Living Shorelines Joint Stakeholder Meeting
Center for Coastal Environmental Health and BioMolecular Research
Wednesday May 2nd 2018

EVALUATING LIVING SHORELINES TO INFORM REGULATORY DECISION-MAKING IN SC:

PROJECT UPDATE ON MONITORING EFFORTS.

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DNR

National Estuarine Research Reserve System Science Collaborative

NOAA

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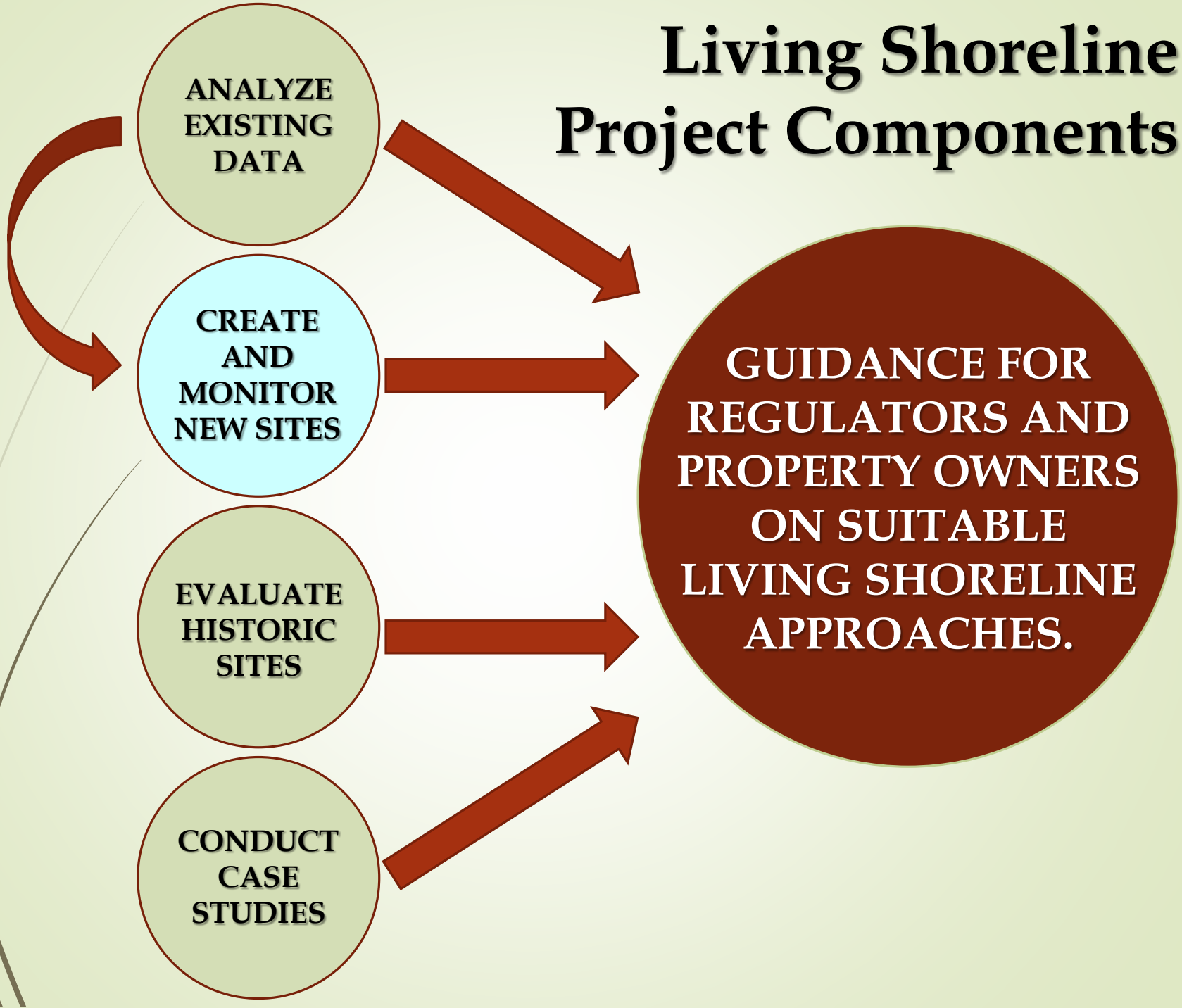
Fiber treatment advice: Josh Moody

2015-2018 NSC Project Goals:

