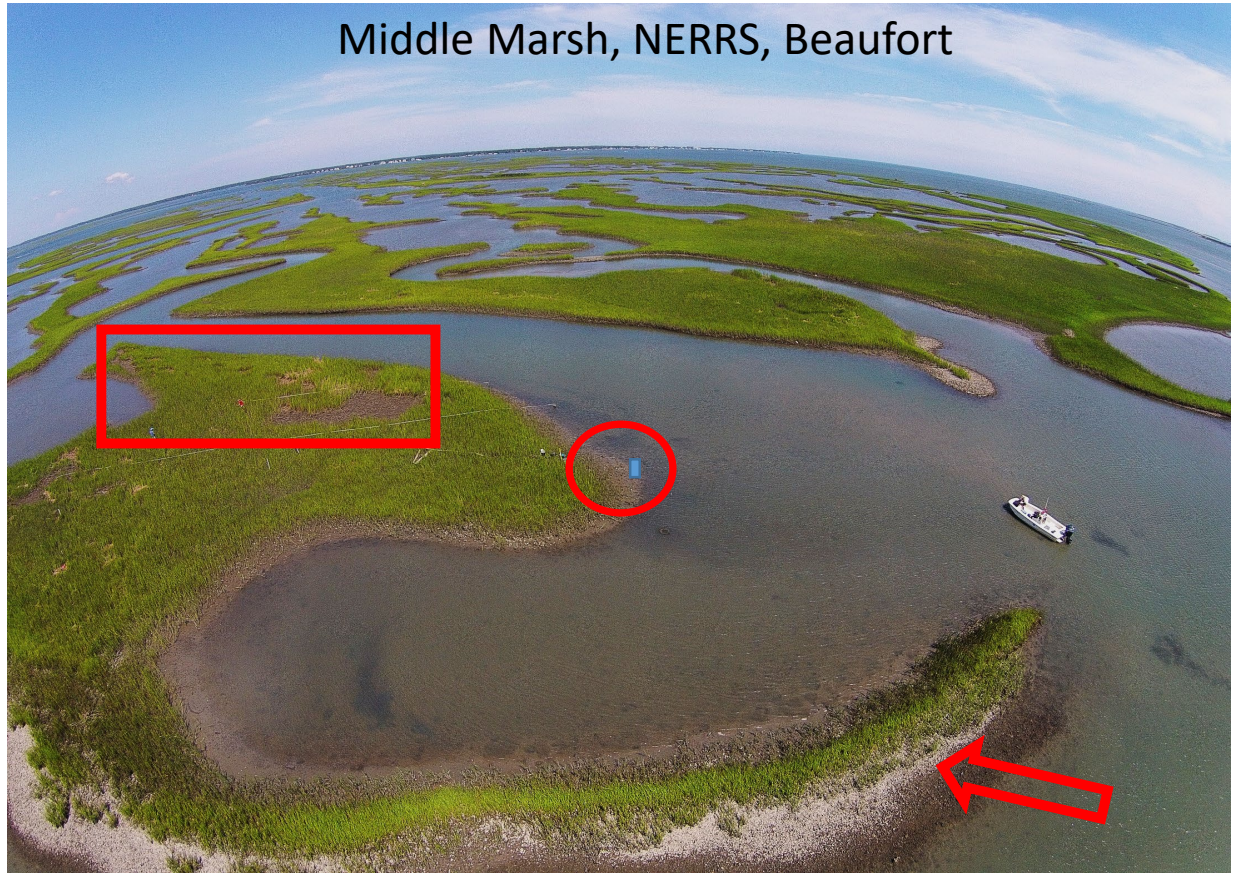
NC Salt Marshes: Threats and Conservation Opportunities

