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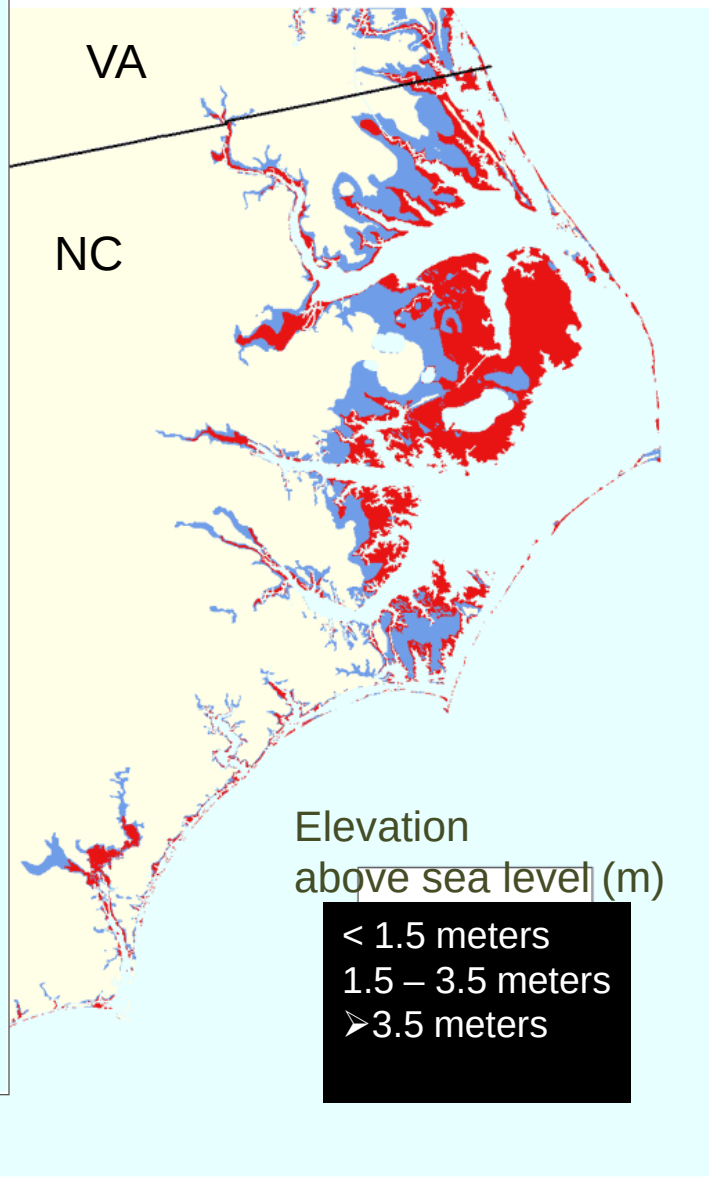
The Living Shoreline approach to estuarine shoreline stabilization

Carolyn Currin

NOAA Lab, Beaufort NC

Photo: Univ of MD

North Carolina coastline is low-lying, and RSLR adds to problem of shoreline erosion



NC has an estimated 8-10,000 miles estuarine shoreline

In portions of NC estuarine shoreline, erosion rates of 2-20m/yr have been measured (Riggs 2002); Neuse and New River Estuary 0.5-1.0 m/yr

Statewide shoreline mapping begun recently

Fringing shoreline marshes
It's all about the edge

1. **Marsh edge provides most valuable fishery habitat (nursery, food, and refuge)**
   (Hettler 1989, Minello et al. 1994, Peterson and Turner 1994, Currin et al. 2007)
2. **Marsh edge effectively reduces wave energy and traps sediments**
   (Knutson 1982, Christiansen et al. 2000, Leonard et al. 2002, Morgan et al 2008)
3. **Habitat complexity, trophic linkages and biodiversity all maximized at the marsh edge**

In response to real, or perceived, shoreline erosion, property owners can either

-use a General Permit to obtain a bulkhead (1-2 days)

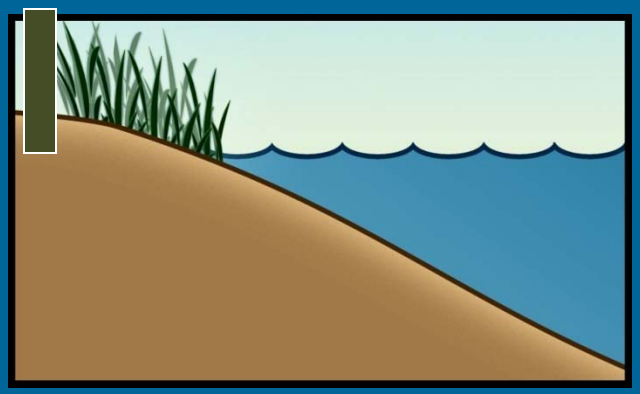
-use a Legislature-mandated GP for a “living shoreline” (30 days)

New changes in Bulkhead GP reduce shoreward extent to 2 ft from MHW

Stabilized shoreline response to SLR?

