NERRS Science Collaborative Stakeholder Workshop,
Nemours Plantation, Beaufort, SC, December 6th 2012

NATIONAL ESTUARINE RESEARCH RESERVE SYSTEM

A background to oyster reef habitat restoration: project techniques, criteria, and capabilities.

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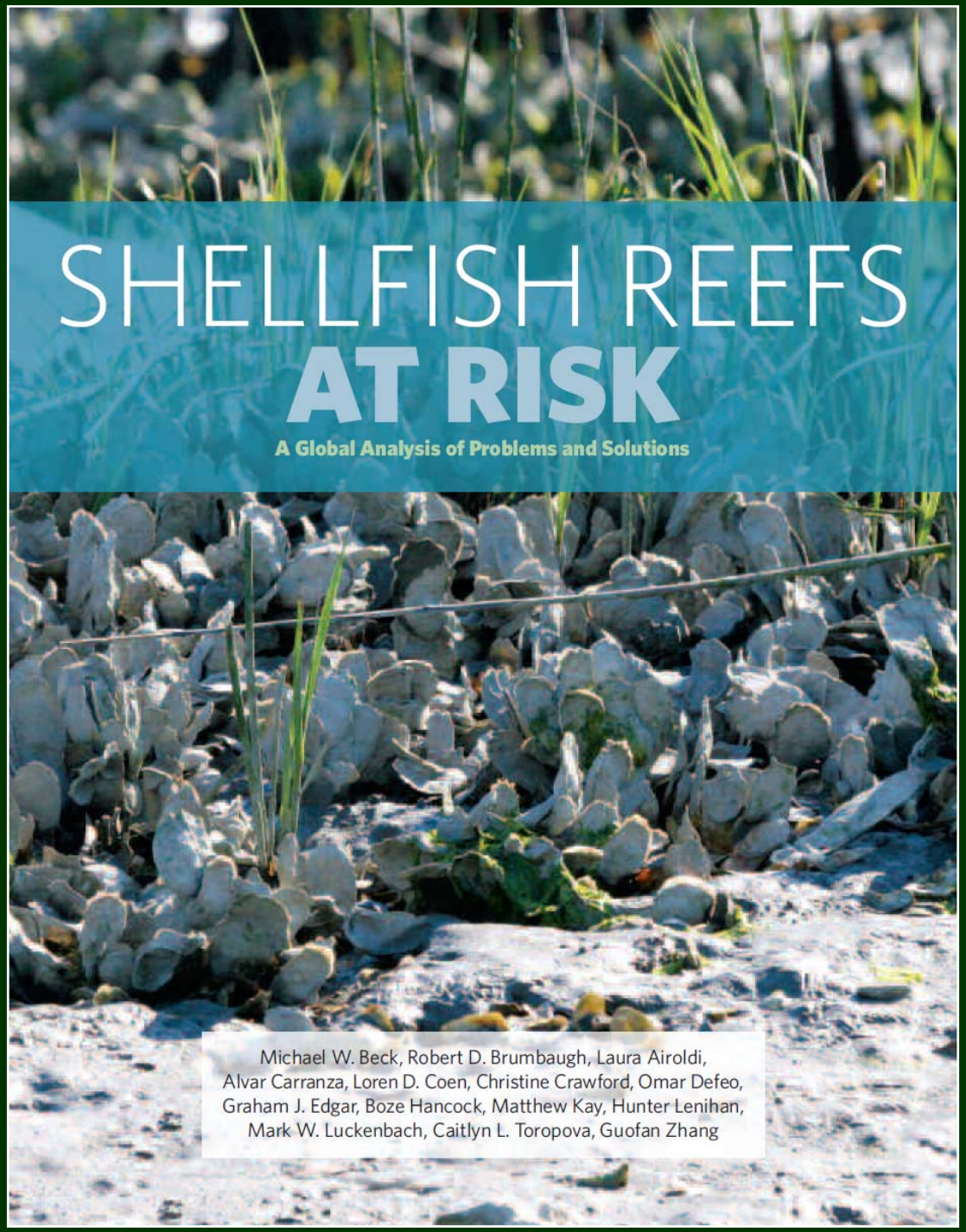
COASTAL TRAINING PROGRAM ACE Basin

SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES

DNR

Outline of talk

- Background to the 'shellfish restoration movement'
- What are the benefits of shellfish restoration?
- What roles do oyster reefs play in our estuaries?
- Approaches to shellfish restoration
    - Brief explanation of oyster biology
    - Which techniques are available?
- Project criteria, resource limitations and considerations in choosing restoration sites



"Once dominant features in many temperate estuaries around the world, native oyster reefs are critically important ecologically and economically…"

"Globally, we estimate that 85% of oyster reefs have been lost – even greater than the losses reported for other important habitats, including coral reefs, mangroves, and seagrasses."

The Nature Conservancy
Shellfish Reefs at Risk (2009).

