Coastal Restoration and Community Economic Development in North Carolina

NC Oyster Summit

March 10, 2015

What Is RTI International

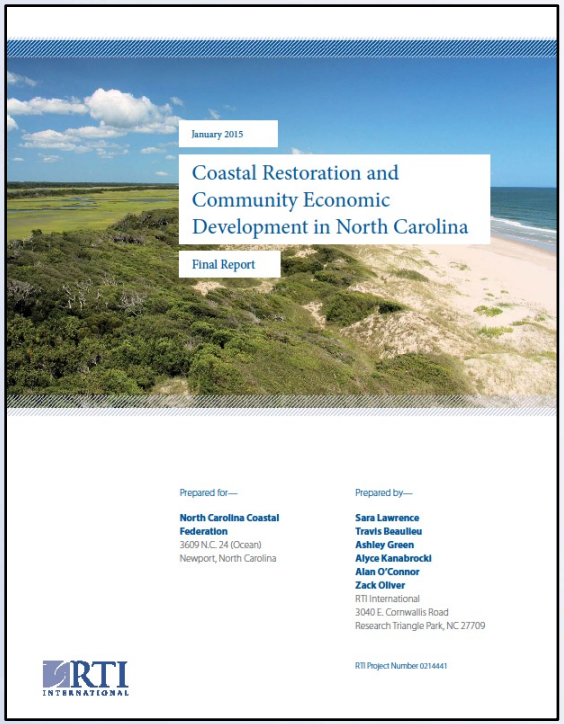
RTI is an independent, nonprofit institute that provides research, development, and technical services to government and commercial clients worldwide.

Our mission is to improve the human condition by turning knowledge into practice.

Key Question

How does coastal restoration in North Carolina affect community and economic development?

- Assess the links between coastal restoration and economic development
- Perform an economic impact analysis of related projects
- Review how other states benefit from coastal restoration
- Identify how coastal restoration fits within the state's larger economic development strategies



Answer

Industry Growth

- Diversify and stablize the economic base
- Foster growth in tourism, recreation, hunting and fishing

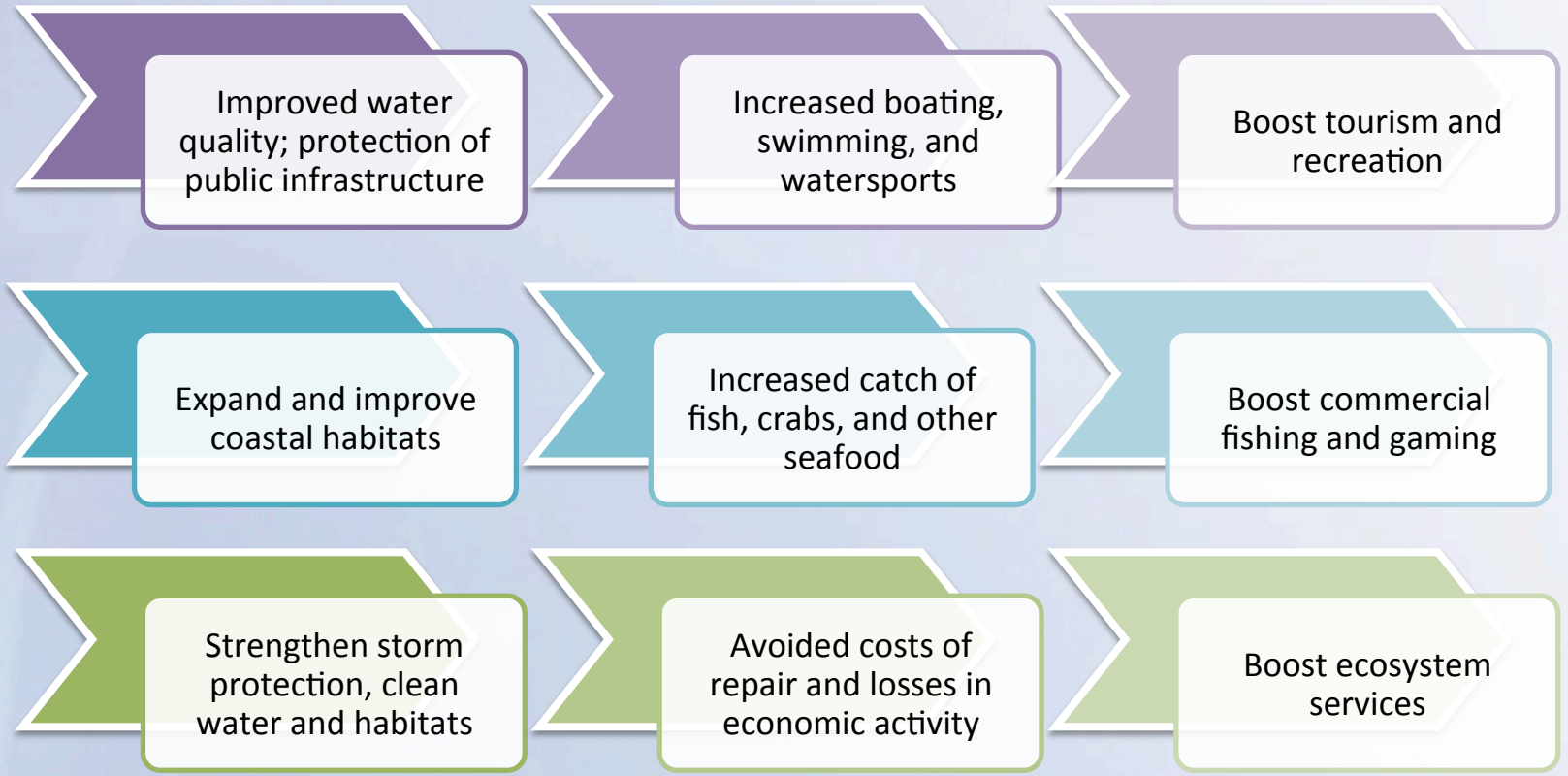
Employment

- Provide jobs to local workers
- Purchase goods and services from local small business

