2021 Coastal Habitat Protection Plan

Wetland Shoreline Protection and Enhancement With Focus of Nature-Based Methods

DEPARTMENT OF ENVIRONMENTAL QUALITY

CHPP Steering Committee | Chris Baillie, East Carolina University | January 21, 2021

Coastal Wetland Classification

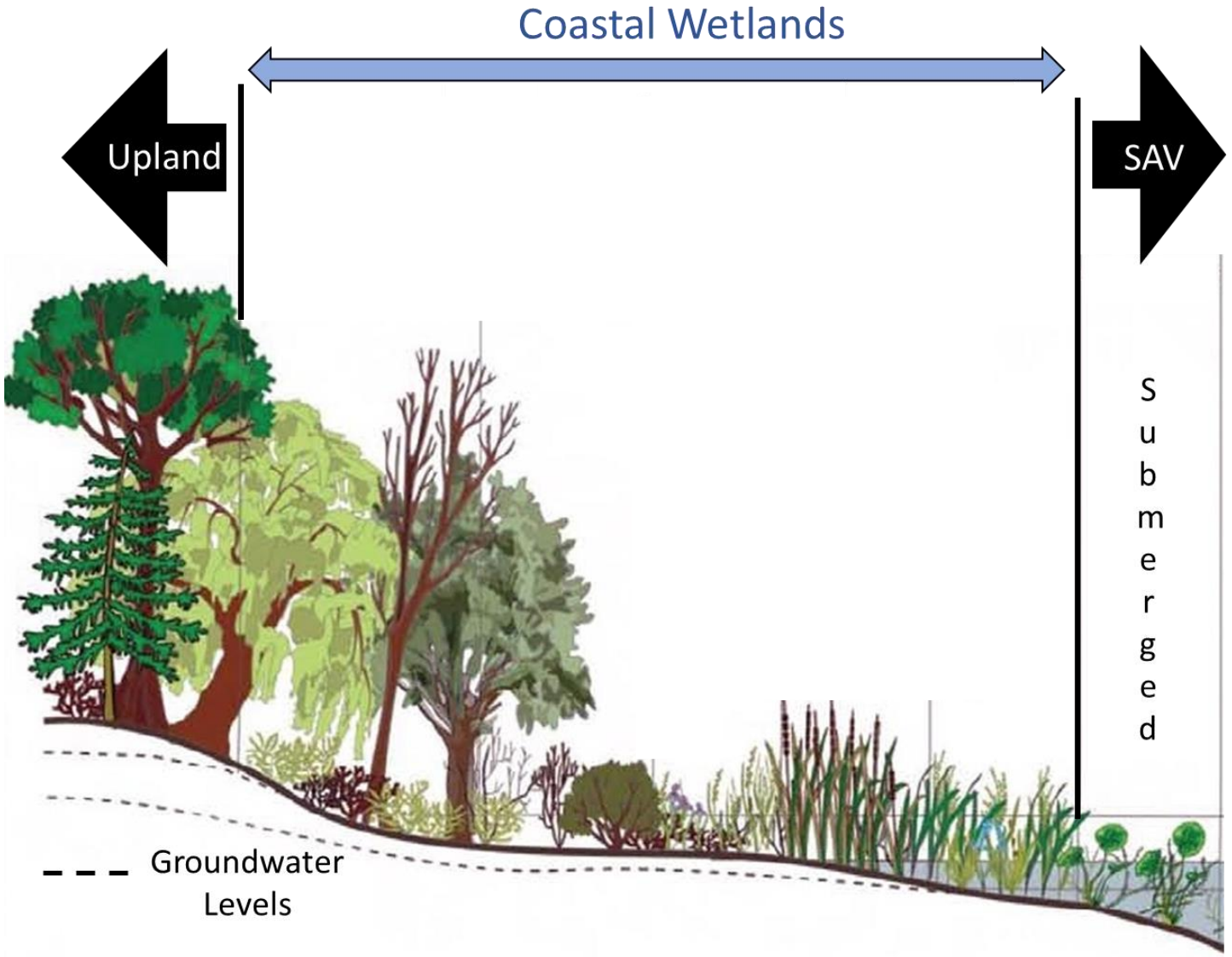
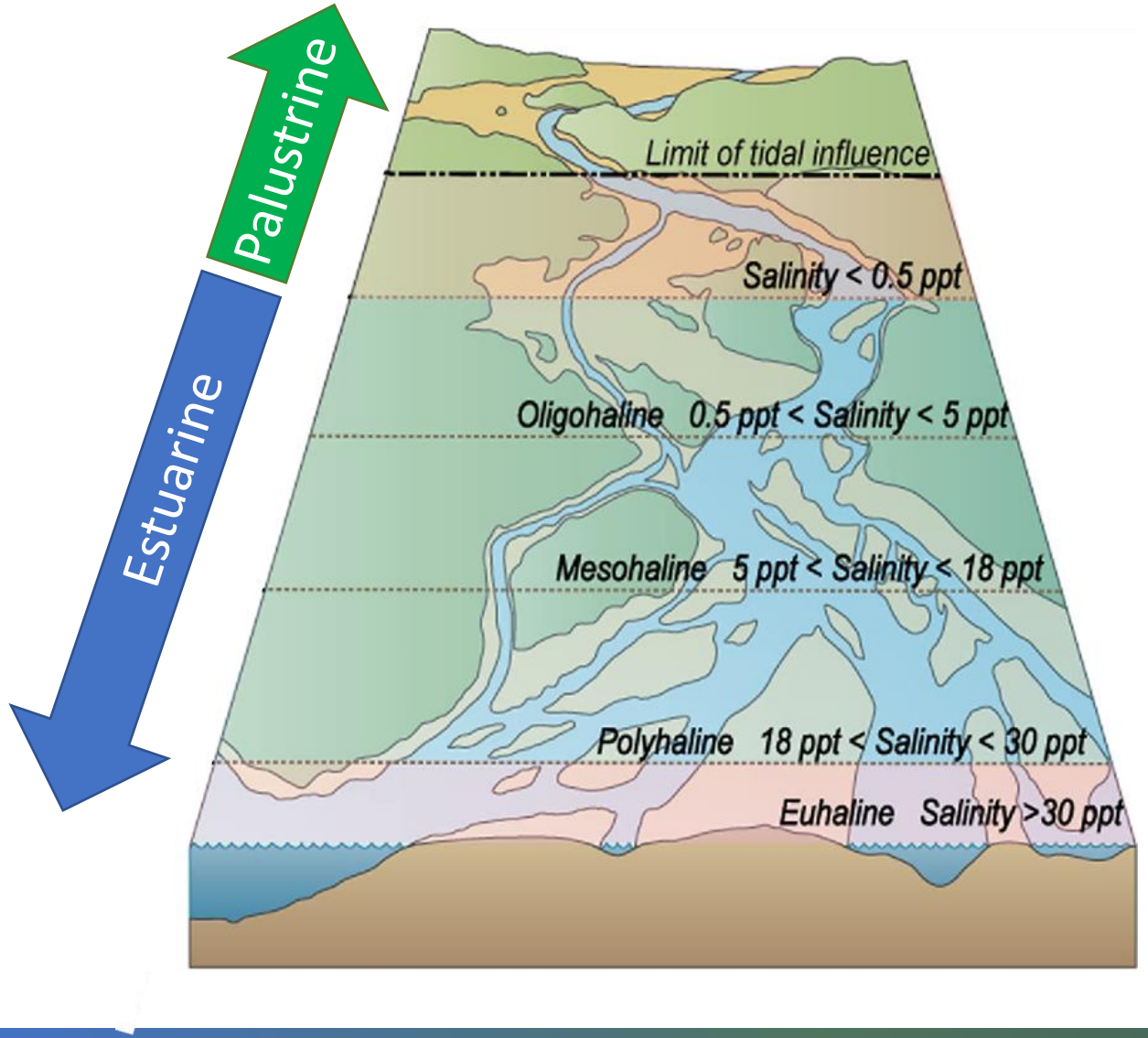


Figure Source: Adapted from Wilcox et al.

Coastal Wetland Classification



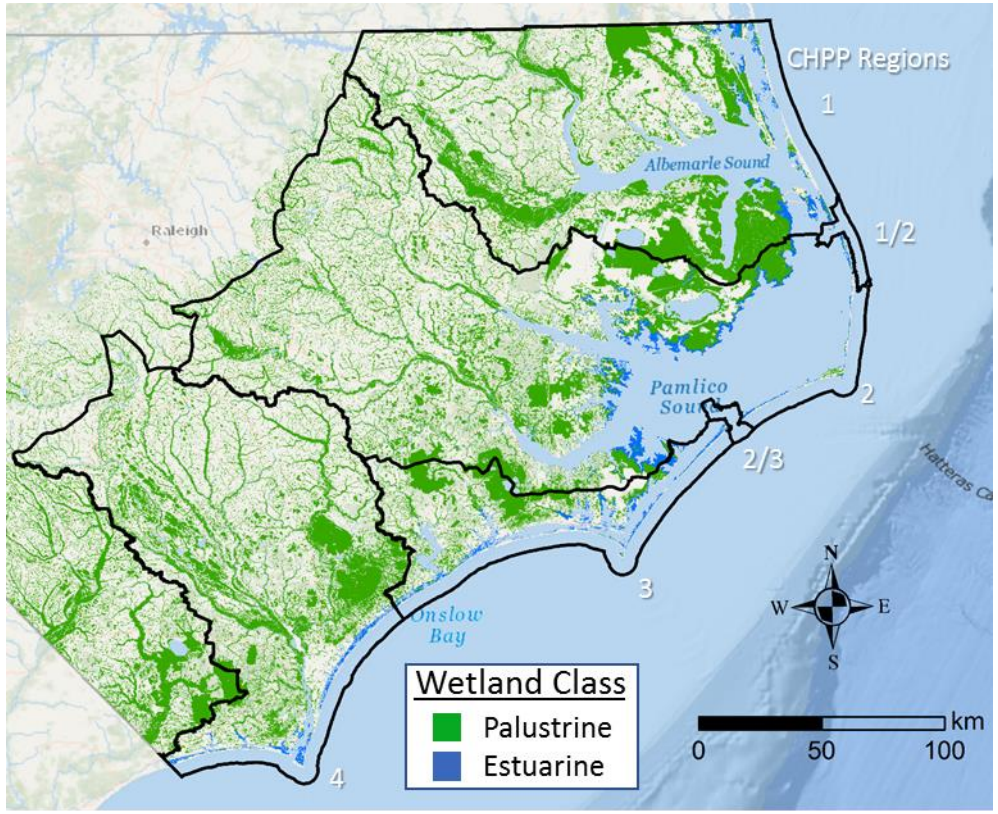


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Figure Source: Adapted from Luo et al. 2017 (left); Data Source: N. Herold, NOAA C-CAP

