



Living shorelines research: erosion control and hurricane resilience

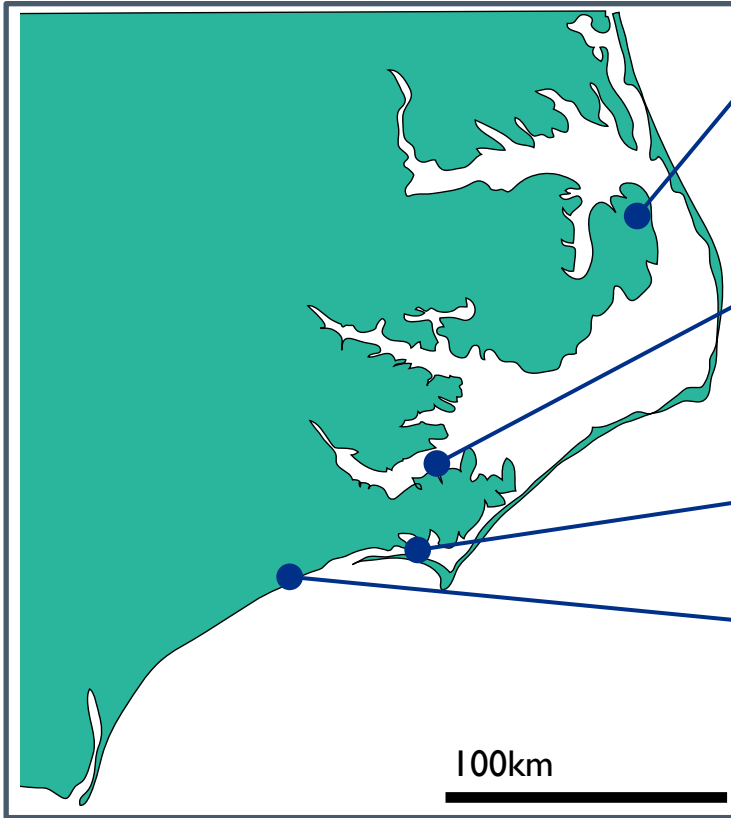
Brandon Puckett (on behalf of an army of colleagues and collaborators)

Estuarine shoreline erosion



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Albemarle Pamlico Sound

-0.8 m/yr (**78 ft in 30 yrs**)

(Riggs and Ames 2003, Eulie et al. 2017)

Neuse River

-0.6 m/yr (**60 ft in 30 yrs**)

-0.5 m/yr wetland shorelines

(Cowart et al. 2011)

Bogue and Back Sounds

-0.1 m/yr marsh shorelines (**10 ft in 30 yrs**)

(Burdick et al. *in prep*)

New River

-0.3 m/yr (**30 ft in 30 yrs**)

-0.2 m/yr marsh shorelines

(Currin et al. 2015)

**Shoreline erosion prevalent; erosion rates higher in larger waterbodies
Wetland vegetation reduces, but does not prevent, erosion**

Of NC's 10,658 miles of estuarine shoreline...

Bulkhead



8556 (590 miles)

Revetment



3195 (210 miles)

