430 Years of Fire History and Change in Pamlimarle Wetlands

Objectives -- Create fine-scale maps of:

- Presettlement Vegetation
- Pre-European Fire Regimes

Cecil Frost
Landscape Fire Ecologist

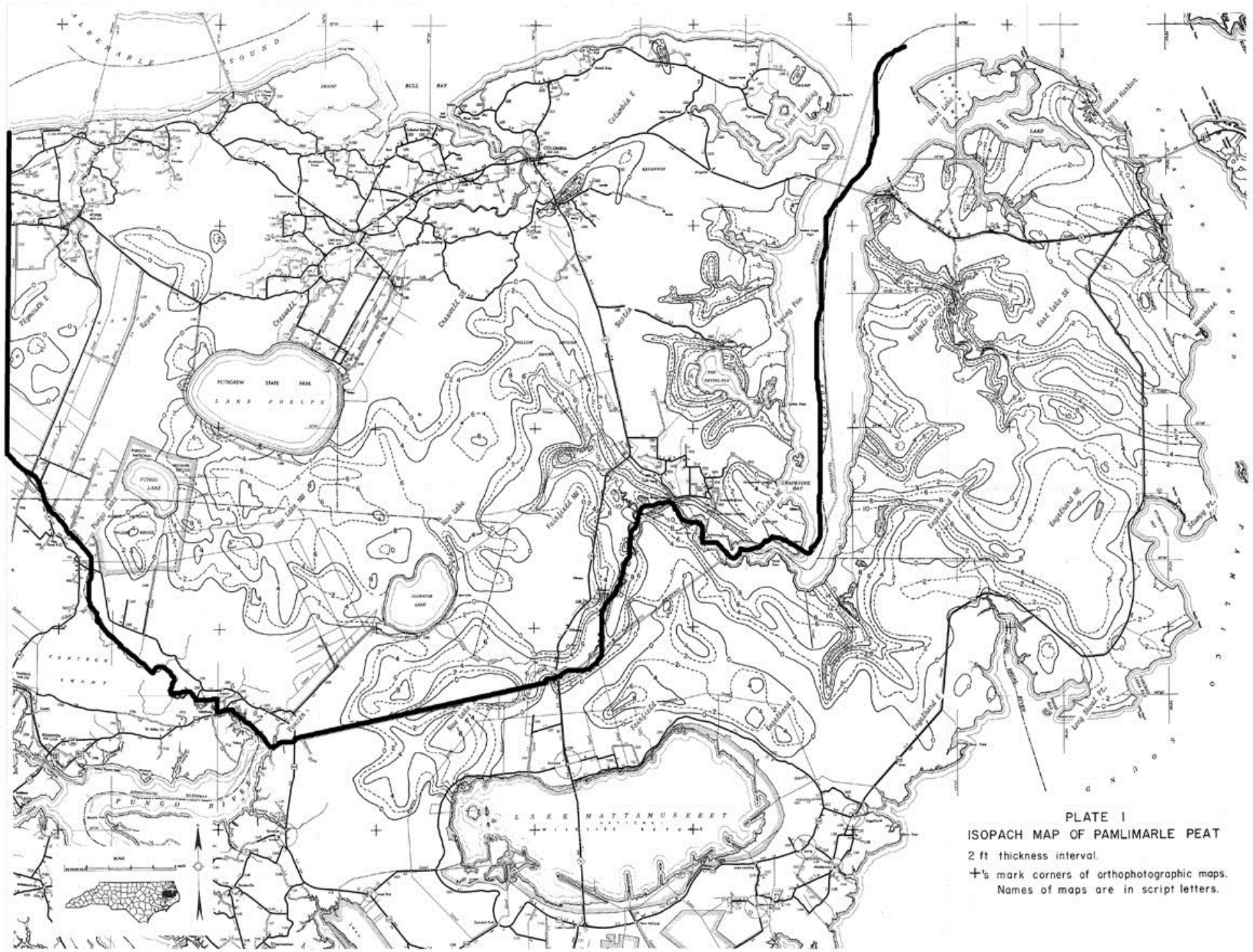


PLATE I

ISOPACH MAP OF PAMLIMARLE PEAT

2 ft thickness interval.

+'s mark corners of orthophotographic maps. Names of maps are in script letters.

Kings Mountain Region - Historical Fire Regime and Fire Paths

Presettlement Fire Regimes of The Kings Mountain Region

Fire Freq. Class	Mean Fire Interval (MFI) years	Estimated Historic Range of Variation (HRV) (90% of Fires) years	Fire Regime Description	Acres	Acres Burned Annually col.5/col2
R	variable	2-30	High elevation rocky outcrop mosaic fire exposed to slightly fire sheltered microsites	1,307	variable
A	4	2-6	Very frequent fires in open shortleaf pine-post oak-black oak savanna and woodland on the most fire exposed uplands. Very light intensity fires in grass	35,708	11,903
B	5	2-7	Frequent light surface fires in grassy pyric hardwood-shortleaf pine woodlands	56,498	14,125
C	6	3-10	Mixed fire-tolerant hardwoods with some shortleaf on only slightly fire-sheltered slopes. Light fires creeping downslope in grass, pine needle and hardwood litter	44,561	8,912
D	7	4-12	Slightly lower frequency, light surface fires in hardwood litter with some grass	21,853	3,642
E	8	5-20	Medium fire frequency in fire shadow of the Broad River and in compartments with enough internal relief to reduce fire spread	5,298	662
F	9	3-25	Hilly area near the river, partly sheltered by adjacent streams and drains	511	57
			Total acres	165,736	
			TOTAL acres burned on an average year in the original landscape		39,301

Legend
- Fire Paths
- Agency Boundary
- Roads

0 0.5 1 2 3 4 Miles

N

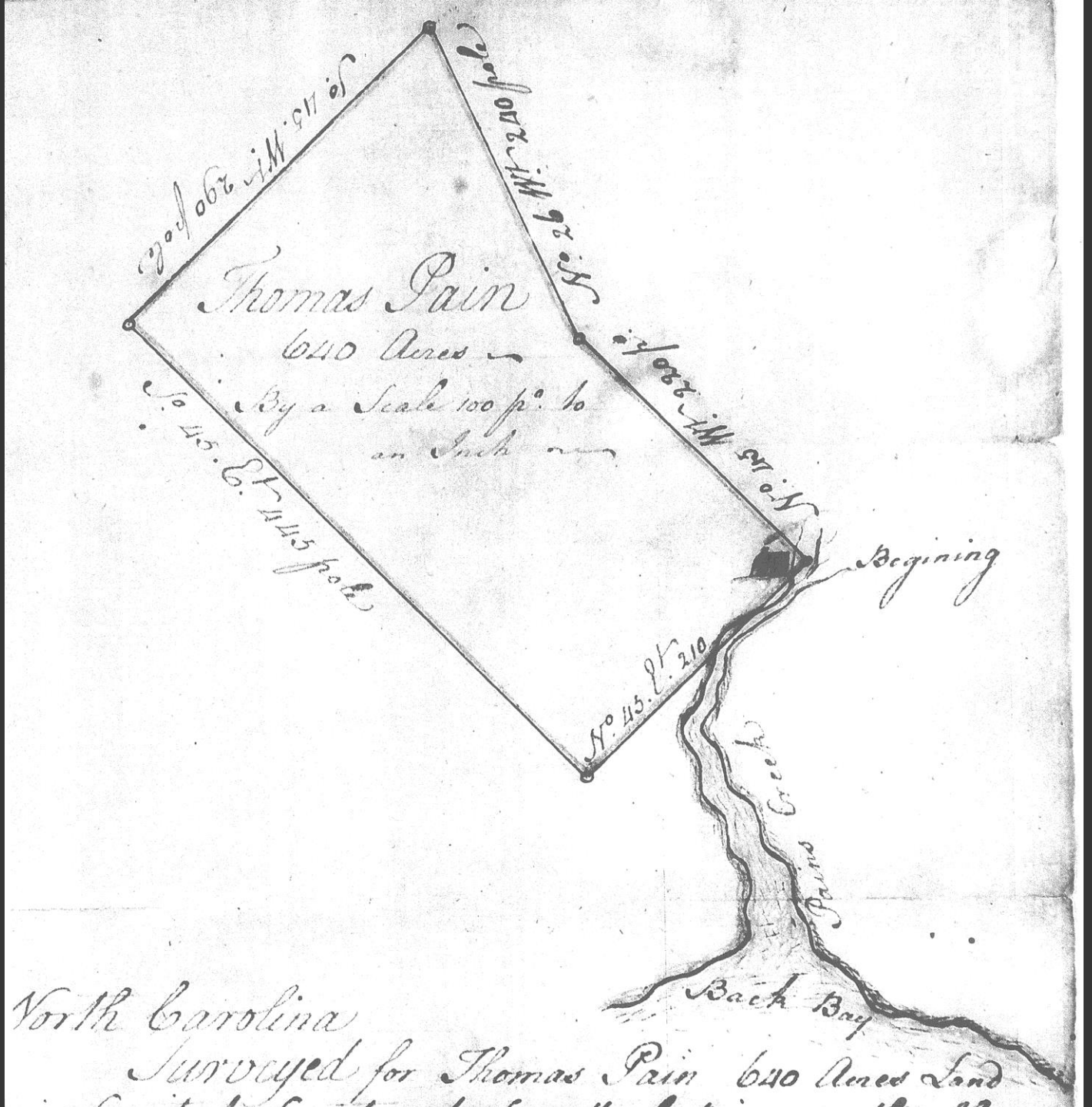
NC State University College of Natural Resources Center for Geospatial Analytics

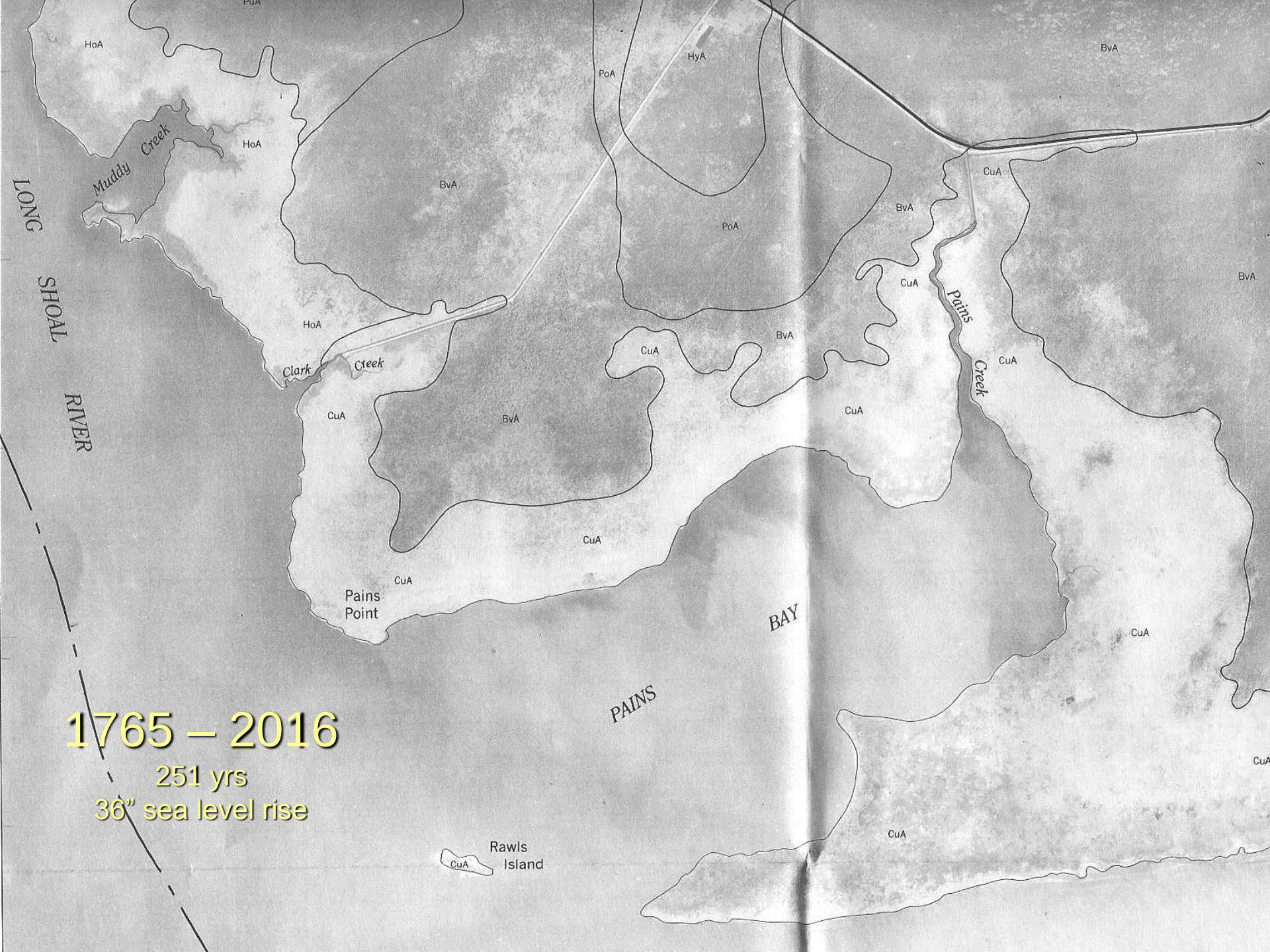
Produced by Cecil Frost and Justin Shedd

December, 2015

Pain's Bay, 1765

250 yrs, 30”