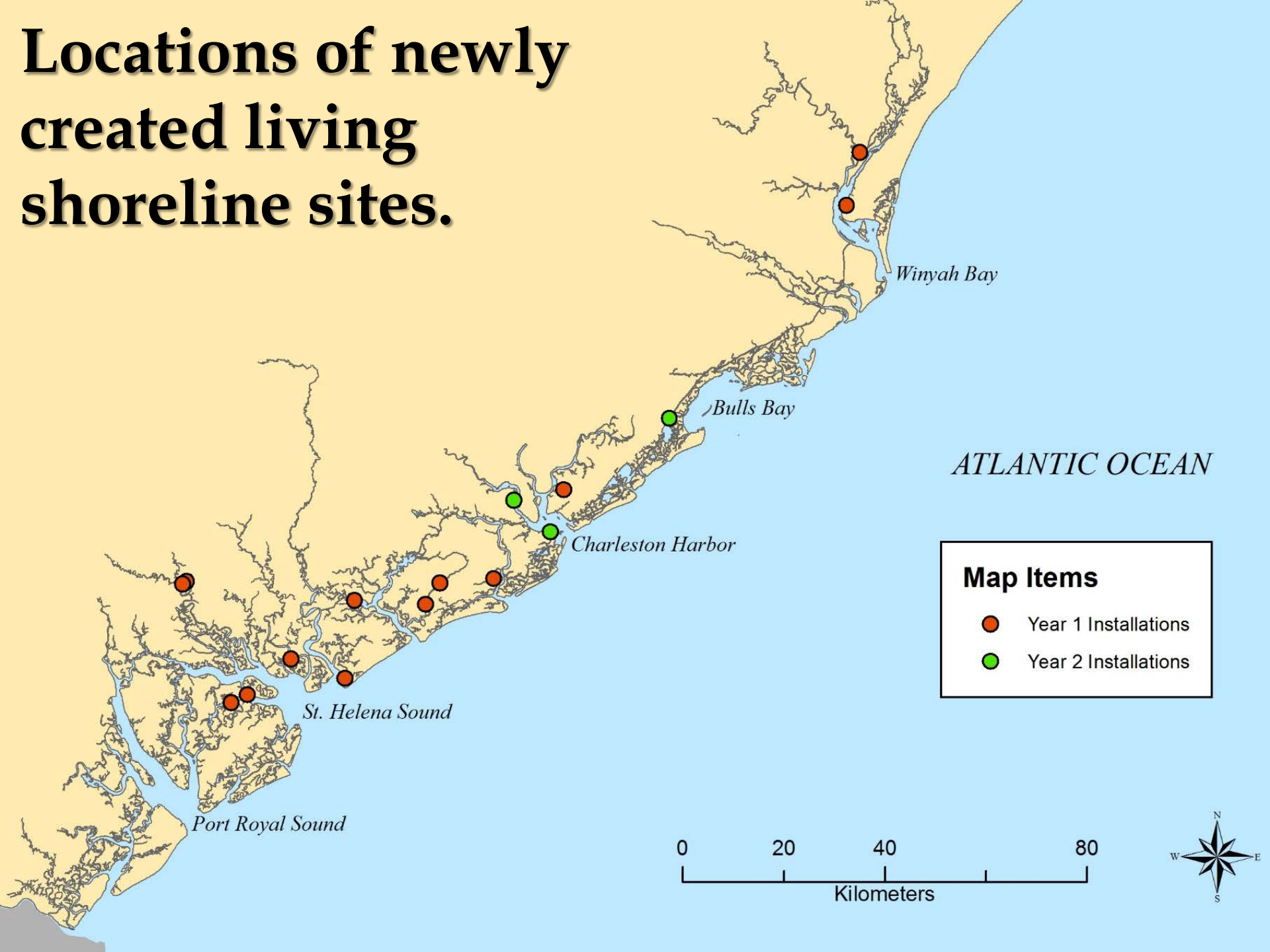
DNR

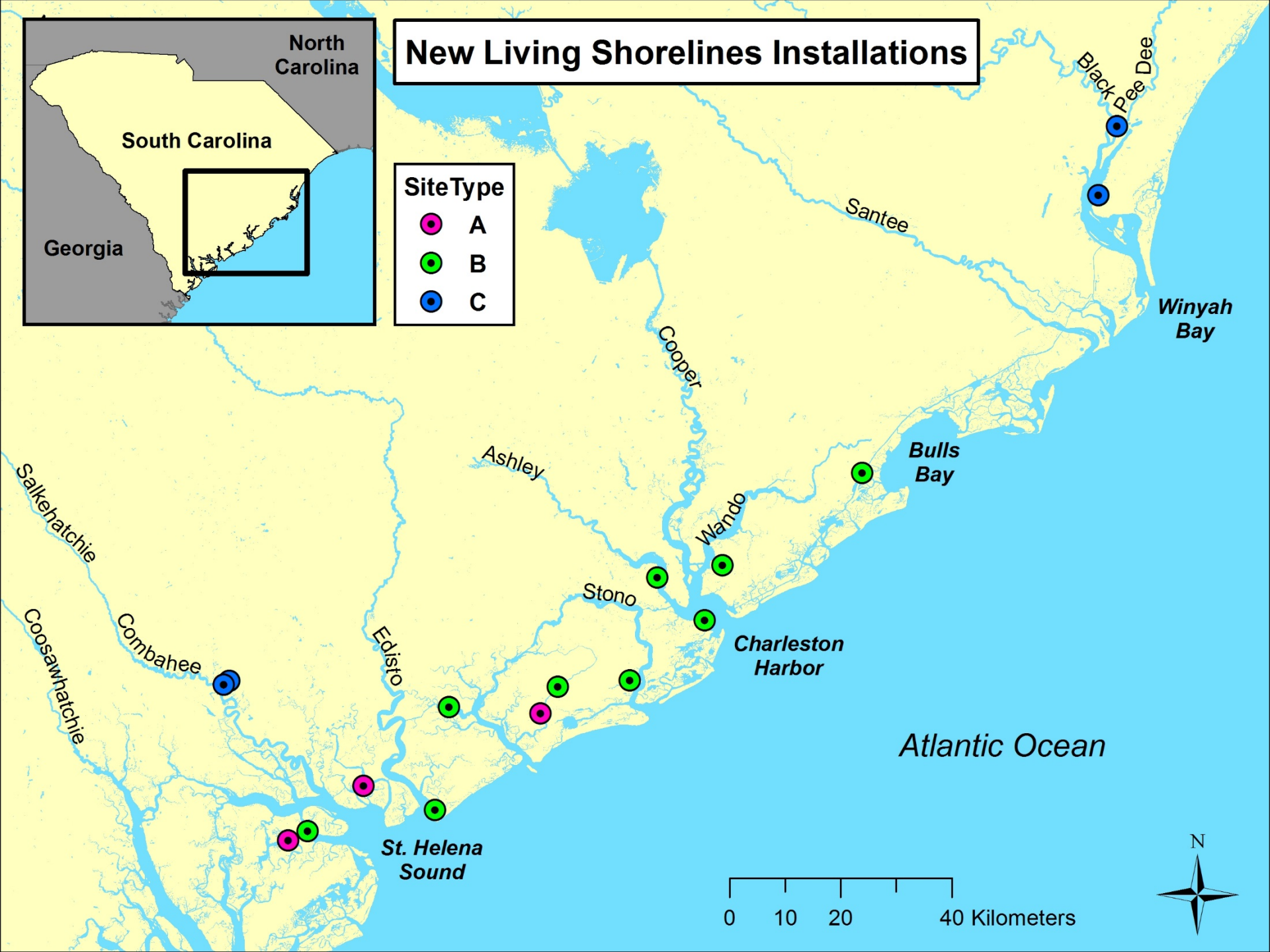
- Expand living shorelines, stabilize and protect marshes, and increase coastal biodiversity and resiliency.
- Provide SCDHEC-OCRM with science-based information on the effectiveness of different living shoreline approaches.
- Develop new living shoreline regulations appropriate for coastal South Carolina's physical conditions.
- Remove barriers to the adoption of *green* alternatives to shoreline stabilization.

Living Shoreline Project Components



Locations of newly created living shoreline sites.




New Living Shorelines Installations
North Carolina
South Carolina
Georgia
Site Type
A
B
C
Black
Pee Dee
Santee
Winyah Bay
Cooper
Ashley
Bulls Bay
Wando
Stono
Charleston Harbor
Salkehatchie
Combahee
Coosawhatchie
Edisto
St. Helena Sound
Atlantic Ocean
0 10 20 40 Kilometers
N

Site Type Categories

Type A

- Successful bagged shell reef (SCORE) sites.
- Physical environment supports oysters.
- Relatively gentle slope.
- Relatively firm sediment.

Type B

- Physical environment supports oysters, but previous SCORE reefs were not successful.
- Steep slope or soft sediment.

Type C

- Physical environment not conducive to oyster-based strategies (e.g., salinity too low, variable)

Site Type Treatment Strategy

Type A

- New bagged shell reef as positive control treatment.
- Both natural fiber treatments; Curlex universally failed; mixed results of coir logs.

Type B

- Soft sediment; bags deployed on pallets.
- Crab traps – included variations of treatment.
- Subset of sites received double coir logs.

Type C

- No oyster based treatments; all natural fiber.
- Total Curlex failure; coir logs mostly worked.

Site Type Characteristics Summary Table

Site Type	DSAS (m yr-1)	AMBUR (m yr-1)	Waterway width (m)	Slope (rise / run)	Bank width (m)	Sink depth (cm)	Mean Nov Salinity	Mean March Salinity
A	0.38 -0.50 (n=3)	-0.05 -0.42 (n=2)	136 620	0.09 0.18	3.4 14.4	3.5 13.8	25.93 30.33	19.05 27.48
B	0.08 -1.18 (n=9)	0.19 -0.65 (n=4)	58 1000+	0.03 0.25	3.3 26.0	8.2 21.3	21.71 32.09	19.57 32.19
C	0.11* -0.30 (n=4)	-0.016 (n=1)	144 200	0.01 017	2.8 4.3	1.9 19.9	2.05 7.8	0.08 1.62

Pairs of values indicate ranges
Numbers in parentheses for AMBUR and DSAS indicate number of sites
* Erosive in 2006-2015 interval

DSAS: Digital Shoreline Analysis System
Example from Port Royal Maritime Center

DSAS: Digital Shoreline Analysis System
Example from Port Royal Maritime Center

Examples of Monitoring Parameters

- Bank slope and sediment "sinkability" (measured pre-installation); site characters.
- Repeated fixed-point photos.
- % cover of live oysters (ImageJ)
- Stem density transects (perp. to shore)
- Additional parameters derived from imagery.
- Elevations (sediment and mid-reef surfaces).
- Marsh edge and escarpment positions.