Carolyn Currin
NOAA NCCOS, Beaufort, NC



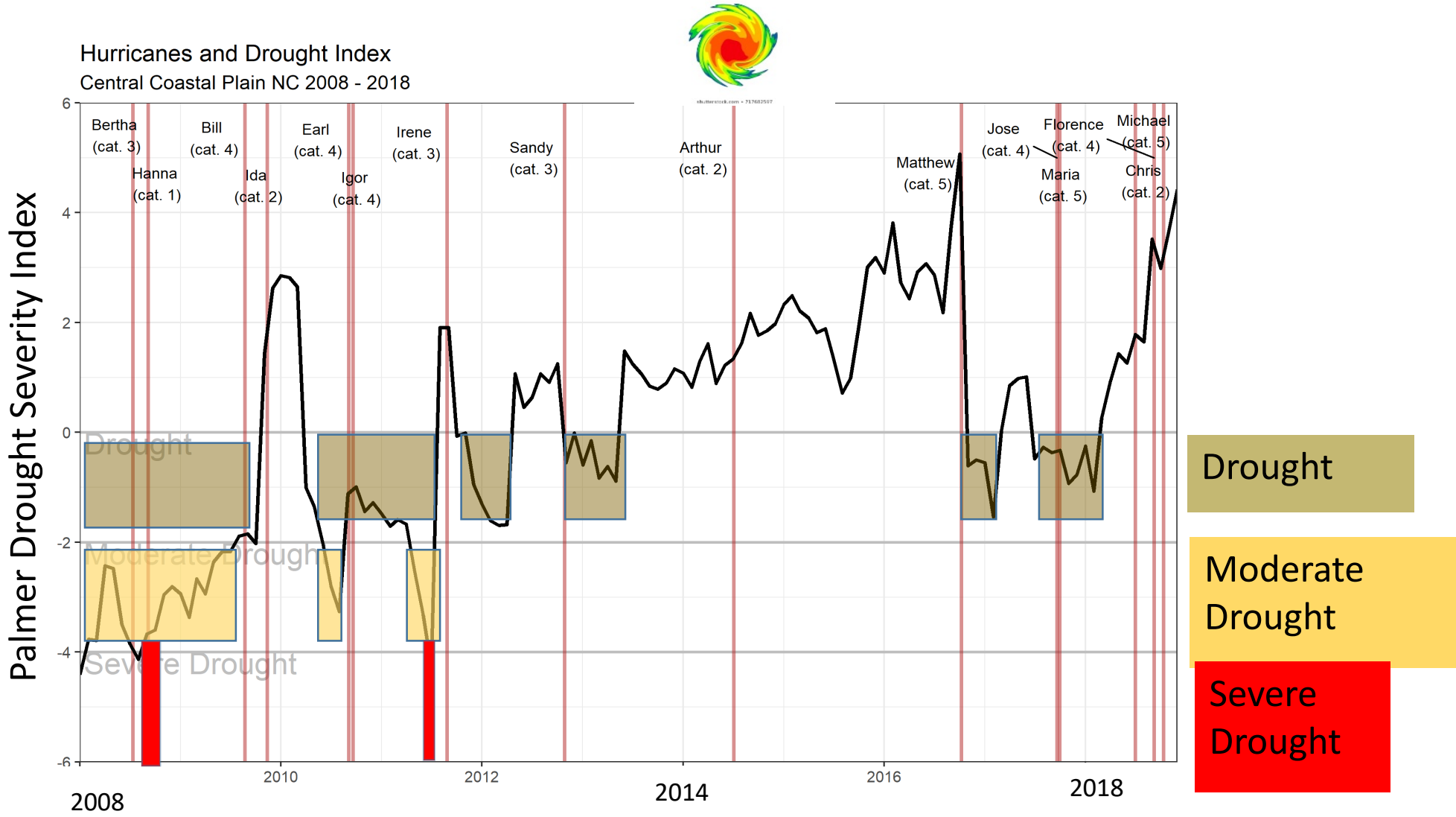
NOAA Beaufort Lab Living Shoreline

Drought **SLR** **Erosion**

Barriers to Landward Migration

Eastern North Carolina Drought and Hurricanes

2008 – 2019

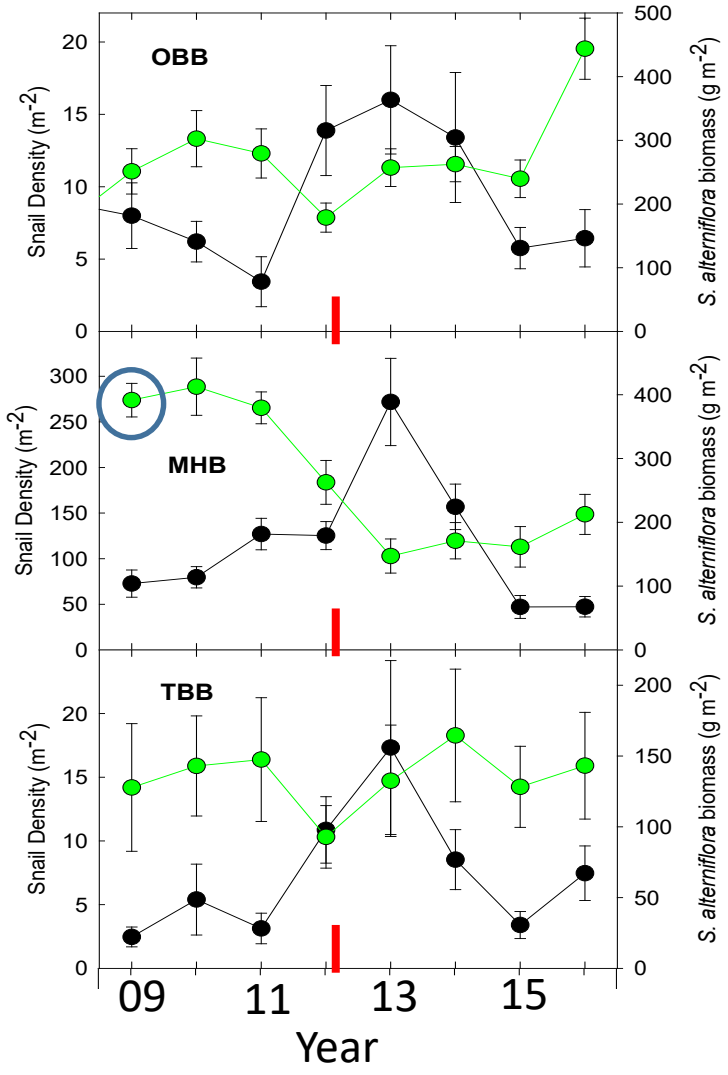


Drought

Moderate Drought

Severe Drought

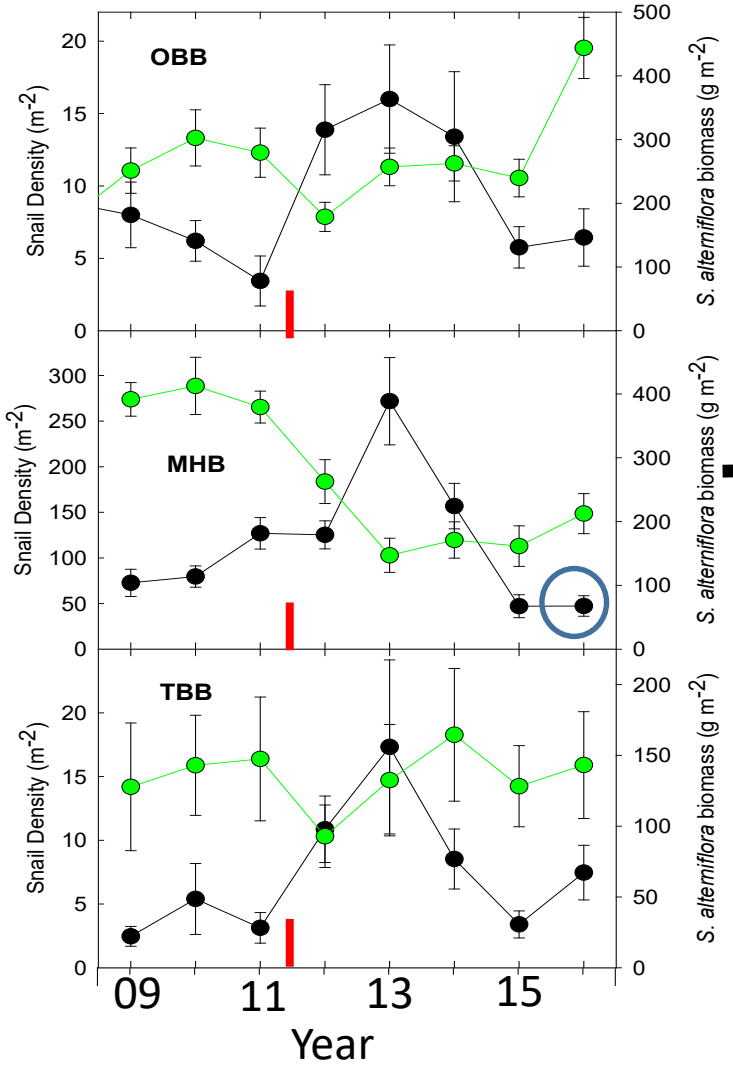
Drought impact on salt marsh biomass



- Significant decline in *Spartina* alterniflora biomass in 2011-12 in MCB Camp Lejeune marshes and Carteret County fringing marshes
- Marsh plant decline followed by *Littoraria* snail increase

MHB 2009

Drought impact on salt marsh biomass



- Significant decline in *Spartina* alterniflora biomass in 2011-12 in MCB Camp Lejeune marshes and Carteret County fringing marshes
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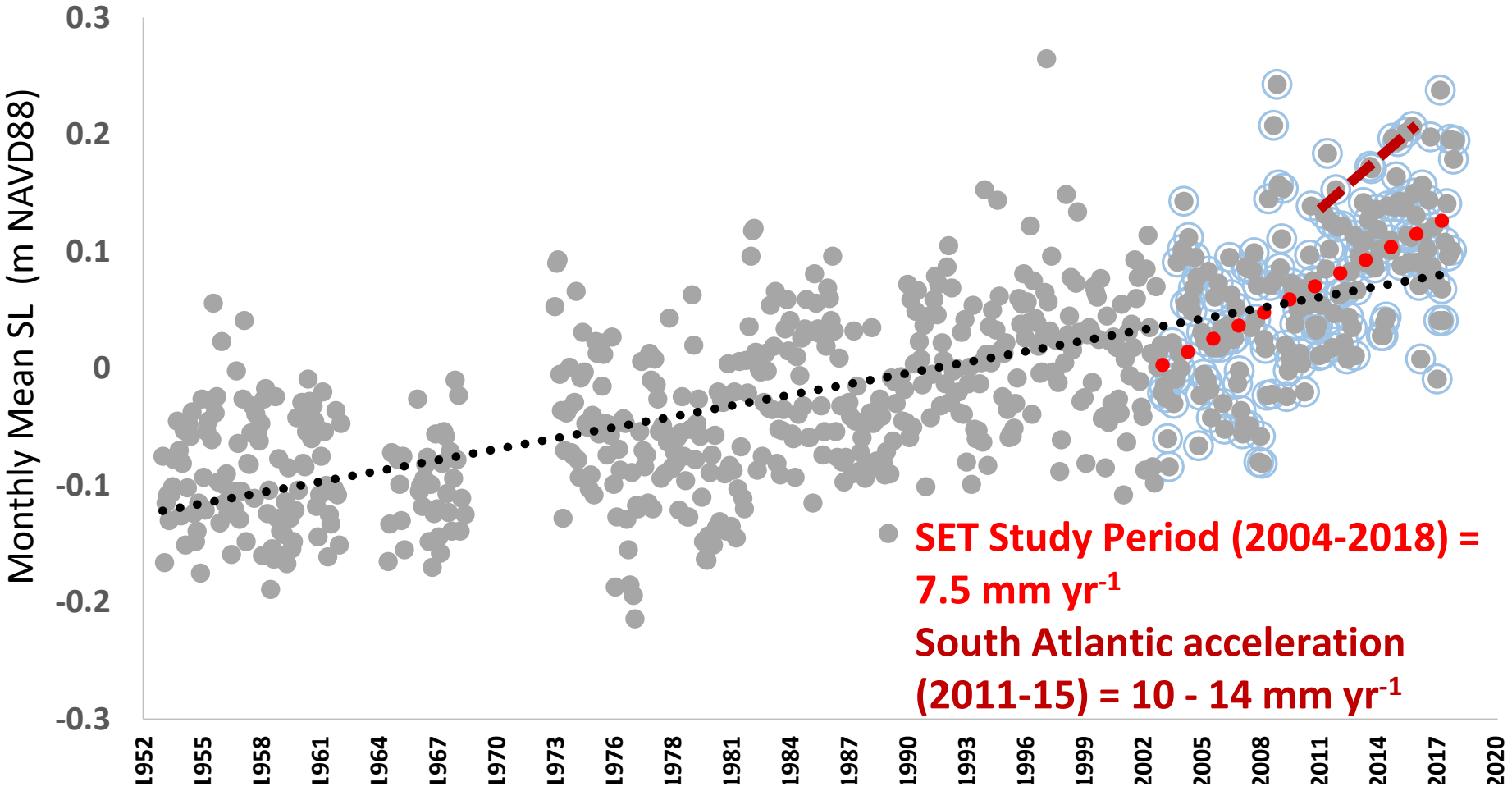
High marshes subject to longterm dieoff from drought events