1765 – 2016

251 yrs

36” sea level rise

Hyde soils,

Pain’s old field

Sea Level Rise + Land Subsidence

Best Estimate of Sea Level Rise in Albemarle Area

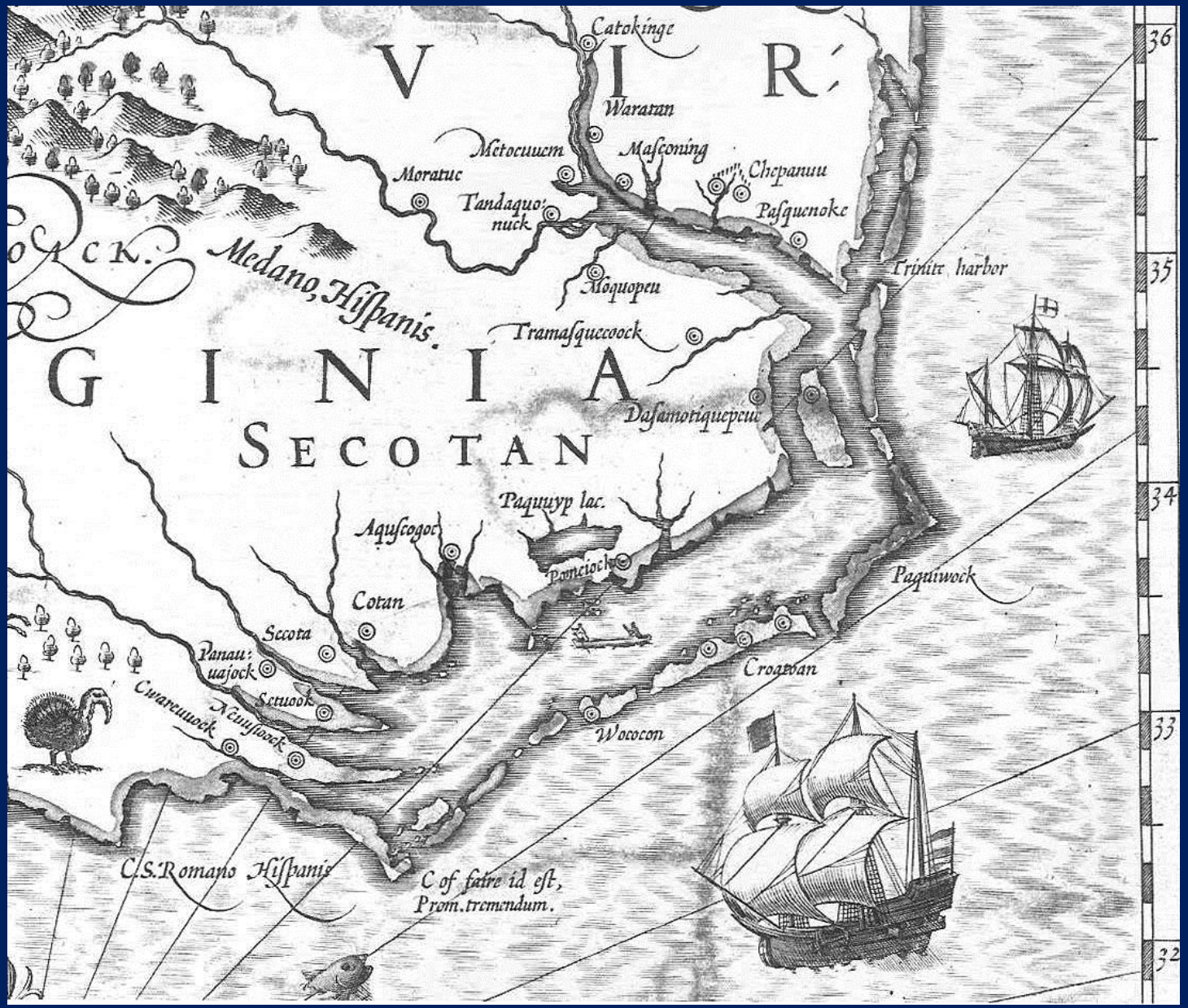
1) **Global ice melt**: 37 cm = 15 inches

2) **Thermal expansion** caused by warming of the oceans:
1mm/ yr = 10 cm/century = 4”

3) **Land subsidence** in the Albemarle area: 8 inches/century, so

TOTAL = 15 + 4 + 8 = **27” (69 cm)**

An outside chance (only 5%): add 47 cm = 18 more + 27” = 45” (close to 4 ft)