Community Development

- Create attractive place to live, work, and play
- Build civic capacity
- Build community assets (e.g., parks and public access points)
- Strengthen resilence to storms and extreme weather

Industry Growth



Based on peer-reviewed literature

Employment

Restoration Type	Jobs Created Per $1Million invested
Shellfish	16.6 – 25.33
Wetlands	10.4 – 29.45
Water Quality	23.1 – 28.8
Living Shorelines	19

Based on peer-reviewed literature

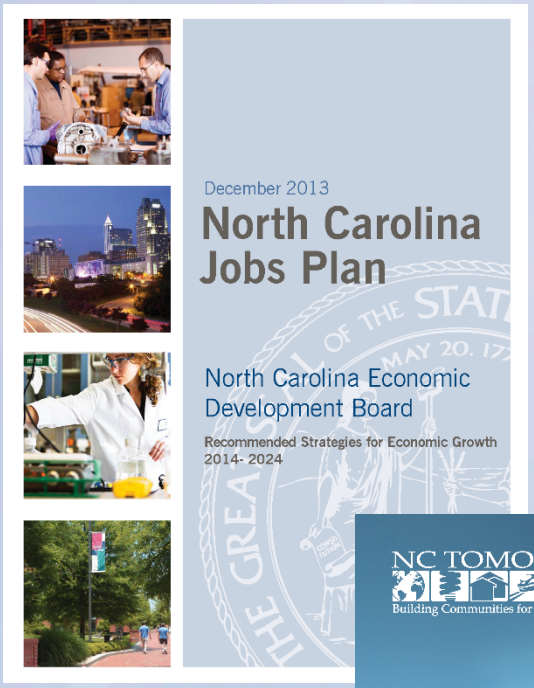
Community Development

- Create attractive places to live, work, and play.
- Build civic capacity
- Strengthen resilience to storms and extreme weather.

Economic Impact Analysis for Four Federation Projects

Project	Funding Received (thousands)	Business Revenue (thousands)	Household Income (thousands)	Jobs
Oyster Restoration	$5,030	$7,507	$1,900	50
Morris Landing	$527	$946	$325	11
North River Farms	$2,437	$5,248	$1,833	55
Bradley Creek Elementary	$76	$137	$47	1
Total	$8,071	$13,387	$4,104	116

How Coastal Restoration Aligns with Economic Development Plans



1. Industry Growth in Tourism
2. Investment in Rural North Carolina
3. Small Business Growth

Conclusions

- Opportunity for coastal restoration to be part of the economic developer's toolkit
- Creates jobs and affects industries and households for workers in sectors such as construction, fisheries, tourism and landscaping
- Jobs and spillovers are accrued almost entirely at the local level to the project
- Fresh approach for supporting small homegrown businesses, rural investment, and supporting tourism and fishing industries
- Projects can kick start employment in sectors negatively impacted from fluctuations in seasonal employment
- Builds civic capacity through engagement with local schools, students and volunteers

More Information

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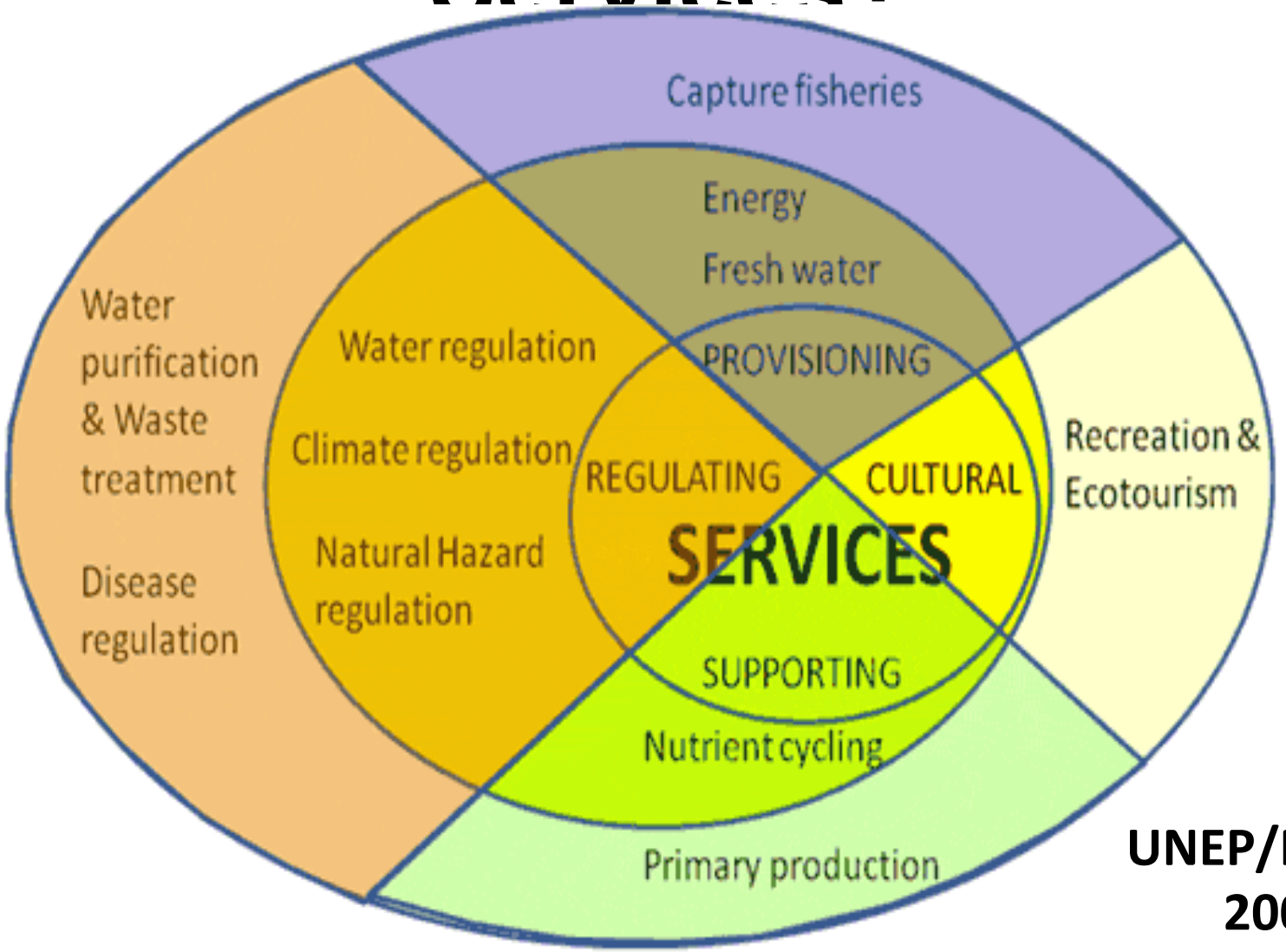
ECONOMIC VALUATION OF ECOSYSTEM SERVICES PROVIDED BY OYSTER REEFS