Maintain vegetation
via sediment accretion
or landward regression

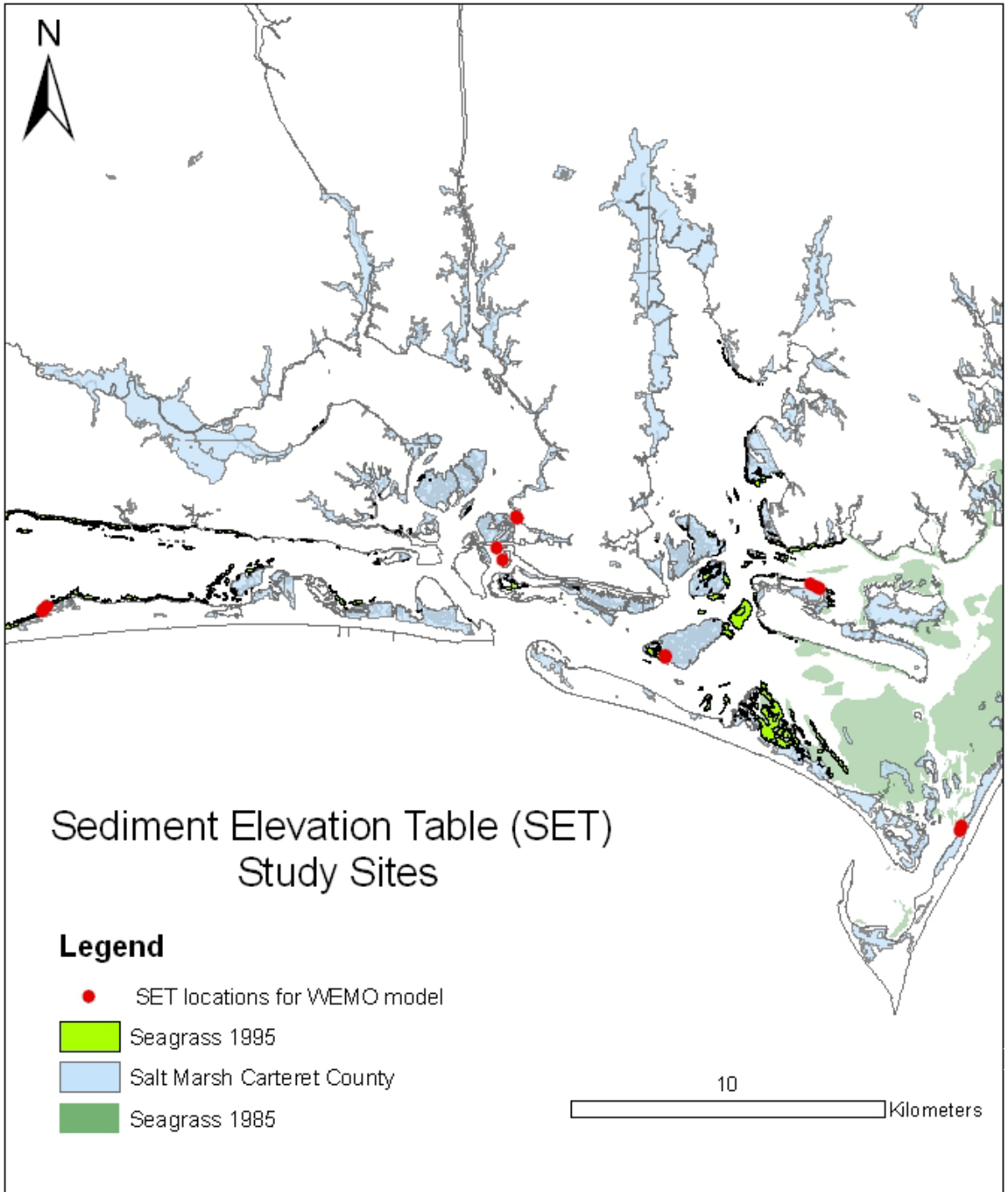
Bulkhead



Sill/breakwater

How will structures built to stabilize the shoreline impact the marshes ability to ‘keep up’ with SLR?

How will structures built to stabilize the shoreline affect the ecosystem services provided by the marsh?