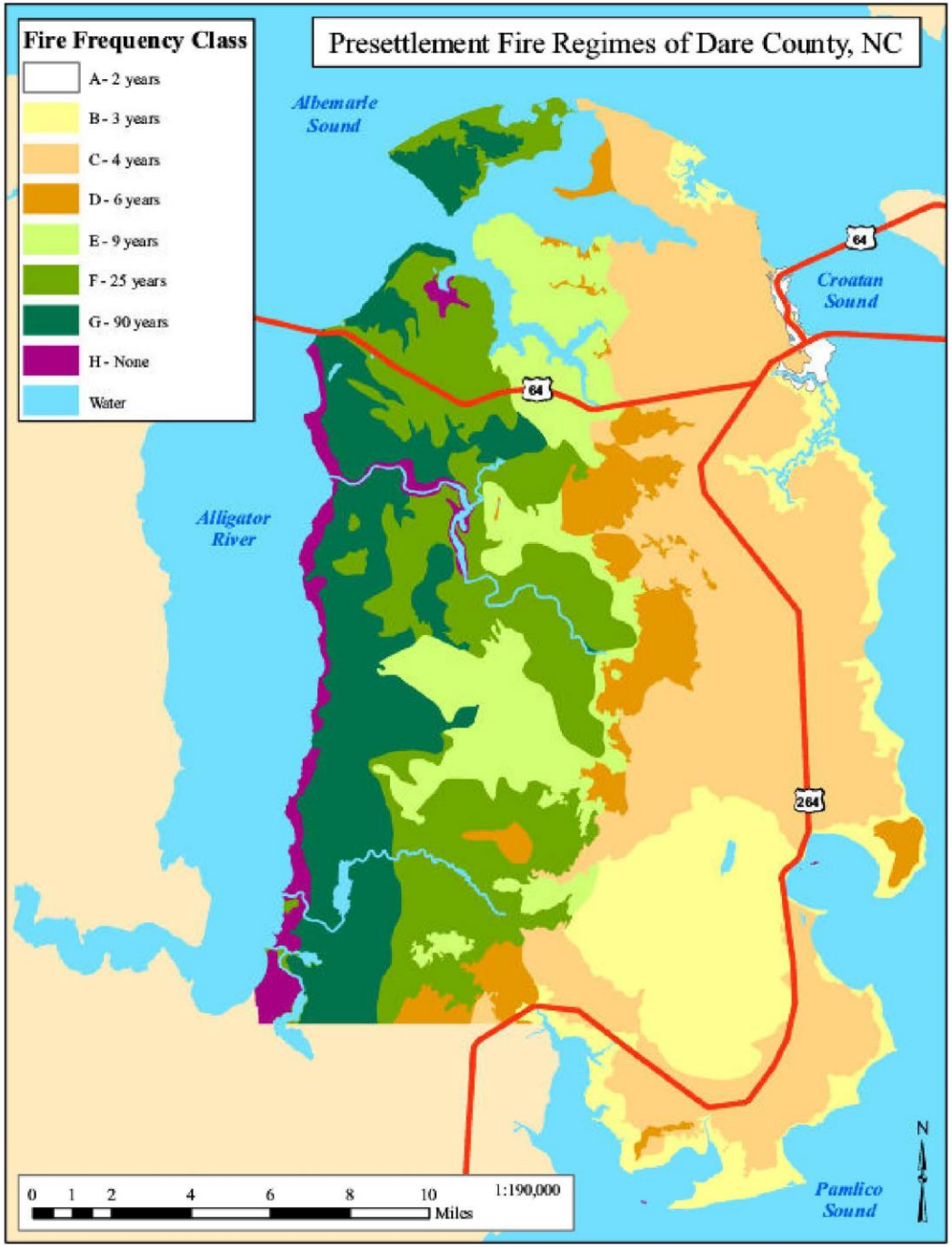
Mercator-Hondius map of 1606

Moseley 1733

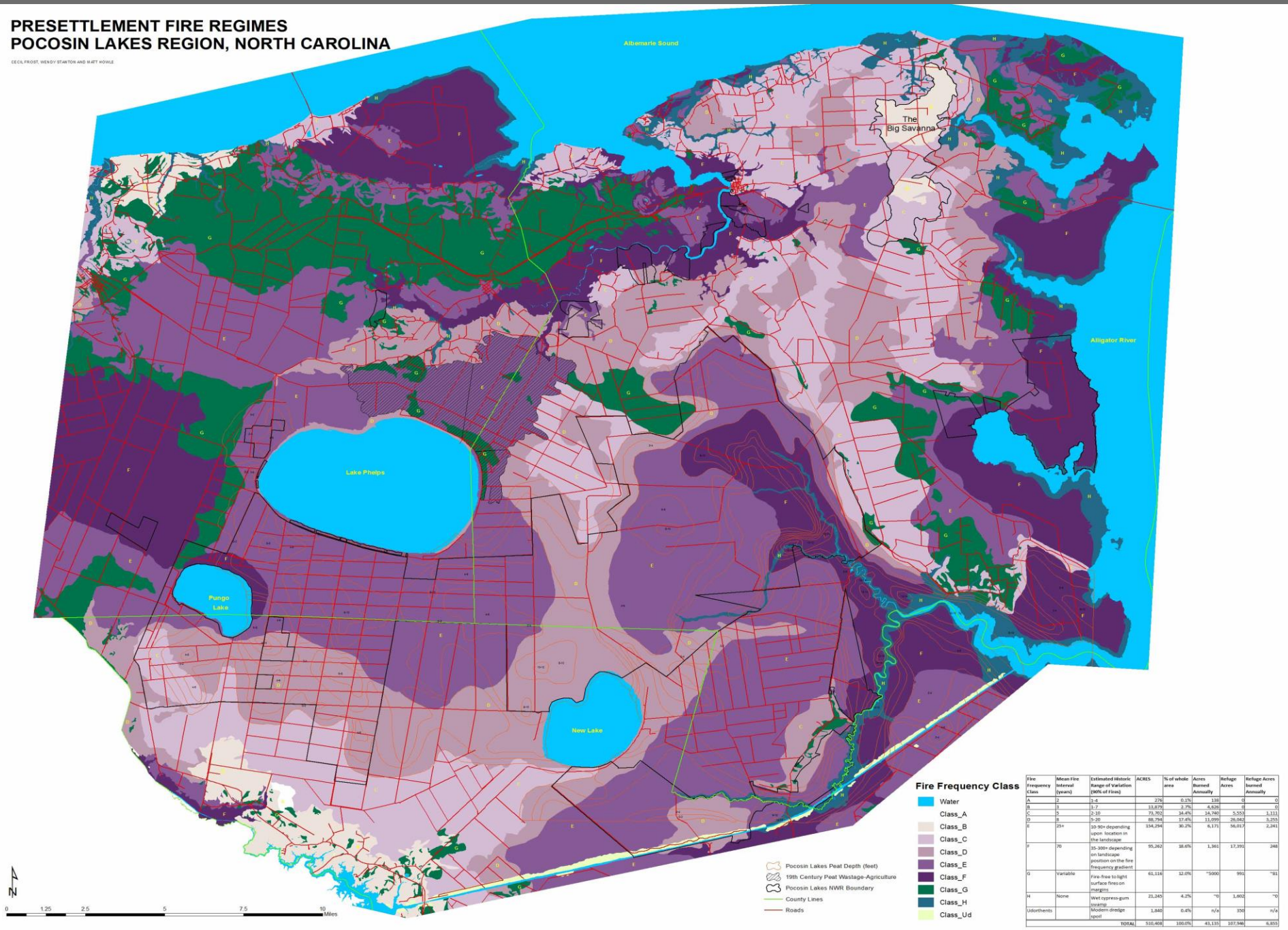
1733-1585 = 148 yrs

Price-Strother map

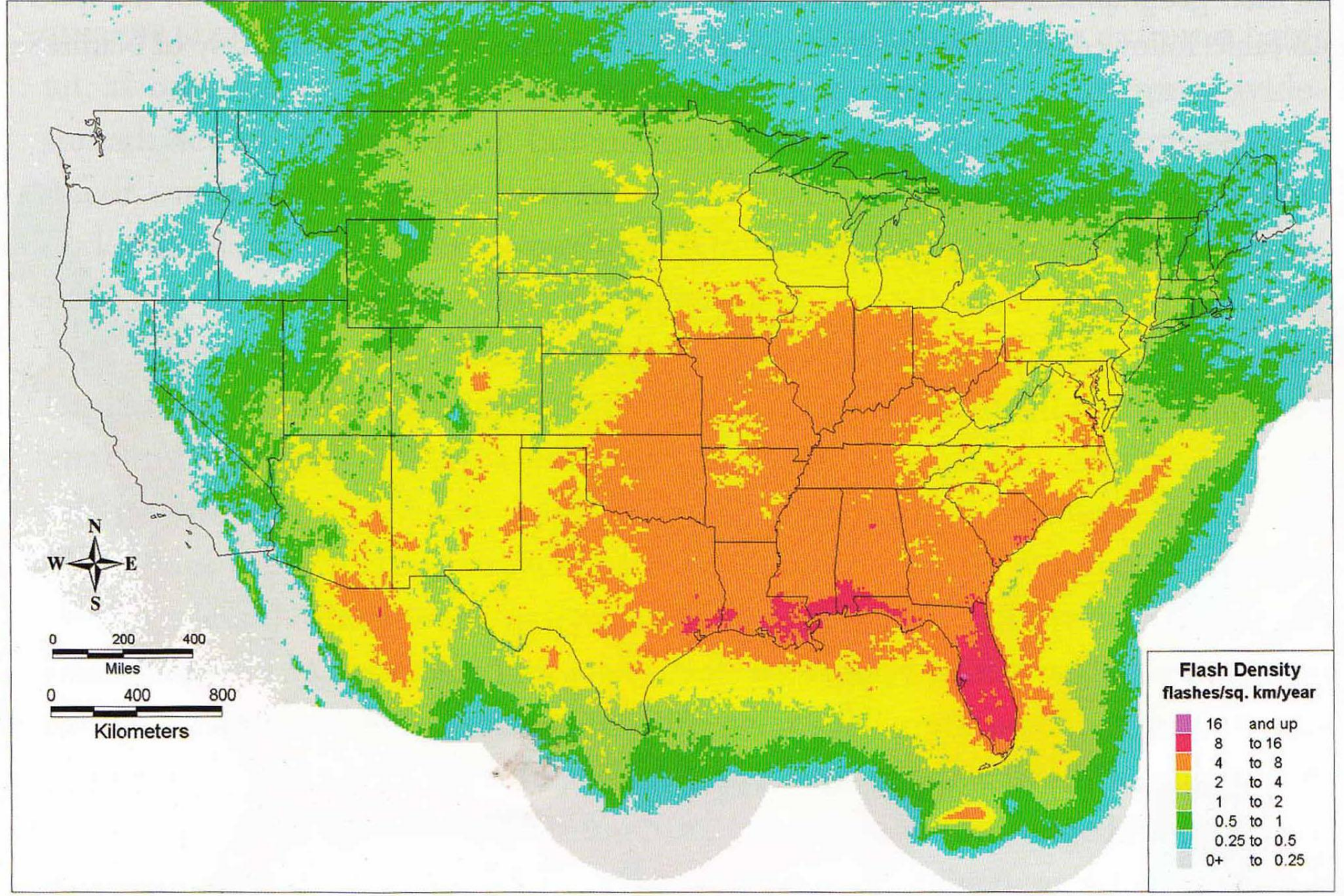
1808



Stumpy Point



Fire Frequency Class	Mean Fire Interval (years)	Estimated Historic Range of Variation (90% of Fires)	ACRES	% of whole area	Acres Burned Annually	Refuge Acres	Refuge Acres burned Annually
A	2	1-4	276	0.1%	138	0	0
B	3	1-7	13,879	2.7%	4,626	0	0
C	5	2-10	73,702	14.4%	14,740	5,553	1,111
D	8	5-20	88,794	17.4%	11,099	26,042	3,255
E	25+	10-90+ depending upon location in the landscape	154,294	30.2%	6,171	56,017	2,241
F	70	35-300+ depending on landscape position on the fire frequency gradient	95,262	18.6%	1,361	17,391	248
G	Variable	Fire-free to light surface fires on margins	61,116	12.0%	~5000	991	~81
H	None	Wet cypress-gum swamp	21,245	4.2%	~0	1,602	~0
Udorthents		Modern dredge spoil	1,840	0.4%	n/a	350	n/a
		TOTAL	510,408	100.0%	43,135	107,946	6,855



VAISALA

1996 - 2005 Flash Density Map

10 kilometer grid

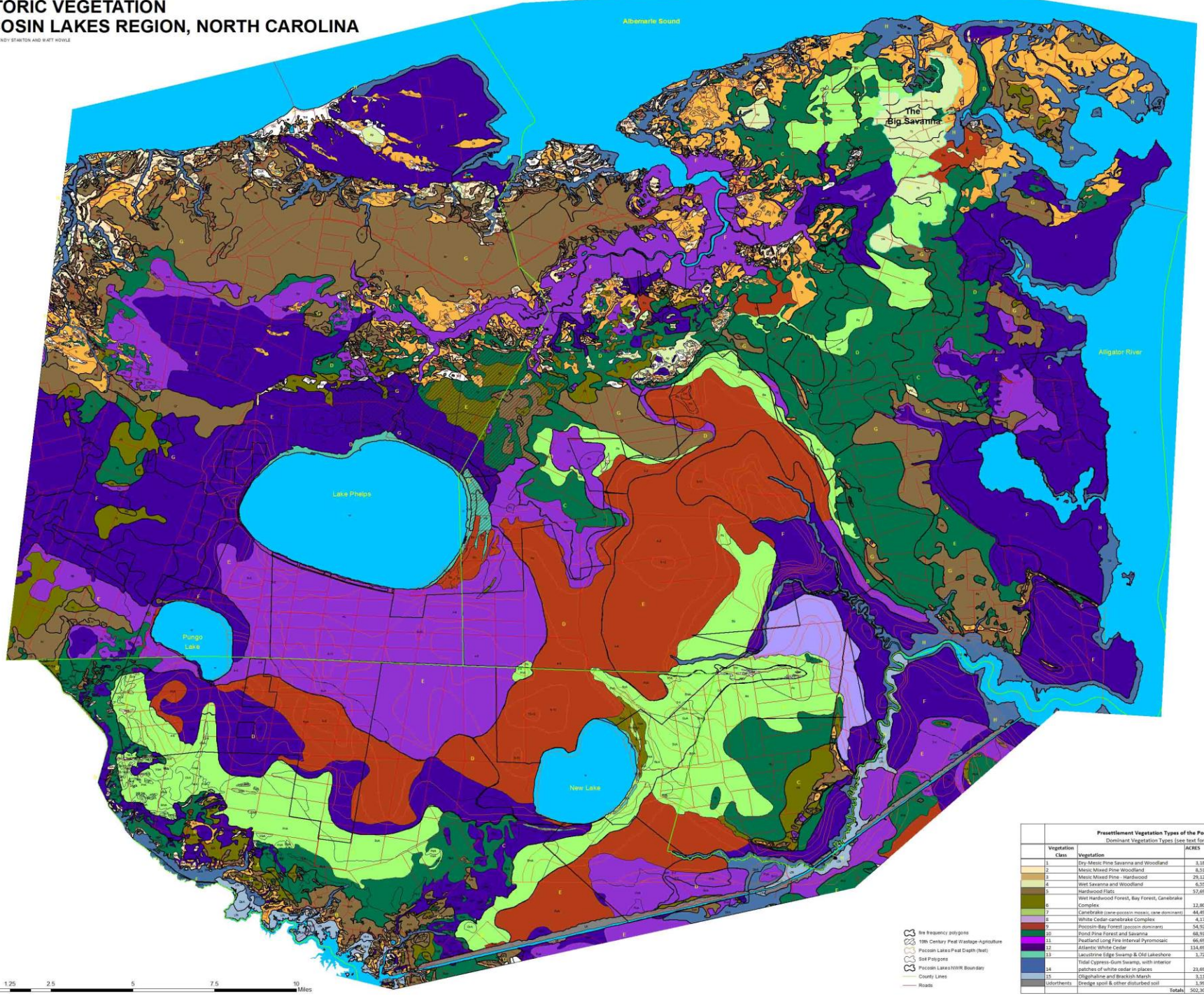
Jan 1, 1996 00:00:00 UTC
To
Dec 31, 2005 23:59:59 UTC

The Lightning Ignition Component

- The Pocosin Lakes area receives about **4 lightning strikes/sq km/yr**
- **It takes 291 to 896 lightning strikes to produce an ignition**
- Pocosin Lakes NW Refuge 107,946 a. is about **437 sq km** x 4 strikes/sq km/yr = 1**,758 lightning strikes/year**
- 1,758/896 = 2 and 1,758/291 = 6. So 2-6 **actual fires per year**
- **But** there would be poor P of I in wet forested types, so use lowest expectation of **4 fires per year historically** from lighting
- The Greater Pocosin Lakes Fireshed is 510,408 a, about 5 times larger, so 1758 x 5 = 8,790 **strikes/year**
- 8,790/896 = 10; 8,790/291 = 30. Choose lower figure **10 fires per year from lightning (3 years = 30 fires)**
- **Bottom line: enough ignition from lightning alone to maintain the major vegetation types**

HISTORIC VEGETATION
POCOSIN LAKES REGION, NORTH CAROLINA

CL FROST, WENDY STANTON AND MATT HOWLE



Presettlement Vegetation Types of the Pocosin Lakes Region
Dominant Vegetation Types (see text for included types)

Vegetation Class	Vegetation	ACRES	Percent of Study Area	Percent of Refuge Land
1	Dry-Mesic Pine Savanna and Woodland	3,187	0.6%	0.0%
2	Mesic Mixed Pine Woodland	8,530	1.7%	0.1%
3	Mesic Mixed Pine - Hardwood	29,127	5.8%	0.3%
4	Wet Savanna and Woodland	6,557	1.3%	0.0%
5	Hardwood Flats	57,695	11.5%	3.8%
6	Wet Hardwood Forest, Bay Forest, Canebrake Complex	12,801	2.5%	7.9%
7	Canebrake (cane-pocosin mosaic, cane dominant)	44,498	8.9%	9.9%
8	White Cedar-canebrake Complex	4,178	0.8%	0.3%
9	Pocosin-Bay Forest (pocosin dominant)	54,925	10.9%	32.0%
10	Pond Pine Forest and Savanna	68,914	13.7%	5.2%
11	Peatland Long Fire Interval Pyromosaic	66,657	13.3%	21.8%
12	Atlantic White Cedar	114,695	22.8%	18.6%
13	Lacustrine Edge Swamp & Old Lakeshore	1,721	0.3%	0.0%
14	Tidal Cypress-Gum Swamp, with interior patches of white cedar in places	23,691	4.7%	1.7%
15	Oligohaline and Brackish Marsh	3,115	0.6%	0.0%
Udorthents	Dredge spoil & other disturbed soil	1,994	0.4%	0.3%
	Totals	502,305	100.0%	100.0%

Atamasco lily response to fire –Hyde Co.

The Frying Pan 1982

The Frying Pan

Sea level white cedar

1984

Synthesis of multiple kinds of evidence for mapping original fire regimes

BIOTIC EVIDENCE

- **Fire frequency indicator species (proxies for fire frequency)**
- **Fire frequency indicator communities (proxies for fire frequency)**
- Reduction in fire frequency by native grazers

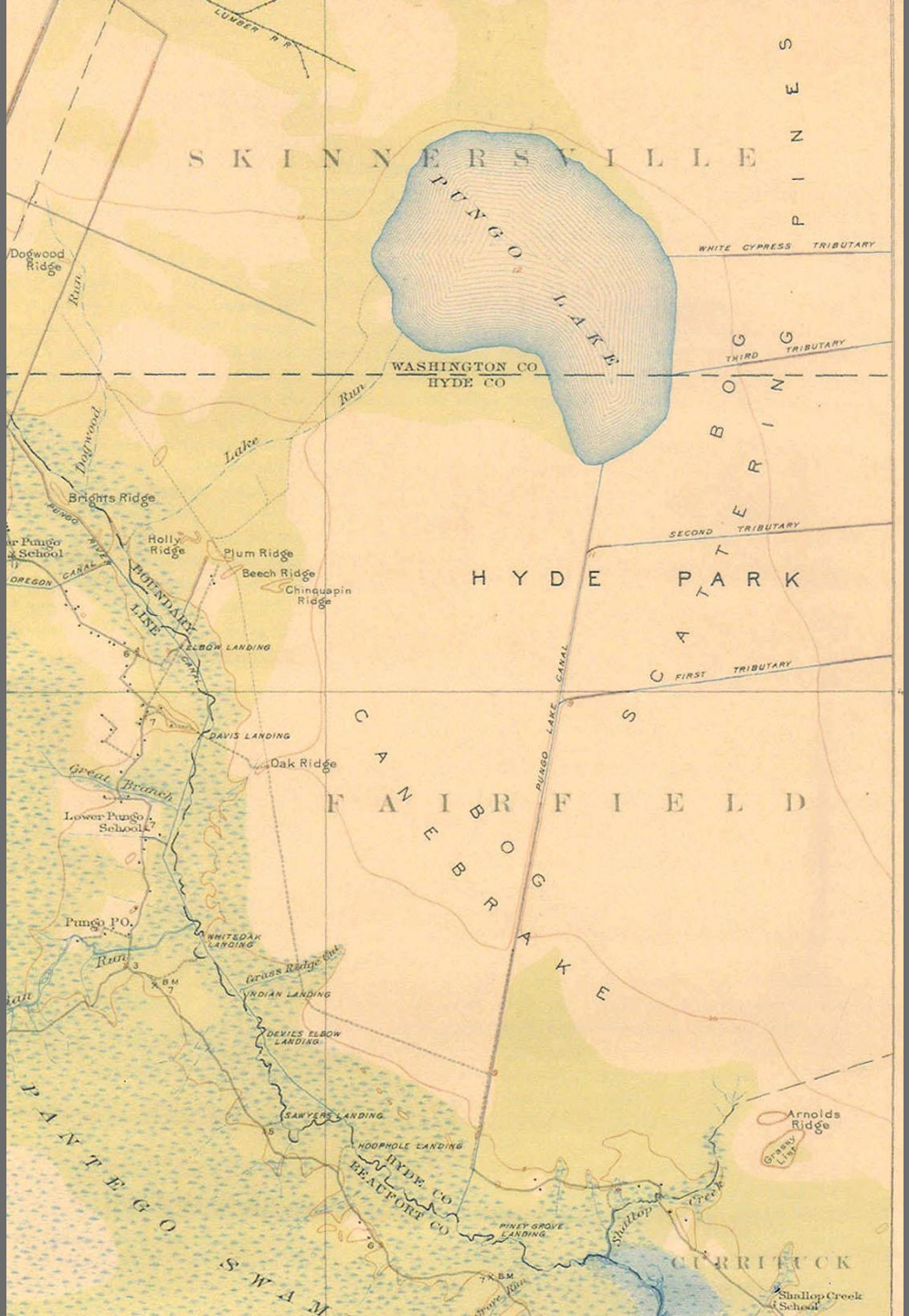
LANDSCAPE AND ENVIRONMENT FACTORS

- **Original fire compartment size**
- Presence of fire barriers, **fire pathways** and fire filters
- **Presence of Landscape-scale Fire Frequency Gradients**
- Topographic position of fire frequency indicator trees
- Effects of soil productivity on fire behavior (mediated by vegetation)
- Lightning generators, strike density and ignition records

