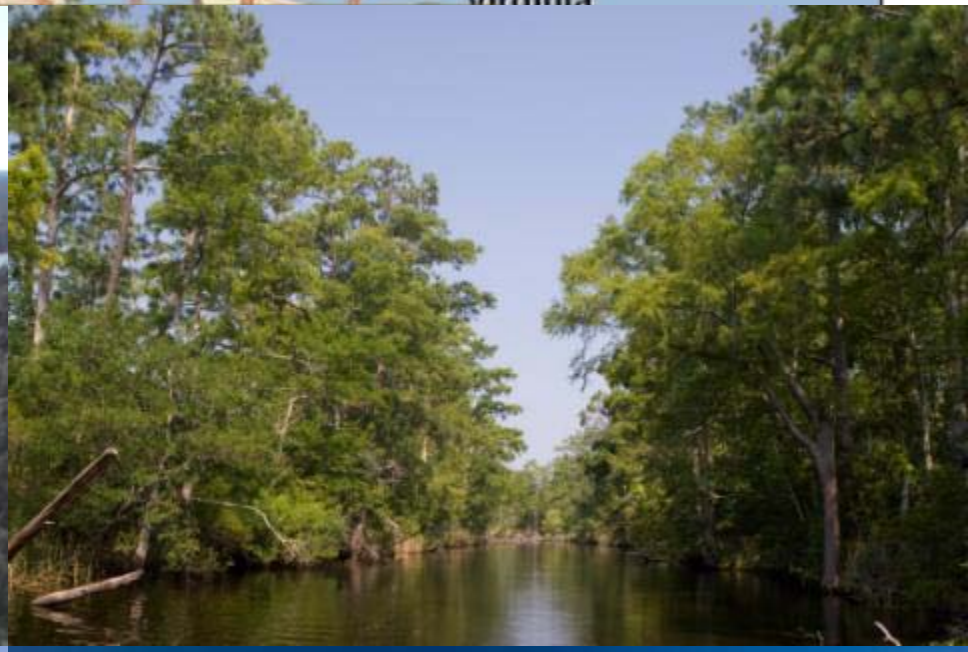
Using ecosystem restoration to build climate change resilience into a coastal habitat complex