Coastal Wetland Classification

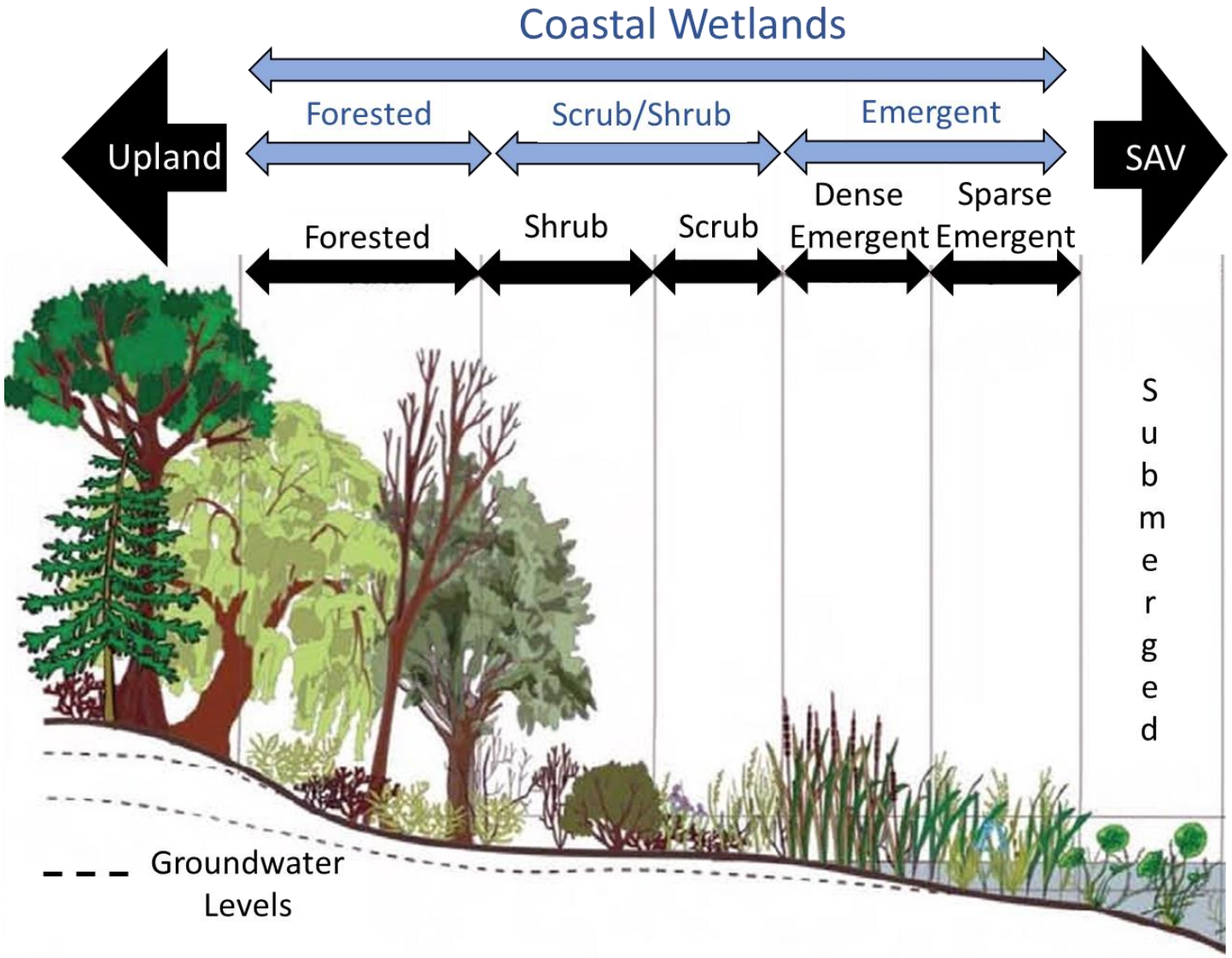

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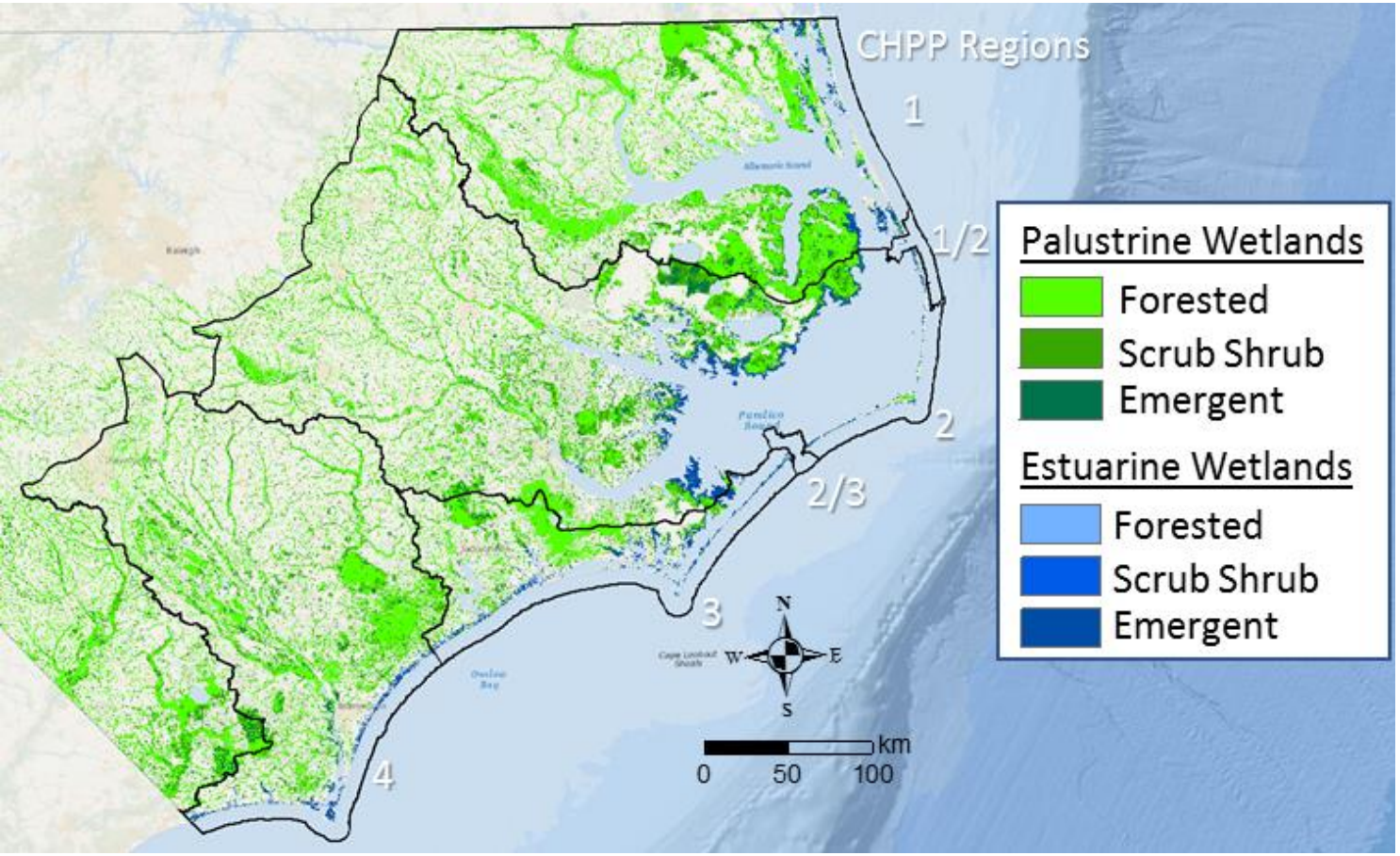
Figure Source: Adapted from Wilcox et al.

NC's Coastal Wetlands Resources



Coastal Wetland Class	Acres (2016)	% of P or E Class	% All Coastal Wetlands
Palustrine Forested Wetland	3,069,690	70.5%	**66.8%**
Palustrine Scrub/Shrub Wetland	1,008,552	23.2%	**22.0%**
Palustrine Emergent Wetland	272,932	6.3%	**5.9%**
Estuarine Forested Wetland	166	0.1%	**0.0%**
Estuarine Scrub/Shrub Wetland	7,747	3.2%	**0.2%**
Estuarine Emergent Marsh	235,425	96.7%	**5.1%**
Total Wetlands	**4,594,513**		**100.0%**

