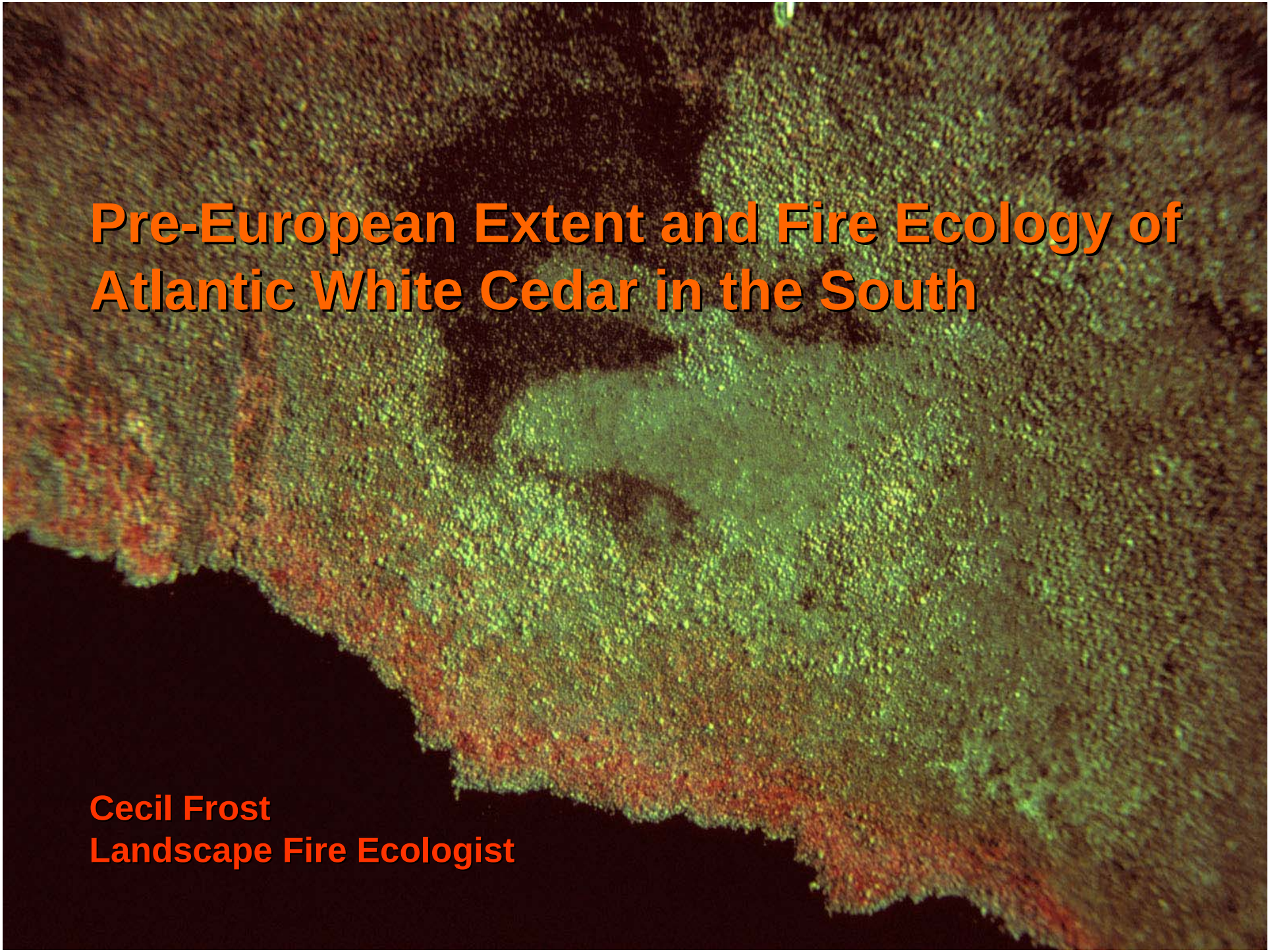
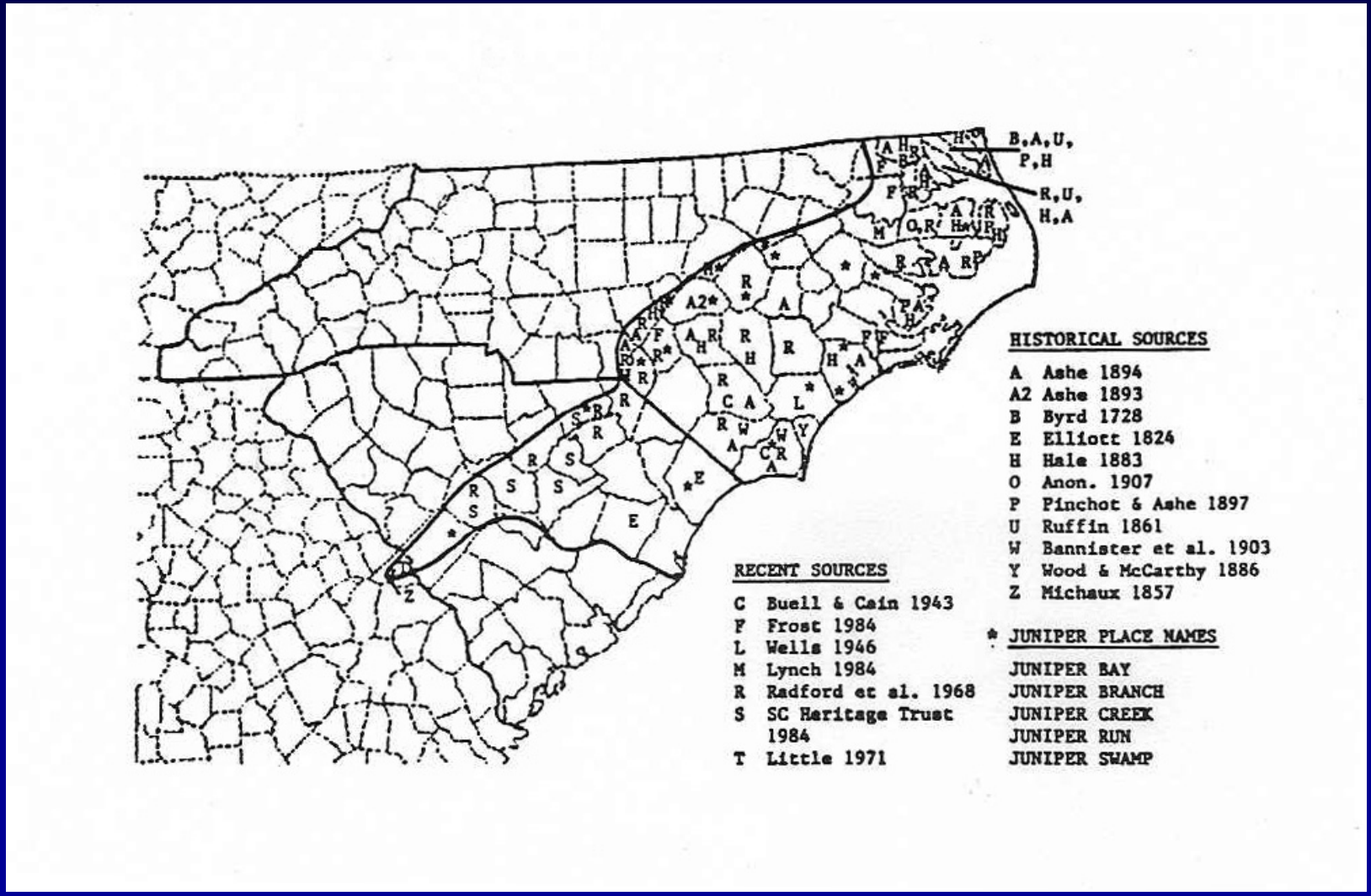


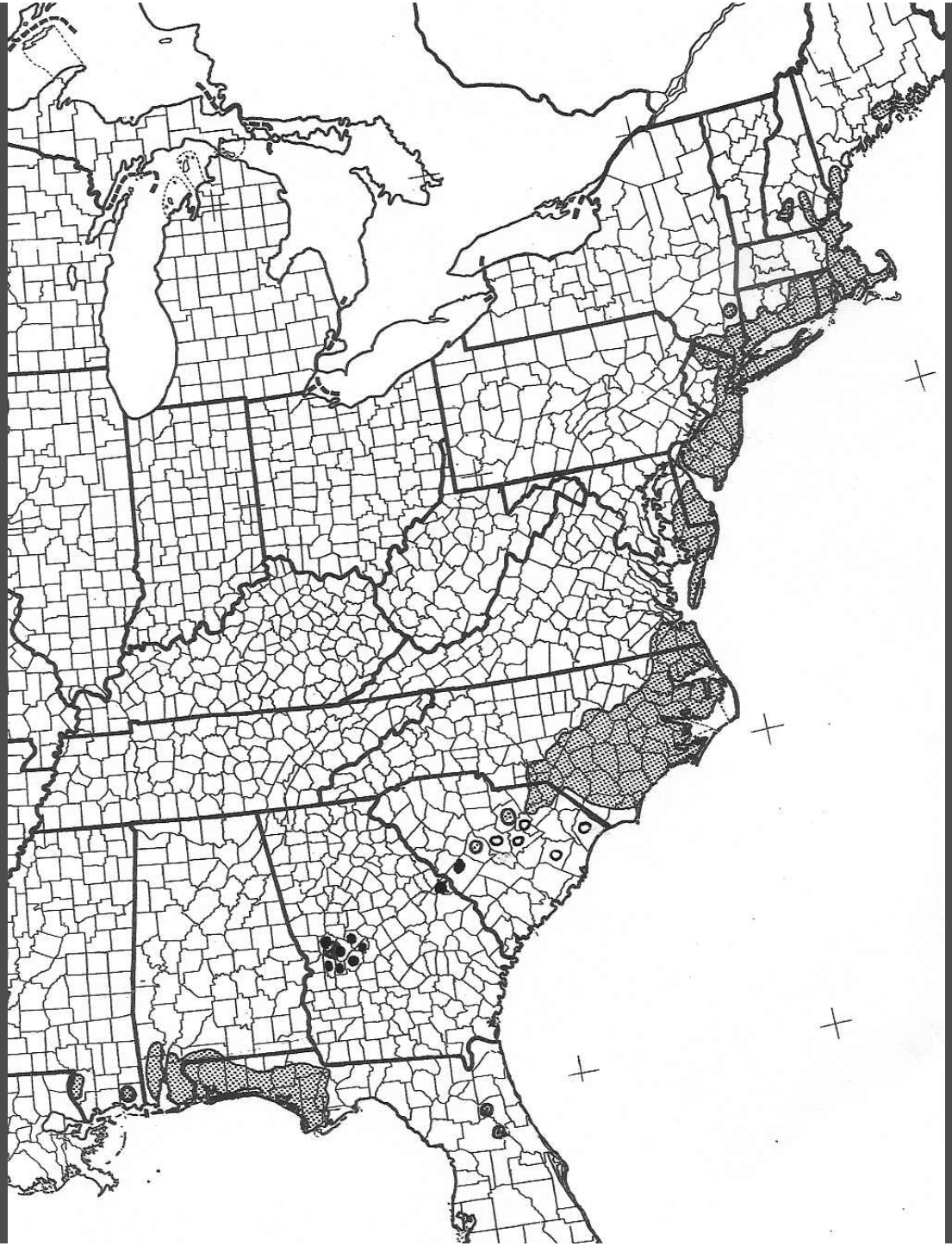
Pre-European Extent and Fire Ecology of Atlantic White Cedar in the South

Cecil Frost
Landscape Fire Ecologist

Historical Range in the Carolinas



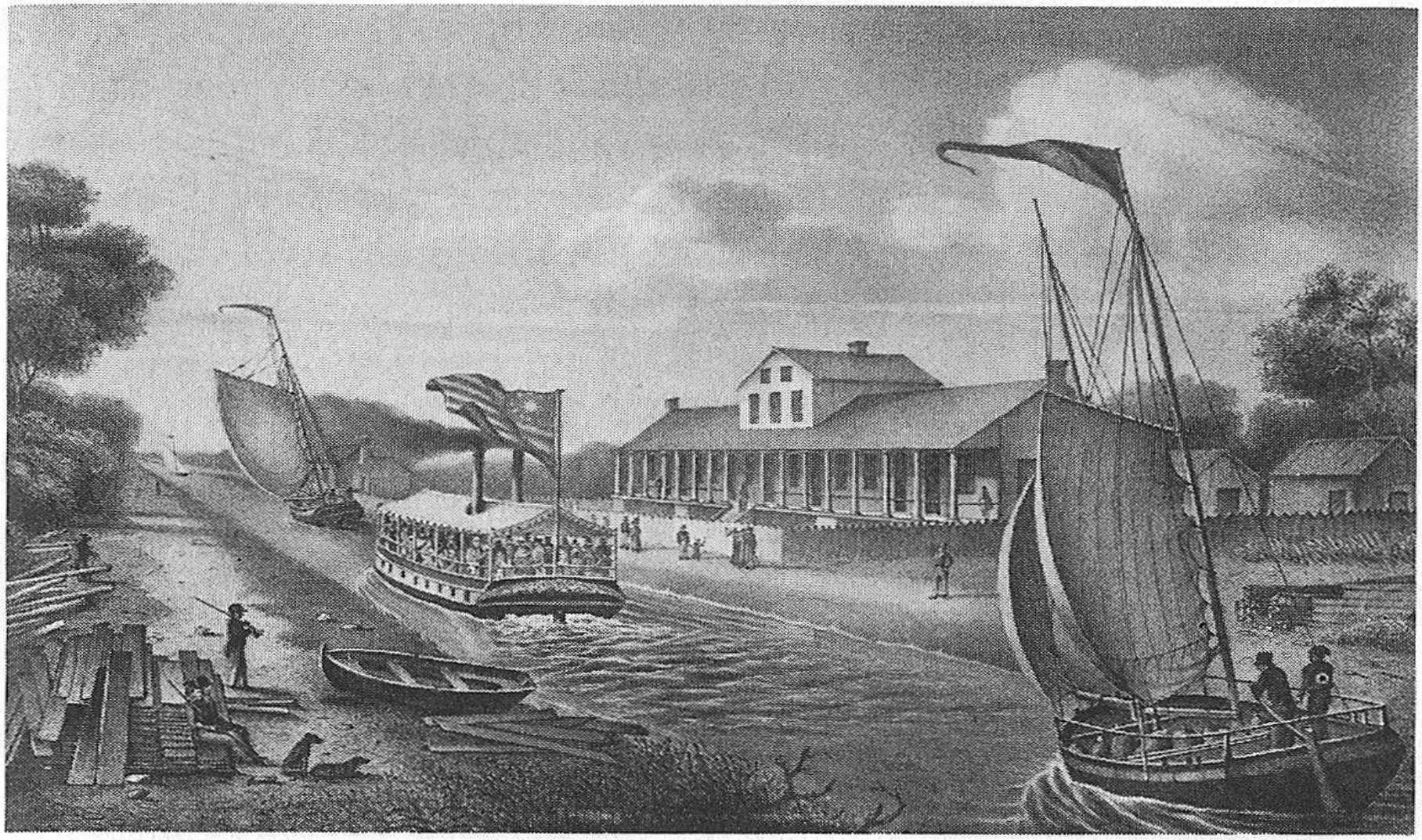
Historical Range in the South



PRIMARY INFLUENCES IN THE DECLINE OF ATLANTIC WHITE CEDAR

- Boat building, shingles and other local uses 1650-1950
- Logging, facilitated by steam technology 1850-1930
- Wetland drainage beginning with passage of laws enabling drainage districts in early 1900s
- 20th century fire suppression 1920-present
- Shift from landscape-scale fires to small compartment management

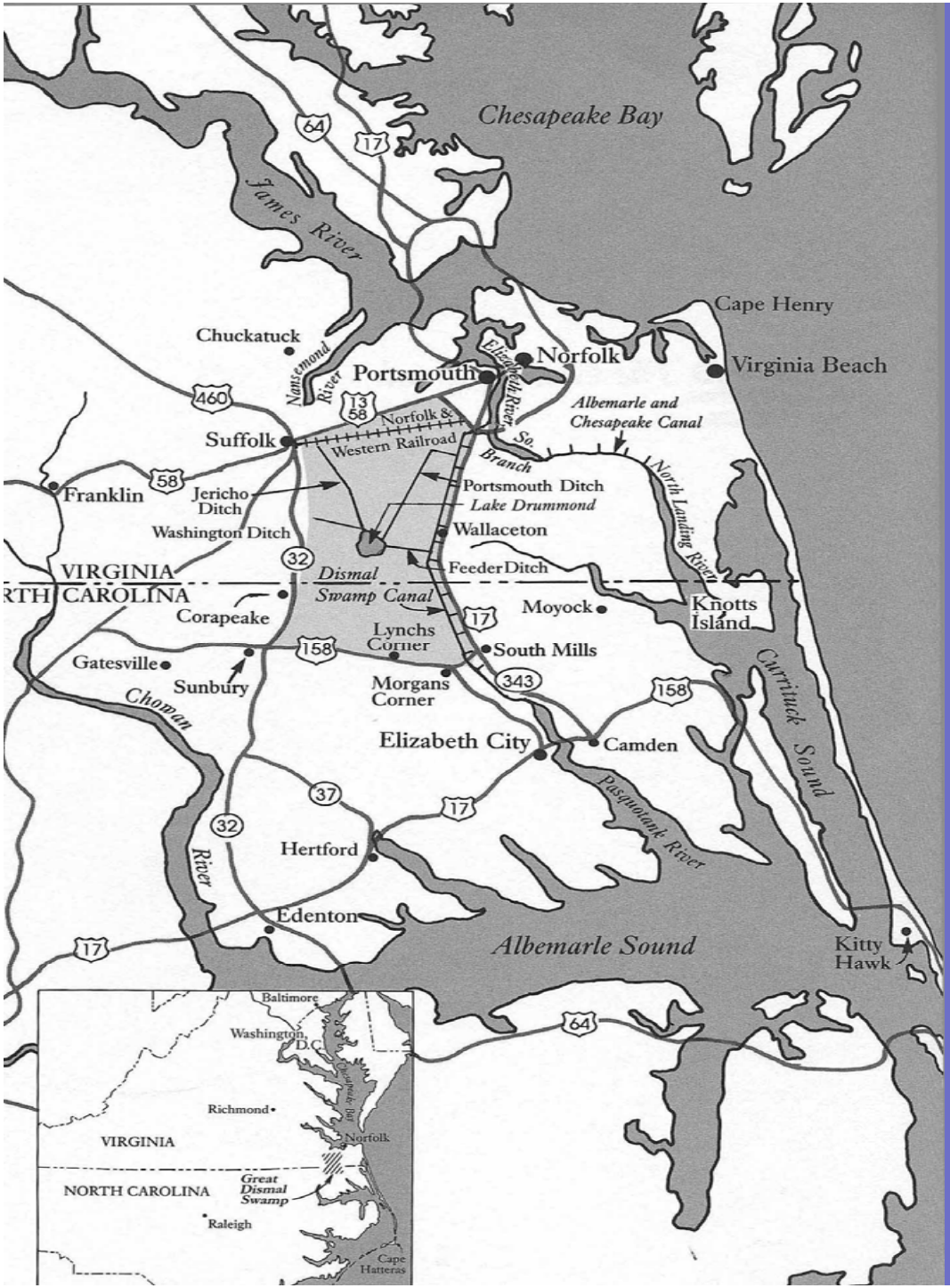
Steam power on the Dismal Swamp Canal 1831



