

Cape Romain National Wildlife Refuge

Climate Change Impacts



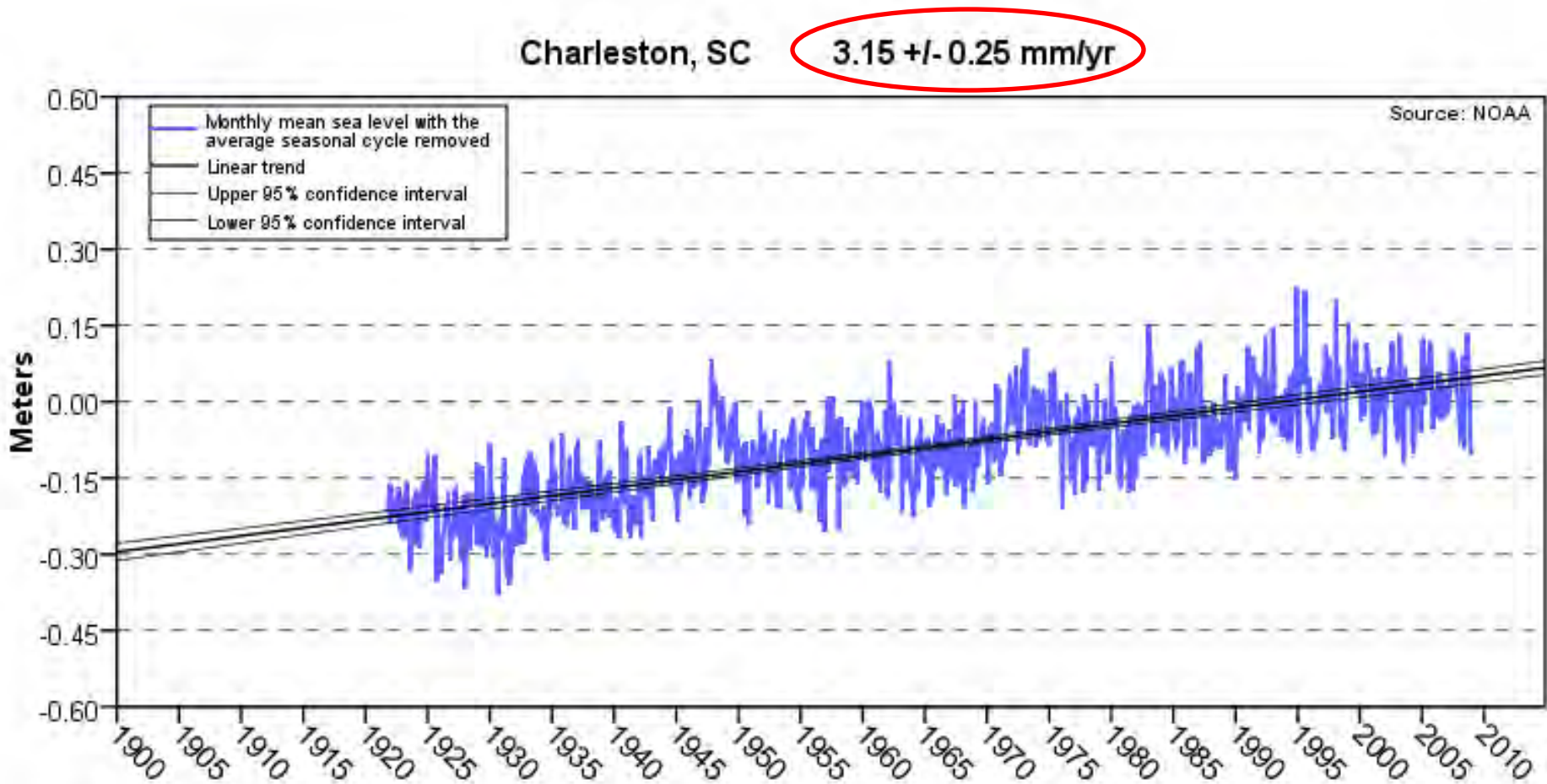
How will the Refuge be Affected by Climate Change?

- Salt marsh fragmentation by rapidly eroding tidal creeks
- Salt marsh submergence during high tide events leading to habitat conversion from marsh to tidal flat to open water
- Barrier island shoreline erosion due to wind, waves, ocean currents, sea level rise, and sediment starvation
- Refuge infrastructure losses due to sea level rise and erosion
- Loggerhead sea turtle nesting beaches, sea bird and shorebird nesting islands undergoing rapid conversion
- Shift in species Composition = Fewer waterfowl (ducks) more wading birds (roseate spoonbill, woodstork)

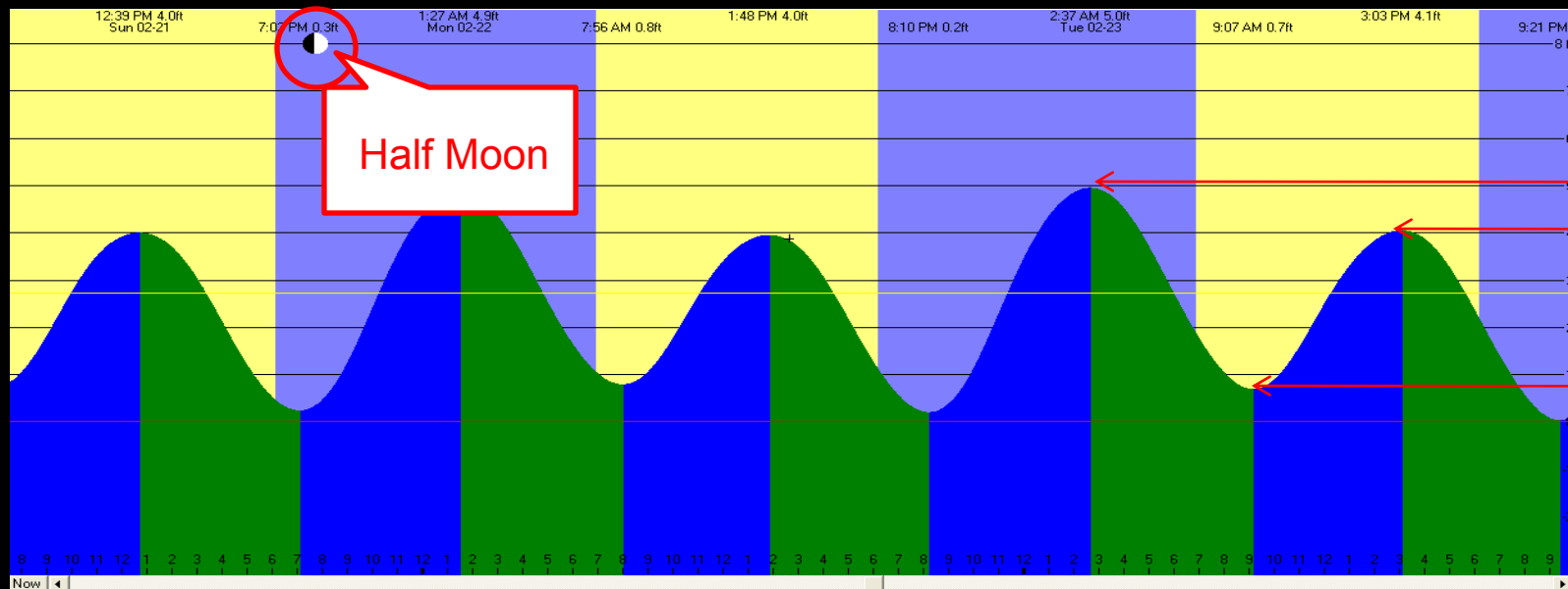
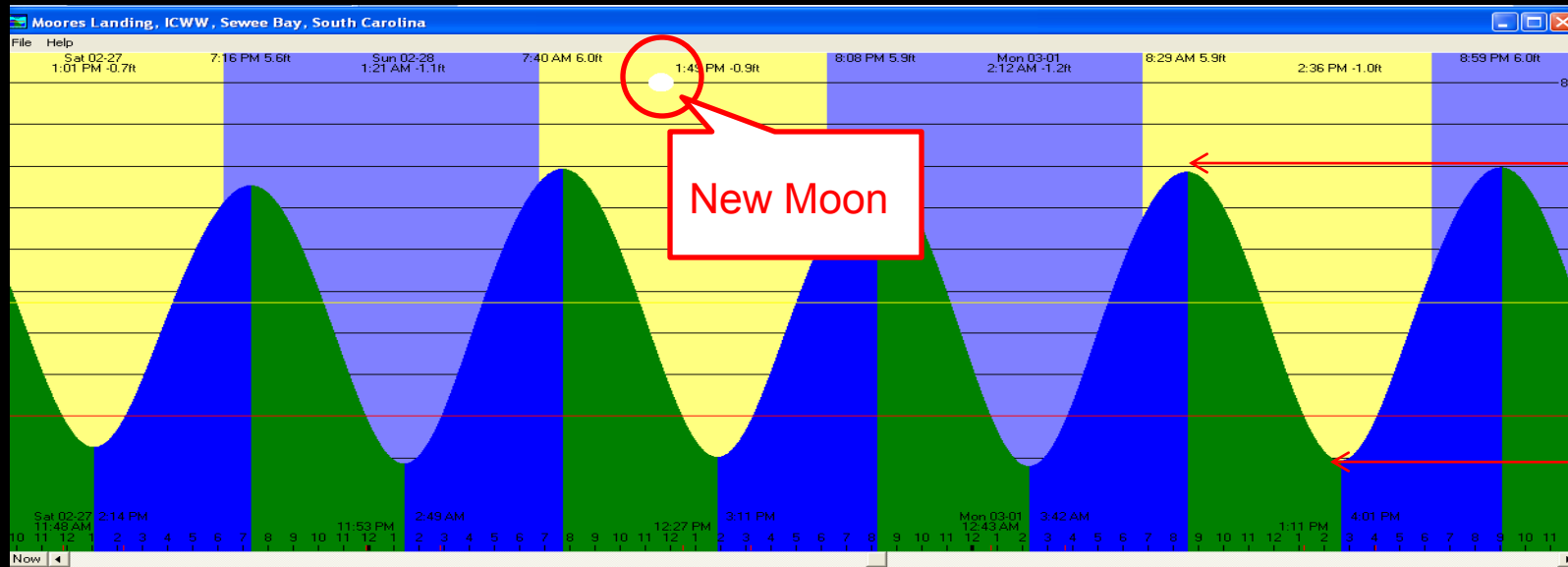