Brian Boutin ¦ November 17, 2011







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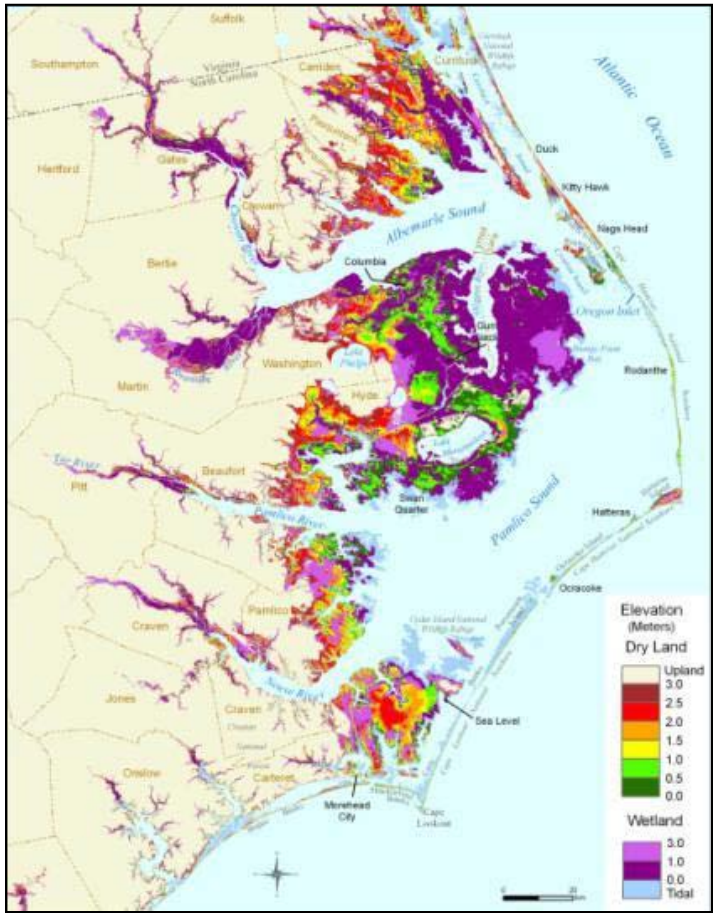
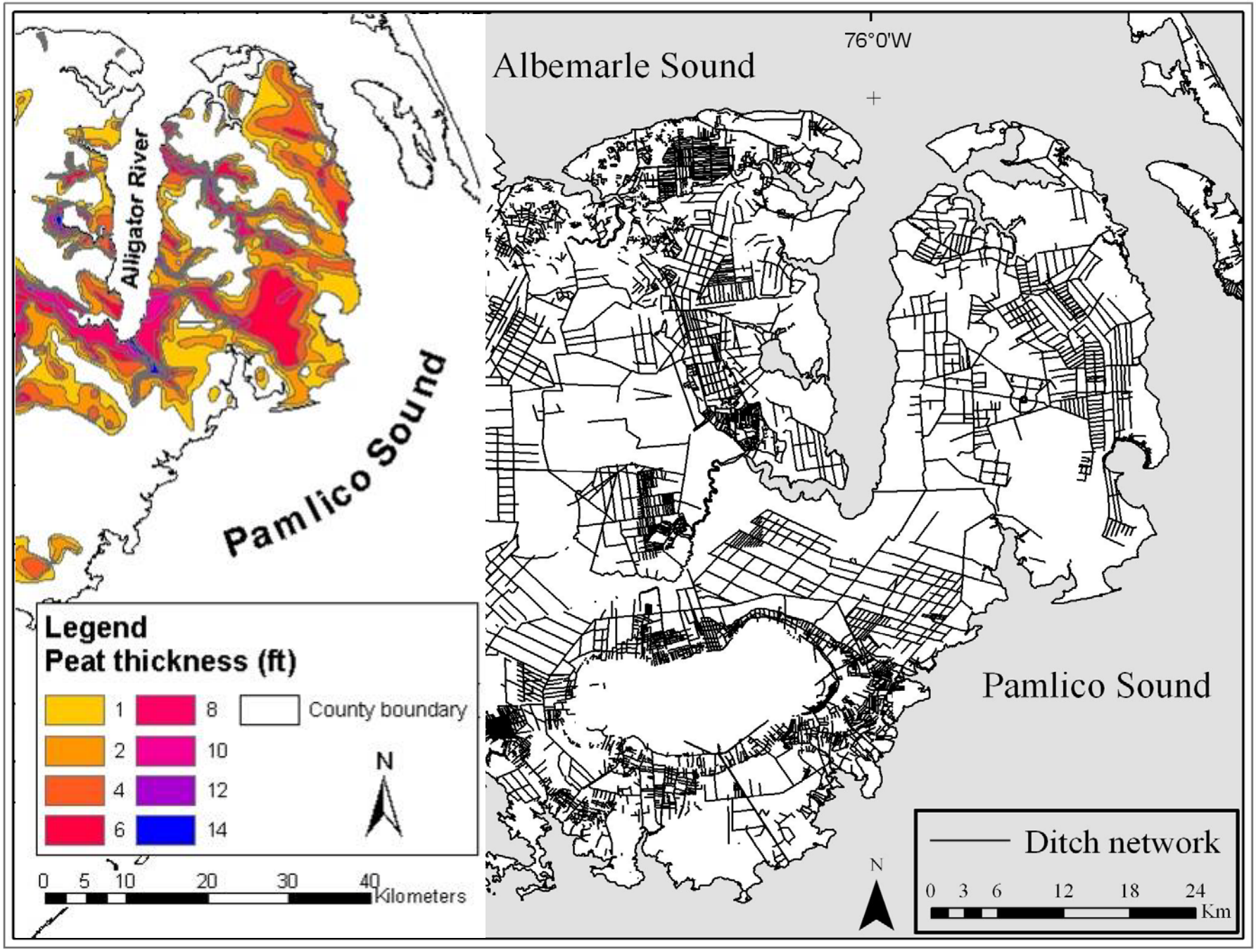
Vulnerability in the Albemarle-Pamlico region



- Extremely flat with low elevation
  - One of the most vulnerable regions to impacts of sea-level rise in terms of area impacted on the US East Coast[1]
- RSLR 3.0-3.3 mm/y[2]
- Susceptible to hurricanes and nor'easters
- Extensive ditching and draining of wetlands

[1]Cahoon et al. 2009
[2]Kemp et al. 2009


Albemarle Sound
76°0'W
Alligator River
Pamlico Sound
Pamlico Sound
Legend
Peat thickness (ft)
1
2
4
6
8
10
12
14
County boundary
N
0 5 10 20 30 40
Kilometers
Ditch network
N
0 3 6 12 18 24
Km





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Effects of altered hydrology on the landscape

Lowest elevations

Saltwater intrusion

- Salt-poisoning of vegetation
- Soil decomposition through sulfate reduction
  - **Locally**: subsidence and increased inundation; release of N and Hg
  - **Globally**: release of CO_2 and CH_4

Higher elevations

Incremental soil loss

- Oxidation

Catastrophic soil loss

- Ignition
  - Evans Road fire in Pocosin Lakes NWR burned over 6 million tons of carbon deposits





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Other climate-related impacts

- Shoreline erosion
- Species invasions
- Inundation







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Why adaptation in the Albemarle-Pamlico region?

