



Living Shoreline Academy @Carteret Community College



Sarah Spiegler, NC Sea Grant

Scott Leahy, Carteret Community College

NC Beach, Inlet & Waterway Association: Spring Meeting, May 10, 2024



COASTAL RESILIENCE

Bouncing back & *building beyond.*

PLAN & BUILD RESILIENCE

Develop and implement plan to become more resilient.



improving forecasts, observation models, computer systems



getting information to decision makers faster



incorporating green infrastructure



DISASTER STRIKES

Disasters can be imminent or strike unexpectedly.



sea level rise



tsunamis



coastal storms and hurricanes



RESPOND

Immediately take action following a disaster.



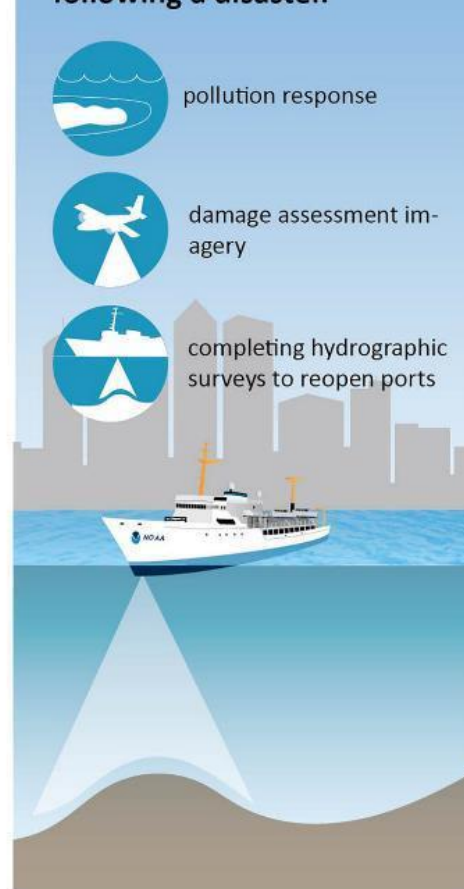
pollution response



damage assessment imagery



completing hydrographic surveys to reopen ports



RECOVER

Assess resilience and manage adaptively.