A-Site Detail: Boy Scout

Marsh

Control

Coir + shell

Curlex + shell

Bagged Shell

Point Type
- Marsh edge
- Treatment corner
- Treatment elevation
- High edge
- Low edge

Bohicket Creek

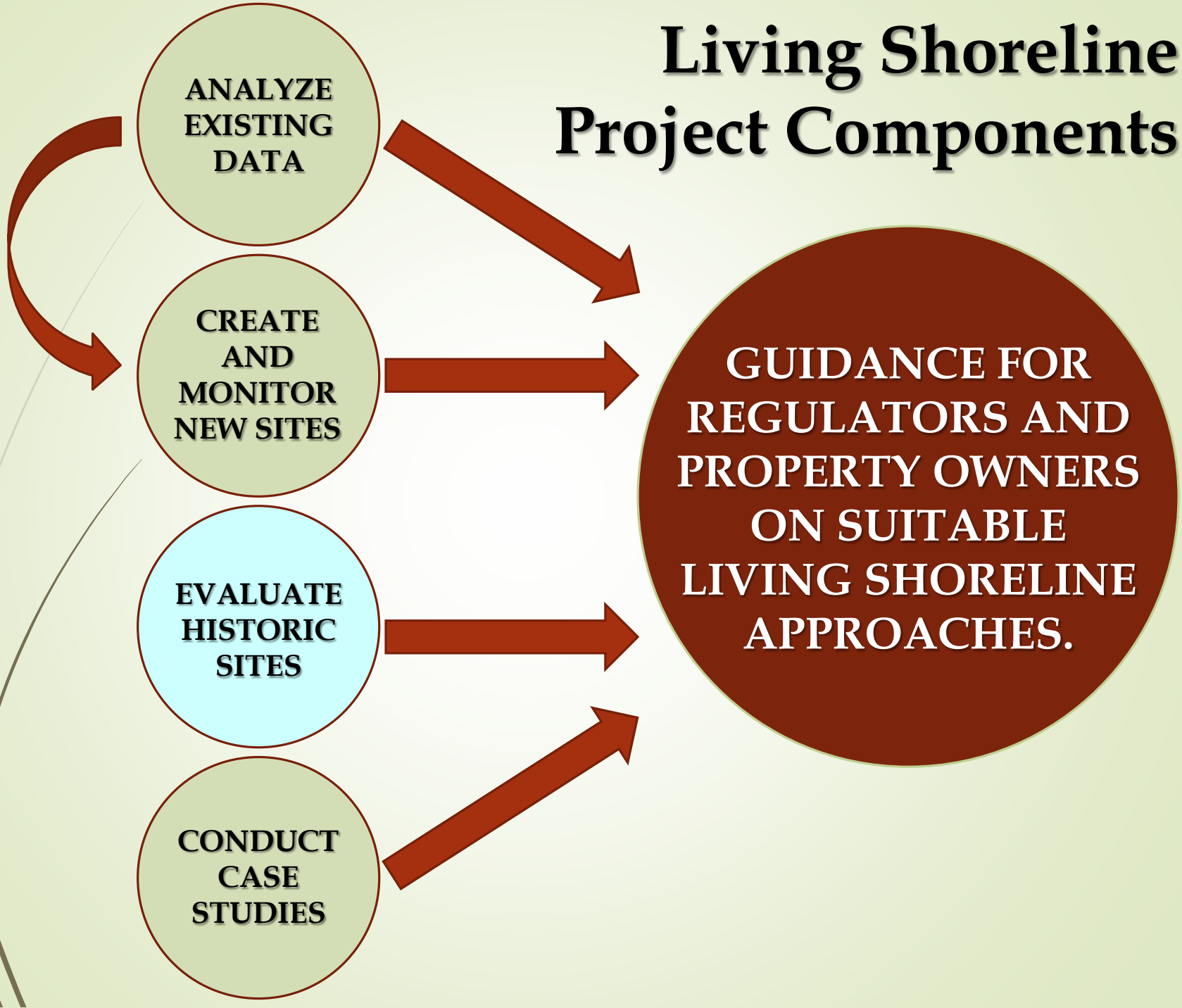
Meters
0 10 20

N

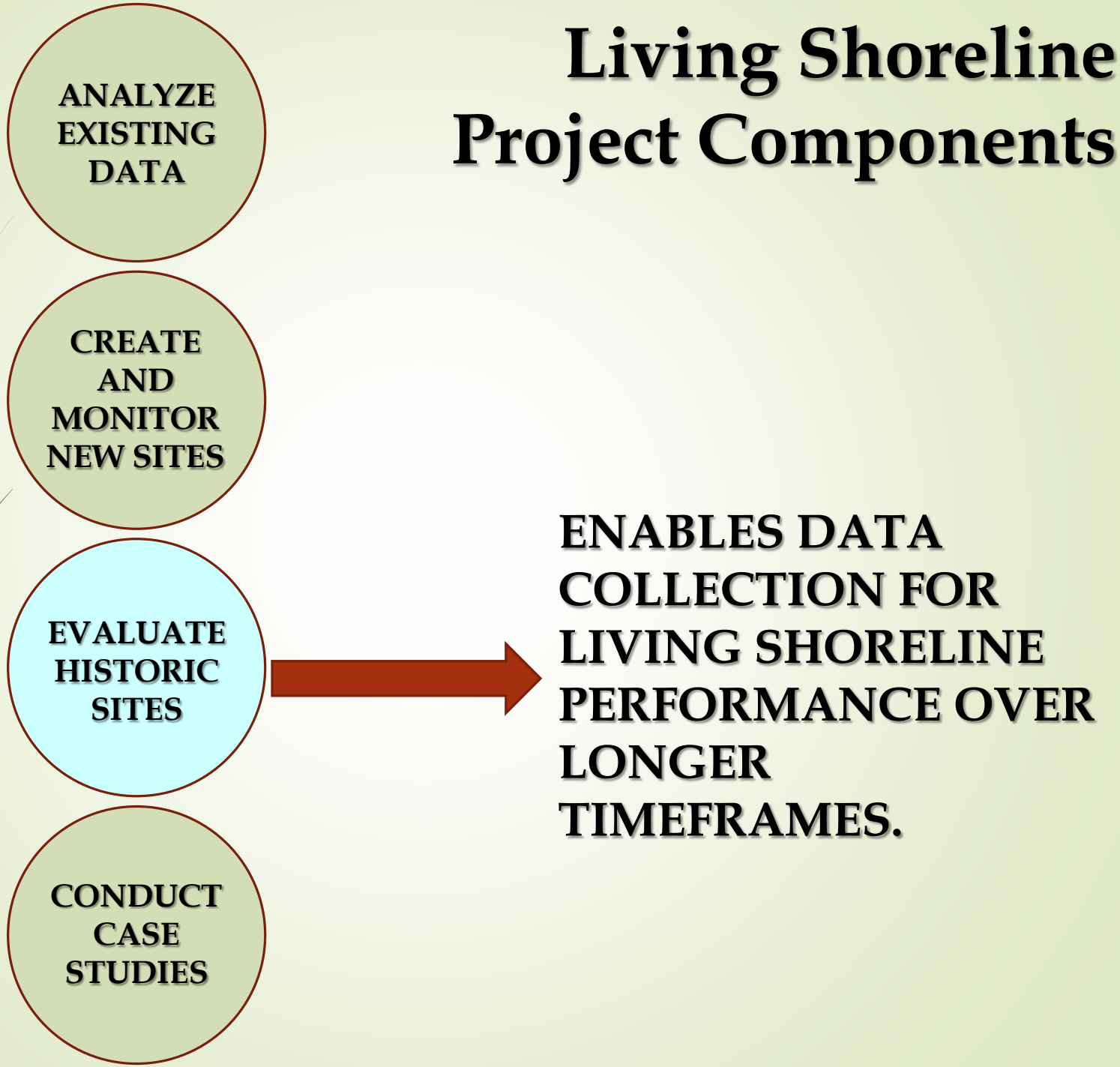
Generalized monitoring timeline for newly created sites:

- **Year 1 sites**
  - Baseline: May – Aug 2016
  - Post-Matthew: Oct 2016 – Feb 2017
  - One-year post: Sept 2017 – Jan 2018
  - Two-years post: Aug – Sept 2018
- **Year 2 sites**
  - Baseline: Aug – Nov 2017
  - One-year post: Aug 2018
- **Addition of *Spartina* plantings**
  - Seedlings prepared over winter
  - Planted in April / May 2018 (subset)

