DHEC LS Working Group
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Charleston, SC

Evaluating Living Shorelines To Inform Regulatory Decision-Making in South Carolina

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NATIONAL ESTUARINE RESEARCH RESERVE SYSTEM SCIENCE COLLABORATIVE

SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES
DNR

DHEC
PROMOTE PROTECT PROSPER
Ocean and Coastal Resource Management

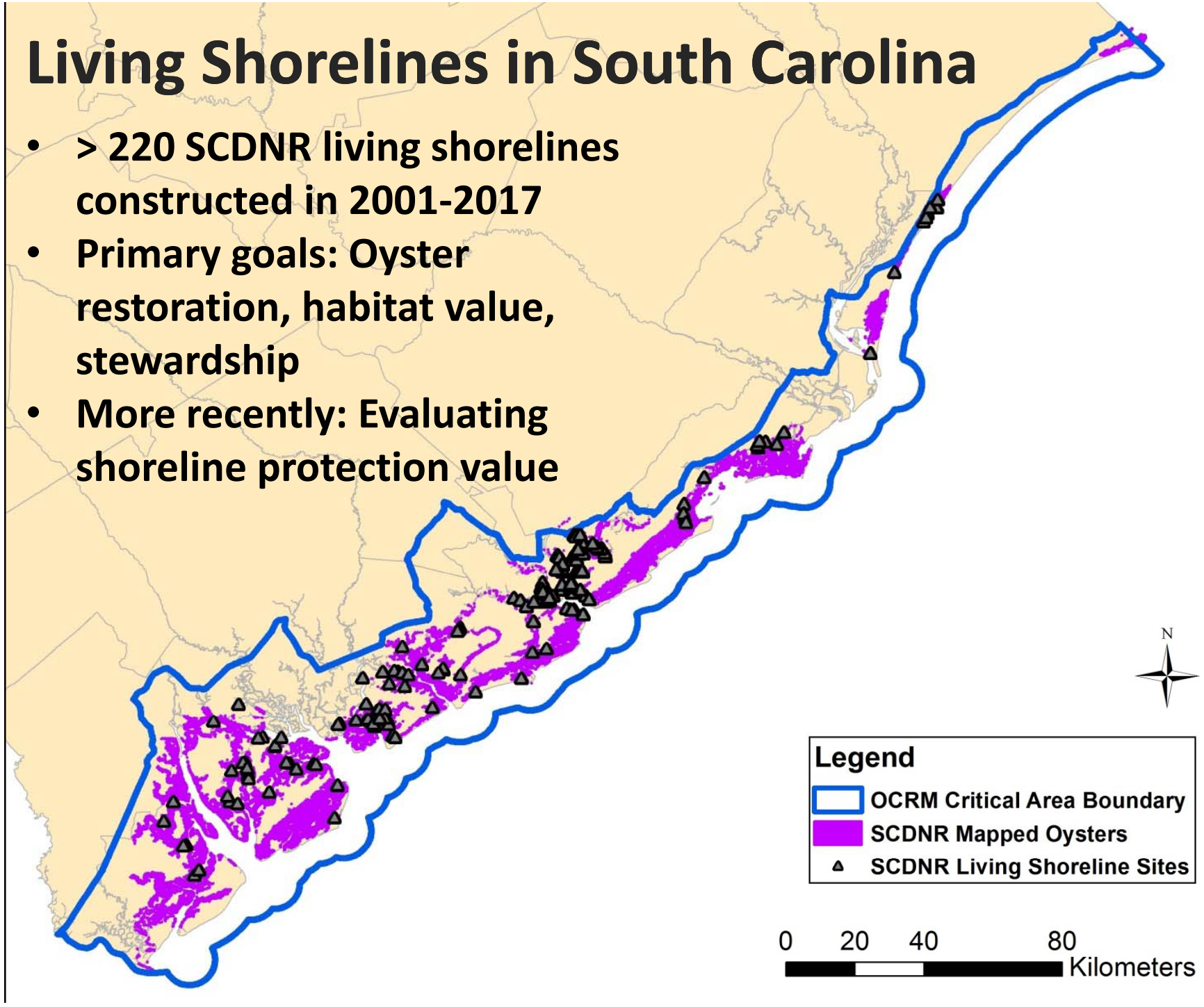
ACE Basin
National Estuarine Research Reserve

North Inlet - Winyah Bay
National Estuarine
Research Reserve

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

Living Shorelines in South Carolina

- > 220 SCDNR living shorelines constructed in 2001-2017
- Primary goals: Oyster restoration, habitat value, stewardship
- More recently: Evaluating shoreline protection value



South Carolina Oyster Restoration & Enhancement (SCORE) Program

Additional Approaches:

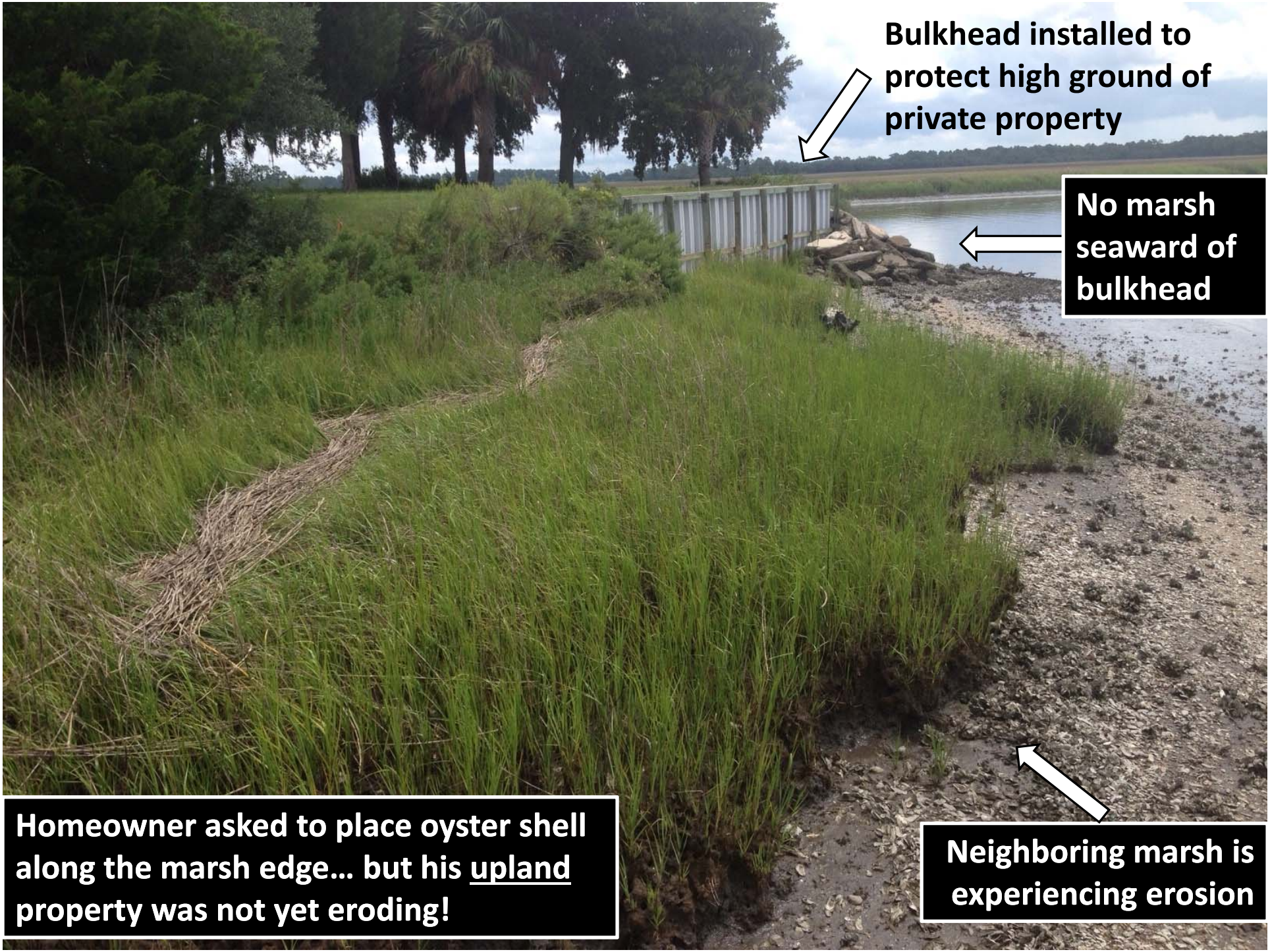
- Creating reefs from salvaged crab traps