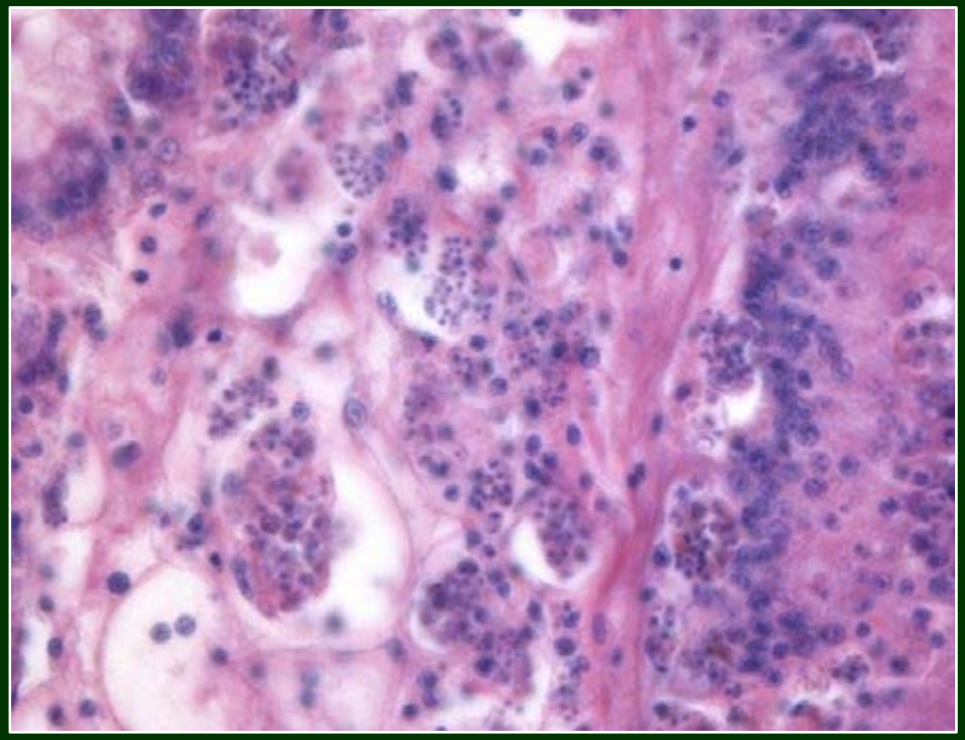
Causes of oyster declines

- Overharvesting and habitat degradation

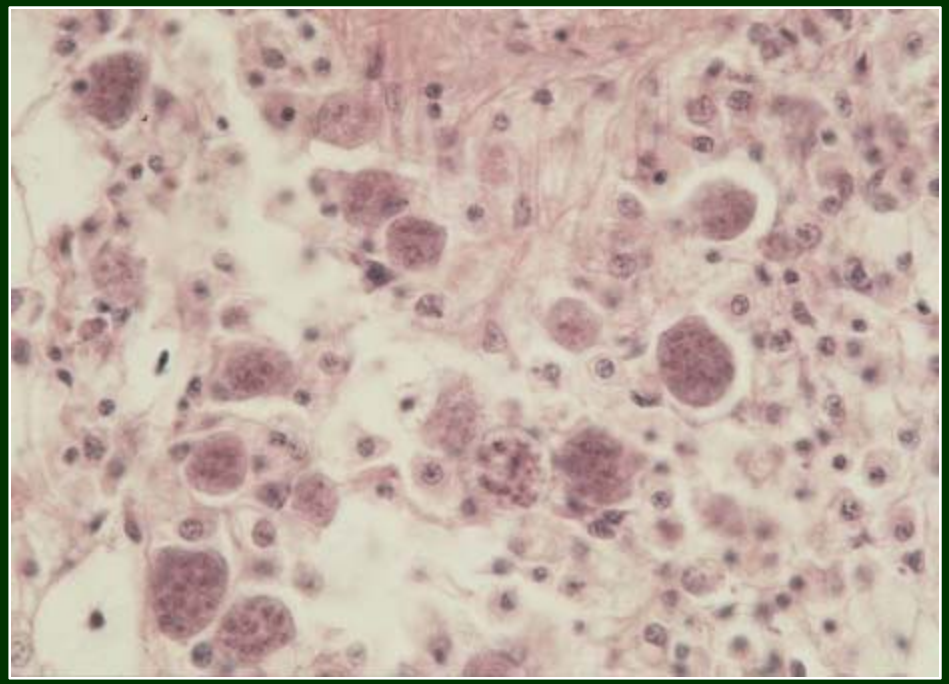
One year's oyster shell from a single Chesapeake Bay shucking house.

Causes of oyster declines

- Endemic oyster diseases

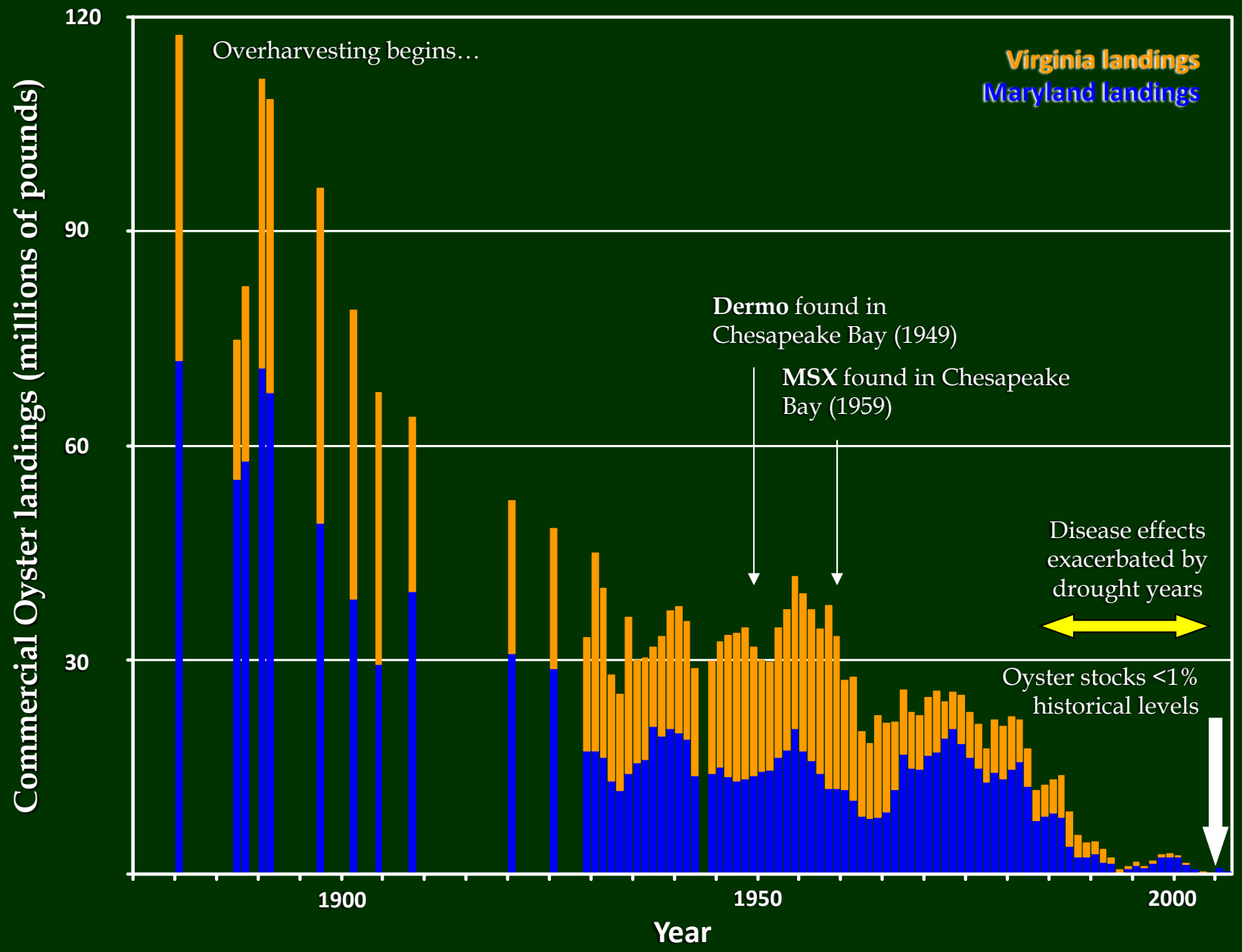


Left: Perkinsus marinus (cause of Dermo). Image courtesy of J-P. Joly, IFREMER.



Right: Haplosporidium nelsoni plasmodia (cause of MSX). Image courtesy of VIMS Shellfish Pathology Laboratory.

A need for oyster reef restoration: The Chesapeake Bay example.