MHB 2016

Relative Sea Level Rise

Beaufort NC tide gauge

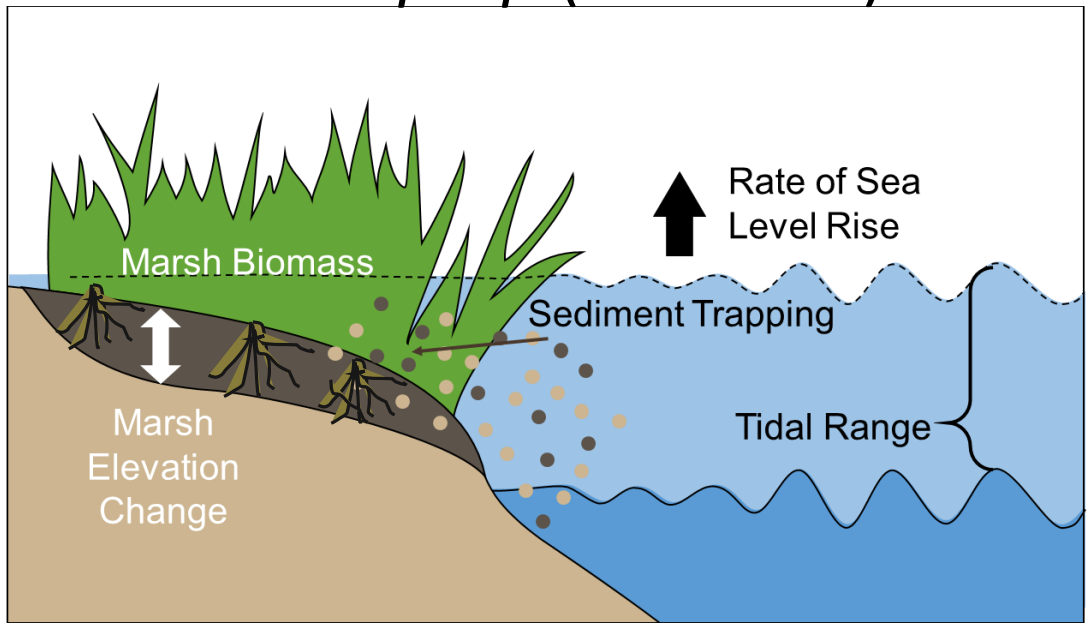
Long term (1953-2018) SLR = 3.1 mm yr^{-1}



NOAA NWLON; Valle-Levinson et al. 2017 GRL

Marsh Response to Sea Level Rise

Keep Up (accretion)

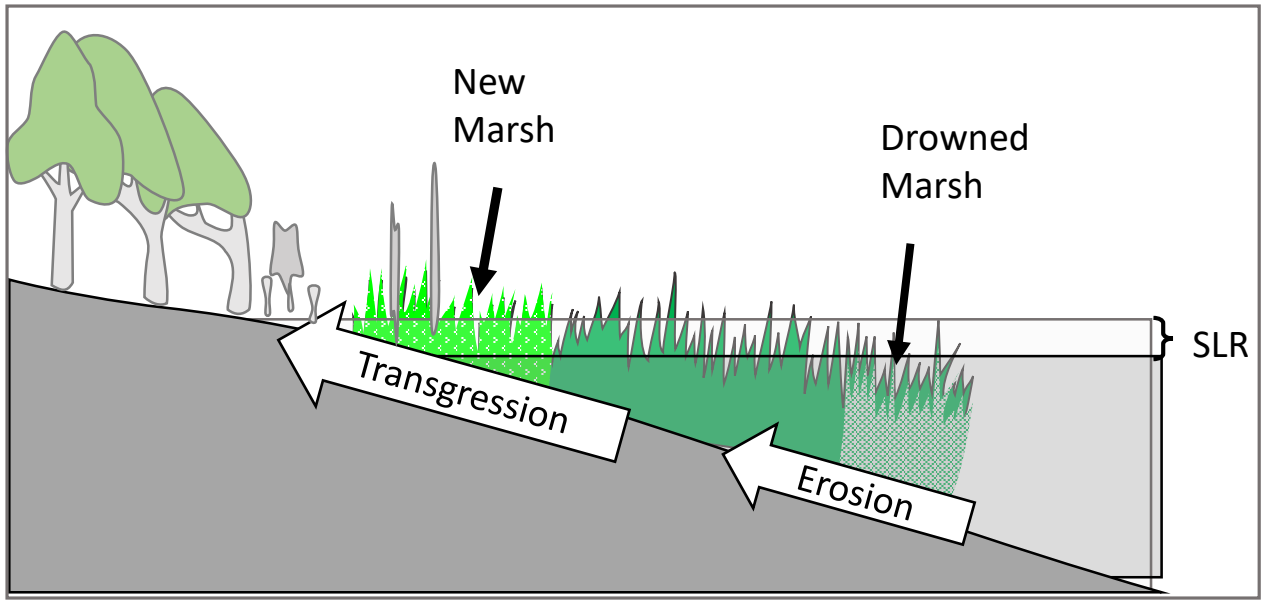


- Requires Adequate Sediment Supply and Plant Biomass

NC salt marshes

- microtidal
- Low suspended sediment
- Low end of *Spartina* primary production

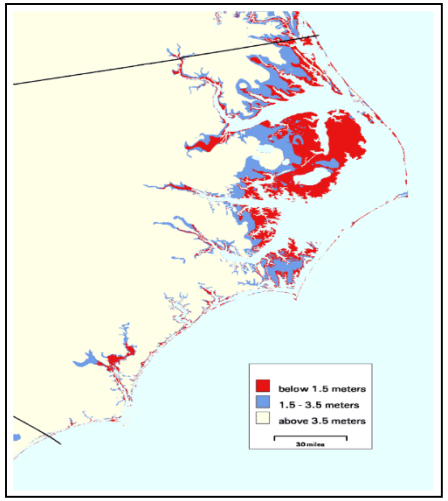
Move Up (transgression)



