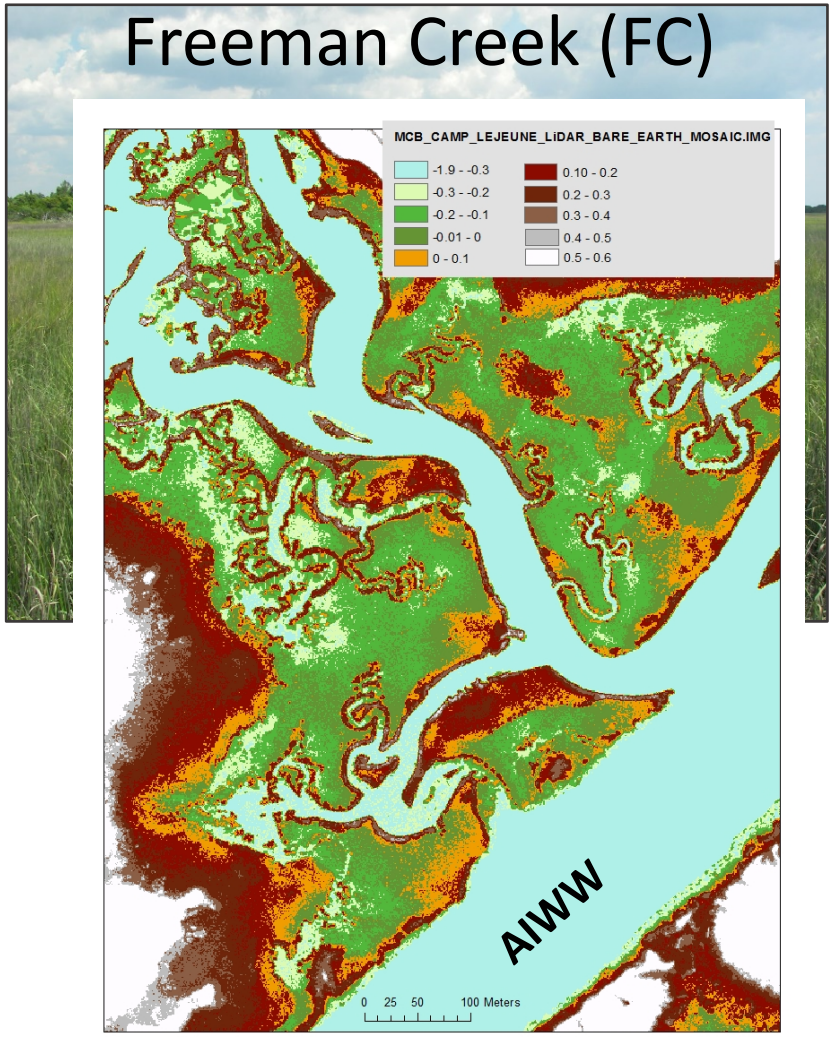


Currin 2019. Living Shorelines for Coastal Resiliency in *Coastal Wetlands: An Integrated Assessment.* Elsevier