assessing damage to communities, economy, and environment



issuing grants to rebuild and restore habitat

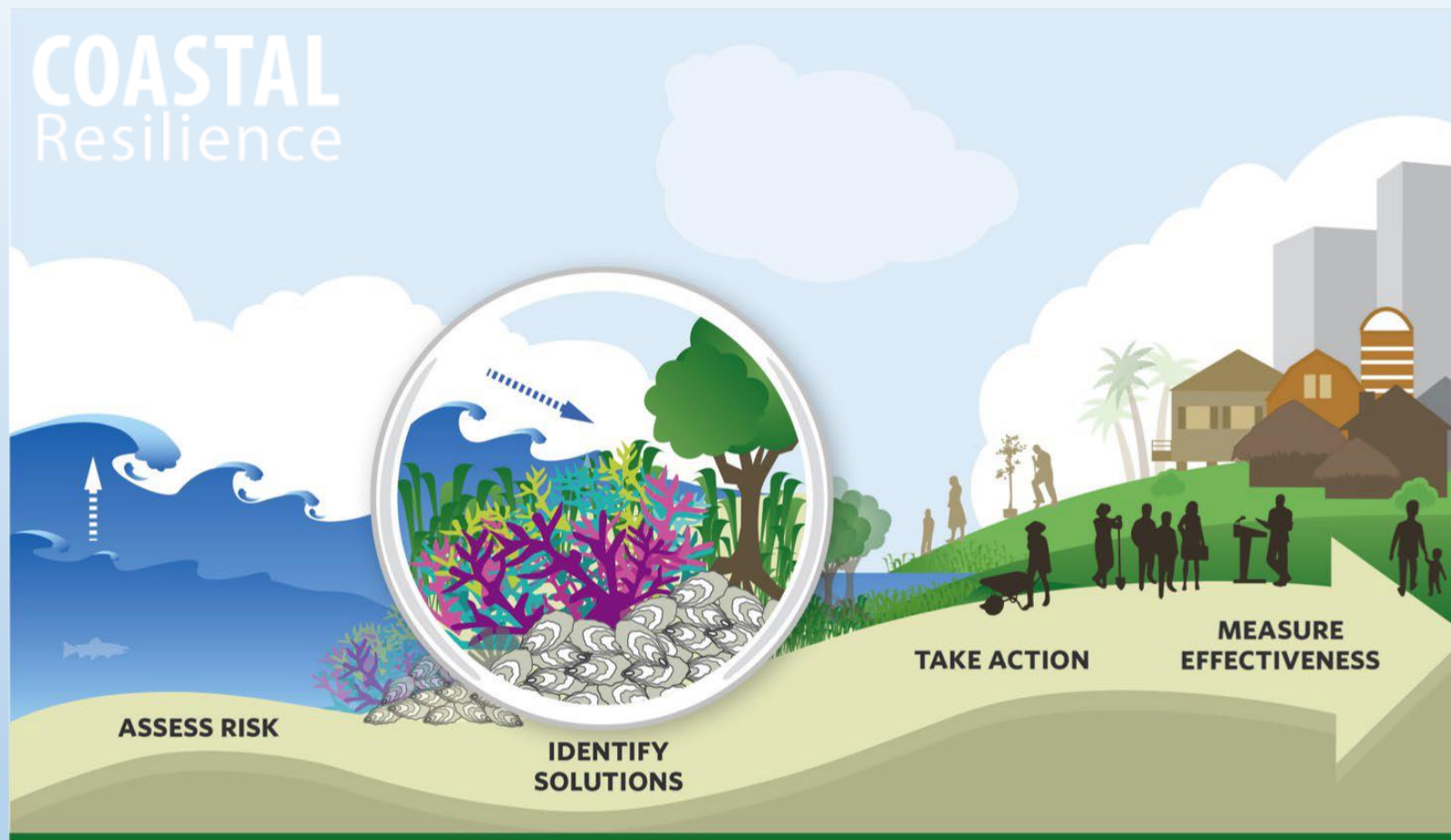


providing data and tools for analysis



Assess resilience and begin planning for the next disaster. *Building resilience is an iterative process.*

COASTAL Resilience



Intersection of **Community** and **Ecosystem** Resilience

Identifying nature-based or green infrastructure solutions, where coastal communities can increase their resilience by effectively **protecting, restoring and sustainably managing** their **natural resources** while strengthening local capacity for climate adaptation.

--*The Nature Conservancy*

What is Resilience?

- **“Resilience”**: *how fast/in what fashion a system can bounce back (or forward) after a disturbance*
- **“Community Resilience”**
- **“Ecosystem Resilience”**




**Beaufort, North Carolina:
2 days before Hurricane
Florence made landfall in
Wilmington, NC (2018)**

2018

2020

2021

2023



State of North Carolina
ROY COOPER
GOVERNOR

October 29, 2018
EXECUTIVE ORDER NO. 80

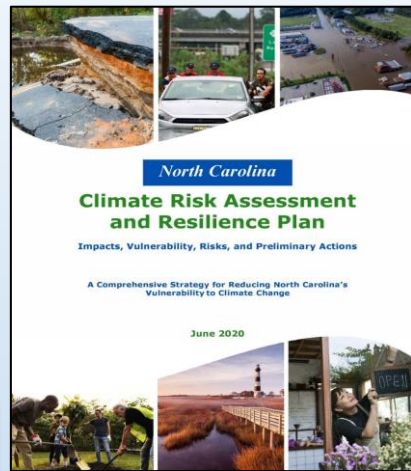
NORTH CAROLINA'S COMMITMENT TO ADDRESS CLIMATE CHANGE AND TRANSITION TO A CLEAN ENERGY ECONOMY

WHEREAS, North Carolina residents deserve to be better educated, healthier, and more financially secure so that they may live purposeful and abundant lives; and

WHEREAS, N.C. Const. art. XIV, § 5 requires the conservation, protection, and preservation of state lands and waters in public trust; and

WHEREAS, North Carolina is well positioned to take advantage of its technology and research and development sectors, along with its skilled workforce, to promote clean energy technology solutions and a modernized electric grid; and

Executive Order 80




North Carolina
Climate Risk Assessment and Resilience Plan
Impacts, Vulnerability, Risks, and Preliminary Actions


A Comprehensive Strategy for Reducing North Carolina's Vulnerability to Climate Change