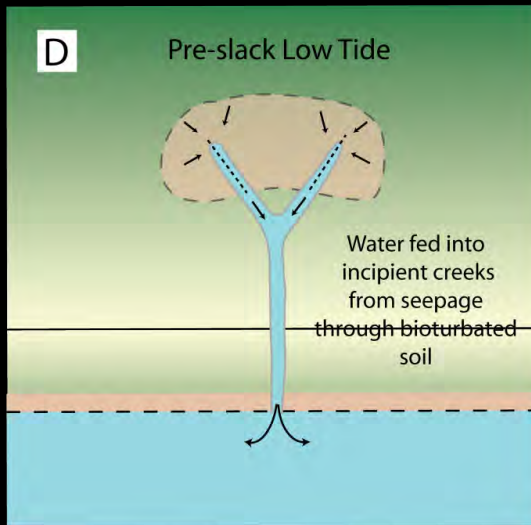
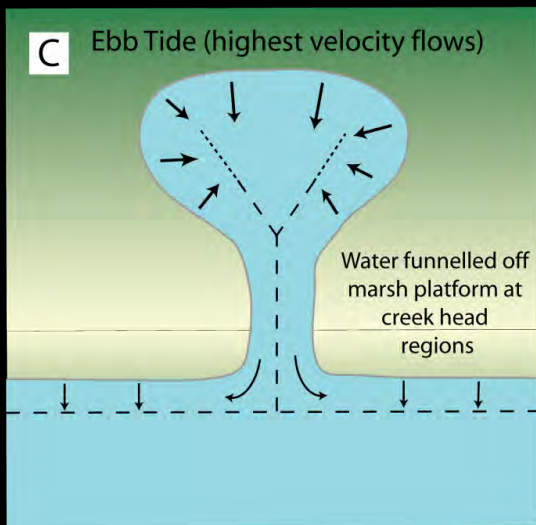
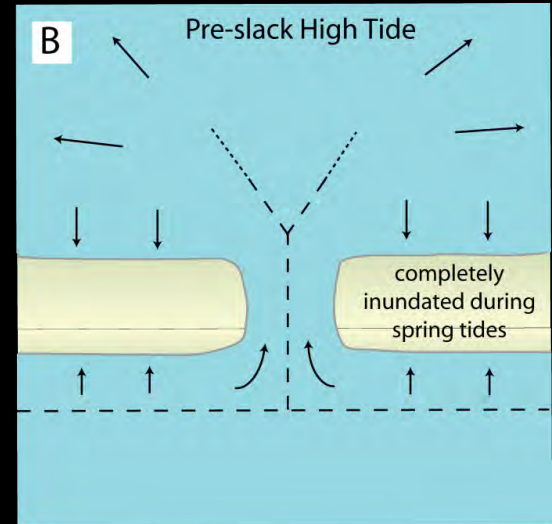
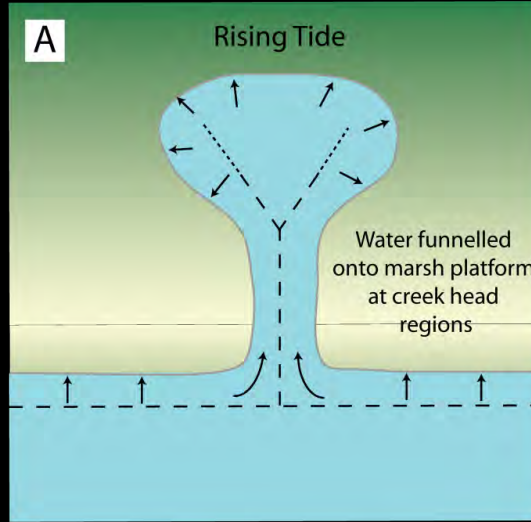
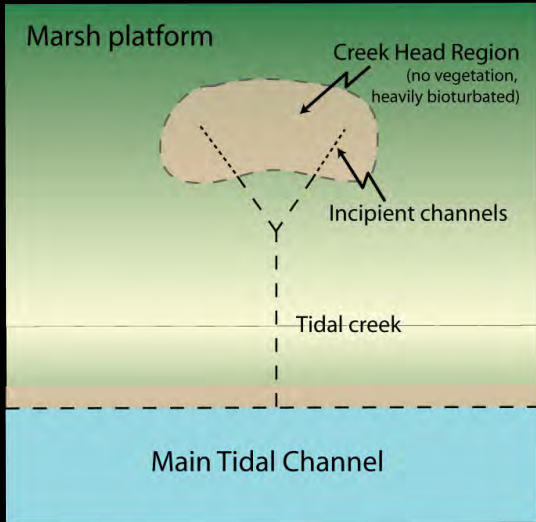
Sea Level Rise Charleston Harbor Since 1923

In the past 100 years - sea levels have risen 3.15 mm/year = 1 foot 4 inches
In the past 20 years - 4.6mm/year = 3.6 inches in 20 years, 1 ½ feet in 100 years)

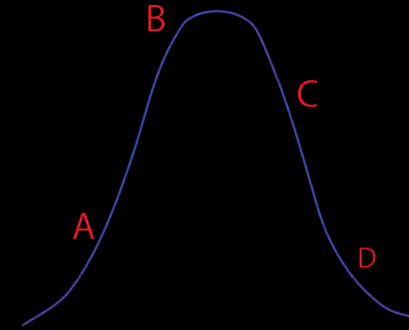


Nothing Level about Sea Level!





Flood Patterns



Can the Salt Marsh Keep Up?

Key factors of the future tidal marsh acres

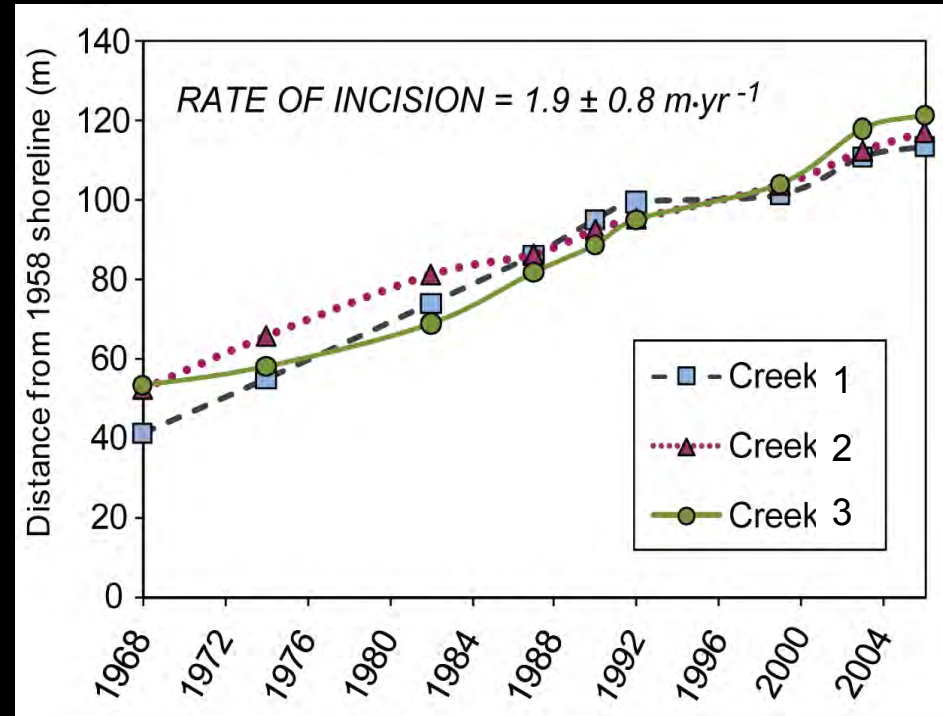
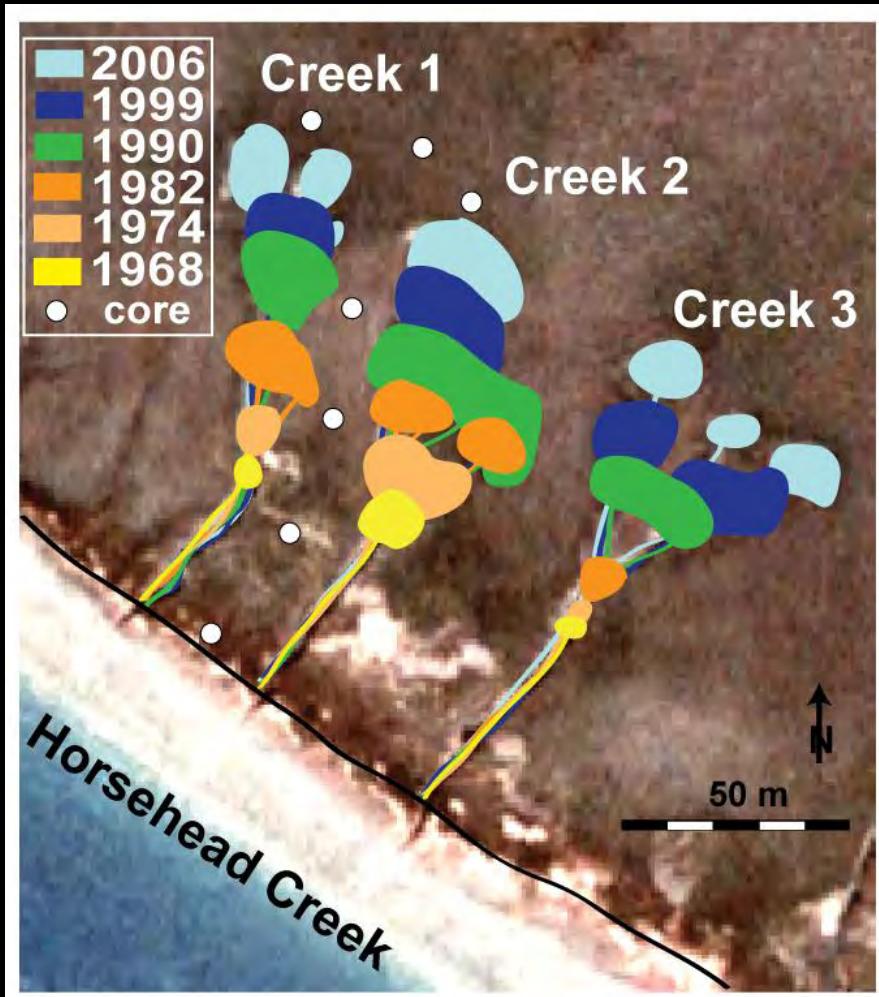
- The Capacity of the Marsh to raise and keep up with rate of Sea Level Rise.
- Rate of Erosion of the Seaward boundary of the marsh
- The availability of space for the marsh to migrate inland.
- Amount of head ward erosion in marsh creeks. *Currently 6.2 feet/year*



Hughes et al (2009), Rapid headward erosion of marsh creeks in response to relative sea level rise, *Geophys. Res. Lett.*, 36, L03602, doi:10.1029/2008GL036000.