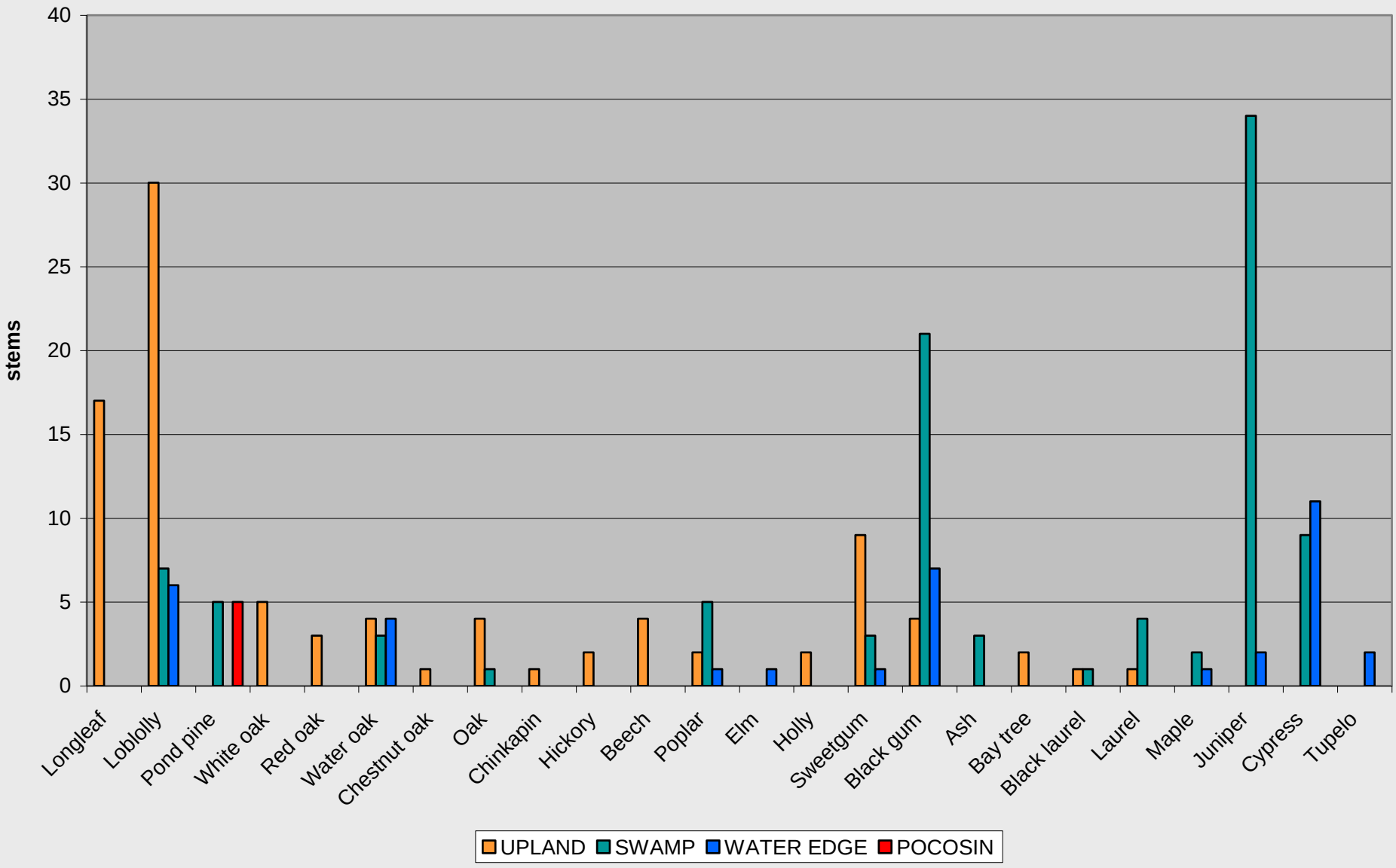
HISTORICAL EVIDENCE

- **Witness trees from early surveys**
- Fire scar chronologies
- Vegetation types mentioned by early travelers or surveyors
- Herbarium records of fire frequency indicator species or communities
- Historical photos or paintings done in the presettlement landscape
- Historical references to use of fire by Native Americans
- **Original Native American population centers**
- Vegetation types on old aerial photos or topo maps.

Belhaven
1941

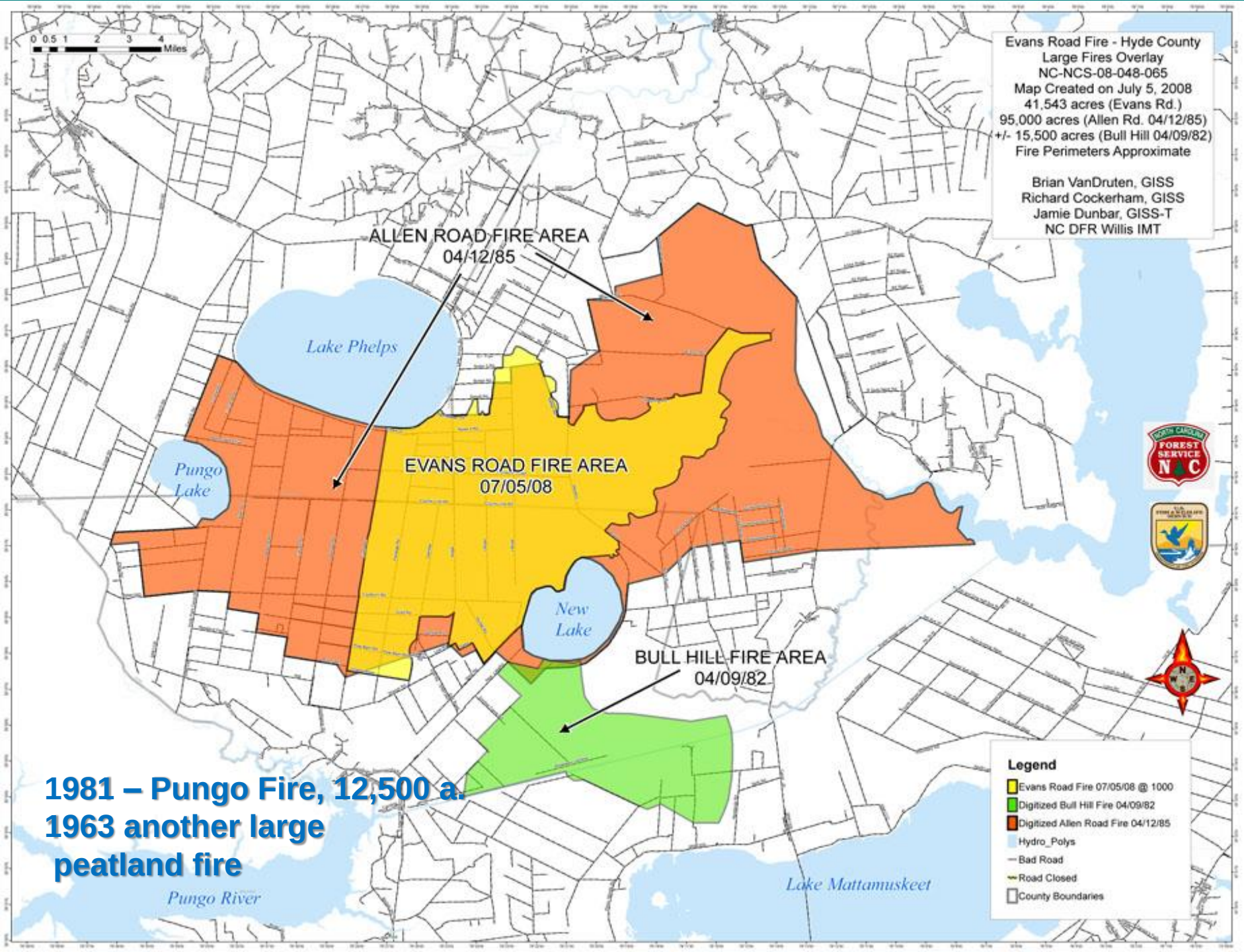


TREES ALONG THE ALBEMARLE AND SCUPPERNONG UPLANDS



PRESETTLEMENT FIRE FREQUENCIES – POCOSIN LAKES REGION

Fire Frequency Class	Mean Fire Interval (years)	Historic Range of Variation (years)	Acres – Whole Region	% of Whole Region	Acres Burned Annually	Refuge Acres	Refuge Acres Burned annually
A	2	1-4	276	0.1%	138	0	**0**
B	3	2-7	13,879	2.7%	4,626	0	**0**
C	5	2-10	73,702	14.4%	14,740	5,553	**1,111**
D	8	5-20	88,794	17.4%	11.099	26,042	3,255
E	25+	10-90+ depending on location in the landscape	154,294	30.2%	6,171	56,017	2,241
F	70	35-300+	95,262	18.6%	1,361	17,391	248
G	Variable	Fire-free to light surface fires on margins	61,116	12.0%	~5,000	991	~81
H	None	Wet cypress-gum swamp	21,245	4.2%	~0	1,602	~0
Ud	n.a.	Dredge spoil	1,840	0.4%	n.a.	350	n.a.
		TOTALS	510,408	100.0%	43,135	107,946	6,855



1981 – Pungo Fire, 12,500 a.
1963 another large peatland fire

CANEBRAKE

Allen Road Fire
April 1985

Western Road,
looking west

PRESETTLEMENT DISTRIBUTION OF PEATLAND VEGETATION OF THE SOUTHEASTERN U.S. ALONG MASTER GRADIENTS OF FIRE FREQUENCY AND DEPTH OF ORGANIC SOIL