June 2020




North Carolina
Natural and Working Lands Action Plan



June 2020




NORTH CAROLINA COASTAL HABITAT PROTECTION PLAN
2021 AMENDMENT
ENHANCING COASTAL FISHERIES THROUGH HABITAT PROTECTION AND RESTORATION

MARSH FORWARD
A REGIONAL PLAN FOR THE FUTURE OF THE SOUTH ATLANTIC COAST'S MILLION-ACRE SALT MARSH ECOSYSTEM

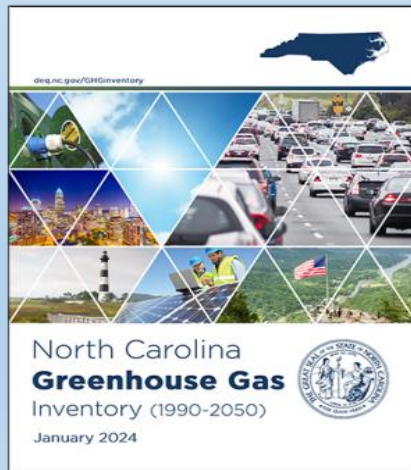
A COLLABORATIVE EFFORT OF THE SOUTH ATLANTIC SALT MARSH INITIATIVE

NORTH CAROLINA COASTAL HABITAT GREENHOUSE GAS INVENTORY




Final Report
September 2023

2024



deq.nc.gov/CGIInventory

North Carolina Greenhouse Gas Inventory (1990-2050)
January 2024



State of North Carolina
ROY COOPER
GOVERNOR

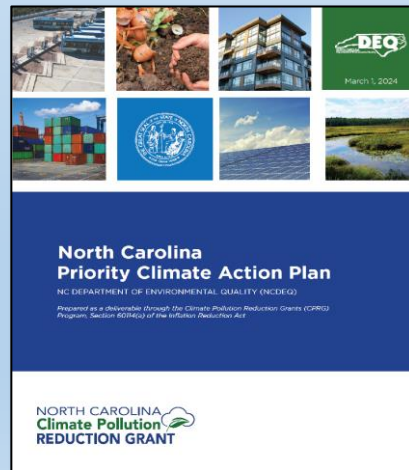
February 12, 2024
EXECUTIVE ORDER NO. 305

AN ORDER TO PROTECT AND RESTORE NORTH CAROLINA'S CRITICAL NATURAL AND WORKING LANDS

WHEREAS, N.C. Const. Art. XIV, § 5 establishes that it is the policy of this State to conserve and protect its lands and waters for the benefit of all its people, that it is a proper function of the state to control and limit the pollution of our air and water and to preserve in every other appropriate way as a part of the common heritage its forests, wetlands, estuaries, beaches, historical sites, open lands, and places of beauty; and

WHEREAS, pursuant to N.C. Gen. Stat. § 113A-3 it is the "... policy of the State to seek, for all of its citizens, safe, healthful, productive and aesthetically pleasing surroundings; to attain

Executive Order 305

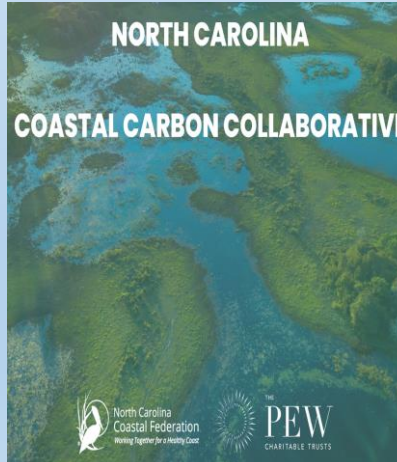


North Carolina Priority Climate Action Plan
NC DEPARTMENT OF ENVIRONMENTAL QUALITY (NCDEQ)

Prepared as a deliverable through the Climate Pollution Reduction Grants (CPRG) Program, Section 60304(c) of the Inflation Reduction Act

NORTH CAROLINA Climate Pollution REDUCTION GRANT


NORTH CAROLINA COASTAL CARBON COLLABORATIVE



North Carolina Coastal Federation
PEW CHARITABLE TRUSTS

North Carolina Salt Marsh Action Plan

Protect, restore, and facilitate the migration of salt marshes in North Carolina to ensure no overall loss of function, benefits, and acreage through 2050 and beyond.