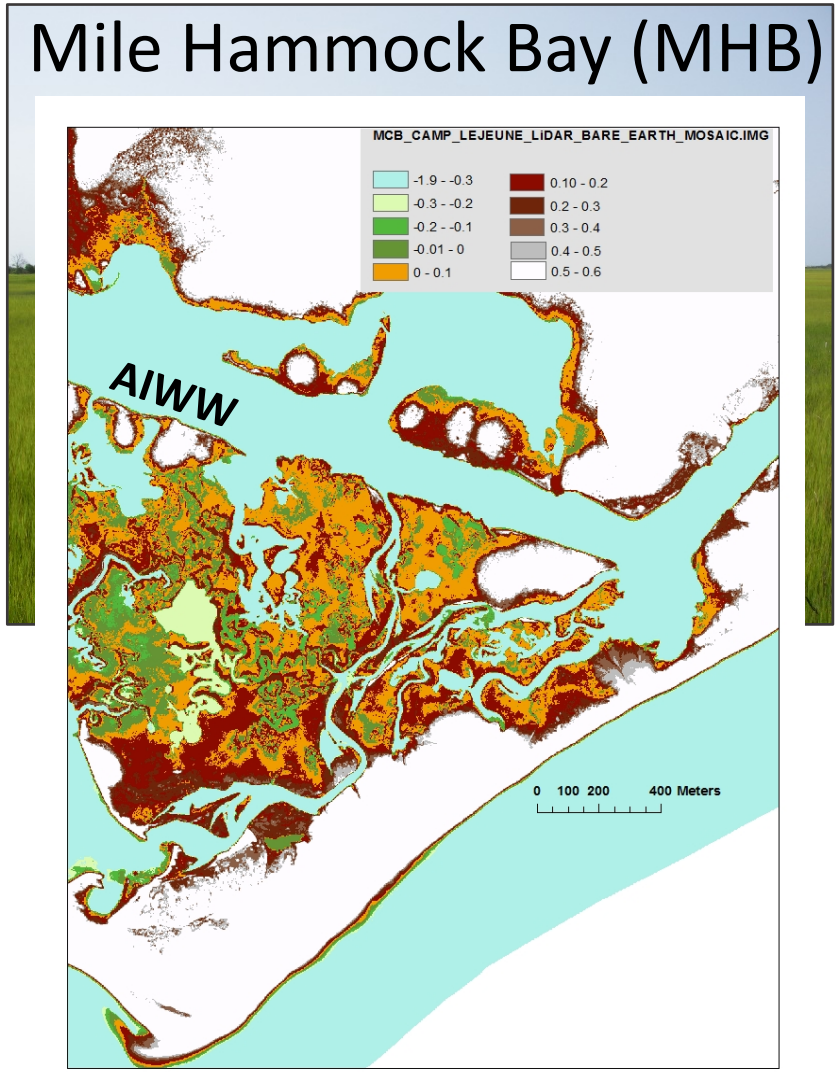
Experimental thin layer application to low-lying and fragmented salt marshes

Carolyn Currin & Jenny Davis
NOAA NCCOS Beaufort NC

Freeman Creek (FC)

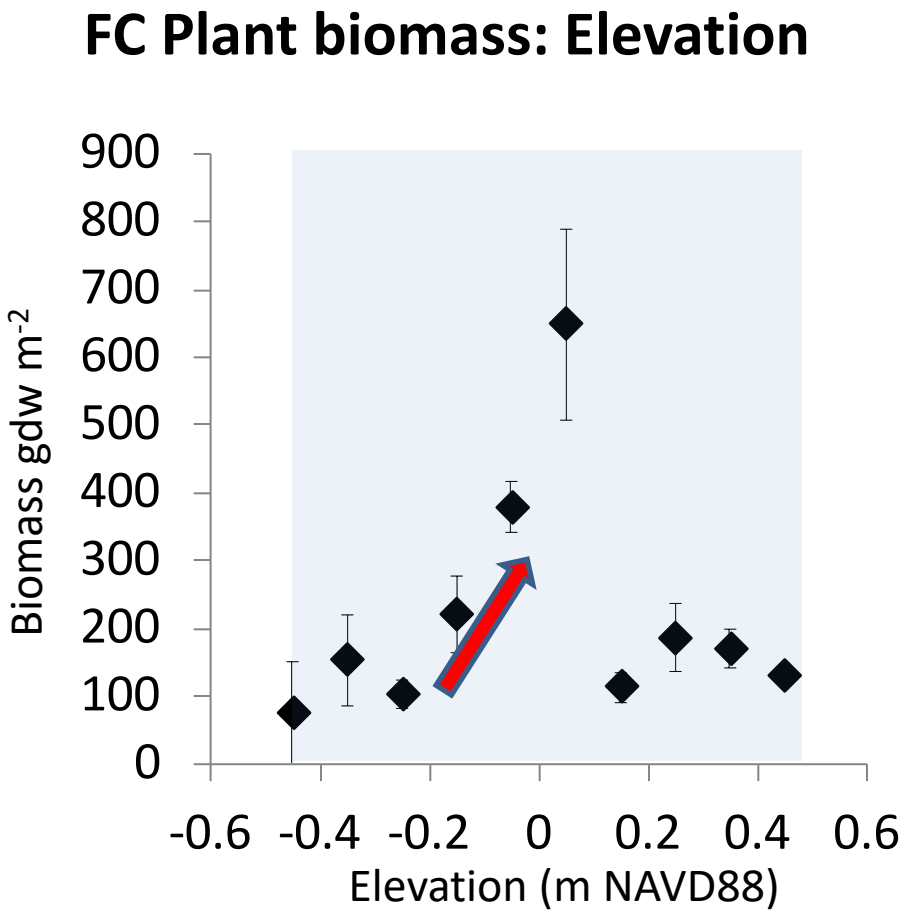


Mile Hammock Bay (MHB)