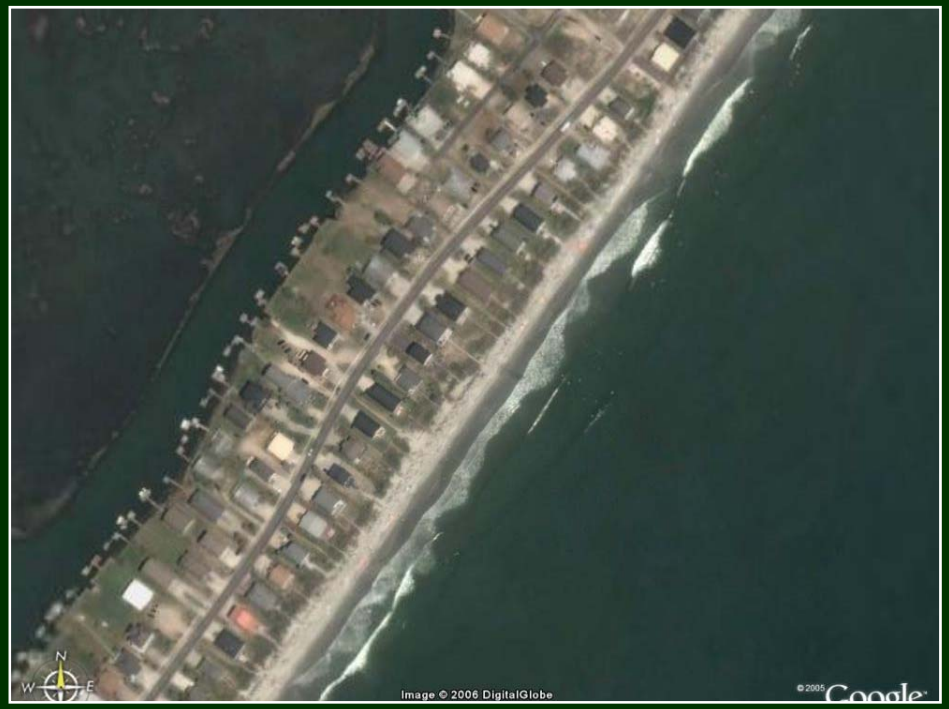


Causes of oyster declines

- Increasing coastal development

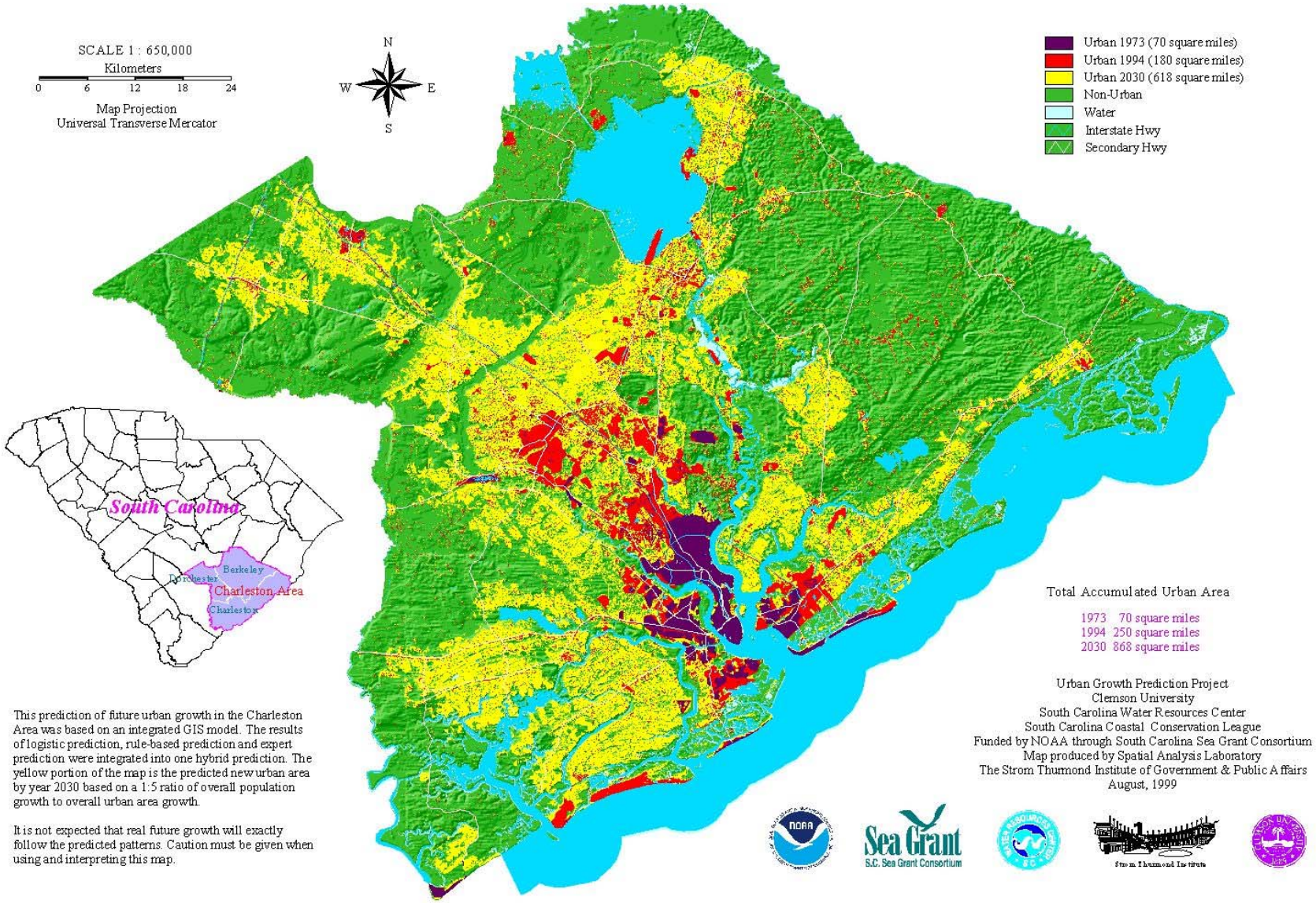
- 66% of the World's human population lives <100 miles from the coast.
- 54% of US human population lives in coastal counties.

- Southeast US Population increased by 58% from 1980 to 2003 (1st by region).
- South Carolina Coastal Counties populations are projected to increase by 35% between 2005 and 2030.



Predicted Urban Growth By Year 2030 in Charleston Area, South Carolina

(Integrated GIS-Based Prediction)



This prediction of future urban growth in the Charleston Area was based on an integrated GIS model. The results of logistic prediction, rule-based prediction and expert prediction were integrated into one hybrid prediction. The yellow portion of the map is the predicted new urban area by year 2030 based on a 1:5 ratio of overall population growth to overall urban area growth.

It is not expected that real future growth will exactly follow the predicted patterns. Caution must be given when using and interpreting this map.

1973	1994	2030
70 sq mi	250 sq mi	868 sq mi

Causes of oyster declines

- Reductions in water quality e.g., algal blooms

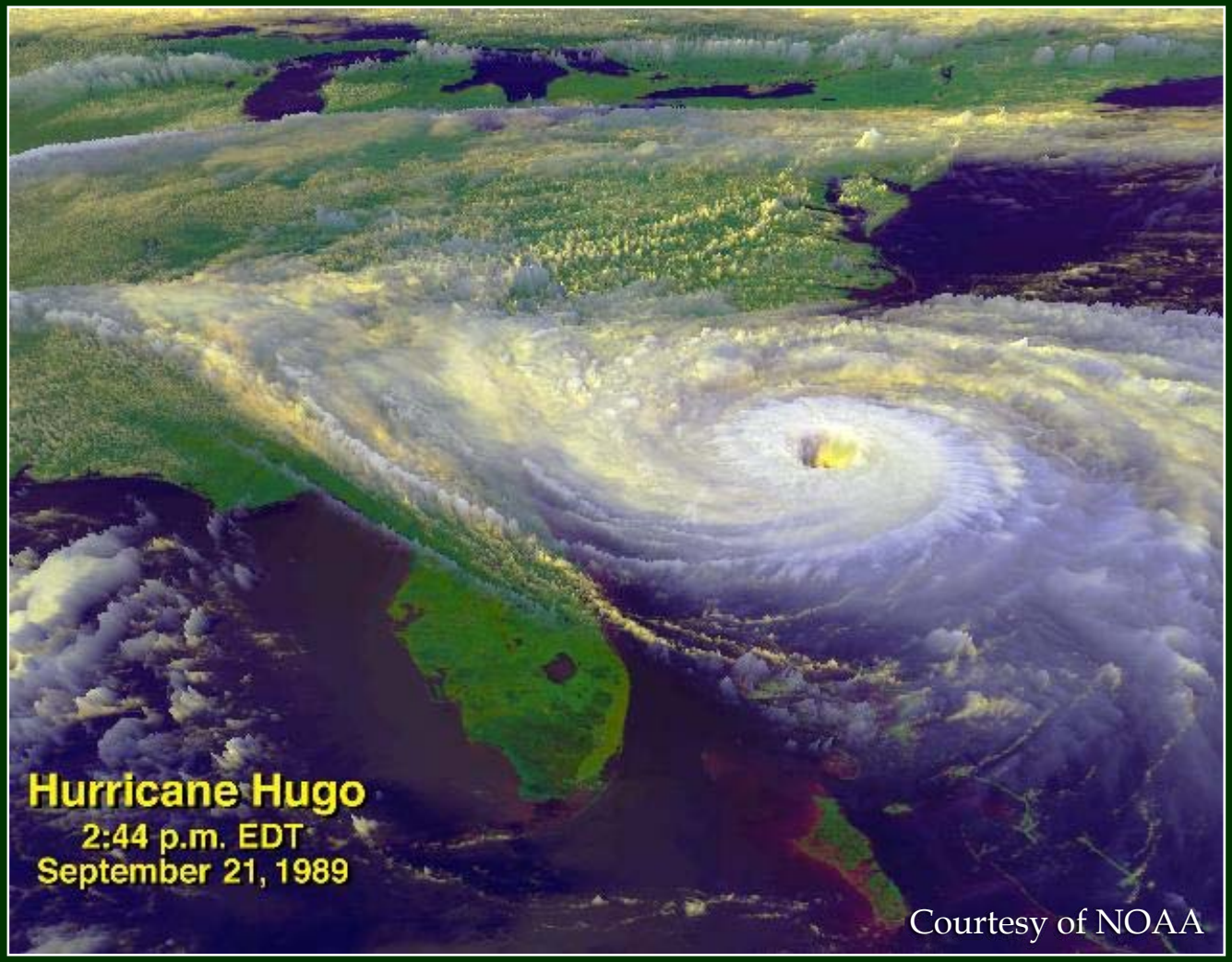
Lingulodinium polyedrum bloom (NOAA)