95% of NC's wetlands are located in the Coastal Plain

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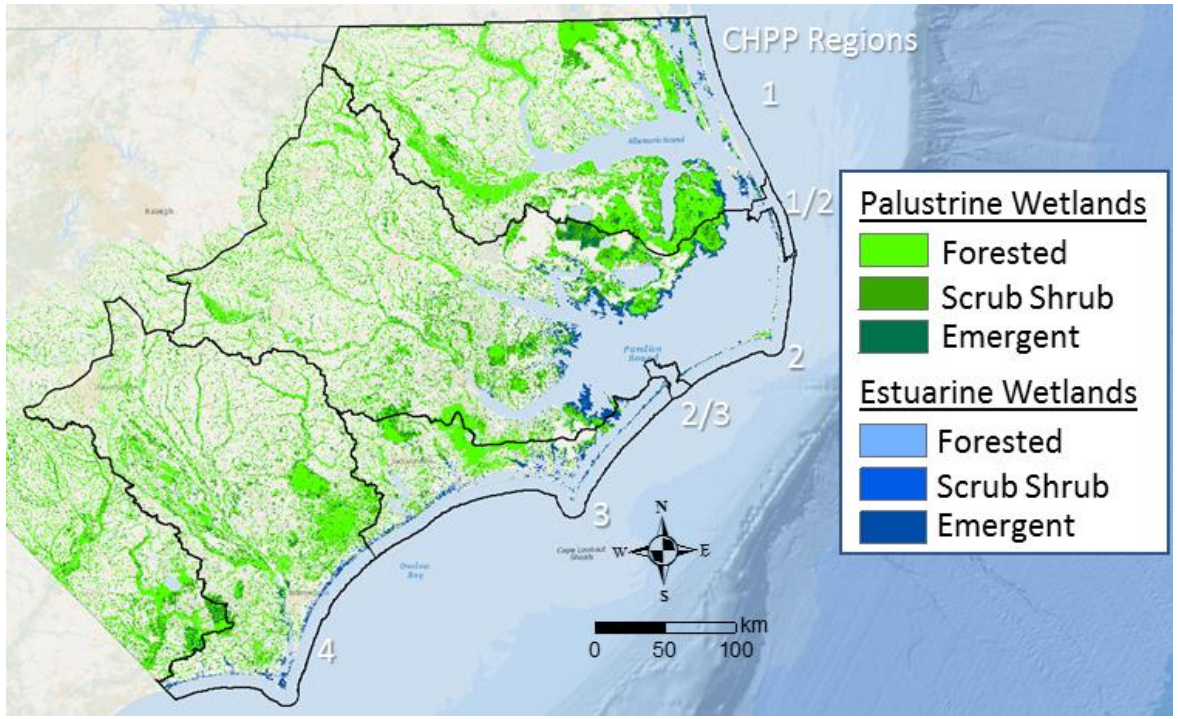
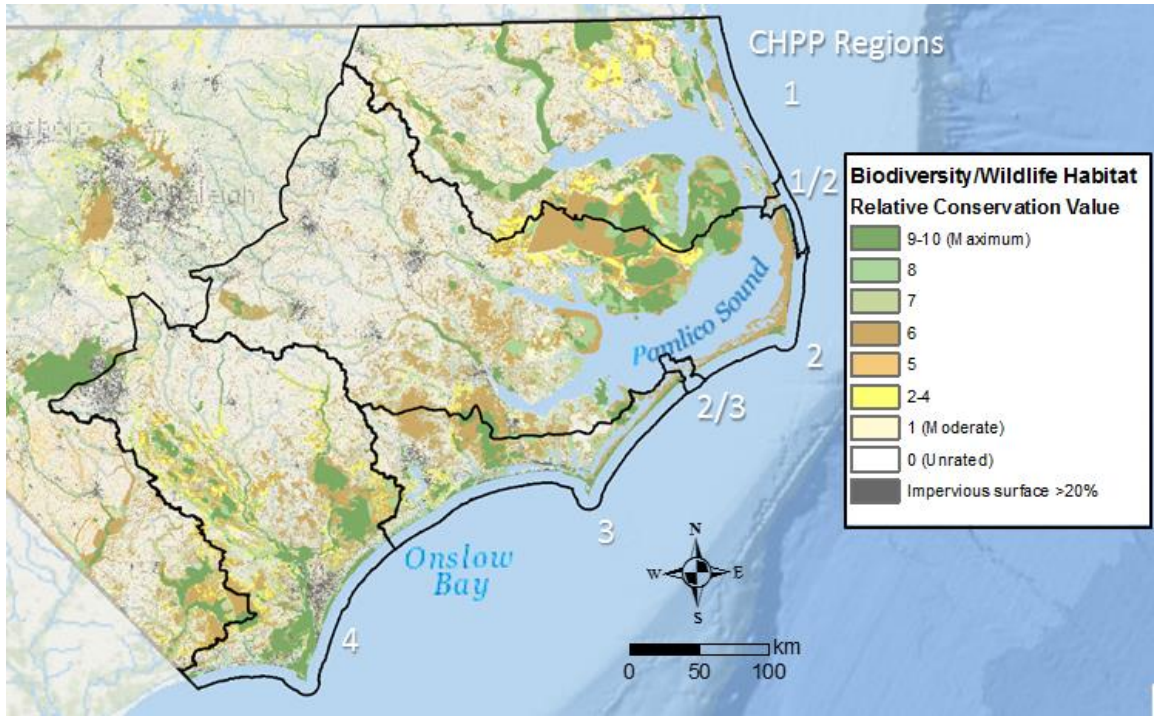
Data Source: Nate Herold, NOAA C-CAP

NC's Coastal Wetlands Resources

Coastal Wetlands



Coastal Biodiversity/Wildlife Habitat



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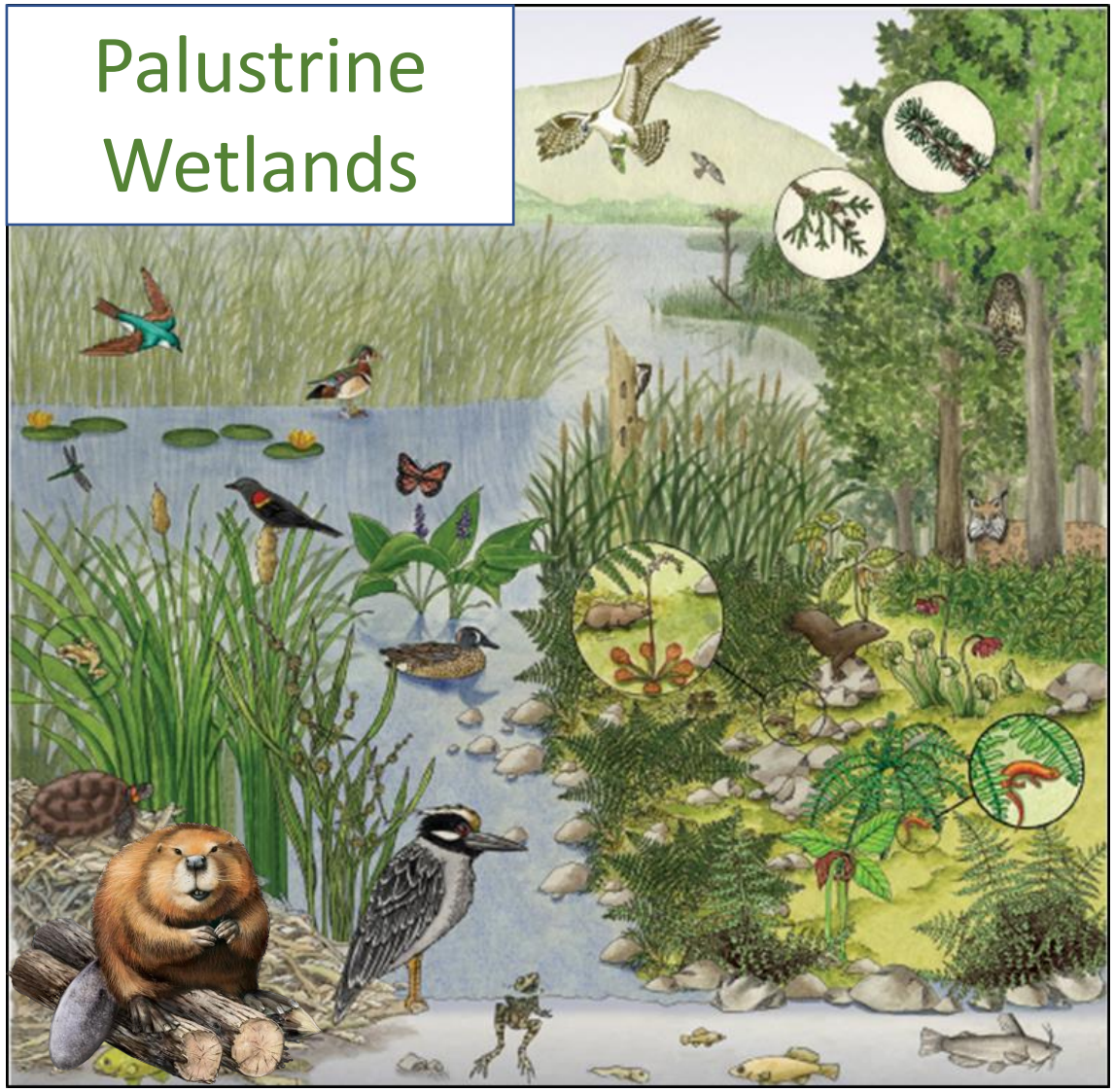
Data Source: Nate Herold, NOAA C-CAP (left); NCDENR (right)

Coastal Wetlands: Habitat Provisioning

Palustrine Wetlands



Estuarine Wetlands

Image Sources: Sheri Amsel

Coastal Wetlands: Fisheries Production

Wetland-Dependent Fisheries Species

Life History Groupings	Species	Wetland Function: Nursery	Foraging	Refuge	Spawning	Corridor
Resident Freshwater or Brackish	White Perch	X			X	
	Yellow Perch	X	X		X	
	Catfish	X	X	X	X	X
Anadromous and Catadromous	American Eel		X	X		X
	River Herring	X	X	X	X	X
	Striped Bass	X	X	X		X
Estuarine and Inlet Spawning and Nursery	Blue Crab	X	X	X		X
	Cobia	X	X			X
	Red Drum	X	X	X		X
	Spotted Seatrout	X	X	X		X
Marine Spawning; Low-High Salinity Nursery	Atlantic Croaker	X	X	X		X
	Atlantic Menhaden	X	X			X
	Shrimp	X	X	X		X
	Southern Flounder	X	X	X		X
	Spot	X	X	X		X
	Striped Mullet	X	X	X		X
Marine Spawning; High Salinity Nursery	Black Sea Bass	X	X	X		X
	Summer Flounder	X	X	X		X

Additional non-fisheries species: Banded killifish, bay anchovy, grass shrimp, mummichog, naked goby, sheepshead minnow, silversides, pinfish

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Table Source: Adapted from 2016 CHPP

Coastal Wetlands: Fisheries Production

Top 10 Commercial Species by lbs. Landed (2019)

LH Traits	Species	Wetland Function: Nursery	Foraging	Refuge	Spawning	Corridor	Commercial Rank (2019, by lbs landed)
Resident Freshwater or Brackish	White Perch	X			X		
	Yellow Perch	X	X		X		
	Catfish	**X**	**X**	**X**	**X**	**X**	**6**
Anadromous and Catadromous	American Eel		X	X		X	
	River Herring	X	X	X	X	X	
	Striped Bass	X	X	X		X	
Estuarine and Inlet Spawning and Nursery	**Blue Crab**	**X**	**X**	**X**		**X**	**1**
	Cobia	X	X			X	
	Red Drum	X	X	X		X	
	Spotted Seatrout	X	X	X		X	
Marine Spawning; Low-High Salinity Nursery	**Atlantic Croaker**	**X**	**X**	**X**		**X**	**5**
	Atlantic Menhaden	X	X			X	
	Shrimp	**X**	**X**	**X**		**X**	**2**
	hern Flounder	**X**	**X**	**X**		**X**	**9**
	Spot	X	X	X		X	
	Striped Mullet	**X**	**X**	**X**		**X**	**4**
Marine Spawning; High Salinity Nursery	Black Sea Bass	X	X	X		X	
	Summer Flounder	**X**	**X**	**X**		**X**	**3**