- Requires undeveloped space to move into and no topographical barriers

- Low-lying land

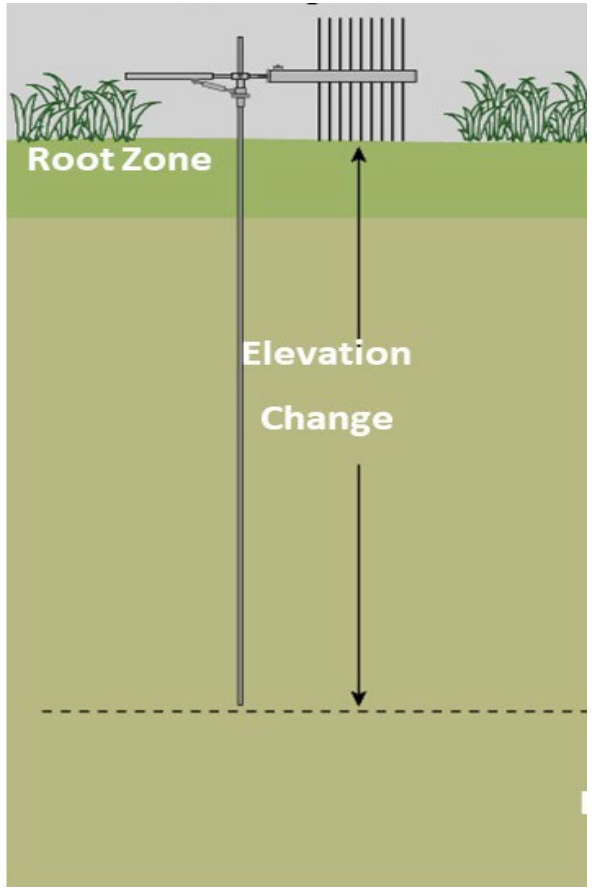
< 1.5 m



NC Salt Marsh Elevation Change

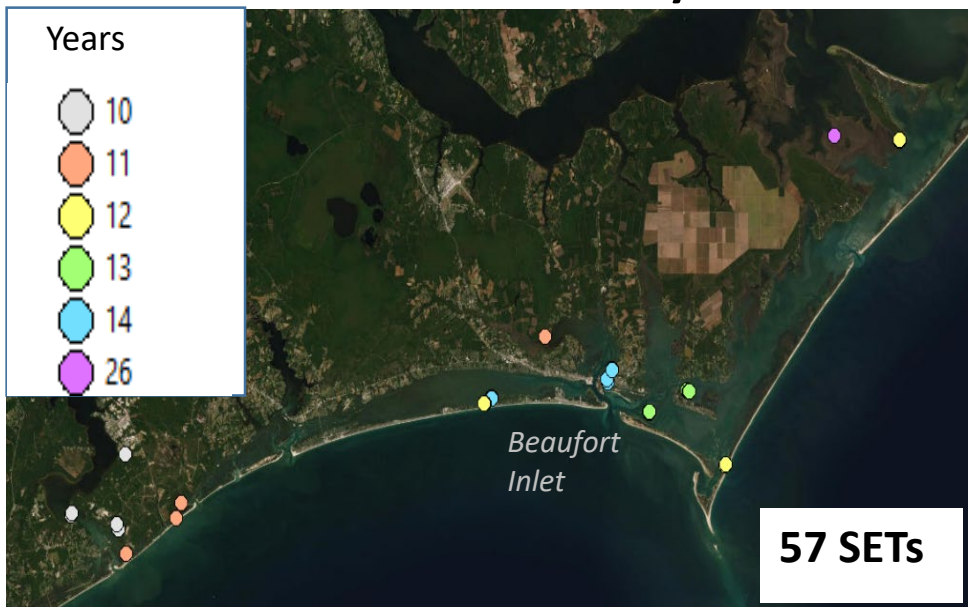
Keeping up?

Surface **E**levation **T**able

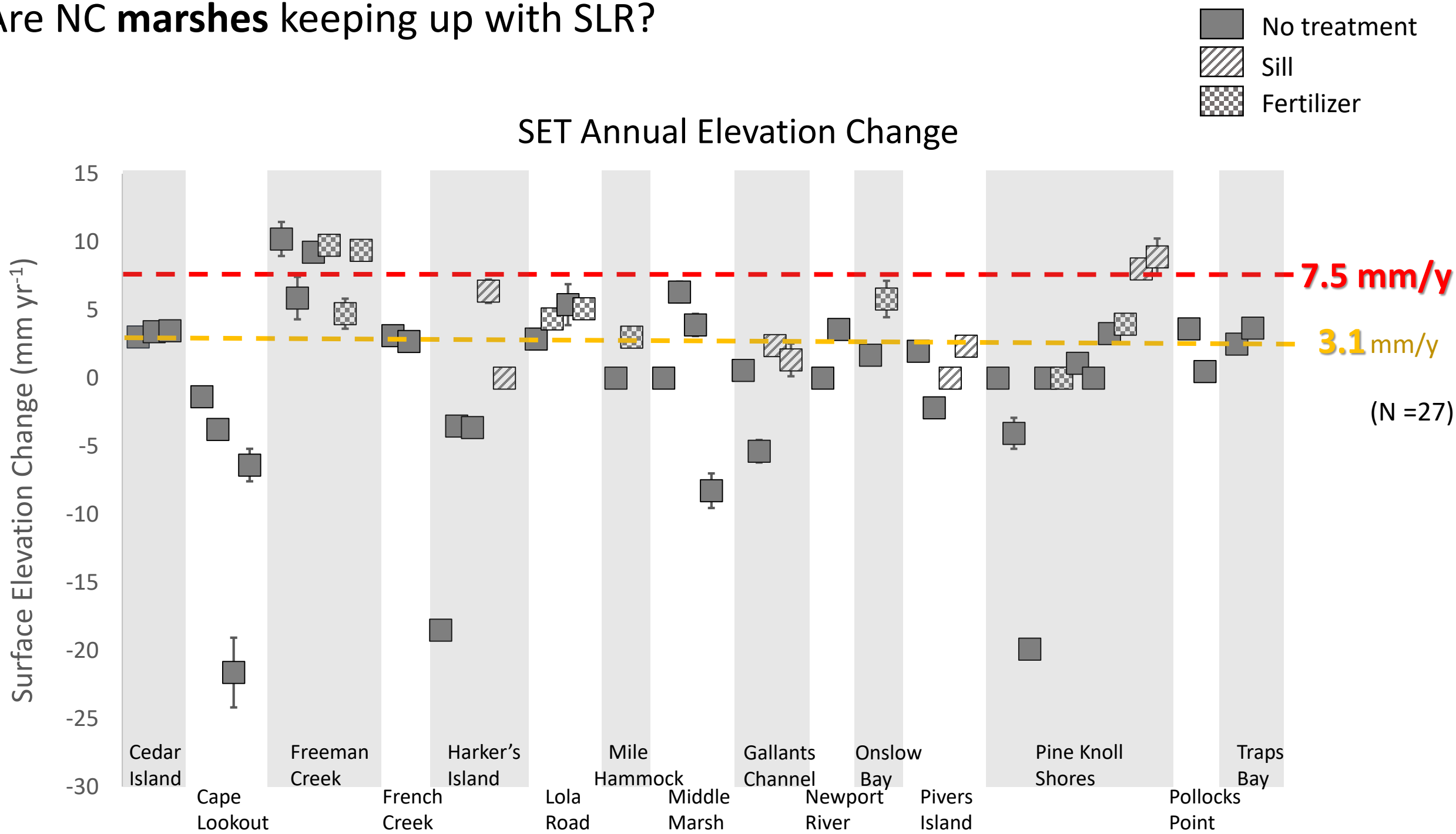


Reading SET at Pine Knoll Shores

Location of Study SETs



Are NC **marshes** keeping up with SLR?