Living Shoreline Project Components

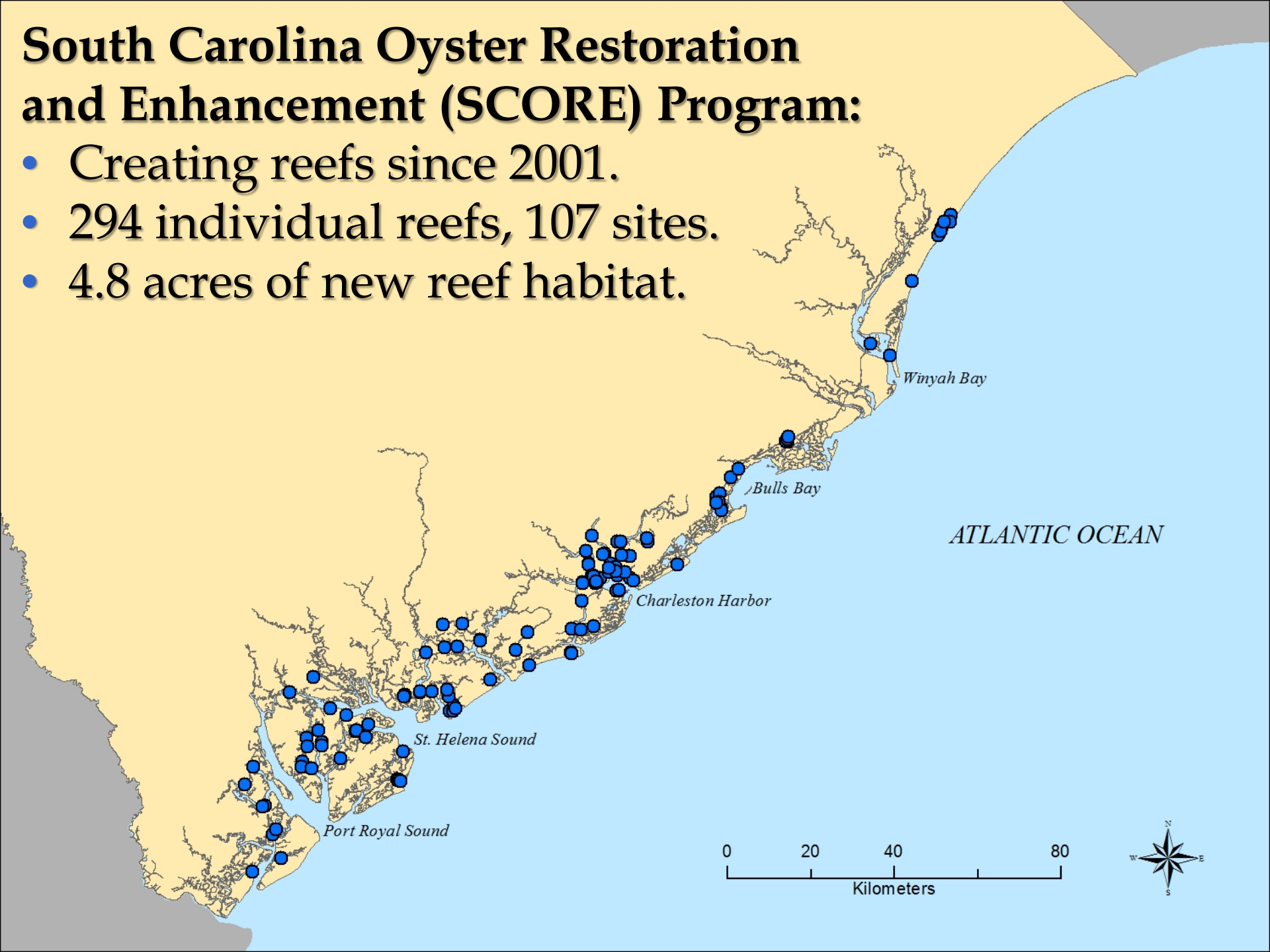


Living Shoreline Project Components



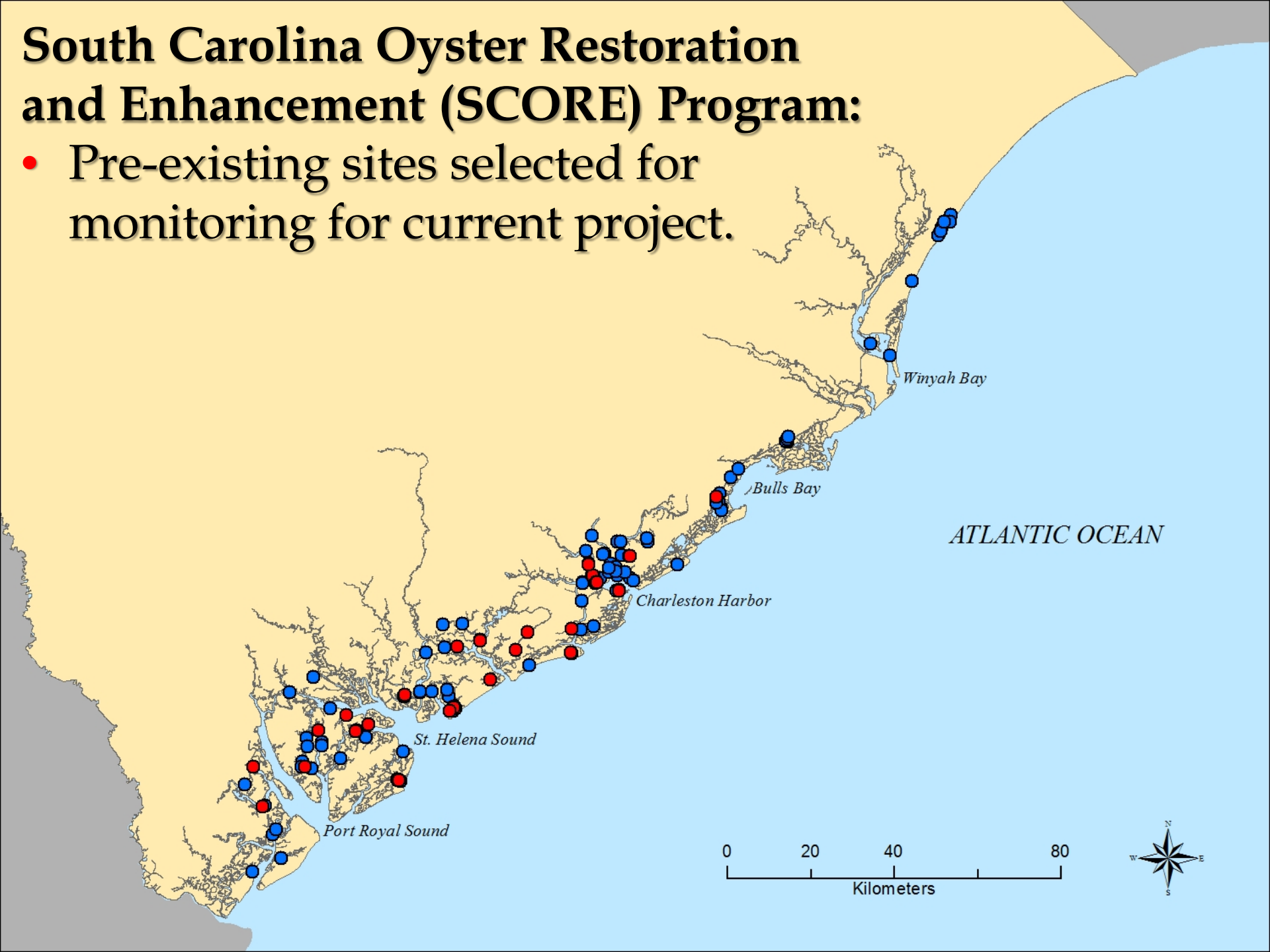
South Carolina Oyster Restoration and Enhancement (SCORE) Program:

- Creating reefs since 2001.
- 294 individual reefs, 107 sites.
- 4.8 acres of new reef habitat.