May 2024

South Carolina Coastal Federation
South Atlantic Salt Marsh Initiative

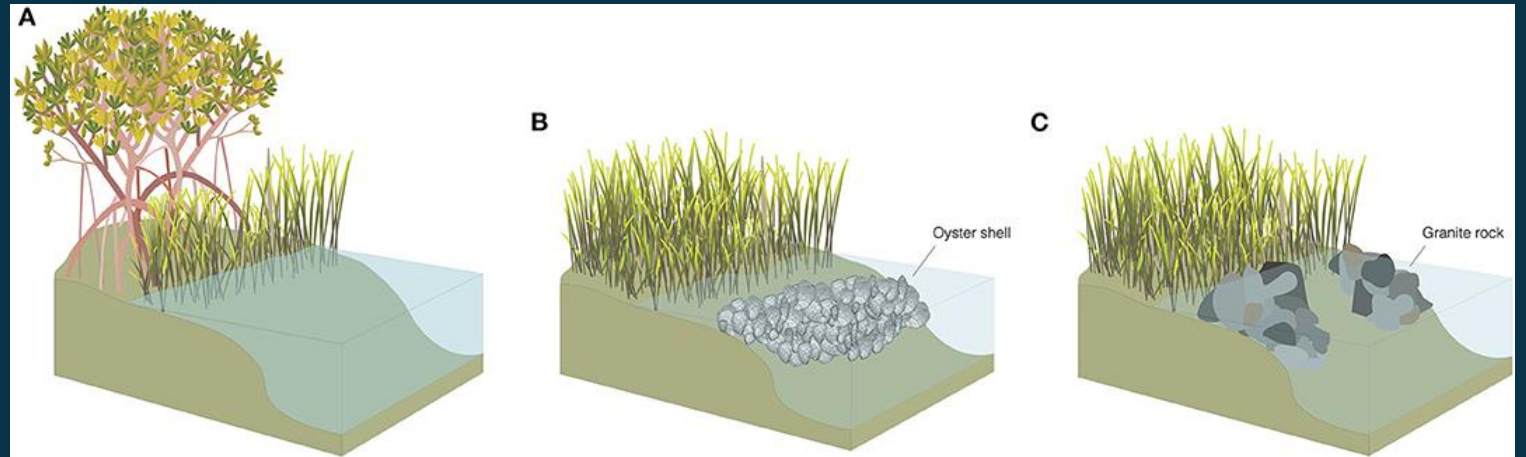
Living shorelines

Shoreline protection approaches that incorporate habitat restoration alone or in combination with some type of built infrastructure to provide coastal protective services to humans.

(NOAA 2015, Smith et al. 2020)



Photo Credits: R. Gittman



Smith et al. 2020 *Frontiers in Marine Science*



LIVING SHORELINES SUPPORT RESILIENT COMMUNITIES

Living shorelines use plants or other natural elements—sometimes in combination with harder shoreline structures—to stabilize estuarine coasts, bays, and tributaries.



One square mile of salt marsh stores the carbon equivalent of **76,000 gal of gas** annually.



Marshes trap sediments from tidal waters, allowing them to **grow in elevation** as sea level rises.



Living shorelines improve **water quality**, provide fisheries **habitat**, increase **biodiversity**, and promote **recreation**.



Marshes and oyster reefs act as natural **barriers** to waves. **15 ft** of marsh can **absorb 50%** of incoming wave energy.