Thin layer disposal of dredged material

Atlantic Intracoastal WaterWay, NC

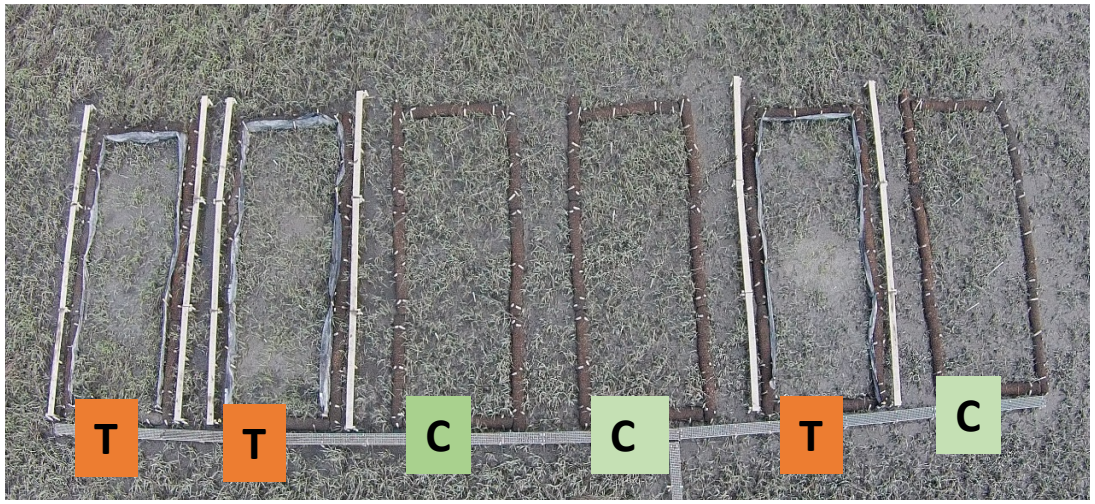


Davis et al. 2017 *Est & Coasts*

FC TLA Plant Response to Sediment Addition

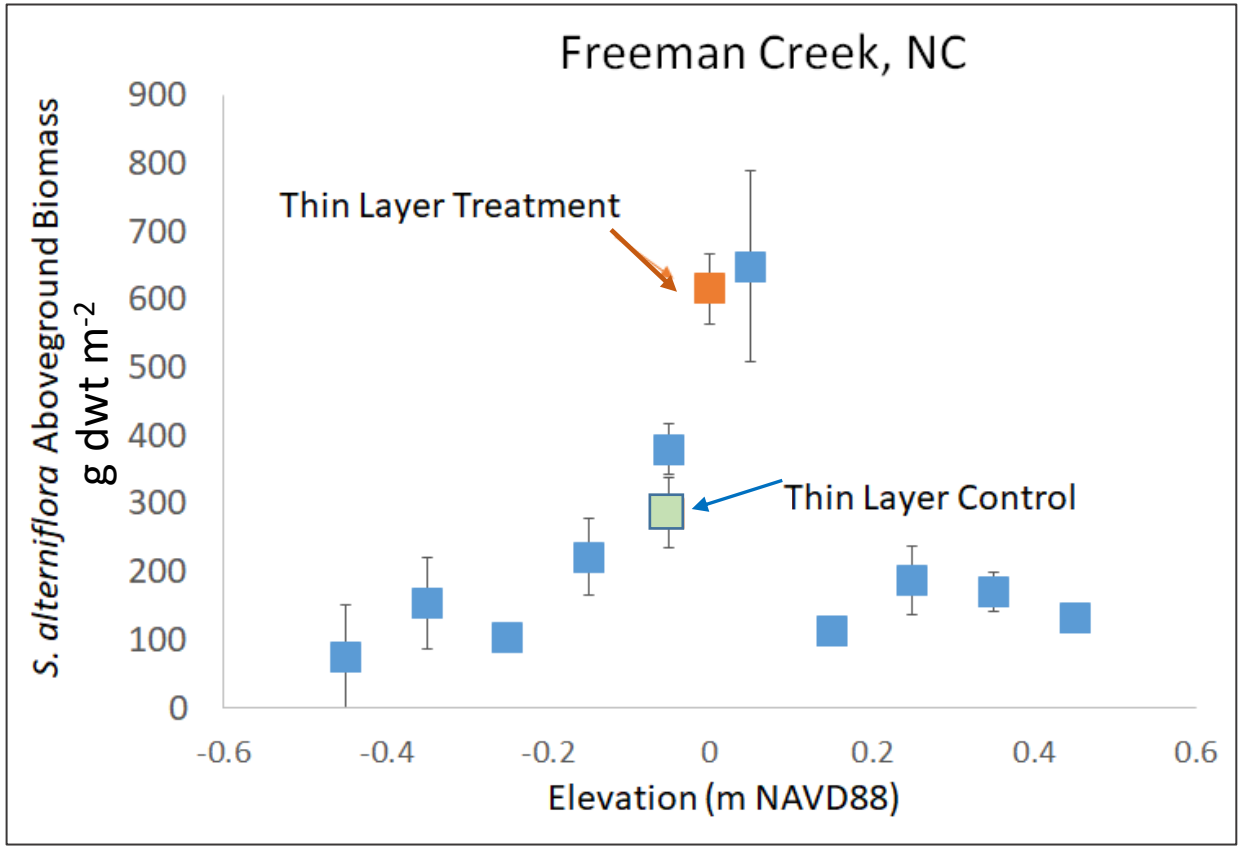
2x increase aboveground *Spartina* biomass