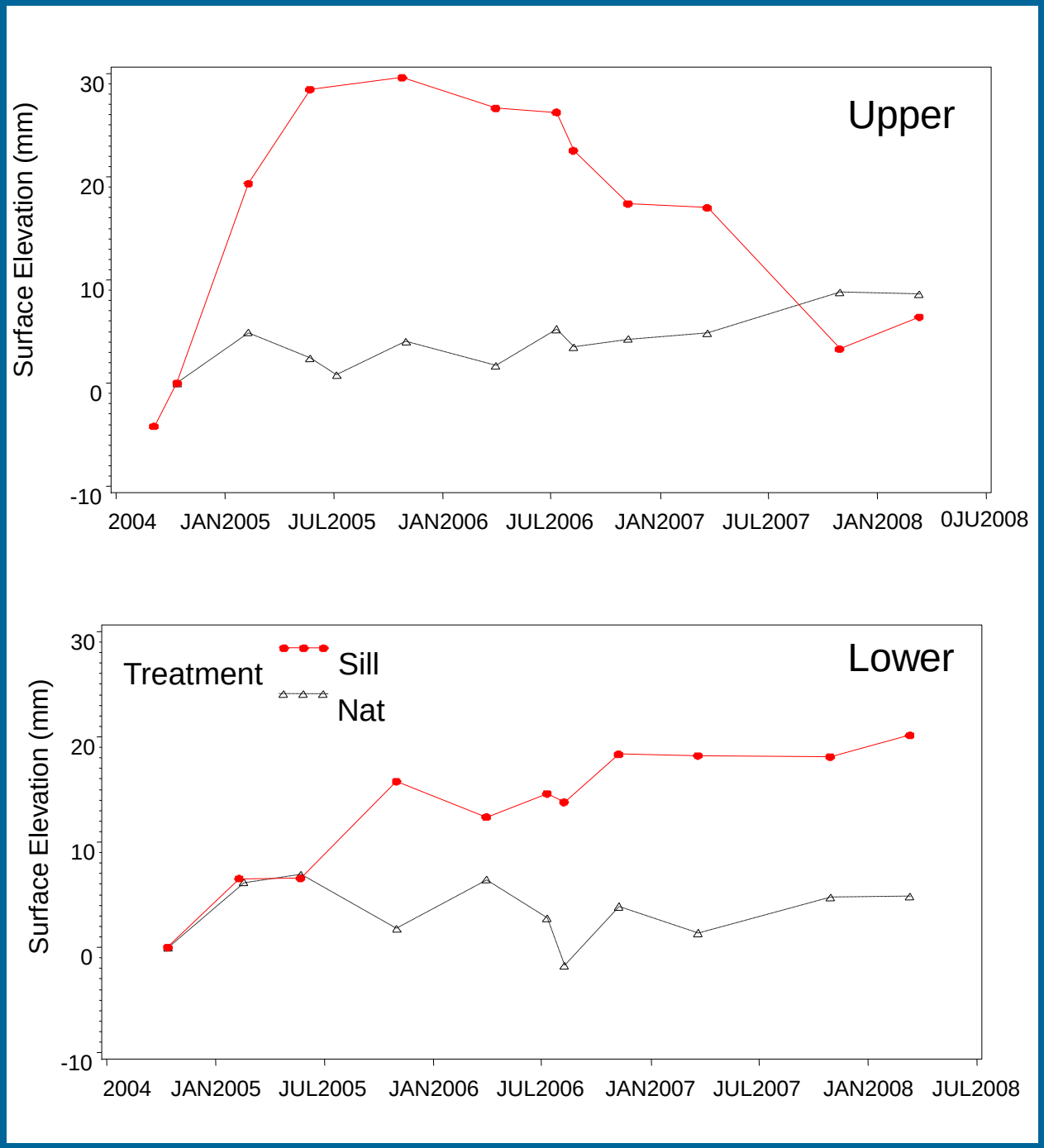


- Are salt marshes keeping up with sea level rise?
- What features influence sediment elevation change in fringing salt marshes?
  - -Wave exposure
  - -Vegetation
  - -Oyster reefs
  - -Tidal elevation/RSL
- Do stone breakwaters significantly effect sediment accretion rates and/or vegetation?

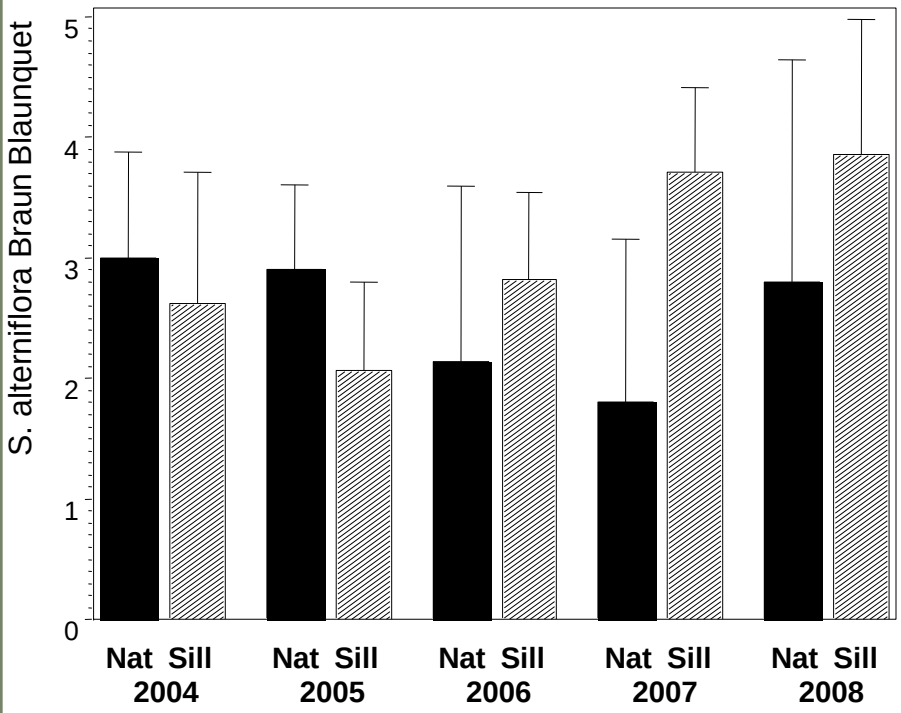
SETs established at upper and lower edges of Spartina alterniflora vegetation at each site