Lake Drummond Hotel, with the Lady of the Lake, *a sternwheel steamboat, north-bound on the Dismal Swamp Canal, 1831*

Steam Dredge in Cypress Swamp

Pinchot & Ashe 1897

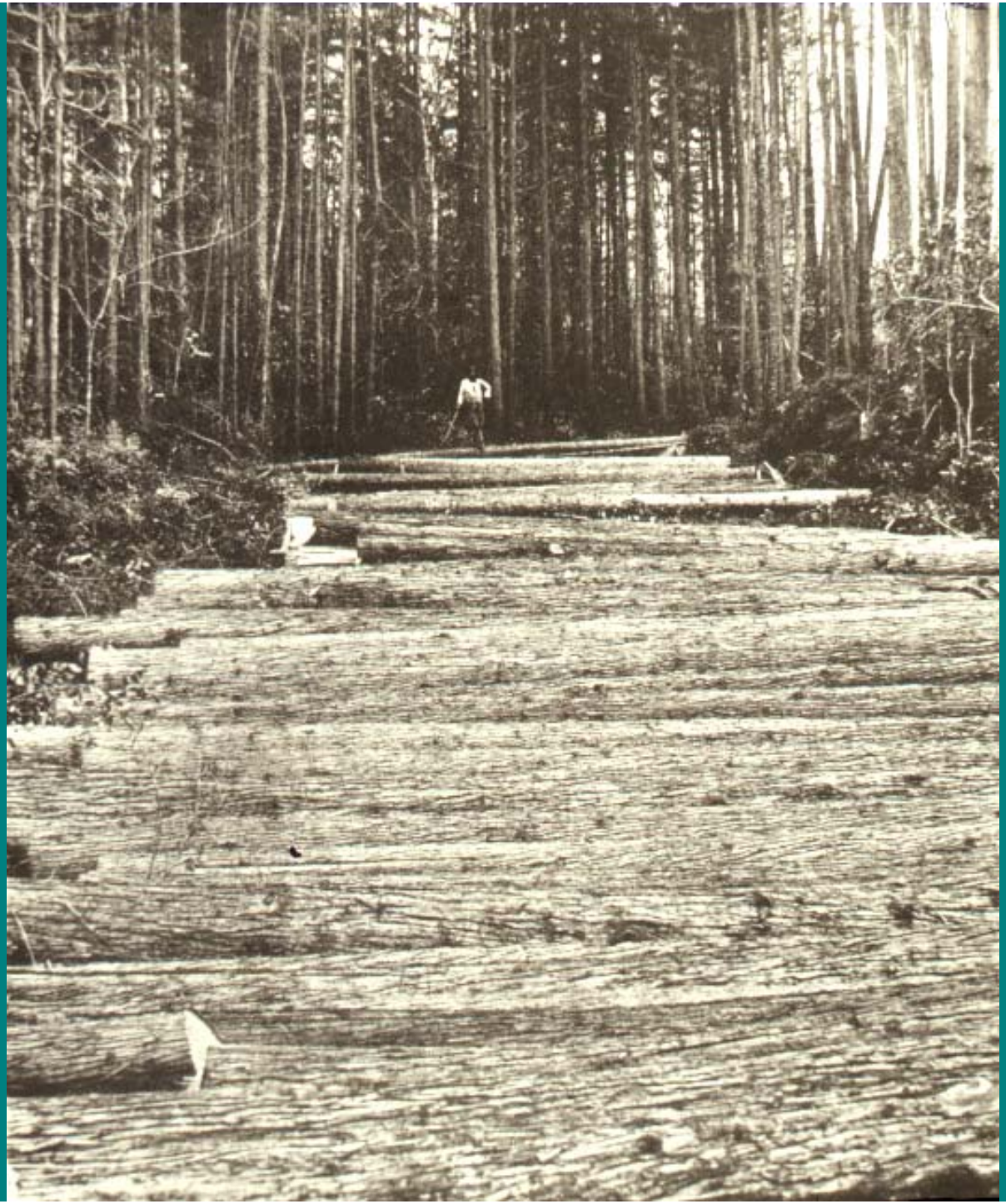


The Dismal Swamp Region

Currituck County, 1882

"The navy yard at Norfolk has long since absorbed all the valuable oak. The avaricious and insatiable saw mills , together with the desire of every man who could buy a pair of oxen and 'Carry-Log', have demolished and transported nearly all our pine…. Juniper very scarce but cheap buckets in abundance This certainly looks like a gloomy picture but more truth than poetry"

___W.H.C. 1882, in P.M. Hale 1883



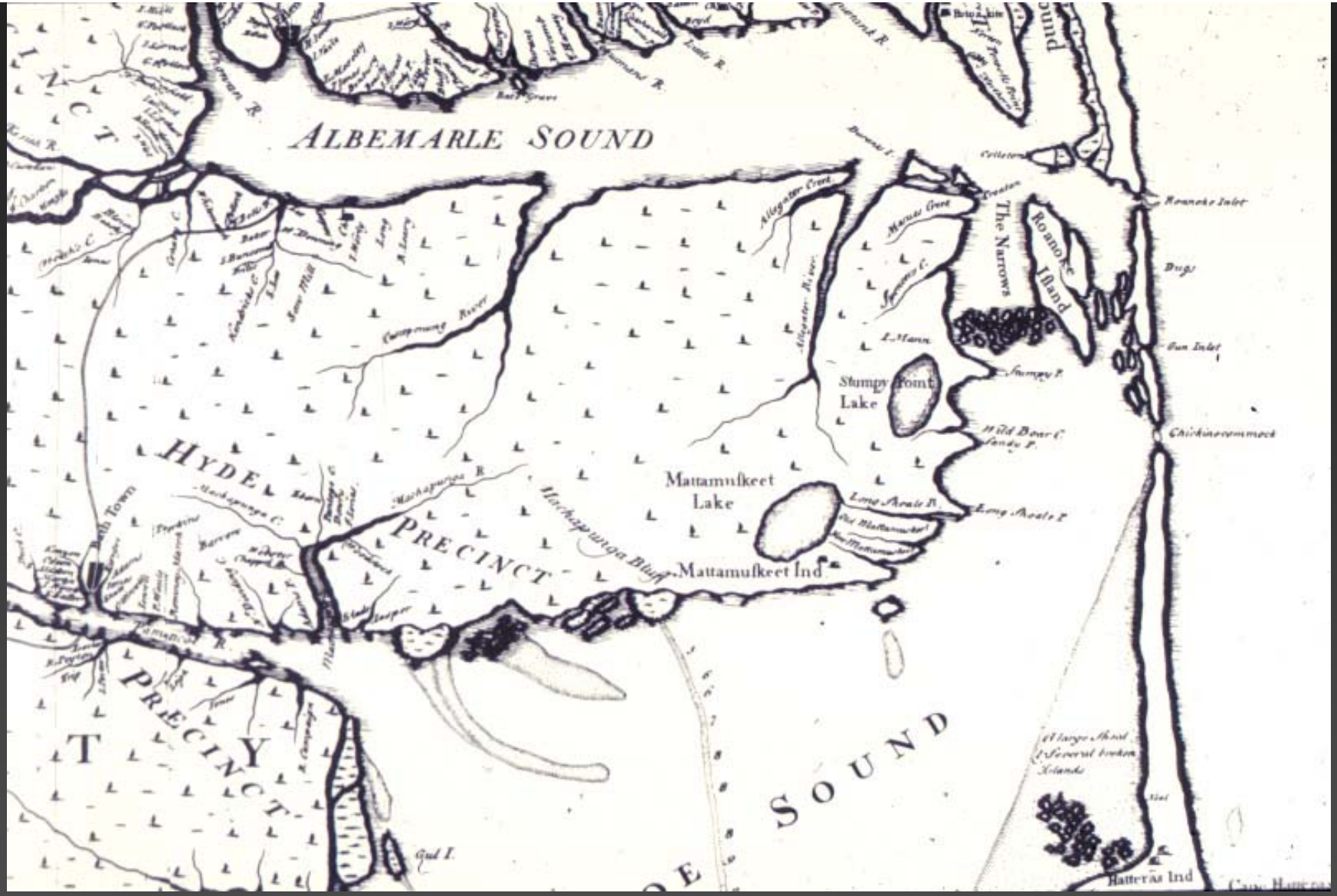
Narrow-gauge logging cars

Surry Parker, in light vest, and some of his family, touring the eastern Dismal, about 1920

Juniper Landing

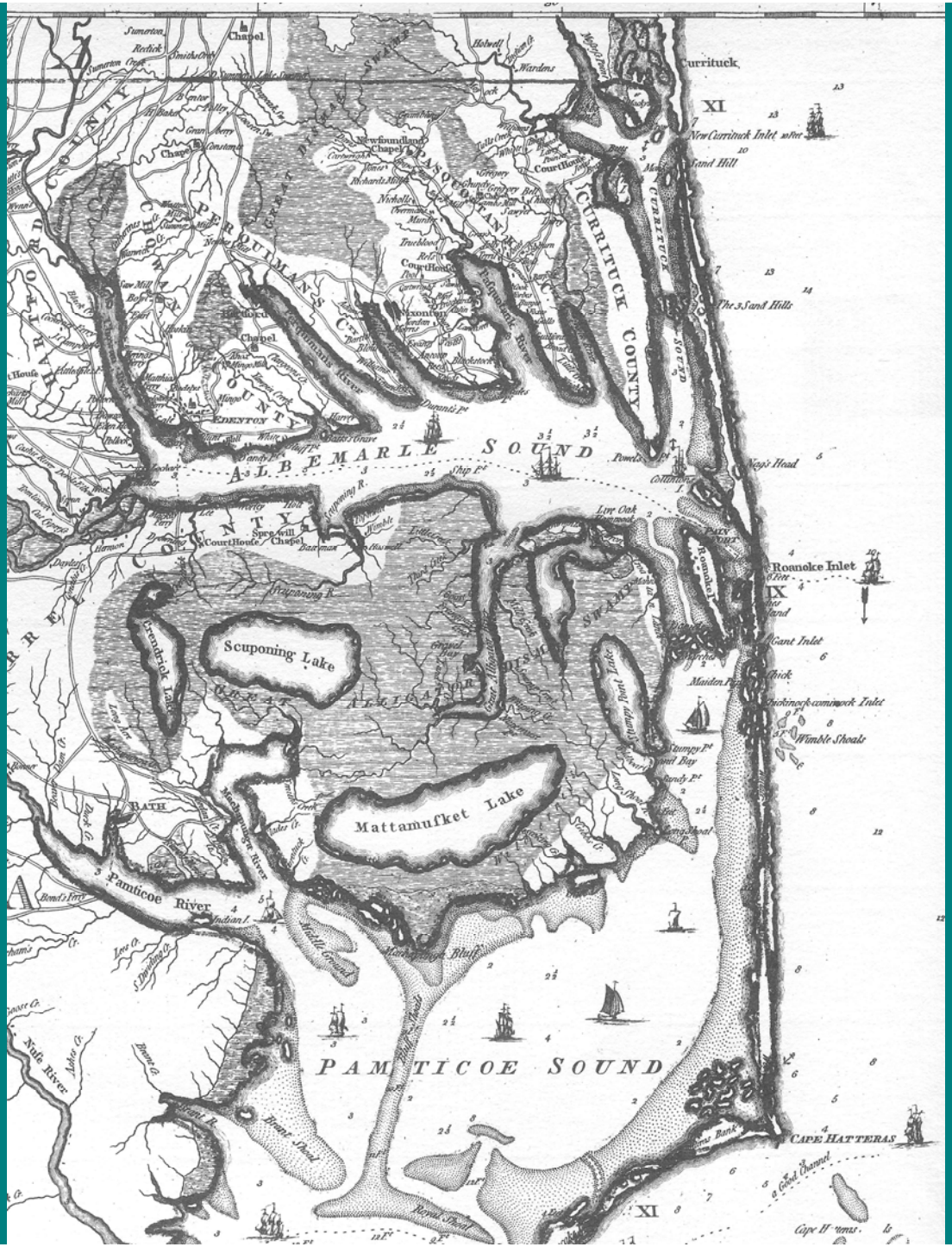
Great Dismal Swamp

Elizabeth River - Norfolk



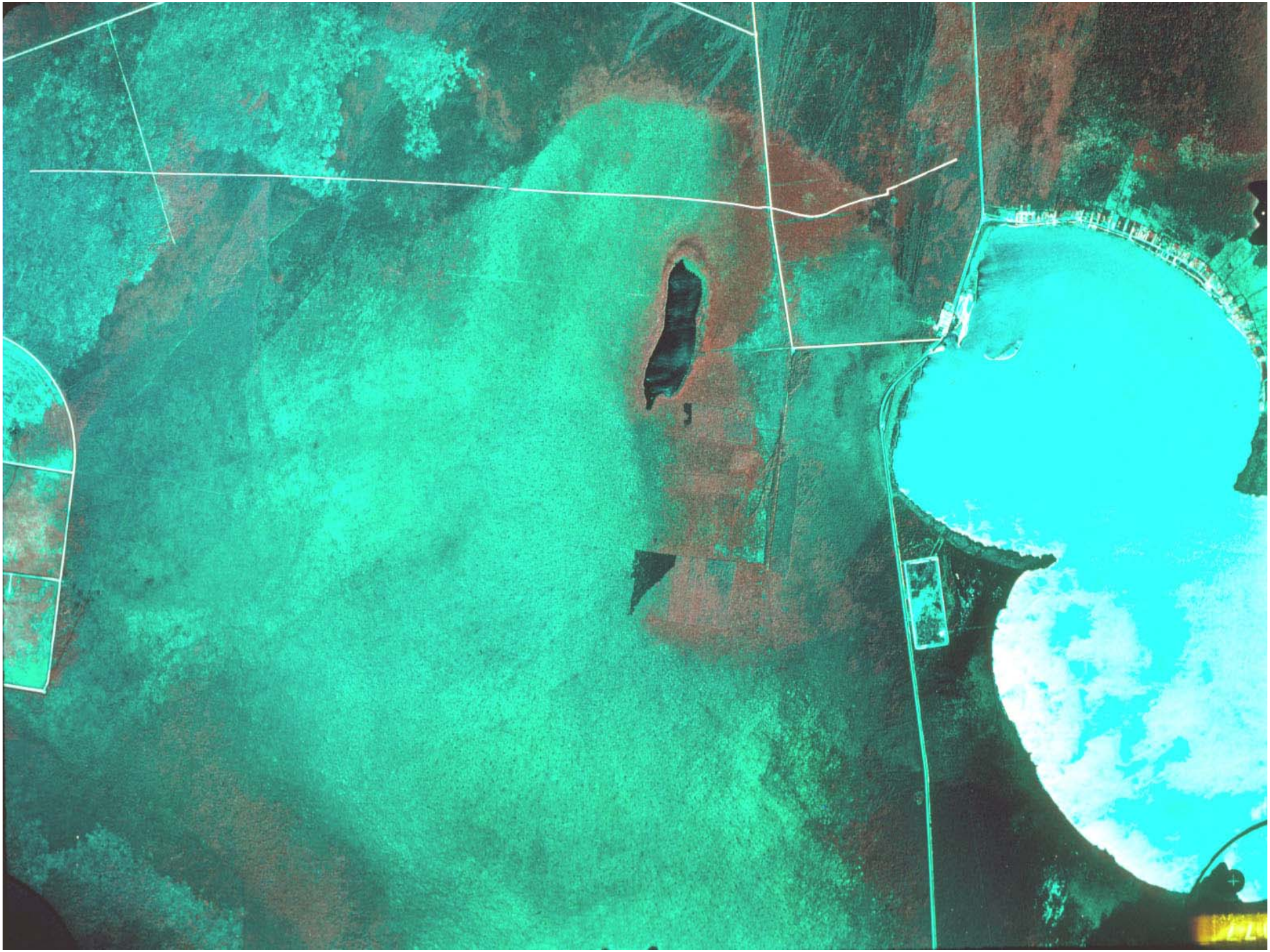
Moseley 1733

Mouzon
1775


Currituck
CURRITUCK COUNTY
ALBEMARLE SOUND
Scuponing Lake
Mattamuskeet Lake
PAMTICOE SOUND
Pamticoe River
Roanoke Inlet
CAPE HATTERAS
EDENTON
Wimble Shoals