Wetland-Dependent Fisheries Species

- 90% of NC's commercial fisheries landings

Year Range	Ex-vessel value (millions of dollars)	Estimated Job Supported	Sales Impact (millions of dollars)
2010-2019	$71-96	7012-8212	$278-369

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Table Source: Adapted from 2016 CHPP

Coastal Wetlands: Fisheries Production

Top 10 Recreational Species by lbs. Harvested (2019)

LH Traits	Species	Wetland Function: Nursery	Foraging	Refuge	Spawning	Corridor	Recreational Rank (2019, by lbs landed)
Resident Freshwater or Brackish	White Perch	X			X		
	Yellow Perch	X	X		X		
	Catfish	X	X	X	X	X	
Anadromous and Catadromous	American Eel		X	X		X	
	River Herring	X	X	X	X	X	
	Striped Bass	X	X	X		X	
Estuarine and Inlet Spawning and Nursery	Blue Crab	X	X	X		X	
	Cobia	X	X			X	
	Red Drum	X	X	X		X	
	Spotted Seatrout	**X**	**X**	**X**		**X**	**1**
Marine Spawning; Low-High Salinity Nursery	Atlantic Croaker	X	X	X		X	
	Atlantic Menhaden	X	X			X	
	Shrimp	X	X	X		X	
	Southern Flounder	X	X	X		X	
	Spot	**X**	**X**	**X**		**X**	**7**
	Striped Mullet	X	X	X		X	
Marine Spawning; High Salinity Nursery	Black Sea Bass	X	X	X		X	
	Summer Flounder	X	X	X		X	

Wetland-Dependent Fisheries Species

- 90% of NC's commercial fisheries landings

Year Range	Ex-vessel value (millions of dollars)	Estimated Job Supported	Sales Impact (millions of dollars)
2010-2019	$71-96	7012-8212	$278-369

- 60% of NC's recreational harvest

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Table Source: Adapted from 2016 CHPP

Coastal Wetlands: Fisheries Production

Top 10 Recreational Species # of Directed Trips (2019)

LH Traits	Species	Wetland Function: Nursery	Foraging	Refuge	Spawning	Corridor	Recreational Rank (2019, by # of directed trips)
Resident Freshwater or Brackish	White Perch	X			X		
	Yellow Perch	X	X		X		
	Catfish	X	X	X	X	X	
Anadromous and Catadromous	American Eel		X	X		X	
	River Herring	X	X	X	X	X	
	Striped Bass	X	X	X		X	
Estuarine and Inlet Spawning and Nursery	Blue Crab	X	X	X		X	
	Cobia	X	X			X	
	Red Drum	**X**	**X**	**X**		**X**	**3**
	Spotted Seatrout	**X**	**X**	**X**		**X**	**1**
Marine Spawning; Low-High Salinity Nursery	**Atlantic Croaker**	**X**	**X**	**X**		**X**	**7**
	Atlantic Menhaden	X	X			X	
	Shrimp	X	X	X		X	
	Southern Flounder	**X**	**X**	**X**		**X**	**4**
	Spot	**X**	**X**	**X**		**X**	**8**
	Striped Mullet	X	X	X		X	
Marine Spawning; High Salinity Nursery	**Black Sea Bass**	**X**	**X**	**X**		**X**	**10**
	Summer Flounder	**X**	**X**	**X**		**X**	**4**

Wetland-Dependent Fisheries Species

- 90% of NC's commercial fisheries landings

Year Range	Ex-vessel value (millions of dollars)	Estimated Job Supported	Sales Impact (millions of dollars)
2010-2019	$71-96	7012-8212	$278-369

- 60% of NC's recreational harvest

Year Range	Est. Direct Expenditures (billions of dollars)	Estimated Job Supported
2010-2019	$3.1-4.8	33k-45k

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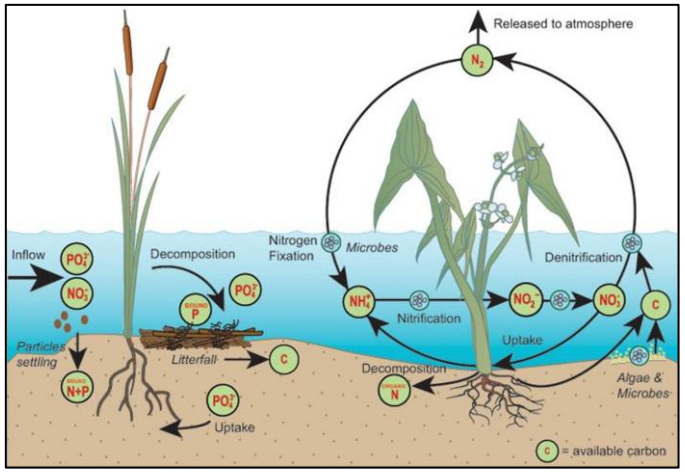
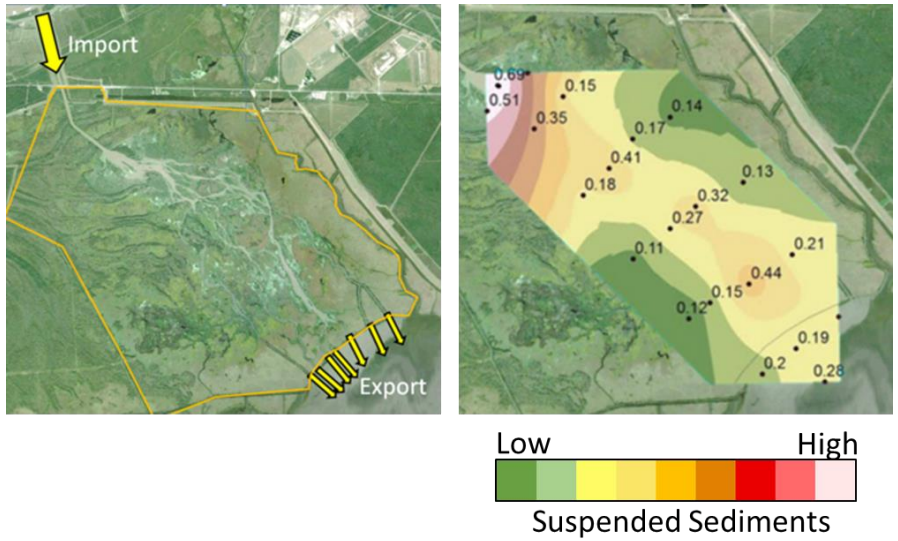
Table Source: Adapted from 2016 CHPP

Coastal Wetlands: Water Quality Enhancement





- Palustrine
  - Up to 80-90% N & P reduction[1]
  - >50% *E. coli* reduction[2]
  - 80% and 54% reduction in runoff flow and volume, respectively[3]
- Estuarine
  - Up to 100% of ambient nitrogen and 50-60% of experimentally enriched nitrate (70-fold ambient levels)[4]

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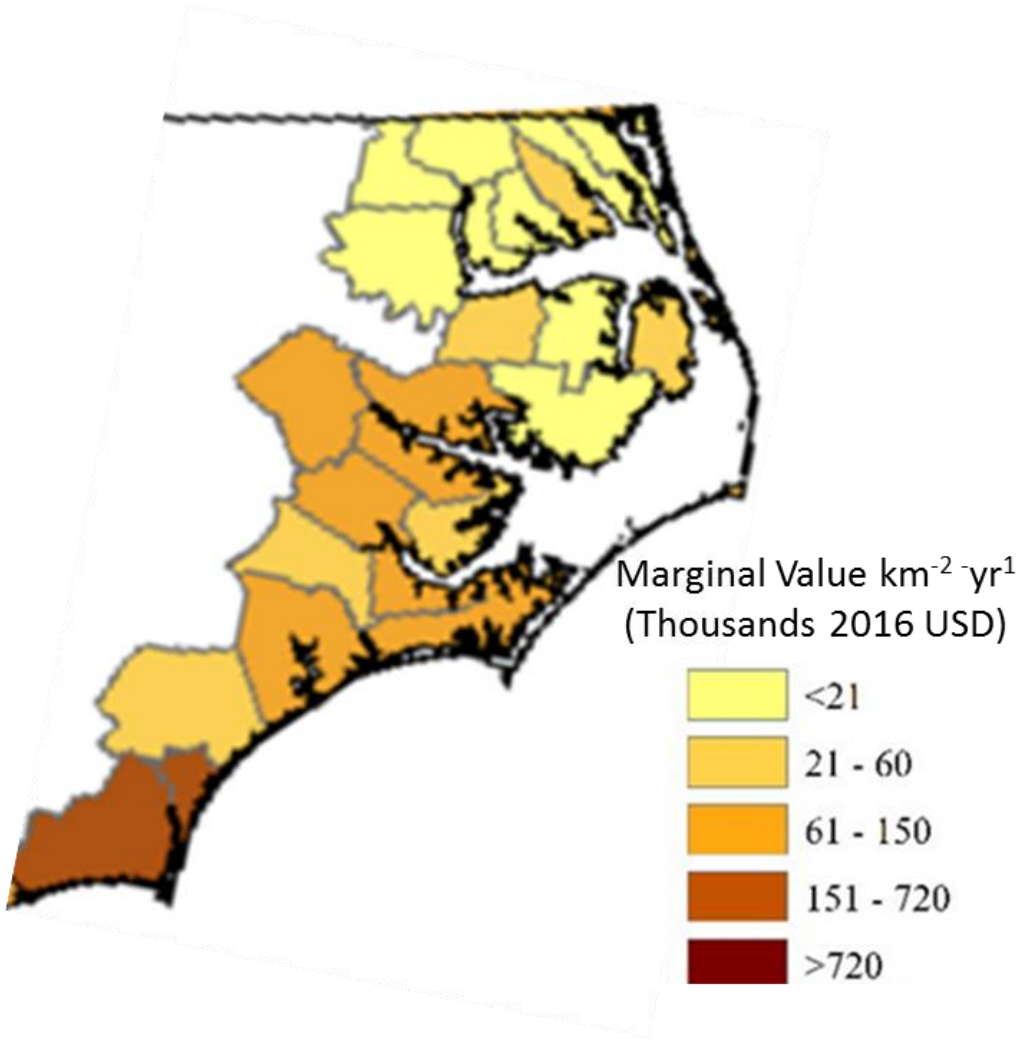
1 EPA 2006; 2.Humphrey et al. 2014; 3 Lenhard and Hunt 2011; 4. Drake et al. 2009. Image Sources: Julia Erdman (top), Snedden (bottom)

Coastal Wetlands: Storm Surge and Flood Mitigation



- Estuarine
  - Marsh <10m width: 50-80% wave height reduction. [1]
  - 30-yr storm protection value: >$1 million km^{-2} in 8 of 22 coastal NC counties. [2]
  - New Hanover: $454,000 km^{-2} yr^{-1} x 33.2 km^{-2} : $15.1 million yr^{-1}.