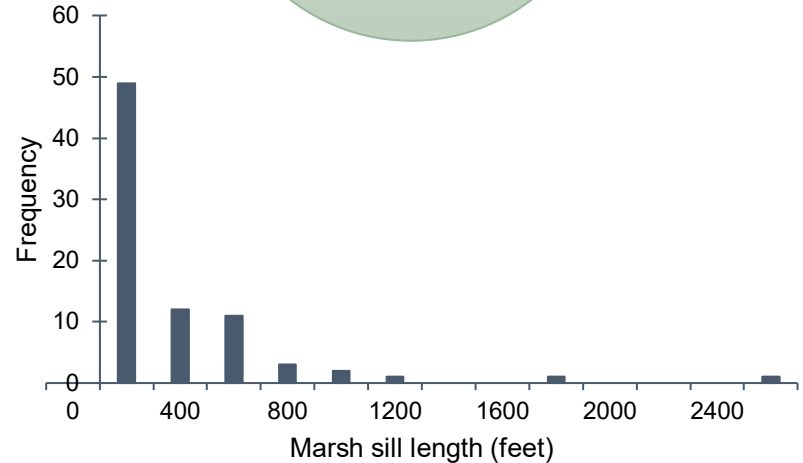
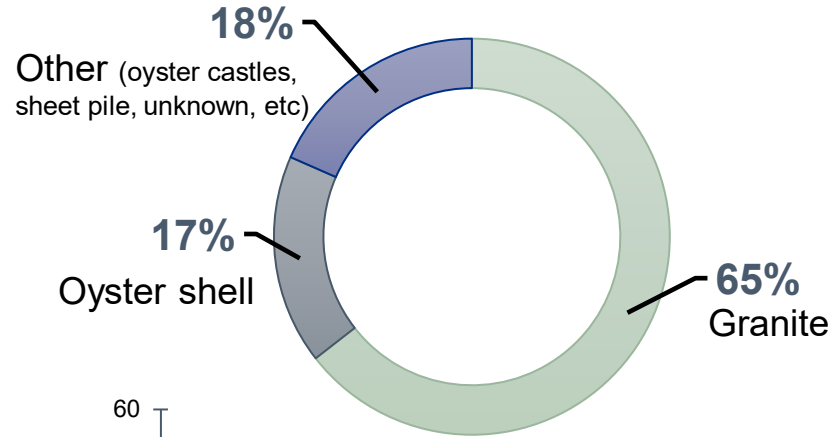
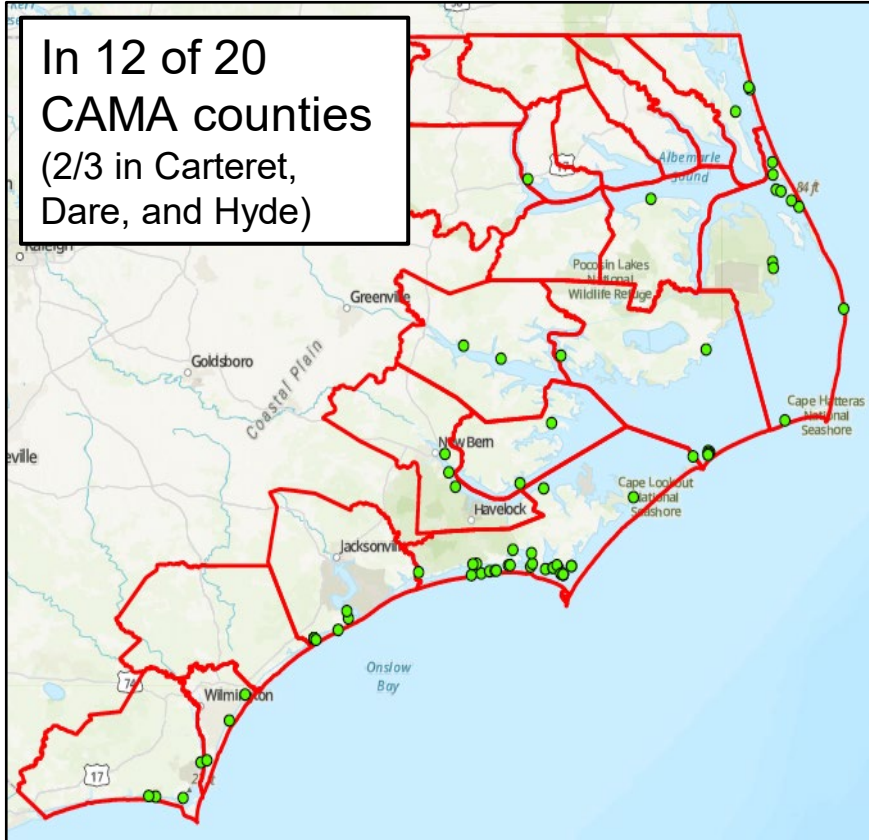
Sill



76 (4.25 miles)*

Marsh sills by the numbers (2018)