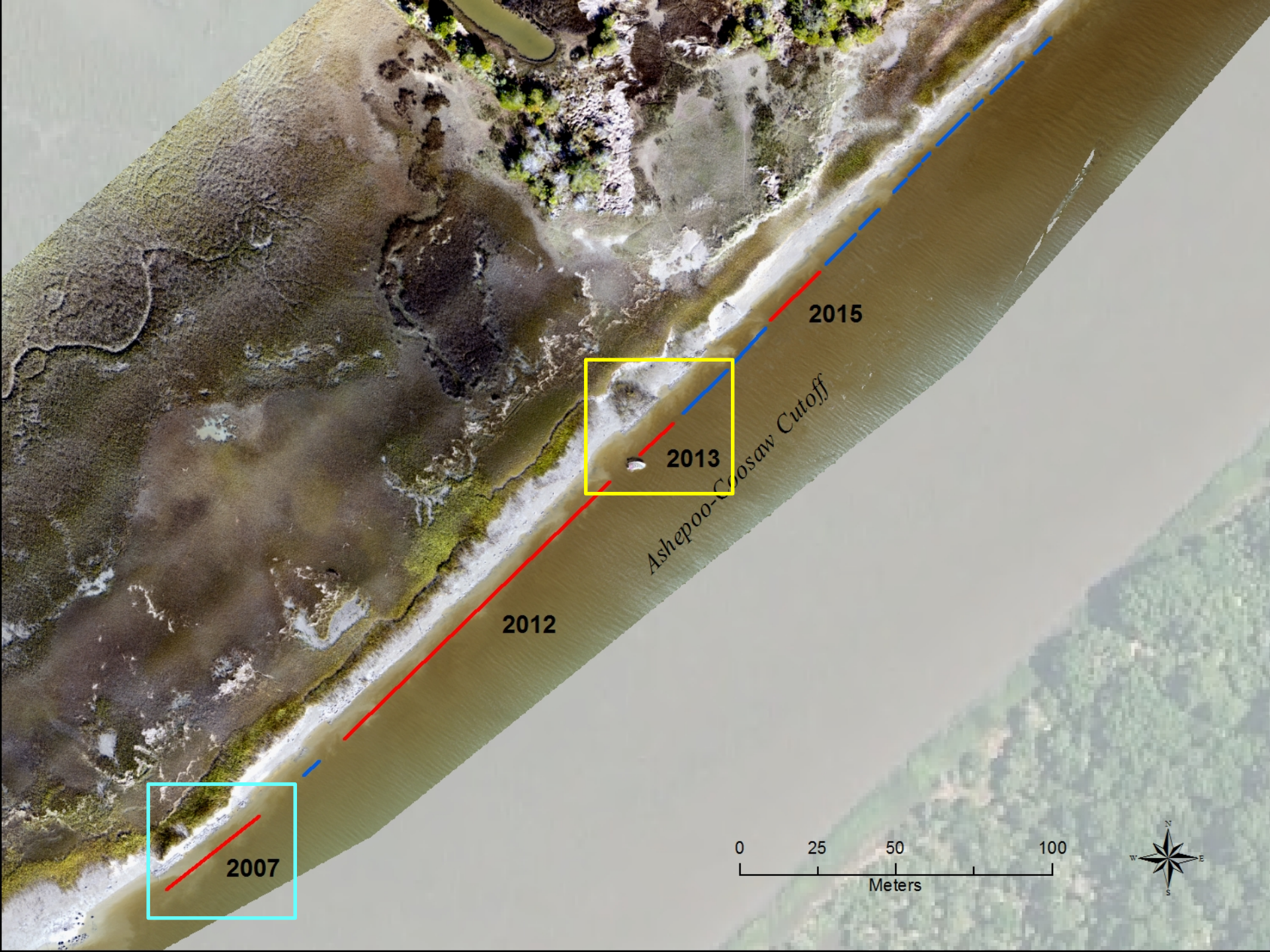


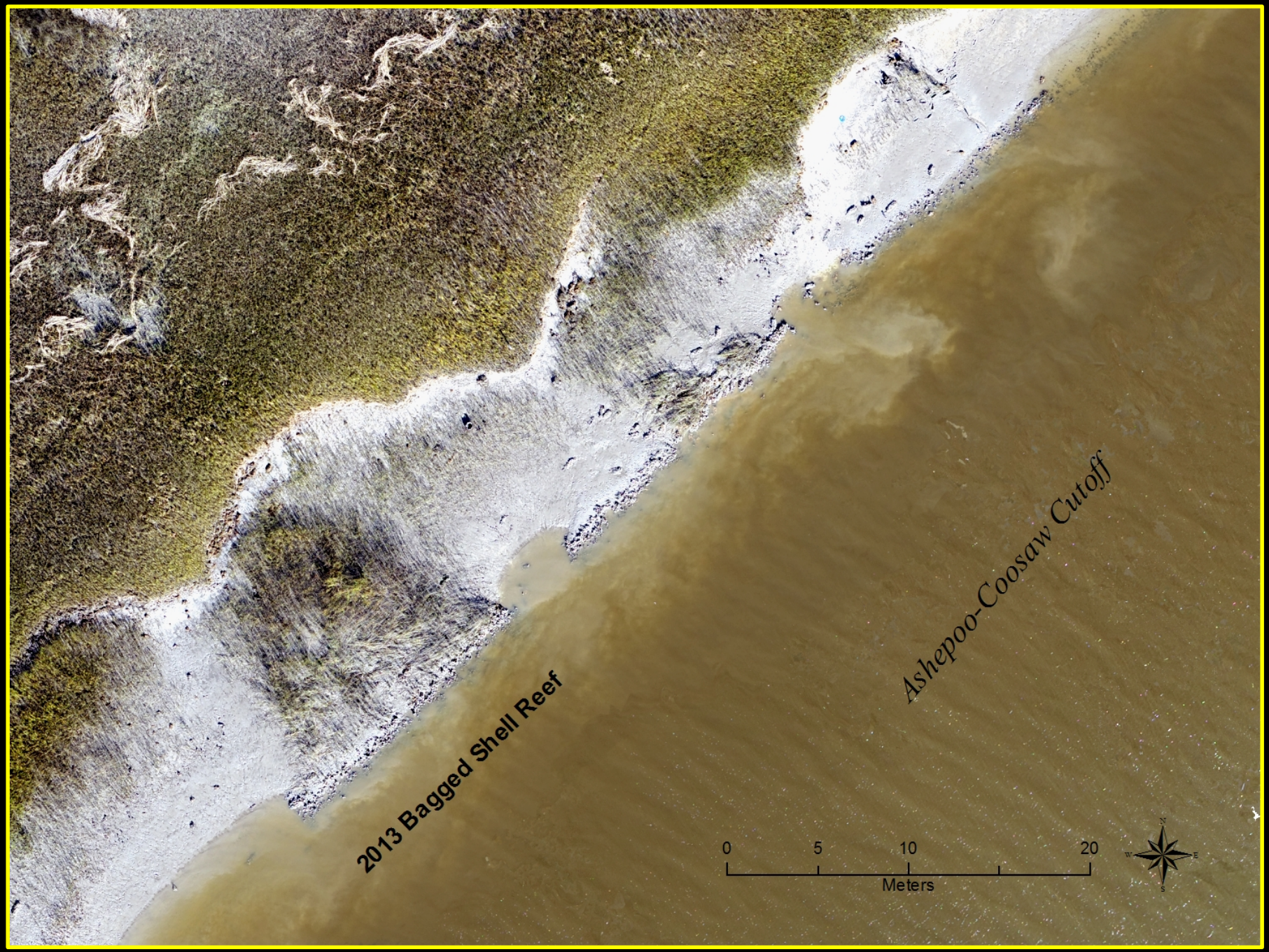
South Carolina Oyster Restoration and Enhancement (SCORE) Program:

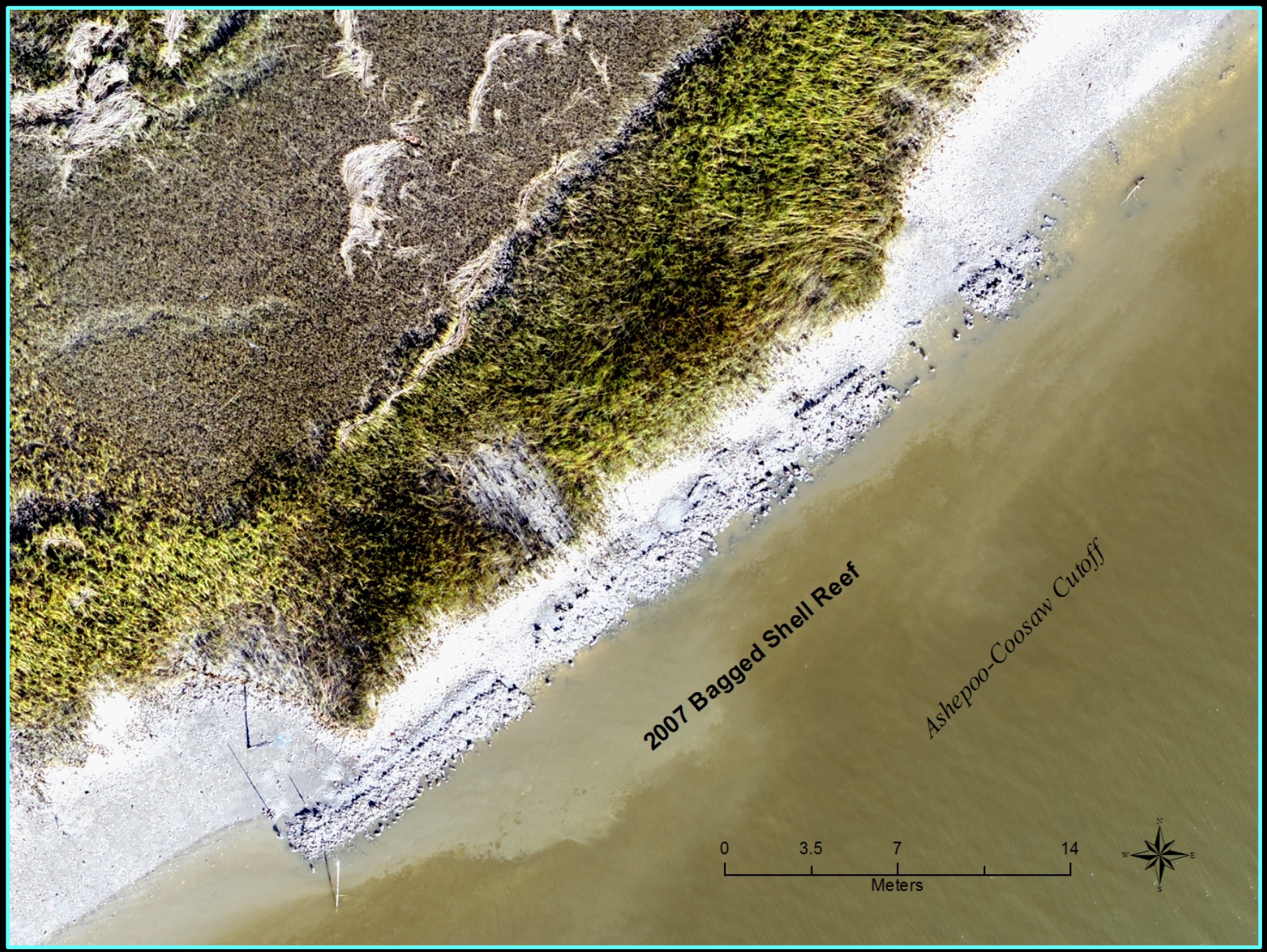
- Pre-existing sites selected for monitoring for current project.



			Reef Age (Years, in 2016)															
Monitoring Year	Bagged Shell Reef Site	# Reefs @ Site	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
YEAR 1 (December 2016 - January 2017)	Chechessee River	1		X														
	Abbapoola Creek	2	X				X											
	Big Bay Creek	2			X					X								
	Big Bay Edisto	5	X			X		X				X				X		
	Ashepoo-Coosaw Cutoff	4		X		X	X					X						
	Dataw Island	2								X								X
	Boy Scout Camp	1											X					
	Ashley River	3		X		X		X										
	Scott Creek	1			X													
	Wadmalaw River	2		X			X											
YEAR 2 (October 2017 - December 2017)	Bears Bluff #1	1										X						
	Bears Bluff #2	2				X					X							
	Wappoo Cut	3	X		X	X												
	Ocella Creek	1					X											
	Waddell Mariculture Center	2						X								X		
	Hunting Island	5		X	X		X		X		X							
	Lucy Point Creek	1					X											
	Pigeon Point	1					X											
	Kiawah Island	1														X		
	Port Royal Maritime Center	1			X													
	Battery Creek	1								X								
	Totals	42	3	5	5	5	7	3	1	3	2	3	1	0	0	3	0	1