Jonathan Grabowski Charles Peterson

Northeastern University UNC-Chapel Hill IMS

What are Ecosystem Services?



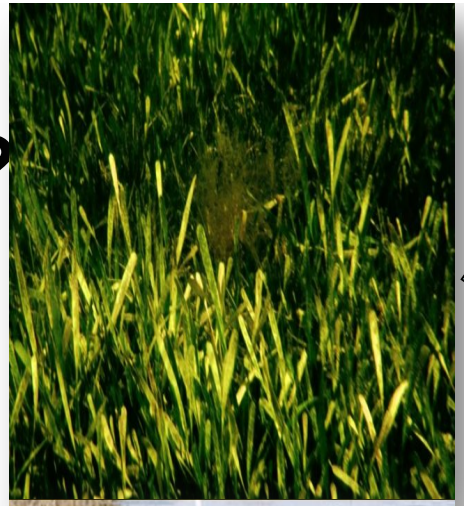
UNEP/MEA 2005

Can we estimate the economic value of each service?

Quantifying the Bioeconomic Value of Ecosystem Goods and Services

- **Monetary Approaches:**
  - **Consumptive goods & services**
    - **Market value of resource**
  - **Non-consumptive goods & services**
    - **Revealed preference models**
      - **Replacement costs, Travel cost methods, expected damage function**
    - **Stated preference models**
      - **Contingent valuation/Willingness-to-pay models**

How do We Measure Restoration Success?



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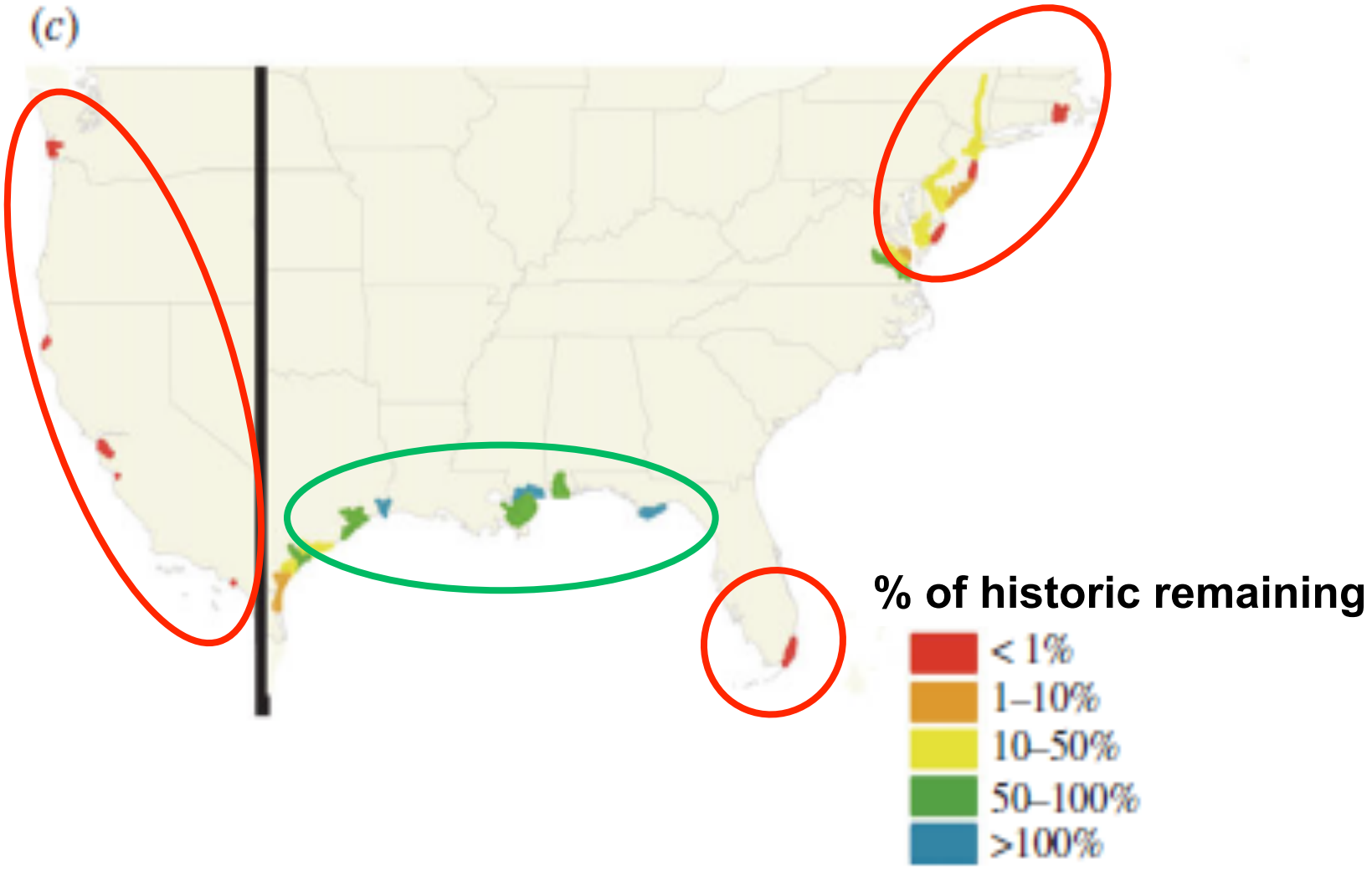
Outline