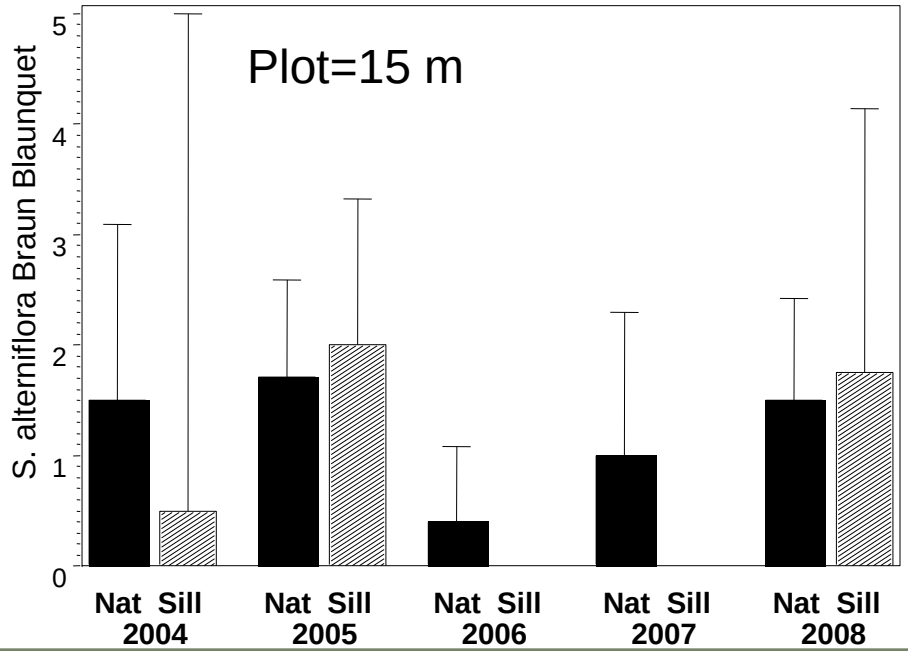
Natural reference marsh

Data from
Surface Elevation Tables established at upper and lower edges of *Spartina alterniflora* vegetation in fringing salt marshes on Pivers Island.



C. A. Currin
NOS NOAA
Beaufort, NC





Pivers Island Natural and Sill marshes *Spartina alterniflora* % cover

Cover classes estimated using Braun Blanquet system
1= 1-5%
2=6-25%
3=26=50%
4=51=75%
5=>75%

0m plots established at lower edge of S. altnerniflora distribution in 2004
15m plots established 13-15 m landward of 0m plots