Price-Strother 1808

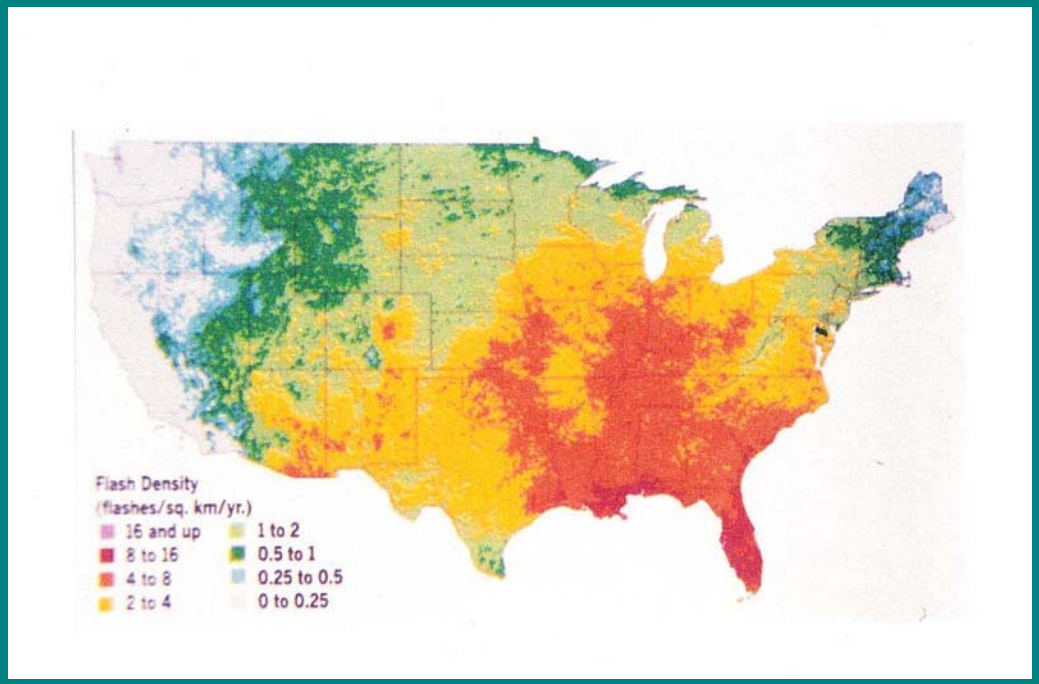
U.S. Coast Survey 1865



The Frying Pan 1982

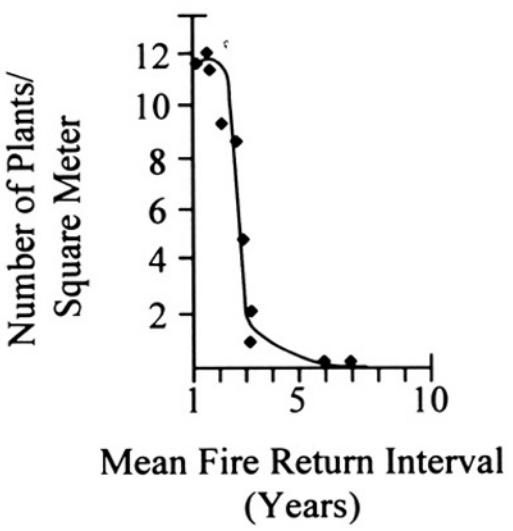
The Frying Pan 1982

Ignition Sources:
Lightning ground flash data

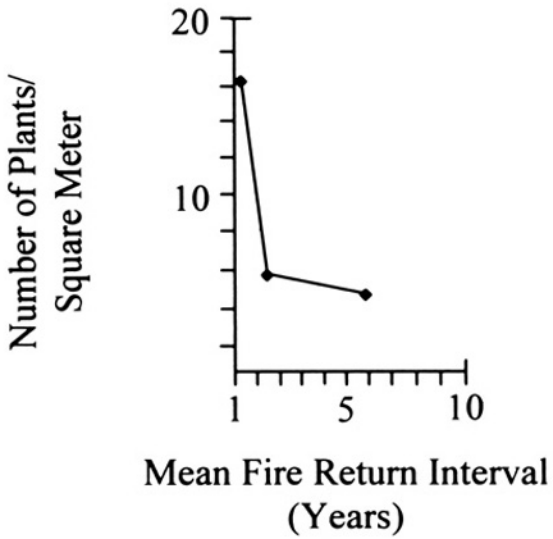


Venus flytrap (*Dionaea muscipula*), a fire frequency indicator species

Venus Flytrap



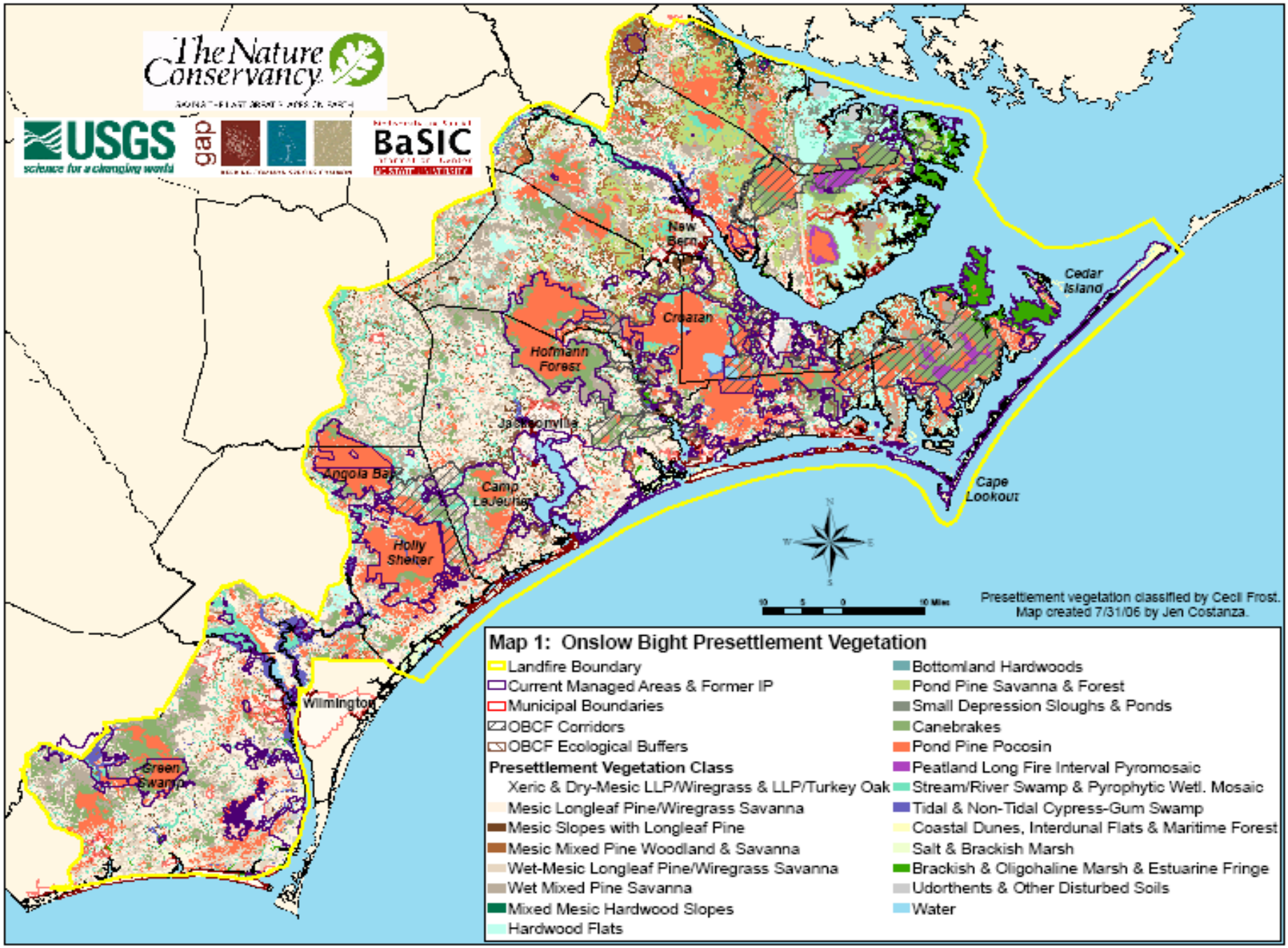
Lysimachia Asperulifolia



Longleaf Pine Savanna

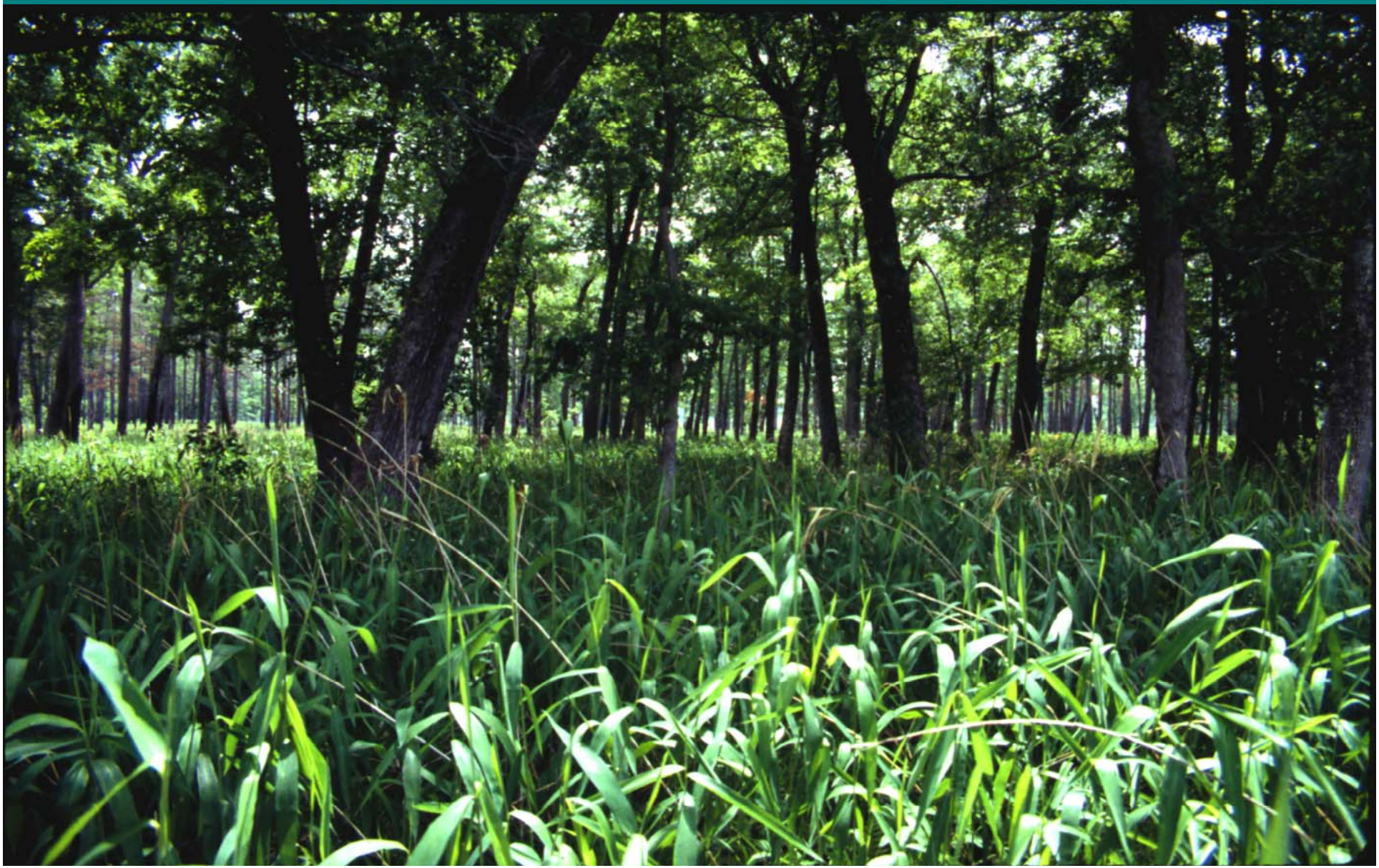
“destroyed by fire” (newspaper account)

Longleaf pine 6 weeks after fire


The Nature Conservancy
USGS
science for a changing world
gap
BaSIC
New Bern
Cedar Island
Croatan
Hofmann Forest
Jacksonville
Angola Bay
Camp Lejeune
Holly Shelter
Cape Lookout
Wilmington
Green Swamp
N
S
E
W
10 5 0 10 Miles
Presettlement vegetation classified by Cecil Frost.
Map created 7/31/06 by Jen Costanza.
Map 1: Onslow Bight Presettlement Vegetation
Landfire Boundary
Current Managed Areas & Former IP
Municipal Boundaries
OBCF Corridors
OBCF Ecological Buffers
Presettlement Vegetation Class
Xeric & Dry-Mesic LLP/Wiregrass & LLP/Turkey Oak
Mesic Longleaf Pine/Wiregrass Savanna
Mesic Slopes with Longleaf Pine
Mesic Mixed Pine Woodland & Savanna
Wet-Mesic Longleaf Pine/Wiregrass Savanna
Wet Mixed Pine Savanna
Mixed Mesic Hardwood Slopes
Hardwood Flats
Bottomland Hardwoods
Pond Pine Savanna & Forest
Small Depression Sloughs & Ponds
Canebrakes
Pond Pine Pocosin
Peatland Long Fire Interval Pyromosaic
Stream/River Swamp & Pyrophytic Wetl. Mosaic
Tidal & Non-Tidal Cypress-Gum Swamp
Coastal Dunes, Interdunal Flats & Maritime Forest
Salt & Brackish Marsh
Brackish & Oligohaline Marsh & Estuarine Fringe
Udorthents & Other Disturbed Soils
Water

BOTTOMLAND VEGETATION TYPES WITH FREQUENT FIRE ON UPLANDS	
VALLEY TOPOGRAPHY	**RESULTING COMMUNITY**
level bottom with low sides (FIRE EXPOSED)	canebrake
wide bottom with gentle sides	pond pine canebrake
wide bottom with moderately sloping sides	hardwood canebrake
narrow bottom with steeper sides	**white cedar**
narrow bottom with very steep sides (FIRE SHELTERED	bottomland hardwoods or cypress-gum swamp

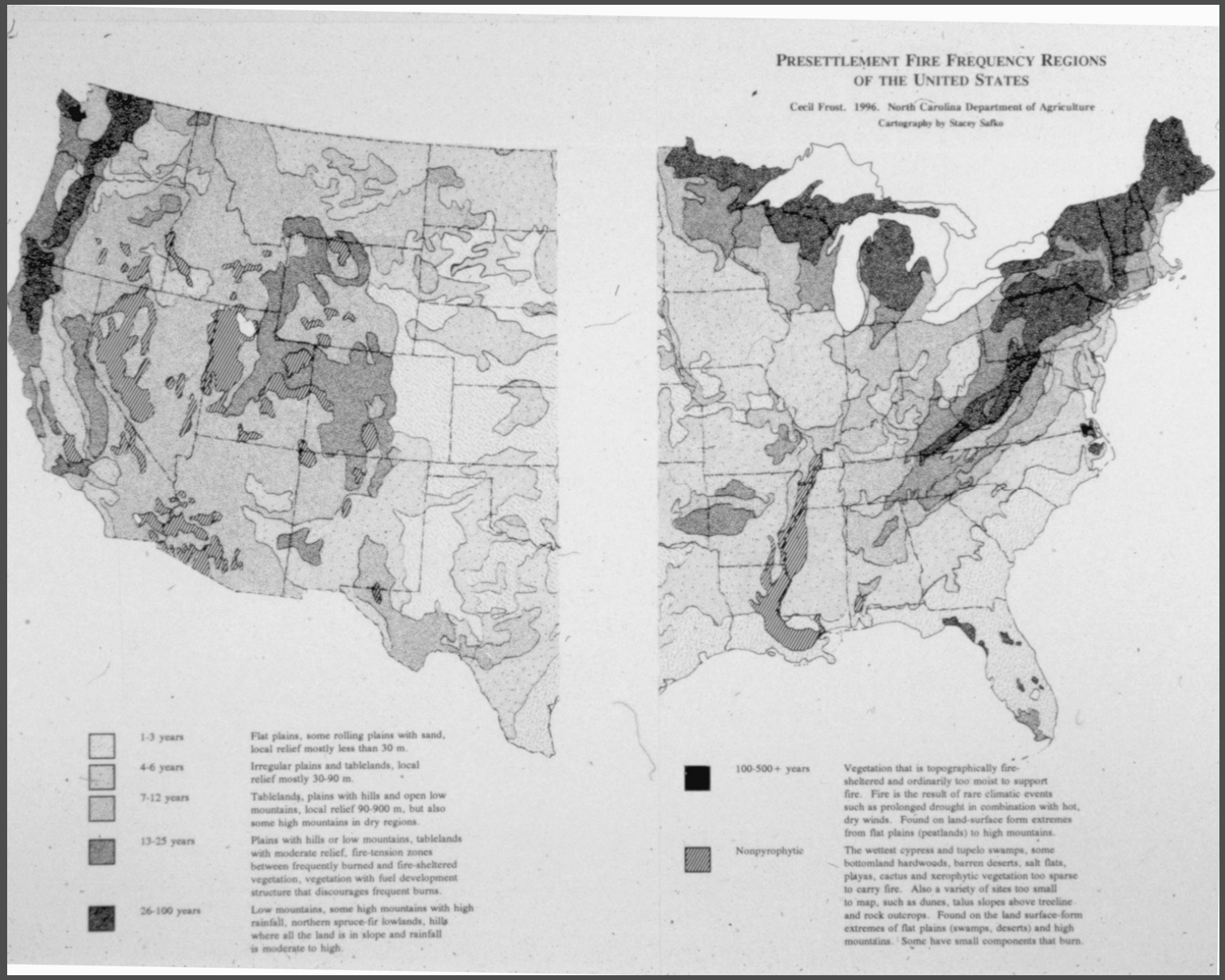
Hardwood Canebrake



Atlantic White Cedar

Bones Creek, Mac Ridge Impact area

Presettlement fire regimes of the U.S.