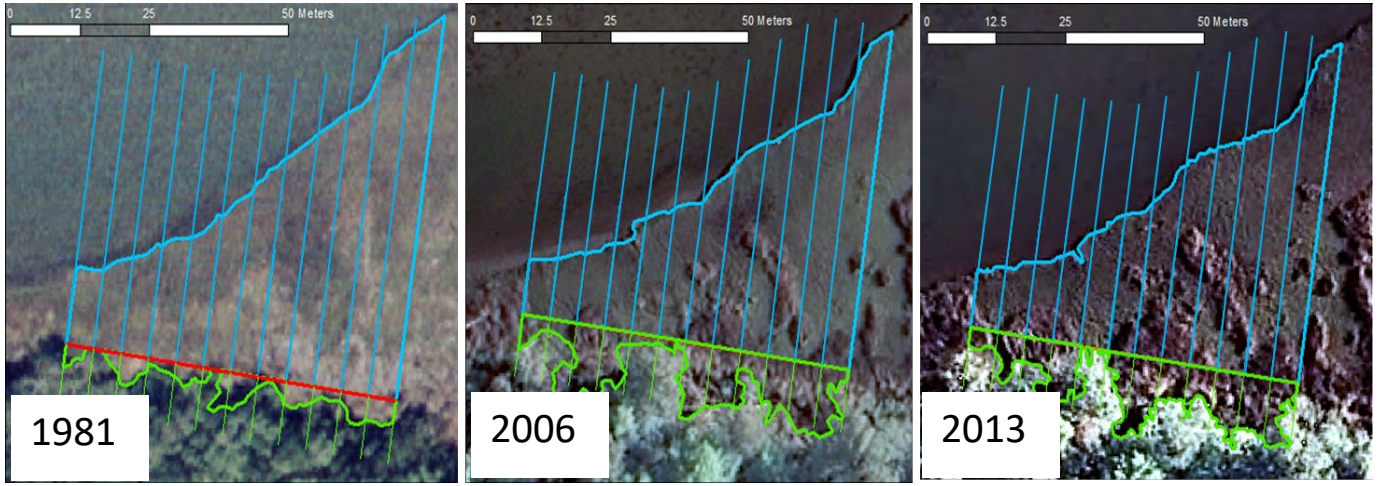


Moving Up: Marsh Migration into Uplands

- North Carolina – between 2001-2014, 15% of coastal forest in unmanaged public land changed to salt-tolerant shrubs and marsh…'
  Smart et al. 2020. Environmental Research Letters
- Chesapeake Bay – in last century, 94 km^2 of drowned eroded marsh replaced by 101 km^2 new marsh in uplands *Schieder et al. 2018*

Migration Corridors critical to maintaining marsh habitat

- Carteret County NC – Marsh landward expansion documented at half of non-bulkheaded sites, only 16% maintained area
  -**Bulkheaded sites**, with no landward expansion, had **3x higher net loss of marsh area**



Burdick et al, Submitted Est&Coasts

- Statewide modeling efforts to identify and protect corridors for marsh migration

TNC Resilient Coastal Sites for Conservation in the South Atlantic US (2019) https://www.nature.ly/SEcoast

NC NWL Action Plan Coastal Habitats
Olander and Warnell https://storymaps.arcgis.com/collections/2154ab2816674f7d8c7429fe87f48830?item=4

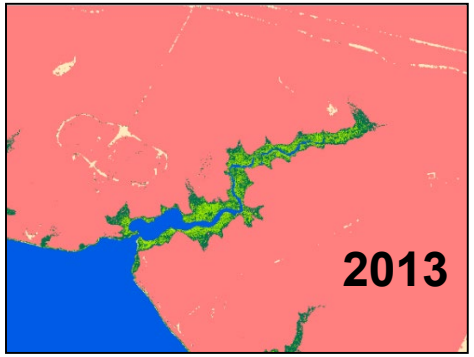
Predicted Marsh Migration varies by slope, sediment, and SLR rate

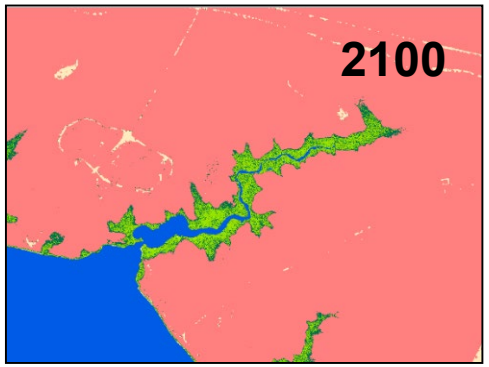
MCB Camp Lejeune marshes

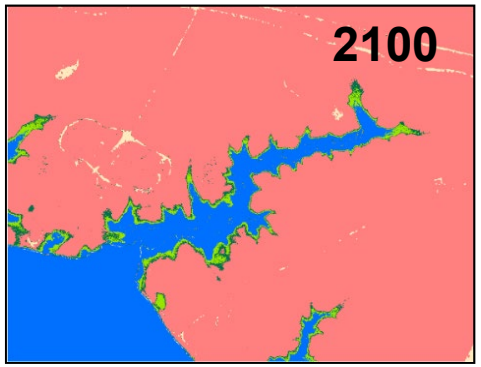
-No built infrastructure barriers at these sites

-Species change and marsh expansion at coastal sites

Traps Bay



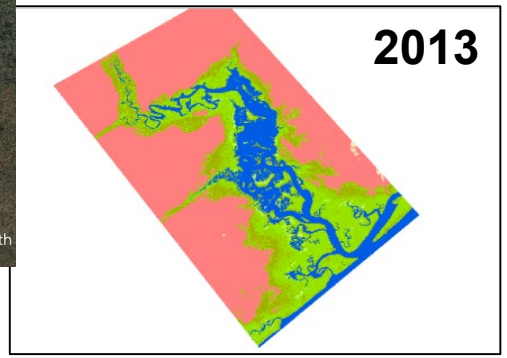


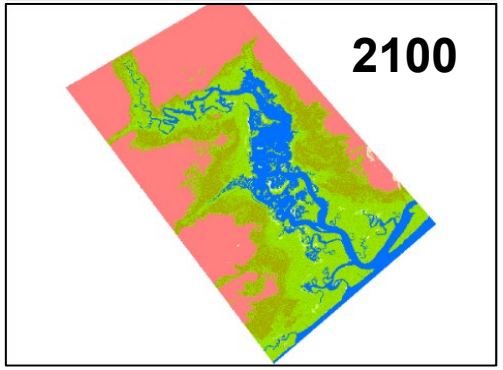


Lowest (0.3m)

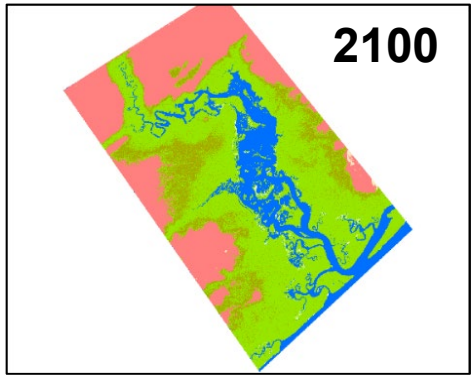
Medium (1.3m)