Palustrine

- Groundwater recharge: Up to 100,000 gallons $acre^{-1}$ day^{-1}. [3]

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1. Currin et al. 2017; 2. Sun and Carson 2020; 3. Turner 1991 Figure Source: Sun and Carson 2020

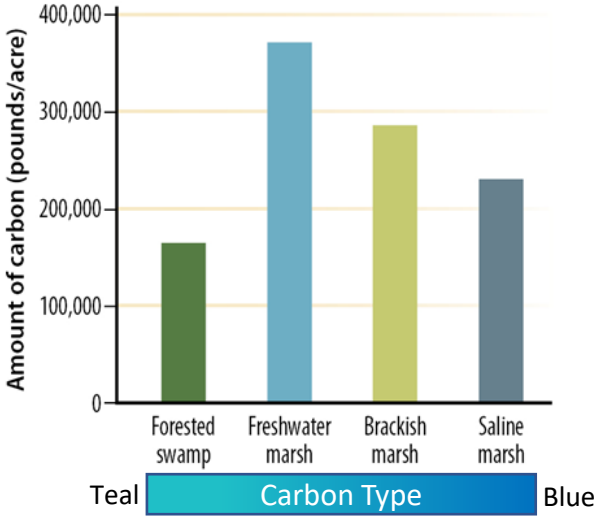
Coastal Wetlands: Shoreline Stabilization & Carbon Sequestration

Shoreline Stabilization

- Estuarine
  - Vegetated shoreline erosion rate ~50% of unvegetated shorelines (Cedar Island & New River Estuary, NC).[1,2]

Carbon Sequestration

- Tidal saline marshes: 30-50x CO_2-e relative to terrestrial forests.[3]
- NC coastal marsh CO_2-e stored: 64 million metric tons.[4]



1. Cowart et al. 2010; 2. Currin et al. 2015; 3. McLeod et al. 2011; Warnell and Olander 2020; Image Sources: Amanda Davis (Inset top); Figure Source: Wang & Dodla

Coastal Wetlands: Recreation & Tourism

Recreation

- Cultural, social, educational and economic benefits.

Tourism

- 14 of NC's 20 coastal counties poverty rate above state's average. [1]

- Top 10 NC Counties per capita tourism impact: 4 coastal (Dare [#1, $27,290 resident^{-1}], Hyde, Currituck, Carteret).[2]

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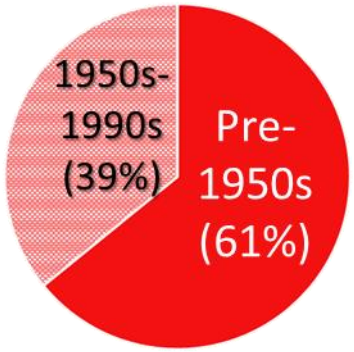
1. NC Department of Economic Security 2. NC Commerce TEIM; Image Source (clockwise from top left): NCWRC, NCDEQ NC State Parks

Coastal Wetlands: Centuries of Loss

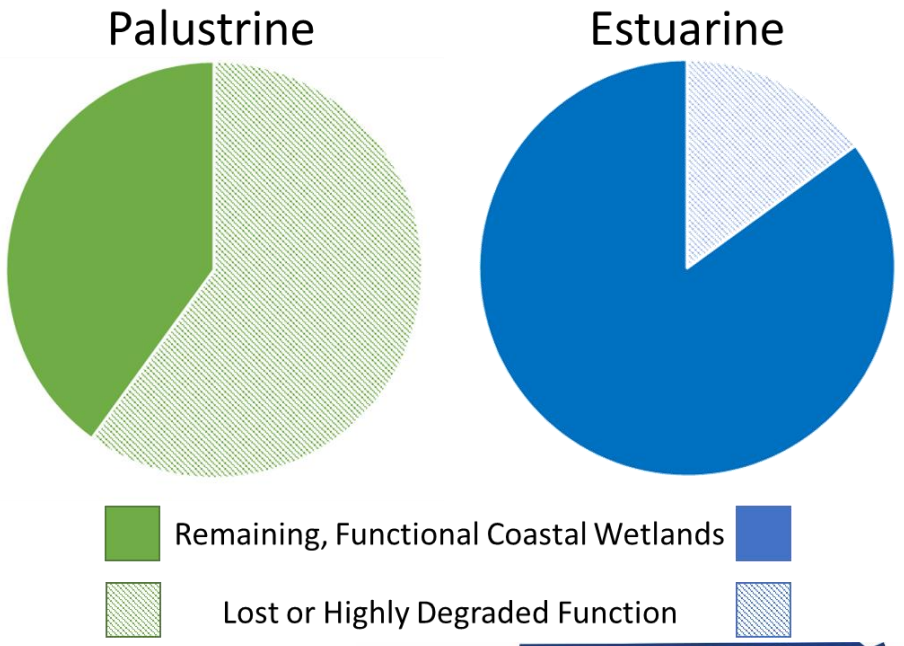
Centuries of Wetland Loss (Pre-Colonial-Late 1990s)

Time Period	Coastal Wetland Loss (% loss of Historic Extent)
Pre-Colonial-Early 1950s	35.4%
Pre-Colonial-Early 1980s	51.3%
Pre-Colonial-Late 1990s	57.9%

% Coastal Wetland Losses Pre-2000



Losses Not Evenly Distributed:



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Data: Cashin et al 1992, USFWS National Wetlands Inventory

Coastal Wetlands: Loss in Recent Decades

Recent Coastal Palustrine Wetland Trends (1996-2016)

	Coastal Palustrine Wetland Change (acres)			
Time Period	**Palustrine Forested Wetland**	**Palustrine Scrub/Shrub Wetland**	**Palustrine Emergent Wetland**	**All Palustrine Wetland Clases**
2011-2016	-42,969	40,277	5,816	**3,124**
2006-2011	-115,836	99,574	-265	**-16,527**
2001-2006	-150,287	89,661	35,664	**-24,962**
1996-2001	-279,324	147,607	35,204	**-96,513**
20-Yr Total	**-588,416**	**377,119**	**76,419**	**-134,878**

Positive value indicate net gains, Negative values indicate net losses

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Data: NOAA C-CCAP Courtesy of Nate Herold

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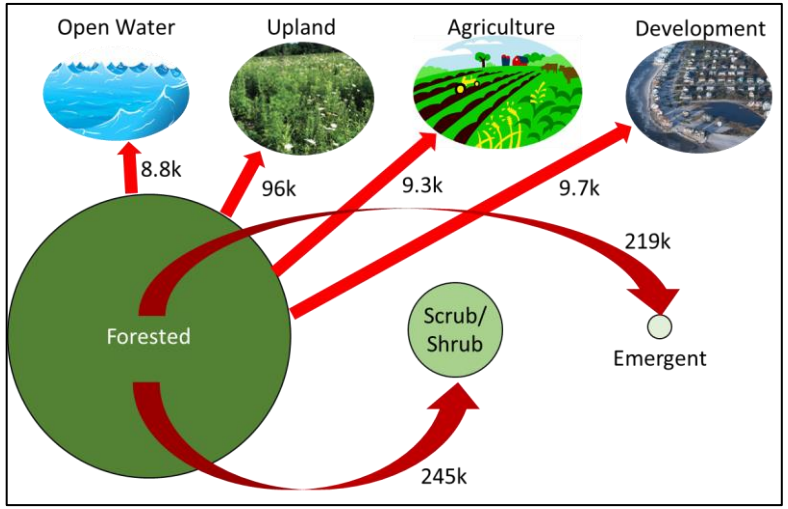
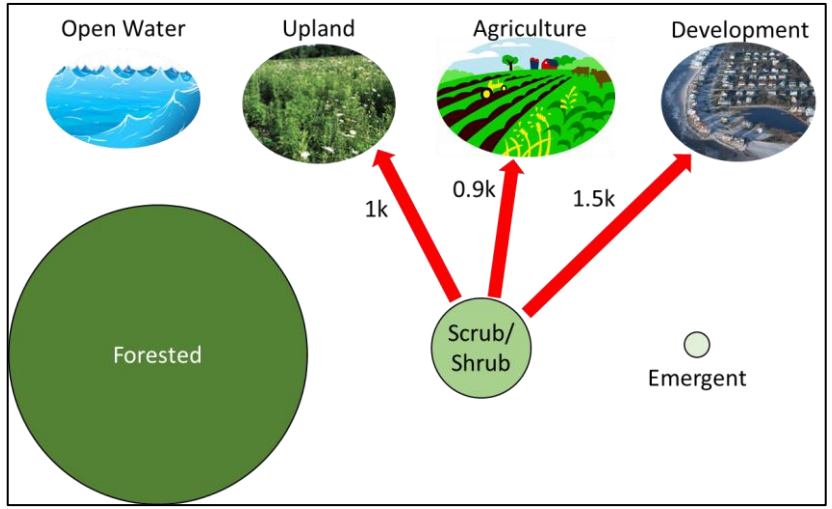
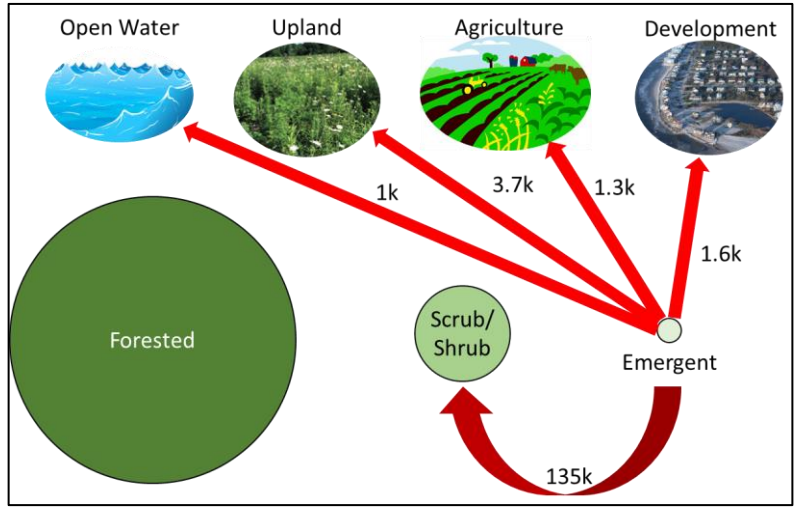
Palustrine Forested Losses:



Palustrine Scrub/Shrub Losses:



Palustrine Emergent Loss:



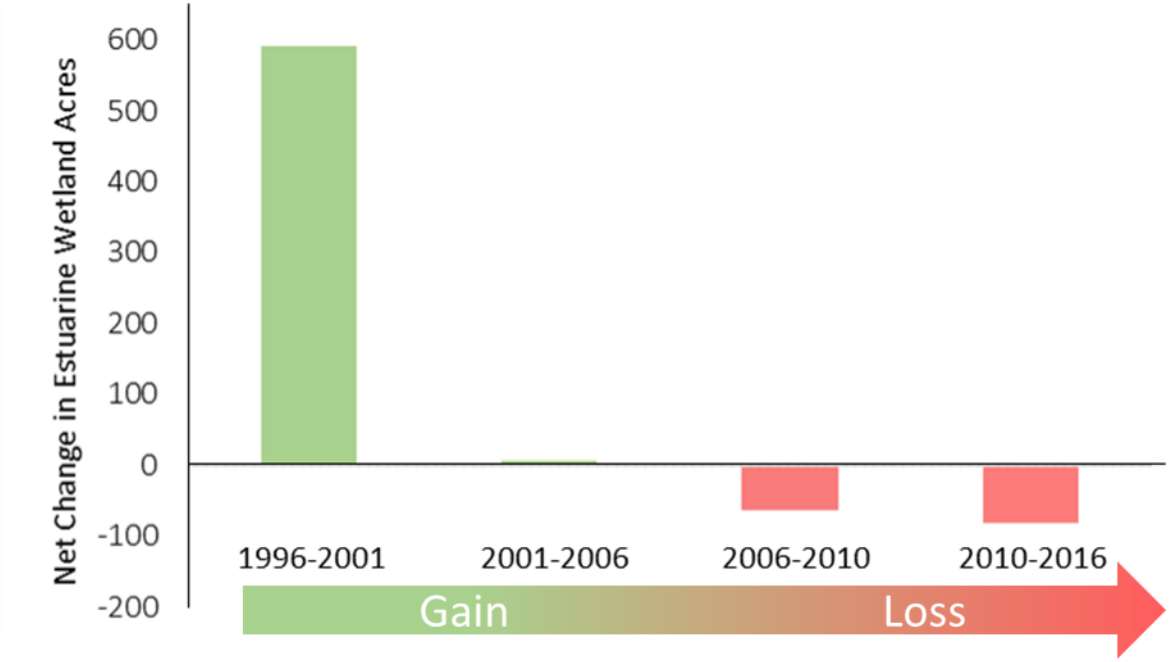
Data: NOAA C-CCAP Courtesy of Nate Herold

Coastal Wetlands: Loss in Recent Decades

Recent Coastal Estuarine Wetland Trends (1996-2016)

Time Period	Coastal Estuarine Wetland Change (acres)
2011-2016	-81
2006-2011	-63
2001-2006	2
1996-2001	590
20-Yr Total	448

Positive value indicate net gains, Negative values indicate net losses



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Data: NOAA C-CCAP Courtesy of Nate Herold

Coastal Wetlands: Loss in Recent Decades

Recent Coastal Estuarine Wetland Trends (1996-2016)

Time Period	Percent of of 5-year acreage losses attributable to conversion from:					
	Estuarine to Development	Estuarine to Agriculture	Estuarine to Upland	Estuarine to Palustrine	Estuarine to Unconsolidated Shore	Estuarine to Open Water
2011-2016	19%	0%	11%	0%	38%	32%
2006-2011	37%	0%	37%	0%	26%	0%
2001-2006	21%	79%	0%	0%	0%	0%
1996-2001	10%	48%	42%	0%	0%	0%

1996-2001 → 2011-2016

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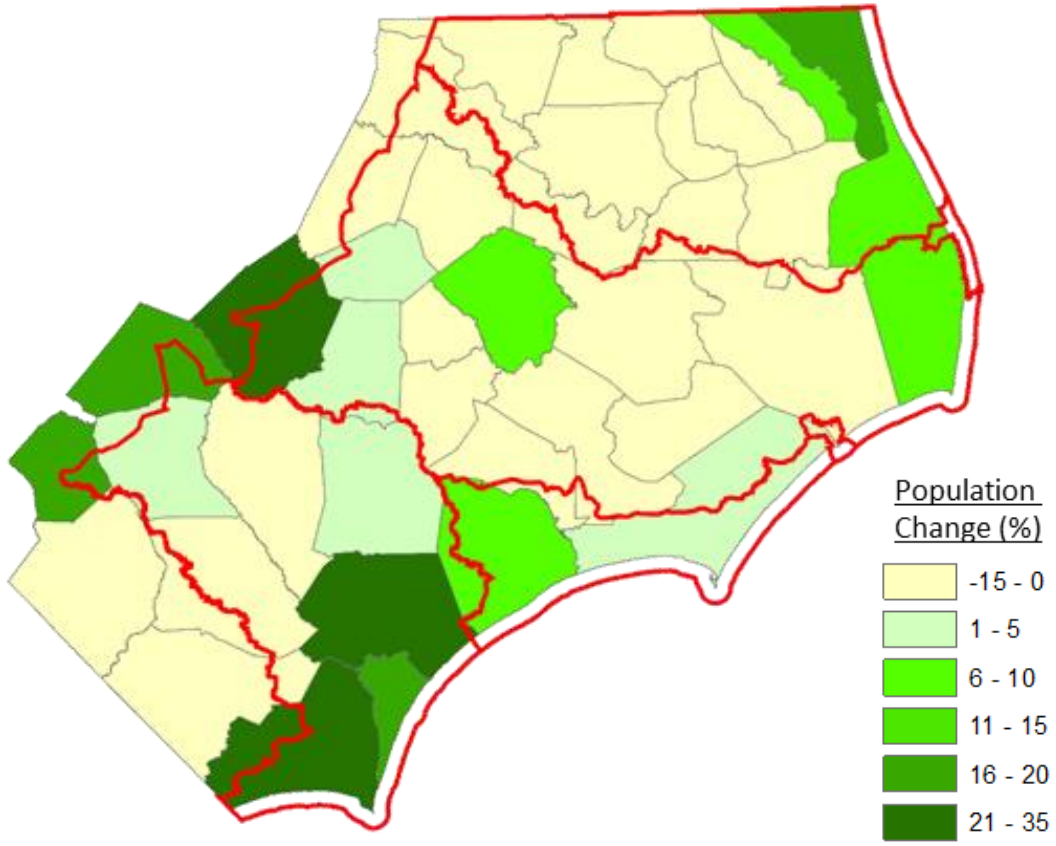
Data: NOAA C-CCAP Courtesy of Nate Herold; Images: Free Clipart (Left,Right), WCU (Middle)

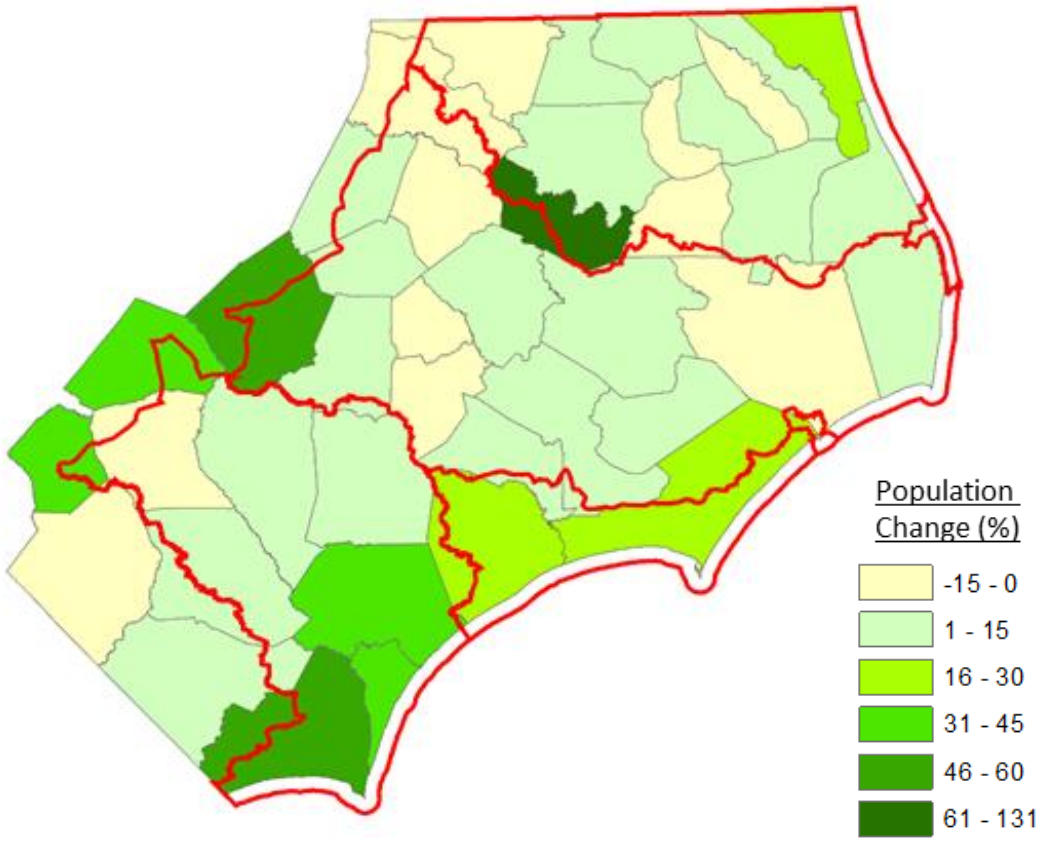
Coastal Wetlands: Current and Future Threats