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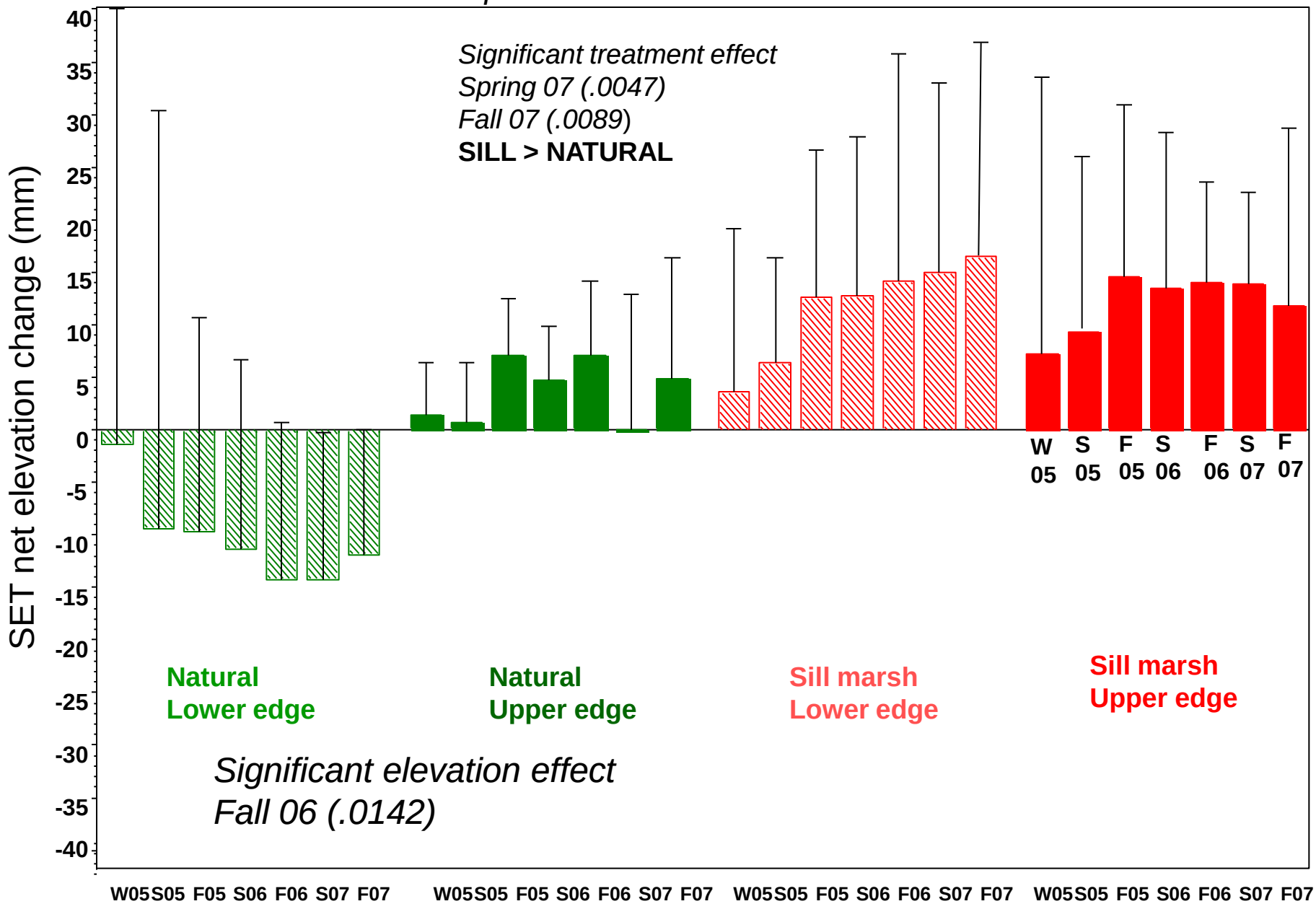
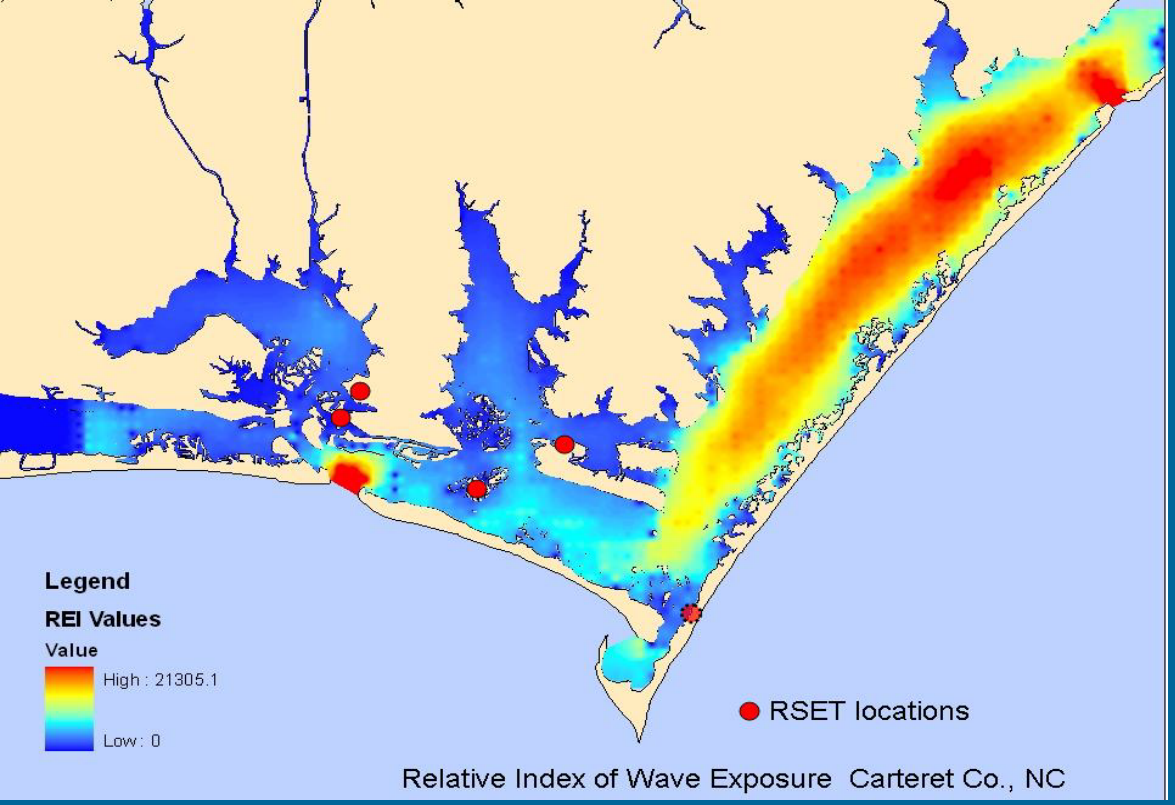
Beaufort, NC

2004-2007 North Carolina Marsh SET results

Spartina alterniflora marshes





Wave **E**xposure **Mo**del (WEMo)