- Vulnerability = significant impacts manifest in the near-term
- Large investment in conservation
- Dependence of regional economy on natural systems
  - Direct - tourism; commercial and recreational fishing; hunting
  - Indirect – storm surge protection; water resources; water quality
- Maintenance and/or enhancement of ecosystem resilience = maintenance and/or enhancement of ecosystem services





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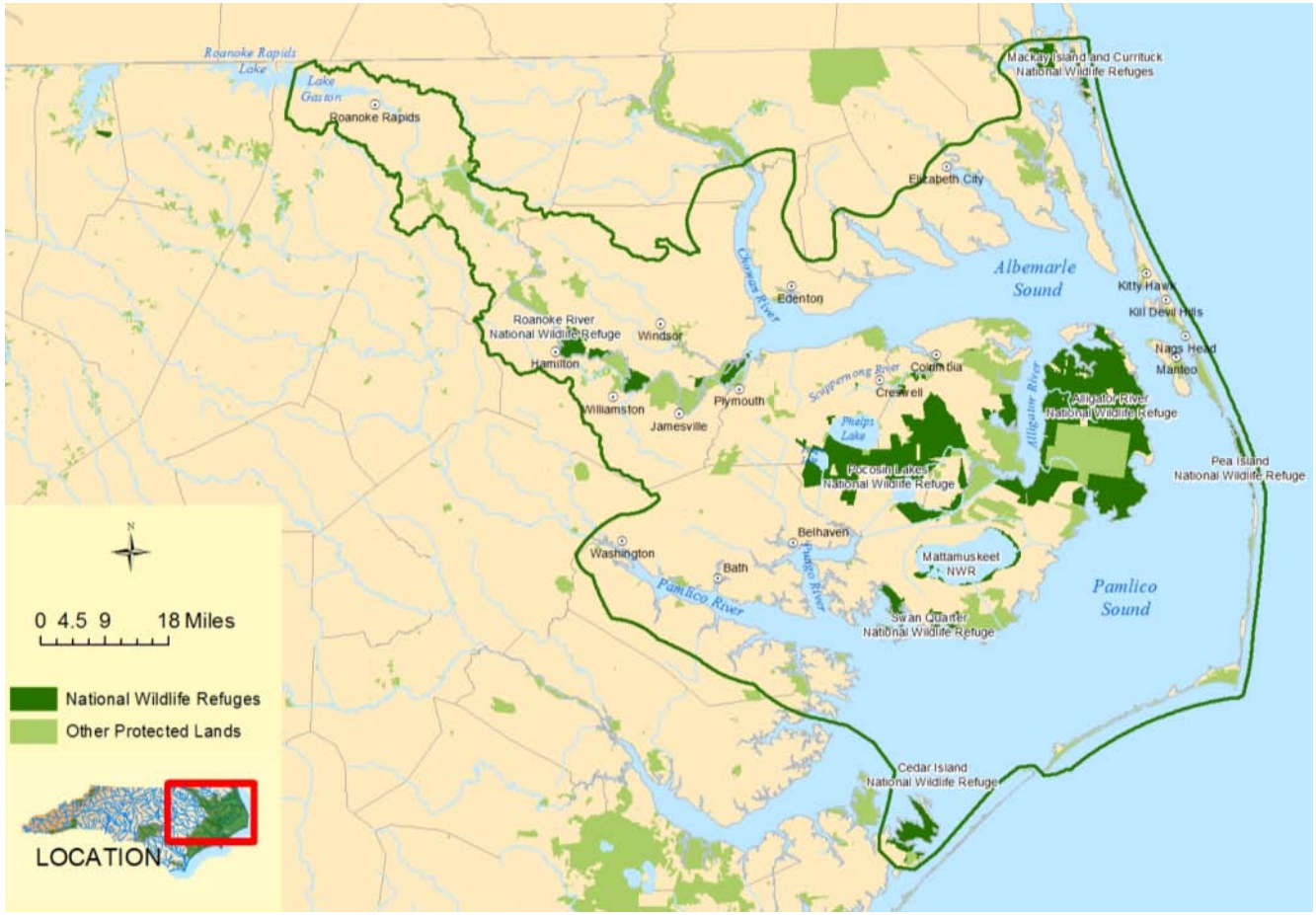
Partnership for resilient coastal ecosystems

- Primary conservation partner: U.S. Fish and Wildlife Service
- Focus on nine refuges in NC Coastal Plain
- Goal: slow transition and ensure maintenance of ecosystem services







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Strategies to address climate change stressors

Wave energy and storm surge attenuation

- Construction of nearshore oyster reefs
- Establishment of submerged aquatic vegetation

Managed habitat transition

- Maintenance and enhancement of marsh buffers
- Planting salt- and flood-tolerant vegetation (e.g. bald cypress)
- Removal of invasive species (e.g. *Phragmites australis*)

Hydrologic restoration

- Installation of water control structures or ditch plugs

Strategic acquisition of priority lands

- Work with key partners to identify climate resilient tracts for connectivity between conservation lands and corridors for wetland migration