Causes of oyster declines

- Erosion e.g., boat wakes

Causes of oyster declines

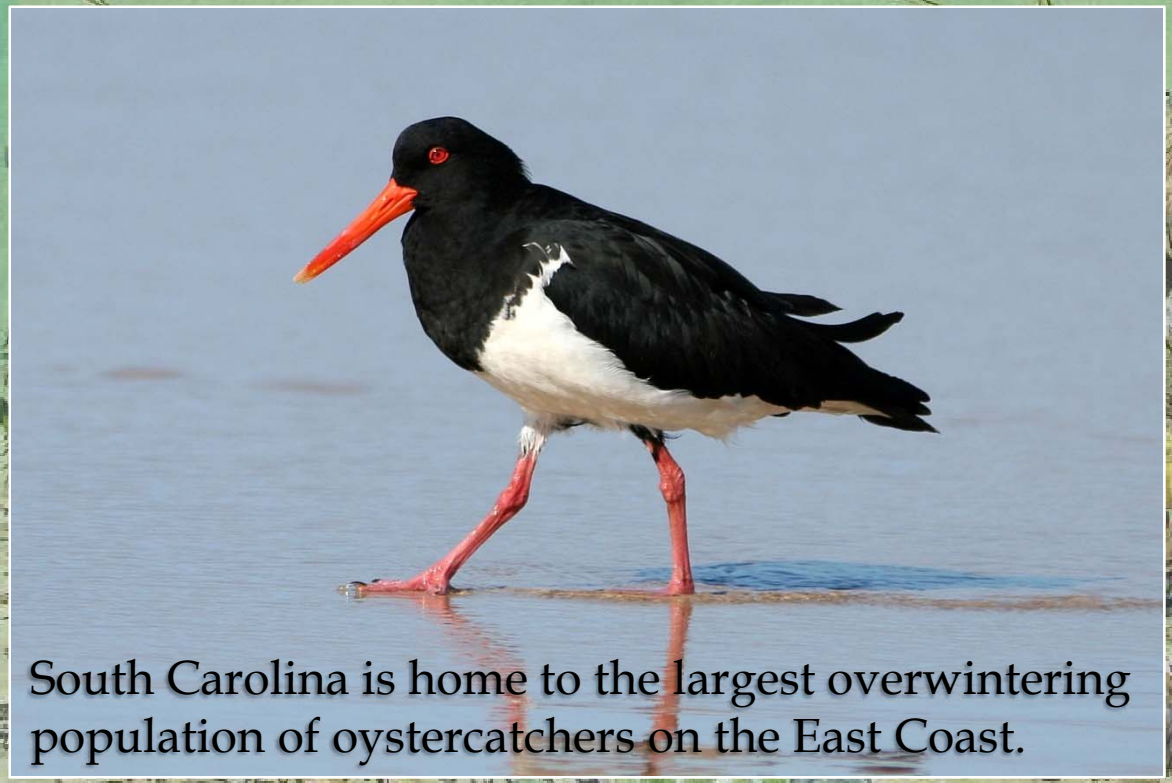
- Climate change (e.g., SLR, increased storminess, ocean acidification)



Courtesy of NOAA

Why should we restore reefs?

- Provision of habitat (e.g., for fish, crustaceans, birds, mammals)



South Carolina is home to the largest overwintering population of oystercatchers on the East Coast.

Commissioned illustration by Kent Forrest, copyright of VIMS

Why should we restore reefs?

- Improvements in water quality & clarity e.g., in some areas, oyster reefs support the occurrence of submerged aquatic vegetation

Photo courtesy of Dave Harp

Why should we restore reefs?

- Shoreline protection (reduce erosion) e.g., natural breakwaters for saltmarsh habitat

Why should we restore reefs?

- Support fisheries and local economies

Successful oyster reef restoration depends in large part on a fundamental understanding of oyster biology, including the life cycle….

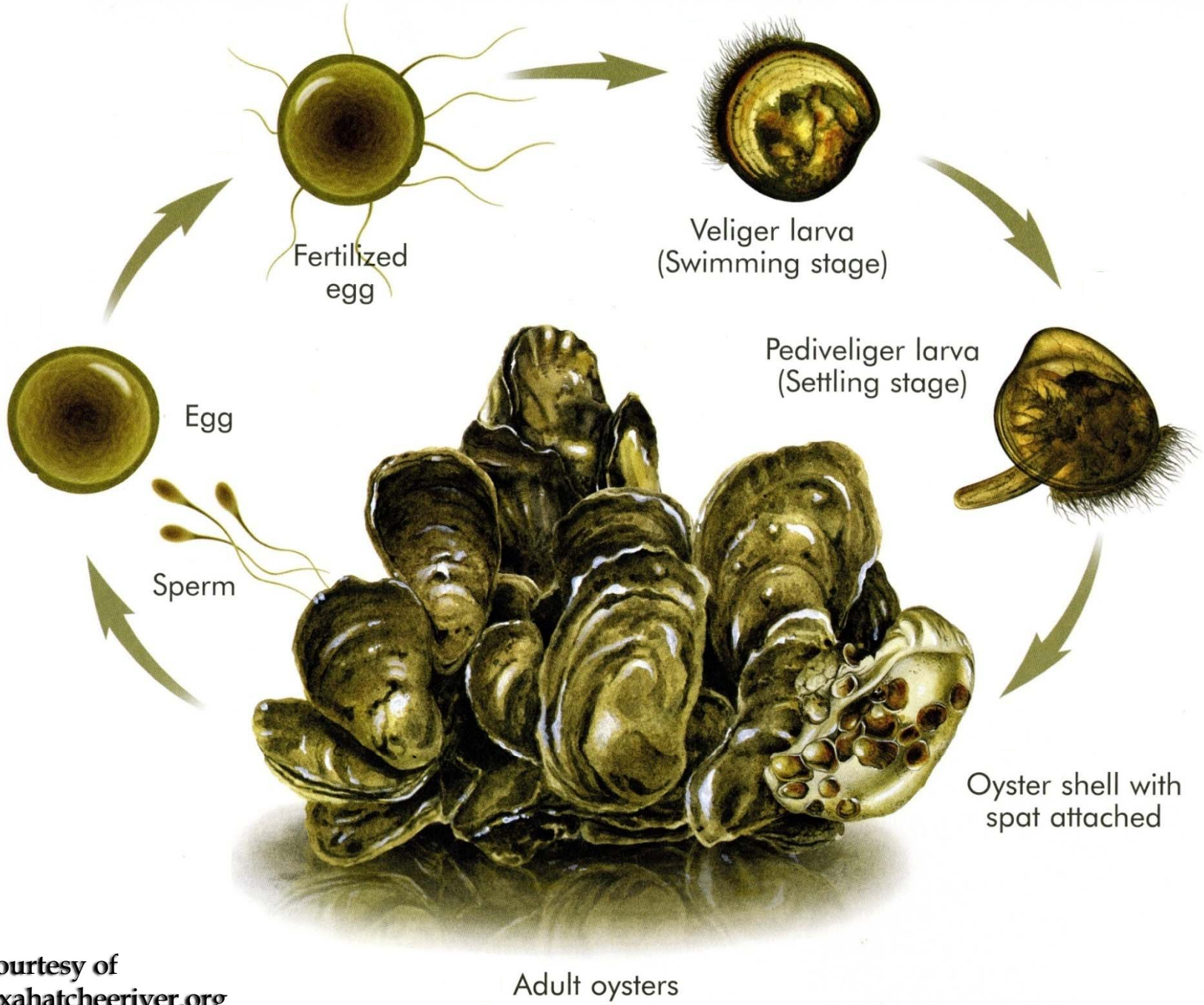


Image courtesy of www.loxahatcheeriver.org

Scenarios for oyster restoration

- 'Broodstock limited' (e.g., VA/MD)
  - Low numbers of adults (broodstock); few larvae produced; few larvae available to settle on substrate
  - Restoration solution = increase the number of adults in population
- 'Substrate limited' (e.g., South Carolina)
  - Sufficient broodstock; lack of appropriate substrate for settlement
  - Restoration solution = provide suitable substrate (e.g., oyster shell)

How will we restore reefs?