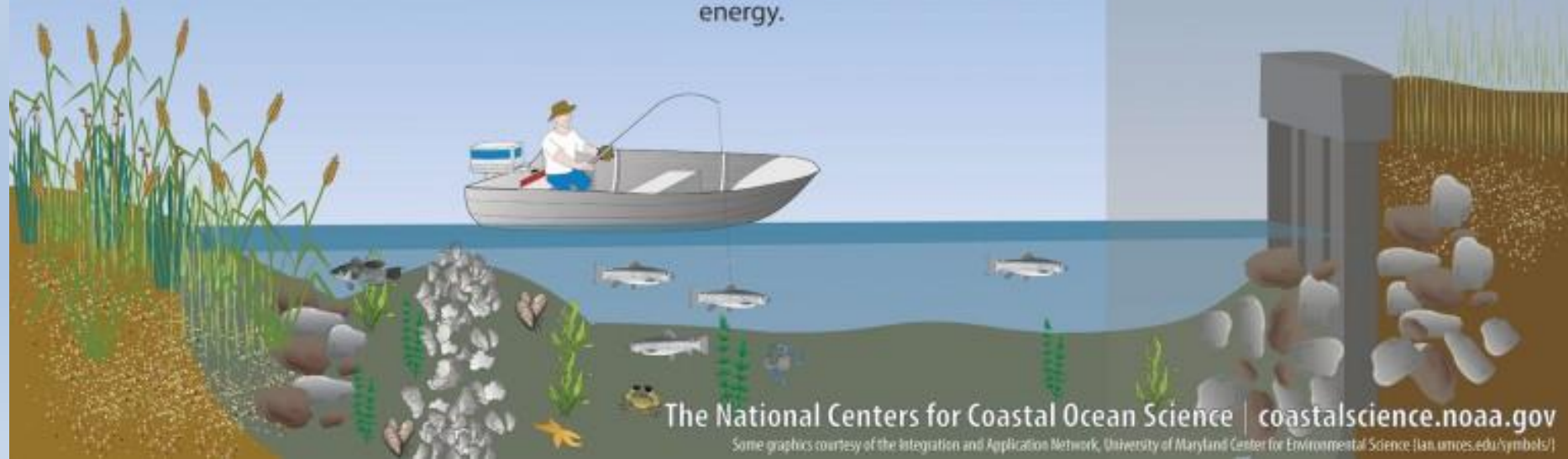
Living shorelines are **more resilient** against storms than bulkheads.



33% of shorelines in the U.S. will be **hardened** by **2100**, decreasing fisheries habitat and biodiversity.



Hard shoreline structures like **bulkheads** prevent natural marsh migration and may create seaward **erosion**.



Why Use Living Shorelines?

- Natural, effective and economical way to stabilize eroding shorelines
- Outperforms bulkheads short- and long-term
- Requires minimal maintenance
- Increases property value
- Typically less expensive than bulkheads

Ocean & Coastal Management 102 (2014) 94–102

Contents lists available at ScienceDirect

Ocean & Coastal Management

ELSEVIER journal homepage: www.elsevier.com/locate/ocecoaman

Marshes with and without sills protect estuarine shorelines from erosion better than bulkheads during a Category 1 hurricane

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^a Institute of Marine Sciences, University of North Carolina at Chapel Hill, Morehead City, NC 28557, USA
^b Department of Biology, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599, USA

Hurricane Irene Impacts (2011)

Credit: Dr. Rachel Gittman

1 year before

1 day after

Hurricane Matthew (2016)

Credit: Dr. Carter Smith

5 years later

Hurricane Florence 2018

Over \$22 billion in damages in
North Carolina (NOAA estimates)

Eastern shoreline @Carteret Community College:
more than \$1 million in damages



Photo Credits: S. Spiegler



Photo Credits: S. Spiegler



Photo Credits: S. Spiegler

Carteret Community College and Civic Center



Photo Credits: S. Spiegler



Photo Credit: NOAA Beaufort Lab

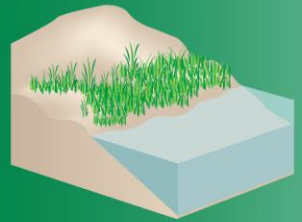
Duke University Marine Lab and NOAA Beaufort Lab

HOW GREEN OR GRAY SHOULD YOUR SHORELINE SOLUTION BE?

GREEN - SOFTER TECHNIQUES

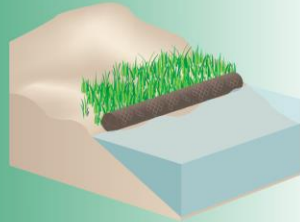
GRAY - HARDER TECHNIQUES

Living Shorelines



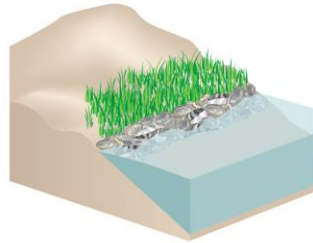
VEGETATION ONLY -

Provides a buffer to upland areas and breaks small waves. Suitable for low wave energy environments.



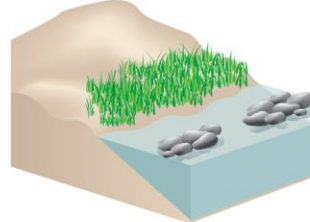
EDGING -

Added structure holds the toe of existing or vegetated slope in place. Suitable for most areas except high wave energy environments.