Bears Bluff National Fish Hatchery
Collaboration between SCDNR & USFWS
Reef installed on May 2nd, 2011
Photo taken on July 3rd, 2012 (Ben Stone, SCDNR)

Additional Approaches, cont.:

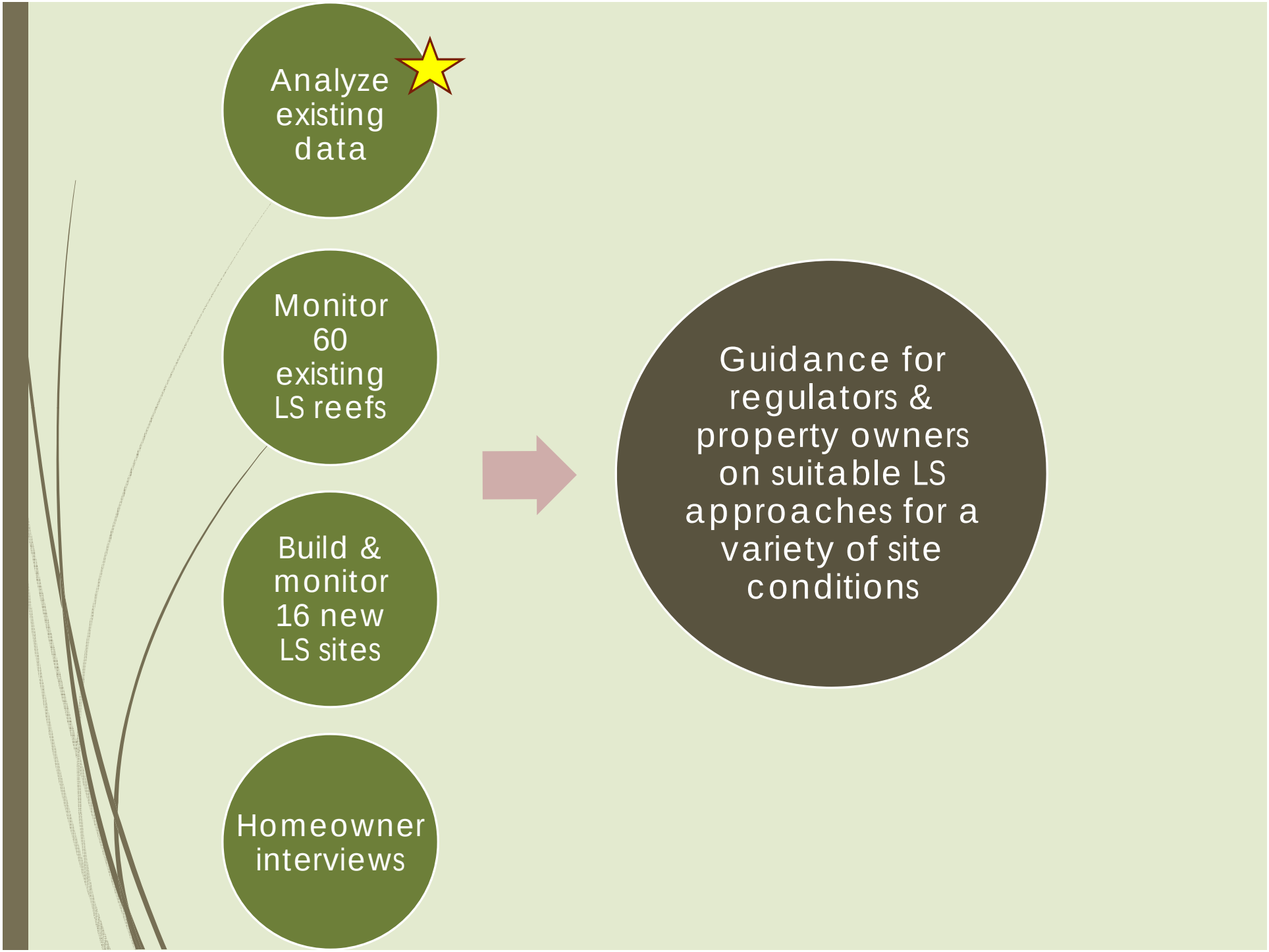
- **Oyster Castles: Interlocking blocks of concrete, limestone, crushed shell, and silica**

Sara Corbett (USACE)


Bulkhead installed to protect high ground of private property
No marsh seaward of bulkhead
Homeowner asked to place oyster shell along the marsh edge… but his upland property was not yet eroding!
Neighboring marsh is experiencing erosion

As a result, SCDHEC reached out to SCDNR:

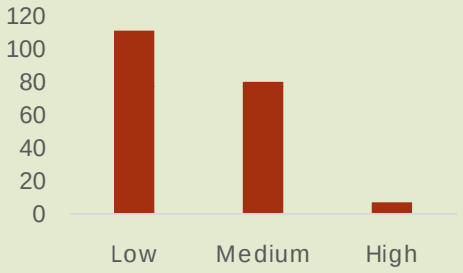
- **Interest in developing new LS-friendly regulations** appropriate for coastal SC's physical conditions, **removing a critical barrier to living shoreline implementation**
- **SCDNR's role** (in collaboration with many partners)**: Provide SCDHEC-OCRM with science-based information** on the relative effectiveness of different LS approaches under a range of regional site conditions


Analyze existing data
Monitor 60 existing LS reefs
Build & monitor 16 new LS sites
Homeowner interviews
Guidance for regulators & property owners on suitable LS approaches for a variety of site conditions

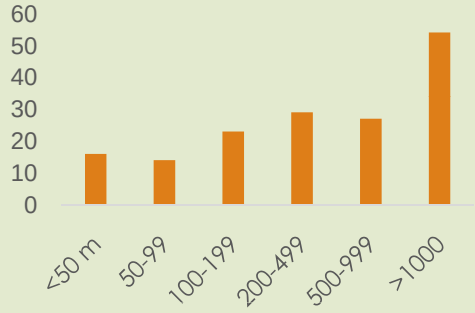
Living Shorelines Reefs in SC

- **As of Jan 2017, our LS DB had data on 218 sites (360 reefs)**
- **Site characteristics:**

Sinkability (N=205)