I. Quantifying oyster habitat losses

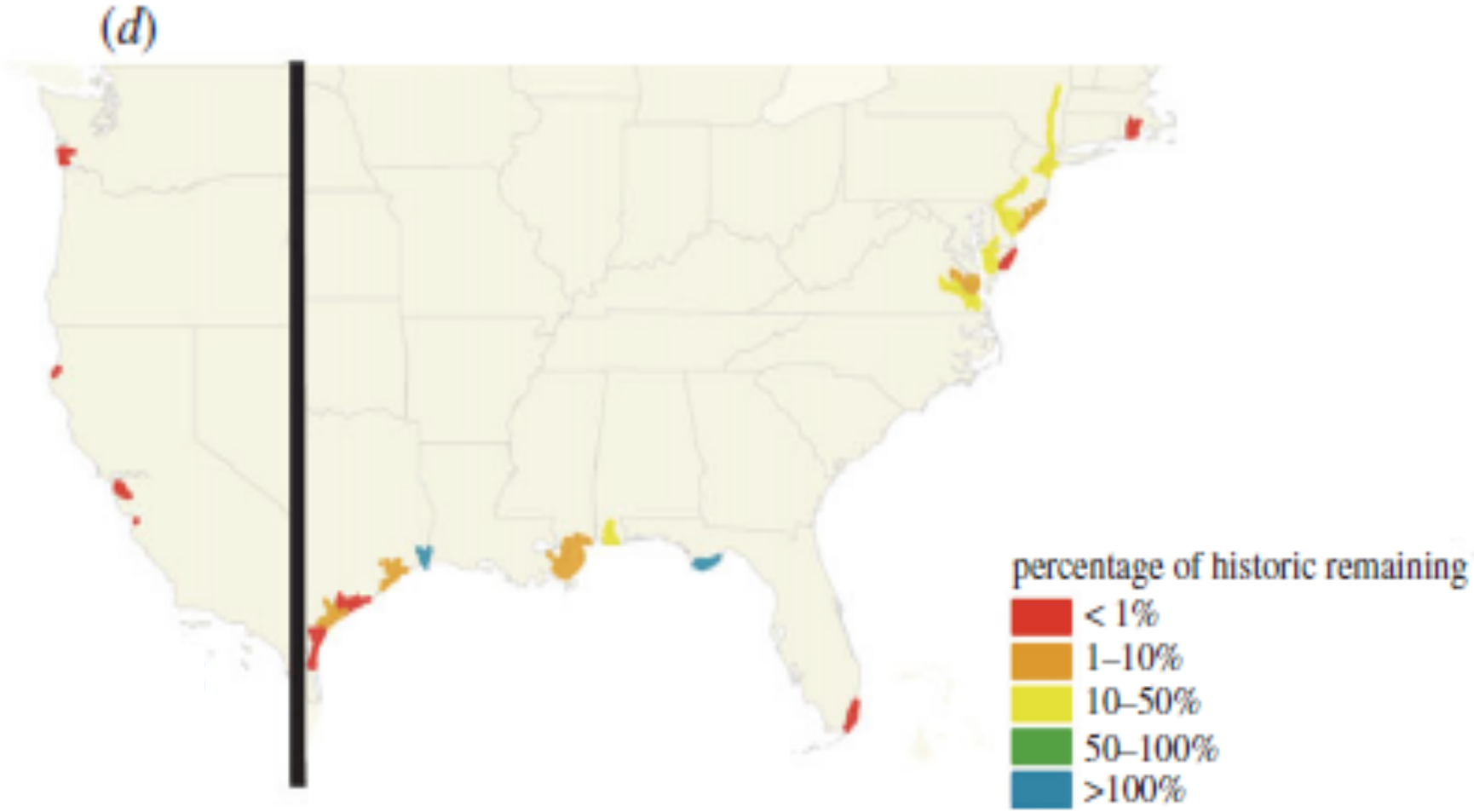
II. Valuing ecosystem services

III. Scaling service delivery

1. Changes in Areal Extent



1. Changes in Oyster Reef Adult Biomass



II. Valuing Oyster Reef Services

- **What are the values of each service provided by oyster reefs?**
- **Does the value of the oysters justify the investment in restoration for reef-degrading harvest of the oysters?**
- **What about the other services – are oyster sanctuaries a good investment?**

Ecosystem Goods and Services Provided by Oyster Reefs

	Ecosystem Service	Benefit/Value
1.	Production of oysters	Market & Recreational Value
2.	Augmented fish production	Market & Recreational Value
3.	Water filtration & Deposition of pseudofeces	↑ SAV, Recreational Use & Remove Anthropogenic N
4.	Stabilization of adjacent habitats	↑ SAV & Salt Marsh Habitat
5.	Provision of habitat for inverts	↑ Biodiversity & Productivity
6.	Carbon burial ?	↓ Greenhouse Gas Concentrations
7.	Diversifying the seascape	↑Synergies among Habitats

1. Production of Oysters

- **Used data from two regions:**

Chesapeake Bay

- **Historical data in Rothschild et al. (1994)**

North Carolina

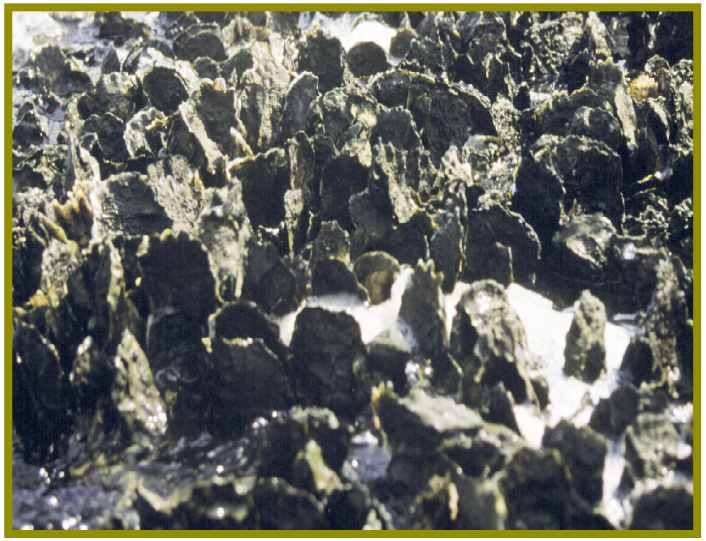
- **Data from restored oyster reef experiments:**
  Lenihan & Grabowski (1998)
  Lenihan & Peterson (2004)