RAPID DEVELOPMENT SINCE 1940's

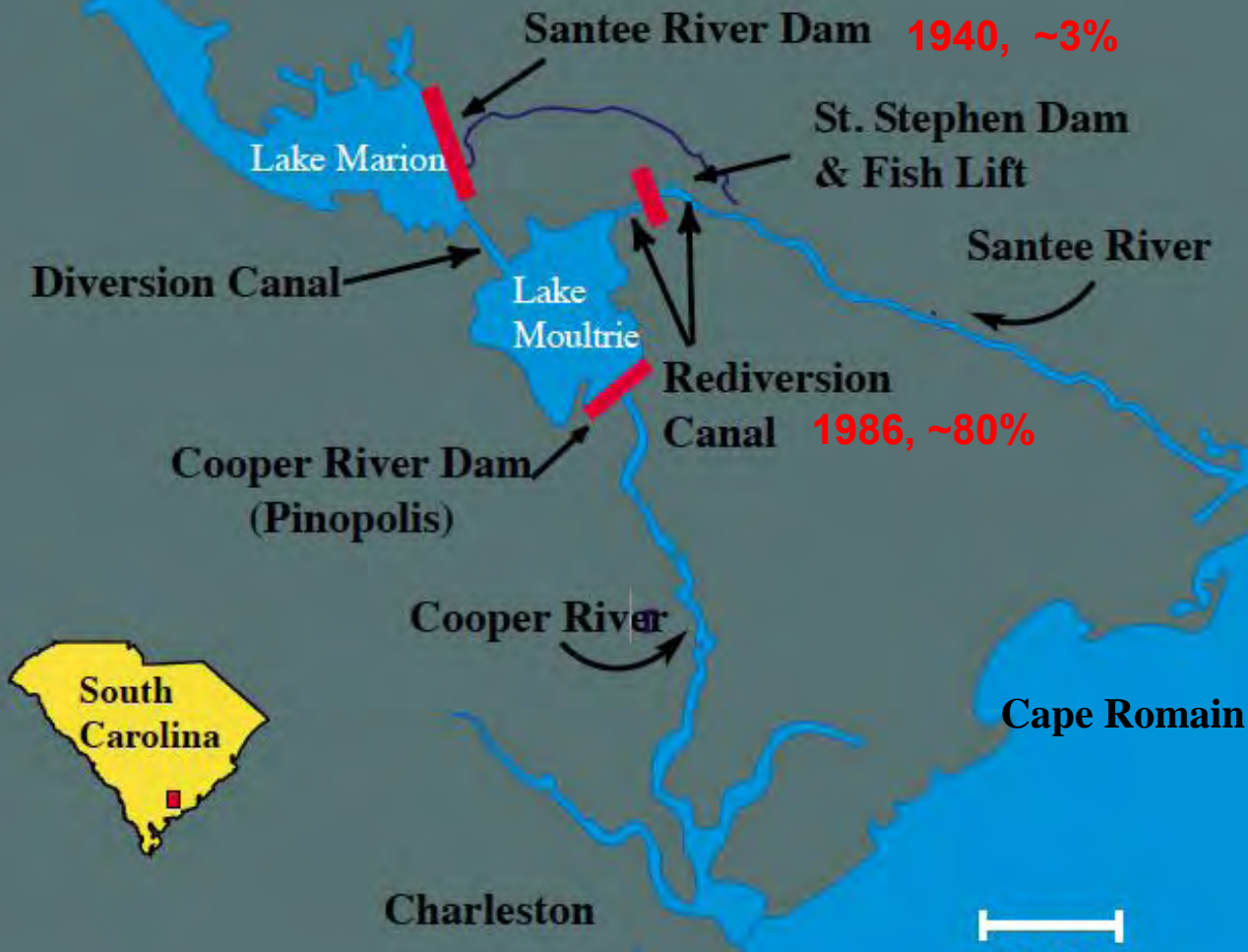


1968 – 2006

RATE OF INCISION = $1.9 \pm 0.8 \text{ m/yr}$

Santee River Delta, South Carolina

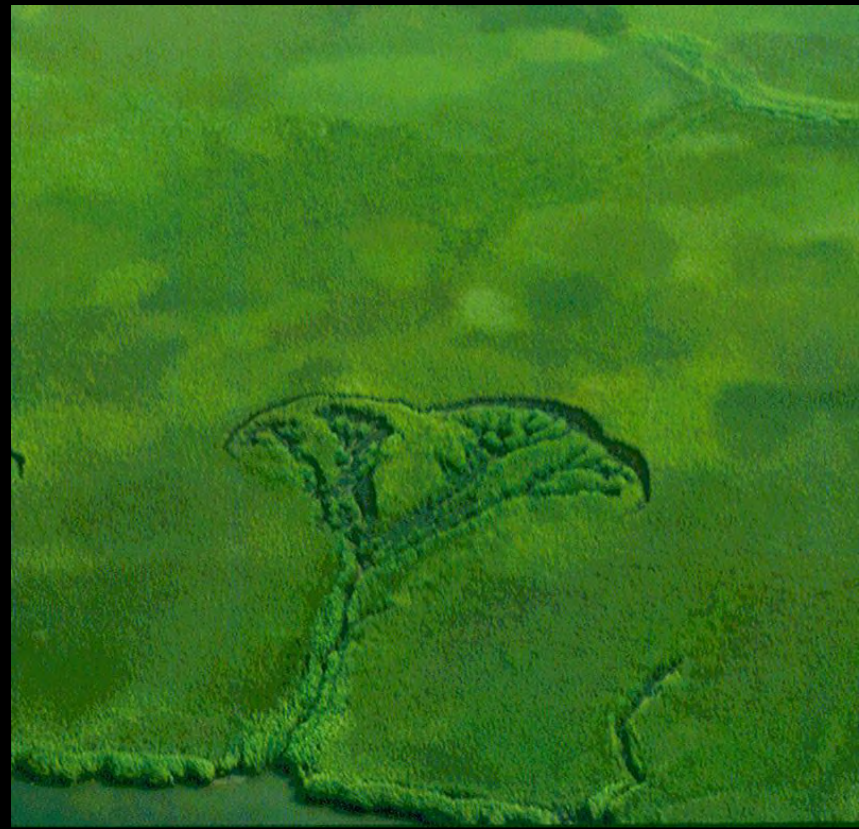
- Area = ~36,000 km²
- ~700 km long



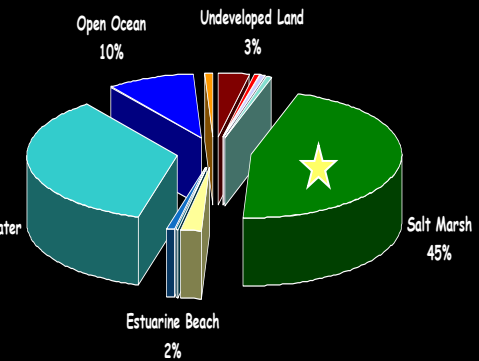
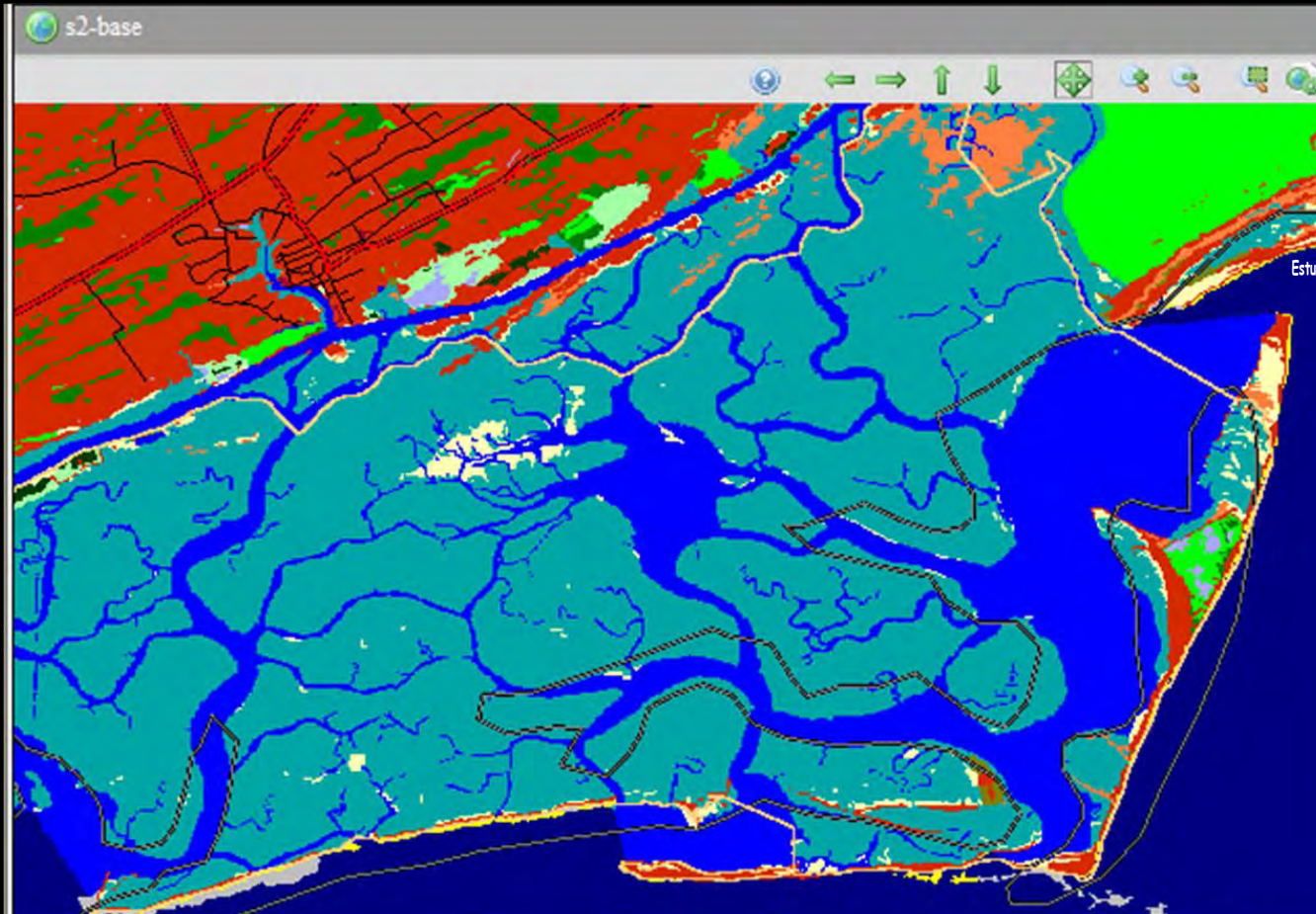
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Summary