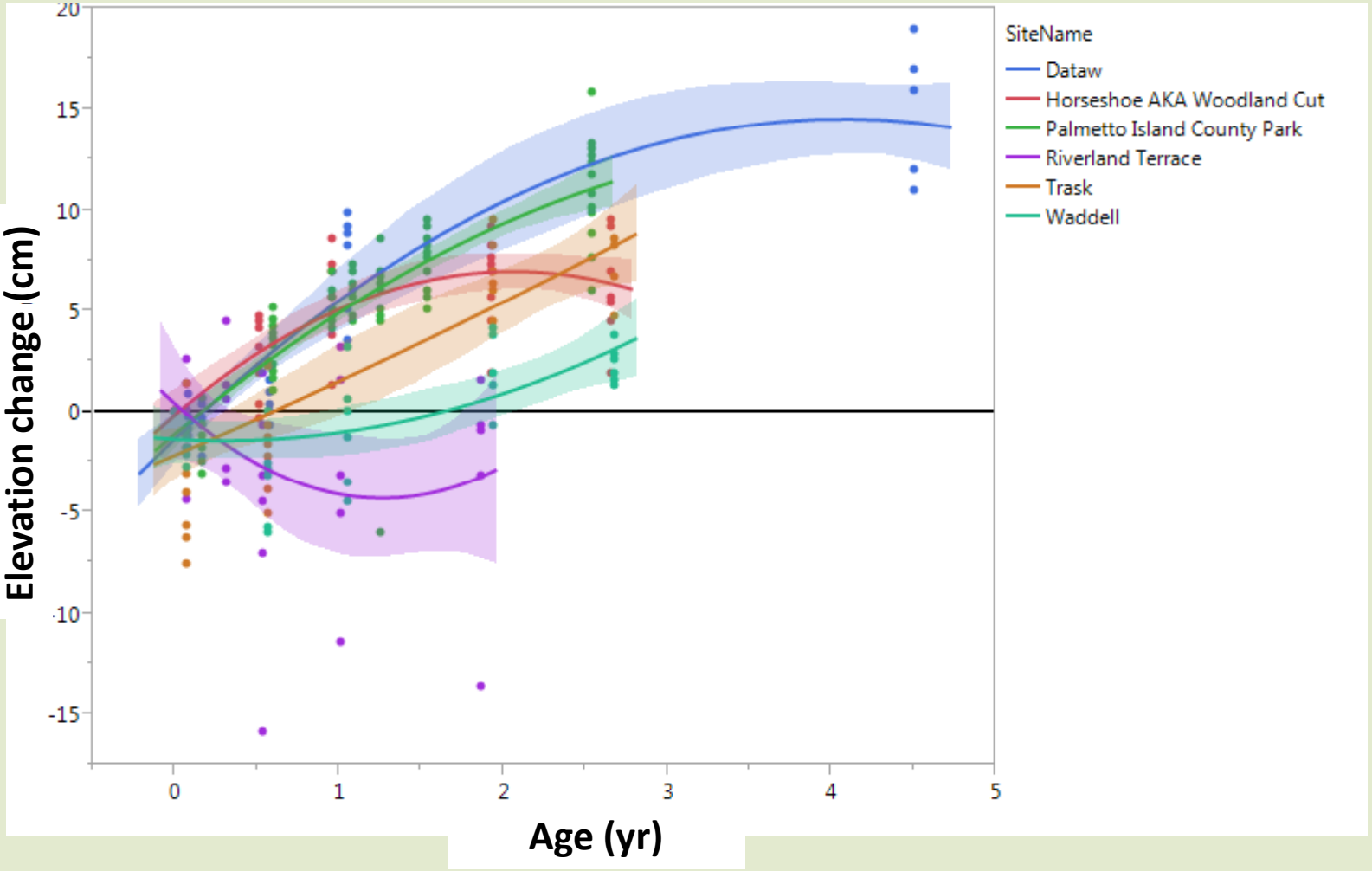
Relative slope (N=198)



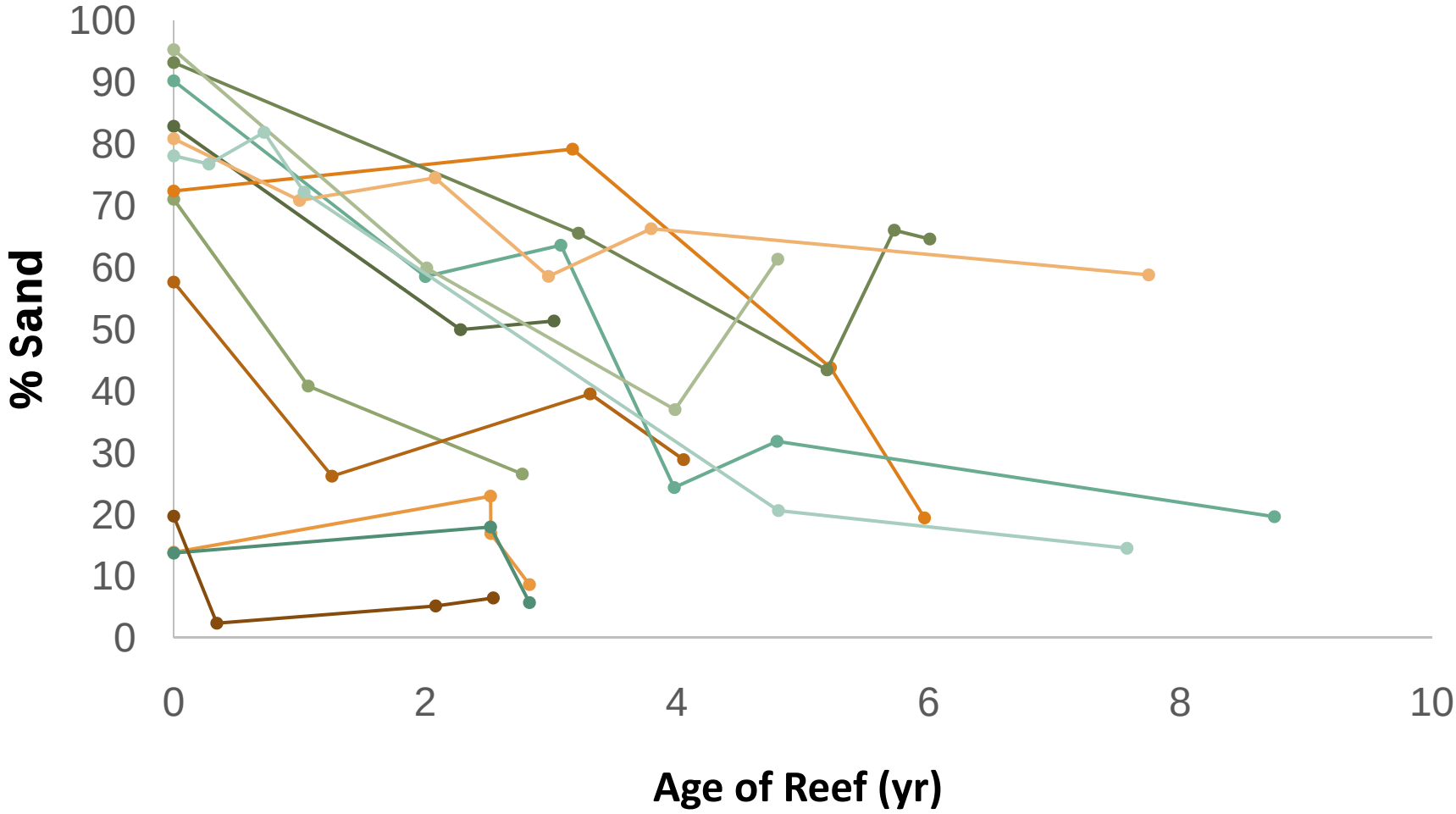
Waterbody width (N=163)