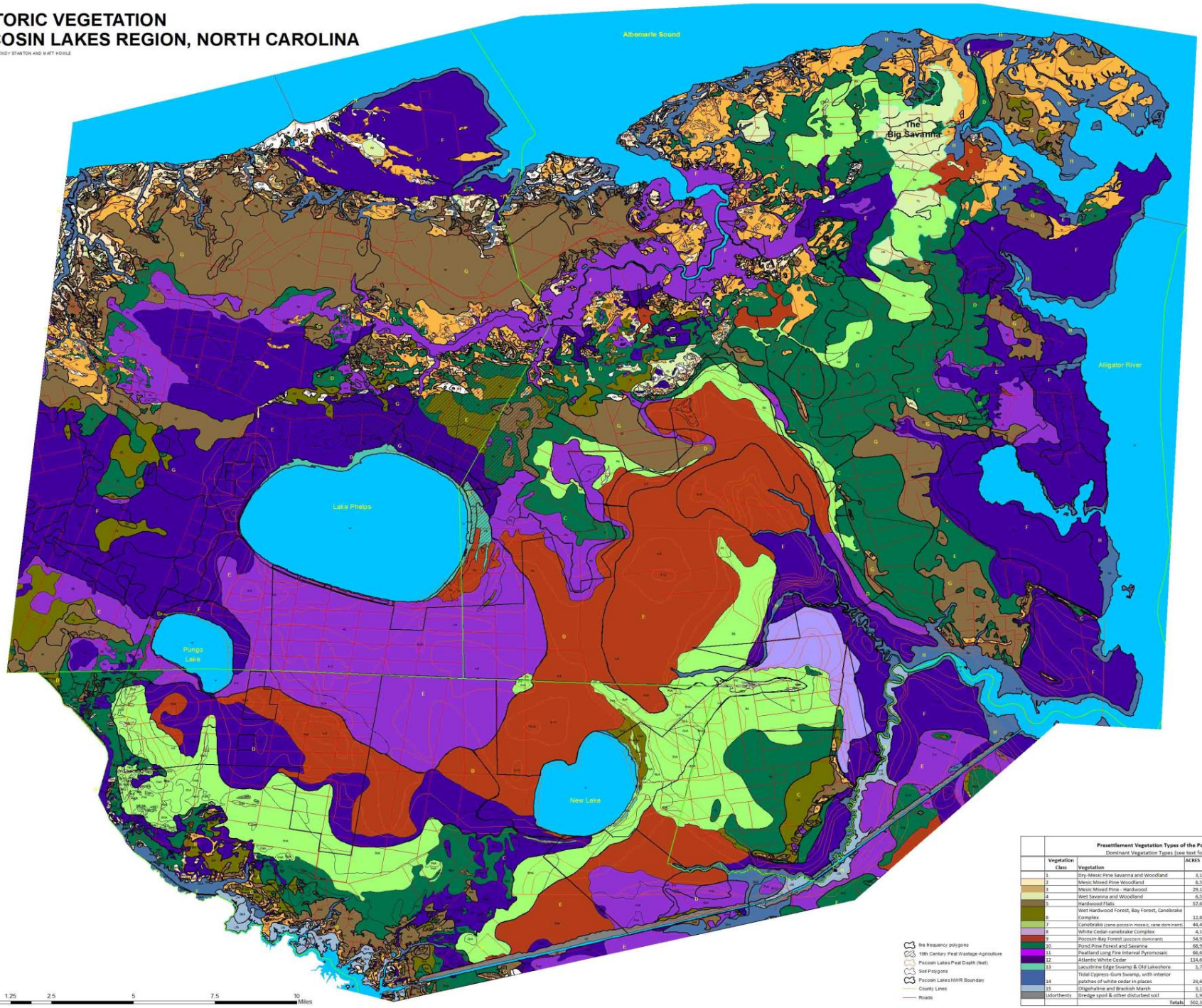
CELLS 1-32: MODERATELY FERTILE SITES

FIRE FREQUENCY

ORGANIC MATTER DEPTH	1-3 YEARS	4-6 YRS	7-12 YRS	13-25 YRS	26-50 YRS	51-100 YRS	100-300 YRS	NEVER BURNED
Seasonally wet mineral soils ROW 1	Species-rich wet prairie with graminoids and grass-leaved forbs CELL 1	Species-rich wet prairie, with dwarf shrubs CELL 2	ANGL, ARGI, CLJA, ILGL, CYRA, CLMO, tree saplings CELL 3	Small ACRU, NYBI, LIST, PISE, PITA, PIEL, TAAS CELL 4	Dense ACRU, NYBI, TAAS, LIST, PISE, PITA, PIEL/ ARGI, Shrubs CELL 5	PITA, PIEL, TAAS, QUMI, PISE, ACRU, LIST/ sparse ARGI, ferns CELL 6	TADI, FRPE, LIST, ACRU, NYBI, QUMI other bottomland oaks/mesophytic herbs CELL 7	TADI, NYBI, FRPE, LIST, ACRU, bottom-land oaks CELL 8
Soils with thin organic layers, 10-30 cm thick ROW 2	Wet prairie and bog graminoids and forbs, patches of ARGI, ANGL CELL 9	Dense canebrake CELL 10	Alternating canebrake and pocosin CELL 11	PISE, ACRU, PITA, PIEL, TAAS, LIST/ ARGI CELL 12	PISE, PITA, PIEL, TAAS, LIST, NYBI/ PEPA, MAVI CELL 13	PISE forest, PITA, PIEL, TAAS, bottomland hardwoods, bay forest CELL 14	TADI, NYBI, FRPE, LIST, PITA/ ACRU, FRCA/ Carex, swamp herbs CELL 15	TADI, NYAQ, NYBI/ ACRU, FRCA, ULAM/ swamp shrubs, herbs CELL 16
Shallow histosols, 30-100 cm thick ROW 3	Open bog with dwarf shrubs, graminoids, pitcher plants, short cane, mosses CELL 17	Dense canebrake CELL 18	Alternating canebrake and pocosin CELL 19	PISE/ canebrake, alternating with PISE-ACRU tall pocosin CELL 20	Patch mosaic: PISE forest, ACRU forest, CHTH forest, bay forest with PEPA, MAVI CELL 21	Patch mosaic: CHTH forest, TADI/ACRU forest, PISE forest, NYBI forest, bay for. CELL 22	Extensive CHTH forest and patch mosaic as in Cell 22 CELL 23	TADI in wet swamps, cycling ACRU forest in peatlands (hypothetical) CELL 24
Deep histosols, peat deeper than 1 m ROW 4	Open bog with low shrubs, pitcher plants, grasses and sedges CELL 25	Canebrake or Low pocosin with ANGL, and bog herbs CELL 26	Alternating canebrake and pocosin, or medium to tall pocosin CELL 27	Tall pocosin with PISE, GOLA, ACRU; PISE forest, bay forest, CHTH patch mosaic CELL 28	Patch mosaic of types seen in Cell 22 CELL 29	Extensive CHTH forests and patch mosaic of types seen in cell 22 CELL 30	Extensive old growth CHTH forests and patch mosaic of types in cell 22 CELL 31	TADI in wet swamps, cycling ACRU forest in peatlands (hypothetical) CELL 32

HISTORIC VEGETATION
POCOSIN LAKES REGION, NORTH CAROLINA

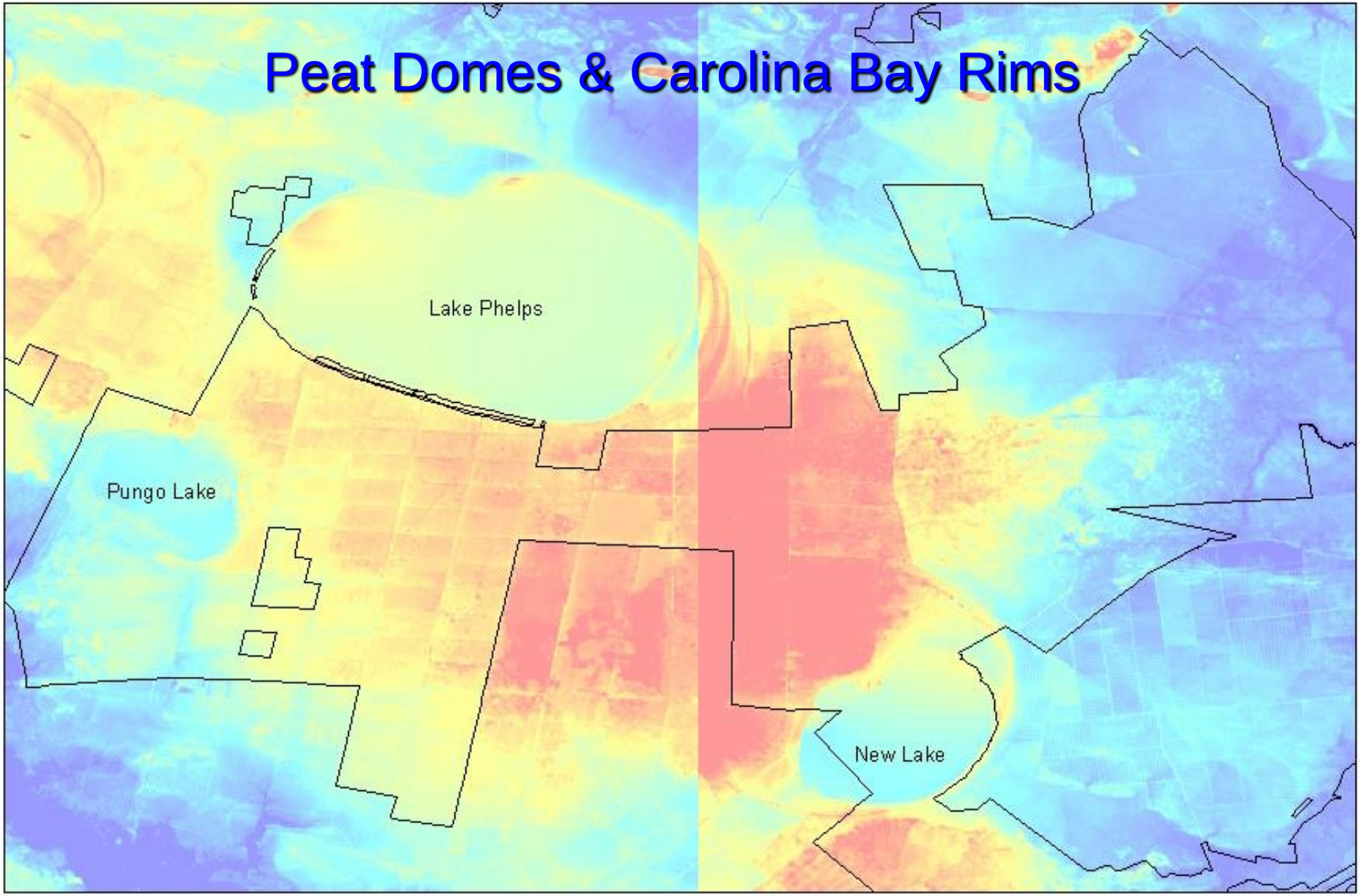
CECIL FROST, WENDY STANTON AND MATT HOWLE



Presettlement Vegetation Types of the Pocosin Lakes Region
Dominant Vegetation Types (see text for included types)

Vegetation Class	Vegetation	ACRES	Percent of Study Area	Percent of Refuge Land
1	Dry-Mesic Pine Savanna and Woodland	3,187	0.6%	0.0%
2	Mesic Mixed Pine Woodland	8,510	1.7%	0.1%
3	Mesic Mixed Pine - Hardwood	29,127	5.8%	0.3%
4	Wet Savanna and Woodland	6,557	1.3%	0.0%
5	Hardwood Flats	57,695	11.5%	3.8%
6	Wet Hardwood Forest, Bay Forest, Canebrake Complex	12,801	2.5%	7.9%
7	Canebrake (cane-pocosin mosaic, cane dominant)	44,498	8.9%	9.9%
8	White Cedar-canebrake Complex	4,178	0.8%	0.3%
9	Pocosin-Bay Forest (pocosin dominant)	54,925	10.9%	32.0%
10	Pond Pine Forest and Savanna	68,914	13.7%	5.2%
11	Peatland Long Fire Interval Pyromosaic	66,697	13.3%	21.8%
12	Atlantic White Cedar	114,695	22.8%	16.6%
13	Lacustrine Edge Swamp & Old Lakeshore	1,721	0.3%	0.0%
14	Tidal Cypress-Gum Swamp, with interior patches of white cedar in places	23,691	4.7%	1.7%
15	Oligohaline and Brackish Marsh	3,115	0.6%	0.0%
Udorthents	Dredge spoil & other disturbed soil	1,994	0.4%	0.3%
	Totals:	502,305	100.0%	100.0%