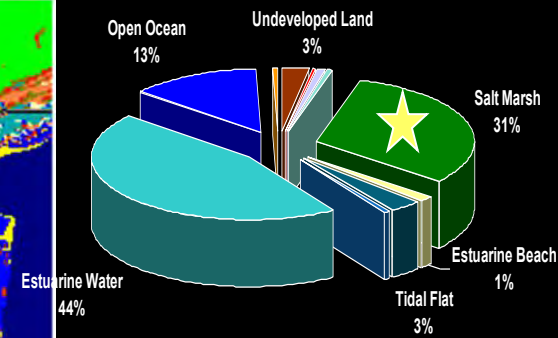
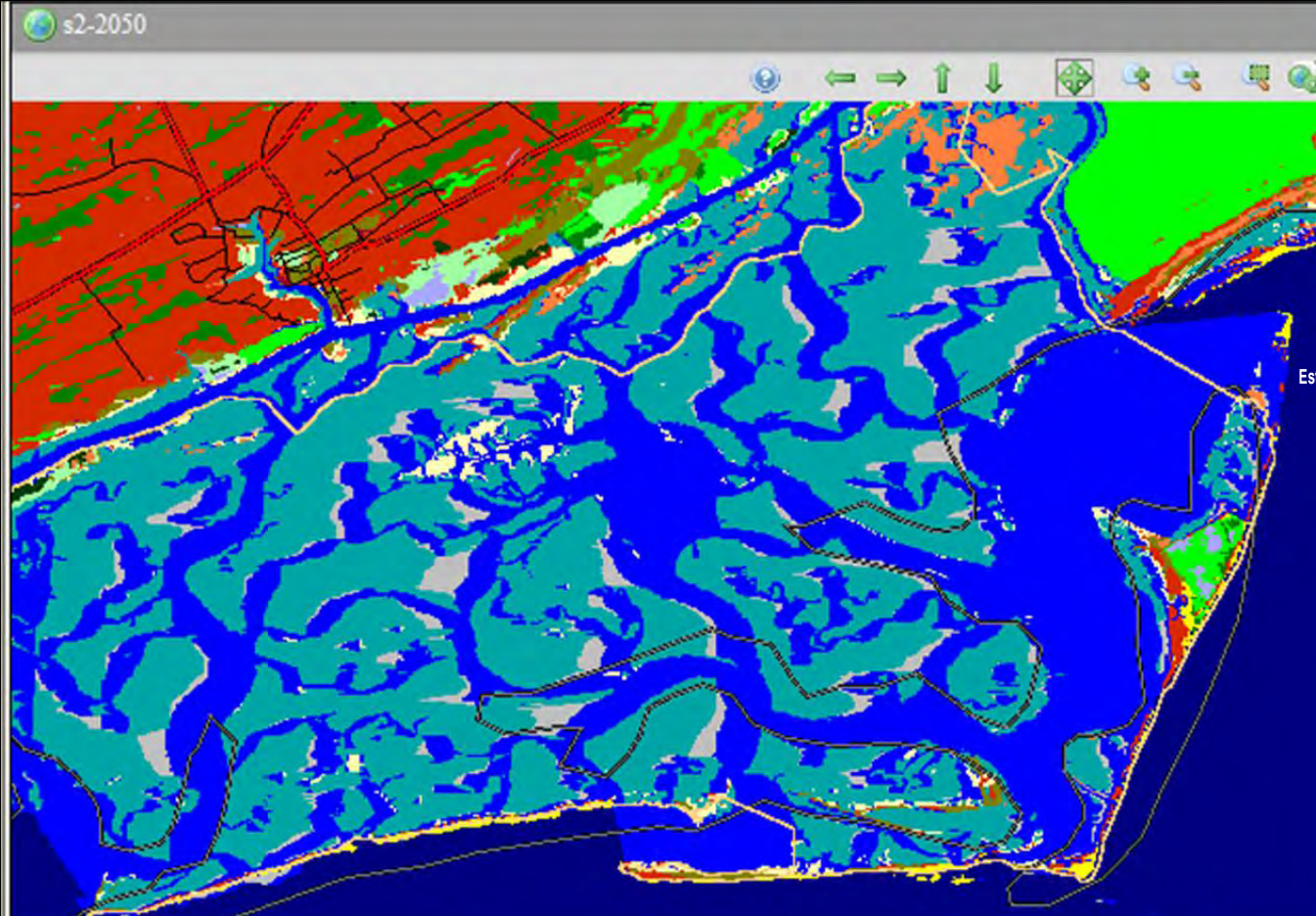
- Straight, evenly spaced channels forming rapidly
- Area of high regional SLR and very local SLR due to damming (increased hydro period).
- Accumulation limited by dams
- Channel network expansion relates to increased tidal prism
- Ability to erode the marsh facilitated by vegetation removal and bioturbation (crabs).
- In areas where sediment has sufficiently low strength and high RSLR may respond the same way?



Cape Romain NWR 29,820 Acres (45%) Salt Marsh



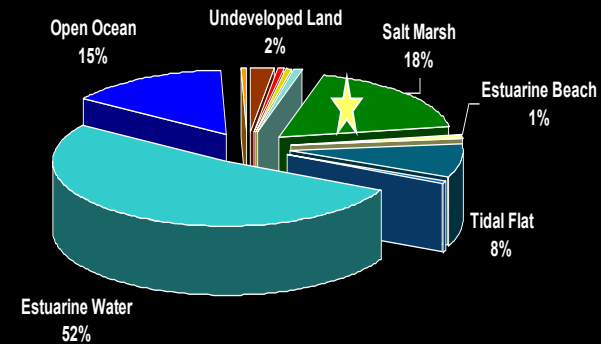
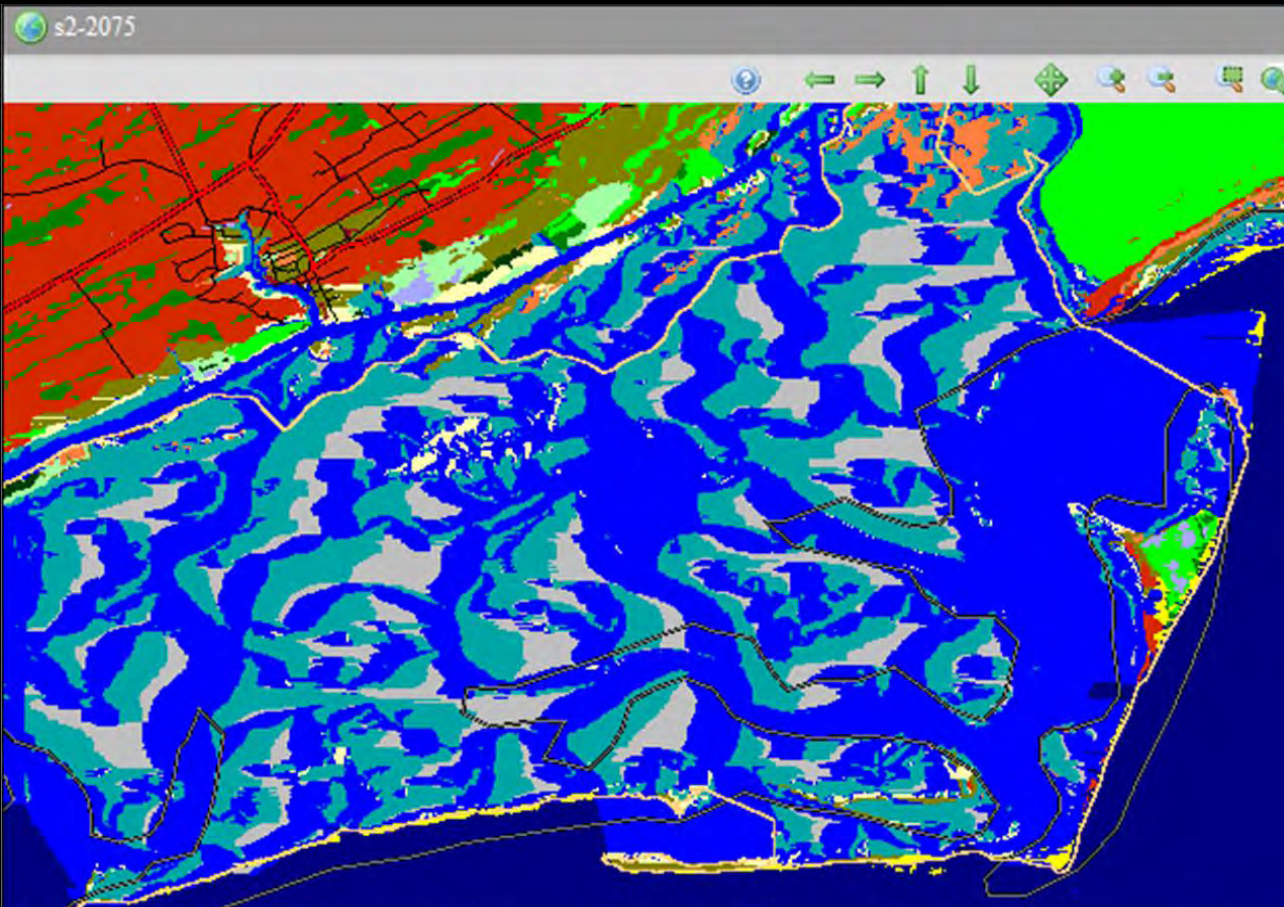
2050 Cape Romain NWR 20,542 Acres (31%) Salt Marsh



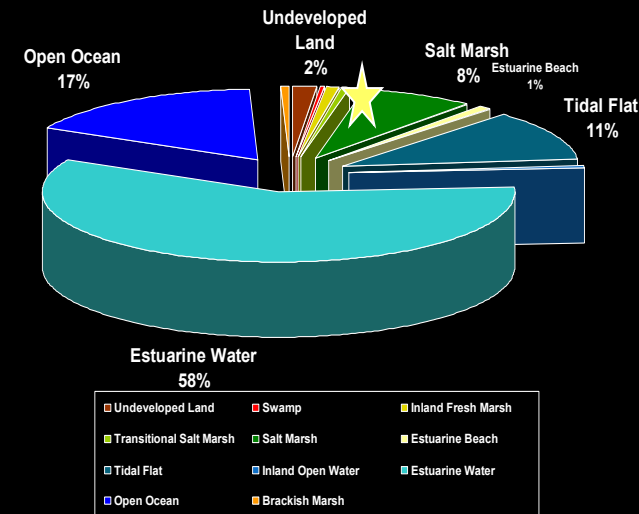
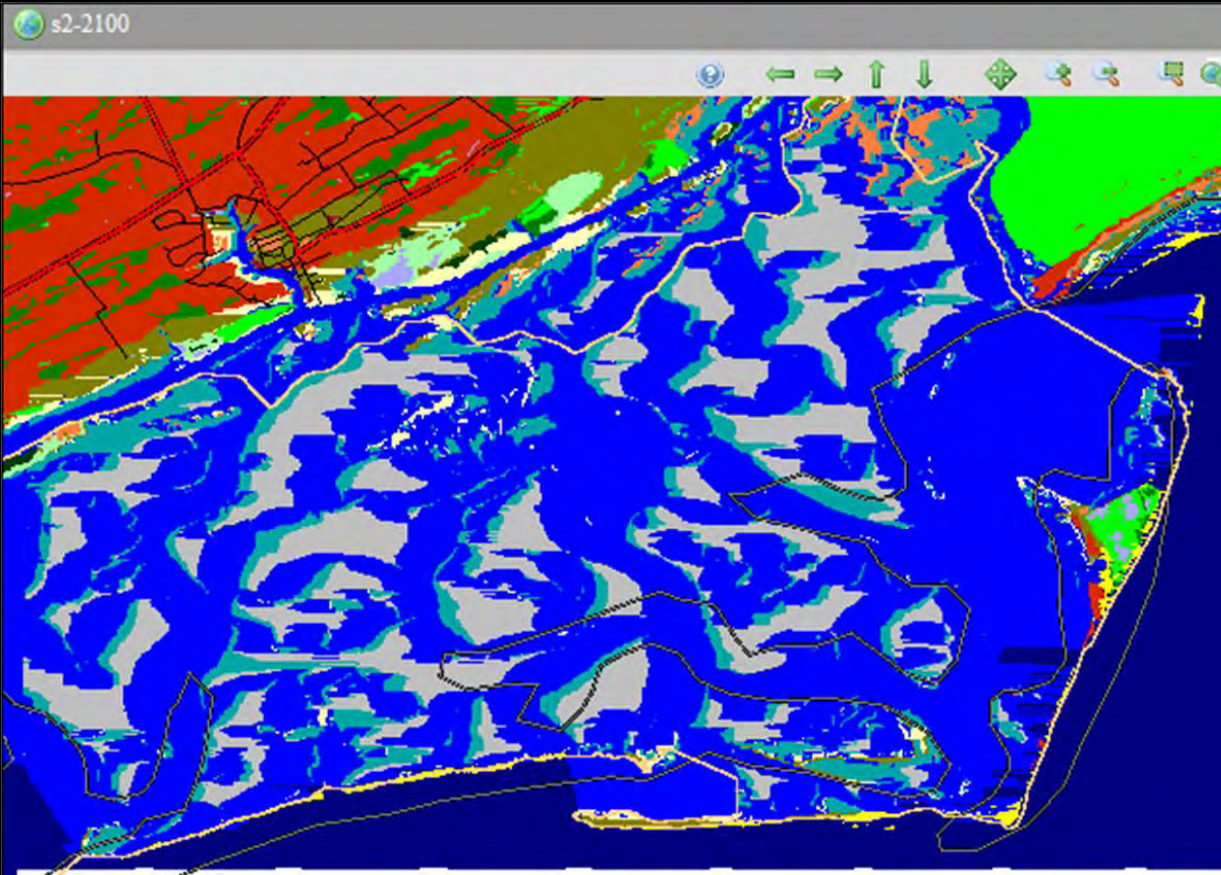
- Undeveloped Land
- Inland Fresh Marsh
- Salt Marsh
- Tidal Flat
- Estuarine Water
- Brackish Marsh
- Swamp
- Transitional Salt Marsh
- Estuarine Beach
- Inland Open Water
- Open Ocean