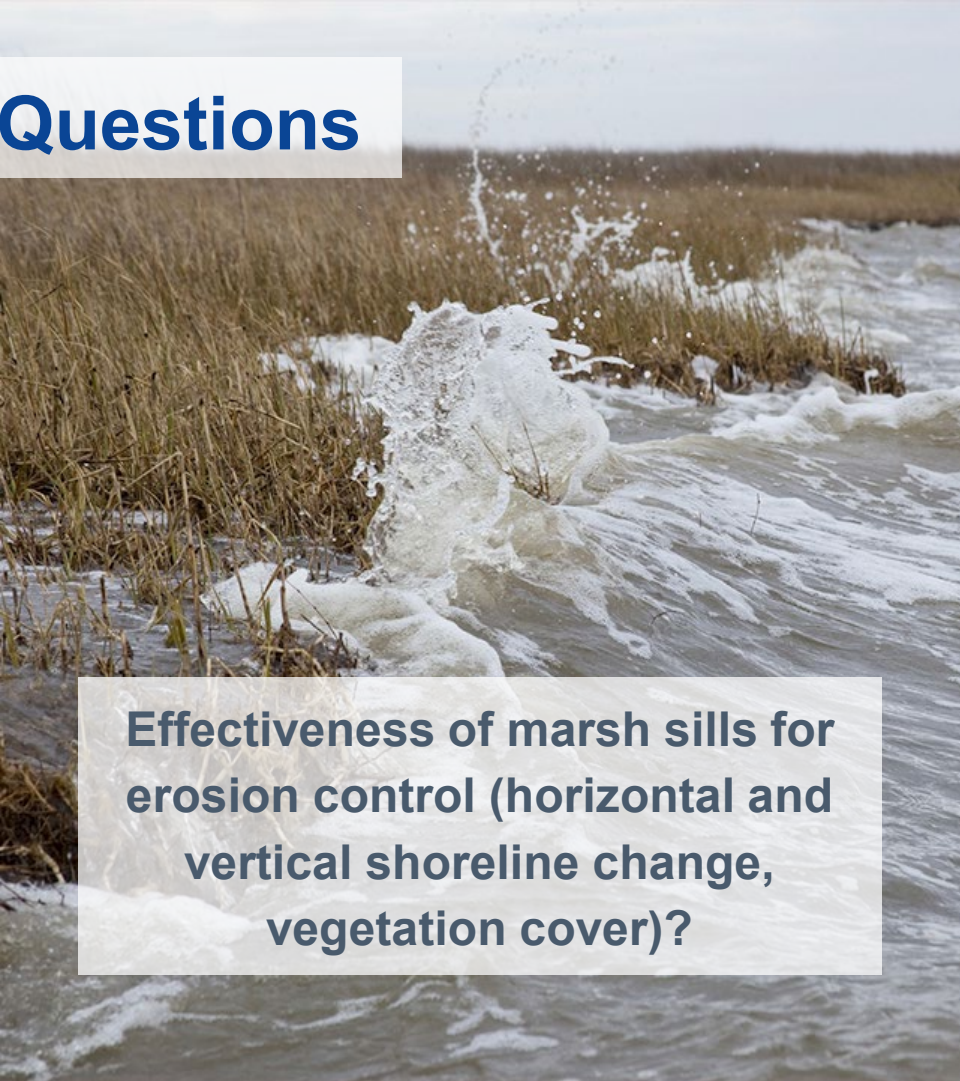
In 12 of 20 CAMA counties (2/3 in Carteret, Dare, and Hyde)





Research Questions

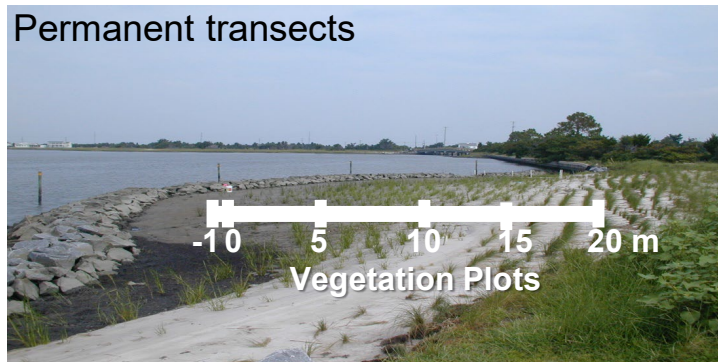
Resilience of marsh sills to hurricanes (structure, shoreline erosion, vegetation)?



Effectiveness of marsh sills for erosion control (horizontal and vertical shoreline change, vegetation cover)?