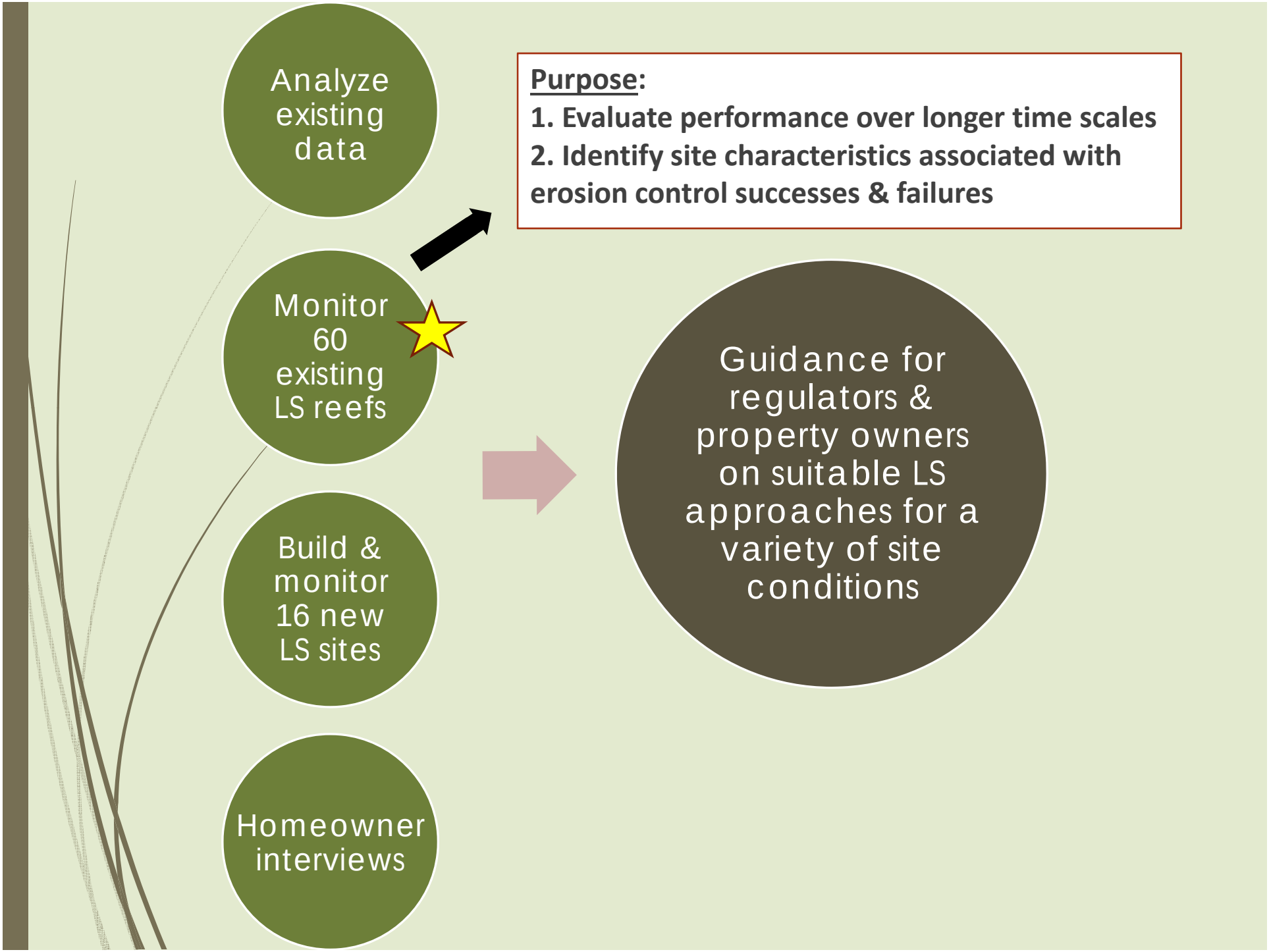
- **Pre-existing monitoring data: N**
  - **Sediment accretion: 12**
  - **Sediment characteristics: 24**

Accretion of Sediment Behind Reefs



Sediment Composition Upslope of Reef




Analyze existing data
Monitor 60 existing LS reefs
Build & monitor 16 new LS sites
Homeowner interviews
Purpose:
1. Evaluate performance over longer time scales
2. Identify site characteristics associated with erosion control successes & failures
Guidance for regulators & property owners on suitable LS approaches for a variety of site conditions

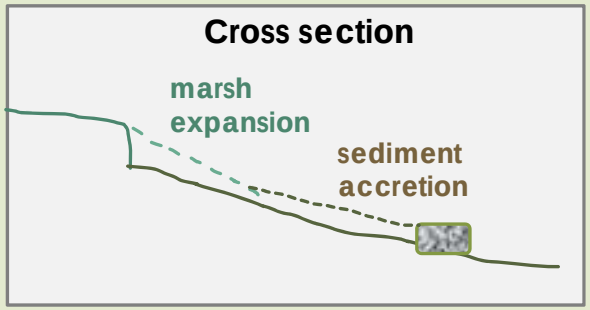
Monitoring of Pre-existing Reefs (N=62)

REEF MATERIAL	INSTALLATION YEAR															
	2001	2002	2003	2004	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Bagged Shell	1	1	1	1	1	2	1	3	1	2	3	6	4	5	3	1
Bagged Shell + Pallets								1			1	1*	1		2	
Crab Traps											1	4	1	2	2**	1
Oyster Castles										2		4	2	1		

* Spartina planted behind reef
** Modified crab traps (not salvaged)

- # reefs/site = 1-6 (there are 7 sites with 3+ reefs)
- Each reef area will be compared to an adjacent, unaltered control area
- The reefs at Port Royal Maritime Center (4 types) were monitored 2x

Monitoring of Pre-Existing Reefs



= Fixed point photo

= R8: Position and elevation of reef & marsh edge

= R8: Elevation transect

= Quadrat for plant density transect or Quadrat for oyster % cover

= Sediment sample collection for % silt/clay

Elevation transect (x1)
Plant density transect (x3)