Initial on-the-ground focus: Alligator River NWR

Point Peter Road demonstration site

Four components

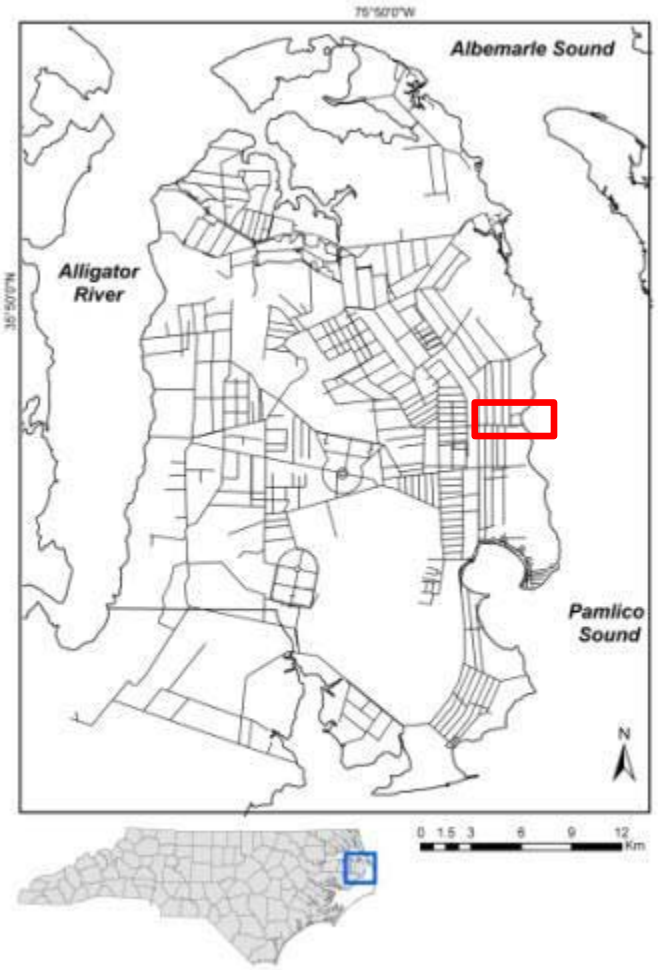
1. Salt-tolerant tree plantings
2. Hydrologic manipulation
3. Invasive species control
4. Nearshore oyster reefs

Significant impacts evident

- Shoreline erosion
  - ~5 m per y[1,2]
- Invasive species
- Saltwater intrusion[3]
- Vegetation transition

Accessibility

- Monitoring
- Education



[1]Wang and Allen 2008; [2]Patel 2009; [3]Poulter et al. 2008

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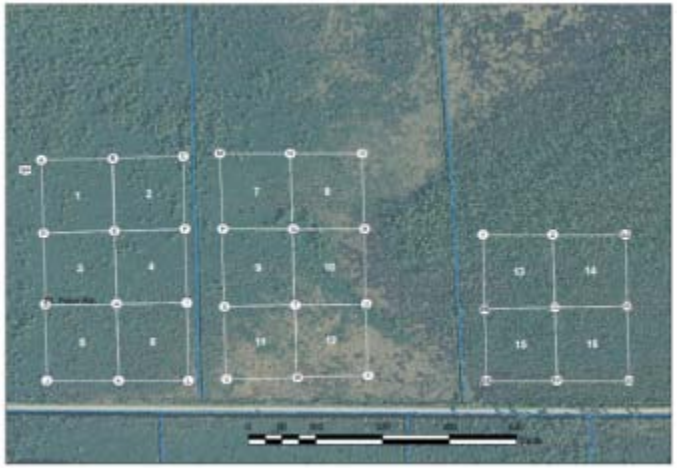
Experimental salt-tolerant tree plantings

- 80 acres total in 40 acres of planting area and 40 acres of control
  - 4 planting treatments
- 11,500 bald cypress; 2,000 black gum; 6,750 pond pine
- Planted March 2010







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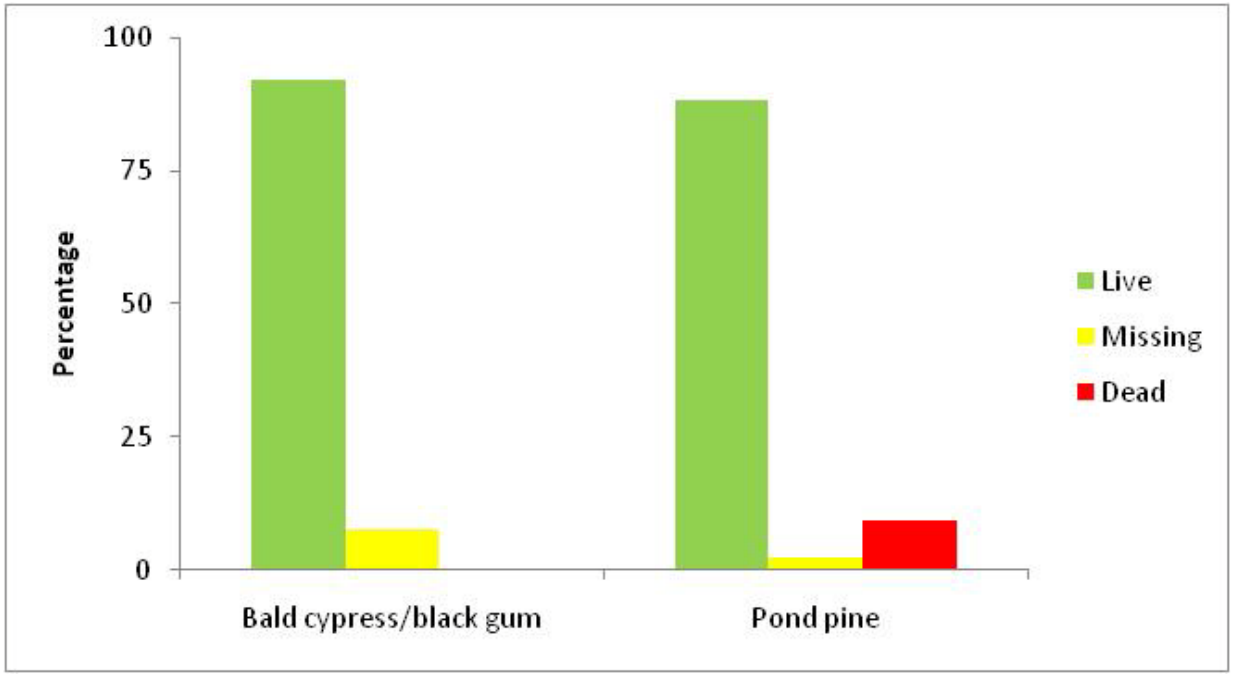
Experimental salt-tolerant tree plantings



