

**THE SCUPPERNONG COASTAL SYSTEM:
POCOSINS, CAROLINA BAYS, AND
BLACK-WATER STREAMS**

**AN INTEGRATED, INTERDISCIPLINARY CASE STUDY OF
THE NATURAL AND CULTURAL RESOURCES FOR
DEVELOPMENT OF ECOTOURISM**

**A Report of the North Carolina Land of Water (NC LOW)
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The Black-Water Scuppernong River and Floodplain Swamp Forest

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FUNDED BY

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TABLE OF CONTENTS

1. THE SCUPPERNONG REGION	5
A Coastal System Rich with Natural and Cultural Assets	
The Scuppernong Case Study	
2. WHAT IS THE SCUPPERNONG COASTAL SYSTEM (SCS)?	7
3. SCUPPERNONG LANDSCAPE AND ECOSYSTEMS	9
The Scuppernong Coastal System	
Major Landscape Features of the Scuppernong Coastal System	
A. Modern Estuarine, Riverine, and Associated Wetland Ecosystems	
B. Paleo-Shoreline Coastal Systems	
C. Pocosin Swamp Forests and Carolina Bay Lakes	
D. Artificial Drainage System and Associated Road Dikes	
E. Roanoke River Paleo-Braid-Plain Terraces	
4. CULTURAL HISTORY OF THE SCUPPERNONG COASTAL SYSTEM	26
Native American History	
European and African American History	
Today's Demographics	
5. ASSETS OF THE SCUPPERNONG COASTAL SYSTEM	47
Scuppernong Coastal System Assets	
A. Natural Resource Assets	
B. Cultural History Assets	
C. Existing Amenities	
Regional Resource Assets	
6. POTENTIAL NATURAL & CULTURAL ECO-TOURS	52
Different Approaches to Ecotourism Programs	
Potential within the Scuppernong Region	
A. Recreational Eco-Tours: Day-Tripper Programs	
B. Recreational Eco-Tours: Extended Programs	
C. Educational Nature Eco-Tours: Extended Programs	
D. Cultural History Eco-Tours	
E. Fishing and Hunting Eco-Tour Expeditions	
F. Environment and Community Volunteer Eco-Tour Projects	
7. RESOURCE-BASED ECOTOURISM	55
Scuppernong Vision Working Group	
Suggested Approaches	
Addressing Potential Target Groups and Programs	
8. BIBLIOGRAPHY	67
APPENDIX A. GEOLOGIC HISTORY OF THE SCUPPERNONG LANDSCAPE	71
Climatic History and Geologic Framework	
Geologic History of the Scuppernong Landscape	
APPENDIX B. ECOLOGICAL PERSPECTIVE OF THE SCUPPERNONG REGION	80
Ecological Resources of the Scuppernong Coastal System	
Ecosystem Services	
Biodiversity	
APPENDIX C. NORTH CAROLINA LAND OF WATER (NC LOW)	93
Mission and Goals	

1. THE SCUPPERNONG REGION

A Coastal System Rich with Natural and Cultural Assets

A highly recognized North Carolina naturalist and educator, who runs a small eco-tourism business within the Scuppernong coastal system (SCS), refers to the Scuppernong region as a “wildlife spectacle” that he dubs the “Yellowstone of the East”. However, there are no snow-capped mountains, high meadows with elk and bison, and geysers with boiling hot springs. Rather, there are spectacular black-water streams with magnificent cypress and remnant stands of Atlantic white cedar, mysterious pocosins with vast swamp forest habitat, enigmatic Carolina bays and bay lakes, and ghost forests as rising sea level drowns ancient riverine swamps. The concentration of winter waterfowl (e.g., tundra swans and snow geese), raptors (e.g., bald eagles and osprey), mammals (e.g., black bear, bobcat, river otter, and rare encounters with red wolves), make this a paradise for wildlife-watchers and photographers.

The Scuppernong has a long and intriguing cultural history which began 11,000 years ago with Native Americans. Their small and sustainable villages occupied these awesome estuarine, riverine, and associated wetland systems with their cypress dugout canoes that are now preserved in the Carolina bay lakes. With the arrival of European-American explorers the Scuppernong region transitioned slowly for the first 125 to 130 years as the two extremely diverse cultures clashed (from the first English Colony of 1584-1587 through the Tuscarora Indian War of 1711 to 1713). Following this unfortunate confrontation and the increased role of African-American slaves, the Scuppernong region evolved through an explosion of economic development and utilization of the vast natural resource base over the next two centuries (from the 1750s into the early 1980s). The region has now evolved into a preservation mode with establishment of a network of National Wildlife Refuges, Conservation Lands, and State Historical and Park facilities. Yes, a diverse group of ecotourism businesses visit Yellowstone National Park, but they also are beginning to visit the Scuppernong coastal system due to its dramatically different, but unique wetland habitats, abundance of wildlife, and diverse cultural history.