ESCARPMENT

MARSH

Bank Width

1.5 m

1.5 m

1.75 m

1.75 m

MLW

1

2

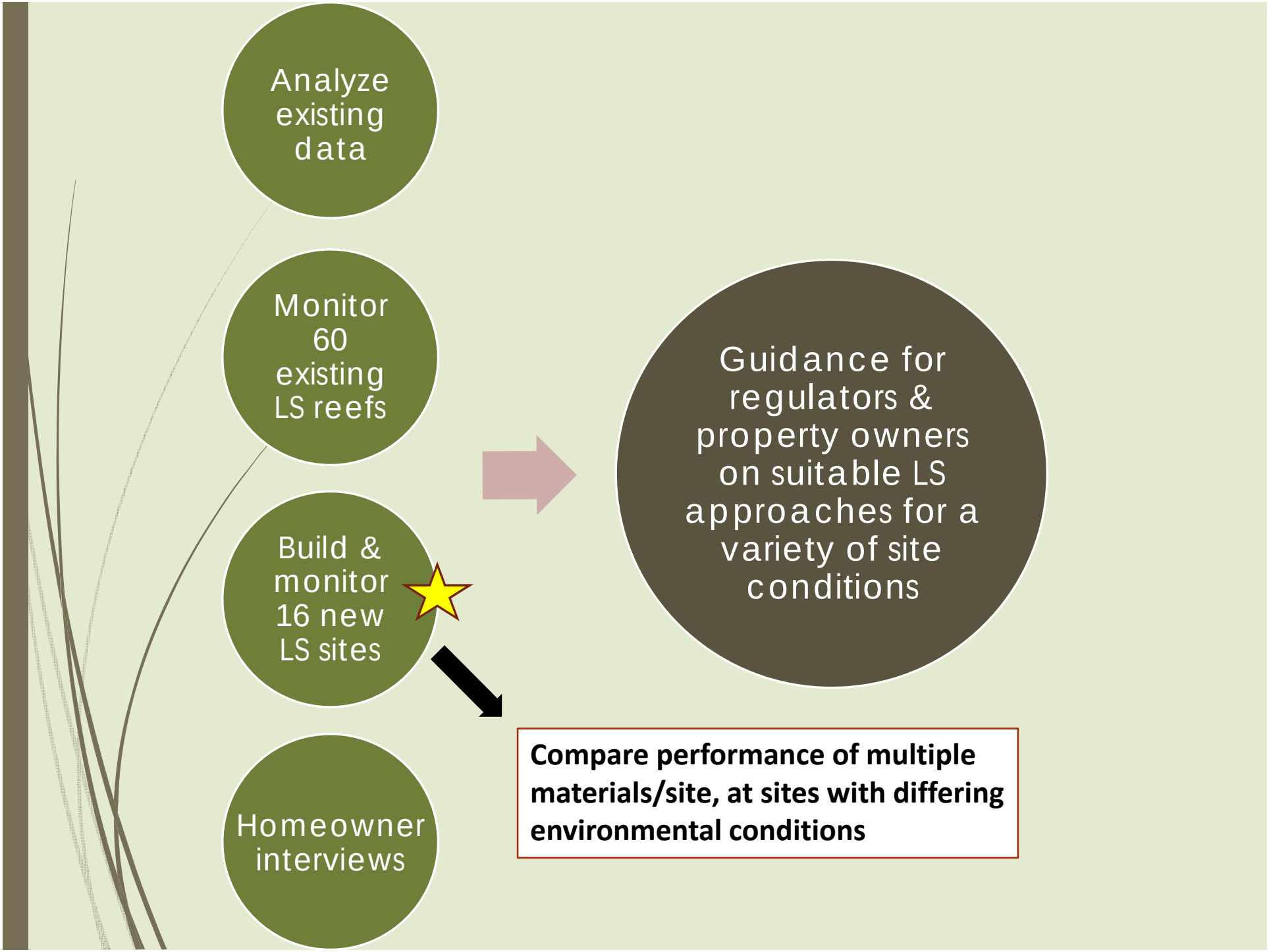
3

4

5

6

7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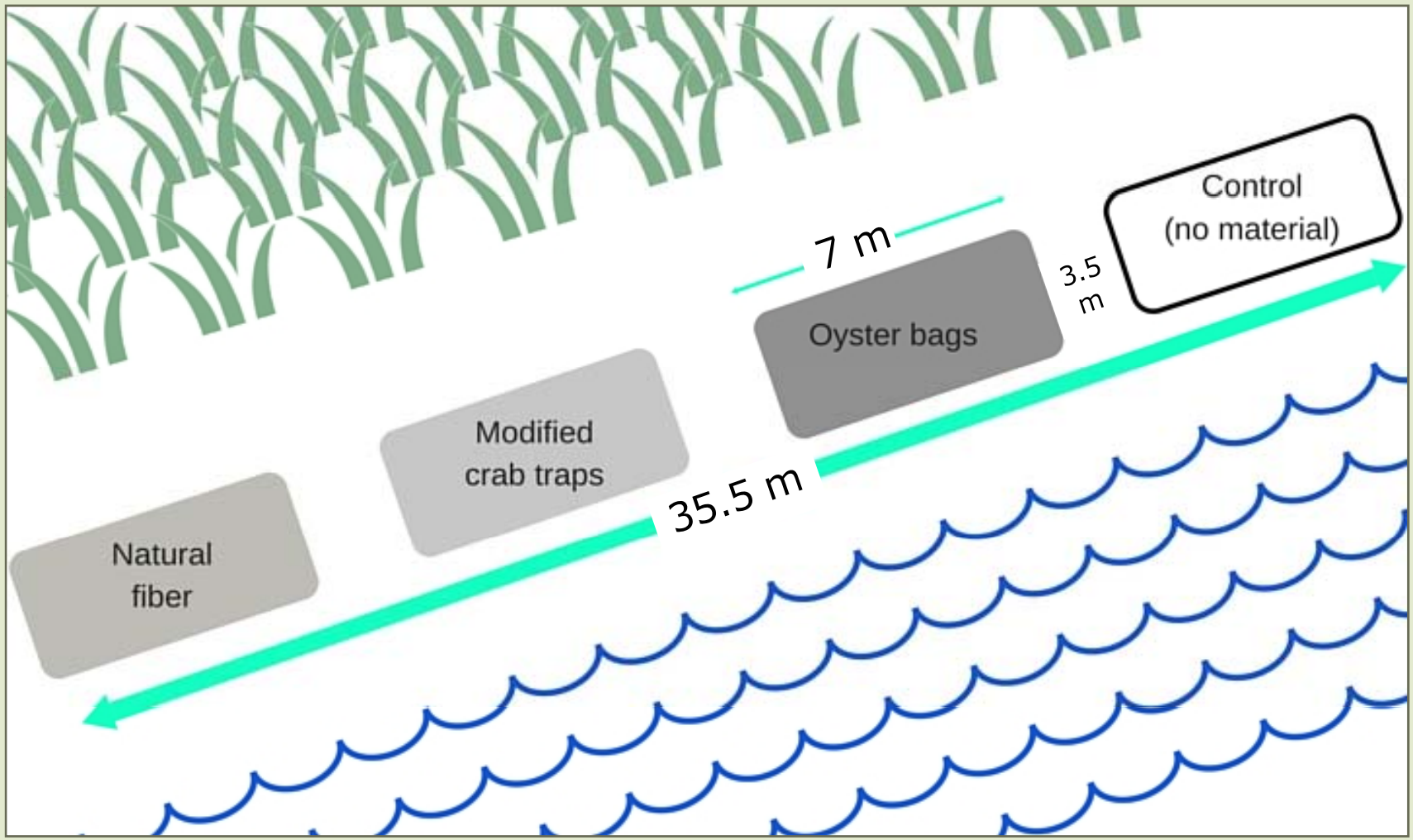
Guidance for regulators & property owners on suitable LS approaches for a variety of site conditions
Compare performance of multiple materials/site, at sites with differing environmental conditions

Experimental Design: New Sites

- 4 different materials with additional variations (treatments)
- The combination of treatments varies by site type
- 3-6 treatments + control area per site



Treatment: Bagged oyster shell ("bags")