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

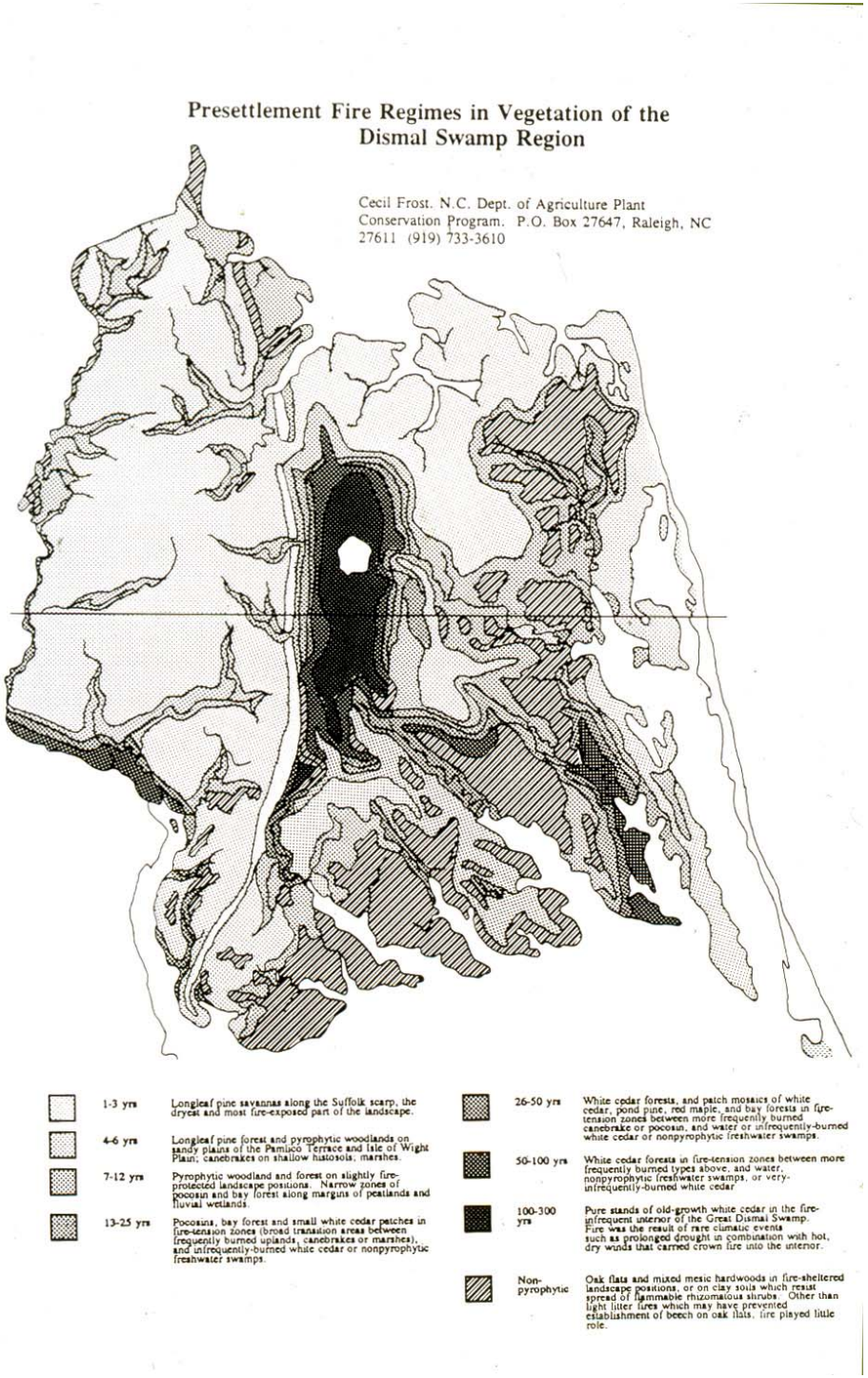
FIRE FREQUENCY

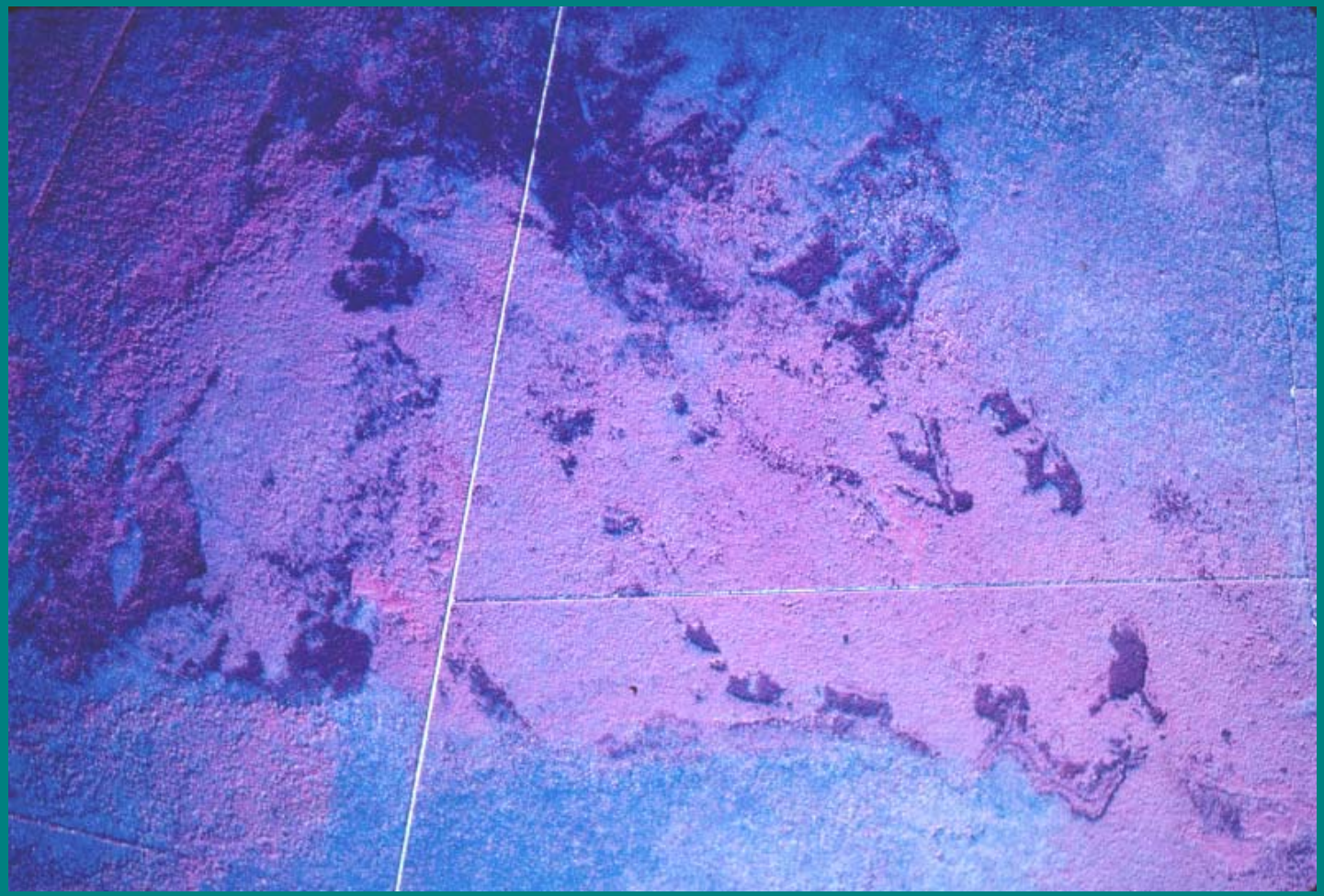
ORGANIC MATTER DEPTH	1-3 YEARS	4-6 YRS	7-12 YRS	13-25 YRS	26-50 YRS	51-100 YRS	100-300 YRS	NEVER BURNED
Seasonally wet mineral soils ROW 1	Species-rich wet prairie with graminoids and grass-leaved forbs CELL 1	Species-rich wet prairie, with dwarf shrubs CELL 2	ANGL, ARGI, CLJA, ILGL, CYRA, CLMO, tree 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

Presettlement Fire Regimes

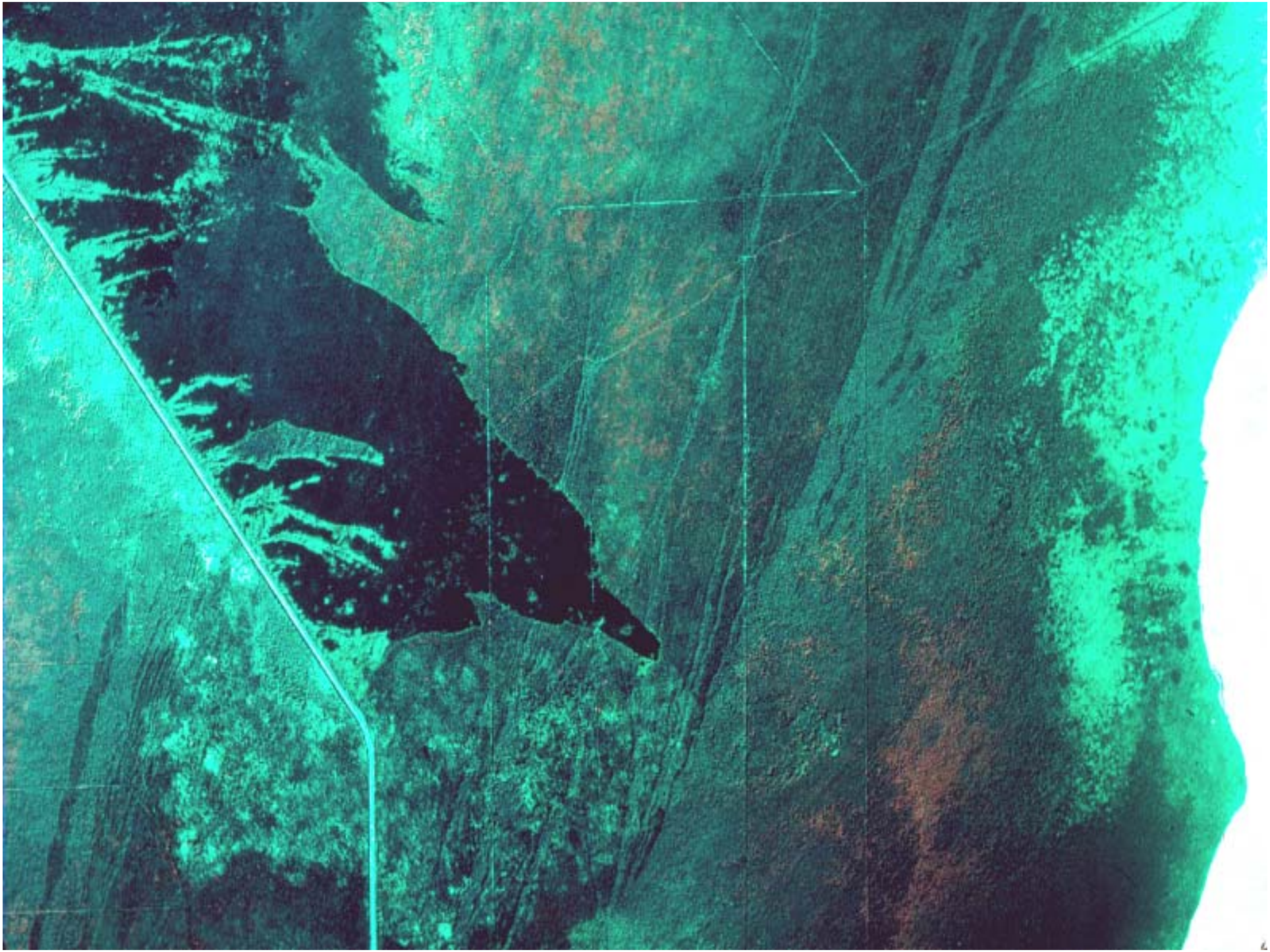
Great Dismal Swamp NWR

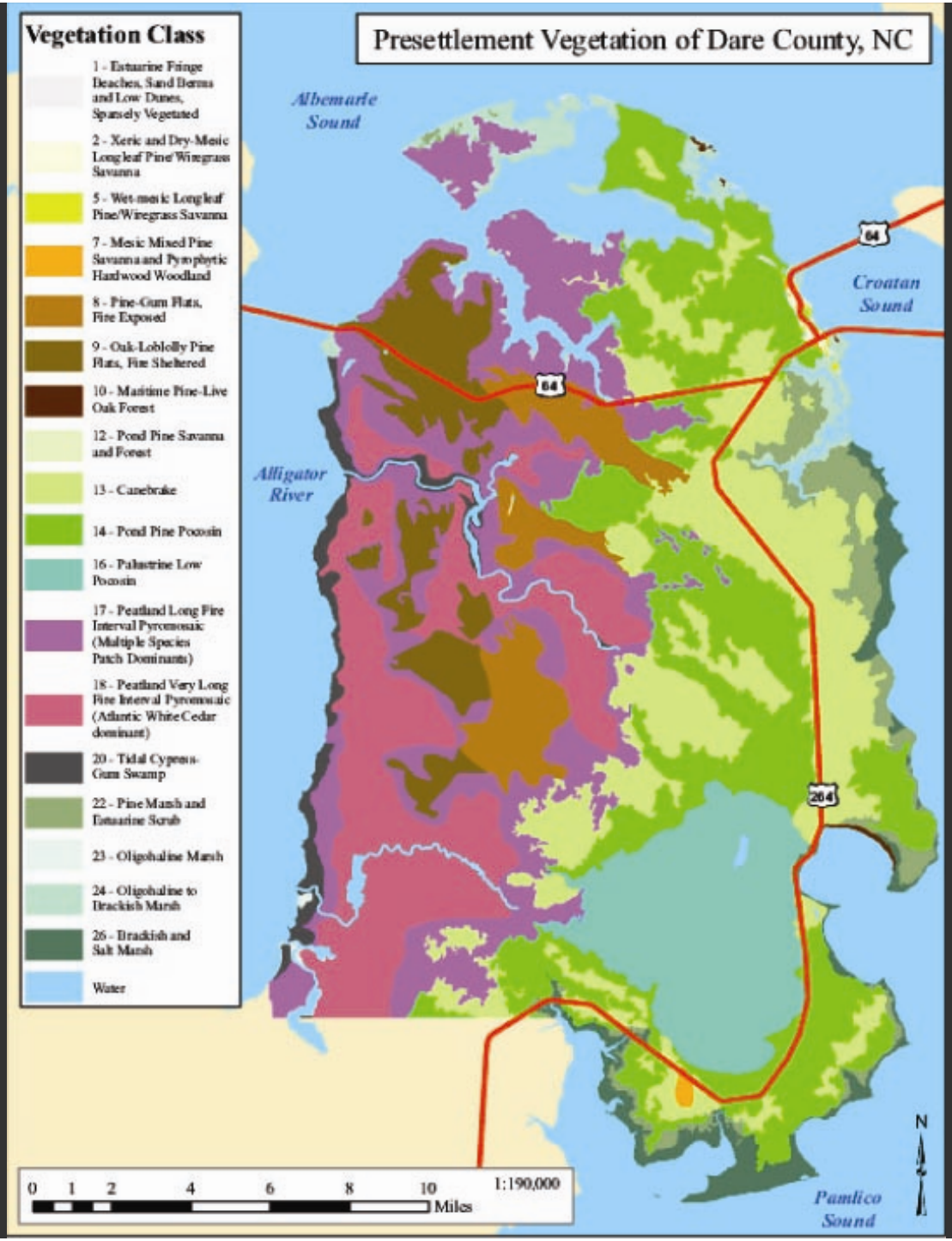
(coarse scale)