“The Scuppernong Story” is an environmental history of a small coastal system through approximately 125,000 years of climate change and landscape evolution. The cultural over-print on these landscapes and their ecosystems represent eleven millennia of human occupation. This story is the natural and cultural history of a dynamic geologic landscape, a complex and highly diverse set of ecosystems, and the human groups who inhabited this region characterized by dramatic environmental evolution.

The Scuppernong Case Study

Small towns in North Carolina, like many throughout the U.S., have been hard-pressed to create new economic opportunities. Similar to other rural communities in North Carolina, the Inner Banks portion of the *North Carolina Land of Water* coastal system (NC LOW in Figure 1-1) faces a number of challenges including loss of jobs, population decline, high poverty rates, empty buildings, and crumbling infrastructure. In an effort to stimulate new economic opportunities, NC LOW focuses on developing a strategy for natural and cultural, resource-based

ecotourism as means of diversifying the rural economy. The current project examines the potential of developing resource-based ecotourism in one area of the NC LOW coastal system. Results will provide a framework for other areas of the NC LOW region and assist in bringing a vision of natural resource-based tourism to fruition and improve the local quality of life through economic development that enhances and protects the environment and culture of the region.

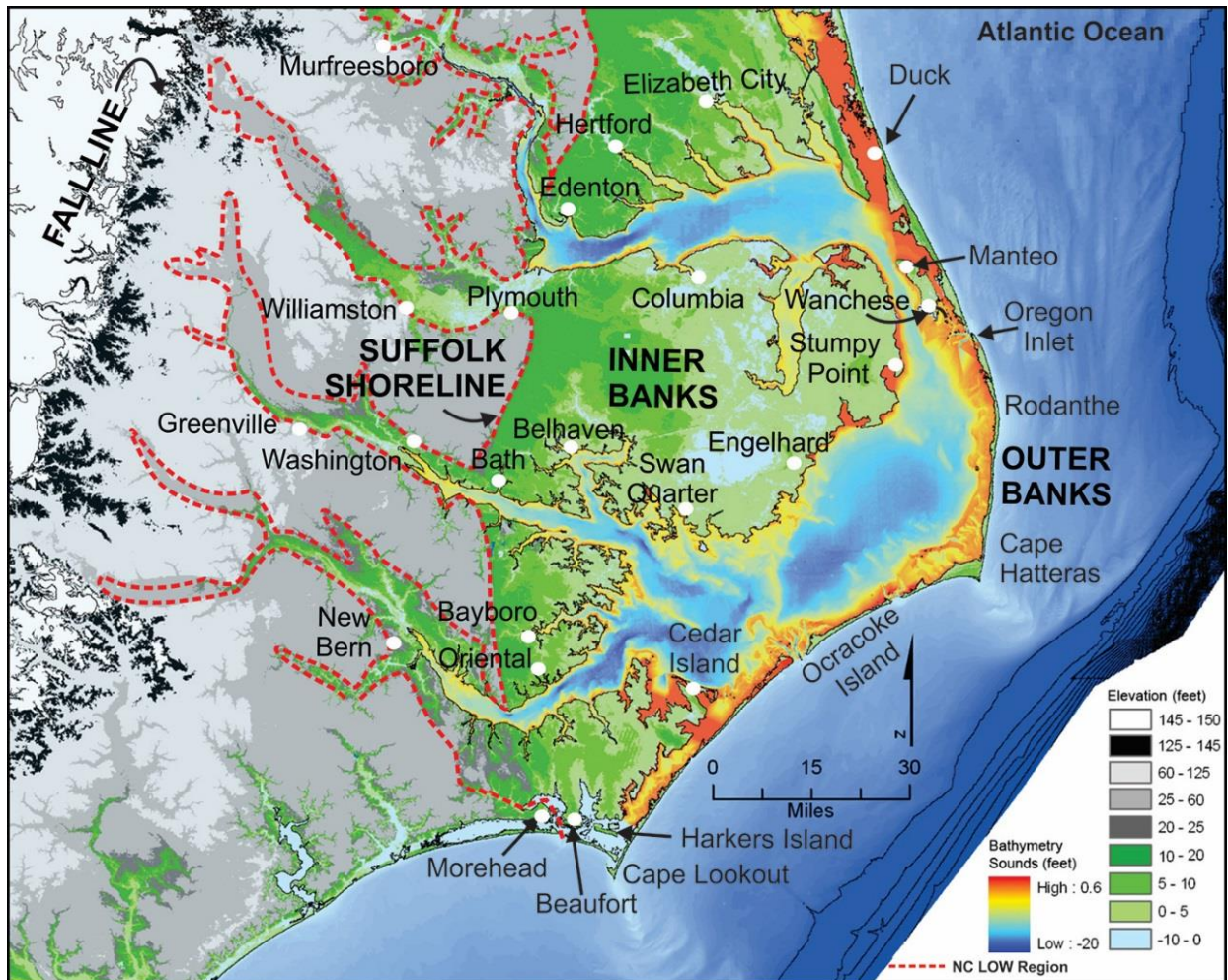


FIGURE 1-1. This color topography (land elevation) and bathymetric (water depth) map of the North Carolina Land of Water (NC LOW) coastal system includes the Inner and Outer Banks of northeastern North Carolina. The area defined as NC LOW occurs between the red dashed line (the Suffolk Shoreline and associated river bottoms) on the west and the Outer Banks barrier islands on the east. Land elevations and water depth are color-coded as indicated in the legend. The locations of some major towns are indicated. The black zone (Fall Line) on the western side of the map is the contact between the Piedmont Province (west) and Coastal Plain Province (east). Topographic data are from NC DOT's 2007 LiDAR.

Why is the North Carolina Land of Water (NC LOW) producing this report and what is the role of the report as we go forward? This report is an integrated summary of the natural and cultural resource assets that occur within the Scuppernong coastal system (SCS). Many