~10 cm increase in elevation



20 yrs of sediment accumulation in 2 weeks

15 months post-application



Thin layer disposal of dredged material

Marsh Fragmentation

Mile Hammock Bay

Erosion of pond and creek edges is predicted to result in more fragmentation – particularly in systems with low sediment supply

*** Boat wakes exacerbate the problem in this area**

Mile Hammock Bay Site, NC

Snell pumping sediment to pond April 2018

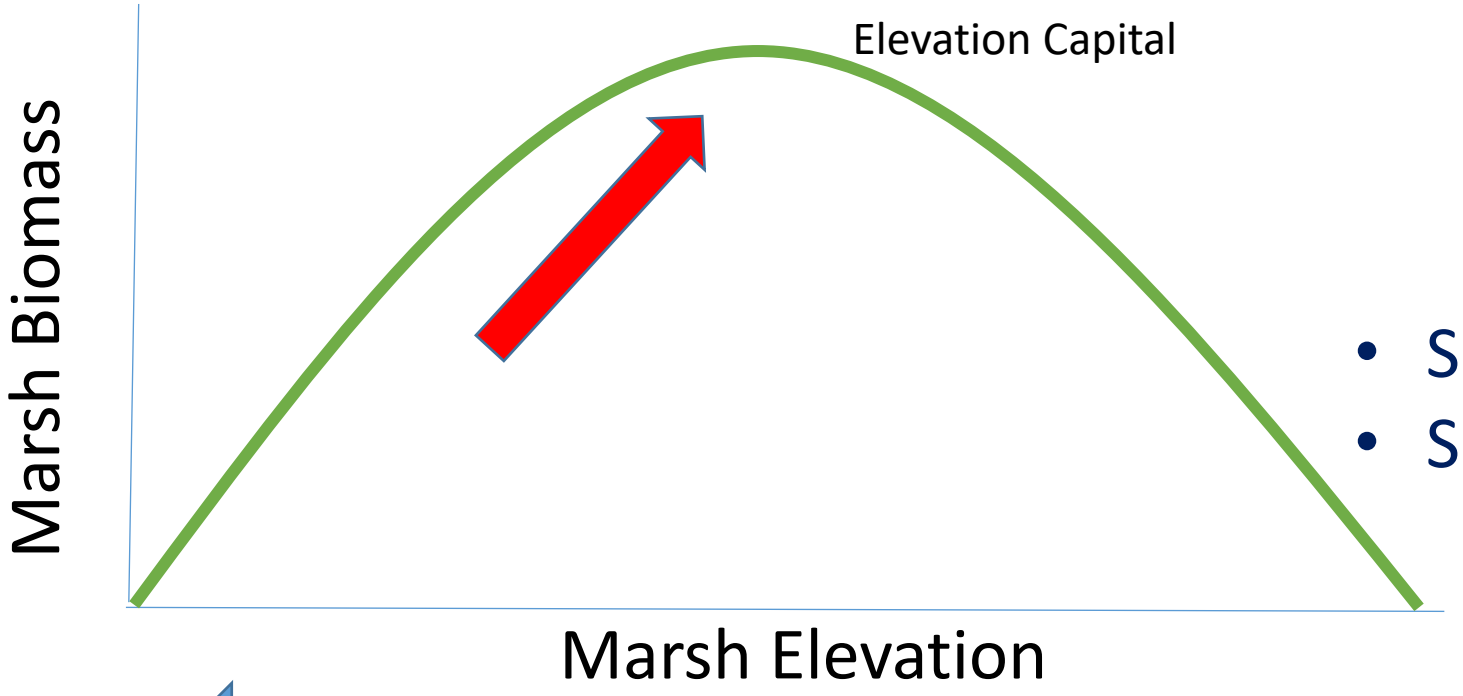
https://coastalscience.noaa.gov/news/nccos-usace-help-marines-keep-pace-with-sea-level-rise-at-camp-lejeune-video/

