Land Manager’s Perspectives on Climate Adaptation

Raye Nilius, Project Leader, South Carolina Lowcountry Refuges
US Fish and Wildlife Service, National Wildlife Refuge System
Cape Romain National Wildlife Refuge
66,287 Acres, extending 22 miles
along the South Carolina coast

29,000 acres of Class I Wilderness
Cape Romain NWR Supports Habitat for Rare Wildlife

- Loggerhead Sea Turtle
- Red Knot*
- Red Wolf
- West Indian Manatee
- Piping Plover
- Wood Stork
- Sea Beach Amaranth
- Atlantic Sturgeon

* Red Knot is currently in the listing process
Nesting Sea Turtles

• Loggerhead reproductive maturity is 30+ years.

• Sea turtles come home to lay their eggs. They nest every 2-3 years, on average, laying about 120 eggs, 4-6 times in one season.

• Nesting season is May – October. Eggs incubate for 50-60 days

• Cape Romain’s beaches receive 1,000 to 1,900 nests annually, yielding 120,000-228,000 hatchlings a year. The highest nesting density north of Florida
Nesting Sea Turtles

• Hatchling gender is determined by incubation temperatures during middle third of embryo development
  - Above 85.1°F = more females
  - Below 85.1°F = more males

• Hatchlings emerge at night and are guided by moonlight or light reflected off waves

• Artificial light leads them astray, causing death from exposure or predators
Shorebirds

• Populations of nearly half of the 72 North American shorebird species are declining. Shorebirds are especially vulnerable to changes in stopover and wintering habitats. Beach nesting species are among the most vulnerable.

• Cape Romain provides year-round feeding and loafing habitat, and spring breeding and nesting habitat for 22 species of shorebirds in the Atlantic Flyway.

• Only 25 important stop-over sites in coastal areas support more than 100,000 shorebirds. Cape Romain Refuge is one of those 25 sites.
Shorebirds are epic migrants, flying up to 15,000 miles between wintering areas in South America and Arctic breeding grounds.

A Ruddy Turnstone’s journey from Brazil, where it was banded, to Cape Romain in SC took 4 1/2 days. Cape Romain’s protected habitats allowed the bird to rest, feed, and gain fat, to fuel its long flight to the Arctic nesting grounds.

Undisturbed beaches with food and resting areas are crucial for shorebird survival.

Information provided by Felicia Sanders, Wildlife Biologist, SCDNR
Shorebirds R Us

- Cape Romain is one of only 20 sites of *international* importance for shorebird populations, in both North and South America. The refuge supports at least 15% of eastern populations for 8 species:
  - Red knot (25% of wintering population)
  - American Oystercatcher
  - Willet
  - Dunlin
  - Semi-palmated Plover
  - Short-billed Dowitcher
  - Whimbrel
  - Wilson's Plover
Physical Effects of Climate Change on Refuge Habitats

- Rising sea levels flood salt marsh, creating new tidal creeks that fragment the marsh platform.

- Rising sea levels accelerate beach erosion on barrier islands, destroy loggerhead sea turtle nests, wash over shorebird and seabird nests, and degrade or eliminate nesting habitat.

- Increased storm frequency and severity creates storm surge that washes over and flattens dunes, erodes beaches, and degrades coastal nesting and foraging habitats.

- Long term drought conditions degrade water quality in Bulls Island managed wetlands and impact the quality and quantity of habitat for waterfowl, wading birds, shorebirds, and seabirds.
Climate Change Effects on Refuge Establishing Purposes

• Est. 1932 to support migratory birds, in 1970’s - endangered species and Class I Wilderness

• Habitat – Species

• Changes in climate alter habitat. Altered habitats support different assemblages of species

Climate change is habitat in motion

Photo by Ricky Wrenn
Changing Sea Levels in Charleston Harbor, SC

There's nothing level about sea level

Compare:
Sea Level Rise in 100 Years

Charleston, SC  +12
Cedar Key, FL   +7
San Diego, CA   +8
Grand Isle, LA  +40
Skagway, AK     -70
<table>
<thead>
<tr>
<th>Variable</th>
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<th>Lost on 4 Islands</th>
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<tr>
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**Crystal Ball GIS Tool**