individuals have expertise in exact disciplines and management of specific organizations with discreet goals and objectives. However, there are few individuals or organizations with the goal of integrating all of these disparate groups and disciplines; it is one of NC LOW's goals to do that for a discrete portion within the larger-scale "NC LOW" region.

Because NC LOW does not have the resources to focus on the entire NC LOW region, it became imperative that a smaller, but representative component of NC LOW be defined and developed as a regional case study. Thus, it is the goal NC LOW that this SCS case study will be used as a model that can be duplicated in other drainage basins within the broader region of NC LOW. The present report represents a critical step that defines the natural and cultural resource assets for the SCS case study region, but it is only the first step! The SCS report is a semi-technical document that defines the essential-natural and cultural resource asset information for the next three critical steps for development of a sustainable ecotourism economy within the Scuppernong region. It provides the groundwork for:

1. Producing a series of public, non-technical educational components of "The Scuppernong Story", an integrated, interdisciplinary history of this region utilizing multiple formats for museums, educational tourism, virtual tourism, school systems, public, TV, etc.
2. Providing the ideas for developing an "Implementation Plan" along with organizing a "Scuppernong Stakeholder Working Group" of regional leaders and experts to help guide and implement the multitude of ecotourism opportunities.
3. Delineating the background information for writing proposals to fund and implement the various ecotourism opportunities within the SCS region.

2. WHAT IS THE SCUPPERNONG COASTAL SYSTEM (SCS)?

The Scuppernong coastal system is a tributary drainage system to the Albemarle Sound and Pamlico River drowned-river estuaries (Figure 2-2). A complex set of geologic landscape features comprise the Scuppernong region that includes ancient ocean shorelines and riverine terraces, the more recent drowned-river estuaries, and modern tributary streams and associated pocosin swamp forests. The spectacular black-water Scuppernong River transitions upstream into a series of smaller tributary streams whose headwaters are in the elevated wetlands of perched upland pocosins (Native American name for a "swamp on a hill"). Unique fresh-water, Carolina Bay lakes are situated in the pocosin and on the high inter-stream divide between Albemarle Sound and the Pamlico River Estuary. Numerous small towns and villages are interspersed among vast areas of drained farmland, riverine wetlands and swamp forests.