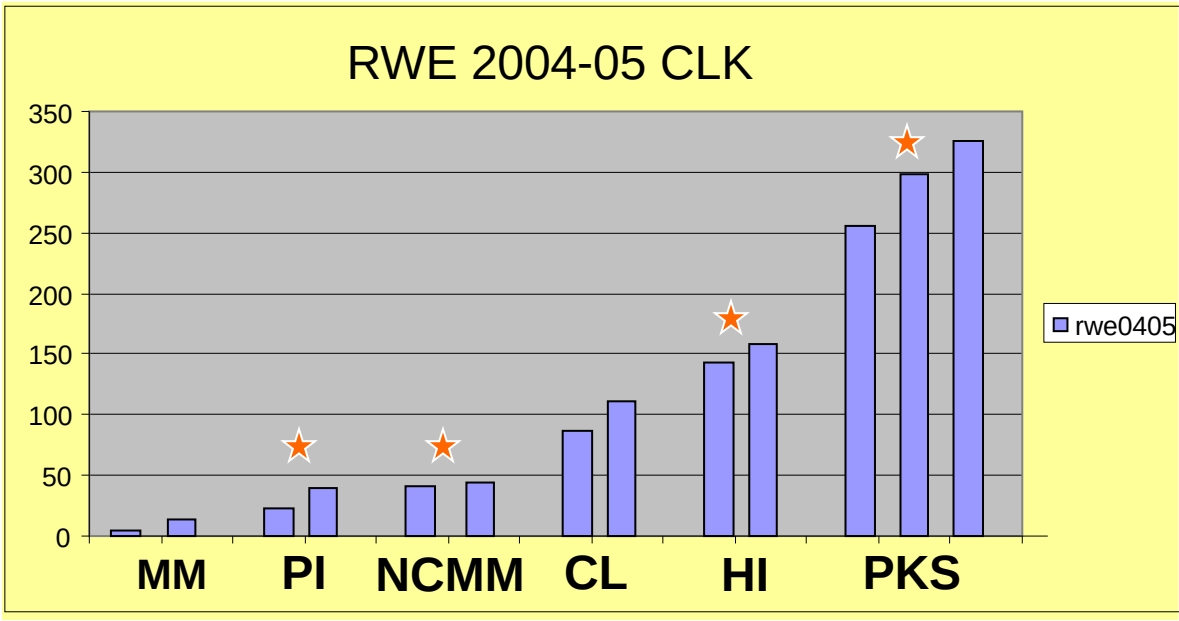
M.Fonseca & A. Malhotra

Uses bathymetry, shoreline and wind data to calculate Rep. Wave Energy (RWE) in units of W/k or kg-m/s^{3,}

90% of Carteret Co. shoreline marshes located in sites with RWE <375

Range of all salt marsh habitat in Carteret Co = 0 to 2500

★ Stone sill sites



Sills increase sediment accretion rates
Lose lower intertidal habitats
Design for site conditions

… use oysters instead?

Living Shoreline Approach in other states

Delaware-requires approach, need waiver to avoid. Contractor engagement key.

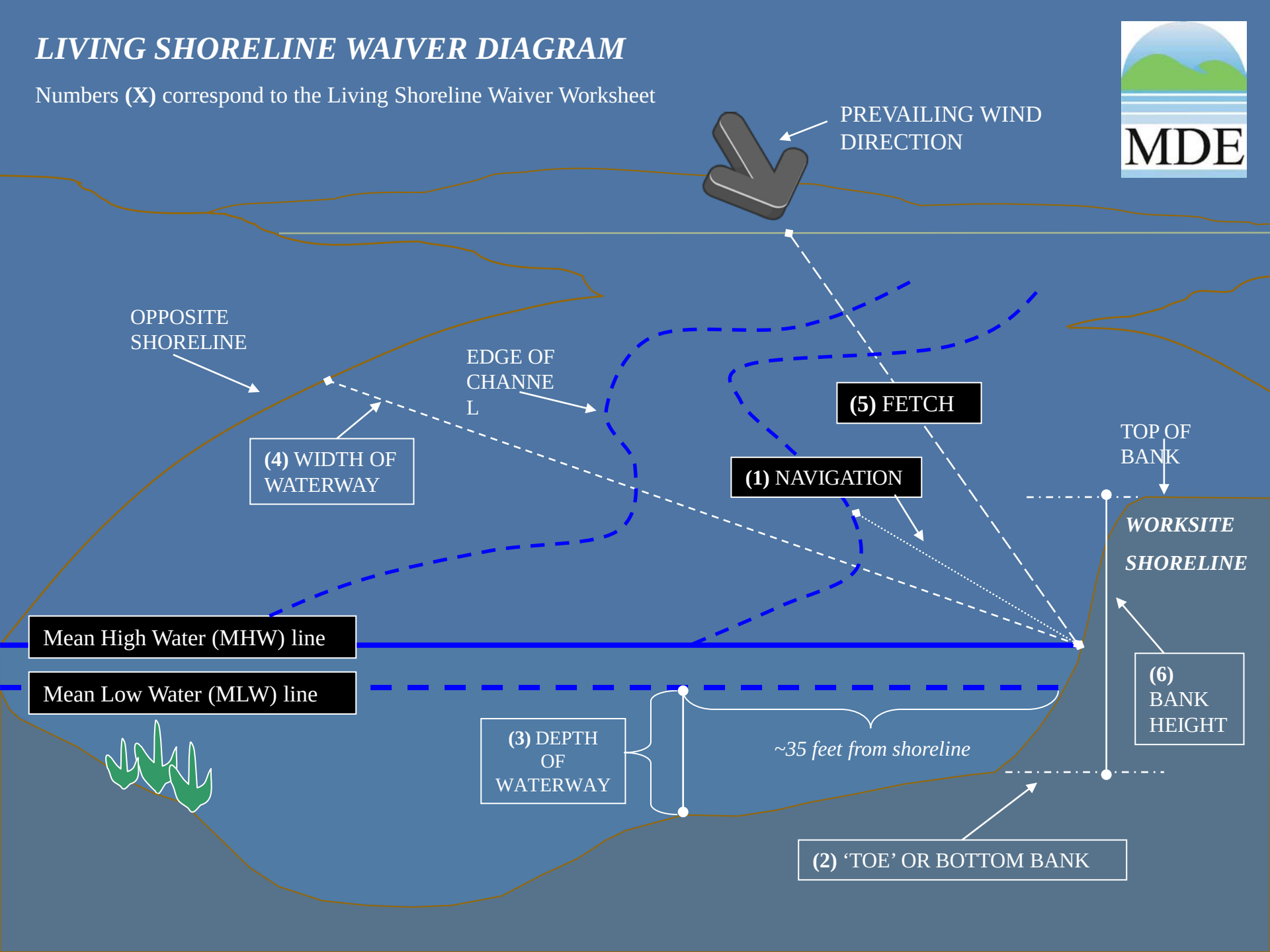
Maryland-require approach in 2008 legislation, need waiver to avoid