Methods

Permanent transects



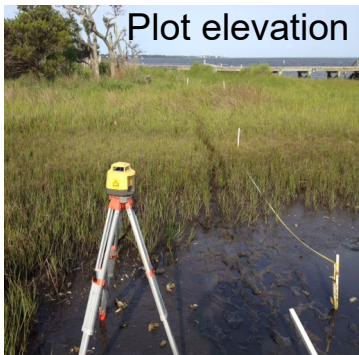
Vegetation cover



Before and after extreme events



Plot elevation




Vegetation line



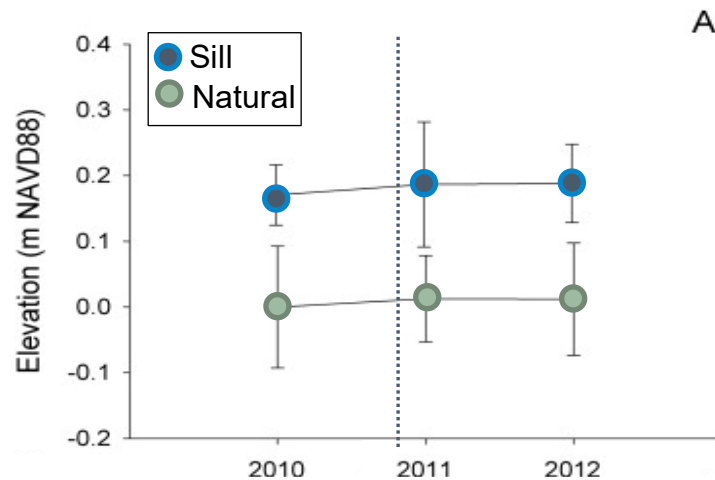
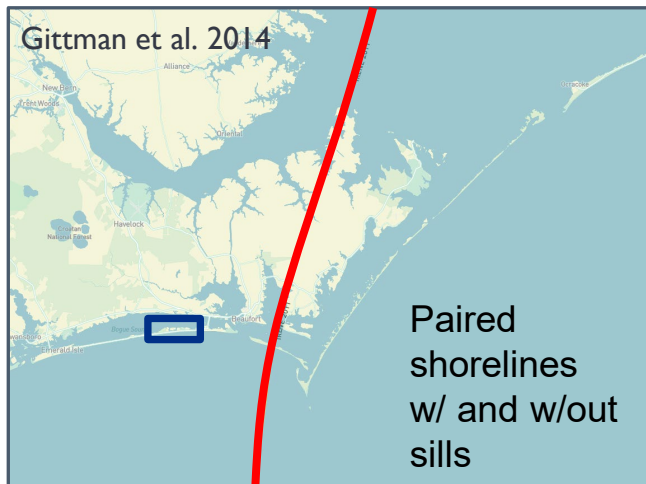
Paired sites*



A satellite image of a hurricane over the ocean. The hurricane is a large, swirling cloud system with a distinct eye and spiral bands. The surrounding ocean is dark blue, and there are some white clouds scattered around. In the top left corner, a portion of a landmass is visible, showing green vegetation and some brownish areas. A semi-transparent white rectangular box is overlaid on the top left of the image, containing text.

Resilience of marsh sills to hurricanes (structure, shoreline erosion, vegetation)?

Hurricane Irene (2011)



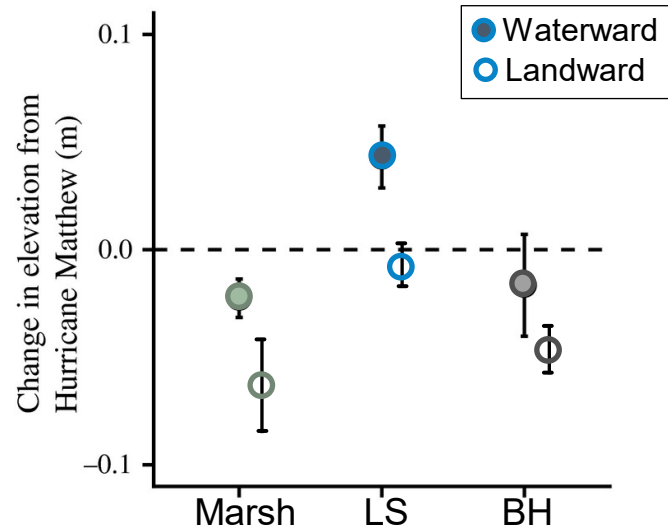
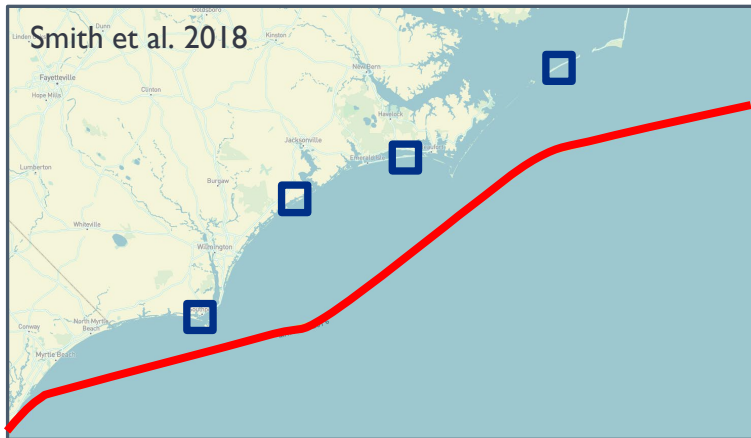
Before