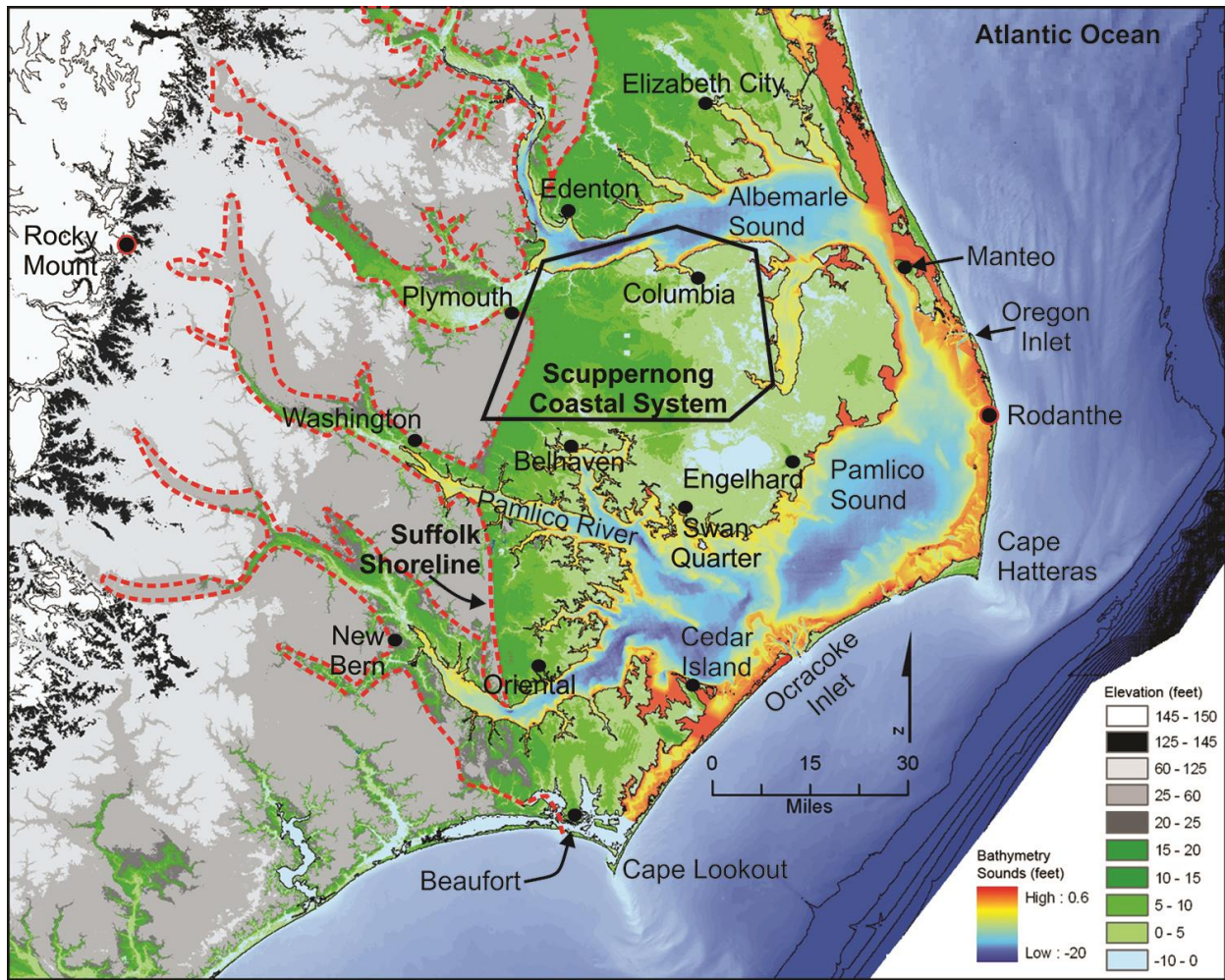


FIGURE 2-2. A color topography (land elevation) and bathymetry (water depth) map shows the location of the Scuppernong coastal system (black polygon) within the North Carolina Land of Water (NC LOW). The area defined as NC LOW occurs between the red dashed line (the Suffolk Shoreline and associated river bottoms) on the west and the Outer Banks barrier islands on the east. Elevation and depth colors are shown in the legend. Land elevation rises systematically from the lower Coastal Plain (light to dark greens) through the central and upper Coastal Plains (grays), to the Piedmont Province (white) on the west. The black zone on the western side of the map is the Fall Line where the older crystalline rocks of the Piedmont Province become buried by the younger marine sediments of the Coastal Plain Province. Topographic data are from NC DOT's 2007 LiDAR.

For the past 125,000 years of earth history, the geologic landscape and associated ecosystems of the Scuppernong region evolved as natural and interdependent partners. The Native Americans arrived about 11,000 years ago, but their environmental impacts and historical records have been minimal. However, the arrival of Europeans in the late 16th century brought a new force onto the landscape, slowly at first but then exploding about three hundred years ago, first with the aid of African-American labor, followed by the industrial revolution of the 19th century. The settler's goal during these three centuries was to remake northeastern North

Carolina “in the image of Europe” in which the economic forces conceived “water, soil, forest, plants, and animals as potential commodities” that were “manipulated to optimize production as they were extracted, traded, and degraded” (Kirby, 1995). Nature’s forces of climate change (sea-level rise, storms, floods, and fire) which controlled the dramatic evolution of the landscape and its ecosystems were also the forces that dictated the dynamics of the more recent development of human culture and its history. Thus, “The Scuppernong Story” intertwines the geologic landscape and its ecosystems with the human history.