Peat Domes & Carolina Bay Rims



Prepared by Stacy Troumby
For Fire History Project

NAD 1983
StatePlane North Carolina

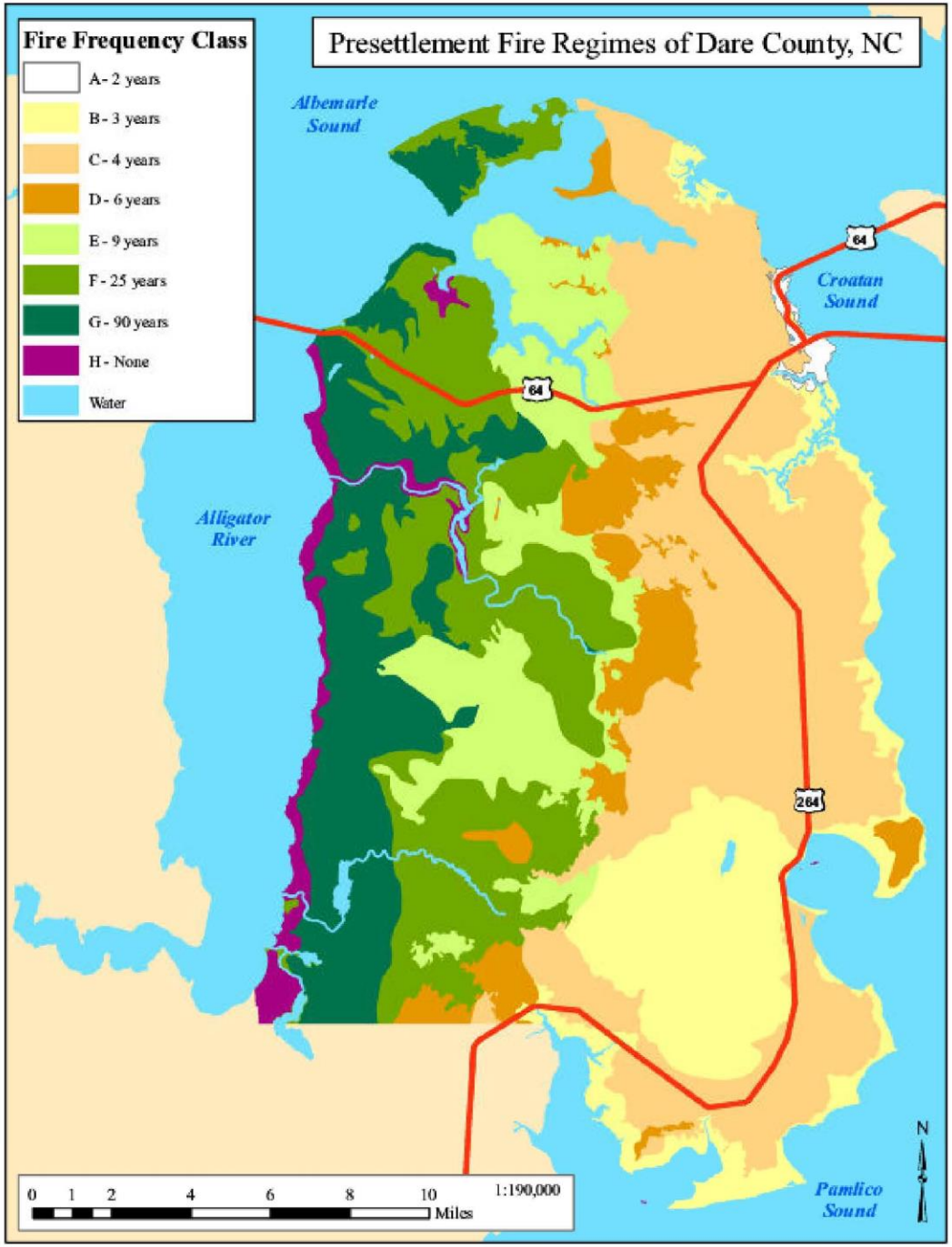
PLNWR_boundary

High : 12.6273

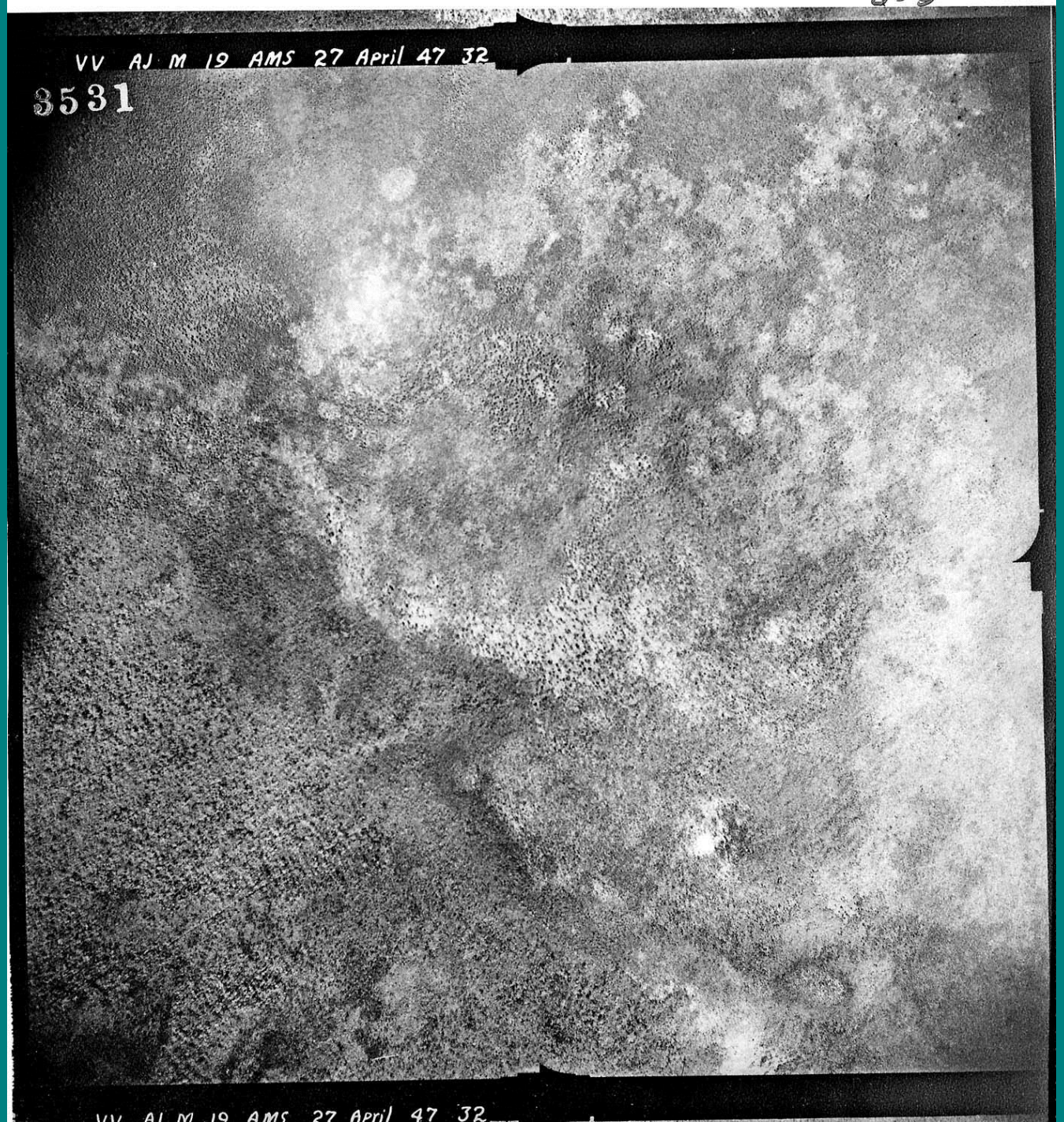
Low: 0

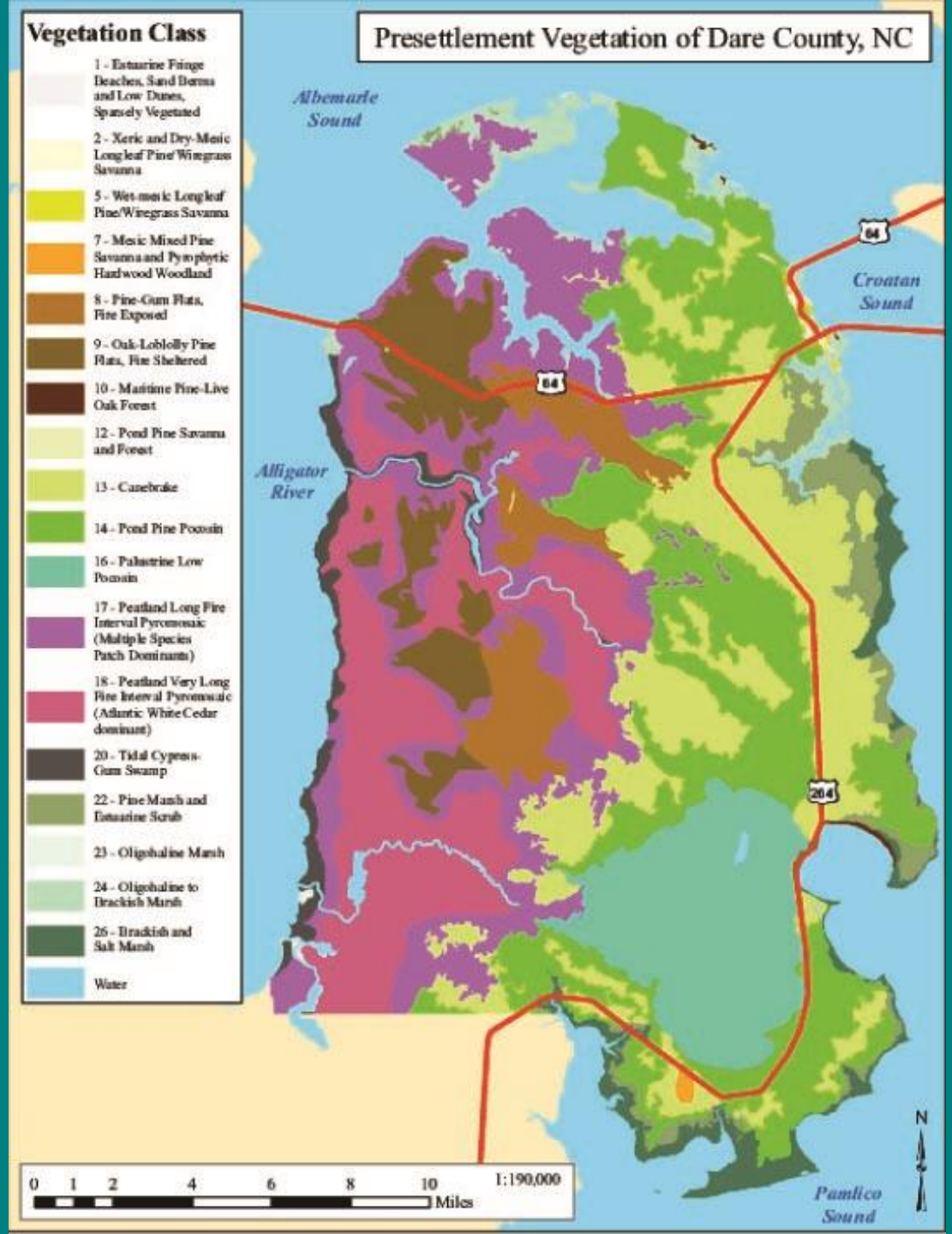
0 1 2 4 6 8 10
Miles

NAD 1983
State Plane North Carolina

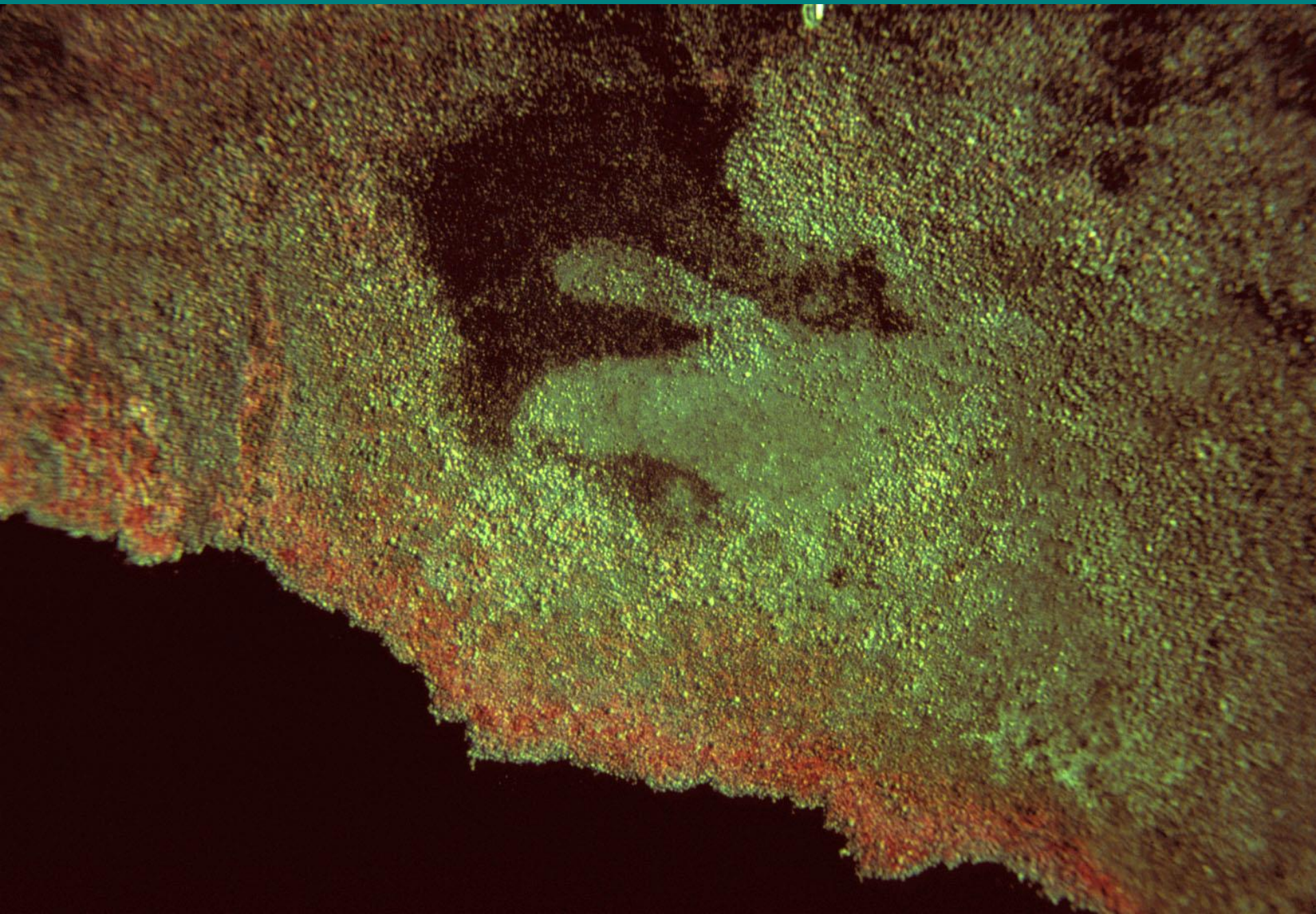


Stumpy Point


VV AJ M 19 AMS 27 April 47 32
3531


Presettlement Vegetation of Dare County, NC
Vegetation Class
1 - Estuarine Fringe Beaches, Sand Berms and Low Dunes, Sparsely Vegetated
2 - Xeric and Dry-Mesic Longleaf Pine/Wiregrass Savanna
5 - Wet-mesic Longleaf Pine/Wiregrass Savanna
7 - Mesic Mixed Pine Savanna and Pyrophytic Hardwood Woodland
8 - Pine-Gum Flats, Fire Exposed
9 - Oak-Loblolly Pine Flats, Fire Sheltered
10 - Maritime Pine-Live Oak Forest
12 - Pond Pine Savanna and Forest
13 - Canebrake
14 - Pond Pine Pocosin
16 - Palustrine Low Pocosin
17 - Peatland Long Fire Interval Pyromosaic (Multiple Species Patch Dominants)
18 - Peatland Very Long Fire Interval Pyromosaic (Atlantic White Cedar dominant)
20 - Tidal Cypress-Gum Swamp
22 - Pine Marsh and Estuarine Scrub
23 - Oligohaline Marsh
24 - Oligohaline to Brackish Marsh
26 - Brackish and Salt Marsh
Water
Albemarle Sound
Croatan Sound
Alligator River
Pamlico Sound
64
64
264
N
0 1 2 4 6 8 10 Miles
1:190,000