Population Growth & Development

2010-2019



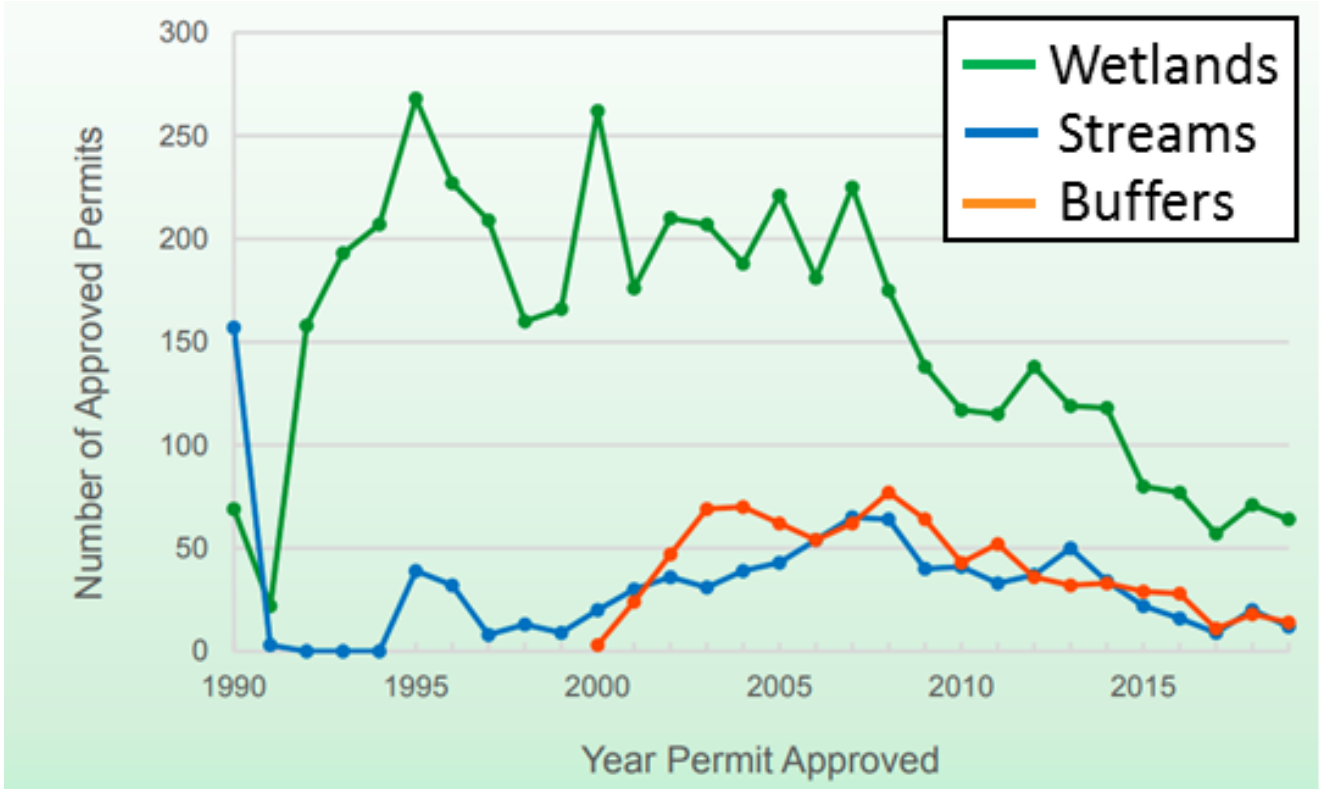
2019-2039

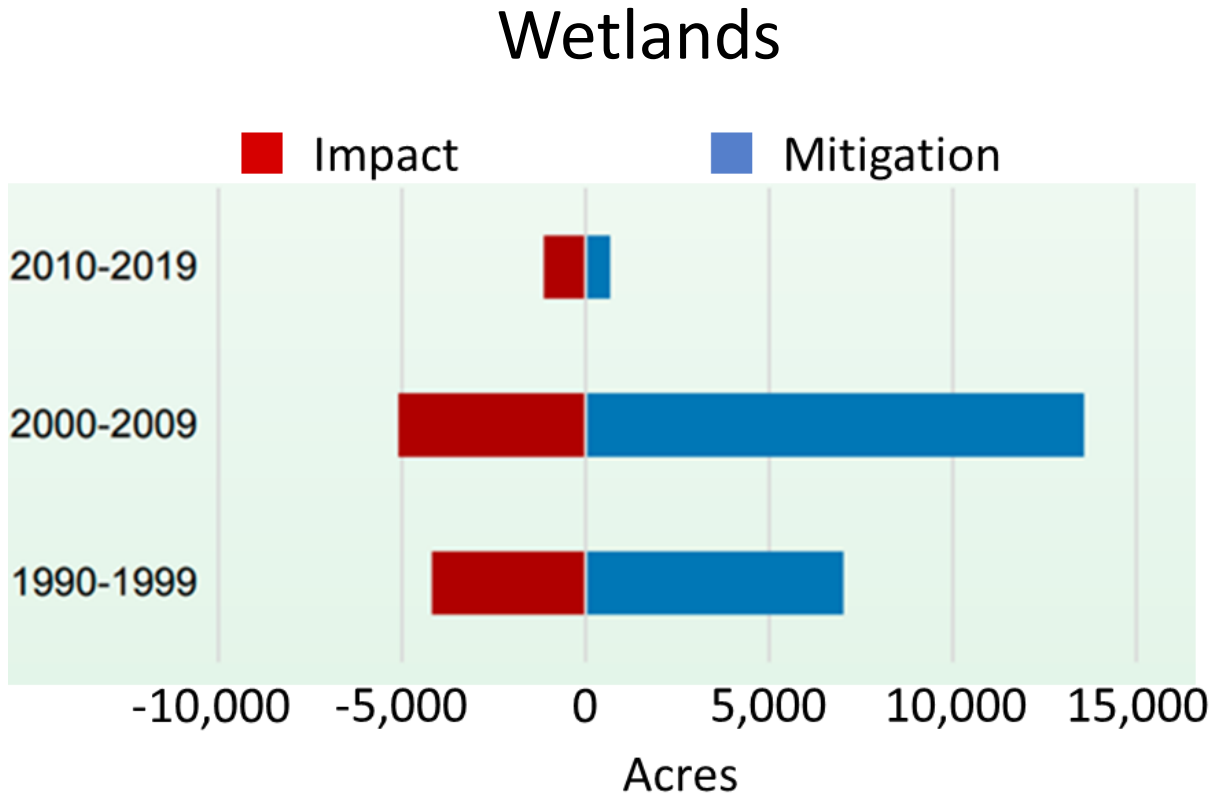


Data Source: NC OSBM

Coastal Wetlands: Current and Future Threats

Insufficient Regulatory Protections





Data Source: NCDEQ; Figures: A. Mueller

Coastal Wetlands: Current and Future Threats

Insufficient Regulatory Protections

Waters of the United States (WOTUS) Change

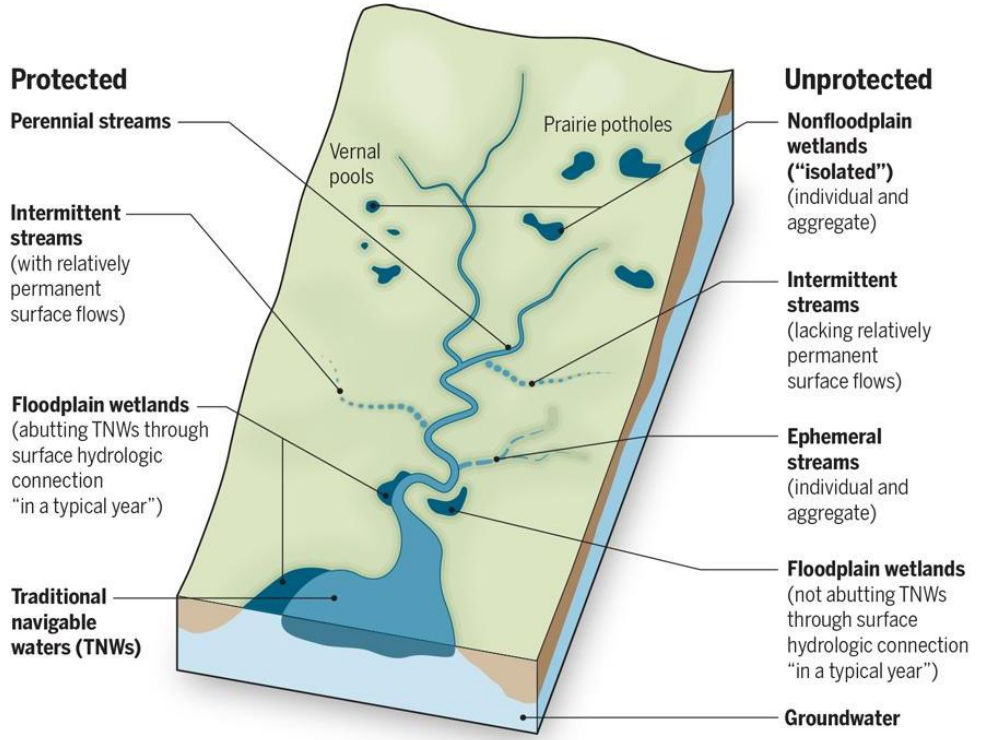
◆

The Hardison Amendment on Water:

"It is the intent of the General Assembly that the effluent standards and limitations and management practices adopted hereunder shall be no more restrictive than the most nearly applicable federal effluent standards and limitations and management practices."