The vast swamp lands within the SCS endured until technological ingenuity could overcome the inconveniences of shallow-water streams, undrained wetlands, and black-land peat soils. The thick wetland deposits of carbon-rich peat soils were the scourge of economic development within the enormous and impenetrable swamp lands of the SCS. Ironically, carbon from fossil fuels was the source of power that drove both the industrial revolution and hydrologic ditching and draining of the wetlands of coastal North Carolina.

3. SCUPPERNONG LANDSCAPE AND ECOSYSTEMS

The Scuppernong Coastal System

The geologic story of the Scuppernong coastal system (Figure 2-2) is about vast drowned-river estuaries, magical black-water tributary streams and floodplain swamp forests, ancient meander- and braid-plain deposits, ethereal pocosin swamps and thick deposits of organic peat, mysterious Carolina bays and Carolina bay lakes, and ancient shorelines and coastal deposits. This story is a 125,000 year history of substantial shifts in climate and associated changes in temperature, precipitation, storms, and sea level that resulted in the depositional and erosional complexity of the modern Scuppernong landscape. In turn, this complex landscape led to the diverse set of ecosystems and natural resources to which Native Americans, and later Europeans and Africans both adapted to and utilized.

This is “The Scuppernong Story” with the Scuppernong River playing the central role (Figure 3-1). What is the origin of the word “Scuppernong”? The written word first occurs on various maps and documents that were produced by the European colonists who arrived in 1584-1587. However, the river’s name had numerous spellings that include “Coscoopernung”, “Cuscoponung”, “Scuconung”, “Scupperlong”, and “Scopernong”. The word ascopo is believed to have an Algonquian source and used by the English colonists (Governor Ralph Lane in 1585) to reference the “big white grapes” that are native to the Albemarle region.

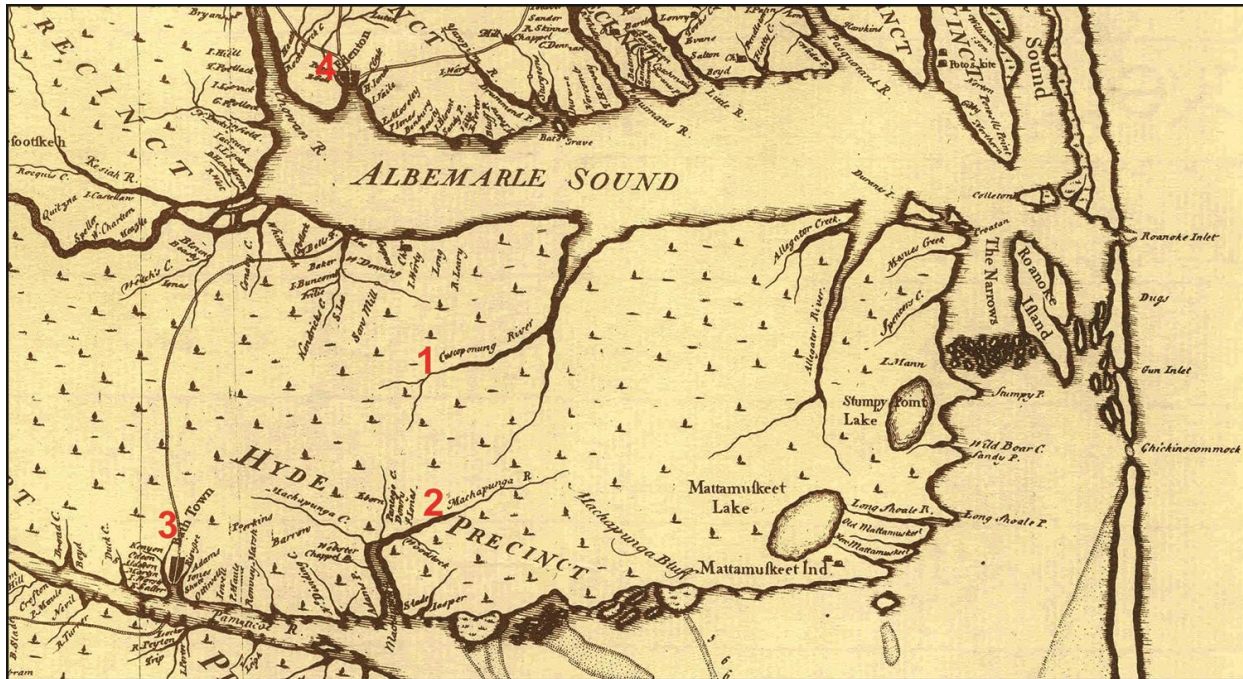


FIGURE 3-1. The Moseley (1733) map of the Albemarle-Pamlico Peninsula shows the “Cuscoponong” River (red #1) on the north side of the Peninsula and the “Machapunga” River (red #2) on the south side. The town of Bath (red #3) was established in 1706 and Edenton (red #4) became the first capital of North Carolina in 1722. Contrast the amount of development indicated by the many names in the area north of Albemarle Sound with the poorly explored Albemarle-Pamlico Peninsula. None of the Scuppernong area lakes had yet been discovered when this map was drawn. The map is from Cumming (1966).