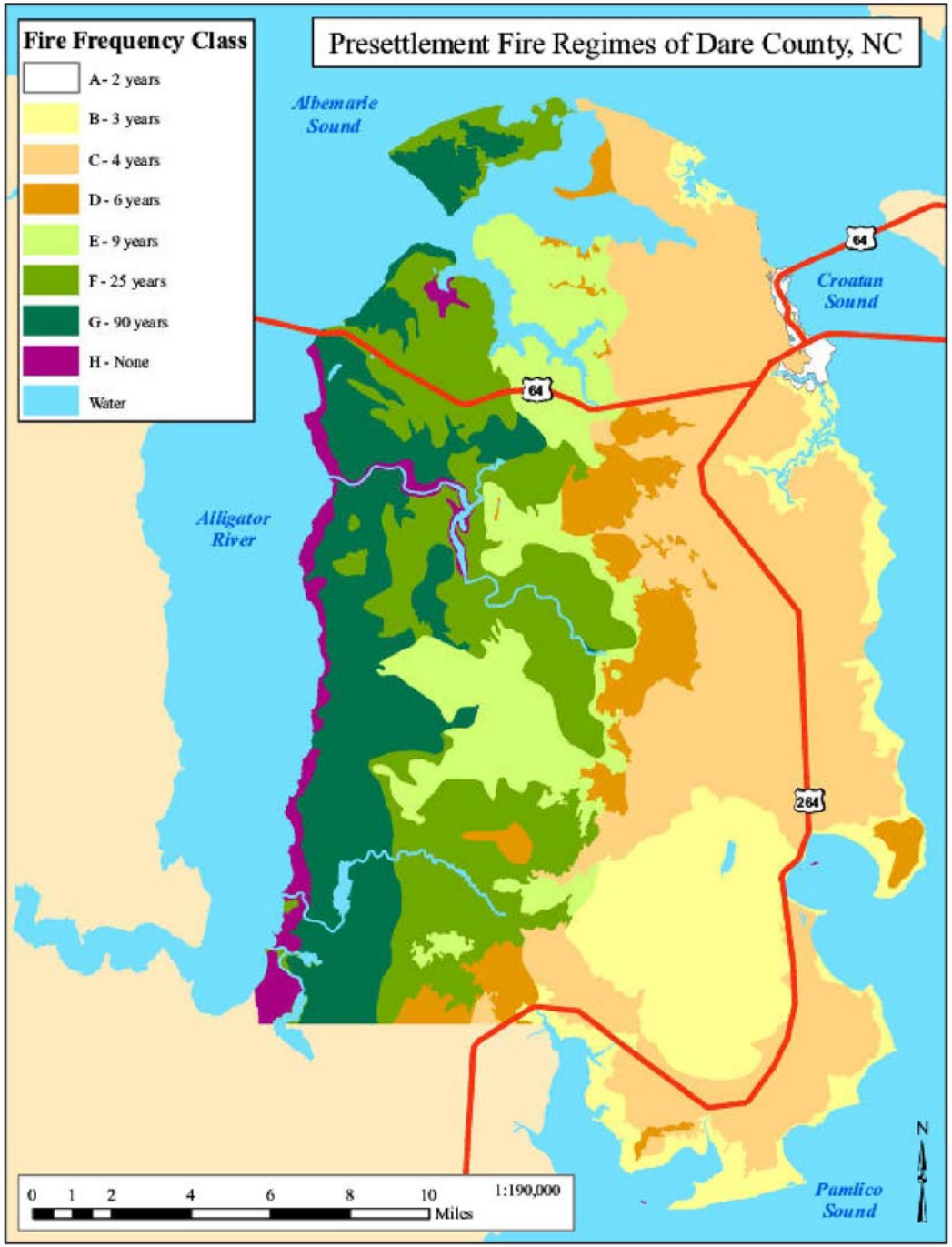




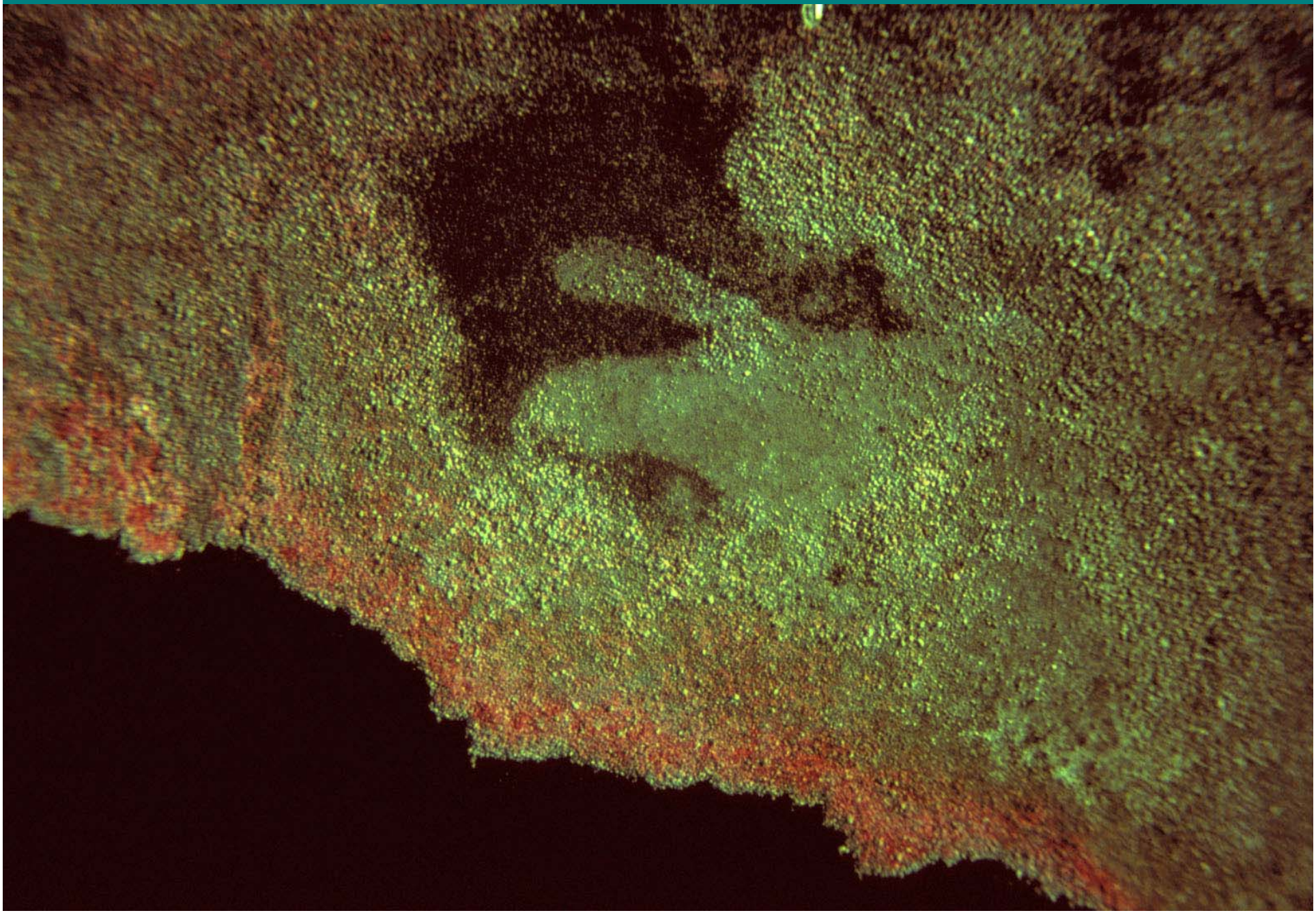
White cedar – future ARNWR 1977




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

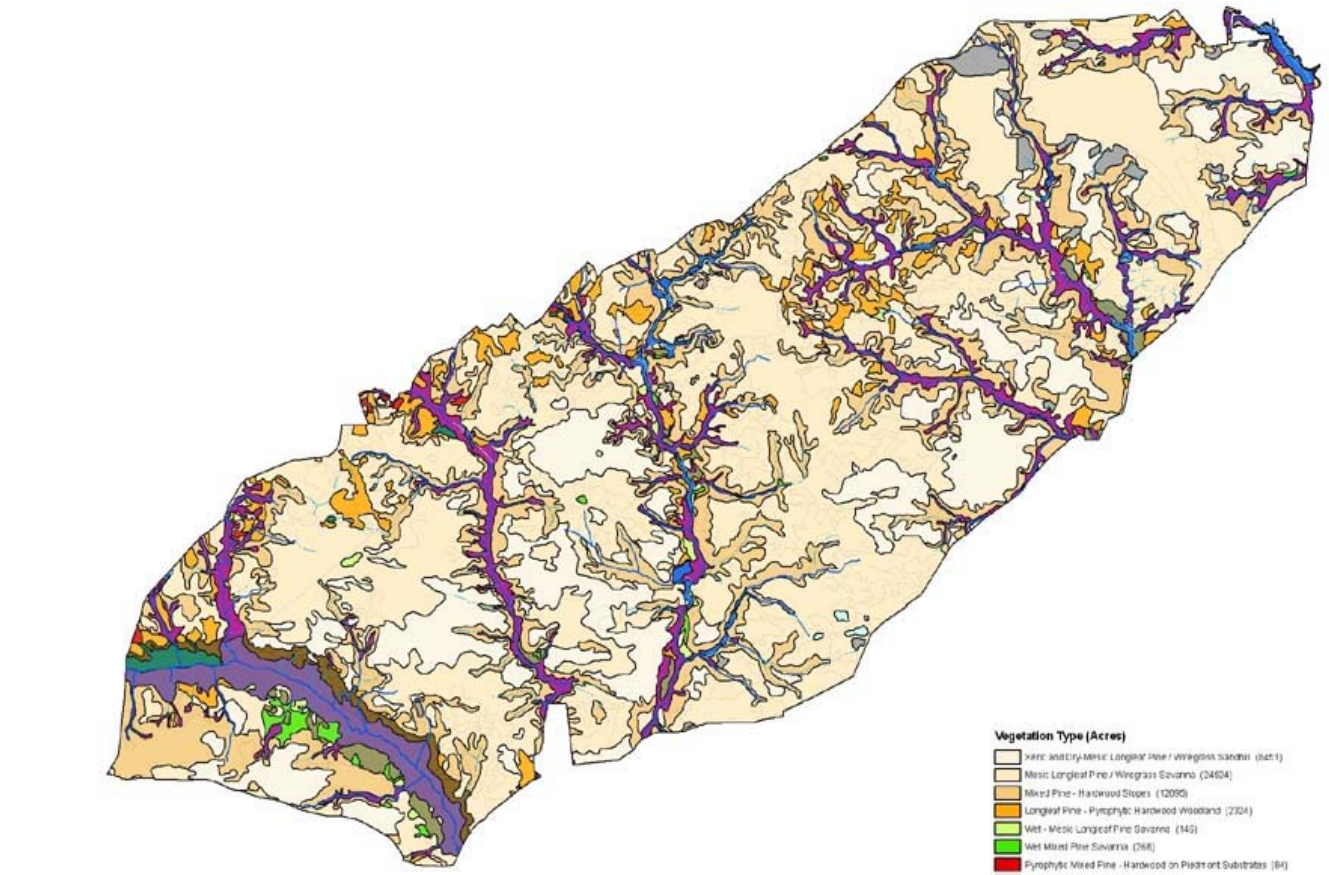

Presettlement Fire Regimes of Dare County, NC
Fire Frequency Class
A - 2 years
B - 3 years
C - 4 years
D - 6 years
E - 9 years
F - 25 years
G - 90 years
H - None
Water
Albemarle Sound
Croatan Sound
Alligator River
Pamlico Sound
64
64
264
0 1 2 4 6 8 10
Miles
1:190,000
N

Peatland Fire Patch Mosaic



Pre-European Vegetation of Fort Gordon

Cecil Frost and Susan Langley



Pre-European Fire Regimes of Fort Gordon

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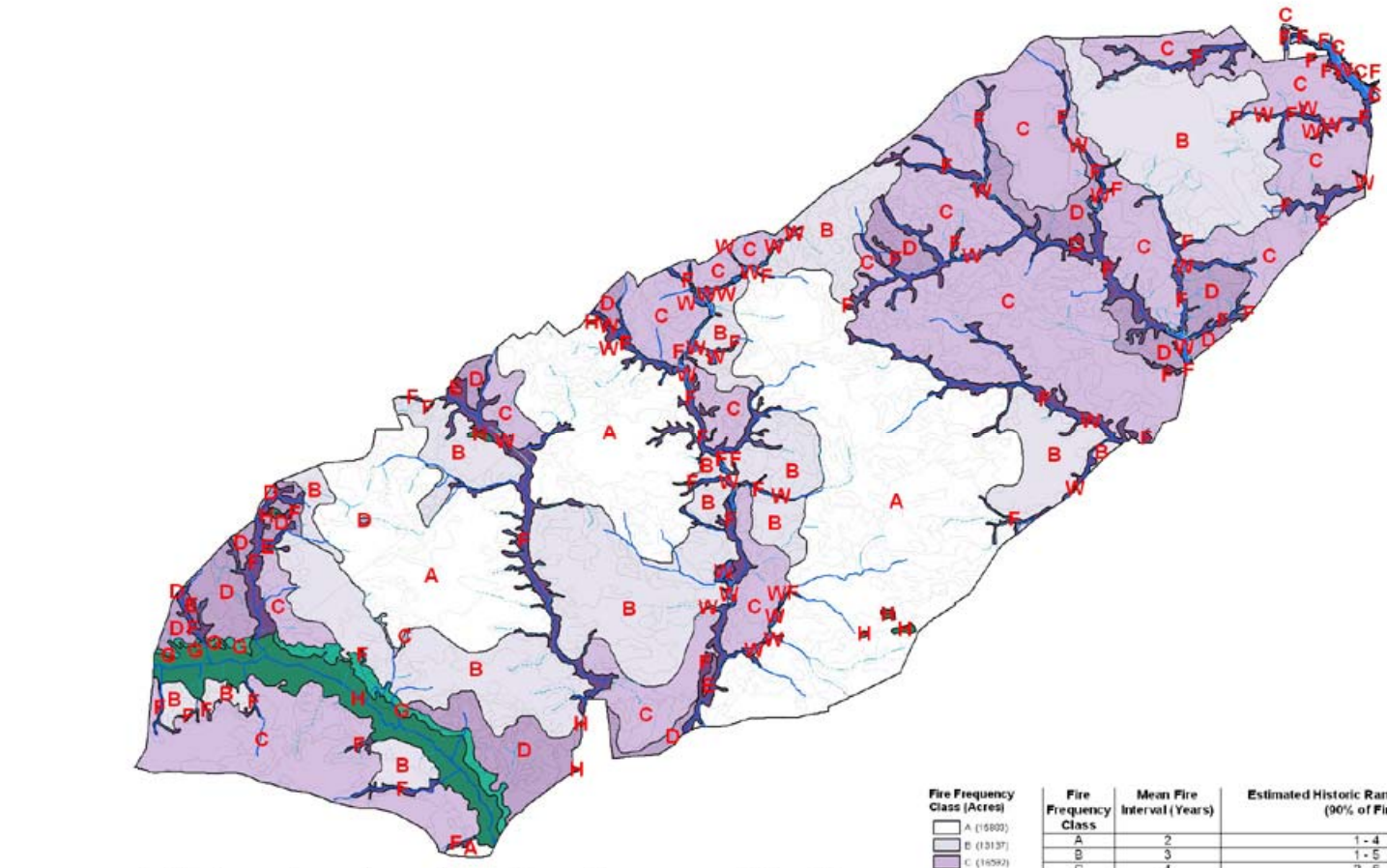


N

1 0.5 0 1 2 3 4 5 Miles

2,500 1,250 0 2,500 5,000 7,500 Meters

1 inch equals 11,795.614176 feet

September 21, 2008

Hydrology and Soils

- Connector
- Perennial
- Intermittent
- Artificial Path
- Soils

Fire Frequency Class (Acres)

- A (15803)
- B (13137)
- C (16592)
- D (3572)
- E (70)
- F (3747)
- G (450)
- H (1535)
- W (515)

Fire Frequency Class	Mean Fire Interval (Years)	Estimated Historic Range of Variation (90% of Fires)
A	2	1 - 4
B	3	1 - 5
C	4	2 - 6
D	5	2 - 9
E	8	4 - 20 +
F	Variable	Beaver and fire influenced wetland mosaic
G	Variable	Infrequent light fires creeping down from tops of slopes
H	None	Never burned except on margins, or rare, light surface fires in thin leaf litter

Presettlement Vegetation Types – Fort Gordon	ACRES	Percent of Uplands
Xeric and Dry-Mesic Longleaf Pine/Wiregrass Sandhill (g)	8451	17.2
Mesic Longleaf Pine/Wiregrass Savanna (g)	24524	50.0
Mixed Pine-Hardwood Slopes (g)	12095	24.6
Longleaf Pine–Pyrophytic Hardwood Woodland (g)	2324	4.7
Wet-mesic Longleaf Pine Savanna (g)	146	0.3
Wet Mixed Pine Savanna (g)	268	0.6
Pyrophytic Mixed Pine-Hardwood on Piedmont Substrates (g)	84	0.2
Mixed Mesic Hardwood Forest	450	0.9
Pine-Hardwood Flats (g)	537	1.1
Small Stream Wetland Mosaic Structured by Fire and Beaver (w)	3822	
Bottomland Hardwood Forest	209	0.4
Bottomland Hardwood-Swamp Forest (w)	1344	
Small Depressions, Seasonally Ponded, with Swamp Black Gum, Ogeche Plum/Maiden Cane (w)	36	
(Udorthents - Disturbed soils and vegetation)	(674)	
Water	515	
Total Water & Wetlands	5717	
Total Upland acres (less Udorthents)	49088	100
Total Grassy Uplands	48,429	98.7
TOTAL	55479	