After



Hurricane Matthew (2016)



A)

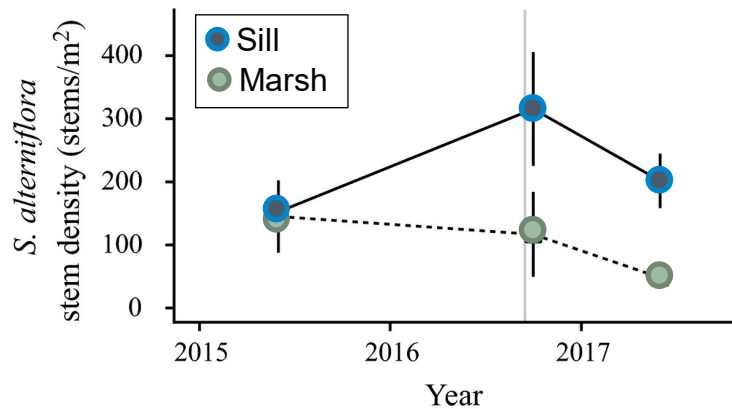
Bulkhead



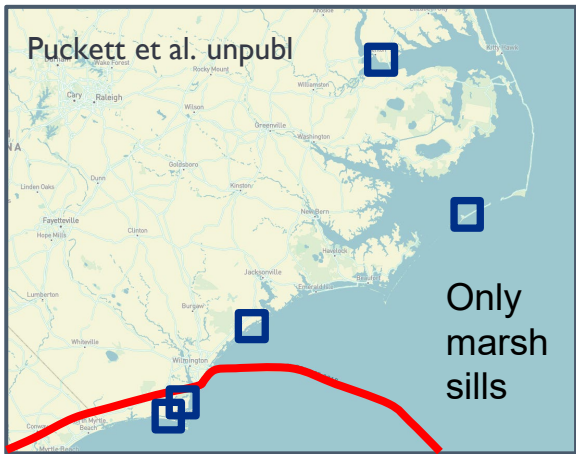
Living shoreline



Natural marsh



Hurricane Florence (2018)



Before

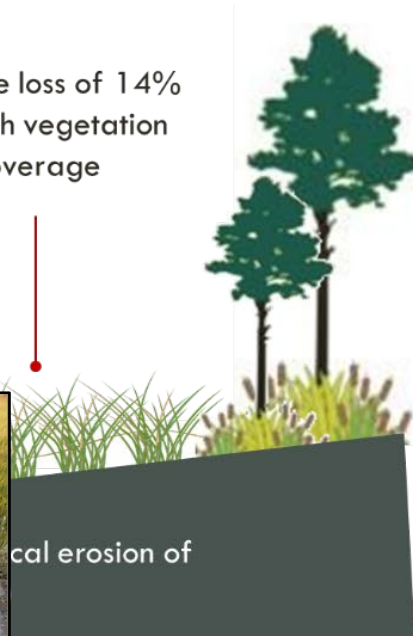


Average marsh edge horizontal erosion 11.8 in (0.3m)