Four different restoration techniques using four different substrates to encourage oyster settlement:

1) Bagged oyster shells (SCORE Program)
2) Loose oyster shells
3) Oyster castles
4) Crab traps (abandoned and unwanted)

In addition, cordgrass (*Spartina alterniflora)* seedlings will be planted in association with the bagged oyster shell reefs constructed each year.

Sites will be evaluated to determine the restoration technique that is most likely to be successful and satisfy the restoration criteria prioritized by you!

1) Bagged oyster shell - South Carolina Oyster Restoration and Enhancement (SCORE) Program: Community-Based Oyster Restoration

Since its inception in 2000, the SCORE Program has worked with >17,000 volunteers (>43, 000 volunteer hours) to construct >2 acres of oyster reef habitat at 46 sites along ~2 miles of South Carolina coastline.

WATER
CAMPAIGN

2002

2001
08 01 2001 12:49

2006

2005

Just chop off this section

2) Loose oyster shells - SCDNR plants 30,000+ bushels of oyster shells each year on intertidal shorelines to create oyster reefs which serve as natural breakwaters for saltmarsh habitat.

Marsh transects:
Yellow = Pre-construction
Green = 2.5 years after oyster reef construction
Oyster footprint = 0.24 acres
Increase in *Spartina* over 2.5 years = 0.27 acres

3) Oyster castles - Application of alternative substrate materials, as natural oyster shell can be limited and expensive.

Oyster castle sites around Jeremy Island
Dec 2009 (~5 months after deployment)

Oyster castle sites around Jeremy Island (including newer sites established in Sept 2011) photographed in March 2012

Newer oyster castle site photographed on September 17th 2012, approximately 1 year after deployment

4) Crab traps – application of marine debris:
Abandoned crab traps in the intertidal zone, Bulls Bay, Cape Romain NWR.

Abandoned crab trap in salt marsh (*left*).

Diamondback terrapin (*Malaclemys terrapin*) trapped in an abandoned crab trap (*right*).

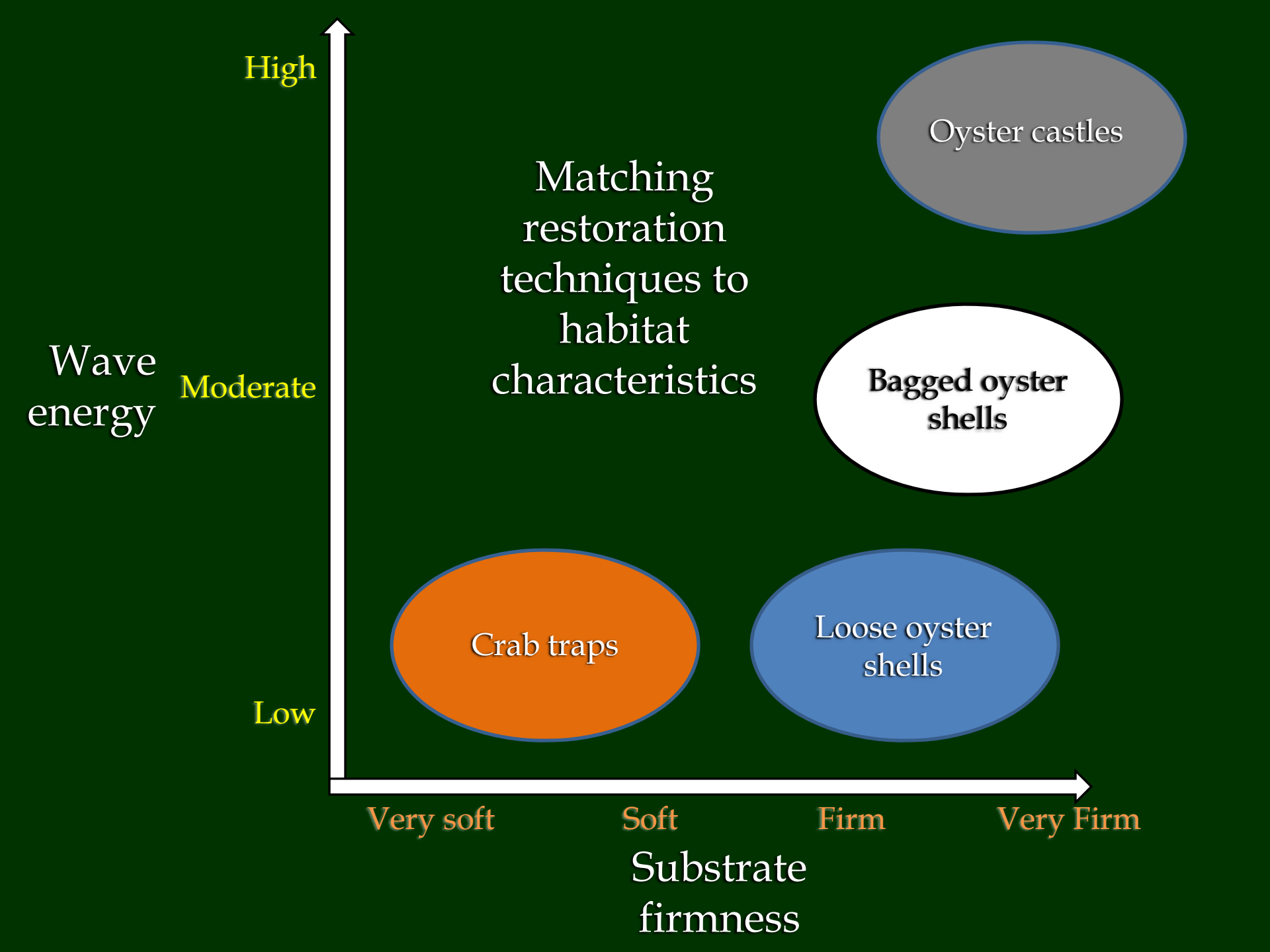
Abandoned and unwanted crab traps recovered by SCDNR have their vents closed, are coated in concrete to attract oyster larvae, and are deployed in coastal waters as substrate for reef development.