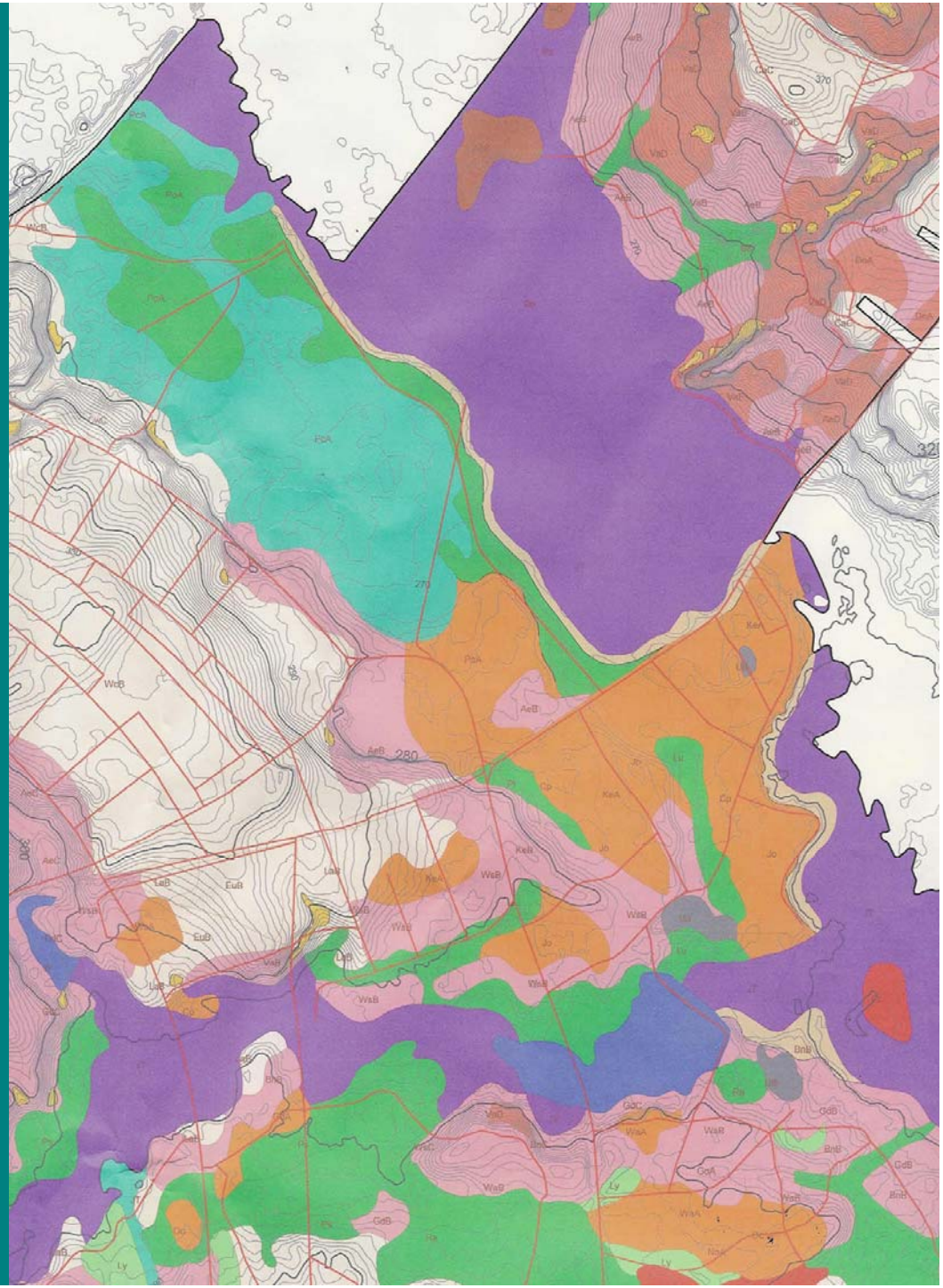
Gravatt Center –

Piedmont-Sandhills transition

Aiken County SC

Camp Mackall

Presettlement Vegetation

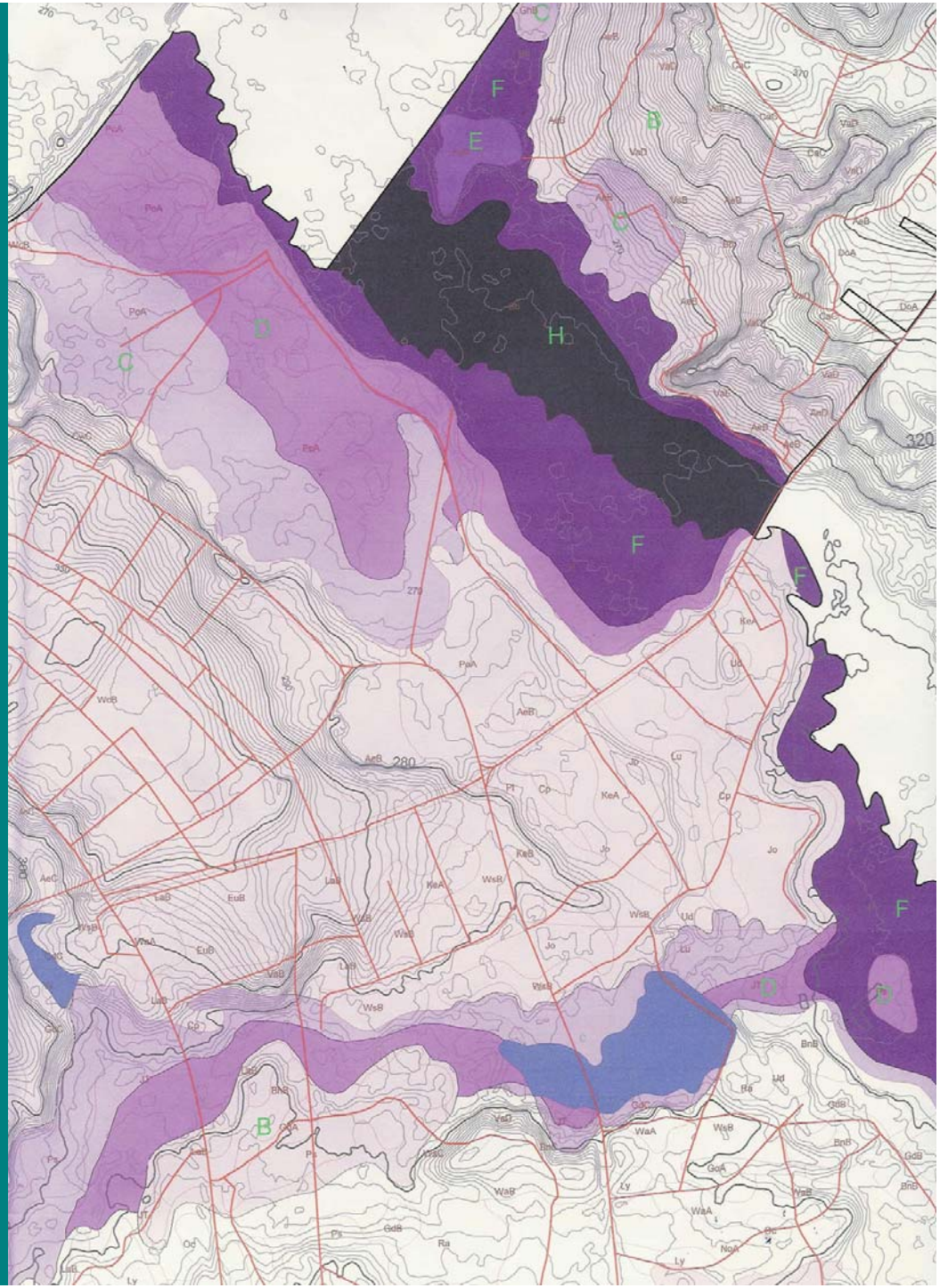


Drowning Creek Swamp – Wet Phase

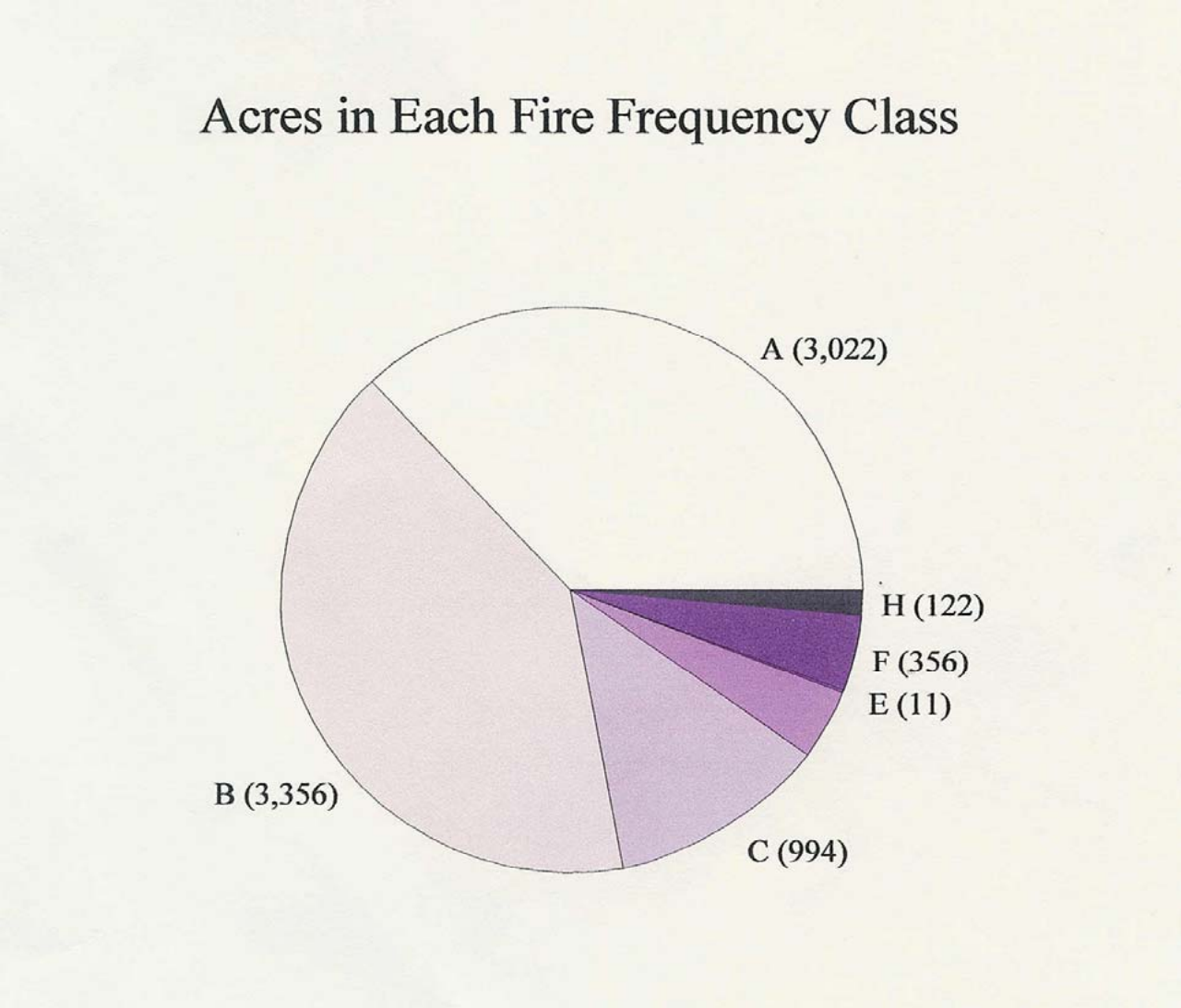
Drowning Creek Swamp – Dry Phase

Camp Mackall

Presettlement Fire Frequency



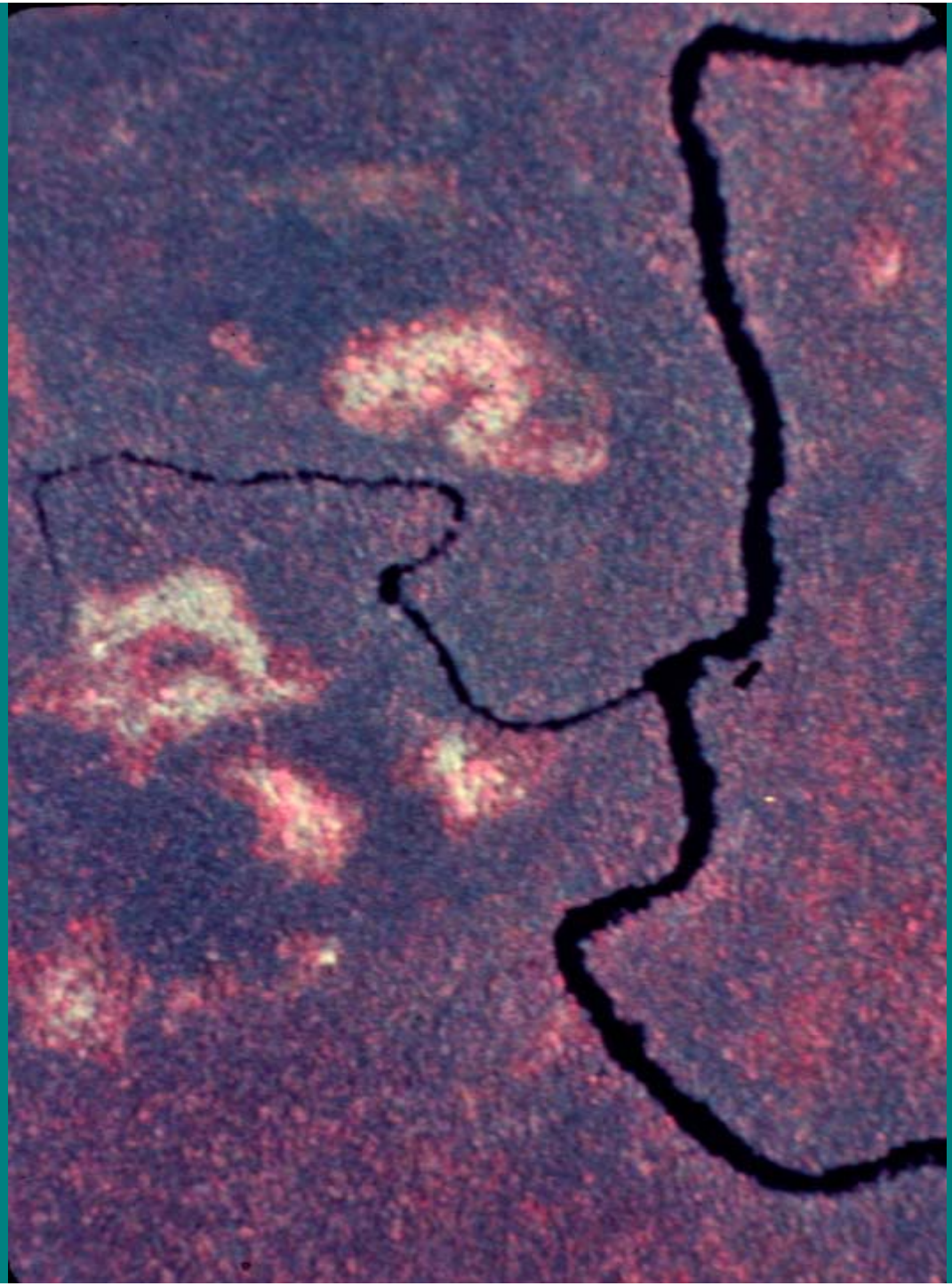
Camp Mackall

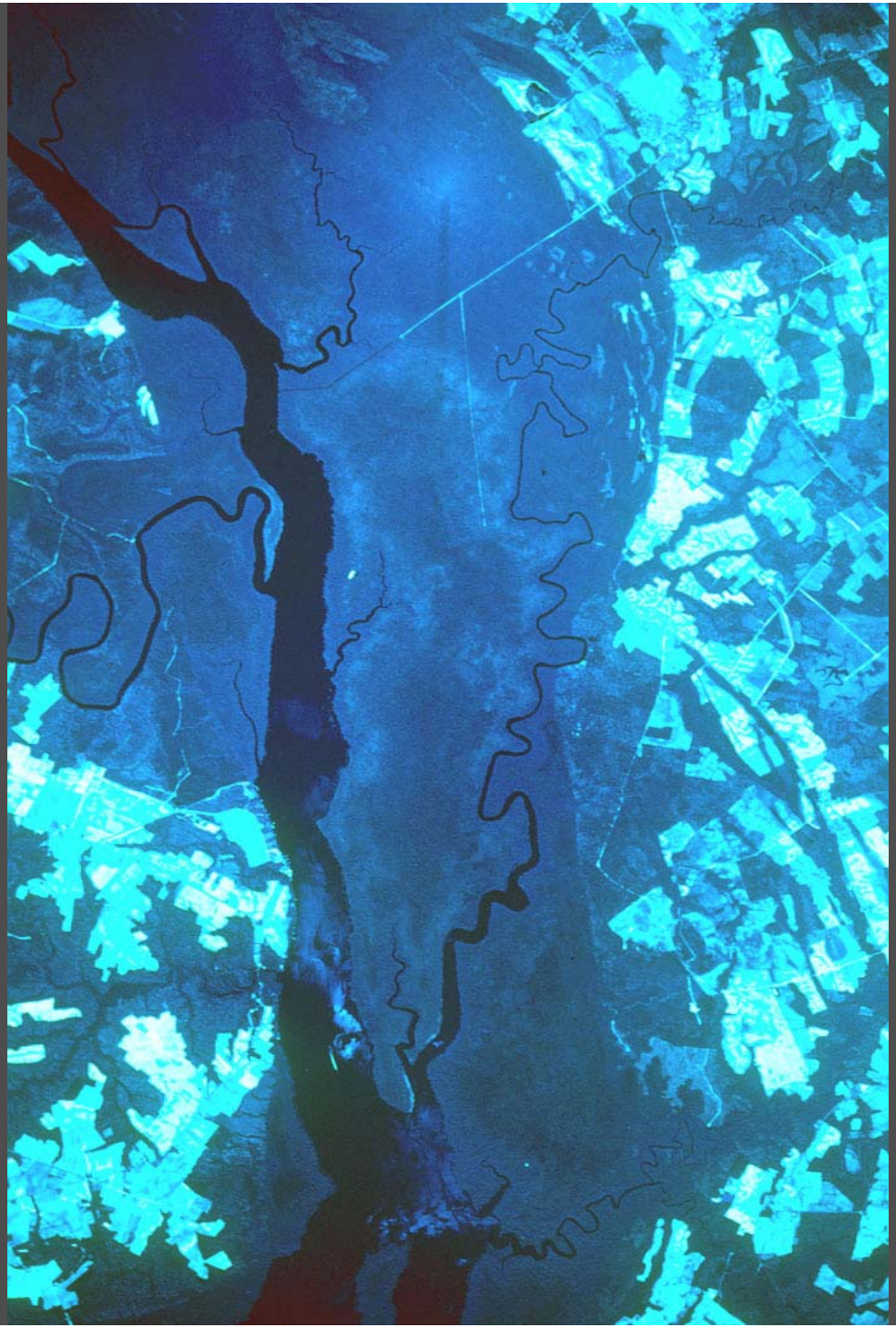


Blackwater River Southampton County, VA

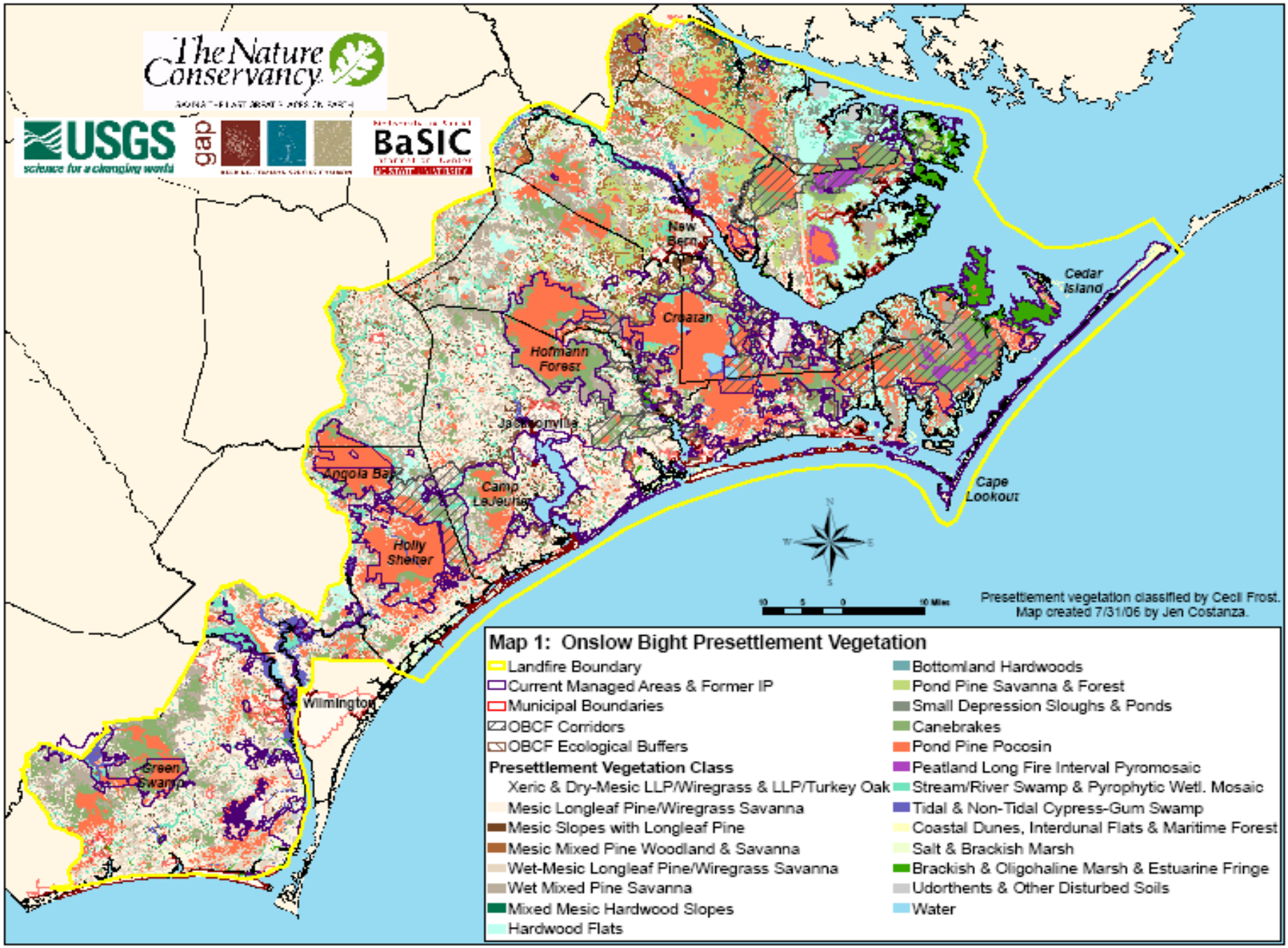
Chowan Swamp

20,000 acres of white cedar





Chowan Swamp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Mesic Slopes with Longleaf Pine
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Wet-Mesic Longleaf Pine/Wiregrass Savanna
Wet Mixed Pine Savanna
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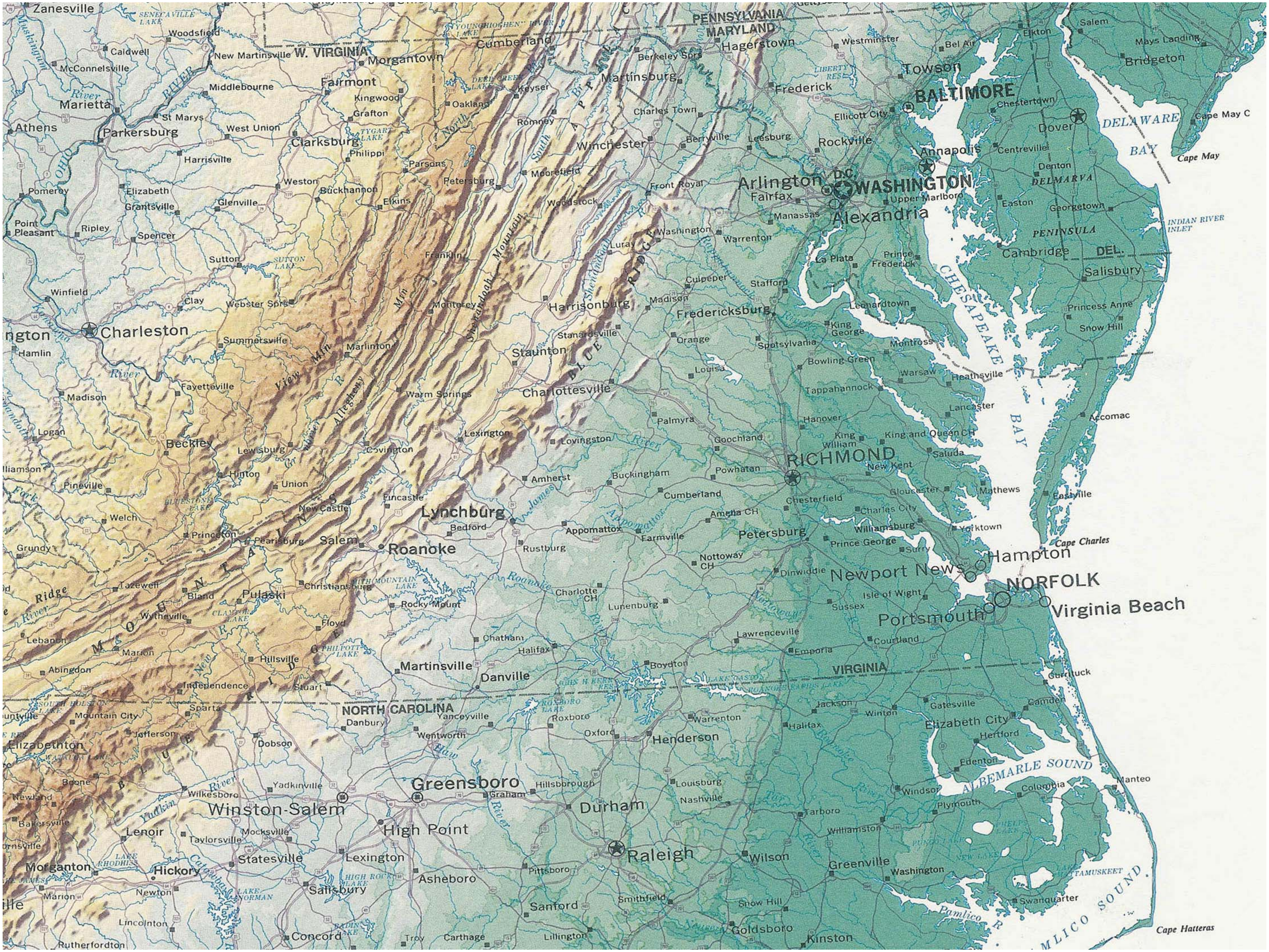
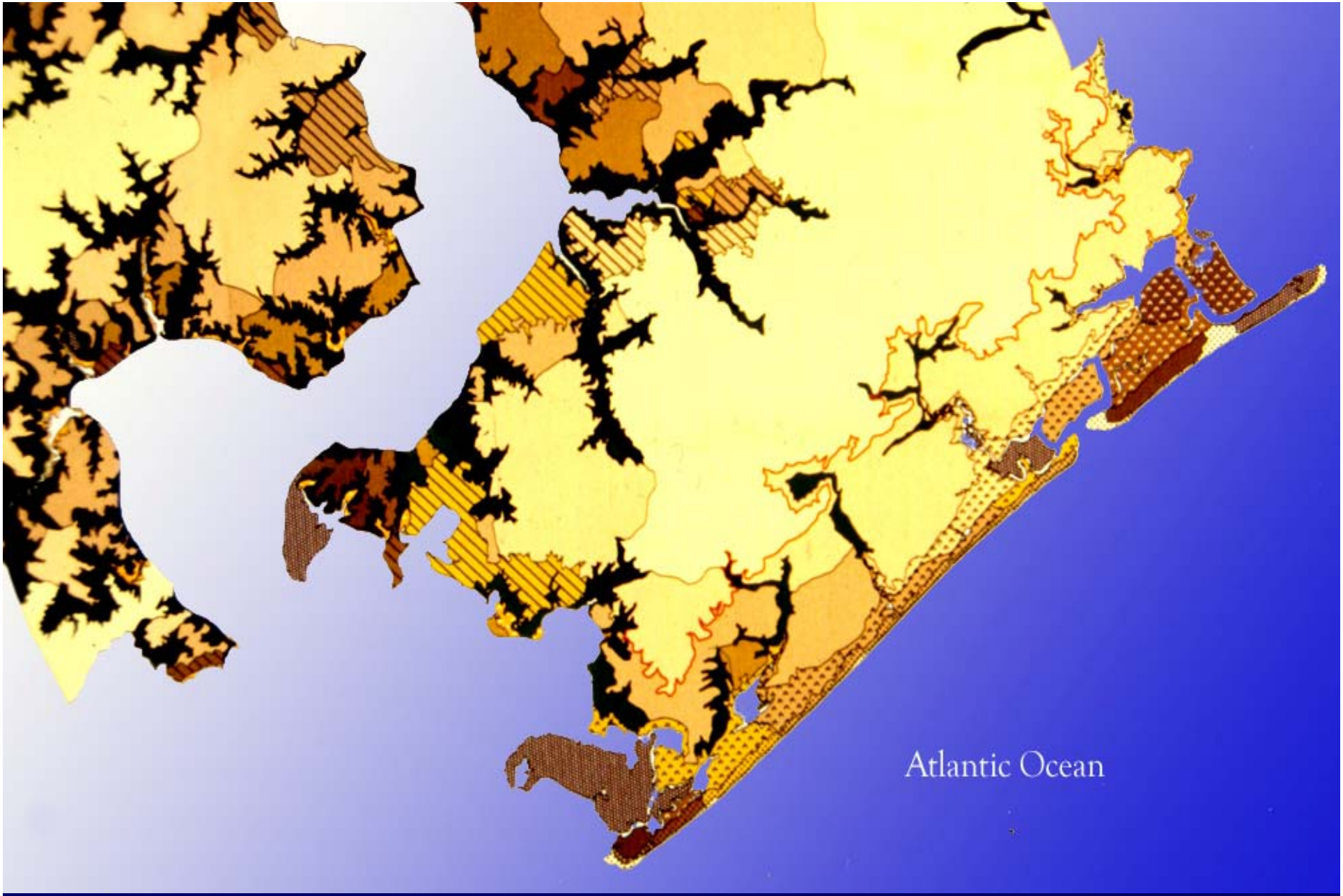
Water



PENNSYLVANIA
MARYLAND
W. VIRGINIA
VIRGINIA
NORTH CAROLINA
DEL.
D.C.
WASHINGTON
BALTIMORE
RICHMOND
NORFOLK
Zanesville
Woodsfield
Caldwell
New Martinsville
Morgantown
Cumberland
Hagerstown
Westminster
Bel Air
Elkton
Salem
Mays Landing
Bridgeton
McConnelsville
Fairmont
Berkeley Sprs
Martinsburg
Towson
Frederick
Marietta
Middlebourne
Kingwood
Grafton
Keyser
Oakland
Romney
Charles Town
Ellicott City
Chestertown
Dover
DELAWARE BAY
Cape May C
Cape May
Athens
Parkersburg
St Marys
West Union
Clarksburg
Philippi
Winchester
Berryville
Leesburg
Rockville
Annapolis
Centreville
Harrisville
Parsons
Petersburg
Moorefield
Front Royal
Arlington
Fairfax
Alexandria
Upper Marlboro
Denton
DELMARVA
Pomeroy
Elizabeth
Grantsville
Weston
Buckhannon
Glenville
Elkins
Woodstock
Manassas
Easton
Georgetown
Point Pleasant
Ripley
Spencer
Sutton
Franklin
Luray
Washington
Warrenton
La Plata
Prince Frederick
PENINSULA
Cambridge
INDIAN RIVER INLET
Salisbury
Winfield
Clay
Webster Sprs