After



Average loss of 14% of marsh vegetation coverage



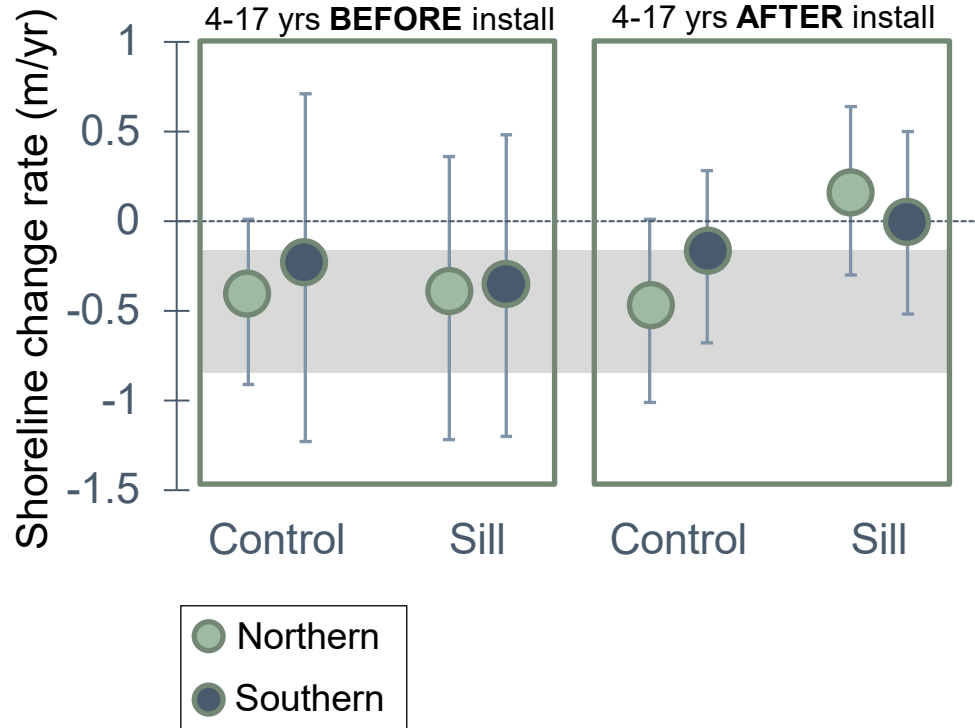
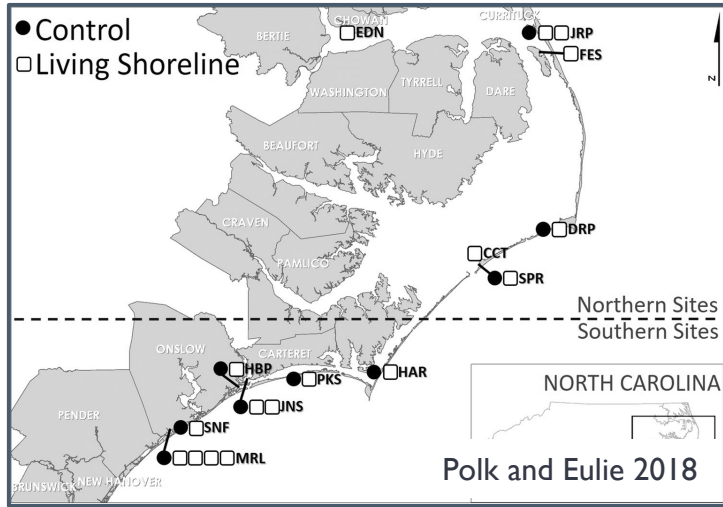
cal erosion of

A photograph showing a salt marsh shoreline. In the foreground, there is a dense patch of tall, dry, brown grasses. To the right, the ocean waves are breaking, creating white foam and splashing water. The sky is overcast and grey. The overall scene depicts a natural coastal environment where waves are interacting with the marsh vegetation.

Effectiveness of marsh sills for erosion control (horizontal and vertical shoreline change, vegetation cover)?

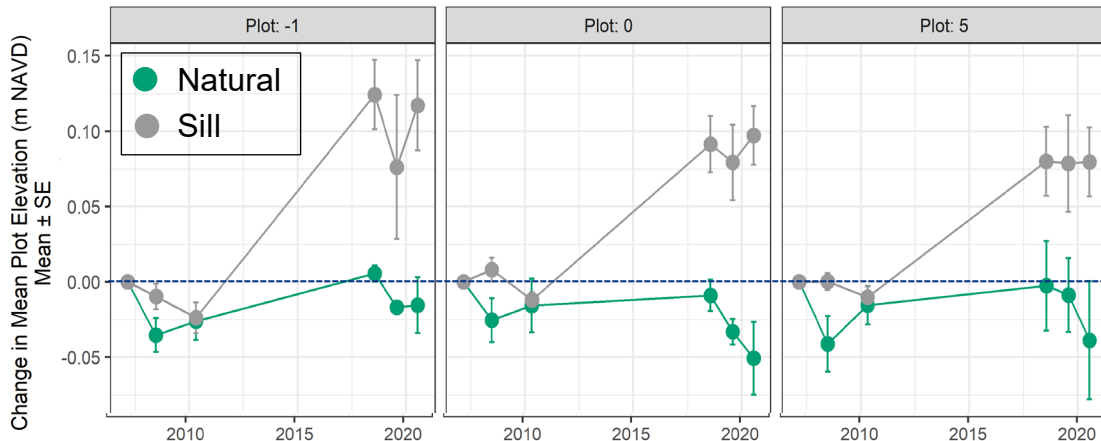
<10% of salt marsh erosion caused by extreme wind events (gale, storm, hurricane). 85% of erosion attributed to frequent wind events (8-30mph; Leonardi et al. 2015)