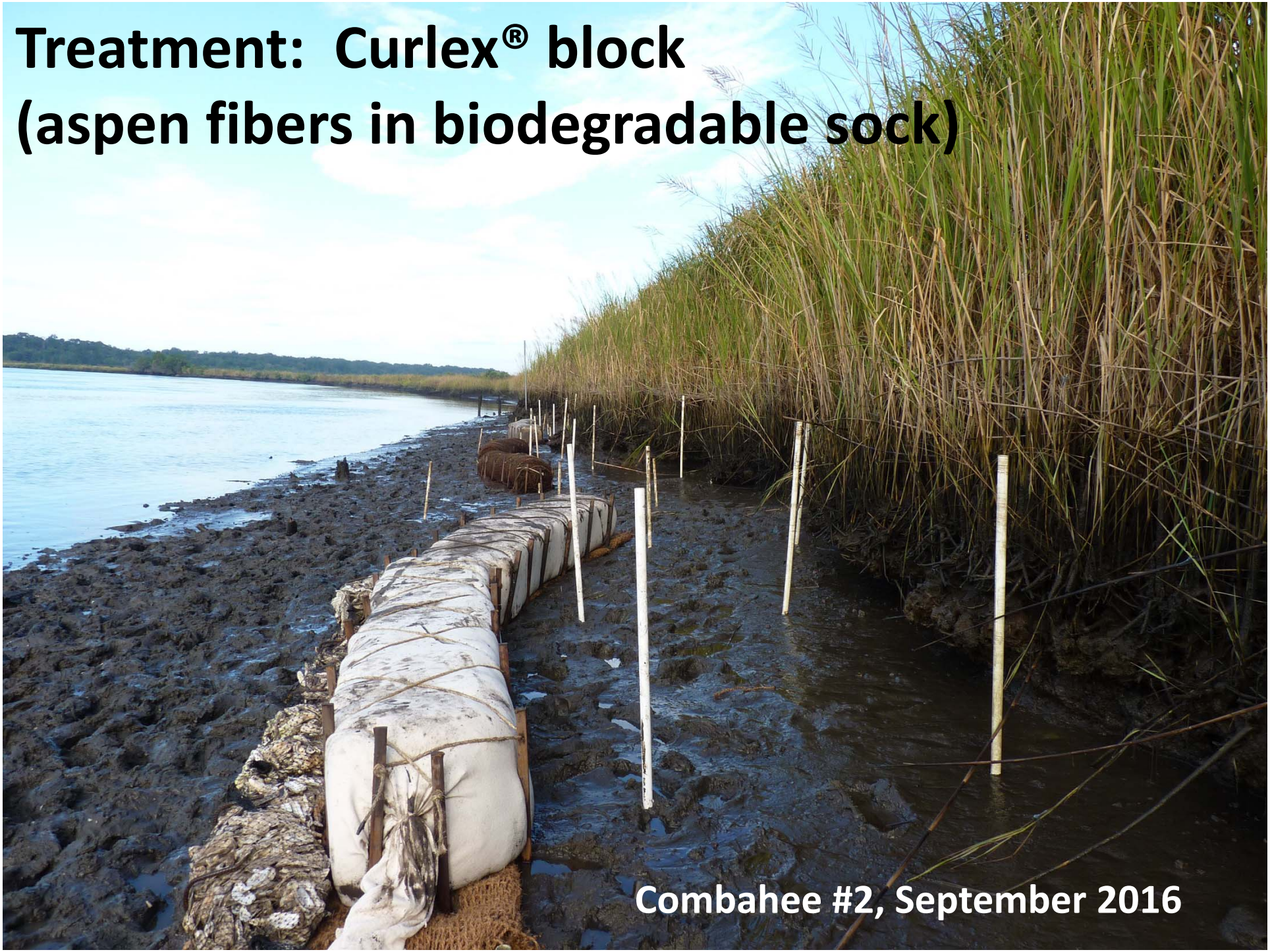
(placed atop wood pallets at soft-sediment sites)

Boy Scout Camp, July 2016

Treatment: Modified crab traps

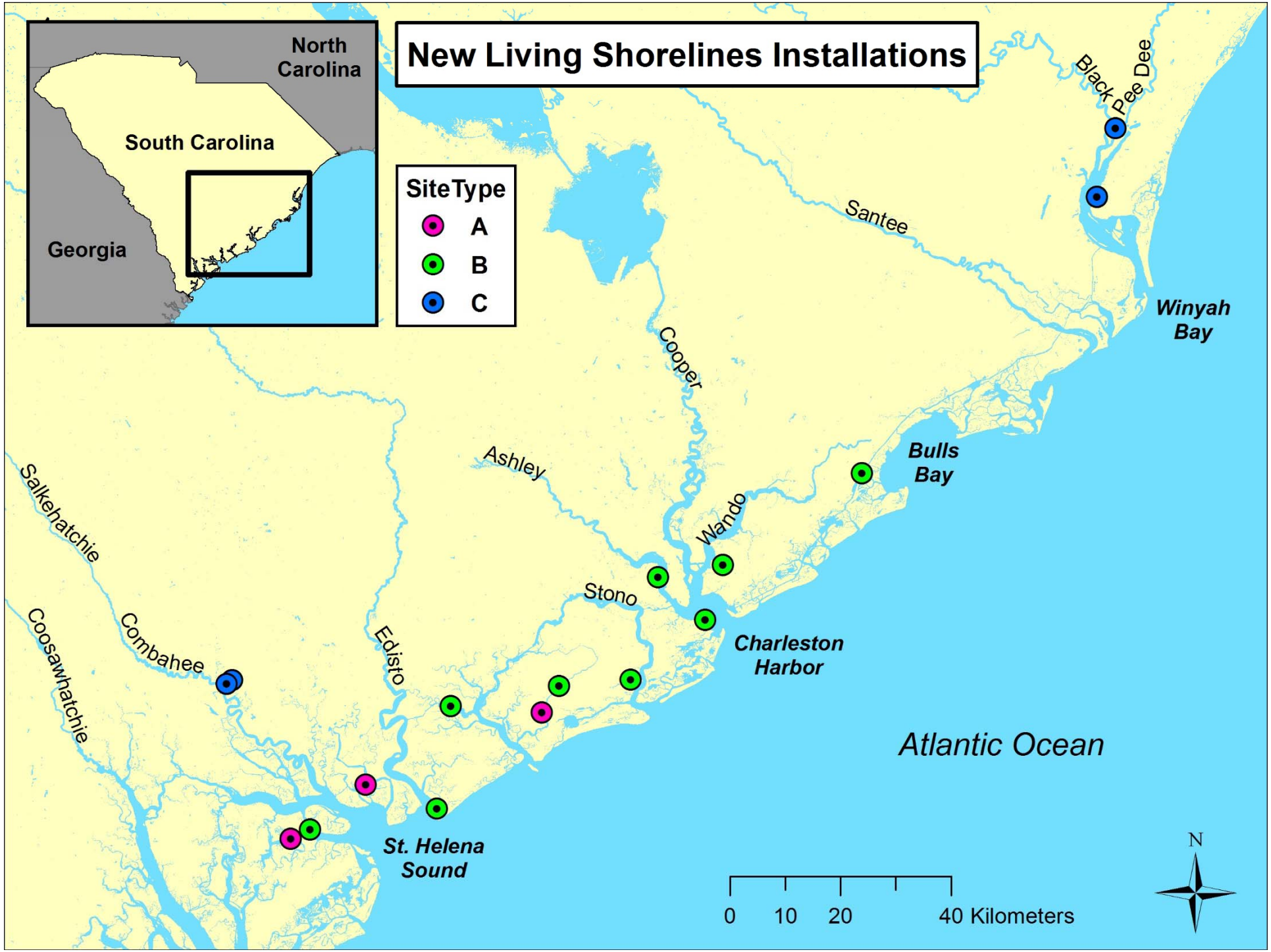

Treatment: Coir log (coconut fiber;
log wrapped in coir mat)
Coosaw Cut, June 2016

Treatment: Curlex® block (aspen fibers in biodegradable sock)



Site Type characteristics:

- **Type A**: Successful bagged shell reefs (SCORE)
  - Oyster-friendly
  - Relatively gentle slope
  - Relatively firm sediment
- **Type B**:
  - Oyster-friendly
  - Steep slope or soft sediment
    - Where SCORE reefs have NOT been successful
- **Type C:**
  - NOT oyster-friendly (Salinity = too low, variable)