Monterey
Harrisonburg
Madison
Culpeper
Stafford
Fredericksburg
Leonardtown
King George
Princess Anne
Snow Hill
CHESAPEAKE BAY
Charleston
Hamlin
Summersville
Marlinton
Staunton
Stanardsville
Orange
Spotsylvania
Montross
Bowling Green
Warsaw
Heathsville
Madison
Fayetteville
Warm Springs
Charlottesville
Louisa
Tappahannock
Lancaster
Logan
Beckley
Lewisburg
Covington
Lexington
Lovingston
Palmyra
Goochland
Hanover
King William
King and Queen CH
Saluda
Accomac
Hinton
Union
Pineville
Amherst
Buckingham
Powhatan
New Kent
Mathews
Eastville
Welch
New Castle
Fincastle
Lynchburg
Bedford
Cumberland
Amelia CH
Chesterfield
Gloucester
Charles City
Williamsburg
Yorktown
Cape Charles
Grundy
Princeton
Pearisburg
Salem
Roanoke
Rustburg
Appomattox
Farmville
Petersburg
Prince George
Surry
Hampton
Newport News
Nottoway CH
Dinwiddie
Tazewell
Bland
Pulaski
Christiansburg
Charlotte CH
Isle of Wight
Virginia Beach
Wytheville
Floyd
Rocky Mount
Lunenburg
Sussex
Portsmouth
Lebanon
Marion
Chatham
Halifax
Lawrenceville
Courtland
Abingdon
Hillsville
Martinsville
Danville
Boydton
Emporia
Currituck
Independence
Stuart
Mountain City
Sparta
Danbury
Yanceyville
Roxboro
Warrenton
Jackson
Winton
Gatesville
Camden
Elizabeth City
Hertford
Jefferson
Dobson
Wentworth
Oxford
Henderson
Halifax
Elizabethton
Boone
Yadkinville
Greensboro
Hillsborough
Louisburg
Nashville
Edenton
ALBEMARLE SOUND
Manteo
Columbia
Newland
Wilkesboro
Winston-Salem
Graham
Durham
Tarboro
Windsor
Plymouth
Lenoir
Mocksville
High Point
Williamston
Bakersville
Taylorsville
Raleigh
Wilson
Greenville
Washington
Morganton
Hickory
Statesville
Lexington
Asheboro
Pittsboro
Newton
Salisbury
Sanford
Smithfield
Snow Hill
Swanquarter
Marion
Lincolnton
Goldsboro
PAMLICO SOUND
Cape Hatteras
Rutherfordton
Concord
Troy
Carthage
Lillington
Kinston

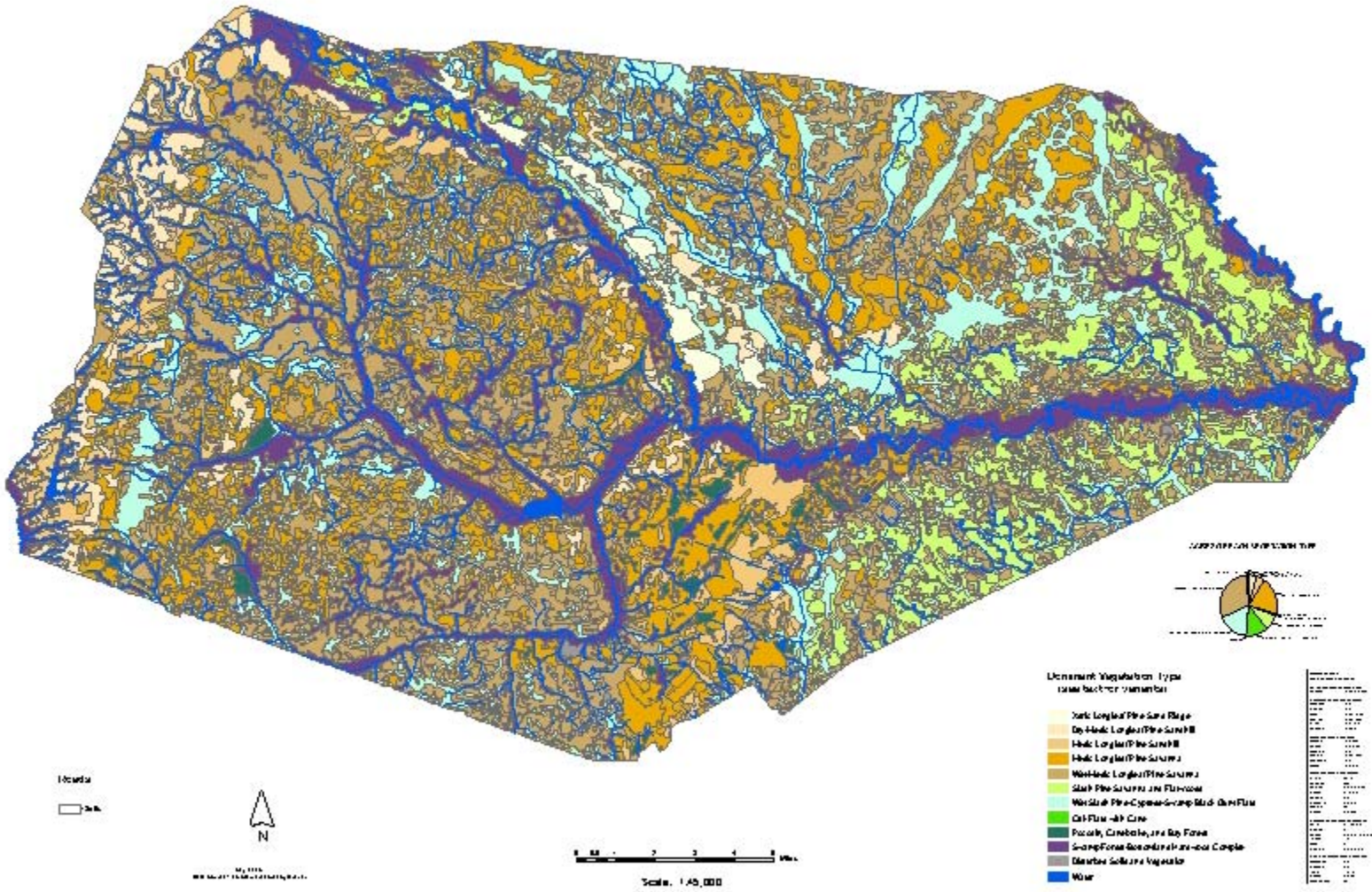
Maps of Original (Presettlement) Vegetation-Croatan Peatlands