Peatland Fire Patch Mosaic



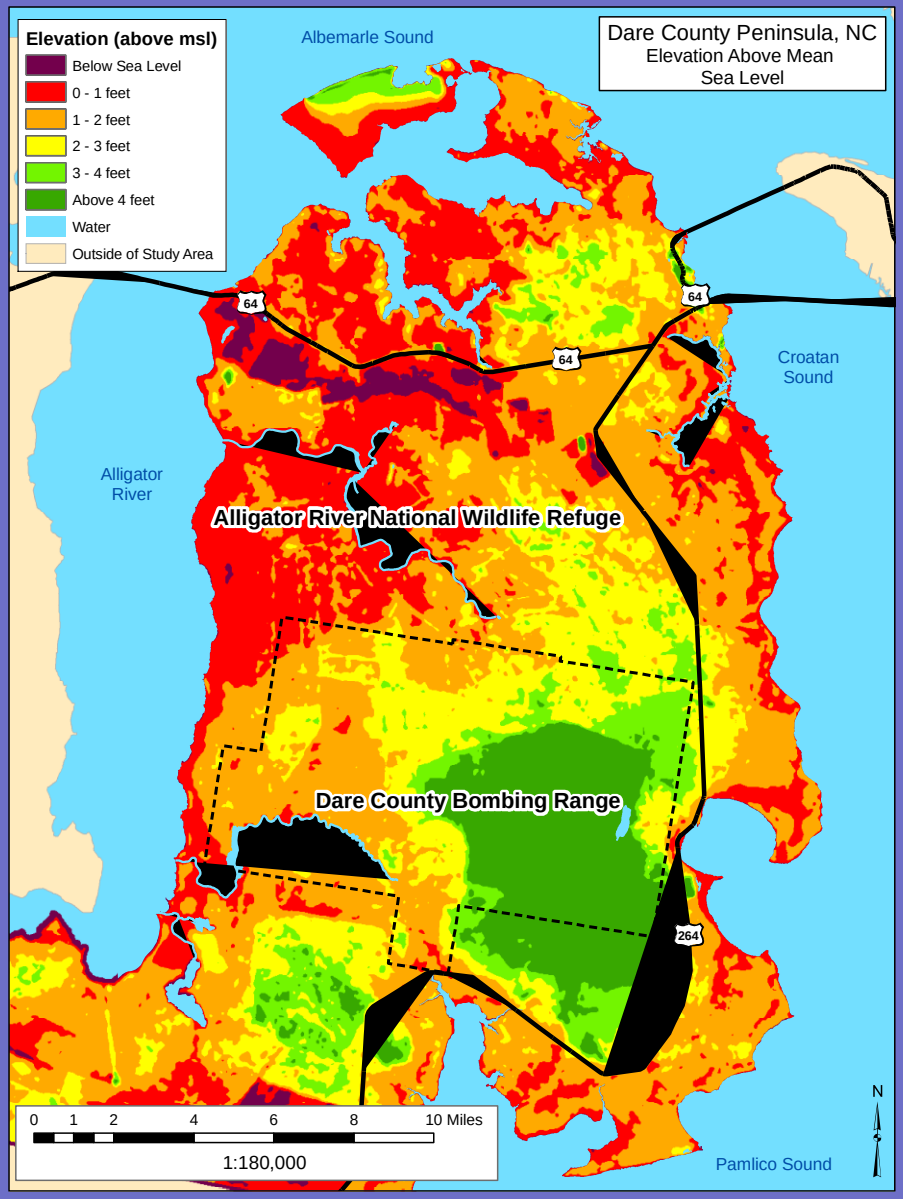
Pre-European Fire Regimes of the Dare Mainland

Fire Frequency Class	Mean Fire Interval (years)	Estimated Historic Range of Variation (90% of Fires) (years)	ACRES	PERCENT
A	2	1-4	1,192	0.6
B	3	1-6	**28,727**	**14.7**
C	4	2-10	63,468	32.5
D	6	3-20	12,484	6.4
E	9	4-50 depending upon vegetation type and location in the landscape	21,993	11.3
F	25	10-100 depending upon vegetation type and location in the landscape	35,116	18.0
G	90	35-300+ depending on landscape position along the fire frequency gradient	**26,357**	**13.5**
H	None	Nonflammable, tidal cypress-tupelo swamp	4,712	2.4
Water			1,239	0.6
		TOTAL	195,288	100

Global Change Impacts

The impacts of sea level rise and long-term climatic changes to the frequency and severity of severe weather events pose risks to coastal ecosystems.

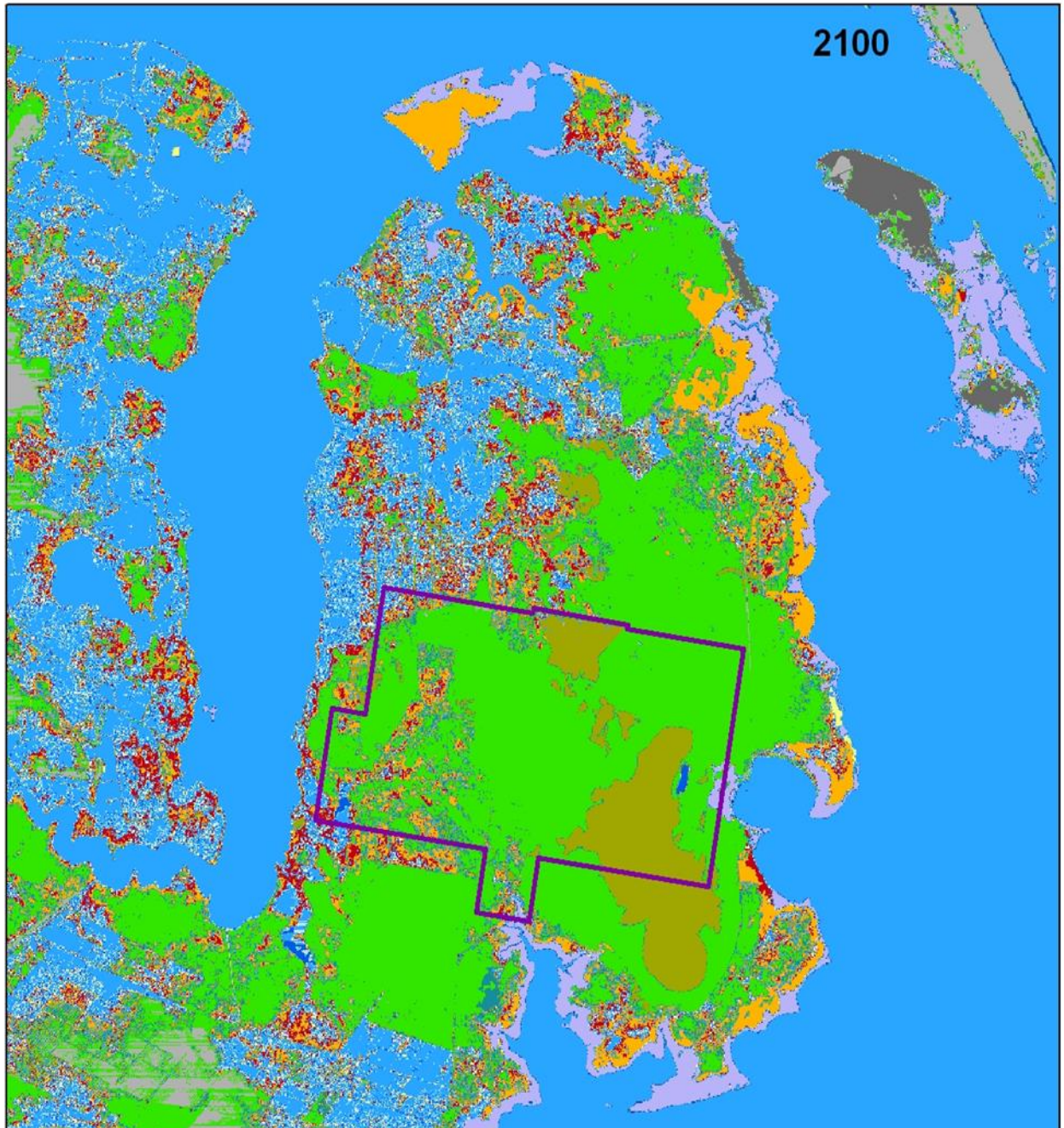
Lidar digital elevation data and receding shoreline on Dare County peninsula illustrate future and current risks.



Conservative Model of Sea Level Rise (SLAMM)

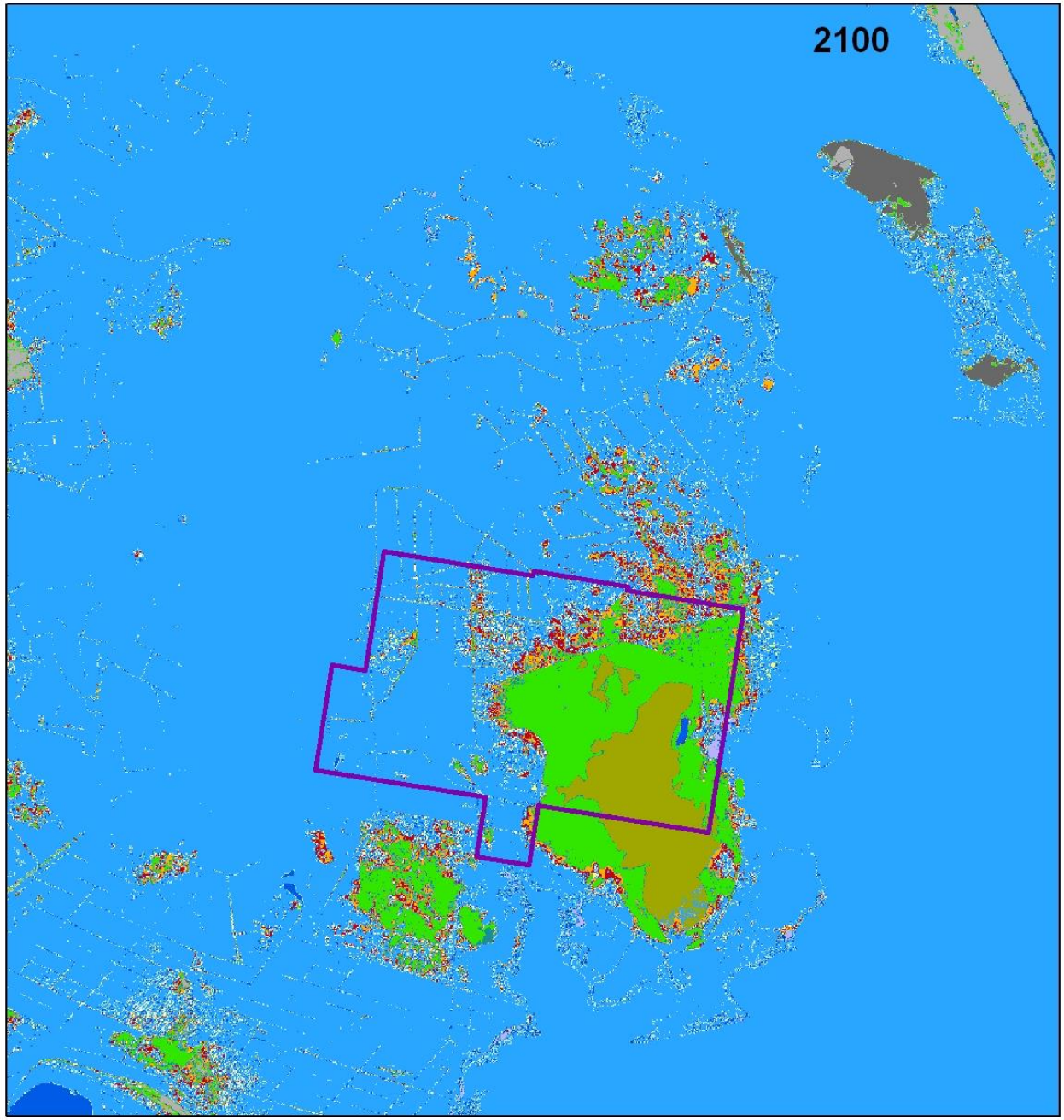
Air Force Dare County Bombing Range Sea Level Rise Simulation

IPCC Scenario A1B Minimum: 0.13 m by 2100



Air Force Dare County Bombing Range
Sea Level Rise Simulation

IPCC Scenario A1B Maximum: 0.7 m by 2100



Rx Fire Implications

for maintaining fire-dependent vegetation and communities for Pocosin Lakes and Alligator River NWRs

Pocosin Lakes

- Critical to have **good water control structures** on all ditches in the central peatlands
- **Use fire to maintain the best peatland canebrakes remaining**
- Use fire as needed to maintain the areas with pitchers plants and other wet low pocosins and bogs