Leadenwah Creek, SC, September 17th 2012
(substrate deployed in April 2011)

Fort Johnson reef on January 27th 2012
(substrate deployed on April 28th 2011)

Hutchinson Cut, SC, May 3rd 2012
Substrate deployed on March 7th 2011
Photo courtesy of Lisa Vandiver, NOAA

Reef at Bears Bluff, July 3rd 2012
(substrate deployed on May 2nd 2011)


Matching restoration techniques to habitat characteristics
Wave energy
High
Moderate
Low
Oyster castles
Bagged oyster shells
Crab traps
Loose oyster shells
Very soft
Soft
Firm
Very Firm
Substrate firmness

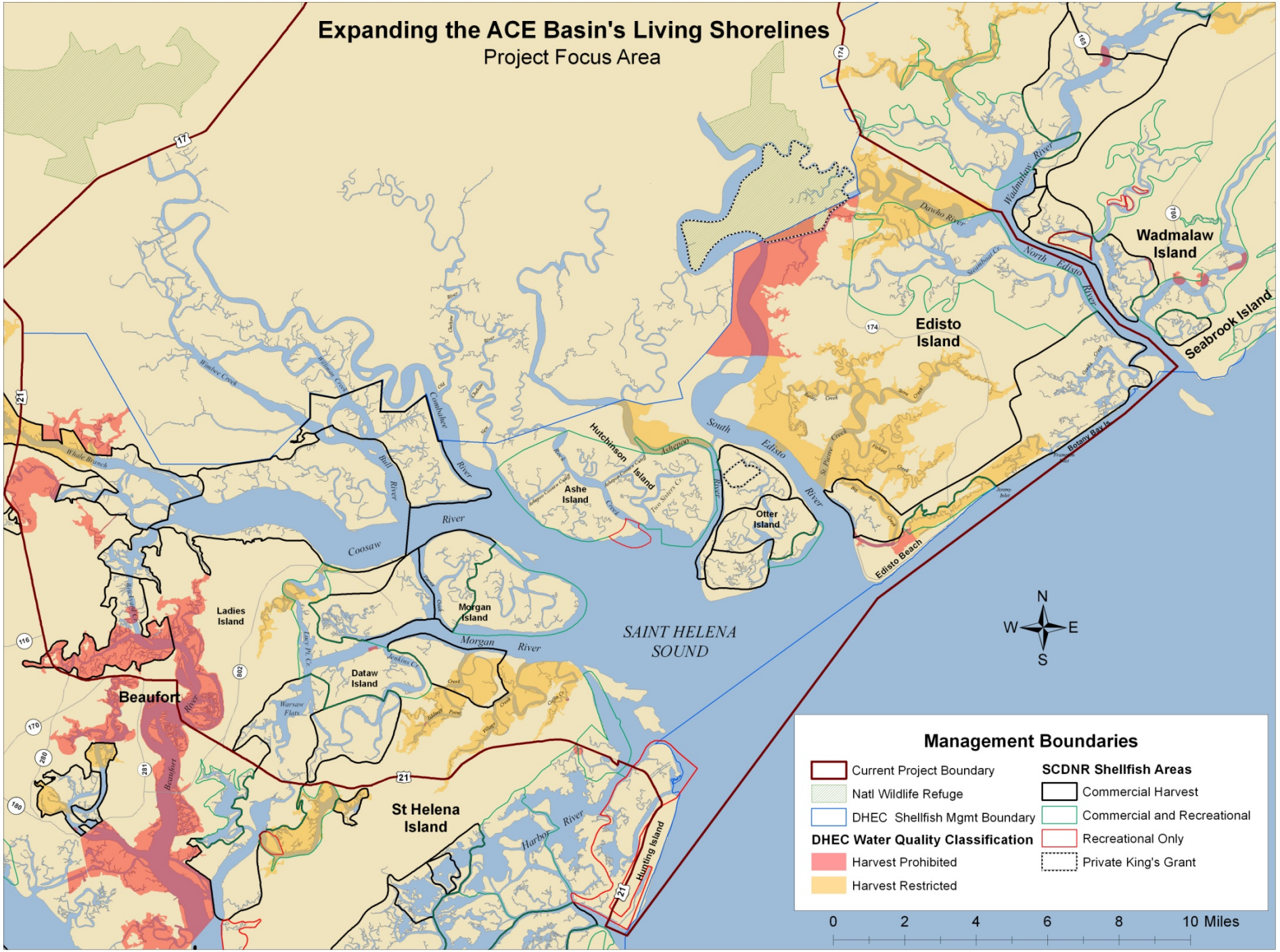
Project criteria and considerations for restoration efforts and site selections.

Projected amount of resources <u>per year</u> (i.e., ceilings for each technique):

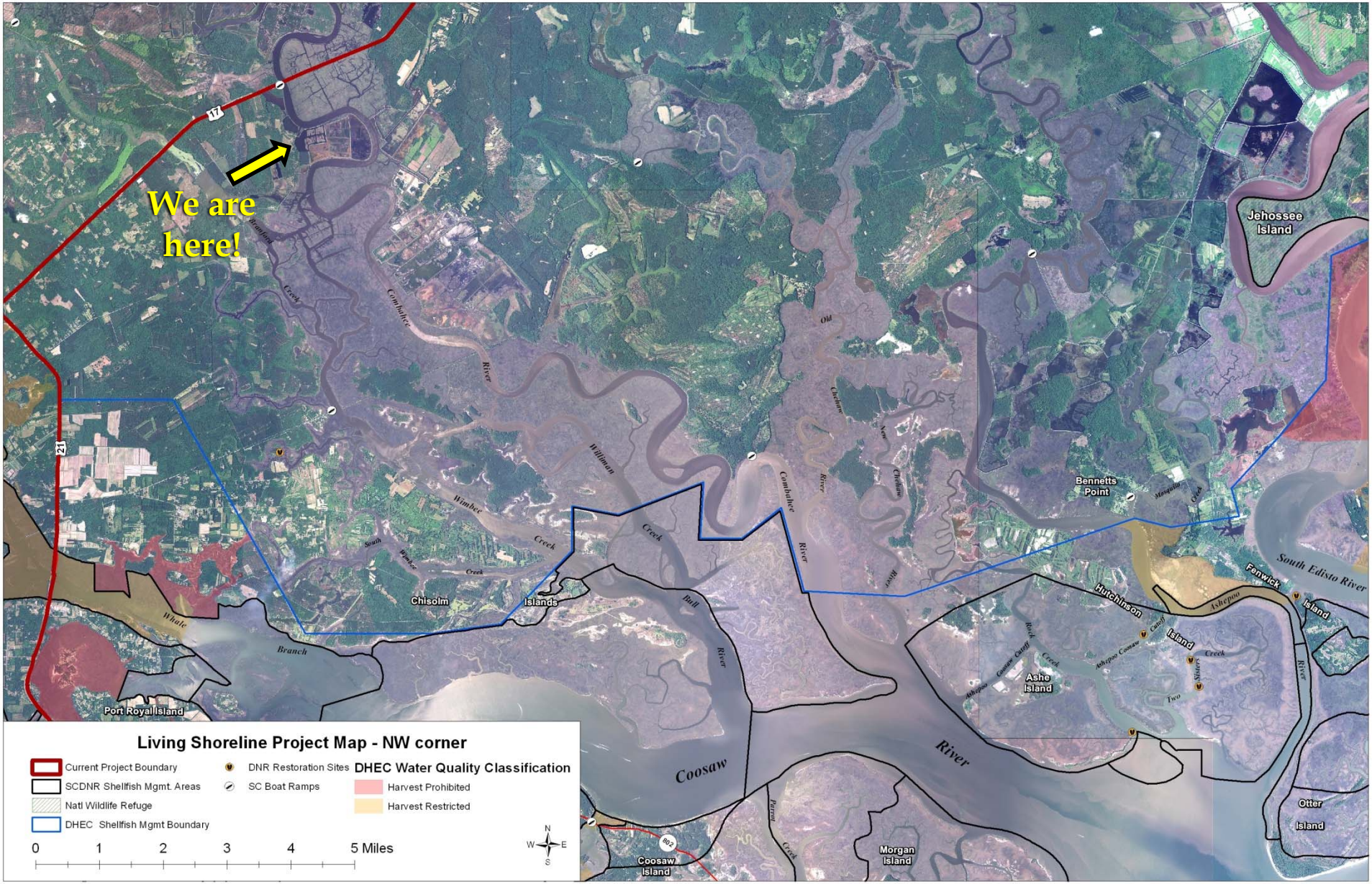
- Bagged oyster shell – approx 0.1 acre
- Oyster castles – 1500 castles (250ft)
- Loose shell planting – approx. 1.0 acre
- Crab trap reefs – 150 traps
- Salt marsh planting – 480 linear feet, 0.04 acres