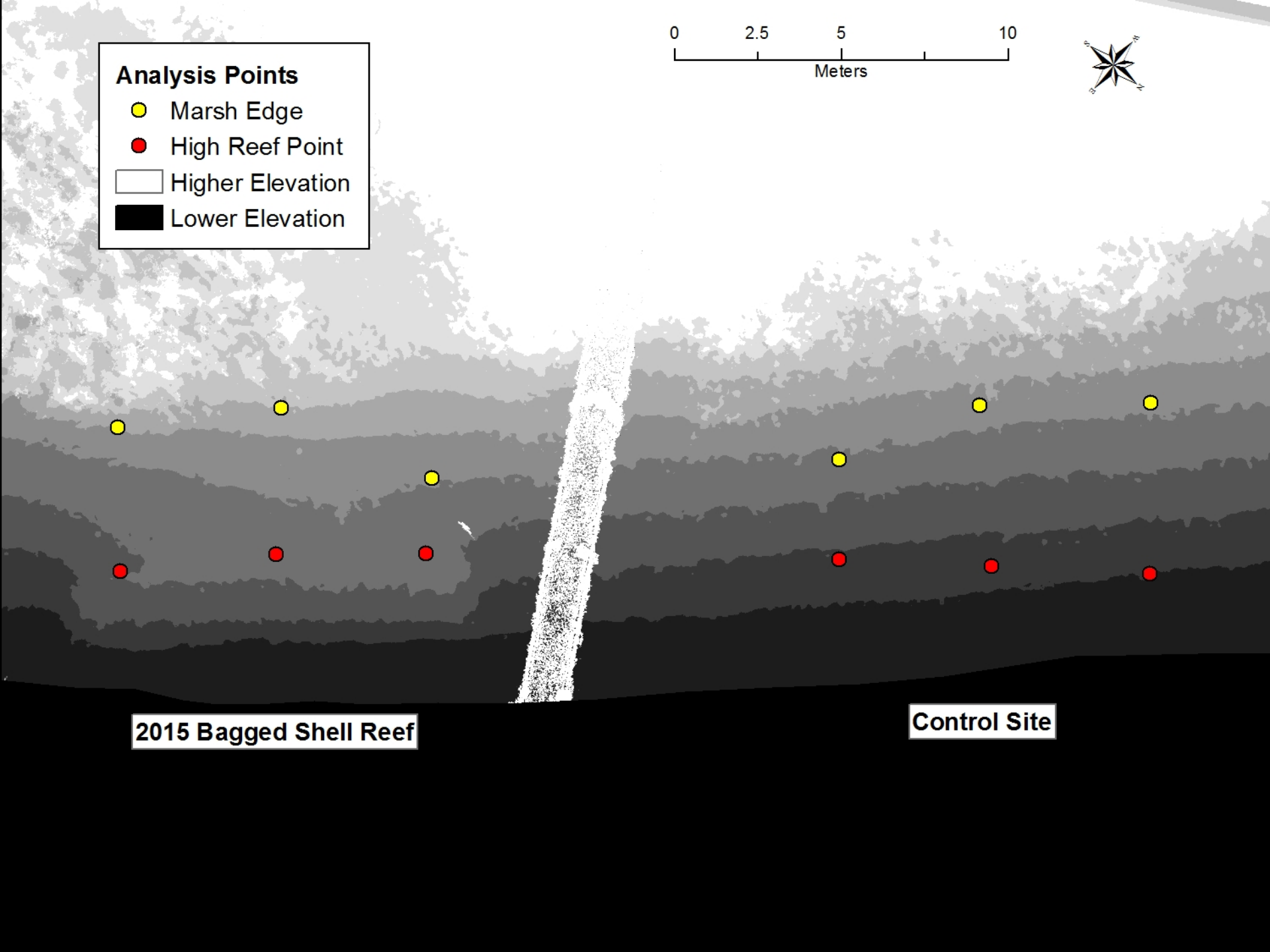

2015
2013
2012
2007
Ashepoo-Coosaw Cutoff
0
25
50
100
Meters
N
W
E
S


2013 Bagged Shell Reef
Ashepoo-Coosaw Cutoff
0
5
10
20
Meters
N
W
E
S

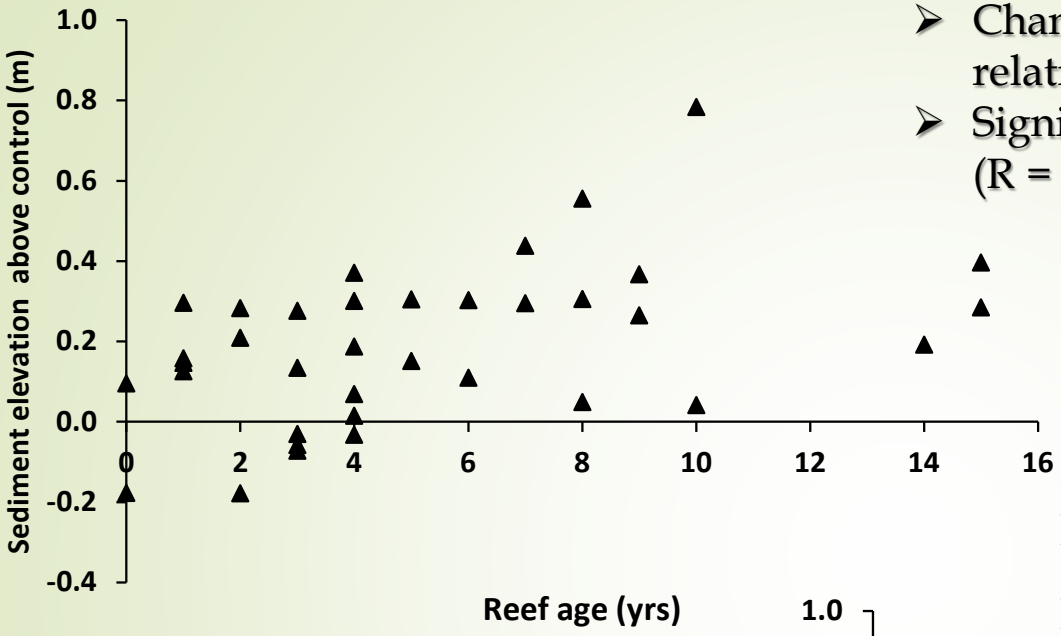

2007 Bagged Shell Reef
Ashepoo-Coosaw Cutoff
0
3.5
7
14
Meters
N
W
E
S

Diversity of integrated data collection approaches.

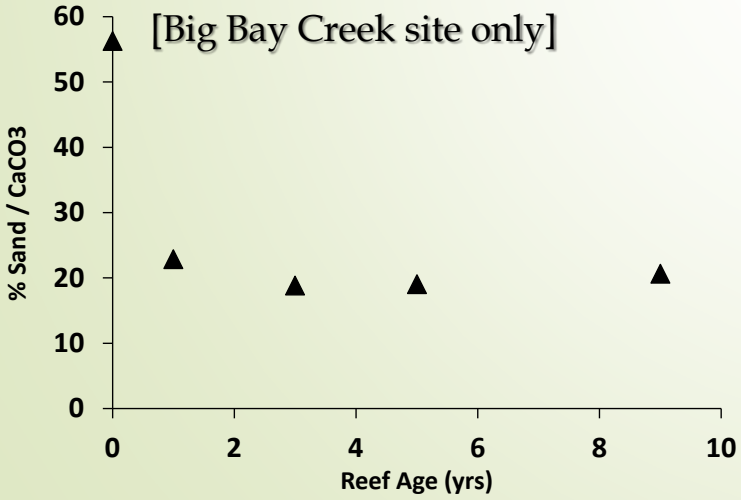

Analysis Points
Marsh Edge
High Reef Point
2015 Bagged Shell Reef
Control Site
Chechessee River
0
2.5
5
10
Meters


Analysis Points
Marsh Edge
High Reef Point
Higher Elevation
Lower Elevation
0
2.5
5
10
Meters
2015 Bagged Shell Reef
Control Site

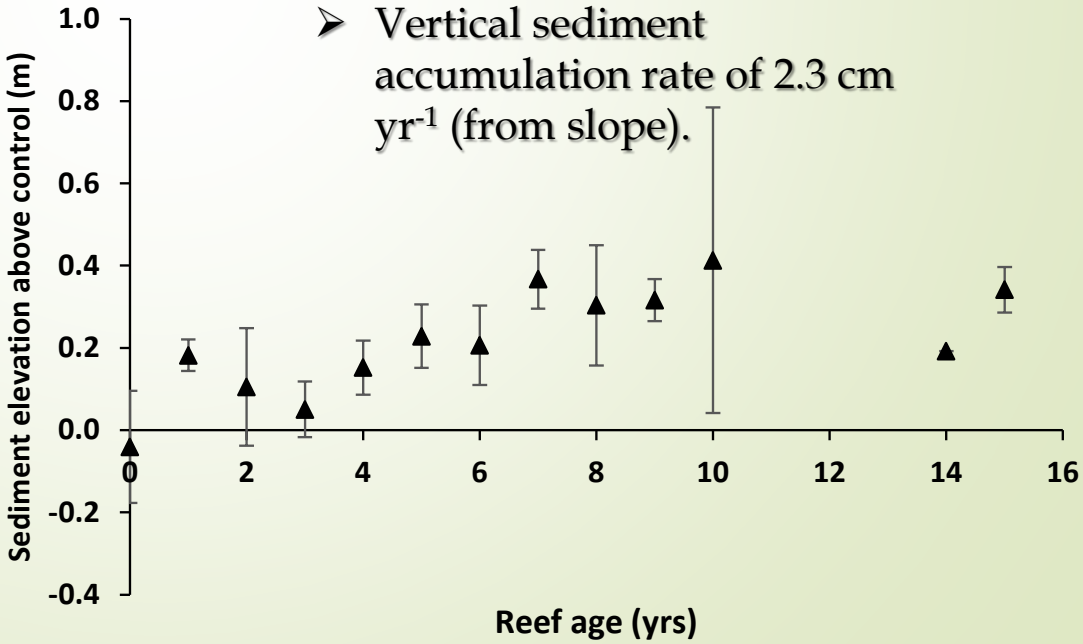
1) Sediment surface elevation change over time.



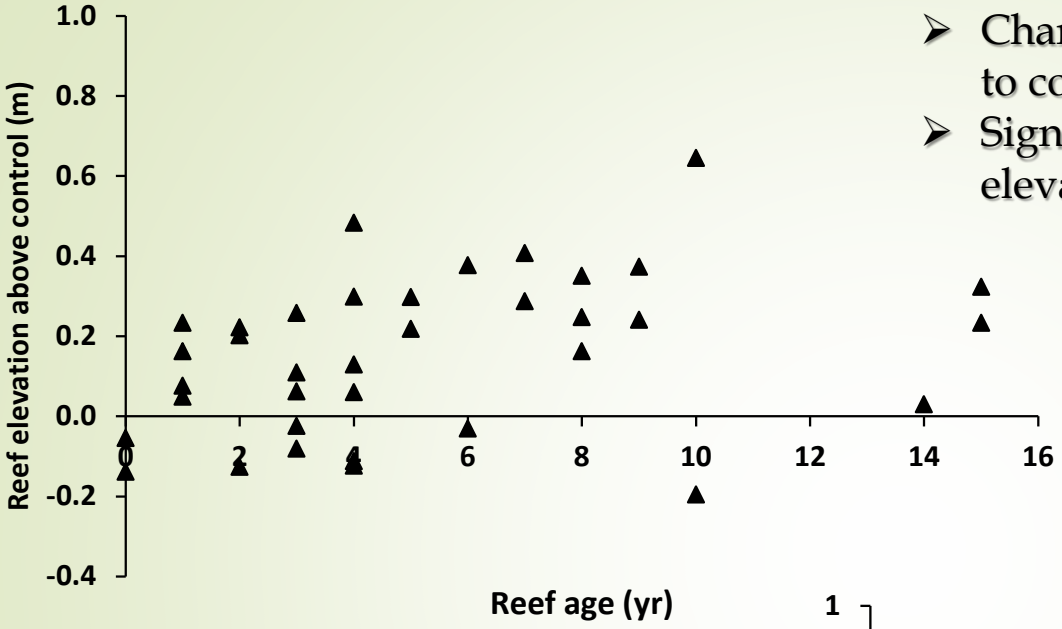
- Change in sediment elevation behind reef relative to control.
- Significant relationship with reef age ($R = 0.21$; $p = 0.0046$).