1. Production of Oysters

- **Chesapeake Bay:**
  - **1890: 550g/m² = $65,876 per HA**
  - **1991: 22g/m² = $2,640 per HA**
- **North Carolina experimental reefs:**
  - **$20,890-52,224 per HA**
  - **s**
- Net Value after accounting for harvesting cost:
  Pristine: $17,072 per HA
  Degraded: $880 per HA

Grabowski and Peterson (2007); Grabowski et al. (2012)

2. Finfish & Crustacean Value: Reef Augmented Fish Production



Pre-Restoration **Post-Restoration**

$$\Delta\ 2^{o}\ \text{Production} = \underline{\quad\quad} \ \text{Kg m}^{-2}\ \text{Yr}^{-1}$$

Meta-Analysis of Research in Southeastern U.S.

Peterson et al. (2003)

Who Catches these Fish & 'Captures' their Value?

1. Commercial Harvesters

Dockside value

2. Recreational Harvesters

WTP, Trip costs

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Commercial Value of Fish from Reefs

	Augmented Fish Production[a] (Kg/10m^2)	Commercial Fish Price[b] ($/Kg)	Augmented Fish Value[c] ($/yr/10 m^2)
Sheepshead Minnow	0.000	$ -	$ -
Bay Anchovy	0.019	$ -	$ -
Silversides (3 spp.)	0.002	$ -	$ -
Gobies	0.644	$ -	$ -
Blennies	0.050	$ -	$ -
Sheepshead	0.586	$ 1.17	$ 0.69
Stone Crab[d]	0.653	$ 6.75	$ 0.88
Gray Snapper	0.114	$ 3.43	$ 0.39
Toadfish	0.022	$ 4.95	$ 0.11
Gag Grouper	0.293	$ 4.82	$ 1.41
Black Sea Bass	0.046	$ 2.90	$ 0.13
Spottail Pinfish	0.005	$ 1.14	$ 0.01
Pigfish	0.135	$ 0.60	$ 0.08
		Total ($/yr/10 m^2):	**$ 3.70**

Annual Net Value: $4,123 per HA

3. Water Quality/Nutrient Processing Value

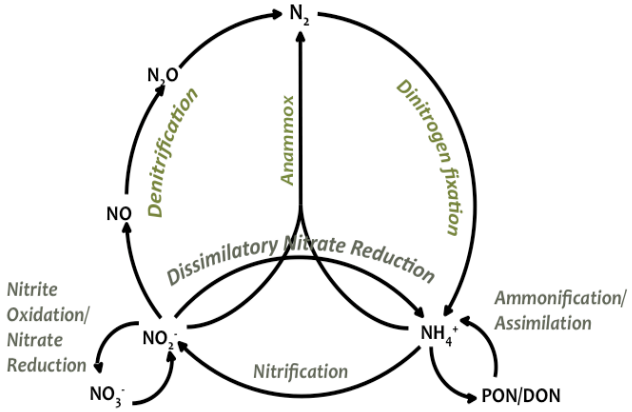
Potential Benefits:

1. Removal of N

2. SAV enhancement

3. Recreational values

Filtration **Denitrificati**



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Replacement costs, nutrient offsets

Valuation of SAV services

WTP for recreation, consume seafood

A. Removal of Nitrogen

- **Calculated Kg N removed per year from denitrification**
- **Compared to the cost of removing N via various management strategies**
  - $24 (avg. for Chesapeake)
  - $120 (max for Chesapeake Bay)
  - **$28.23 – NC Nutrient Offset Credit Program**

N Removal: Denitrification Value

- Used existing data on nitrogen flux in oyster reefs and mud flats (Piehler and Smyth 2011, unpublished data)
- Subtracted denitrification levels on mud flats from oyster reefs
- Net additional flux from oyster reef habitat:
  - Value per HA: $1,385-$6,716
  - Average: $4,050

B. SAV Enhancement Value

- **Used Seagrass Value Estimate:**
  - **Annual: $33,730 per HA (Opaluch unpub. data)**
  - **Total (20 yr lifespan, 3% discount): $516,876 per HA**
- **If 1 HA of oyster reef promotes the creation of:**
  - **0.005 HA of additional SAV: $1,292**
  - **0.010 HA of additional SAV: $2,584**

4. Shoreline Stabilization

Used replacement cost valuation:

- **Calculated cost of shoreline stabilization:**
- **Compared to cost of bulkheads, stone groins, riprap**
  - **Co** **752)**

Bulkhead or Seawall

Riprap Revetment

Shoreline Stabilization

Convert linear m of revetment/bulkhead to m^2 of reef:

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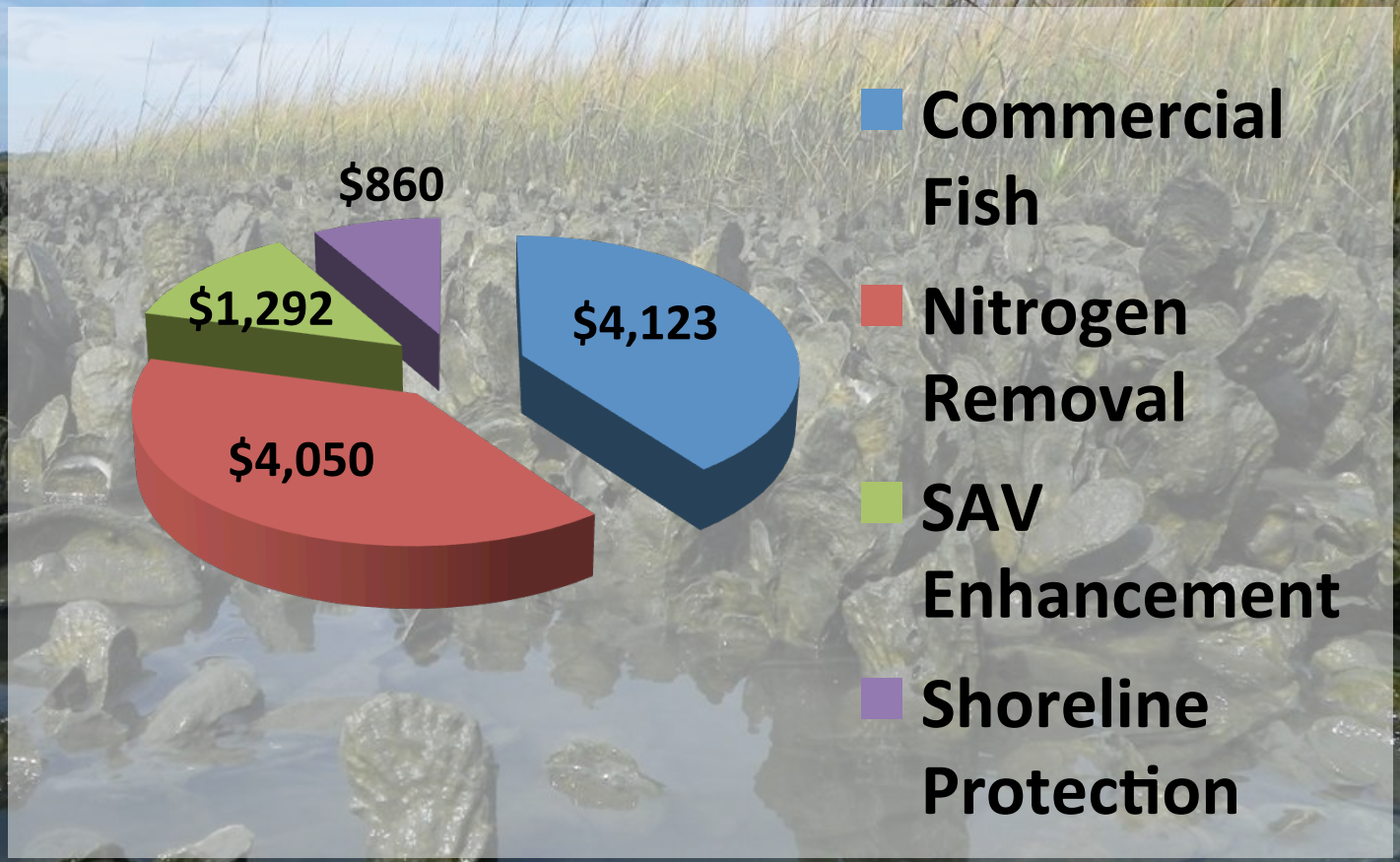
– **1 HA of reef could protect 2,000 m of shoreline**

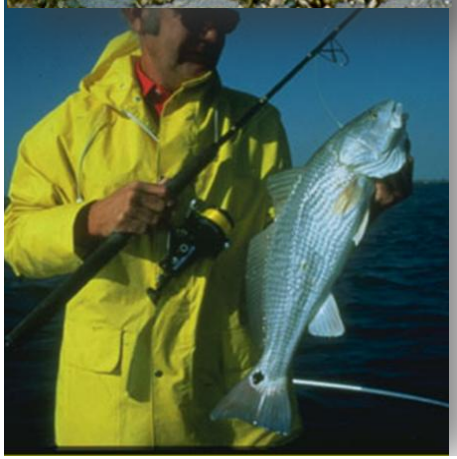
Summary: Oyster Ecosystem Services

Average value of oyster services= $10,325 per hectare



Grabowski et al. 2012

Valuing Ecosystem Services



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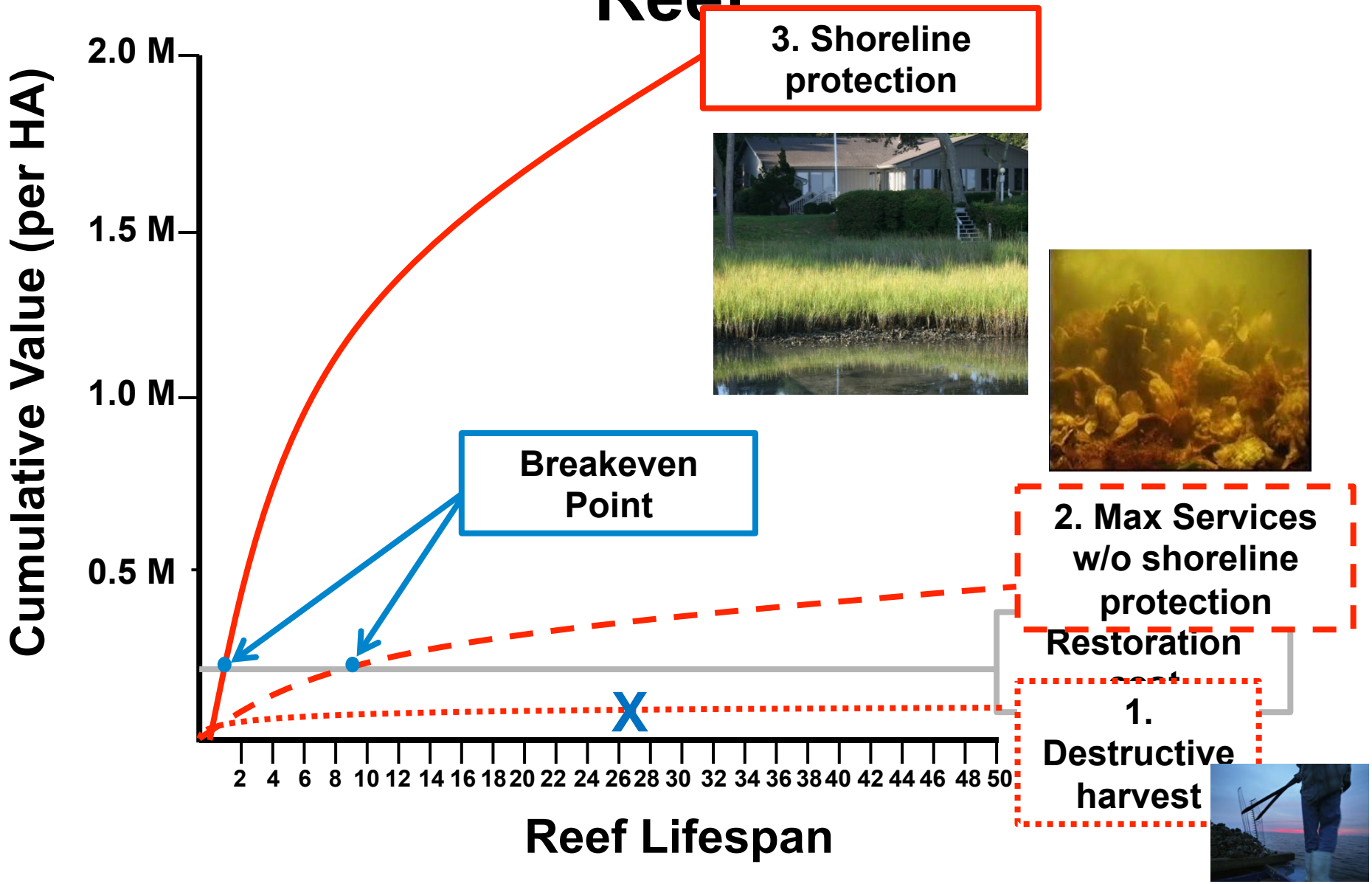
Restoration Scenarios:

1. Destructive harvest

2. Max services w/o shoreline protection

3. Max shoreline protection

Restoration Scenarios:
Lifetime Value Derived from 1 HA Oyster Reef



Questions

- **What are the values of each service provided by oyster reefs?**

  Avg = $10K/HA, can achieve much more

- **Does the value of the oysters merit the investment in restoration to destructively harvest?**

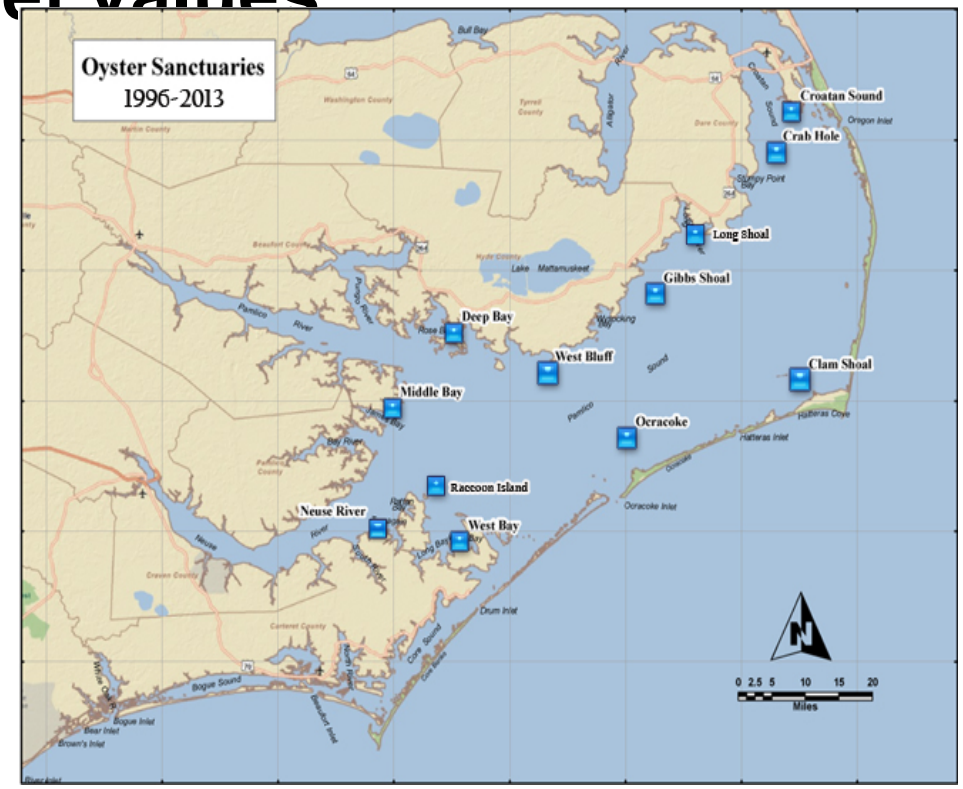
  No*

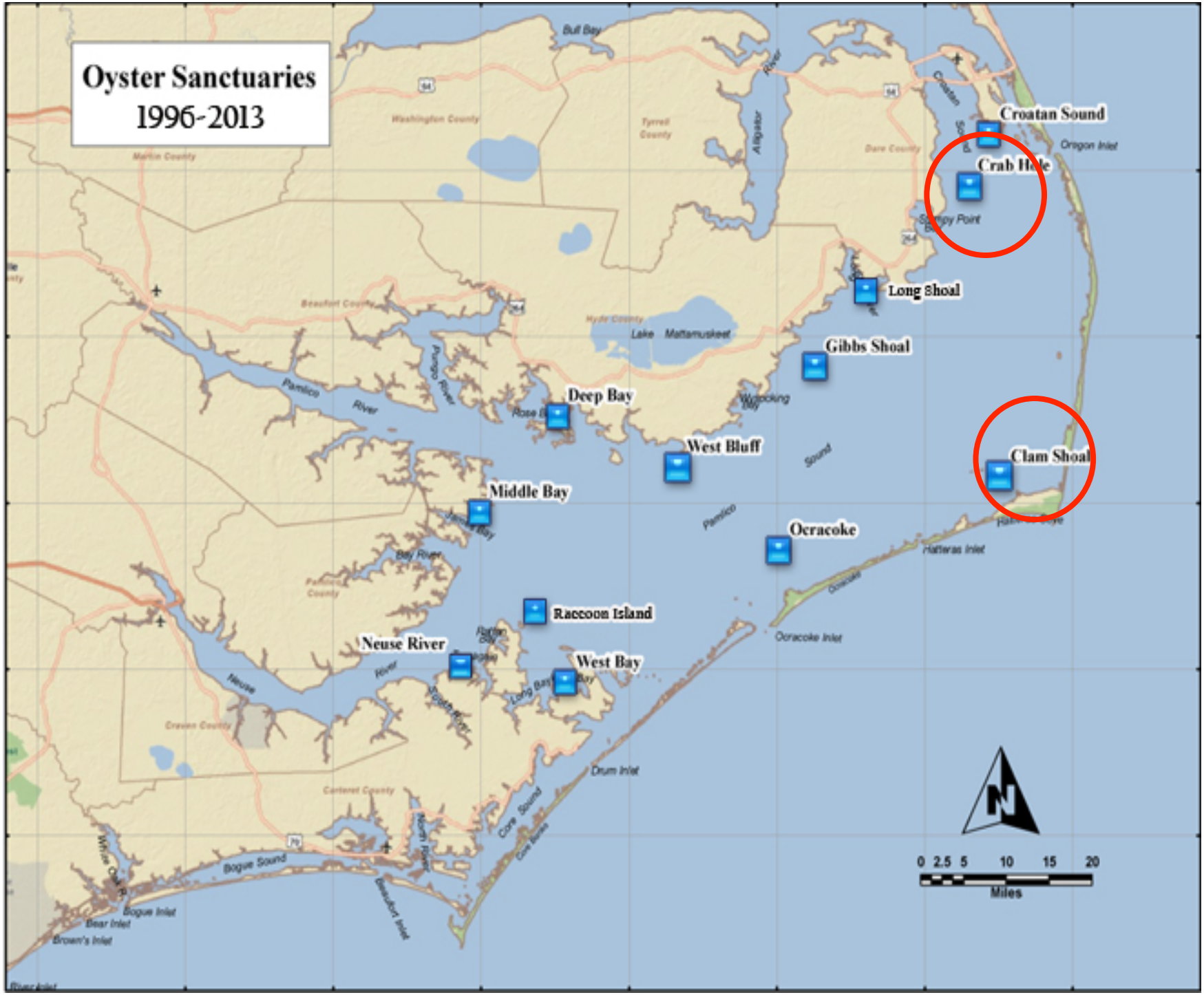
- **What about the other services – are oyster sanctuaries a good investment?**

  Yes; where they are located matters

III. Scaling service delivery

1. Using the NC sanctuary program to examine reef values




Oyster Sanctuaries
1996-2013
Croatan Sound
Crab Hole
Long Shoal
Gibbs Shoal
Deep Bay
West Bluff
Clam Shoal
Middle Bay
Ocracoke
Raccoon Island
Neuse River
West Bay
Bull Bay
Washington County
Tyrrell County
Dare County
Martin County
Beaufort County
Hyde County
Lake Mattamuskeet
Pamlico River
Pungo River
Alligator River
Croatan Sound
Oregon Inlet
Wysocking Bay
Pamlico Sound
Hatteras Inlet
Ocracoke Island
Ocracoke Inlet
Bay River
Pamlico County
Neuse River
Craven County
Carteret County
Drum Inlet
Core Sound
Core Banks
Bogue Sound
White Oak River
Bogue Inlet
Bear Inlet
Brown's Inlet
Barden Inlet
North River
0 2.5 5 10 15 20
Miles

Commercial Fish Value

Crab Hole Sanctuary		
Reef area	Augmented fish value	Value of fish per sanctuary
# acres	$ acre^{-1} yr^{-1}	$ yr^{-1}
18.60	$1,736	$32,286

Clam Shoal Sanctuary		
Reef area	Augmented fish value	Fish value of sanctuary