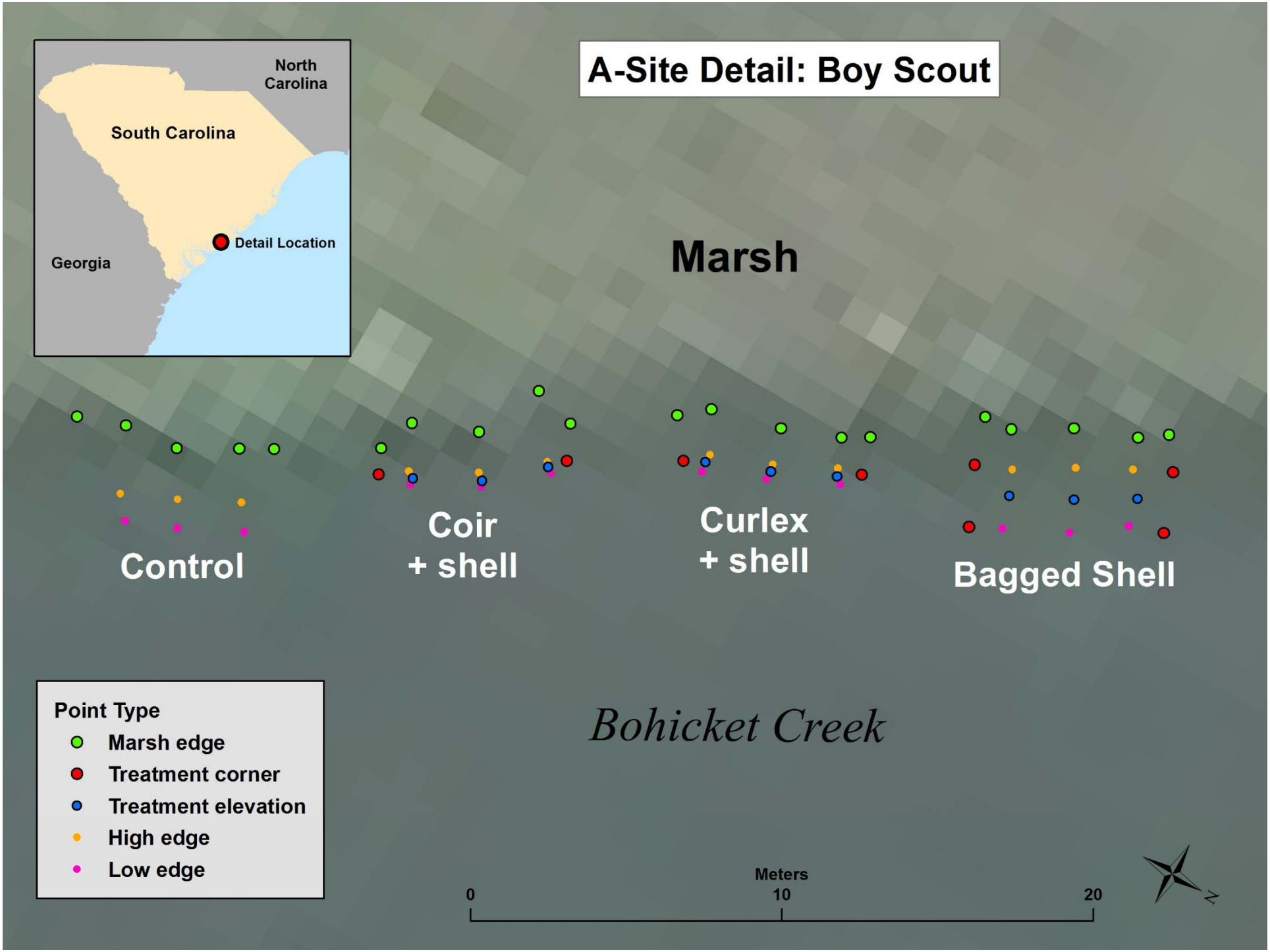

New Living Shorelines Installations
North Carolina
South Carolina
Georgia
Site Type
A
B
C
Black
Pee Dee
Santee
Winyah Bay
Cooper
Ashley
Bulls Bay
Wando
Stono
Charleston Harbor
Salkehatchie
Combahee
Coosawhatchie
Edisto
St. Helena Sound
Atlantic Ocean
0 10 20 40 Kilometers
N

Project Timeline (for new sites)

- June-Sept 2016: Set up 11 new sites (13 planned)
- Oct 2016: Hurricane Matthew!
- Oct-Dec 2016: Collect post-hurricane baseline data
- Feb 2017: Set up 2 new sites
- Aug 2017: Set up 3 new sites
- Aug-Dec 2017: Follow-up monitoring of Year 1 sites & replacement of failed treatments

Monitoring

- Field-work-based parameters include:
  - **Pre-install: Bank slope & sediment "sinkability"**
  - **Repeated fixed-point photos**
  - **Elevation of sediment surface & mid-reef surface**
  - **Marsh edge position & Escarpment position**
  - **Stem density transects (perpendicular to shore)**
  - **% cover of live oysters (ImageJ; for oyster-based reefs)**
  - **Mid-ebb tidal flow (Acoustic Doppler Current Profiler)**
- Additional data will also be incorporated, including: salinity, tidal range, ICW vs not, water body width, 1994-2015 shoreline change (DSAS), etc.


A-Site Detail: Boy Scout
North Carolina
South Carolina
Georgia
Detail Location
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

2016 Installations (n=11)

Site information		Living Shoreline treatments					Installation Date
Type	Location	Bags	Bags + pallets	Crab traps	Curlex Blocs	Coir Logs	
A	Coosaw Cut	✓			✓	✓	June 2016
	Dataw Is.	✓			✓✓	✓✓	July 2016
	Boy Scout	✓			✓	✓	July 2016
B	Hobcaw Cr.		✓	✓	✓		June 2016
	Morgan Is.		✓	✓	✓		June 2016
	Bohicket		✓	✓	✓		June 2016
	Dawho		✓	✓		✓	July 2016
	Abbapoola		✓	✓		✓	July 2016
	Big Bay		✓	✓		✓✓	July 2016
C	Combahee1				✓✓	✓✓	Sept 2016
	Combahee2				✓✓	✓✓	Sept 2016

Hurricane Matthew: Landfall Oct. 2016 in SC

Image courtesy of NOAA

Edisto Island

abcnews4.go.com


Living Shorelines Year 1 Installations
North Carolina
South Carolina
Georgia
Detail Area
Site Type
A
B
C
Hobcaw
Wando River
Cooper River
Ashley River
Charleston Harbor
Stono River
Combahee 1 & 2
Bohicket
Abbapoola
Dawhoo
Boy Scout
Folly Island
North Edisto River
Kiawah Island
Coosaw Cut
South Edisto River
Edisto Island
Atlantic Ocean
Coosaw River
Morgan Island
Big Bay
St. Helena Sound
Dataw
Hunting Island
Kilometers
0
10
20
N

Behind Edisto Island, post-Matthew:

Immediately after installation…

Big Bay Creek, July 26th 2016

Behind Edisto Island, post-Matthew:

Immediately after installation…

Big Bay Creek, July 26th 2016

… and less than 3 months later

Big Bay Creek, Oct 14th 2016

Post-Matthew:

Morgan Island, Nov 14th 2016

Post-Matthew:

Coosaw Cut, Oct. 17th 2016

Post-Matthew Status (n=11)

Site information		Living Shoreline treatments						Installation Date
Type	Location	Bags	Bags + pallets	Crab traps		Curlex Blocs	Coir Logs	
A	Coosaw Cut	✓				X	✓	June 2016
	Dataw Is.	✓				✓ X	✓ ✓	July 2016
	Boy Scout	✓				✓	✓	July 2016
B	Hobcaw Cr.		✓	✓		✓		June 2016
	Morgan Is.		✓	✓		X		June 2016
	Bohicket		✓	✓		✓		June 2016
	Dawho		✓	✓			✓	July 2016
	Abbapoola		✓	✓			✓	July 2016
	Big Bay		✓	✓			✓ ✓	July 2016
C	Combahee1					✓ ✓	✓ ✓	Sept 2016
	Combahee2					✓ ✓	✓ ✓	Sept 2016