Criteria and considerations for site selection:

- Within project boundary
- Proximity of private property (implications of success, failure)
- Accessibility for volunteers, staging reef construction
- SCDNR and SCDHEC classifications
- Exclusivity and intensity of harvesting activities
- Specific interests of stakeholders (e.g., habitat, erosion)


Expanding the ACE Basin's Living Shorelines
Project Focus Area
Wadmalaw Island
Seabrook Island
Edisto Island
Hutchinson Island
Ashe Island
Otter Island
Morgan Island
Ladies Island
Dataw Island
Beaufort
St Helena Island
Hunting Island
Edisto Beach
Botany Bay Is
SAINT HELENA SOUND
Coosaw River
Morgan River
Harbor River
Beaufort River
Combahee River
Bull River
Whale Branch
Wimbee Creek
Wadmalaw River
Dawho River
North Edisto River
South Edisto River
Ashepoo River
Warsaw Flats
Jenkins Cr.
Two Sisters Cr.
Rock Creek
Stiscimbout Cr.
Bailey Creek
Store Creek
St. Pierre Creek
Fishing Creek
Big Bar Creek
Jeremy Inlet
Brickyard Cr.
Lucy Pt. Cr.
Parent Creek
Eddings Point
Village Creek
Coffin Cr.
Old Chehaw River
Chehaw River
Williman Creek
Ashepoo Coosaw Cutoff
N
S
E
W
Management Boundaries
Current Project Boundary
Natl Wildlife Refuge
DHEC Shellfish Mgmt Boundary
DHEC Water Quality Classification
Harvest Prohibited
Harvest Restricted
SCDNR Shellfish Areas
Commercial Harvest
Commercial and Recreational
Recreational Only
Private King's Grant
0
2
4
6
8
10 Miles

Close-up map (Northwestern region)



SCDNR Shellfish Management Classifications

State Shellfish Grounds (SSGs)

- Commercial and recreational harvesting

Public Shellfish Grounds (PSGs)

- Recreational harvesting only (i.e., no commercial harvesting)

Shellfish Culture Permit Areas

- Commercial harvesting – access controlled by permittee
- Permits can change hands
- Planting requirement (50 bushels of shell / acre)

King's Grant Areas

- Granted by Lords Proprietors, British Crown or State
- Shellfish seasons and sanitation laws still apply

SCDHEC Shellfish Harvesting Waters Classifications

- Based on water quality – human health considerations
- No harvesting is allowed outside SCDHEC Management Areas (e.g., above the blue line on the maps provided)
- No harvesting is allowed from areas that are classified by SCDHEC as Prohibited (shaded red)
- Commercial harvesting is allowed from areas that are classified as Restricted (shaded orange) under special permits which include depuration

SCDNR Restoration site evaluations

- Stakeholders are encouraged to sign up to join SCDNR staff in the field to conduct site evaluations.

SITE EVALUATION SIGN UP SHEET										
NAME	LOCATION (e.g. Edisto, Beaufort)	Days Available (check all that apply)								
		7-Jan	8-Jan	9-Jan	10-Jan	11-Jan	22-Jan	23-Jan	24-Jan	25-Jan

SCDNR Restoration site evaluations

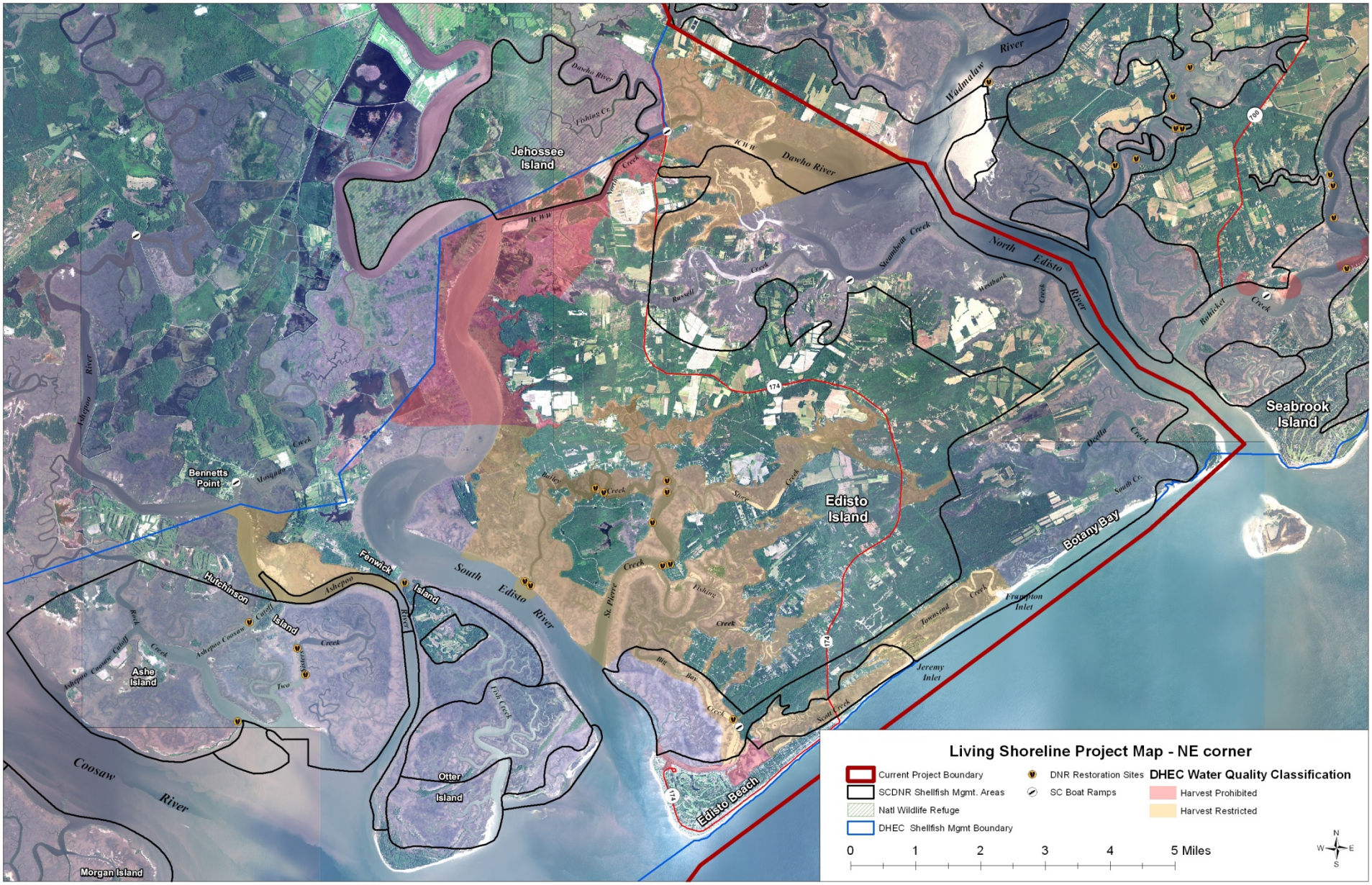
- Stakeholders are encouraged to sign up to join SCDNR staff in the field to conduct site evaluations
- Target dates: January 7th – January 11th 2013
  Back-up dates: January 22nd – January 25th 2013
- Two evaluation teams, 3-5 sites evaluated per trip
- 6 volunteers (3 per boat) on each day