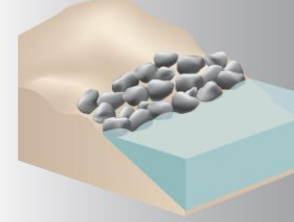
SILLS -

Parallel to vegetated shoreline, reduces wave energy, and prevents erosion. Suitable for most areas except high wave energy environments.



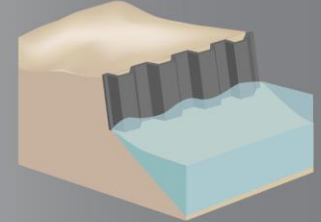
BREAKWATER -

(vegetation optional) - Offshore structures intended to break waves, reducing the force of wave action, and encourage sediment accretion. Suitable for most areas.



REVETMENT -

Lays over the slope of the shoreline and protects it from erosion and waves. Suitable for sites with existing hardened shoreline structures.



BULKHEAD -

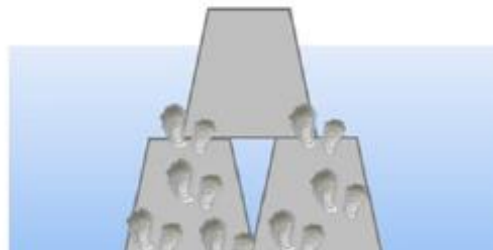
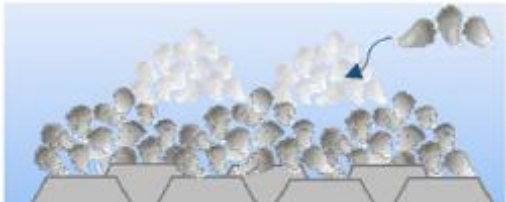
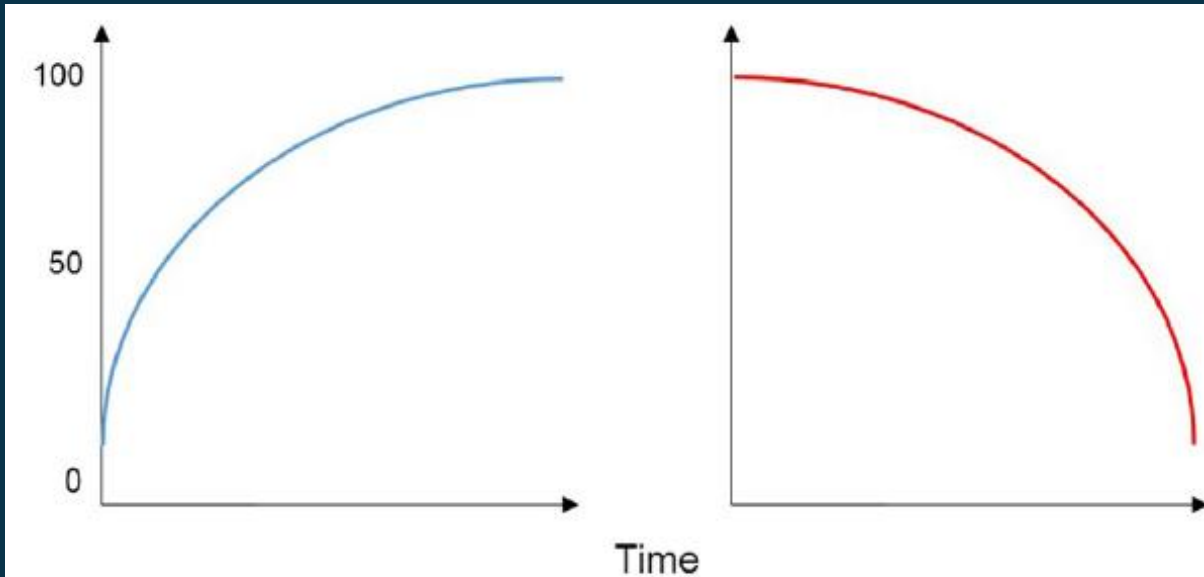
Vertical wall parallel to the shoreline intended to hold soil in place. Suitable for high energy settings and sites with existing hard shoreline structures.