Camp Lejeune, USMC

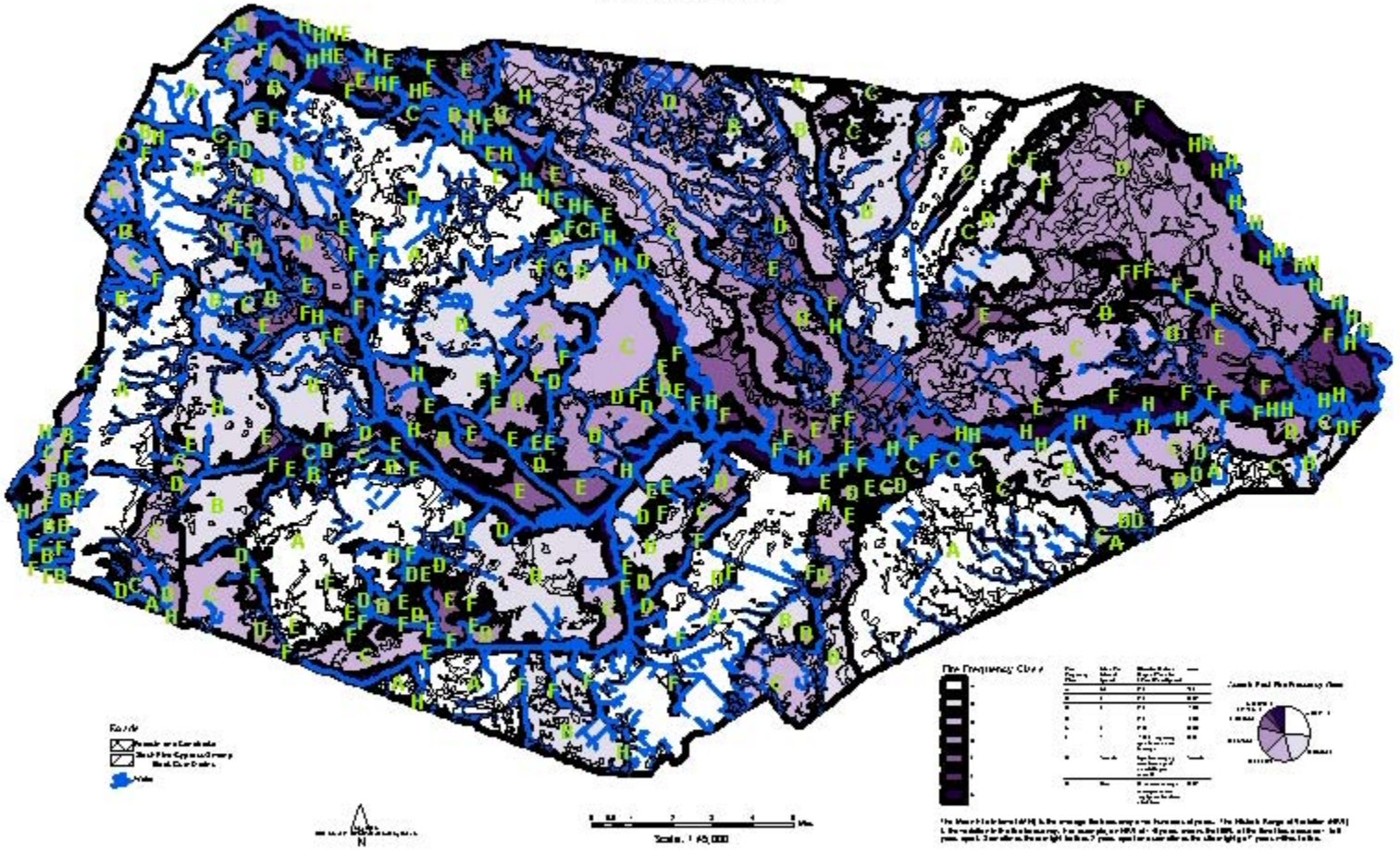
Presettlement Vegetation of Fort Stewart, Georgia

Cecil Frost and Susan Langley



Presettlement Fire Regimes - Fort Stewart, Georgia

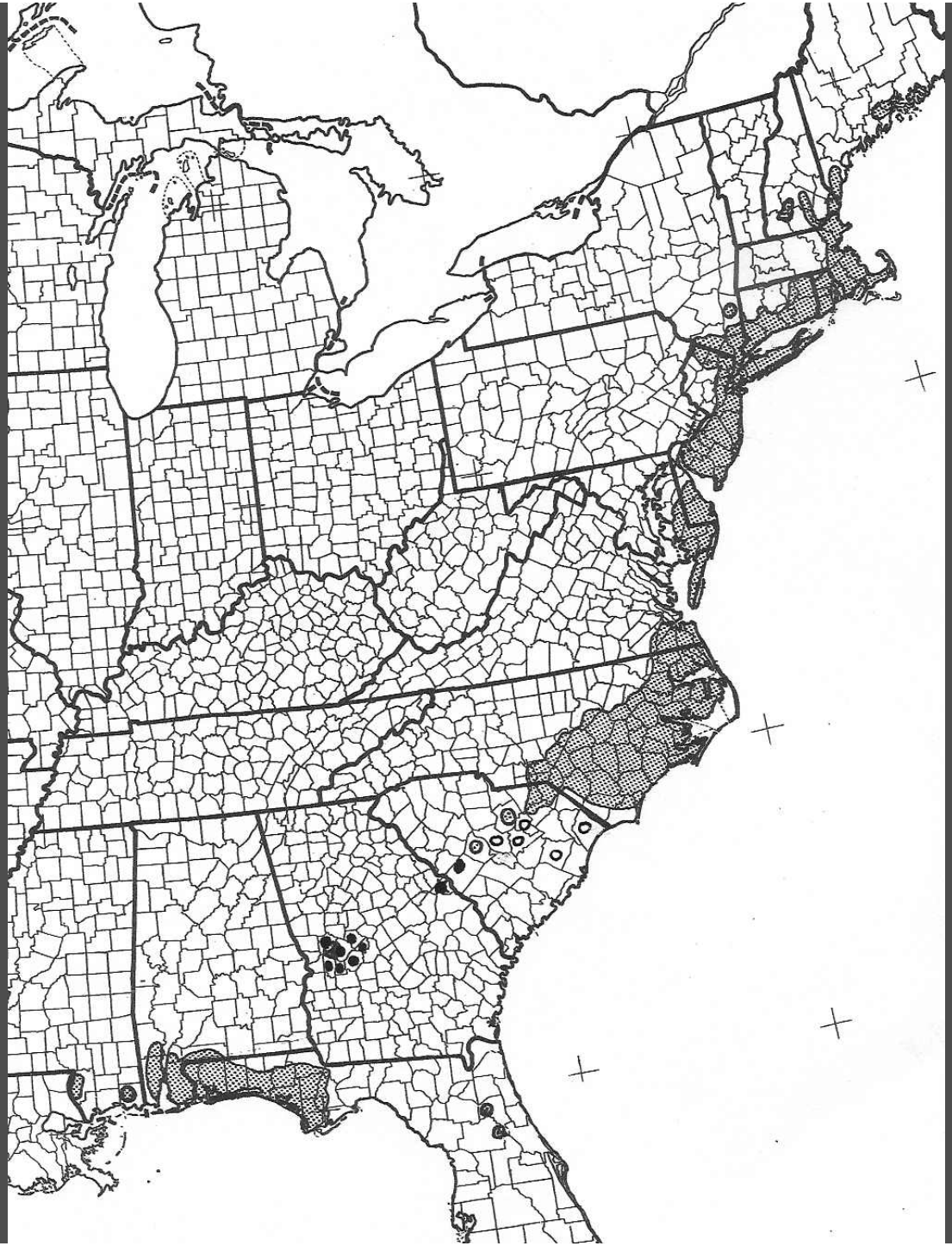
Cecil Frost and Susan Langley



Maintenance burn frequencies for Fort Stewart, Georgia

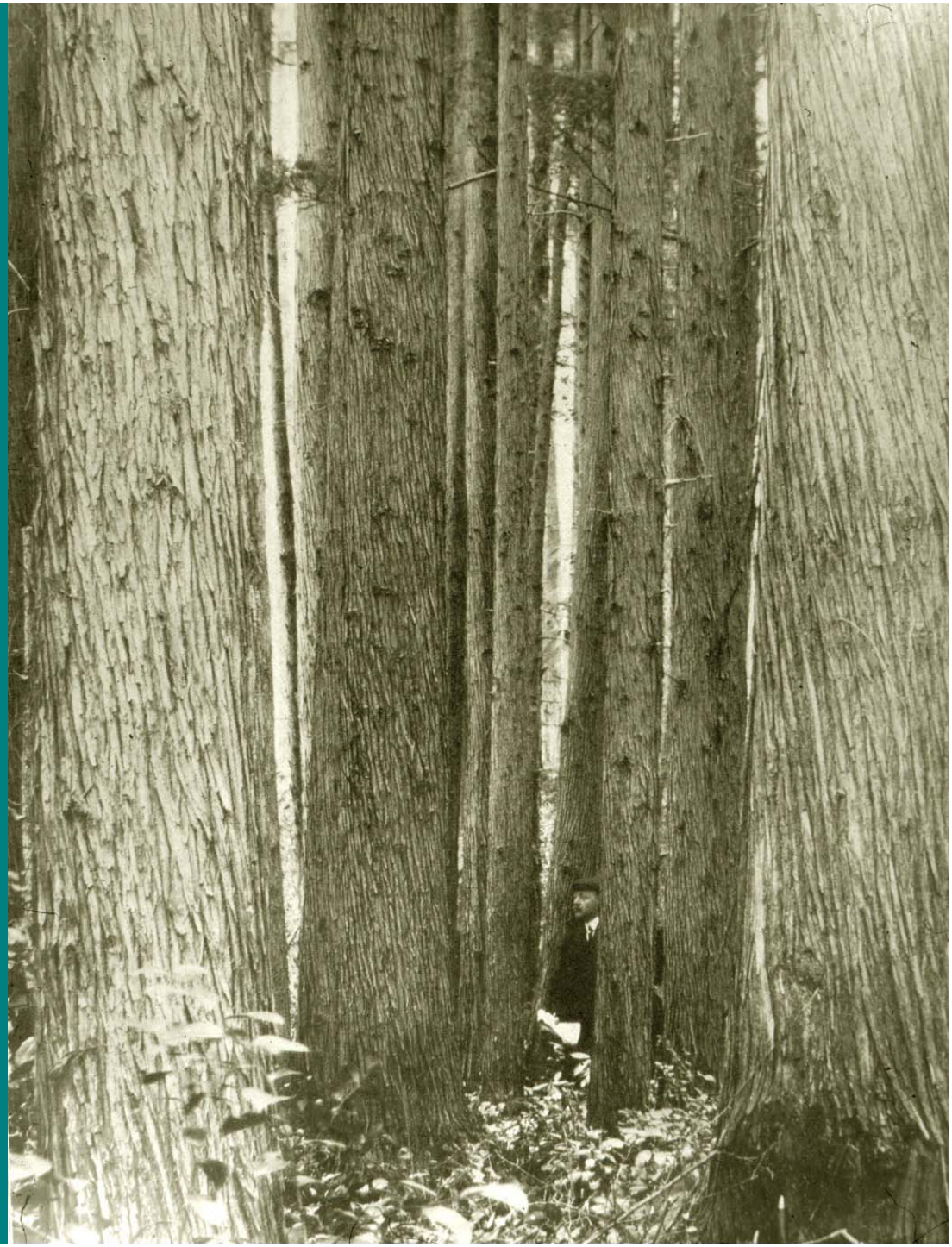
Fire Frequency Class	Mean Fire Interval	Acres	**Average Acres to Burn Per Year (based on whole site but subtract all developed areas)**
A	1.5	72,944	48,629
B	2	53,287	26,643
C	3	47,229	15,743
D	4	45,166	11,292
E	5	22,268	4,454
F	7	11,054	1,579
G	variable	1,065	-0-
H	none	25,987	-0-
		279,000	108,340 (less 9000 acres developed lands and other areas unsuitable for burning)

Historical Range in the South



Virgin white cedar in the Dismal Swamp

1907



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FOA
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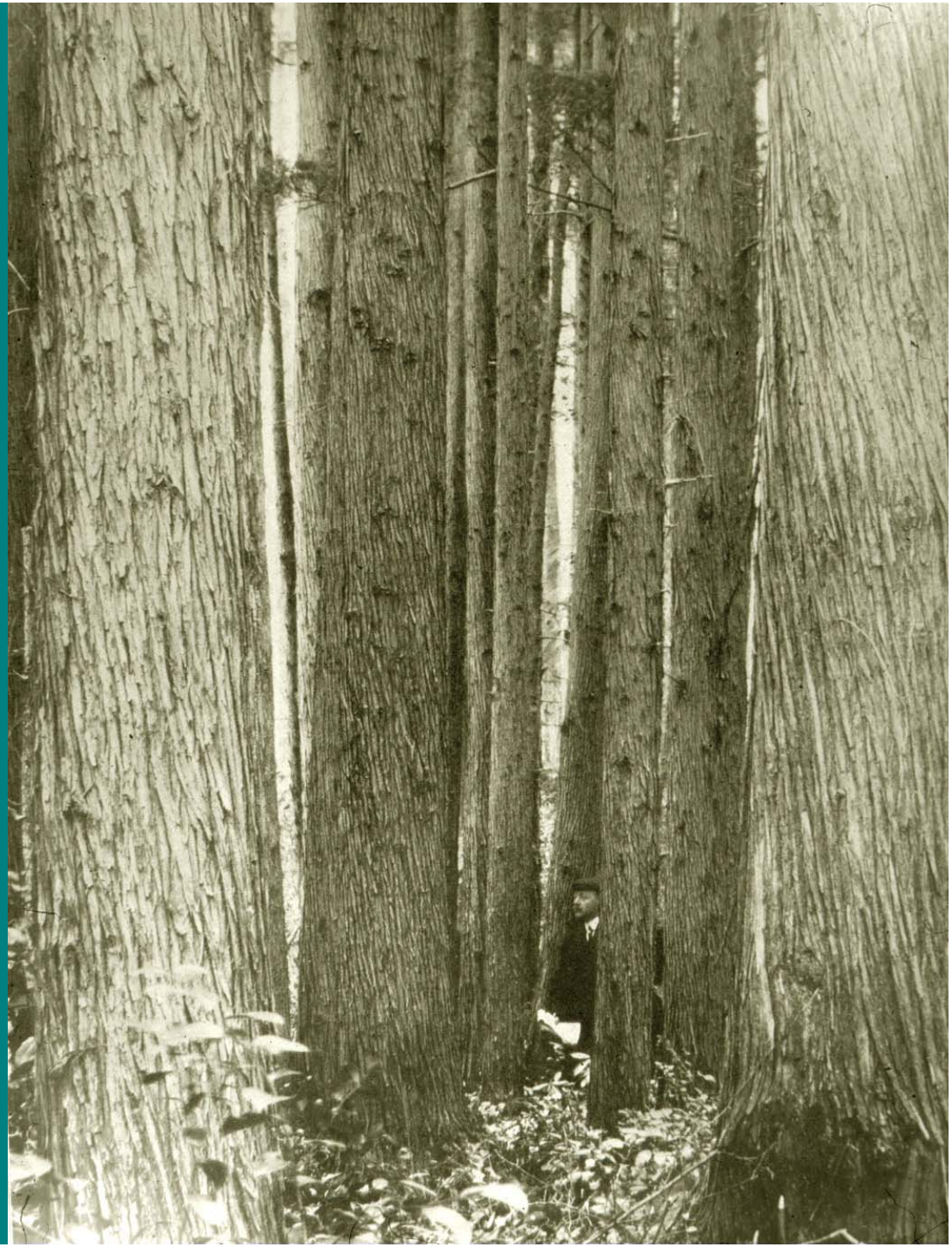
He Wants Your Matchbook.
Celebrating 50 Years.

Fire Frequency Class

Fire Frequency Class	Mean Fire Interval (years)	Estimated Historic Range of Variation (90% of Fires) (years)	Acres
A	1.5	1 - 3	72944
B	2	1 - 5	53287
C	3	1 - 6	47229
D	4	1 - 9	45166
E	5	2 - 20	22268
F	7	4 - 100 + depending upon location in the landscape	11054
G	Variable	Light fires creeping down from tops of river bluffs *(not mapped)*	Variable
H	None	Never burned except on margins or rare, very light surface fires in leaf litter	25987

Virgin white cedar in the Dismal Swamp

1907



“Juniper” or Atlantic White Cedar