Freeman Creek





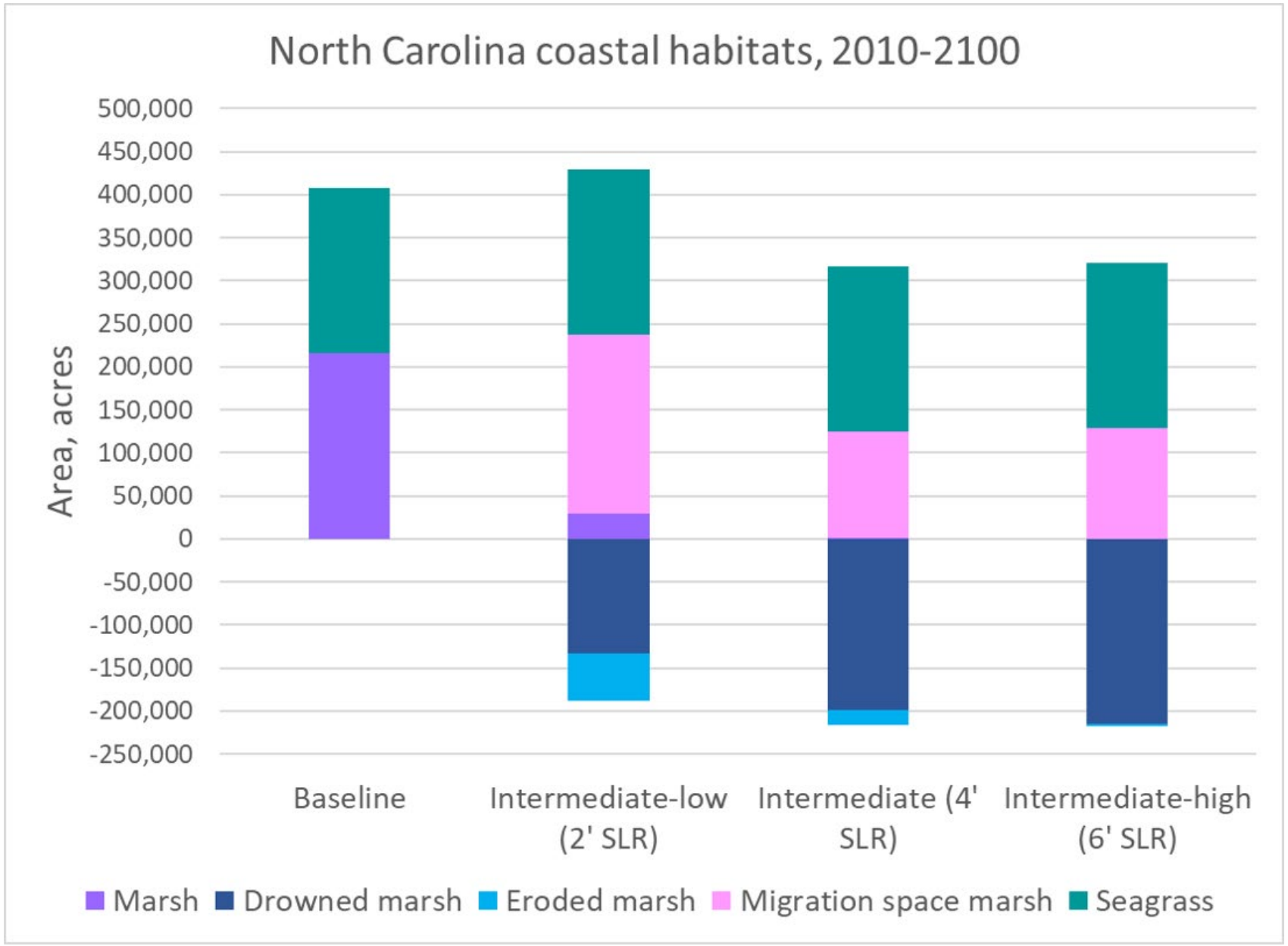
Lowest (0.3m)



Medium (1.3m)

Herbert et al. 2018
DCERP Annual Report

NC Natural & Working Lands, NC Climate Risk and Resiliency Report



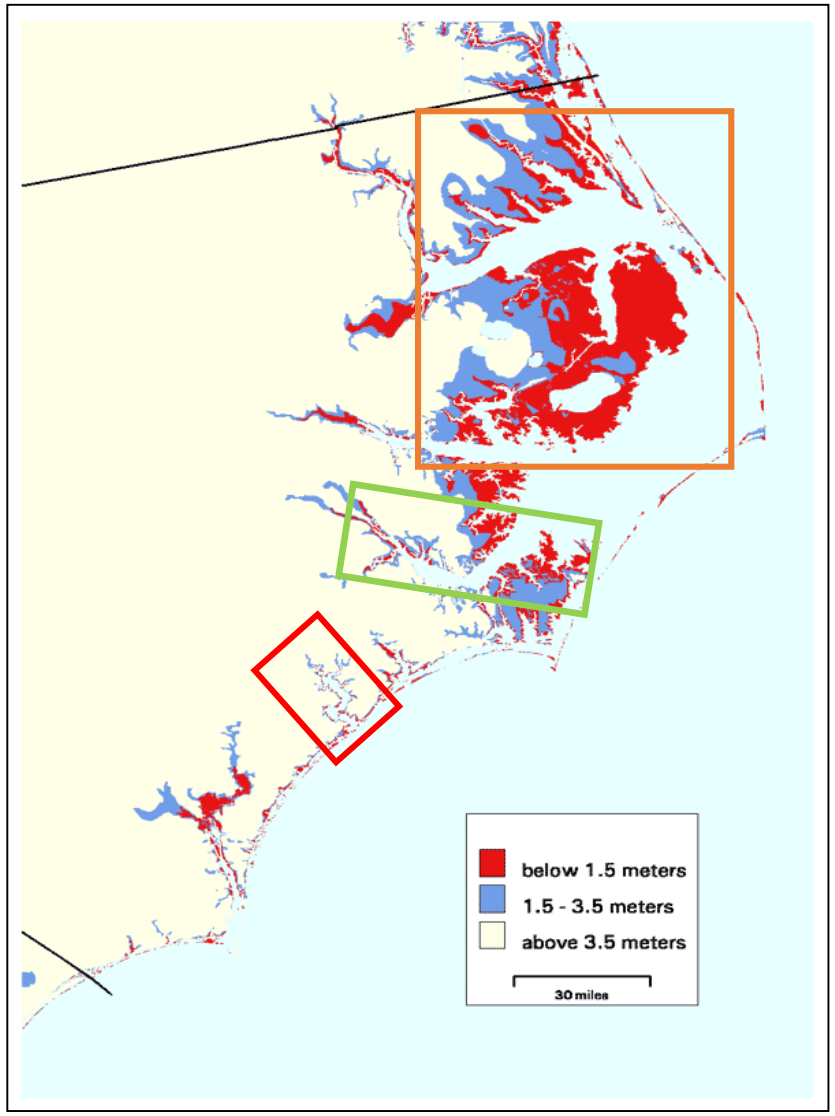
Marsh migration into uplands is primary way that NC marsh habitat will persist into next century

K. Warnell & L. Olander 2020

Marsh Erosion

Fringing Salt Marshes occupy 65% of the NC estuarine shoreline (8000 miles of marsh)