Edge erosion: sills vs natural



Elevation change: sills vs natural

Currin et al. in prep

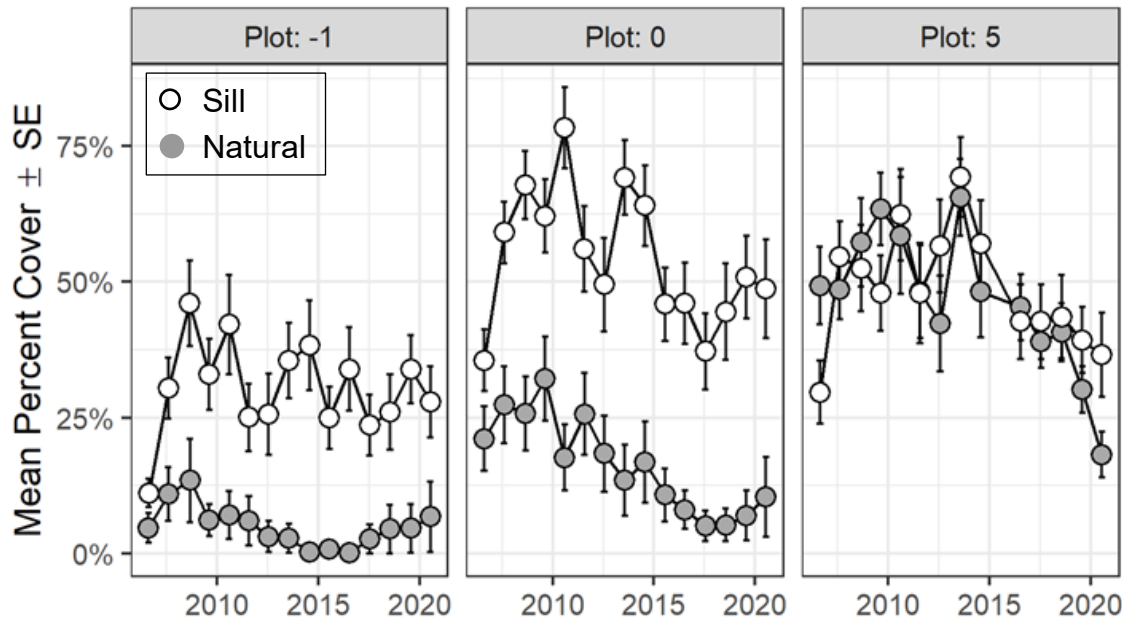


Vegetation cover: sills vs natural

Currin et al. in prep



Spartina alterniflora Percent Cover



Marsh sill living shorelines...