- Cape Island
- Raccoon Key
- Lighthouse Island
- Bulls Island

**CRNWR Barrier Island Acreage Trend**

- Graph showing acreage trend from 1870 to 2010.
Adaptation Strategies

Jacks Pond Wetland Impoundment

Bulls Island 1957

- Perimeter Levee
- Open Field
Levee Setback and Extension as Adaptation for Eroding Shoreline

Jacks Pond Wetland Impoundment

Bulls Island 2014
Erosion Takes Nesting Beaches

Cape Island 1989

Cape Island 2014
Erosion Takes Nesting Beaches

- Erosion reduces areal extent (acreage) of available nesting habitat
- Vertical escarpments prevent sea turtle from accessing the beach
Erosion Takes Nesting Beaches

- Erosion converts suitable nesting habitat to tidal flat or open water, and flattens dunes
- Exposed sea turtle eggs are lost to elements, wave action, predators
1875 – 2007
2,230 Acres Lost
Sandy Point
Here Yesterday, Gone Today

Is there an adaptation strategy that will work here?
Lighthouse Island Winning, Until 2011

459 Acres Gained since 1875
Boston University Study

1. Rapidly advancing tidal creeks - 6.2 ft each year into the marsh platform
2. High local relative sea level rise (3.1mm/yr SLR plus marsh compaction and subsidence)
3. Salt marsh fragmentation

**Summary:** Sea level is rising faster than the salt marsh can accrete

Salt Marsh Fragmentation
Adaptation Strategies
To Promote Sea Turtle Recovery

1. Find nest
2. Remove eggs
3. Relocate nest
Adaptation Strategies to Promote Sea Turtle Recovery

- More than 70% of all nests must be relocated.

- Relocated nests are moved upslope or into hatcheries to protect hatchlings from groundwater intrusion, eroding beach, wave wash, high tide.

- Wire cages are placed over nests to reduce mortality from predators.
Cape Romain’s Beach Babies

Photo by Steve Hillebrand
Success Achieved With Adaptation Strategies

Nest relocation and predator control increases hatch success from 28% up to 82%

Hatch Rate by Island:

- 82% on Cape Island
- 77% on Lighthouse Island
- 57% on Bulls Island

Photo by Steve Hillebrand
Species Adaptation

- Sea birds and shorebirds adapt to the loss of nesting or foraging habitat by simply flying from here to there. If there is enough habitat to support them, they can roll with the changes.

- Sea turtles are loyal to the area where they hatched. The instinctive behavior to nest on natal beaches may interfere with their ability to adapt to habitat losses.
Adapting Infrastructure to Safeguard Wetland Habitats

Legend
- Red: Raise Levee Elevation
- Green: Clear Vegetation from ditch
- Orange: WCS to be Replaced with Rice Trunk
- Blue: Replaced with double flashboard risers
- Purple: Replace with Single Flashboard Riser
- Pink: Clear out around WCS
- Pink: Rice Trunk – No change
Science to Inform Management Decisions

- Sediment Elevation Tables are used to monitor marsh elevation changes.
- Inventory and monitoring is conducted to track bird abundance and nest success on bird nesting islands.
- ARC VIEW GIS software and aerial photography is used to monitor habitat losses and gains on barrier islands, and tidal creek expansion.

Marsh Island
Sea Turtle Genetics Project: Real-time data that will help identify how Loggerhead sea turtles adapt to habitat losses on nesting beaches in GA, SC, and NC. One egg from each nest is analyzed to identify the DNA fingerprint of the nesting female.

- Census of nesting population
- Number of females nesting in SC, GA, and NC
- Number of clutches of eggs laid by each female in a year
- Number of beaches the female is nesting on
- Number of times each turtle nests
- How precisely a daughter returns to her home beach to lay her eggs
Strategies to Safeguard Habitat for the Future

- Goal: Construct a wildlife migration corridor to connect the sea islands to the mainland as habitat losses accelerated

- Partnership with USGS Climate Science Center to determine best options for boundary expansion

- Partnership with Francis Marion National Forest and Congaree National Park to request Land and Water Conservation Funding
Questions?

Cape Romain National Wildlife Refuge

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