2075 Cape Romain NWR 11,928 Acres (18%) Salt Marsh

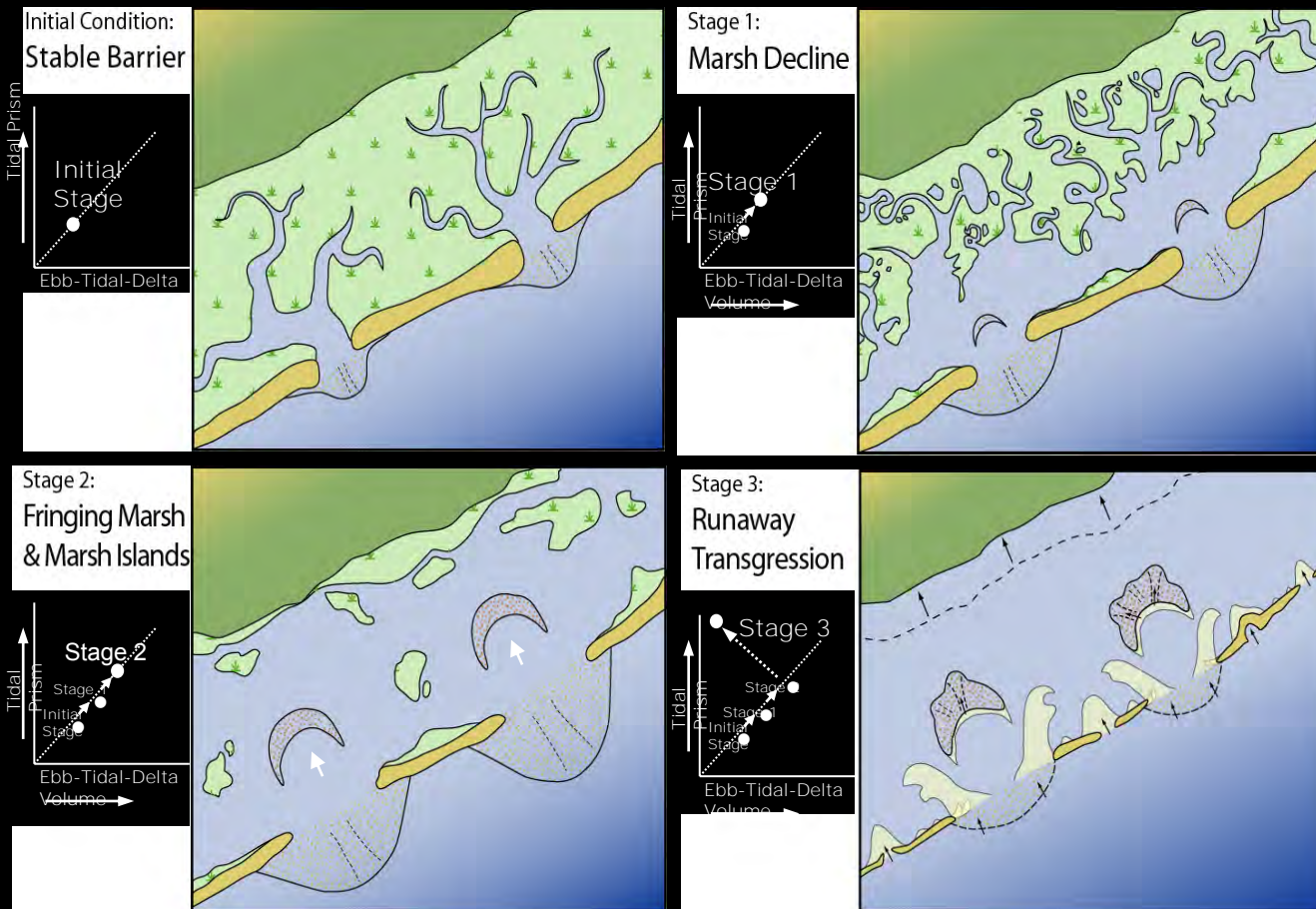


5,301 Salt Marsh Acres by 2100. A loss of 24,519 Acres



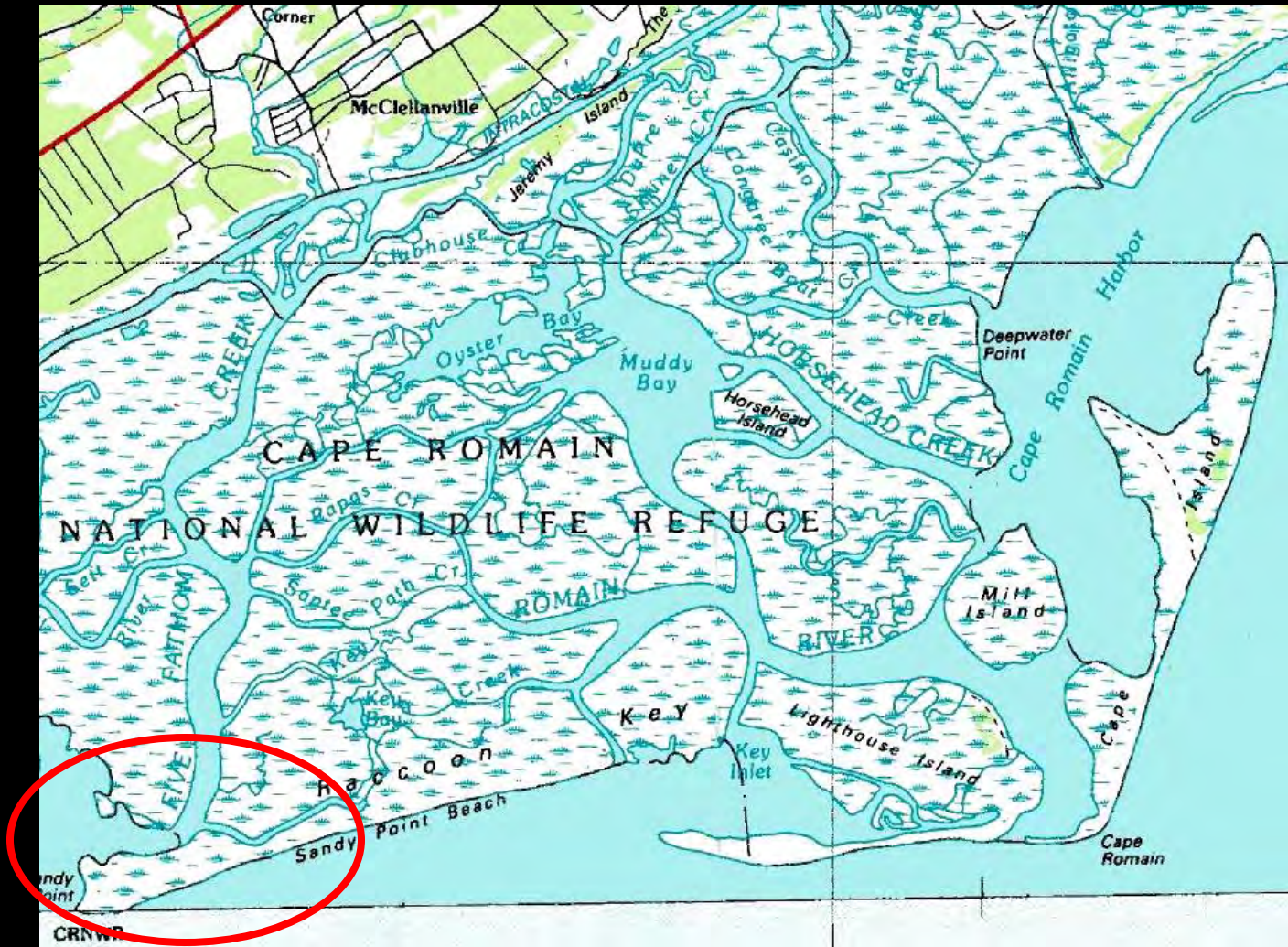
* Based on 2.26 Feet SLR over next 100 years

Model of Barrier and Tidal Evolution in a Regime of Accelerated Sea-Level Rise

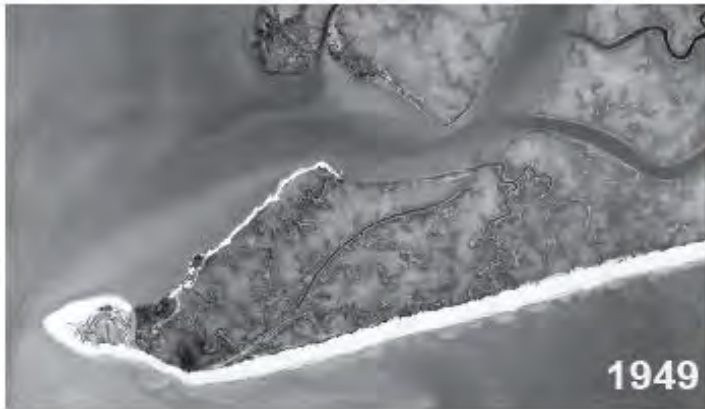


Severe Coastal Erosion on Raccoon Key's Sandy Point

Reference 1983 Topographic Map



SANDY POINT, CAPE ROMAIN, SC



1km

All That Remains of Sandy Point February, 2009



Prediction - Gone by Christmas, 2009

Impacts on Seabird Nesting Habitat on Sandy Point

Least Tern Nesting

1990	144	
2008	26	92% Decline
2009	0	100% Decline

Black Skimmers

1993	228	
2008	0	100% Decline



Bulls Island Historic Shorelines



Compared to today's shoreline:

1852: 2,950 ft

1920: 1,885 ft

1962: 870 ft

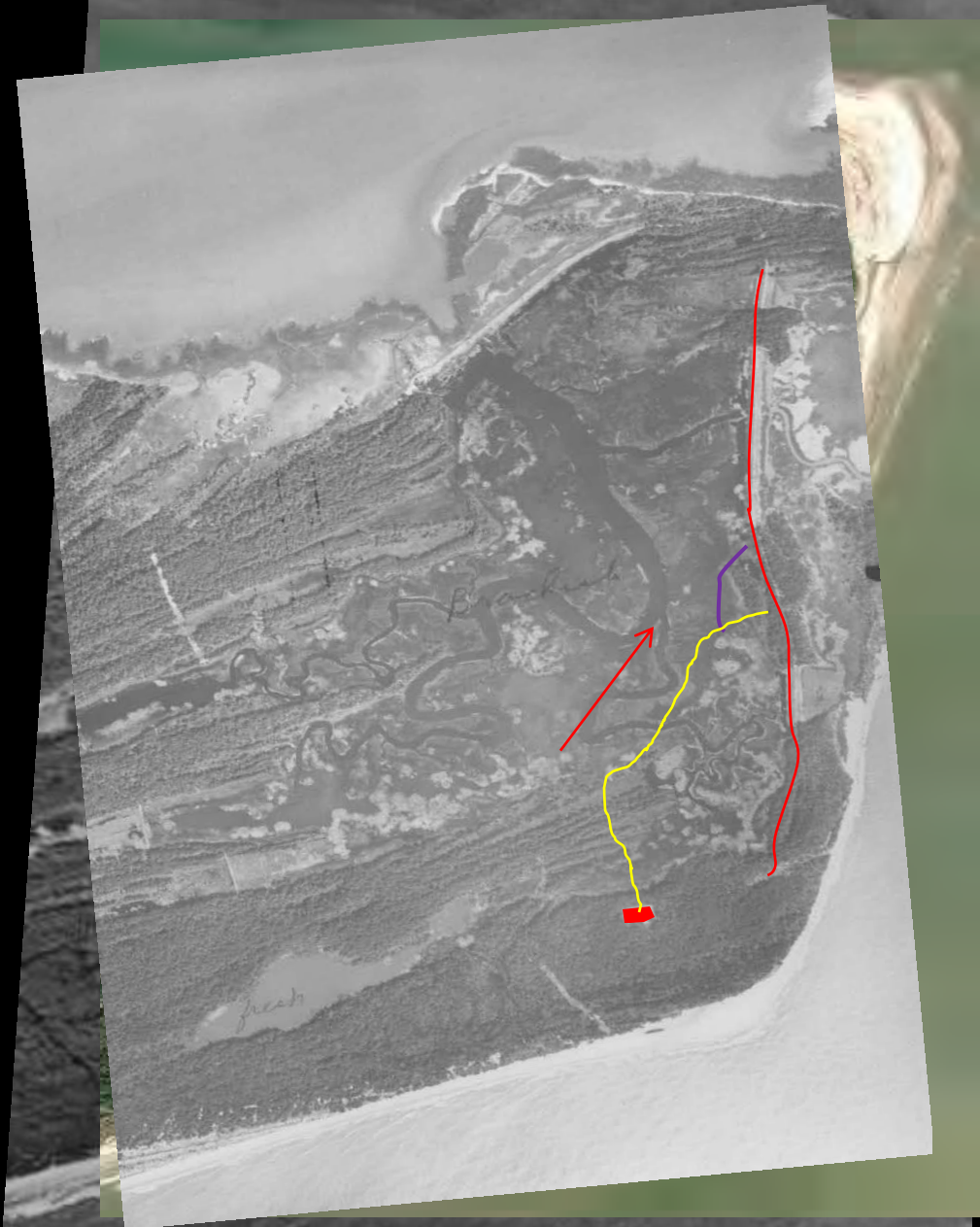
2000: 225 ft

Average rate of erosion:

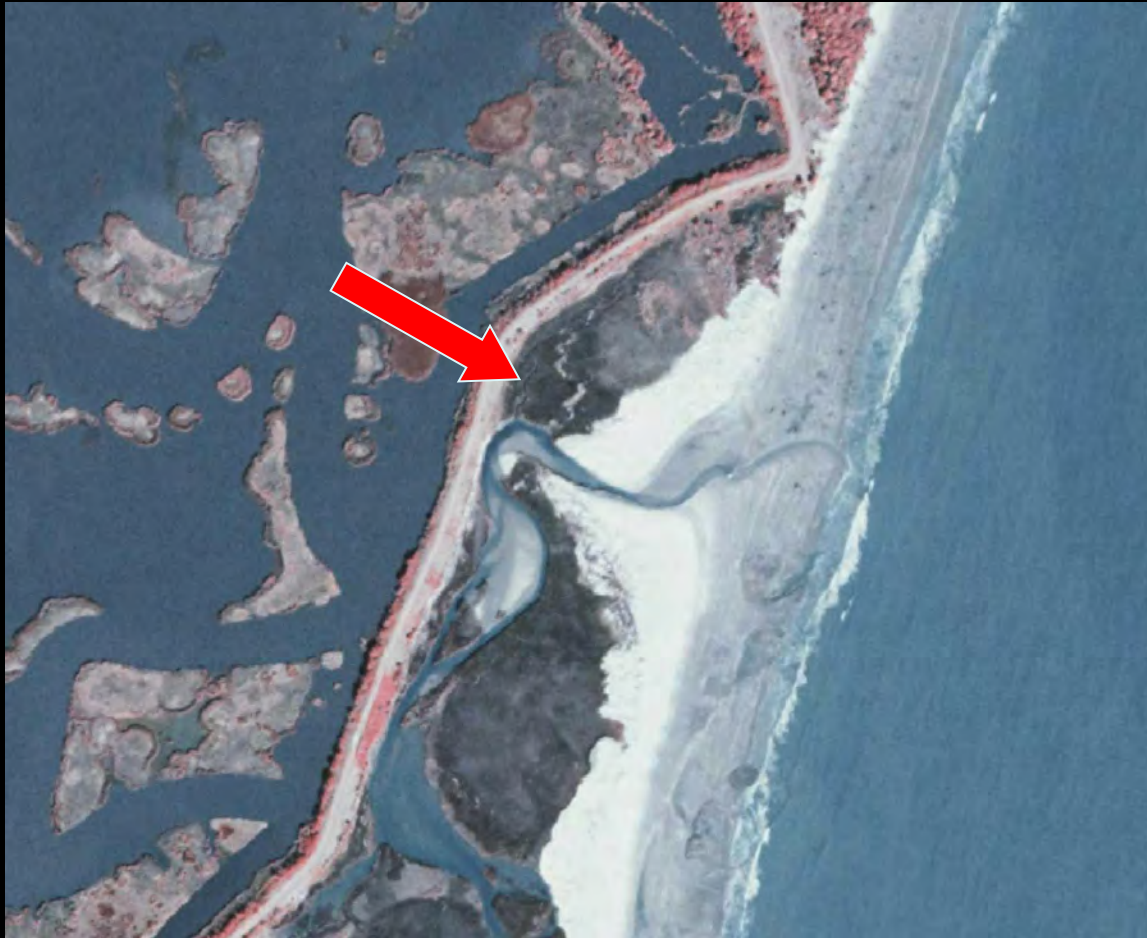
20 to 25 ft/yr

Jack's Creek

- Position of Levee in 1949
- Current Levee constructed 1988
- Redirected levee 2006



Future Breach



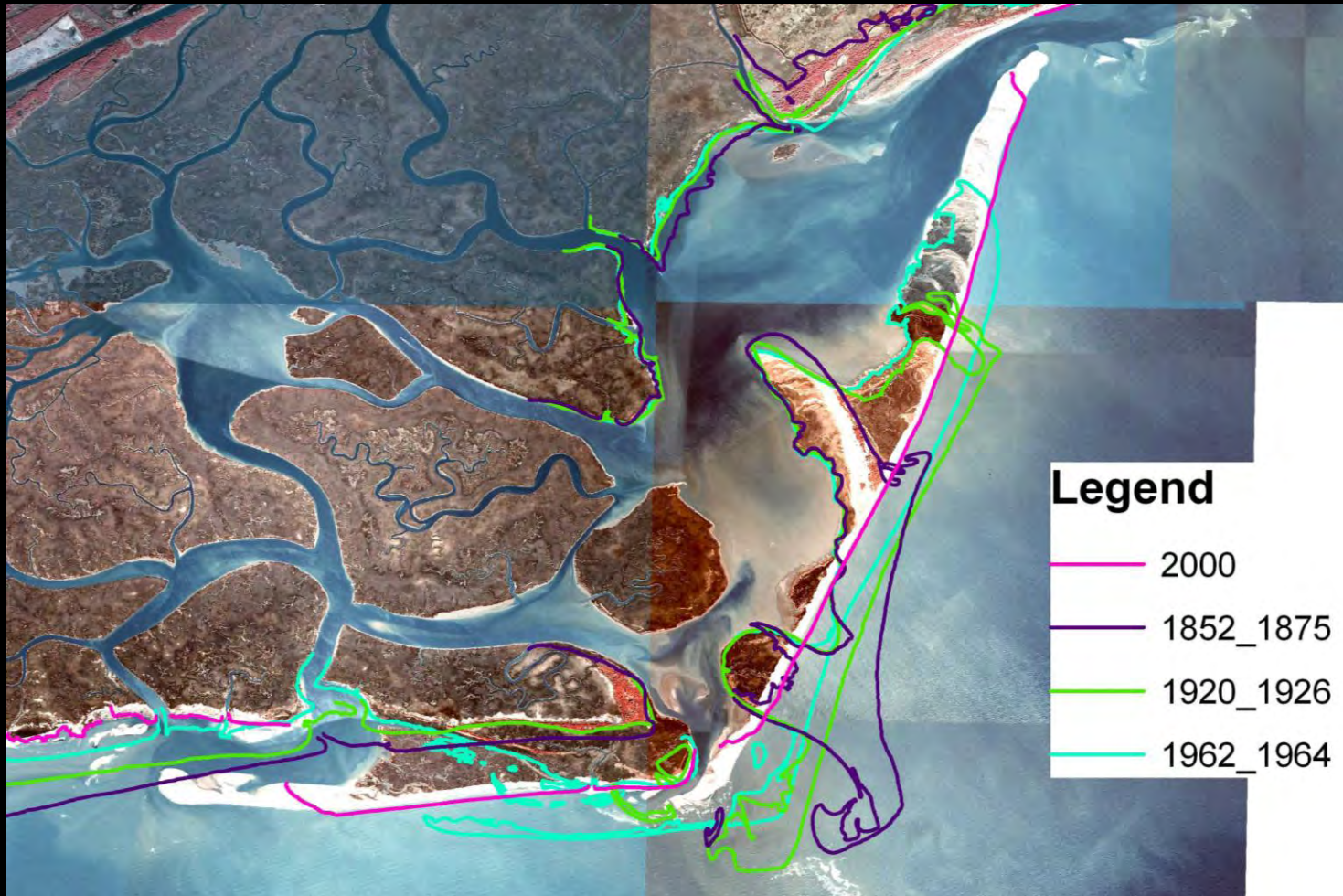
How long before the next breach in the Levee?