- Data averaged by year class.
- Vertical sediment accumulation rate of 2.3 cm yr^{-1} (from slope).

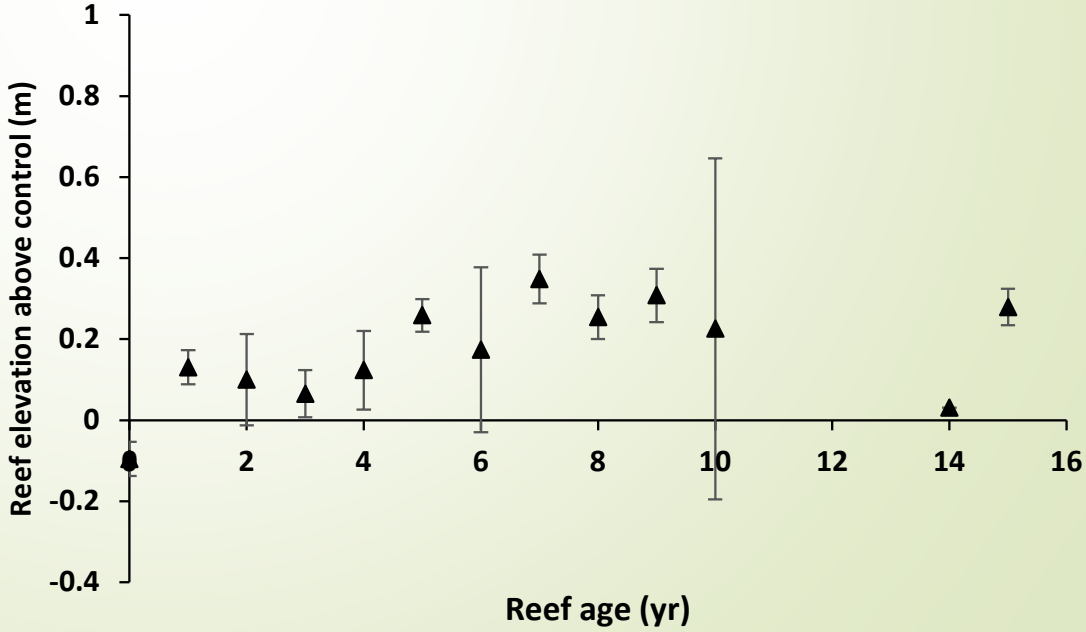


2) Reef surface elevation change over time.

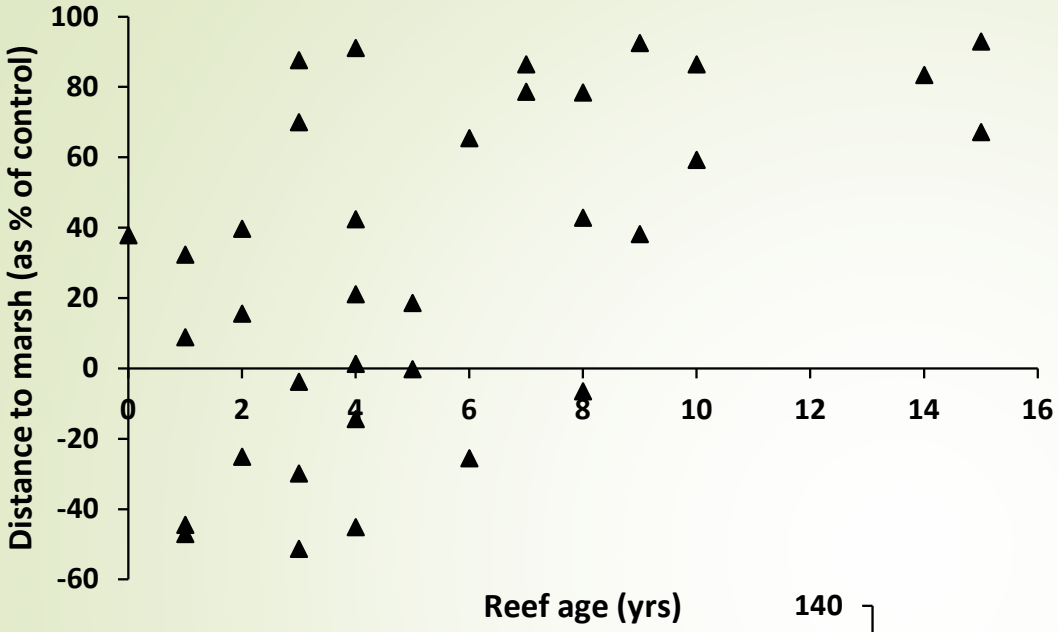


- Change in surface elevation of reef (relative to control) over time.
- Significant relationship between reef elevation and reef age ($R = 0.12$; $p = 0.0401$).

- Data averaged by year class.
- Vertical reef accretion rate of 1.7 cm yr^{-1}.
- Consider SLR and ability of oyster reefs to keep pace…



3) Lateral marsh accretion behind reef over time.

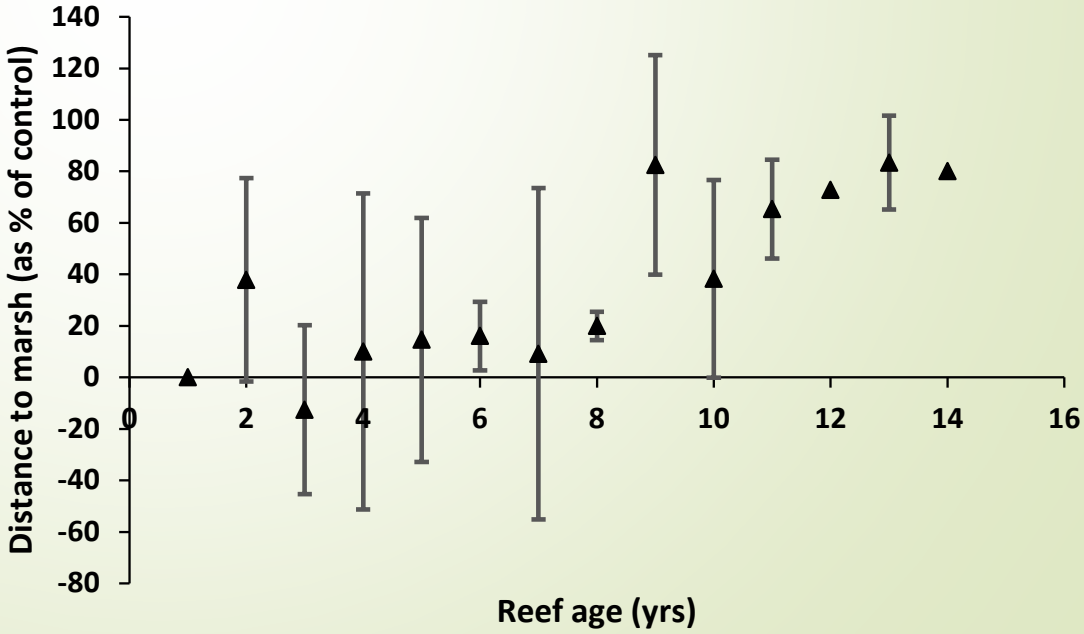


- Response variable:

$$\frac{\text{Control}_{DIST} - \text{Reef}_{DIST}}{\text{Control}_{DIST}} \times 100\%$$

- DIST = Distance from back of plot to marsh edge.
- Significant relationship between marsh accretion and reef age ($R = 0.31$; $p = 0.0005$).

- Data averaged by year class.
- Major effects seen at 8+ years.
- Average lateral accretion rate of marsh of 6.5 cm yr^{-1}.



Next steps…

- Analysis to understand site variability and sequence in developmental trajectories:
  - Surface sediments (0-1 years)
  - Change in elevation (4-6 years)
  - Lateral marsh expansion (4-8 years)
- Monitoring of new living shorelines (scheduled for August-September 2018).
- *Spartina* planting behind 1-yr old living shorelines (paired treatment plots).
- Continued collaboration with SCDHEC, through living shorelines working group (guidance document and 309 funding).


Questions?
Newly planted *Spartina* at Combahee site on April 20th 2018.