SCDNR Restoration site evaluations

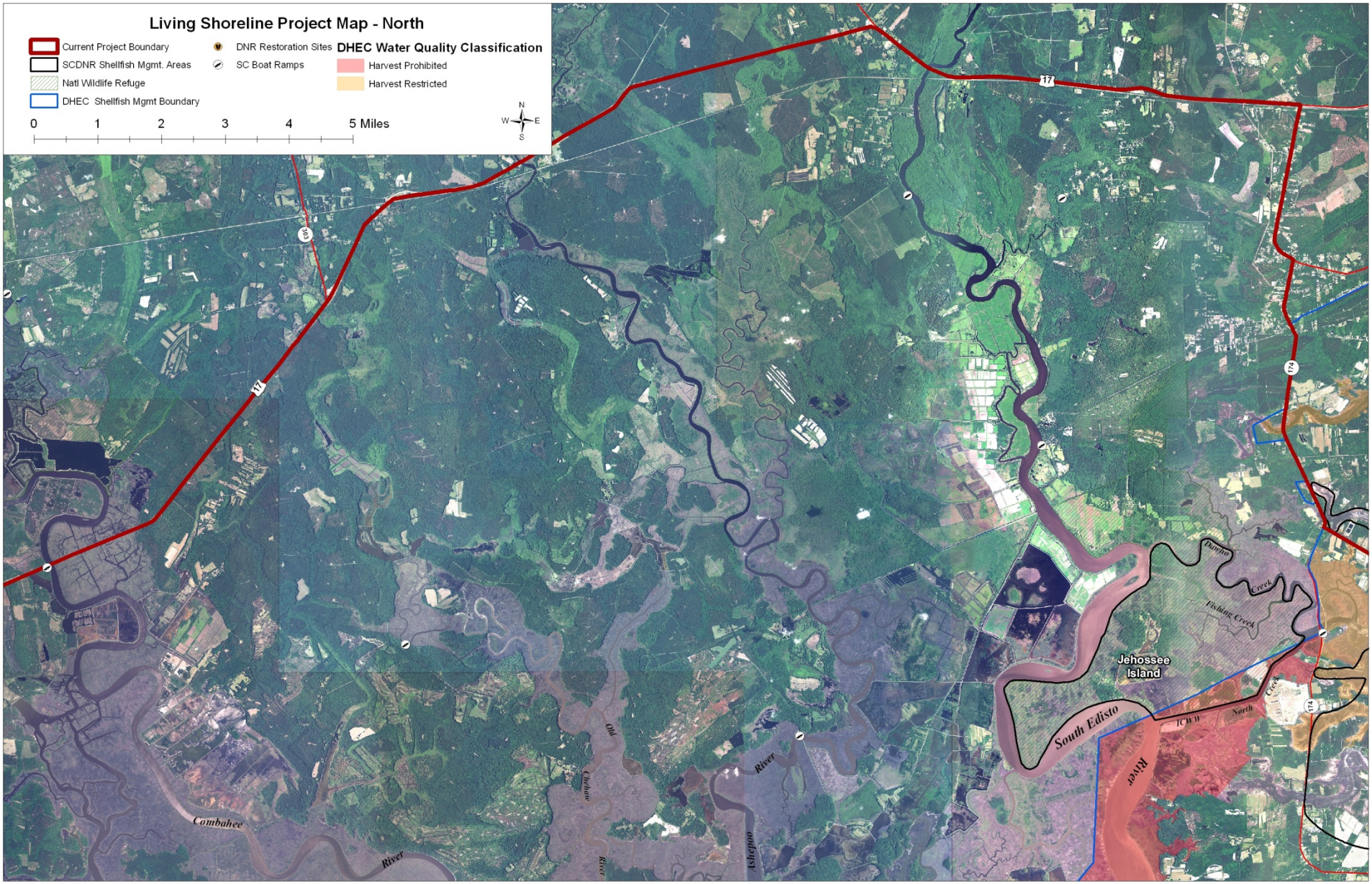
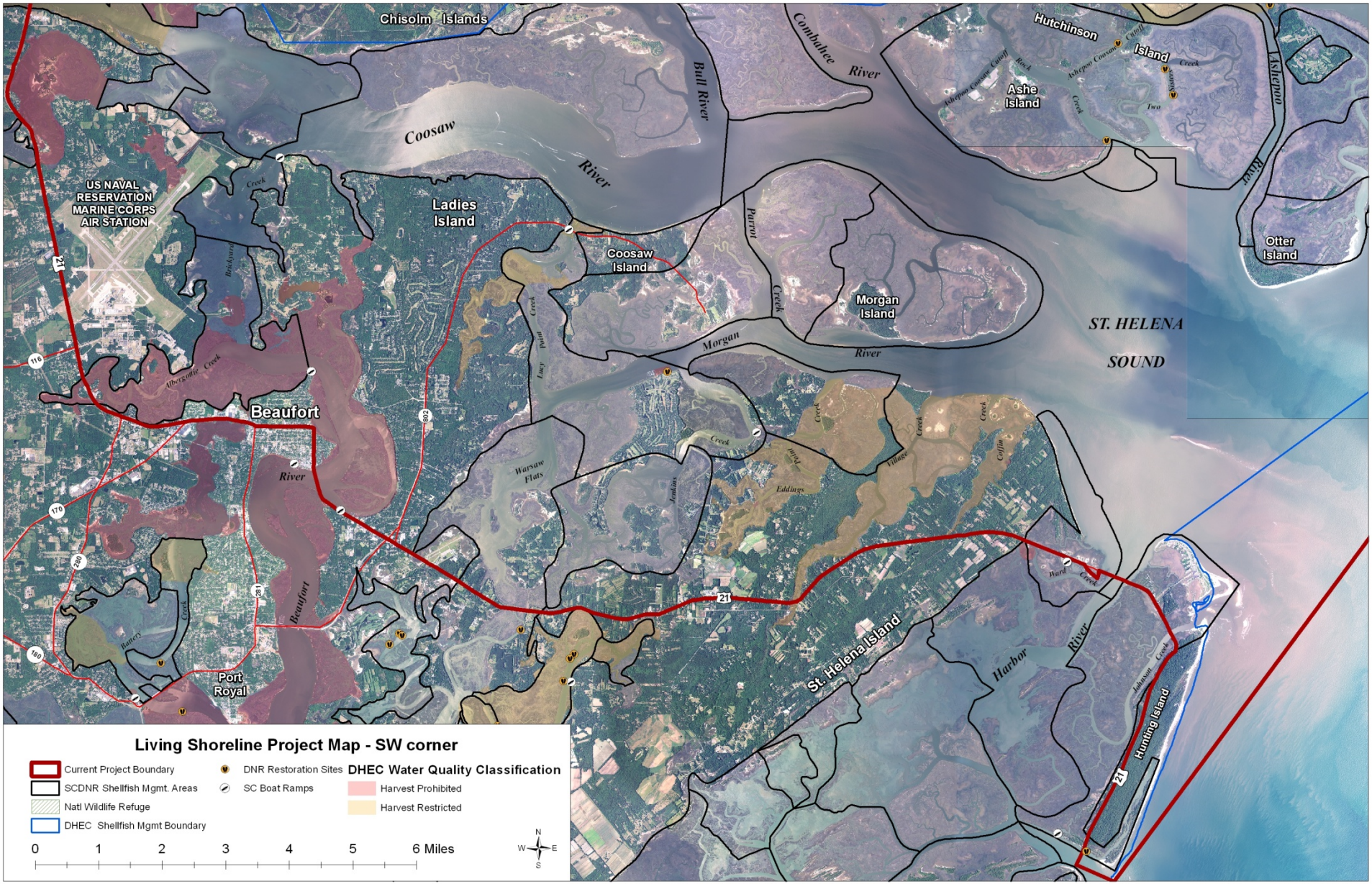
Site evaluations will determine the following:

- Biological feasibility of the site (salinity, physical site characteristics, presence of oysters nearby)
- Accessibility (access points, creek width, etc.)
- Baseline data (GPS coordinates, area of shoreline available, slope, sediment firmness, bank width, creek width, site photos, salinity)
- Suitability for each restoration technique
- Potential conflicts with nearby activities

Close-up map (Northeast corner)



Close-up map (Northern region)



Close-up map (Southwestern region)