1 Year Post-Installation (n=11)

Site information		Living Shoreline treatments					Installation Date
Type	Location	Bags	Bags + pallets	Crab traps	Curlex Blocs	Coir Logs	
A	Coosaw Cut	✓			X	X	June 2016
	Dataw Is.	✓			X X	X ✓	July 2016
	Boy Scout	✓			X	✓	July 2016
B	Hobcaw Cr.		✓	✓	✓		June 2016
	Morgan Is.		✓	✓	X		June 2016
	Bohicket		✓	✓	X		June 2016
	Dawho		✓	✓		X	July 2016
	Abbapoola		✓	✓		✓	July 2016
	Big Bay		✓	✓		✓✓	July 2016
C	Combahee1				X X	✓✓	Sept 2016
	Combahee2				X X	✓✓	Sept 2016

Bagged oyster shell on pallets (15 months)

Abbapoola, Oct. 2017

Modified crab traps (14 months)

Big Bay Creek, Oct. 2017

Coir Log (14 months)

Big Bay Creek, Oct. 2017

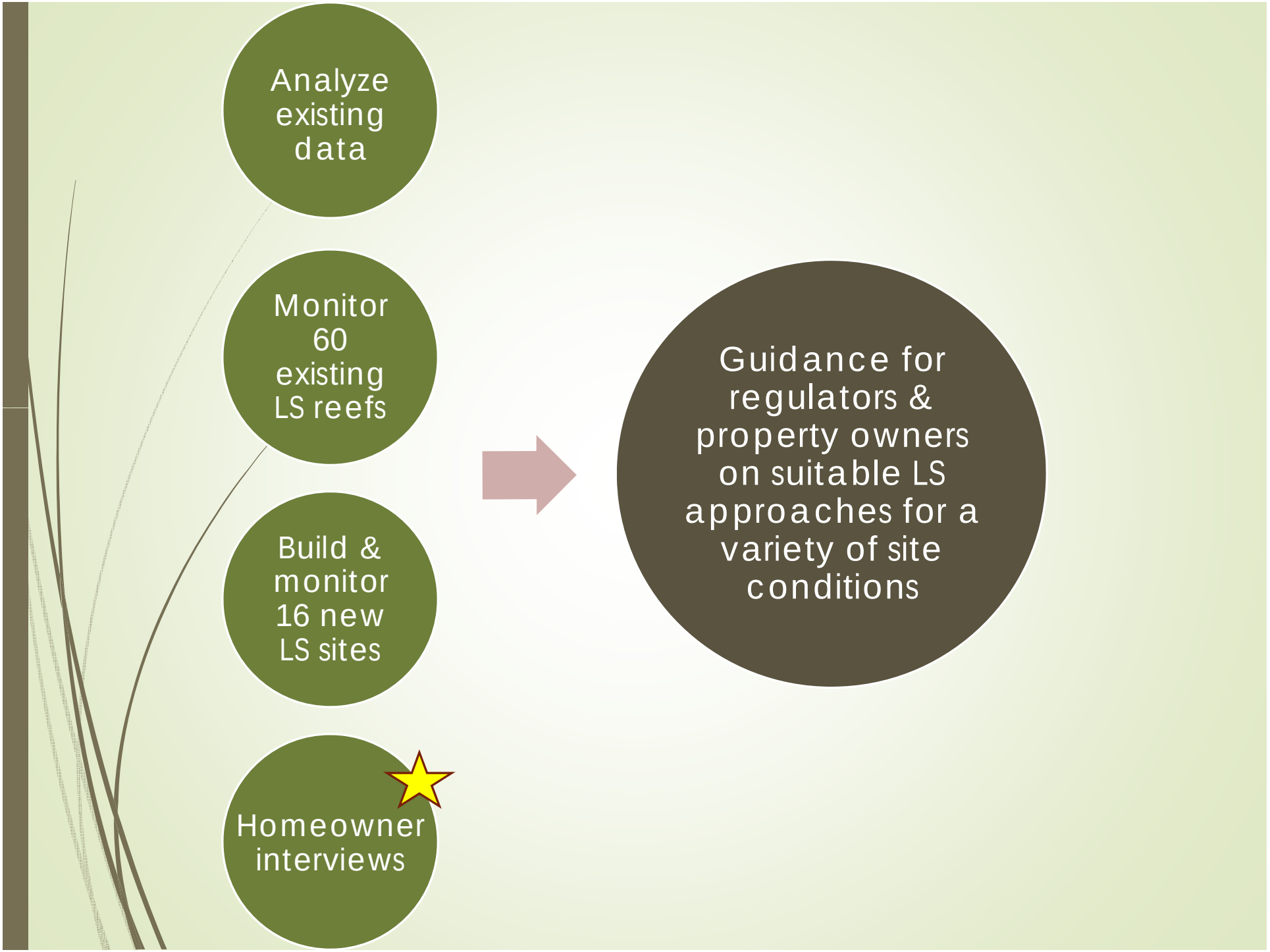
Year 2 : New Installations (n=16)

Sites		Living Shoreline treatments								Year
Type	Location	Bags	Bags + pallets	Traps v1	Traps v2		Curlex	Coir x1	Coir x2	
A	Coosaw Cut	✓					X	X✓✓		2016
	Dataw Is.	✓					X	X✓✓✓		2016
	Boy Scout	✓					X	✓✓		2016
B	Hobcaw		✓	✓			✓	✓		2016
	Morgan Is.		✓	✓			X	✓		2016
	Bohicket		✓	✓			X	✓		2016
	Dawho		✓	✓				X✓		2016
	Abbapoola		✓	✓				✓✓		2016
	Big Bay		✓	✓						2016
	Awendaw		✓✓	✓	✓				✓✓	2017
	Orangegrove		✓✓	✓	✓				✓✓	2017
	Ft Johnson		✓	✓	✓				✓	2017
C	Combahee 1						XX	✓✓✓		2016
	Combahee 2						XX	✓✓✓		2016
	Whitehouse						XX	✓✓✓		2017
	Little Dock						X	X✓		2017

New treatment: Double-row coir log, with vertical & angled stakes

Orangegrove Creek, August 2017

New treatment: Modified crab trap, v.2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Next steps…

- **December 2017 – January 2018**
  - Wrap up monitoring of pre-existing reefs (2 sites)
  - Little Dock & Combahee 2: 1-yr Post monitoring & replacement of failed Curlex treatments
- **Spring-Summer 2018:**
  - Plant behind half of same-site replicate reefs
  - 1-yr Post & 2-yr Post monitoring of new sites
  - *DATA ANALYSIS*
- **Due Fall 2018:**
  - Living shorelines guidance document to SCDHEC
- **2019-2020:**
  - Continue monitoring 16 new sites (funds permitting)

Acknowledgements

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M | Water Center University of Michigan

Project team:

DHEC Promote Protect Prosper Ocean and Coastal Resource Management

South Carolina Department of Natural Resources DNR

ACE Basin National Estuarine Research Reserve

North Inlet - Winyah Bay National Estuarine Research Reserve

NOAA

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Zach Bjur
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Nicole Carey
Alex Miller
Abigail Del Giorno
Austin Sturkie
Tyler Edwards
Aaron Burnette
Catharine Parker

Additional stakeholders:

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