Research Need: Designs and Substrates that Maximize Coastal Protection and Ecological Functions

Designing for oysters

Designing for waves

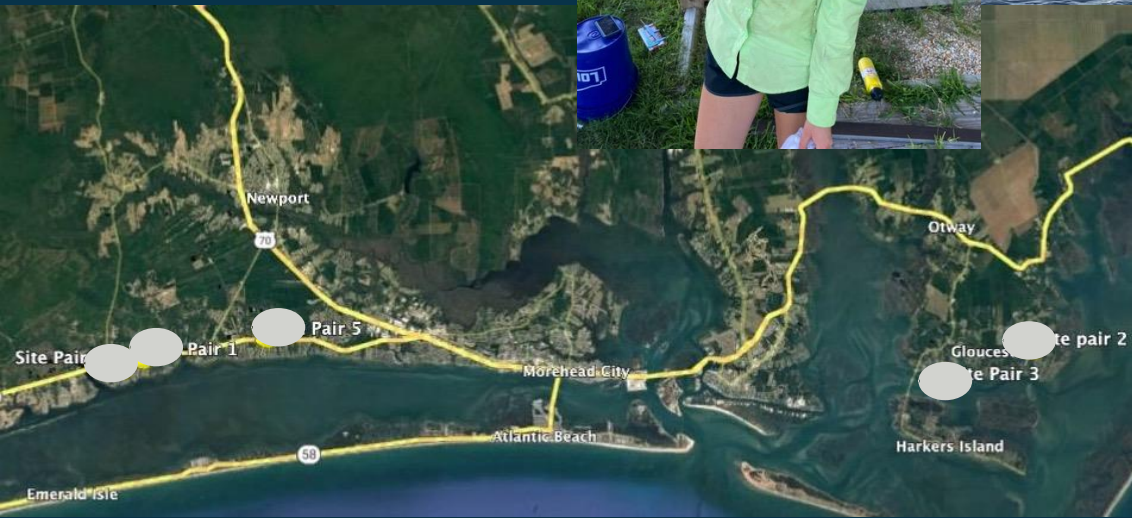
% wave attenuation



Evaluating new designs

Quick Reef™

NATIVE
SHORELINES
a DAVEY company



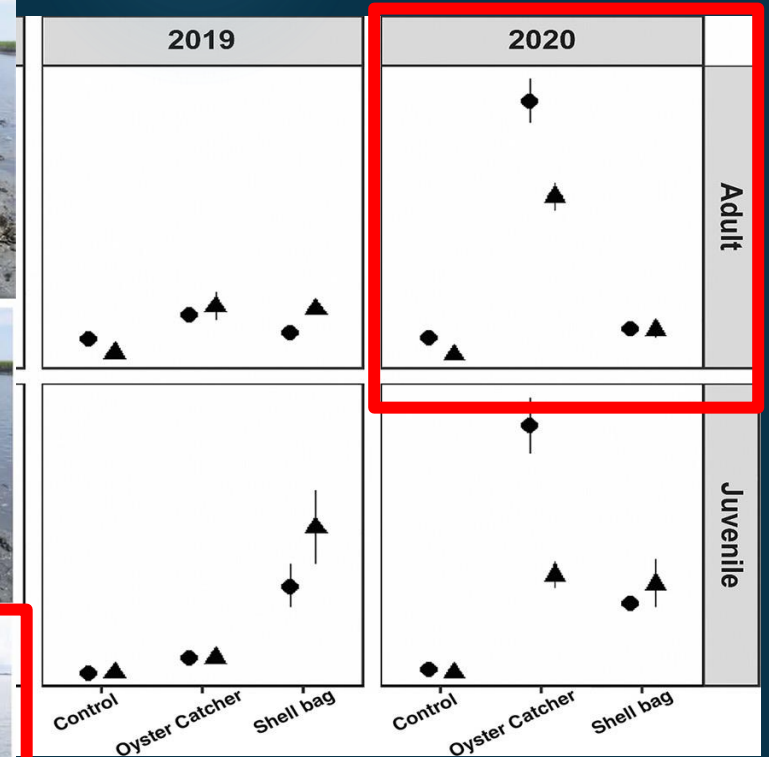
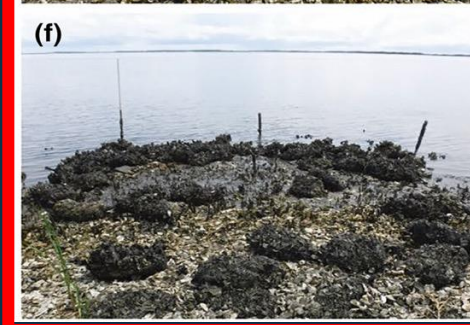
Oyster Catcher™



Shell Bags



Novel Substrates



Evaluating Impacts on Adjacent Foundation Species & Habitat Connectivity



LIVING SHORELINE ACADEMY

Learn the latest techniques, materials, and funding opportunities for shoreline management!