Alligator River & Dare County Bombing Range

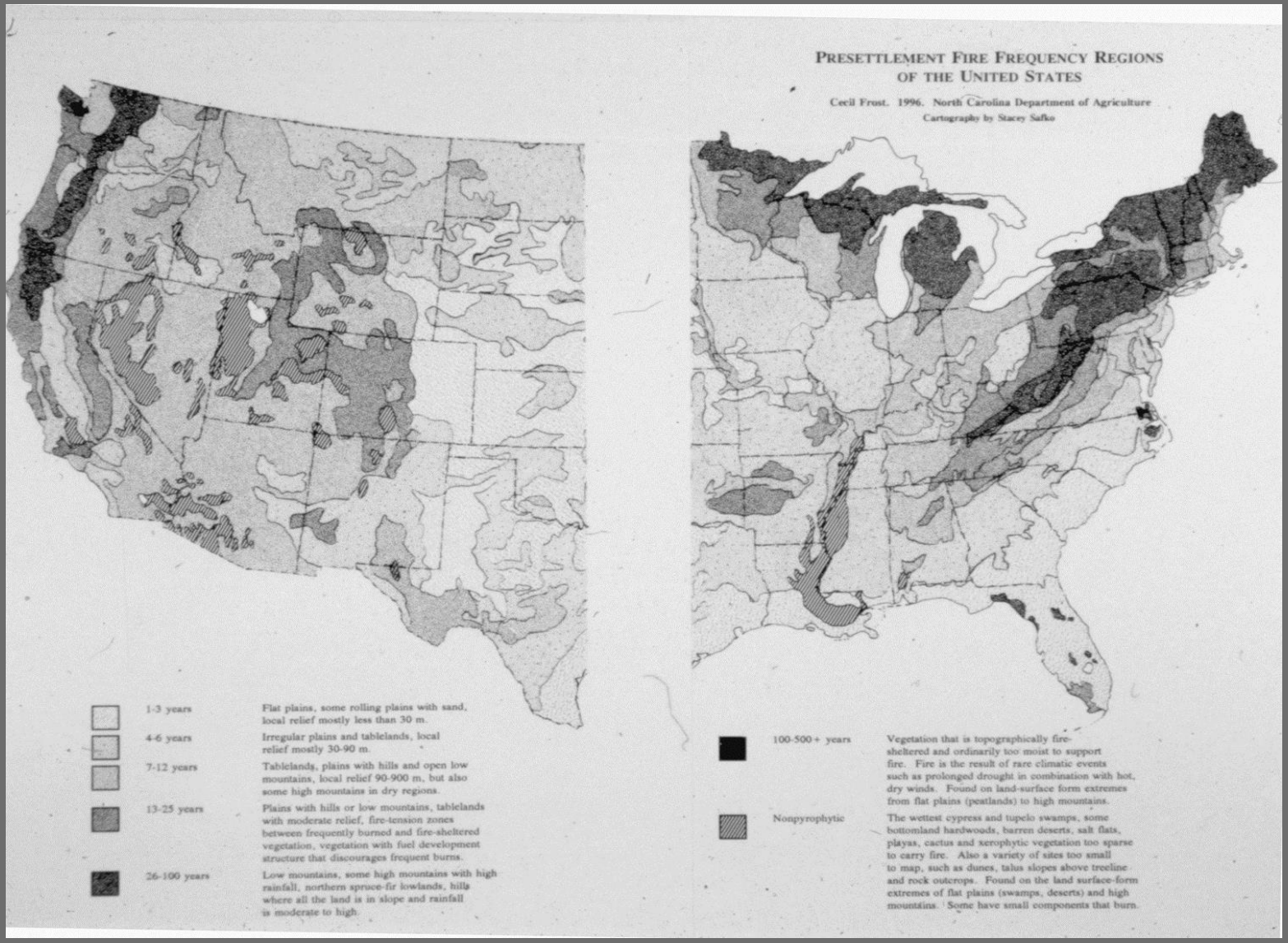
- Use water control structures on all ditches E of US 264
- **Use fire to maintain the canebrakes**, pond pine forest and, possibly, white cedar

Pyro Possum says

"Adapt and Burn!"

Long Shoal River

Presettlement fire regimes of the U.S.



Indians

1585 Indians devastated by introduced European diseases
(Harriott 1590)

1700 (map of settlements) most land vacant for over a century, a handful of Indians remain (115 yrs since plagues)

1733 Moseley map – Indians displaced by planters. Shows only one remaining Indian town, on south side of Mattamuskeet

1791 Pettigrew mentions a place called “Indian Town” on Pamilico Sound south of Lake Pettigrew?

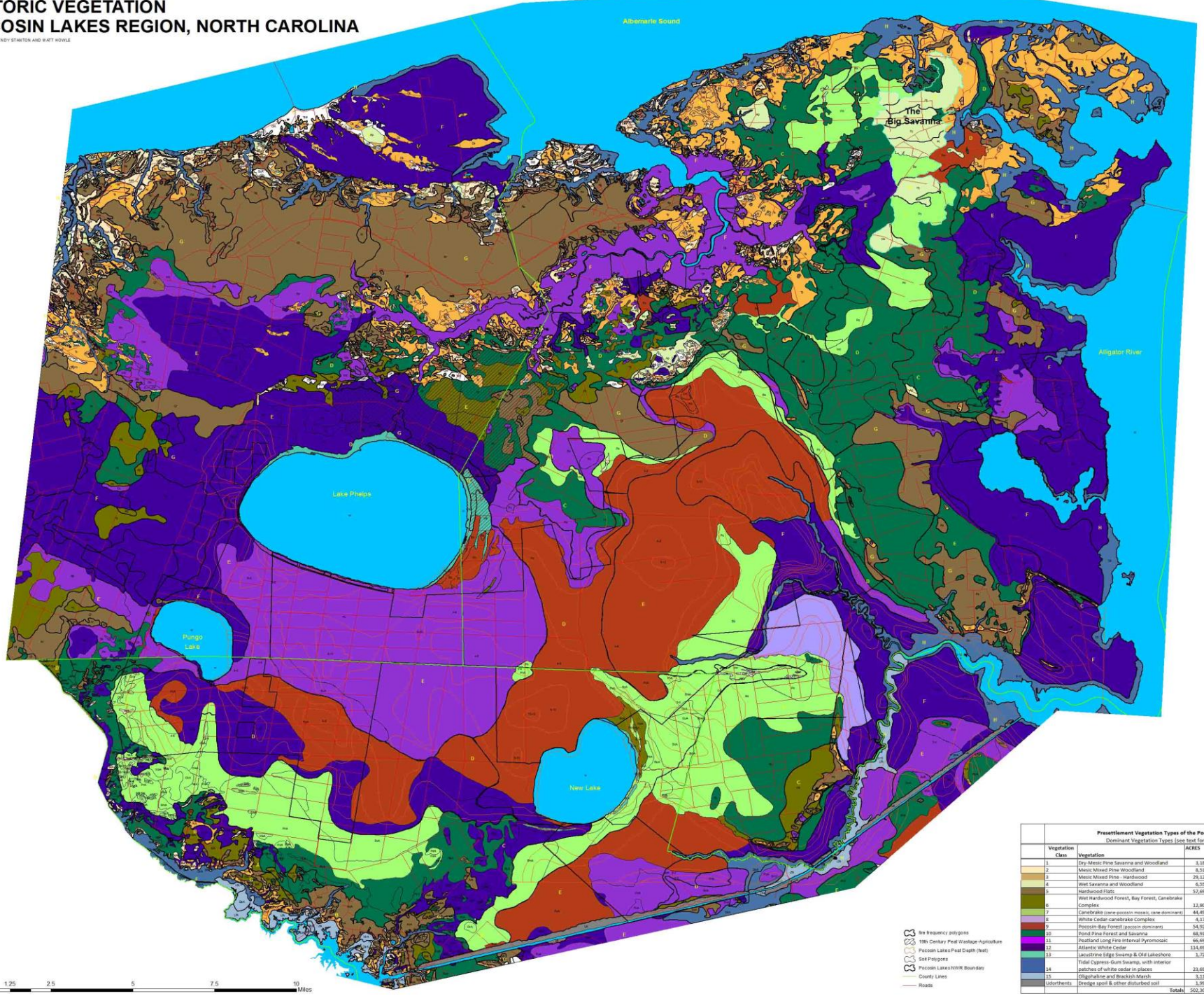
1808 Price-Strother map shows Lake Mattamuskeet ringed with plantations

1910 Antles, the last full blooded Chowanoc Indian woman dies in Gates County

Map of longleaf pine
Sargent 1884

HISTORIC VEGETATION
POCOSIN LAKES REGION, NORTH CAROLINA

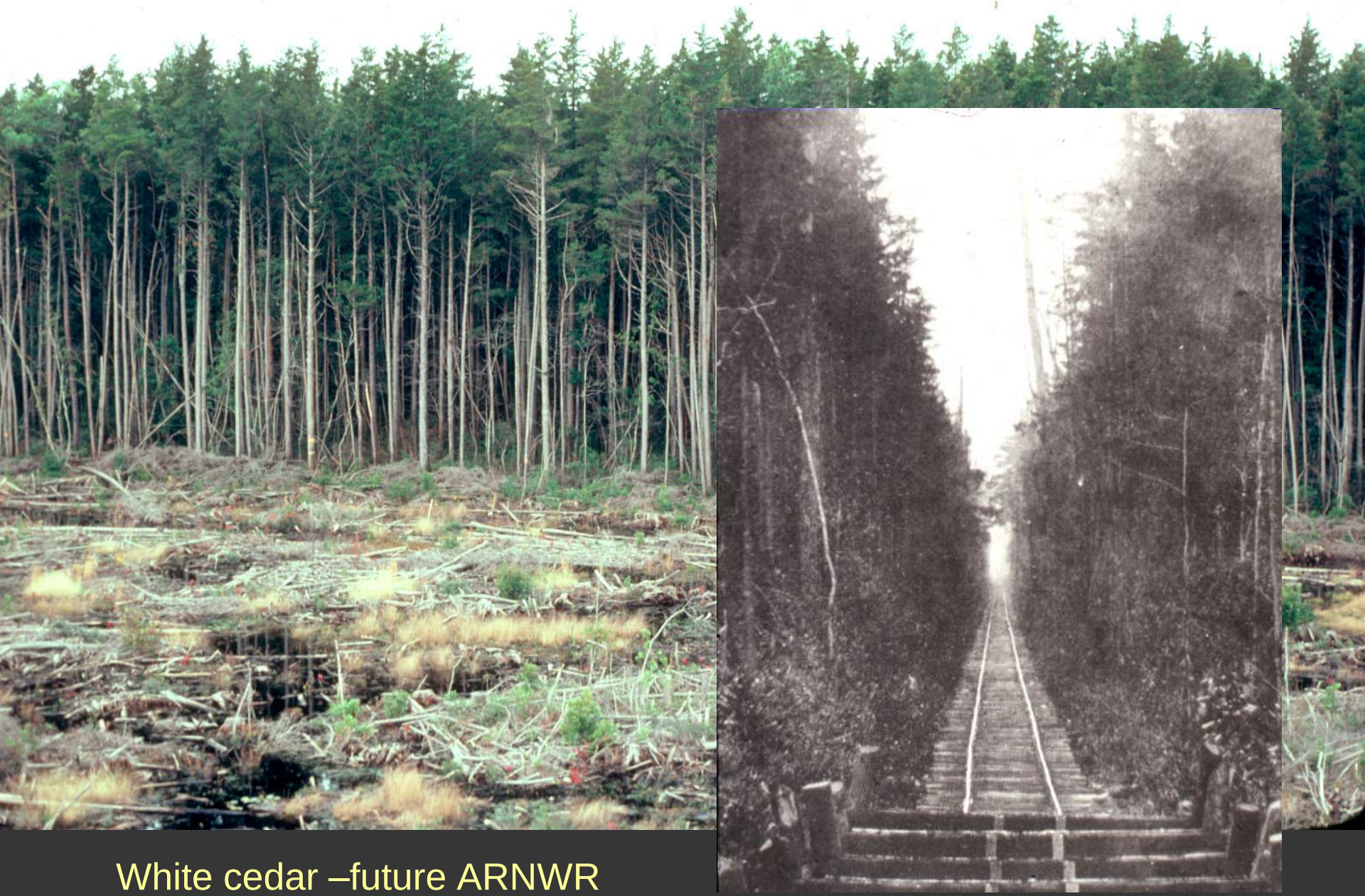
CL FROST, WENDY STANTON AND MATT HOWLE



Presettlement Vegetation Types of the Pocosin Lakes Region
Dominant Vegetation Types (see text for included types)

Vegetation Class	Vegetation	ACRES	Percent of Study Area	Percent of Refuge Land
1	Dry-Mesic Pine Savanna and Woodland	3,187	0.6%	0.0%
2	Mesic Mixed Pine Woodland	8,530	1.7%	0.1%
3	Mesic Mixed Pine - Hardwood	29,127	5.8%	0.3%
4	Wet Savanna and Woodland	6,557	1.3%	0.0%
5	Hardwood Flats	57,695	11.5%	3.8%
6	Wet Hardwood Forest, Bay Forest, Canebrake Complex	12,801	2.5%	7.9%
7	Canebrake (cane-pocosin mosaic, cane dominant)	44,498	8.9%	9.9%
8	White Cedar-canebrake Complex	4,178	0.8%	0.3%
9	Pocosin-Bay Forest (pocosin dominant)	54,925	10.9%	32.0%
10	Pond Pine Forest and Savanna	68,914	13.7%	5.2%
11	Peatland Long Fire Interval Pyromosaic	66,657	13.3%	21.8%
12	Atlantic White Cedar	114,695	22.8%	18.6%
13	Lacustrine Edge Swamp & Old Lakeshore	1,721	0.3%	0.0%
14	Tidal Cypress-Gum Swamp, with interior patches of white cedar in places	23,691	4.7%	1.7%
15	Oligohaline and Brackish Marsh	3,115	0.6%	0.0%
Udorthents	Dredge spoil & other disturbed soil	1,994	0.4%	0.3%
	Totals	502,305	100.0%	100.0%

First Colony Farms peat mining office



White cedar –future ARNWR
1977

Newland, Washington County

NYBI