Erosion of marsh shorelines



NC Shoreline Change Rates

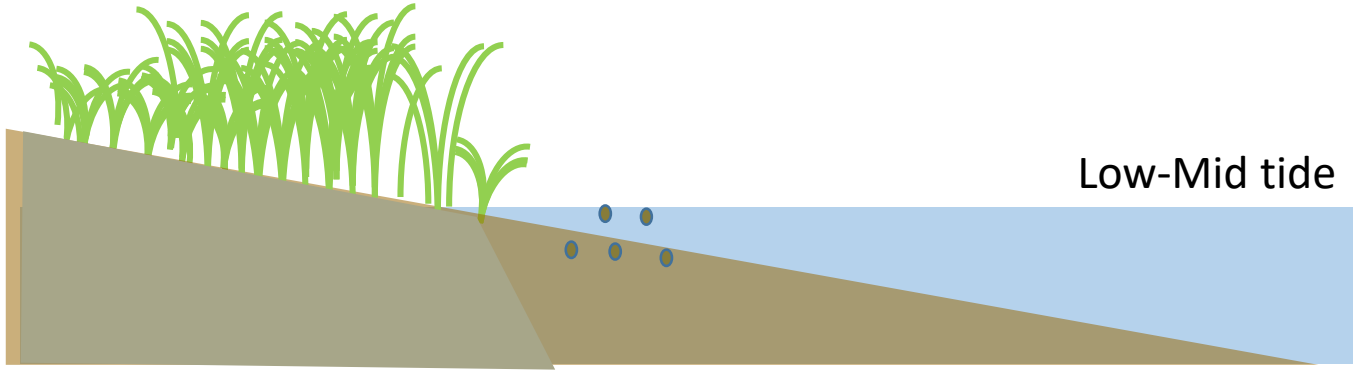
-0.8 m/yr Albemarle Pamlico Sound **(24 m or 78 ‘ in 30 yrs)**
(Riggs and Ames 2003, Eulie et al. 2017)

-0.6 m/yr Neuse River Estuary (**60 ‘ in 30 yrs**)
-0.5 m/yr wetland shorelines
(Cowart et al. 2011)

-0.3 m/yr New River Estuary (**30’ in 30 yrs**)
-0.2 m/yr marsh shorelines
(Currin et al. 2015)

Larger basins have larger shoreline erosion rates
Marsh vegetation does reduce, but not prevent, erosion

Erosion of marsh shorelines

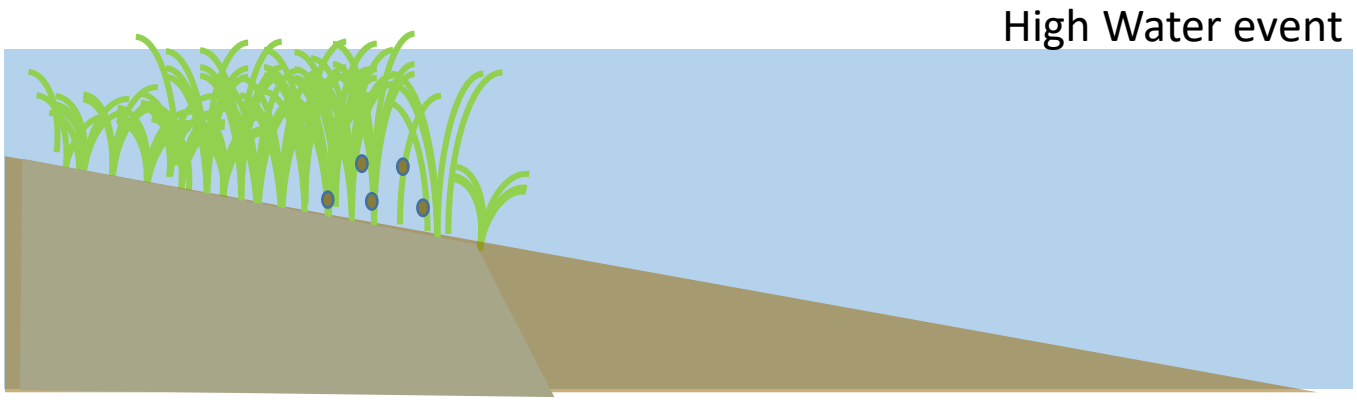


Erosion is greatest when marsh edge is exposed

-Average, sustained wind conditions cause most erosion (Leonardi et al 2015)

There is a Tipping Point in the ratio of vegetated : unvegetated area in a watershed or estuarine basin, controlled by sediment supply and tide range

Many NC estuarine basins and lagoons are already past the tipping point, and will lose most of current fringing marsh without restoration of marsh habitat



Marsh bank erosion does not occur during high water, e.g. hurricanes

- Marsh vegetation can attenuate wave energy when canopy height ~ water level
- Fringing marshes resilient to hurricanes (Currin et al 2008; Gittman et al. 2015)

Conservation Opportunities

Reduce shoreline erosion with Living Shorelines

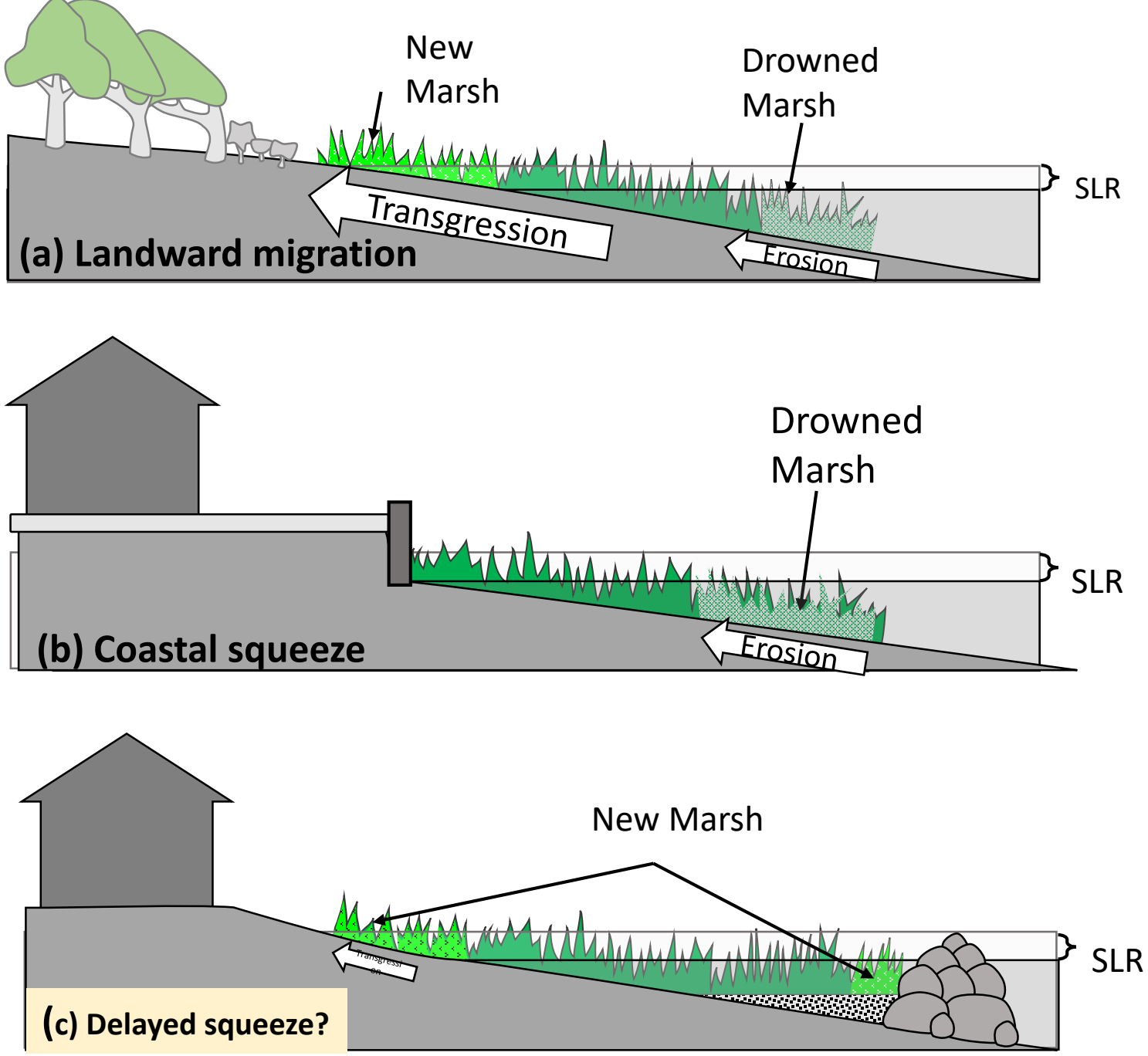
Keep Sediment in the System to support marsh accretion