Two other primary players in “The Scuppernong Story” are the Roanoke River and Albemarle Sound (Figure 3-2). In March 1586, Ralph Lane led his team of 29 men westward in two 15 person rowboats to explore up the River of Morotico and beyond to the territory of the Moratucks. The Morotico River was the Algonquian name for “river of death” due to the common spring flood waters. Subsequently, the present Roanoke River name was derived from the Algonquian word Rawrenok. When the Roanoke reaches sea level it becomes Albemarle Sound, a drowned river estuary that was formed by rising sea level as it flooded up the Roanoke River valley. Albemarle Sound (Figure 3-2) was named for the English nobleman George Monck, 1st Duke of Albemarle. The name originates from Latin *alba* meaning “white” and *margila* meaning “marlstone” which is lime that was a critical ingredient for the agricultural development of the acidic, organic-rich, “blackland” soils of the Albemarle region.

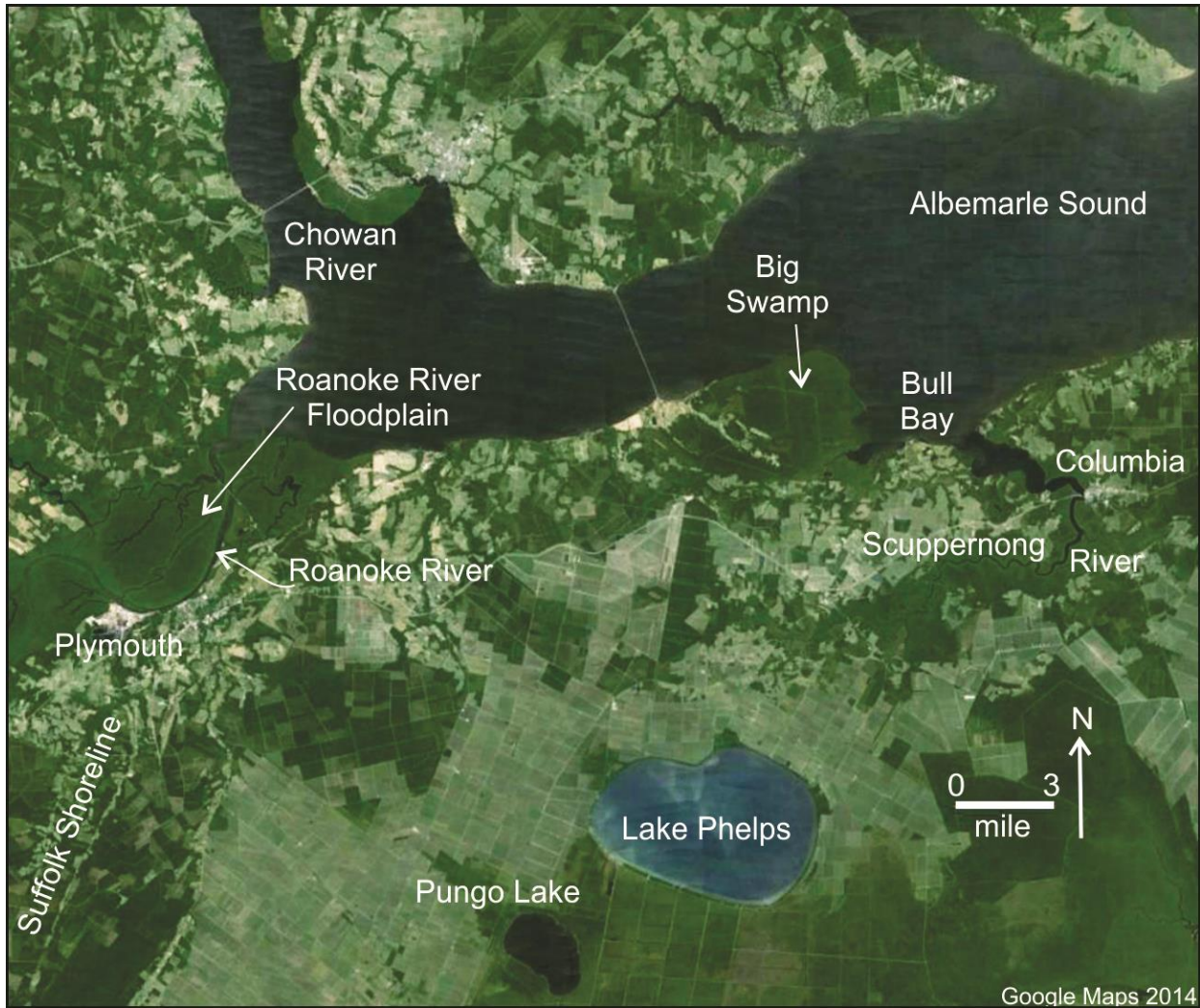


FIGURE 3-2. A 2014 aerial photograph mosaic shows the Roanoke River floodplain and the Albemarle Sound and Chowan River estuaries. The latter two estuaries are the drowned river valleys of the Roanoke and Chowan rivers, respectively, that flooded over the last 9,000 years in response to the ongoing rise in sea level. Notice how the west end of Albemarle Sound terminates abruptly at the broad Roanoke River floodplain swamp forest. South of Albemarle Sound is the Scuppernong River which was formerly a tributary to the Roanoke River during the sea-level low-stand of the last glacial maximum. With the subsequent warming climate, rising sea level flooded up the Roanoke River valley and lower portion of the Scuppernong River valley to form the Bull Bay estuary. Bull Bay grades upstream into the Scuppernong River as the river bottom rises above today's sea level southwest of Columbia. East of the Suffolk Shoreline and south of the Scuppernong River are two Carolina bay lakes (Phelps and Pungo). Notice the immense window-pane shaped network of ditches throughout the Lake Phelps region that were dug to drain this vast wetland system. The aerial photograph is from Google (2014).

Another important player in “The Scuppernong Story” is the term “pocosin”. This mysterious upland world has many different spellings on maps and documents through time that include “Poquosin”, “Perkosan”, “Pocosen”, “Percoarson”, “Pocasan”, and “Poccoson”. This is