± 5 years

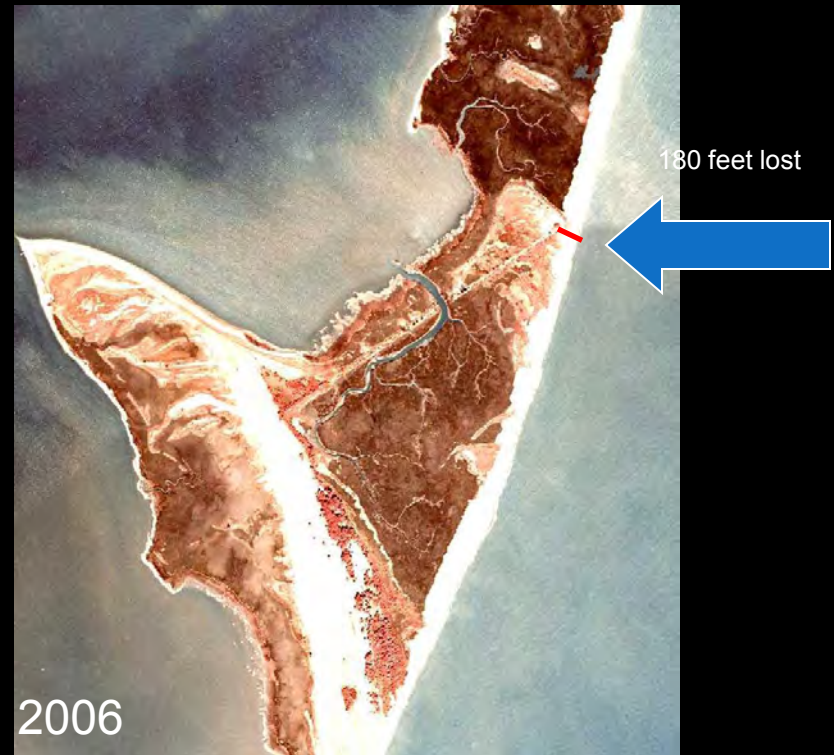


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Cape Island Historic Shoreline



Cape Island



Between 1999 and 2006, approximately 180 linear feet of beach shoreline width was lost to erosion.

Erosion on Cape Island



Low Tide



High Tide



Cape Island Topography



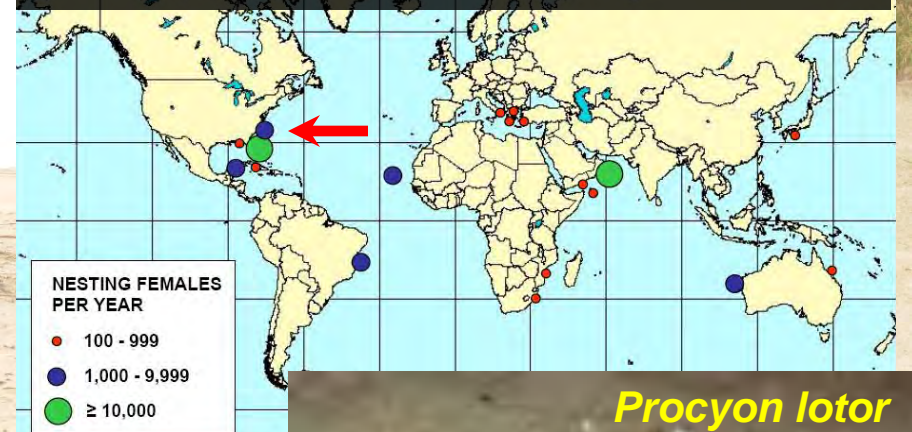
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Cape Island

- Highest density nesting beach of Northern Nesting Assemblage in SE U.S.¹
- Represented 23% of NNA nesting
- Nest Protection Project
 - Nest caging
 - Hatcheries

Relocated Nest on Cape Island

Global Distribution of Nesting Assemblages¹



Procyon lotor



Recovery Program Challenges Due to Sea Level Rise



- Suitable nesting beaches are eroding
- Islands likely to destabilize, fragment
- More nests are subject to inundation then mortality
- Rising global temps may affect gender ratio
- Increased workload needed to address above - not possible with current staff

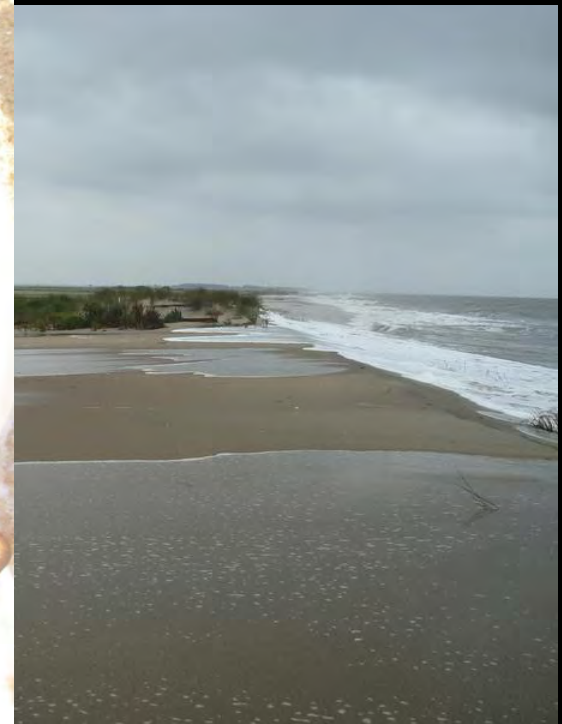
Climate Adaptation

To Relocate or Not To Relocate

■ SLR, Severe erosion, tidal amplitude, productivity

■ Concerns raised about relocation

- Might skew sex ratio
- Could reduce hatchling emergence success
- possibly selects for individuals that occupy poor nest sites
- Unnecessary relocation technique can be avoided