Note: Hurricane Irene placed sound water (16 PSU) on the tree plots for 2 weeks





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Hydrologic manipulation

- Water control structure
  - Flashboard risers
  - Tideflex check valves
  - Three culverts placed under the road to encourage wetland connectivity
  - Completed March 2011
- Sheet pile ditch plug
  - Secondary drainage ditch
  - Completed December 2010








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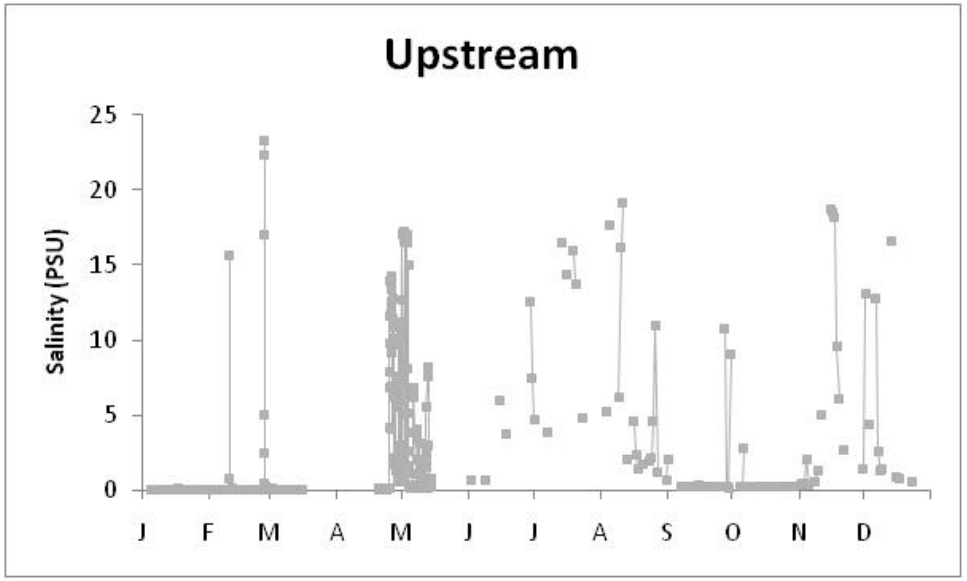
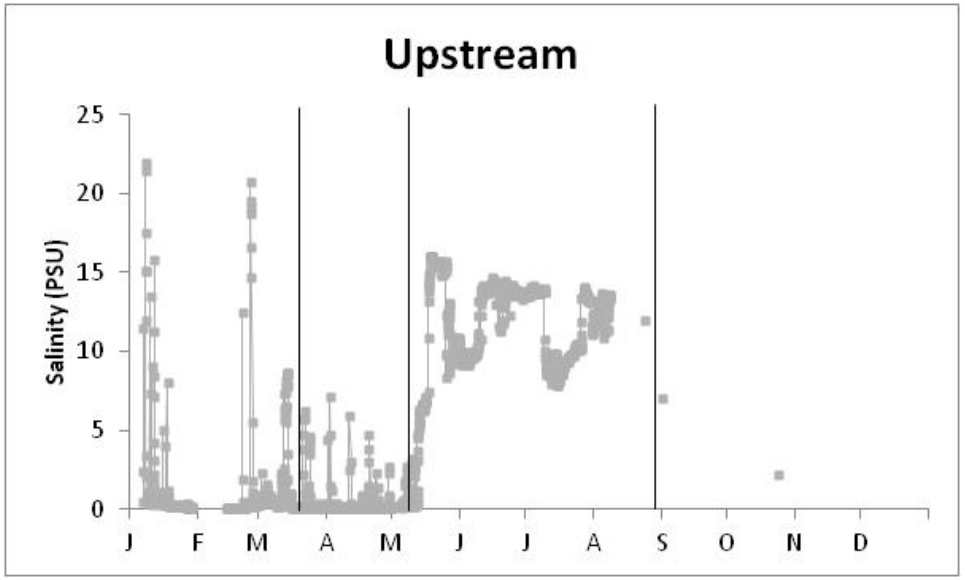
Hydrologic manipulation