an Algonquin word meaning “swamp on a hill”. The word “pocosin”, as used in this document, is inherited from the geologic and ecologic literature, which goes back to explorations and descriptions by Lawson in 1709. In 1875, Kerr described “dismals” or “pocosins” as the swamps occurring at the headwaters of streams (Tooker, 1899). This description puts pocosins on the topographic highs of the inter-stream divides, where the Great Dismal National Wildlife Refuge and Pocosin Lakes National Wildlife Refuge are located, as well as the many other highland swamps throughout the North Carolina Coastal Plain.

Biologically, pocosins are generally water-logged, nutrient-poor, acidic fresh-water bogs dominated by shrubs that form on top of poorly drained clay substrates on flat inter-stream terraces common in the southeastern US Atlantic Coastal Plain (Christensen et al., 1981). Typical vegetation consists of a dense shrub understory of both evergreen and deciduous species (e.g., fetterbush, ti-ti, holly, and honey cups) with scattered and occasional clusters of trees (e.g., pond pine, Atlantic white cedar, bald cypress, red maple, and the bay trees—sweet, loblolly, and red bay) (Figure 3-3). The accumulating organic matter forms an organic-rich peat or “black-land” soil that accretes vertically with time. However, if the peat soils are oxidized by fire or dried out by lowering the surficial water table through drought and/or ditching and draining, they will decompose and the land surface will subside. Thus, the definition of a pocosin as a perched wetland is the application of an old term to a very specific landscape and associated ecosystem. Geologically and ecologically, pocosin wetlands and associated peat deposits differ greatly from riverine floodplains, estuarine marshes, and back-barrier marsh wetlands and their associated peat and bog deposits.



FIGURE 3-3. Photograph shows the upper pocosin within Pocosin Lakes National Wildlife Refuge and demonstrates the dense growth of wetland grasses and shrubs, with scattered wetland tree species.

Major Landscape Features of The Scuppernong Coastal System.

In order to understand the modern SCS and its resources, it is necessary to integrate various types of data sets. First, define the various landscape units by integrating color topography maps with a series of aerial photographs and with field observations. Second, define the geologic units (subsurface stratigraphy) through sediment core analyses from hundreds of drill holes in the scientific literature. Third, assign age estimates to each of the different geologic units. Many age estimates (based on radiocarbon, optical stimulated luminescence, and paleontological and archeological data, etc.) are available from decades of research in the region. Fourth, interpret the evolutionary history of the SCS region. Figure 3-4 is a color topographic map showing the major landscape features within the SCS that are summarized in the following maps and photographs (Figures 3-5 through Figures 3-18).

