Modeling Coastal Ecosystem Services for Decision Support

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What is the Coastal Resilience Network?

CRN aims to provide tools and information to better inform decision-making with a primary goal of identifying vulnerable human and natural communities and enabling adaptation solutions, emphasizing the important role of ecosystems.
Coastal Resilience Approach

TNC’s Coastal Resilience Approach

- Assess Risk
- Identify Solutions
- Take Action
- Measure

Communities at Risk from Coastal Hazards

Large Storm Waves

Hurricanes

Coastal Ecosystems

Smart Development

Resilient Coastal Communities
Establishing the Network

- New York & Connecticut
- Gulf of Mexico
- St. Vincent and the Grenadines
- Puget Sound
- Florida Keys
- Southern California
- U.S. Virgin Islands
- PNG/Solomon Islands
- MesoAmerican Reef
- Gulf of California
Case Example: Mobile Bay, AL
Oyster Reef Ecosystem Services
Reefs = Coastal Protection Services
Case Example: Mobile Bay, AL

Average Annual Catch '95-'04 (tons * 1000)

- Sum 20 ecoregions
  - Adriatic Sea
  - W. Mediterranean
  - NE Brazil
  - SE Brazil
  - Celtic Sea
  - S. Eur. Atlantic Shelf
  - NE New Zealand
  - Amazonia
  - North Sea
  - Gulf St. Lawrence
  - Central NZ
  - Aegean Sea
  - S. Caribbean
  - Greater Antilles
  - Carolinian
  - Floridian
  - Virginian
  - Yellow Sea
  - S. Gulf of Mexico
  - N. Gulf of Mexico
Oyster Reef Restoration Efforts

Small Scale: 50 – 300 meters

Reef Balls

ReefBLK

Large Scale: 150,000 bags
A Public-Private Partnership to build 100 miles of oyster reefs and plant/promote 1,000 acres of marsh/seagrass in Alabama
Restoration Explorer
Using Restoration Explorer as a Guide
Coastal Defense Tool: Oyster Reefs
Coastal Defense Tool: Oyster Reefs

Wave Attenuation Profile

Reef Characteristics
- Your oyster reef is 80.0m from the shoreline, with a base width of 10.0m, and a crest width of 9.0m.
- It is 0.3m tall, and the water depth is 0.5m: it is submerged.
- Offshore wave input conditions are Hs=0.51m, and T=3.04s.

Model Outputs
- On average, wave heights in the region protected by your oyster reef were reduced by 52% (max=80%, min=23%).
- Wave energy was reduced, on average, by 71% (max=91%; min=41%).

Link to the output (turn off popup blocker): **Results Link**
Results!
Marsh Ecosystem Services

Wave attenuation with a healthy tidal marsh.

Wave Height

Mudflat

Tidal Marsh

Dike

Properties Safe

Dike Not Overtopped and/or Damaged

Wave attenuation with a degraded tidal marsh.

Wave Height

Mudflat

Tidal Marsh

Dike

Properties Flooded

Dike Overtopped and/or Damaged
Marshes = Coastal Protection Services
Case Example: Puget Sound, WA

- Low Marsh Boundary
  - 1964
  - 2004

Port Susan Bay Dike Breach (February 4, 2006)

*High tide + 44 knot south wind*
Coastal Defense Tool: Marshes
Coastal Defense Tool: Marshes

The plot above compares wave heights in the current (blue) and future (green) scenarios. The graph shows the percent of no habitat scenario.

**Levee Overtopping**
- **Current scenario**: Levee is high enough to prevent overtopping.
- **Future scenario**: Increase levee by 0.39 m to have negligible overtopping.
- **Al habitat removed**: Increase levee by 1.03 m to have negligible overtopping.

**Wave Attenuation**
- **Mudflat**
- **Tidal Marsh**
- **ESA/PWA**
- **Dike**

Additional Outputs:
- Cross-shore distance from shoreline (m)
- Dispersal mobility

The Nature Conservancy
Protecting nature. Preserving life.
Floodplain Mosaic

- Frequently flooded; natural vegetation and ecosystem services
- Moderate flood frequency; flood-compatible agriculture
- Rarely flooded: agriculture with compensation mechanisms
- Managed wetlands to provide benefits from frequent inundation and to improve water quality
Floodplains by Design: Port Susan Bay, WA
What’s Next?

- Leverage Coastal Resilience and Floodplains by Design
- Multiple habitats, services, and geographies
- Tools for specific coastal/floodplain issues
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