2010



2011







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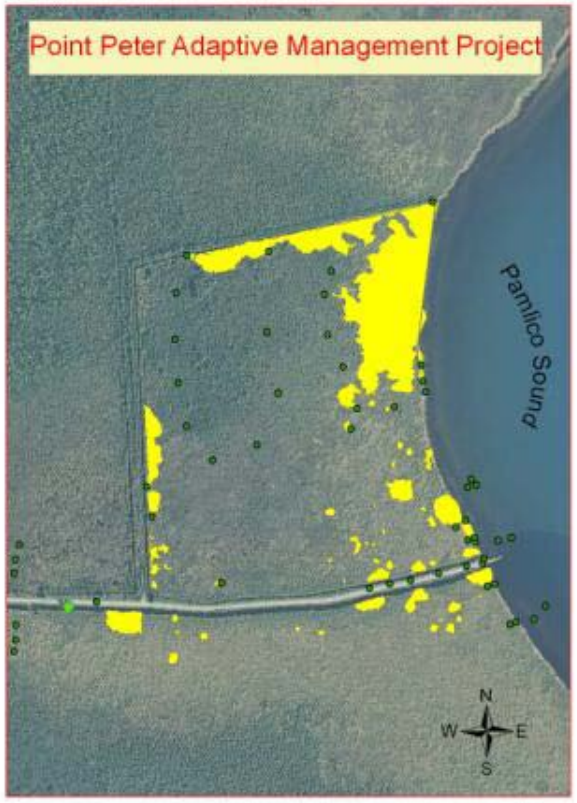
Invasive species control

- 84 acre abandoned waterfowl impoundment
- Eradication of 11.5 acres of *Phragmites australis*
  - Does invasive species control increase vulnerability?
  - Is invasive species control feasible on this landscape?
- Herbicide application completed October 2010
- 60% success rate







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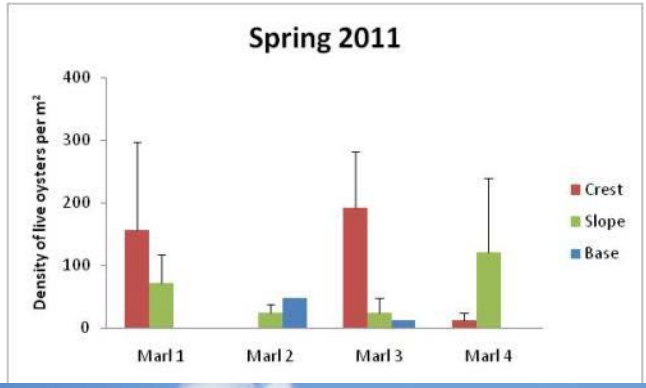
Nearshore oyster reefs

Marl (limestone)