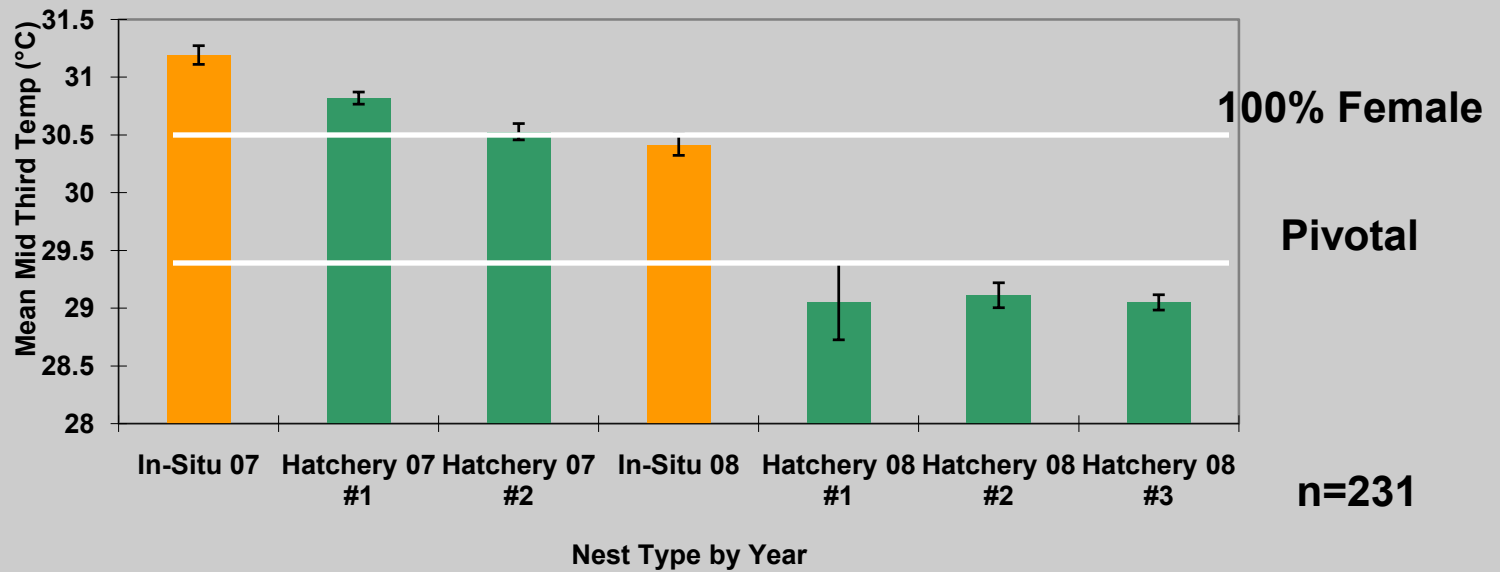


Caretta caretta eggs being relocated

Washover Nests

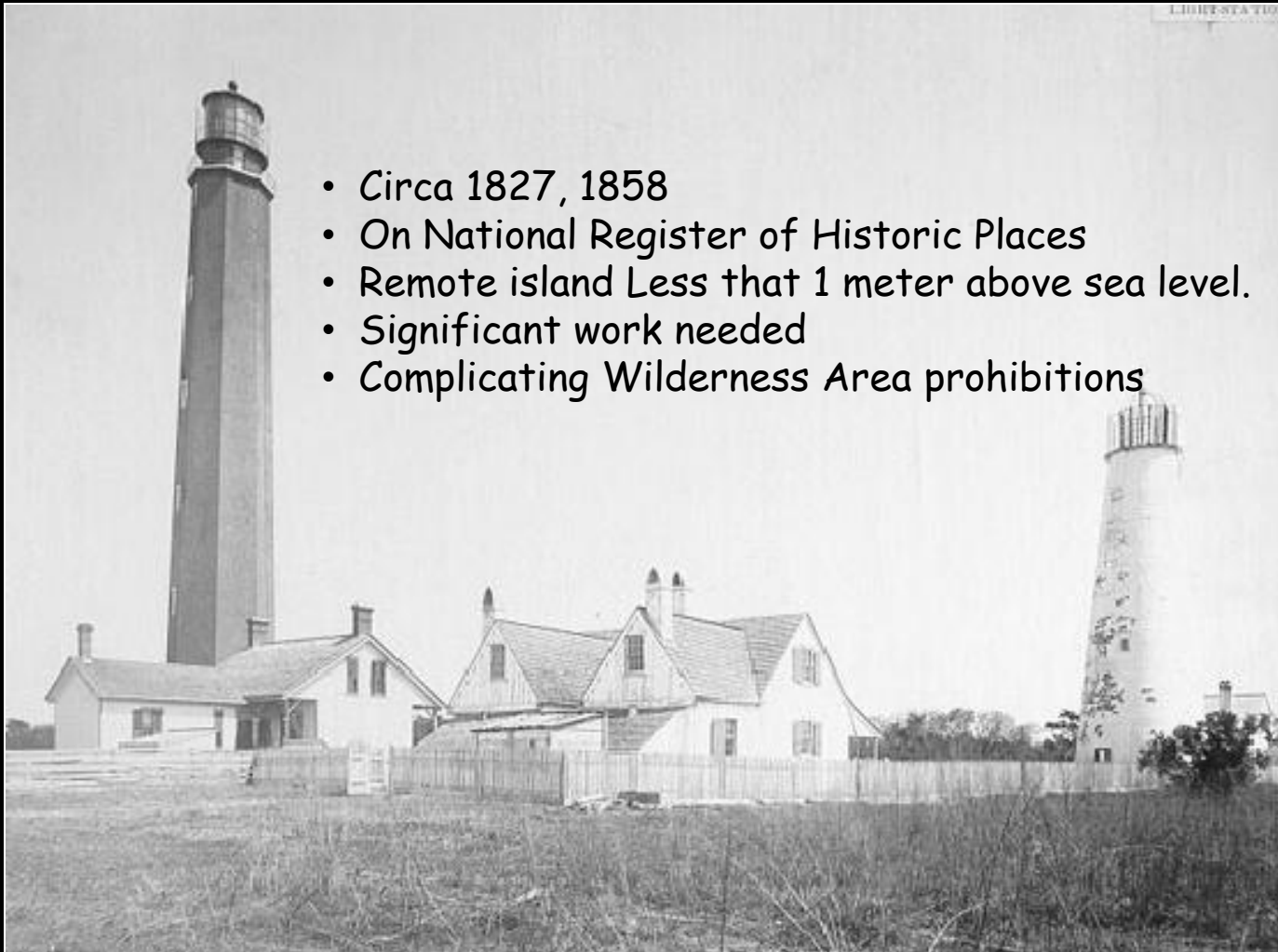


Temperature determines Sex Ratio



Increase in temperature could skew sex ratios.

Cape Romain's Lighthouses



- Circa 1827, 1858
- On National Register of Historic Places
- Remote island Less that 1 meter above sea level.
- Significant work needed
- Complicating Wilderness Area prohibitions

What do we do now?



- Study Rapid Head-ward Erosion of Marsh Creeks and how Santee River sediments play a role in the growth of Marsh.
- Better elevation data (LIDAR) to determine where marsh will grow
- SET Stations in Marsh to determine level of subsidence/growth
- Inventory and Monitor Marsh Birds and Diamondback Terrapins for base line information on species that depend on the marsh.
- Jacks Creek Cross Dike?



US Fish and Wildlife Service

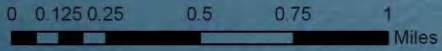
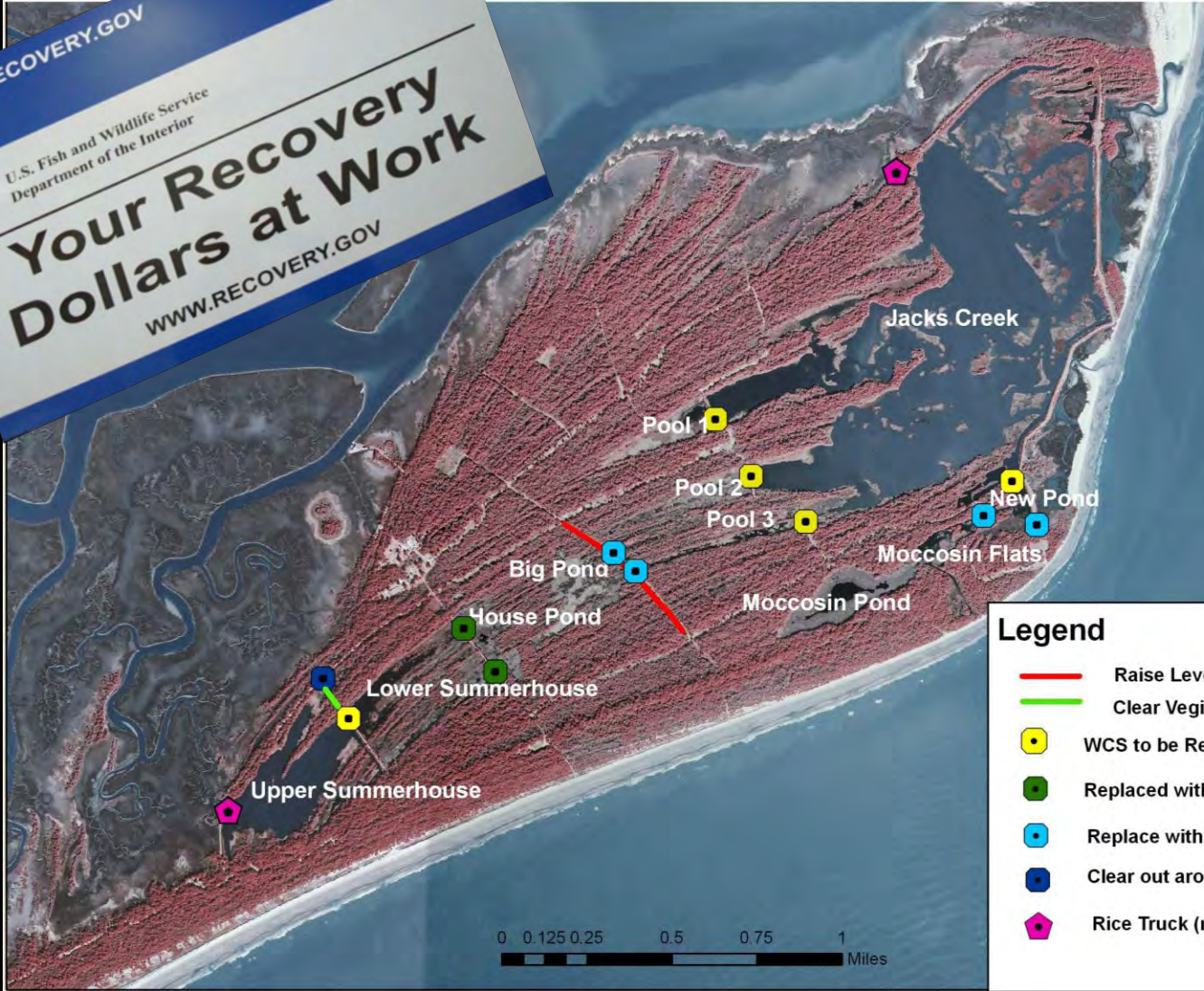
Land and Wetland Restoration ARRA Project

RECOVERY.GOV

U.S. Fish and Wildlife Service
Department of the Interior

Your Recovery Dollars at Work

WWW.RECOVERY.GOV



Legend

- Raise Levee Elevation
- Clear Vegetation from ditch
- WCS to be Replaced with Rice Trunk
- Replaced with double flashboard risers
- Replace with Single Flashboard Riser
- Clear out around WCS
- Rice Truck (no Change)

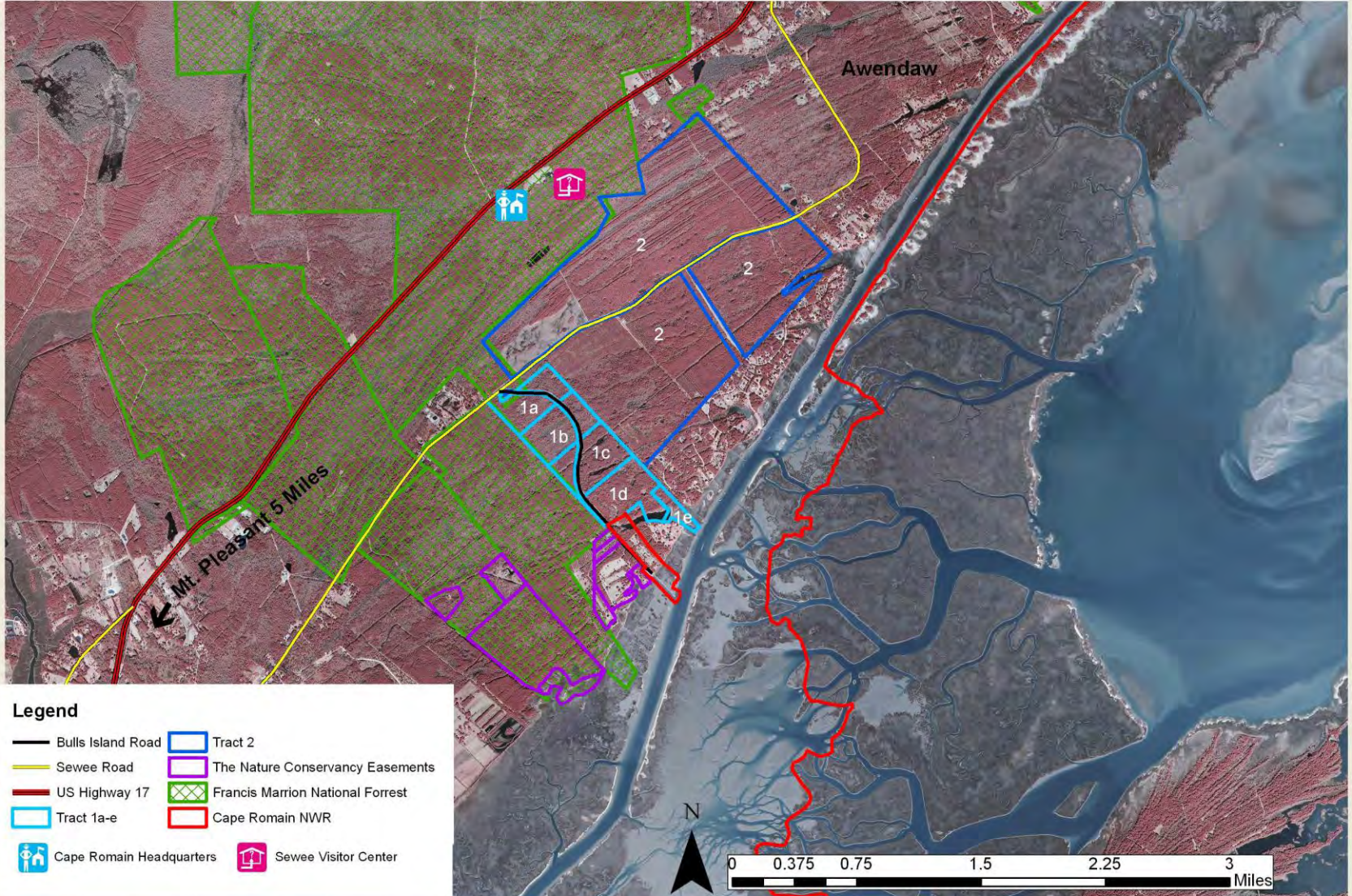


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Questions?