Virginia—local jurisdictions vary, VIMS actively promotes

NC – new GP in 2006,
only 30 projects

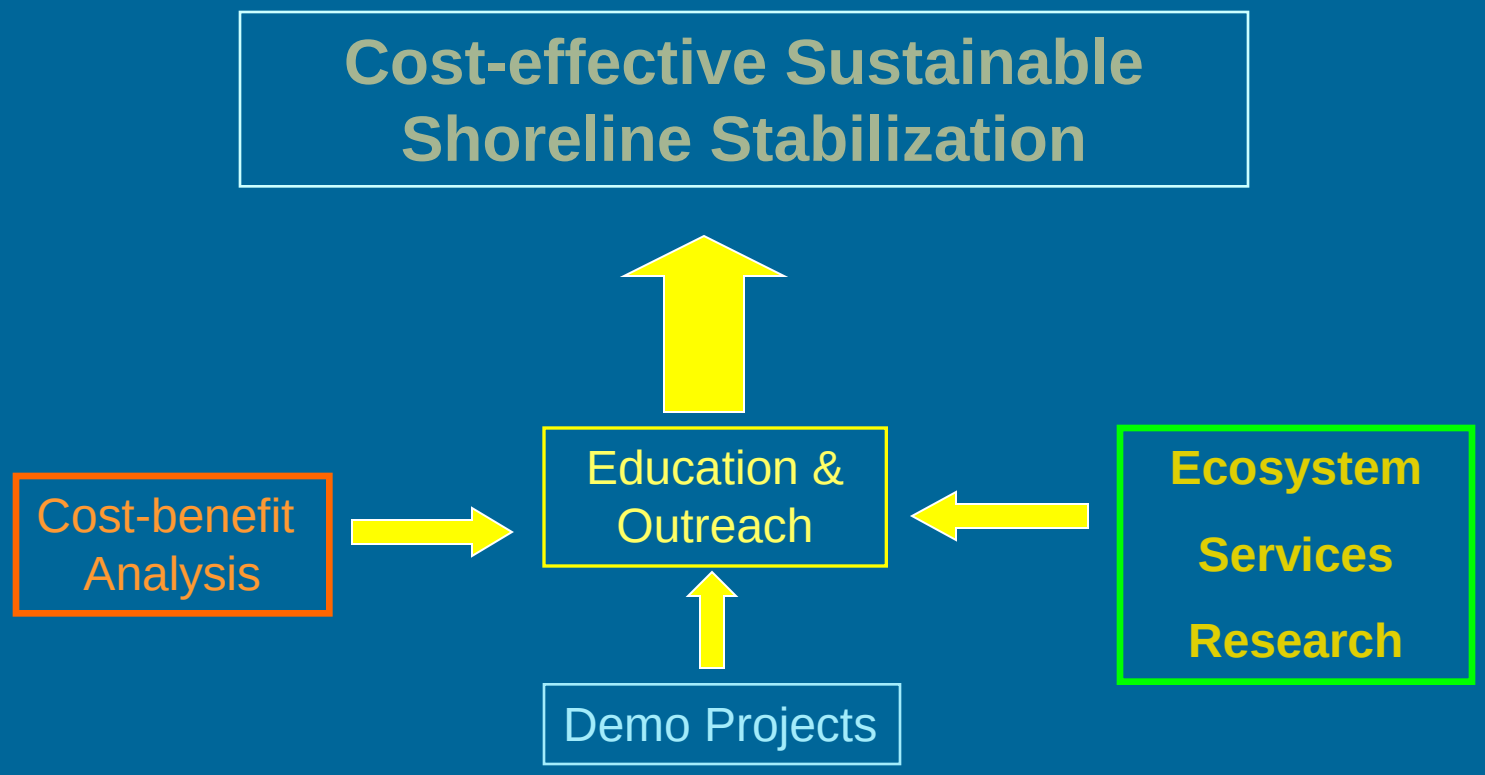
LIVING SHORELINE WAIVER DIAGRAM

Numbers **(X)** correspond to the Living Shoreline Waiver Worksheet



CICEET-funded project

‘Sustainable Estuarine Shoreline Stabilization: Research, Education and Public Policy in NC’