- 400 linear feet
- Reefs installed June 2010

Oyster shell bags

- 400 linear feet
- First 150 feet installed December 2010







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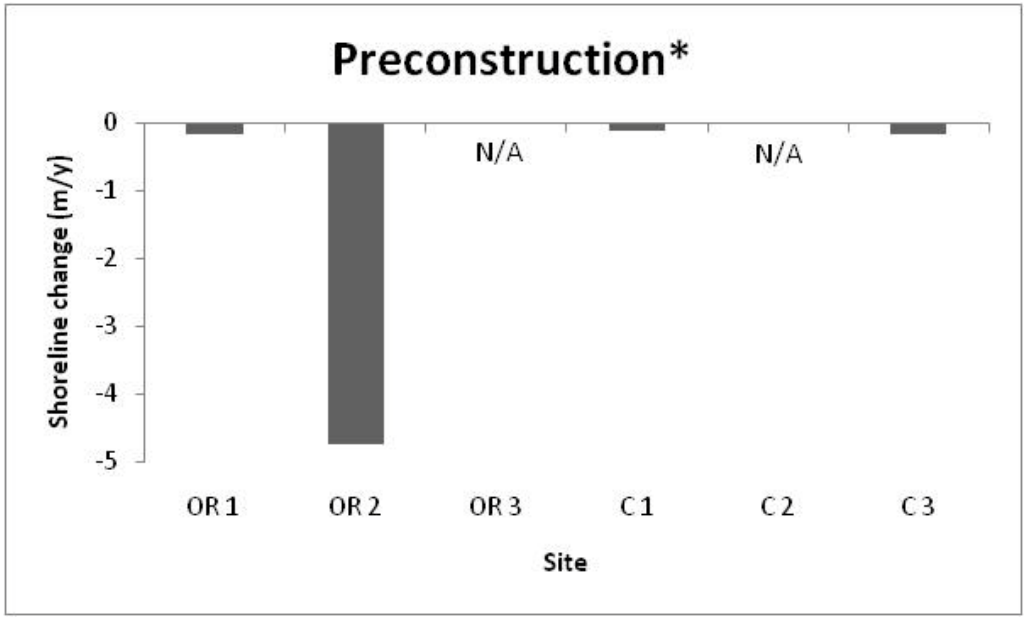
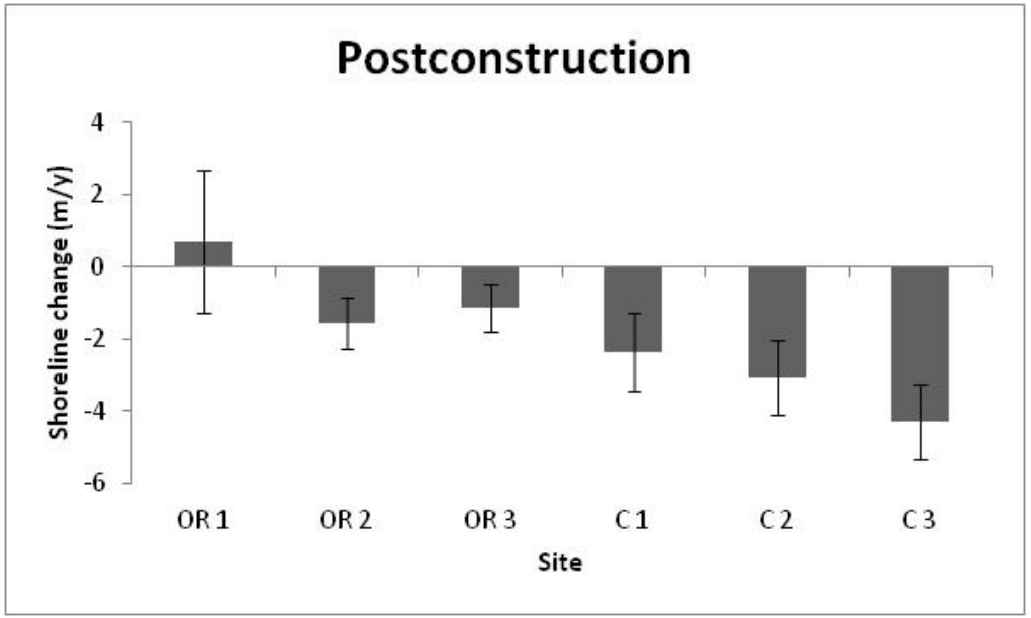
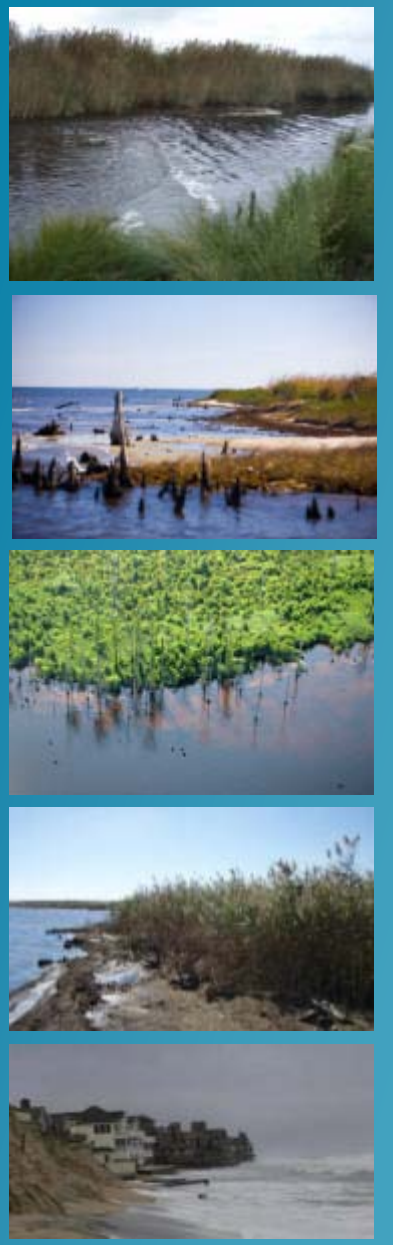
Nearshore oyster reefs