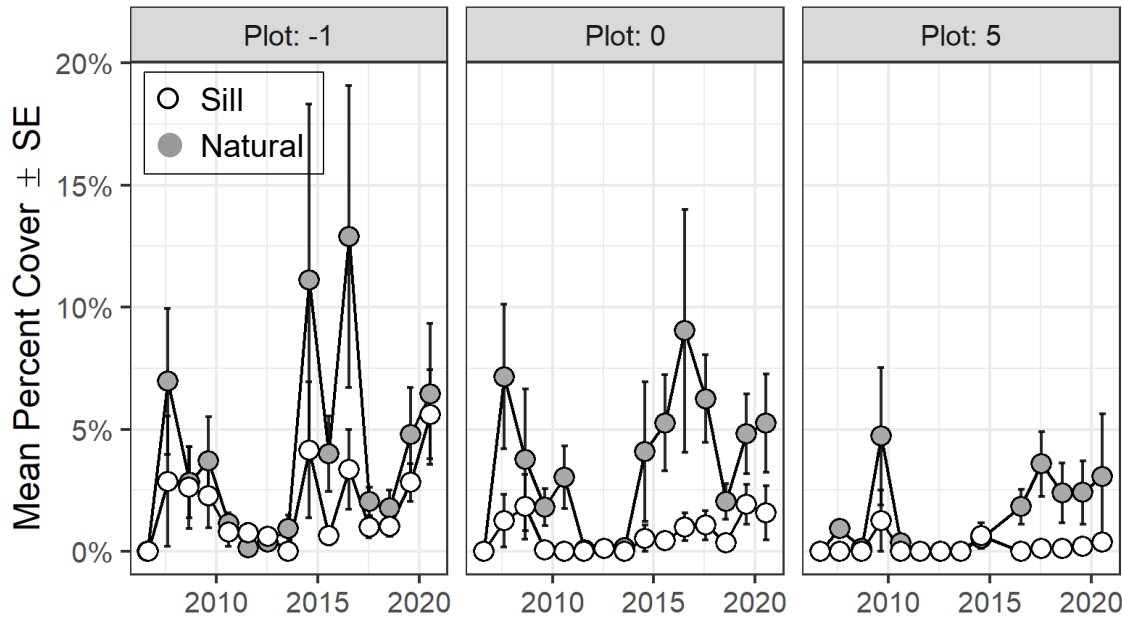
- ...are resilient to extreme events (cat 1)
 - Resistant to impacts: sill integrity, reduce scour and shoreline erosion
 - Rapid recovery and self-repair
- ...reduce horizontal edge erosion or generate accreting marshes (w/in 5 years)
- ...stimulate vertical accretion several meters landward
 - Increase cover and density of low marsh vegetation

Sills reduce marsh edge erosion

Currin et al. in prep



Live Oyster Percent Cover

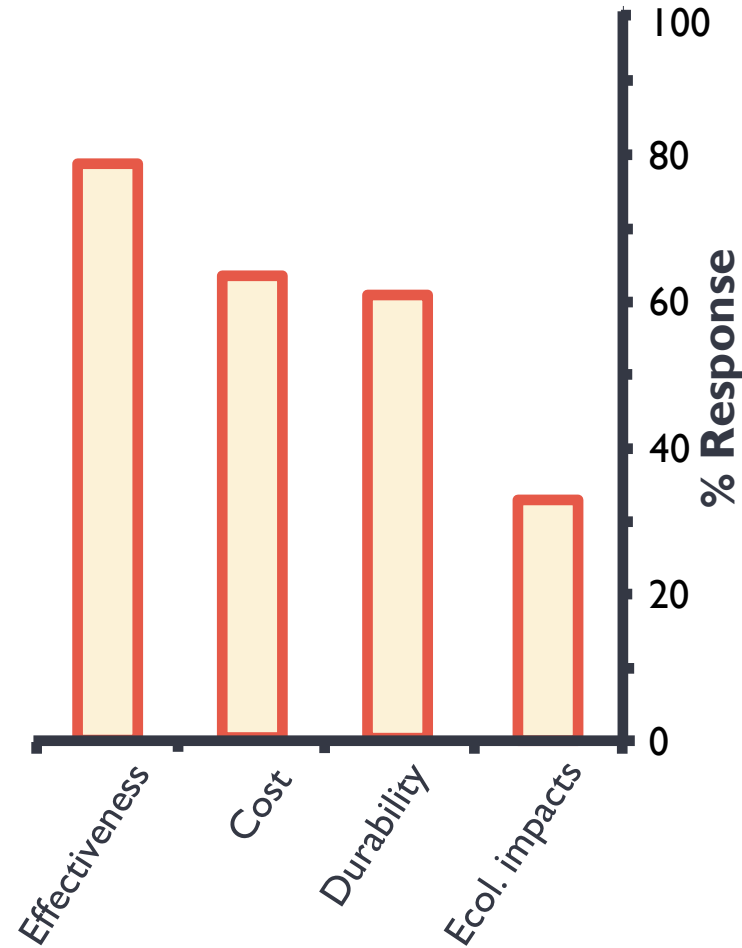


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property owners rank

- 1) effectiveness
- 2) cost
- 3) durability
- 4) environmental

Smith et al. 2017



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