Intro to Living Shorelines

March 27, 2024 2-5pm

- ✓ Basic techniques and guidelines
- ✓ Learn the options for materials
- ✓ Funding Opportunities

Structures & Designs for Living Shorelines

April 3, 10, 17, 24 2-5pm

- ✓ Determine shoreline vulnerabilities
- ✓ Identify proper stabilization techniques for variety of scenarios
- ✓ Develop skills to develop and install living shorelines

These courses are ideal for:
-Shoreline property owners
-Living Shoreline Crew Leaders
-Marine Contractors
-Coastal Enthusiasts

Scan or click here to pre-register.



Photo Credits: S. Spiegler



Carteret Community College Living Shoreline Academy



- The Academy provides training to property owners, managers, environmental stewards and contractors
- The Academy is made up of multiple courses:
 - Introduction
 - Structures and Design
 - Vegetative
 - Construction
 - Field – Study / OJT
- The courses are being delivered and developed each semester



Carteret Community College Living Shoreline Academy



- The Introduction course provides an overview of:
 - Living Shoreline Definitions
 - Benefits and Drawbacks
 - Suitable Locations
 - Types of solutions
 - Costs
 - Permitting
 - Vegetative Planting
 - Serves as the primer for follow on training

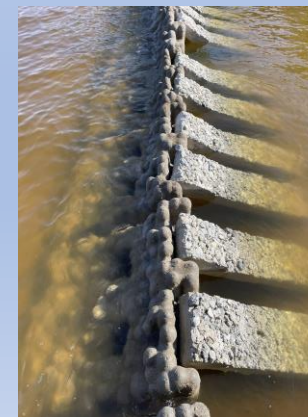
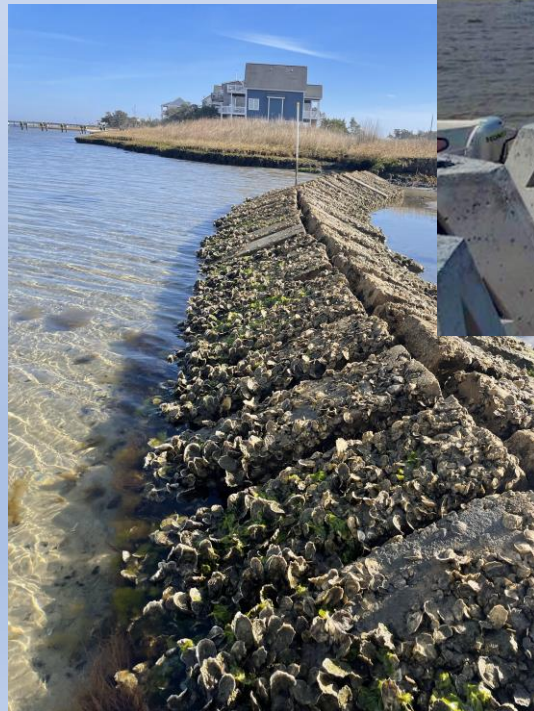


Carteret Community College Living Shoreline Academy



- The Design and Structures course provides a deep dive into:

- Site Survey
- Slope Assessments
- Energy Assessments
- Design Principles
- Substrates
- Drawings
- Permitting



Carteret Community College Living Shoreline Academy



- The Vegetative and Construction courses will be available for Fall 2024.

Topics will include:

- Marsh Grass Selection
- Spartina Grass Propagation
- Upland Plants
- Construction Techniques
- Logistic Considerations



Carteret Community College



- Aquaculture
- Boat Building Academy
- Fiberglass, Resin and Gelcoat
- Marine Service and Repair
- Marine Captain's Licensing
- Marine Diesel
- Outboard Propulsion Systems



Carteret Community College



For more information and registration details:

Contact:

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- LeahyS@Carteret.edu
- 252-222-6090



North Carolina
Coastal Federation
Working Together for a Healthy Coast



Thank you!

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