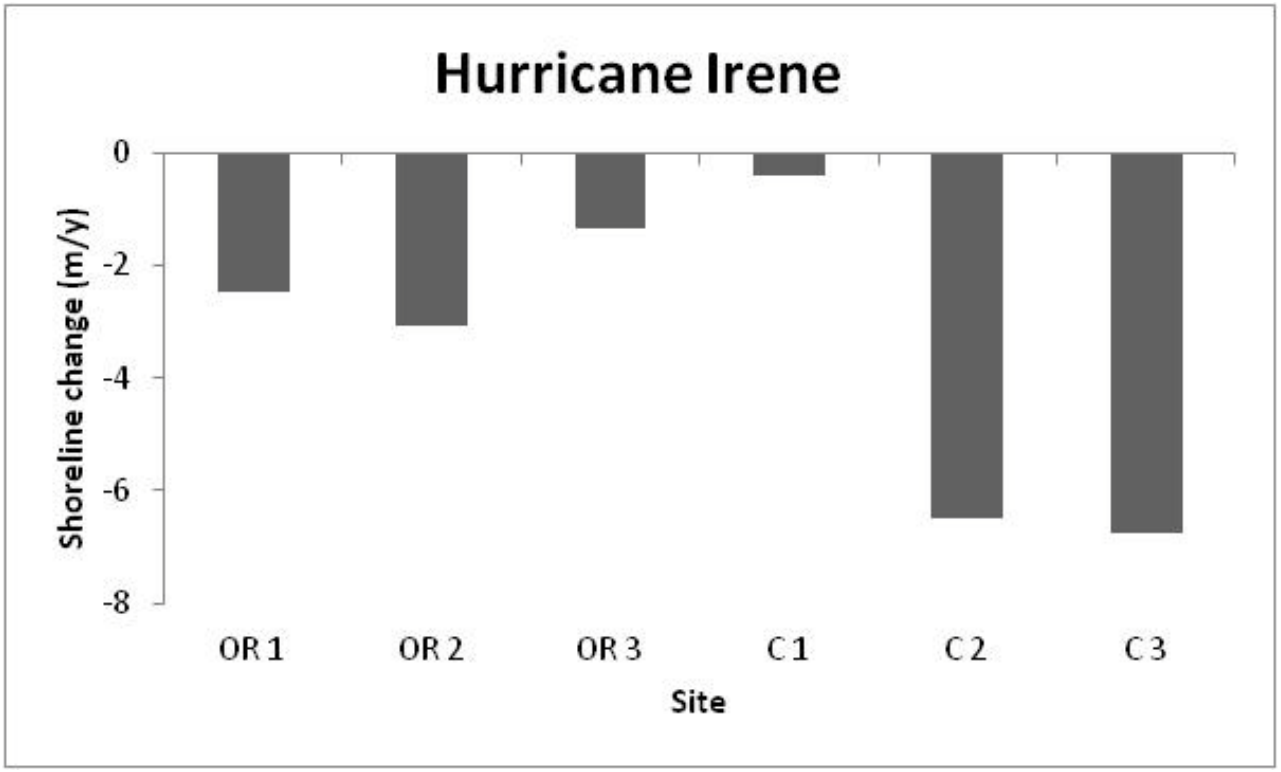


*aerial photographic analysis indicates 5+ m of erosion per y





Hurricane Irene



Note: measurements taken 2 months post-hurricane

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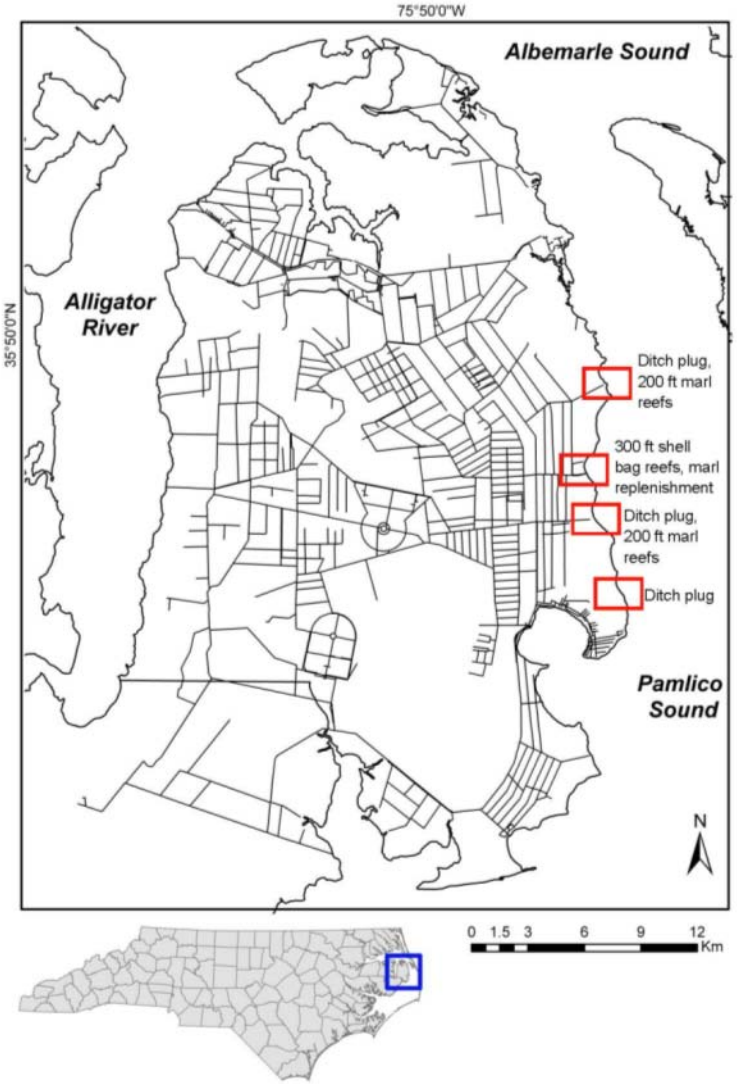
Expansion of coastal adaptation



Alligator River NWR

- Restoration of secondary ditches (ditch plugs)
- Expansion of marl oyster reefs
- Marsh restoration





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Expansion of coastal adaptation

Swanquarter NWR

- ❖ Bell Island fishing pier
- ❖ Replace failing breakwater to address erosion
- ❖ Install 600 linear feet of oyster reef






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Expansion of coastal adaptation

Nags Head Woods
Ecological Preserve

- Oyster reefs
- Submerged aquatic vegetation
- Brackish marsh vegetation
- Maritime salt shrub vegetation
- Grading of high-bank shoreline





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