-Beneficial use of dredged material

-Marsh restoration

Maintain and Restore Marsh Migration Corridors

Using Living Shorelines to protect property and Infrastructure



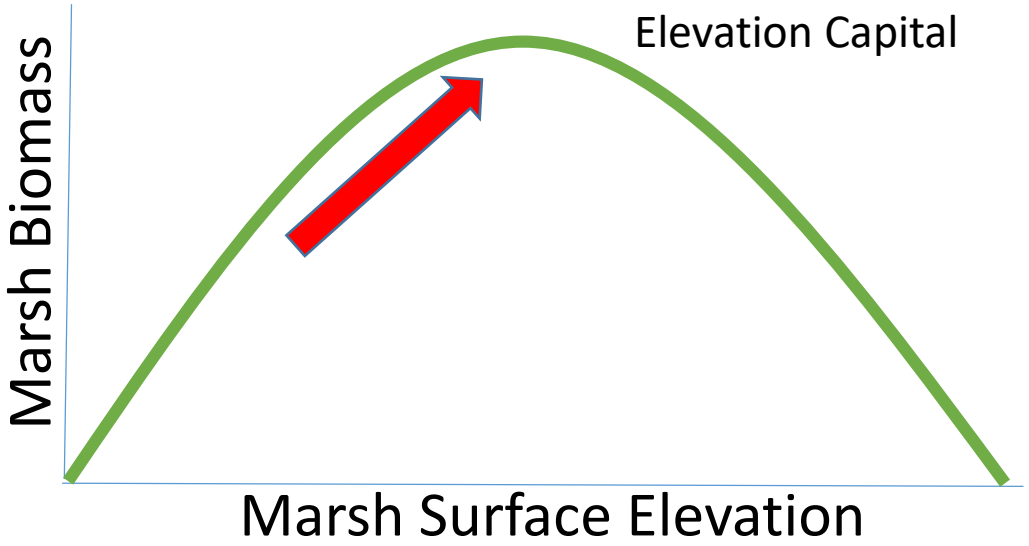
Currin 2019. Living Shorelines for Coastal Resiliency in *Coastal Wetlands: An Integrated Assessment.* Elsevier

Thin layer disposal of dredged material

Keep the Sediment in the System
Build Elevation Capital

MCB Camp Lejeune
Atlantic Intracoastal WaterWay, NC

FC Plant biomass: Elevation



Beneficial use of dredged material

Marsh Fragmentation

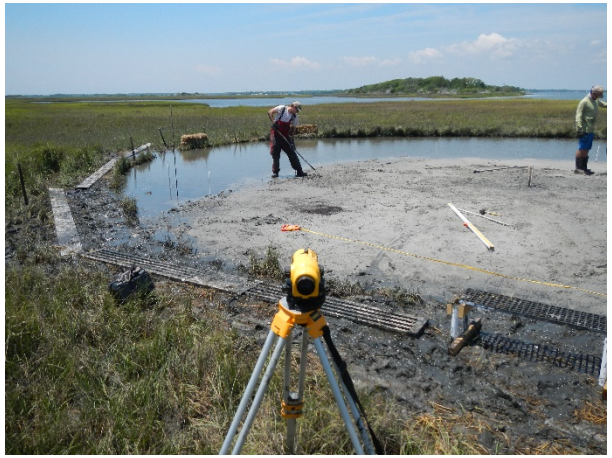
Mile Hammock Bay

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

More marsh area = more sediment trapping

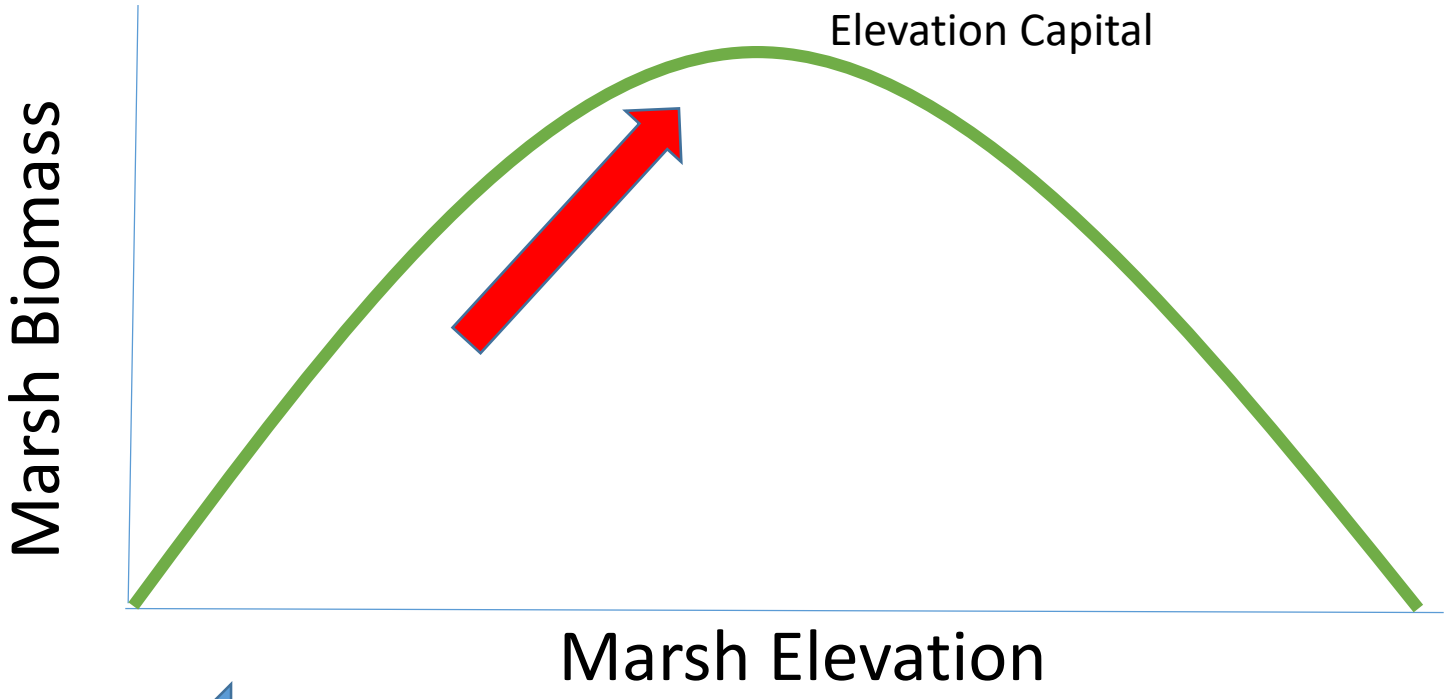
Mile Hammock Bay Site, NC

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?



Fishery Habitat, Denitrification,

Resilience to Sea Level Rise

-SLR, wave energy, erosion, droughts, storms and built infrastructure will increase

-Conservation will need to plan for FUTURE conditions