How to balance Resiliency and Ecosystem Services?

What time frame should be targeted for restoration and resilience projects?

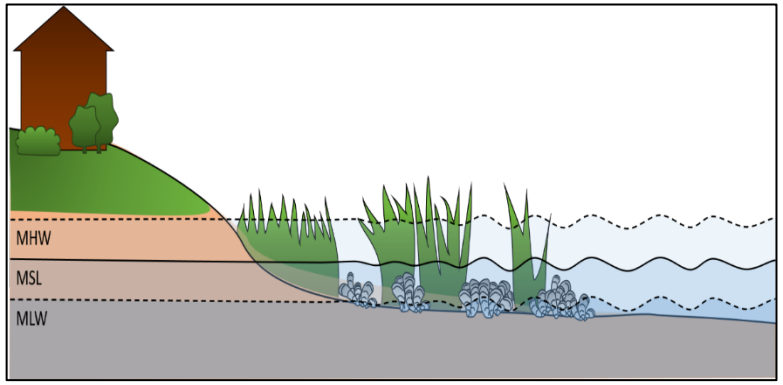
Can we balance Magnuson-Stevenson and Clean Water Acts with resiliency?

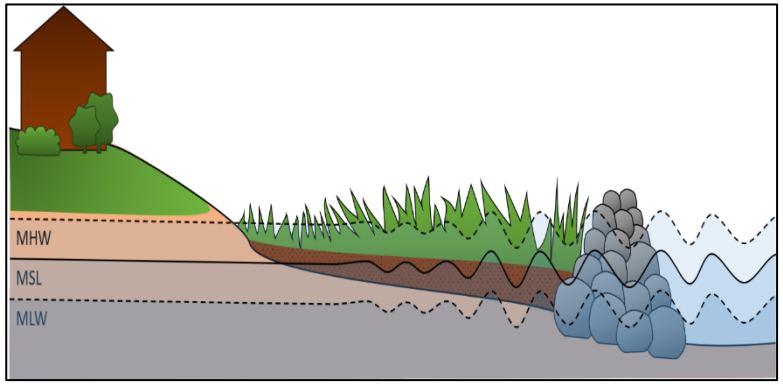
Should property owners be told a Living Shoreline is not ‘a line in the sand’?



- Site specific factors
- Site specific goals

Habitat Change leads to changes in Ecosystem Services.. and RSLR vulnerability





	Ponded	Low Marsh	High Marsh	Stone Sill LS
−	• Less SLR resiliency • Vegetation • C emission	• Less SLR resiliency • Lower plant diversity	• Less faunal utilization • Reduced denitrification • Reduced Sediment trapping	• Shallow subtidal • Reflect wave energy • Non-native hard substrate; Invasives
+	• Fish utilization • Denitrification	• Faunal utilization • Denitrification • Sediment trapping • C sequestration	• Greater SLR resiliency • Greater plant biodiversity • C Sequestration	• Sediment trapping • Erosion protection • Fish biodiversity • Oyster settlement