# acres	$ acre^{-1} yr^{-1}	$ yr^{-1}
26.96	$1,736	$46,798

Recreational Fish Value

Crab Hole Sanctuary

% of NC Trips to reef sanctuaries	Fishing effort # trips yr^{-1}	Added value per trip $ $trip^{-1}$	Fish value of sanctuary $ yr^{-1}
0.1%	2,469	$19.73	$48,708
1.0%	24,687	$19.73	$487,083

Clam Shoal Sanctuary

% of NC Trips to reef sanctuaries	Fishing effort # trips yr^{-1}	Added value per trip $ $trip^{-1}$	Fish value of sanctuary $ yr^{-1}
0.1%	3,578	$19.73	$70,601
1.0%	35,783	$19.73	$706,008

Augmented DNF Value

Crab Hole Sanctuary					
Reef area	Halo area	DNF Value	Oyster reef DNF Value	Oyster sed. DNF Value	Value of DNF per sanctuary
# acres	# acres	$ acre^{-1} yr^{-1}	$ yr^{-1}	$ yr^{-1}	$ yr^{-1}
18.60	2.91	$5,621	$104,551	$16,378	$120,929

Clam Shoal Sanctuary					
Reef area	Halo area	DNF Value	Oyster reef DNF Value	Oyster sed. DNF Value	Value of DNF per sanctuary
# acres	# acres	$ acre^{-1} yr^{-1}	$ yr^{-1}	$ yr^{-1}	$ yr^{-1}
26.96	4.55	$5,621	$151,542	$25,582	$177,124

Projecting the Value of Each Sanctuary

Long-term projected values	Additional Benefits		
Reef life span	Crab Hole	Clam Shoal	**Total**
1 year	$206,218	$300,747	**$506,964**
5 years	$972,749	$1,418,652	**$2,391,401**
10 years	$1,811,851	$2,642,394	**$4,454,245**
25 years	$3,698,626	$5,394,056	**$9,092,682**
50 years	$5,465,110	$7,970,288	**$13,435,398**

Collaborators

- **Robert Brumbaugh, Robert Conrad, Andrew Keeler, Jim Opaluch, Michael Piehler, Sean Powers, and Ashley Smyth, Joel Fodrie, Steven Scyphers, Rachel Gittman, Line Zu Ermgassen**