Sustainable Estuarine Shoreline Stabilization: Research, Education and Public Policy in NC

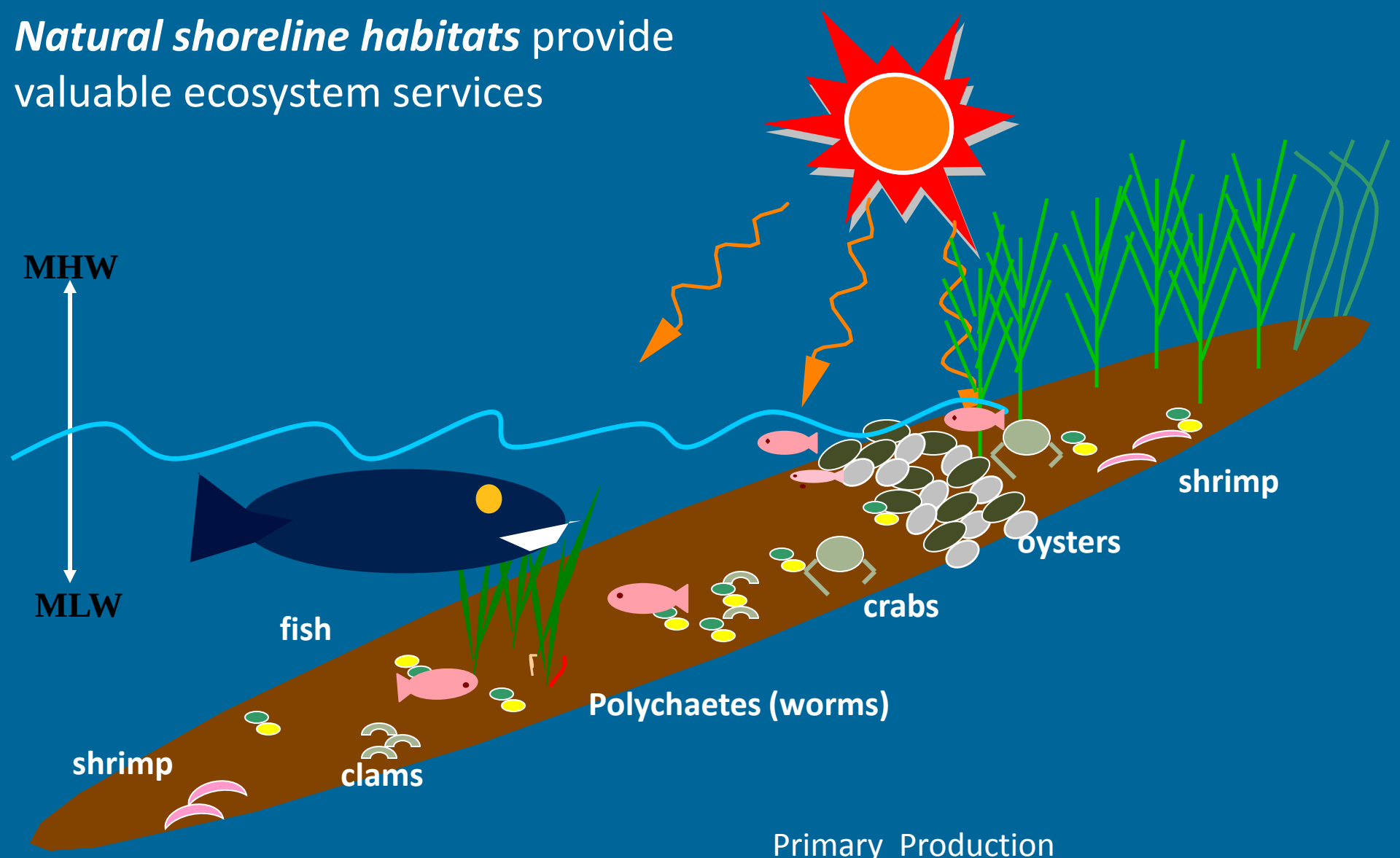
Phase I Research:

How do bulkheads impact ecosystem services of shoreline habitats?

C.Currin, M. Fonseca, G. Piniak NOAA **Wave reflection, sediment suspension and elevation**
J. Fear NC NERR **Marsh vegetation**
M. Piehler UNC-CH **Groundwater and nutrient cycling**
M. Posey UNC-W **Infauna response**
C. Peterson UNC-CH **Fish utilization**

Figure 1: North Carolina coastal area, showing the NoCo (tidal range < 0.1m), CeCo (tidal range ~1m), and SoCo, (tidal range ~2m). Red areas represent National Estuarine Research Reserve Properties. Purple areas represent other State Coastal Reserves.

Natural shoreline habitats provide valuable ecosystem services



Primary Production
Wave Attenuation
Sediment Trapping
Habitat for Fish and Shellfish
Nutrient and Contaminant Removal