— G.S. 143-215(c)

◆

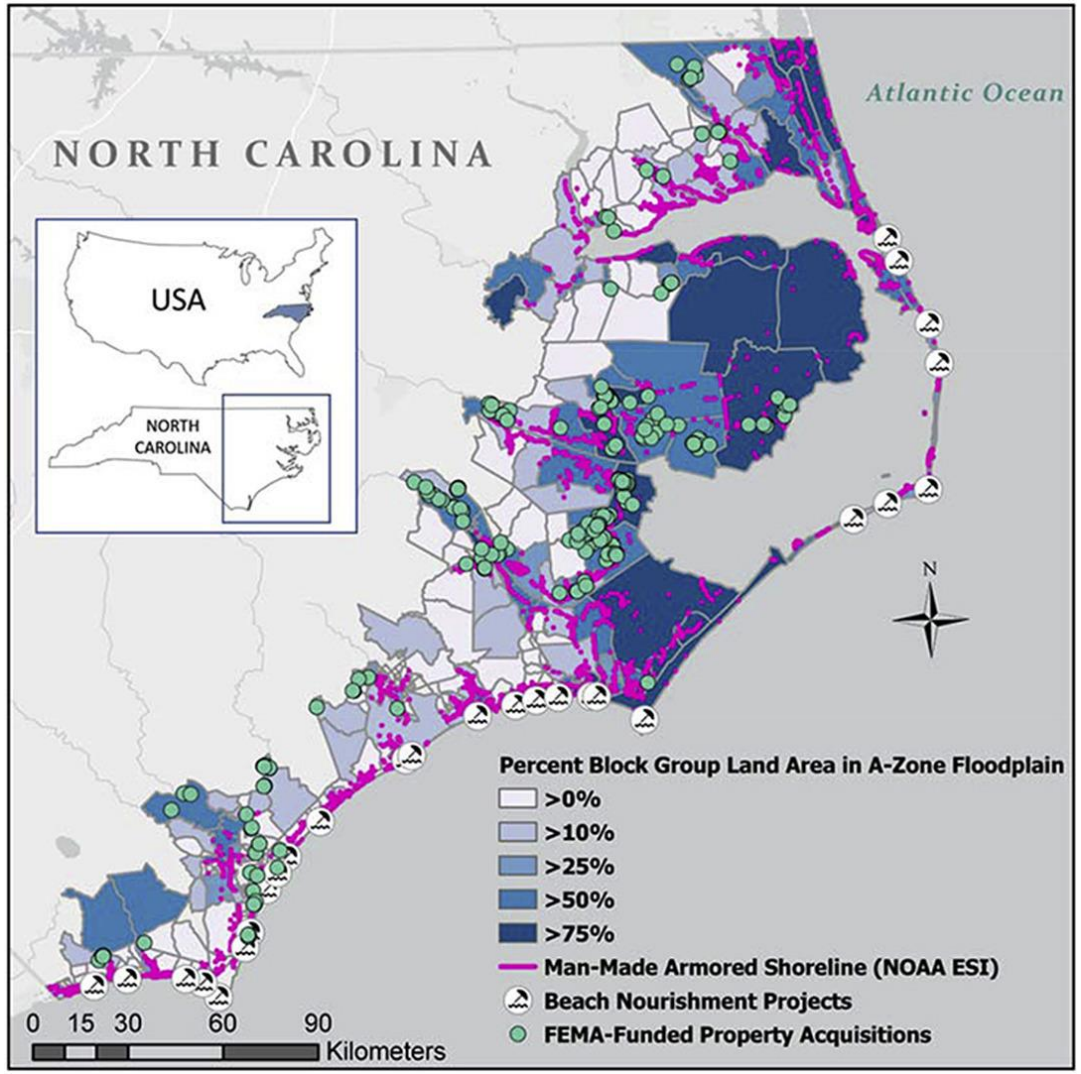


Lost Jurisdiction (of 163 NC WAM Reference Wetlands)

17% of Coastal Wetland Sites

Image Source: Melissa Thomas Baum

Coastal Wetlands: Current and Future Threats



Shoreline Armoring

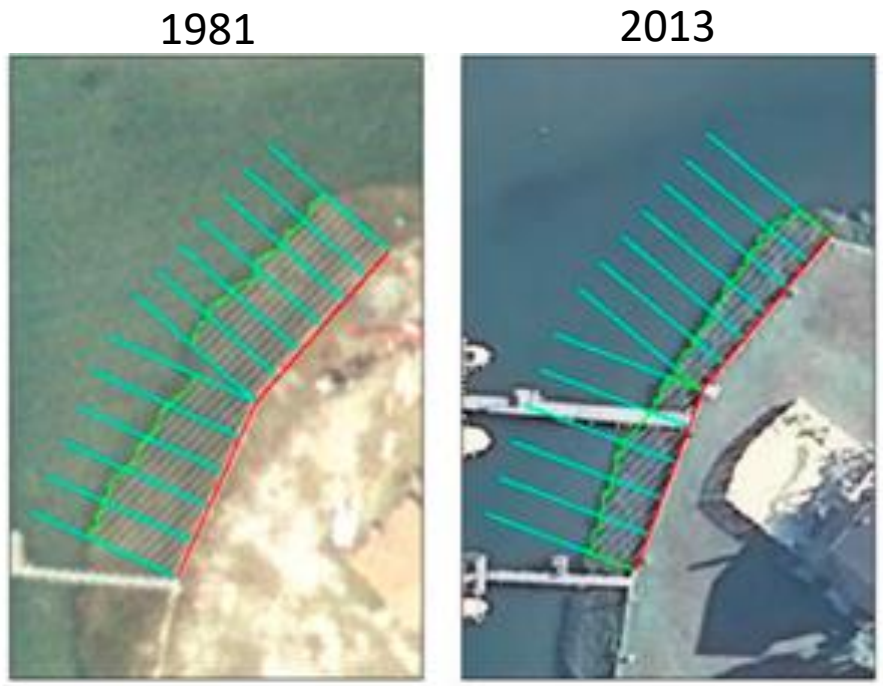


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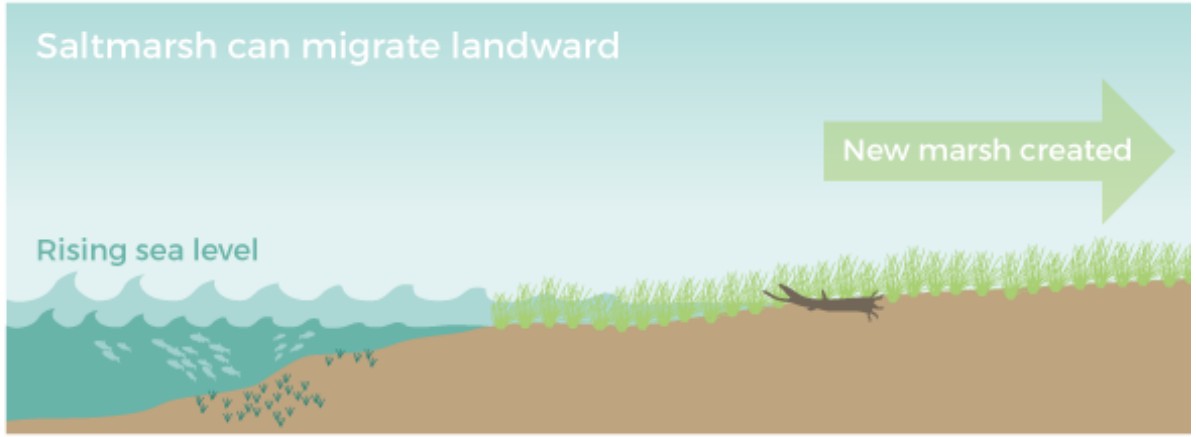
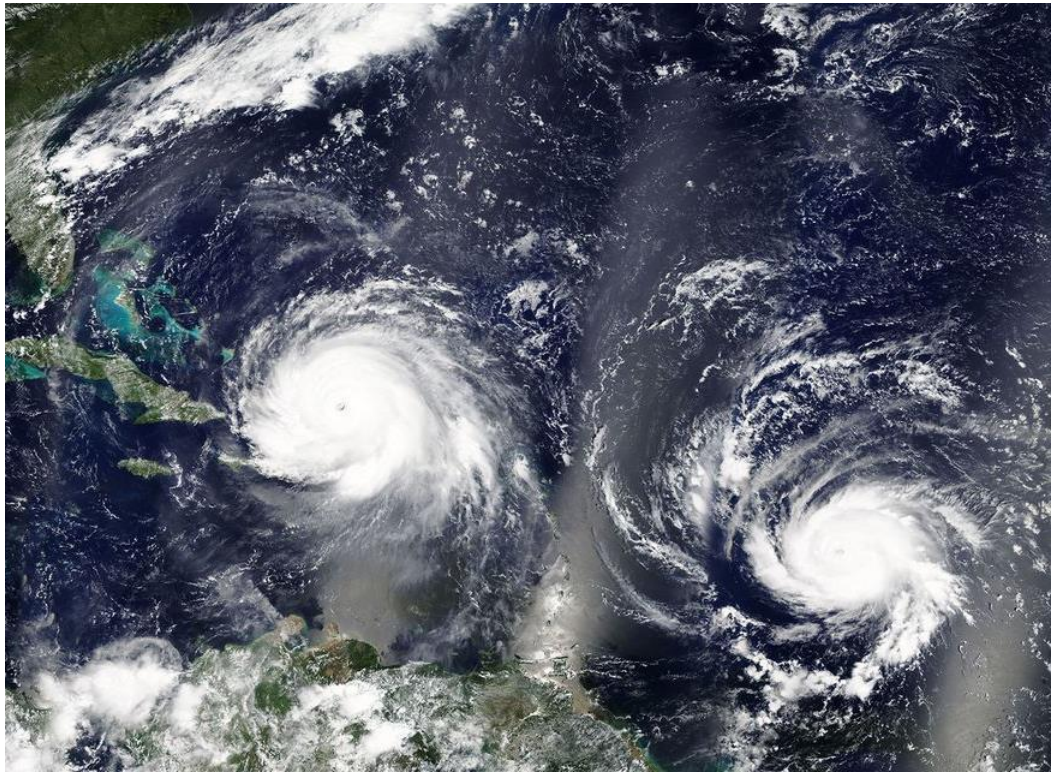
Image Source: Siders & Keenan 2020 (left); Burdick 2018 (right)

Coastal Wetlands: Current and Future Threats

Climate Change: SLR & Storms





NORTH CAROLINA
Department of Environmental Quality

Image Source: Ocean Watch; Ornes 2018

Questions?