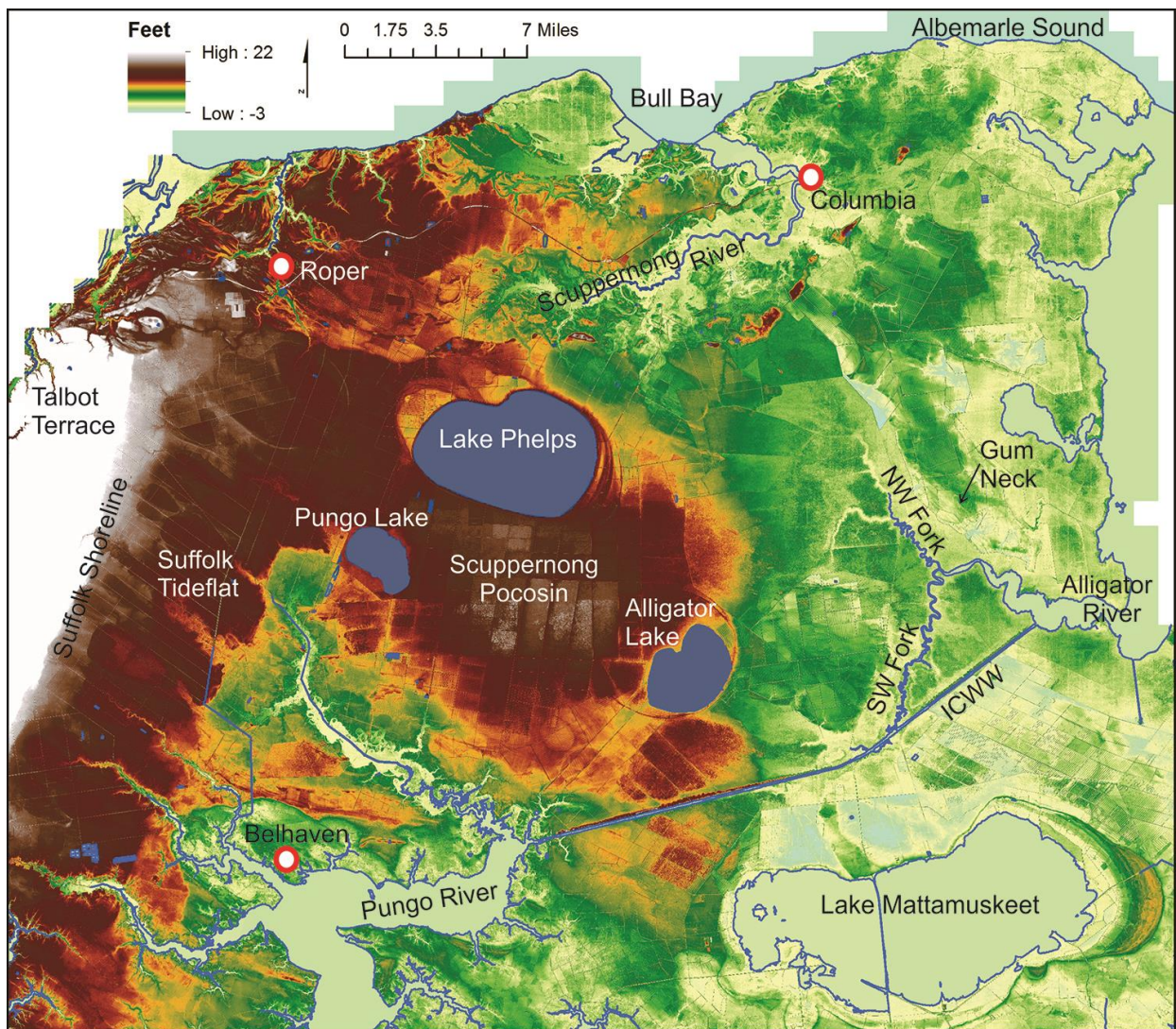


FIGURE 3-4. A color topography map shows the landscape features of the SCS. Mean sea level is pale green on this map. Land elevation rises systematically from mottled pale green (~0 to 3

feet) along the east and southeast margins, to green (~4 to 7 feet), orange to red (~8 to 10 feet), dark red (~11 to 19 feet), to gray (~20 to 29 feet). White is the highest elevation along the western margin (>30 feet above mean sea level). Pungo Lake is 9 feet, Phelps Lake is 10 feet, and Alligator Lake is 6 feet above mean sea level. Lake Mattamuskeet (pale green in southeast corner) is maintained at or slightly below mean sea level by dikes and pumping stations. Topographic data are from the 2015 North Carolina Floodplain Mapping Program.

Modern Estuarine, Riverine, and Associated Wetland Ecosystems

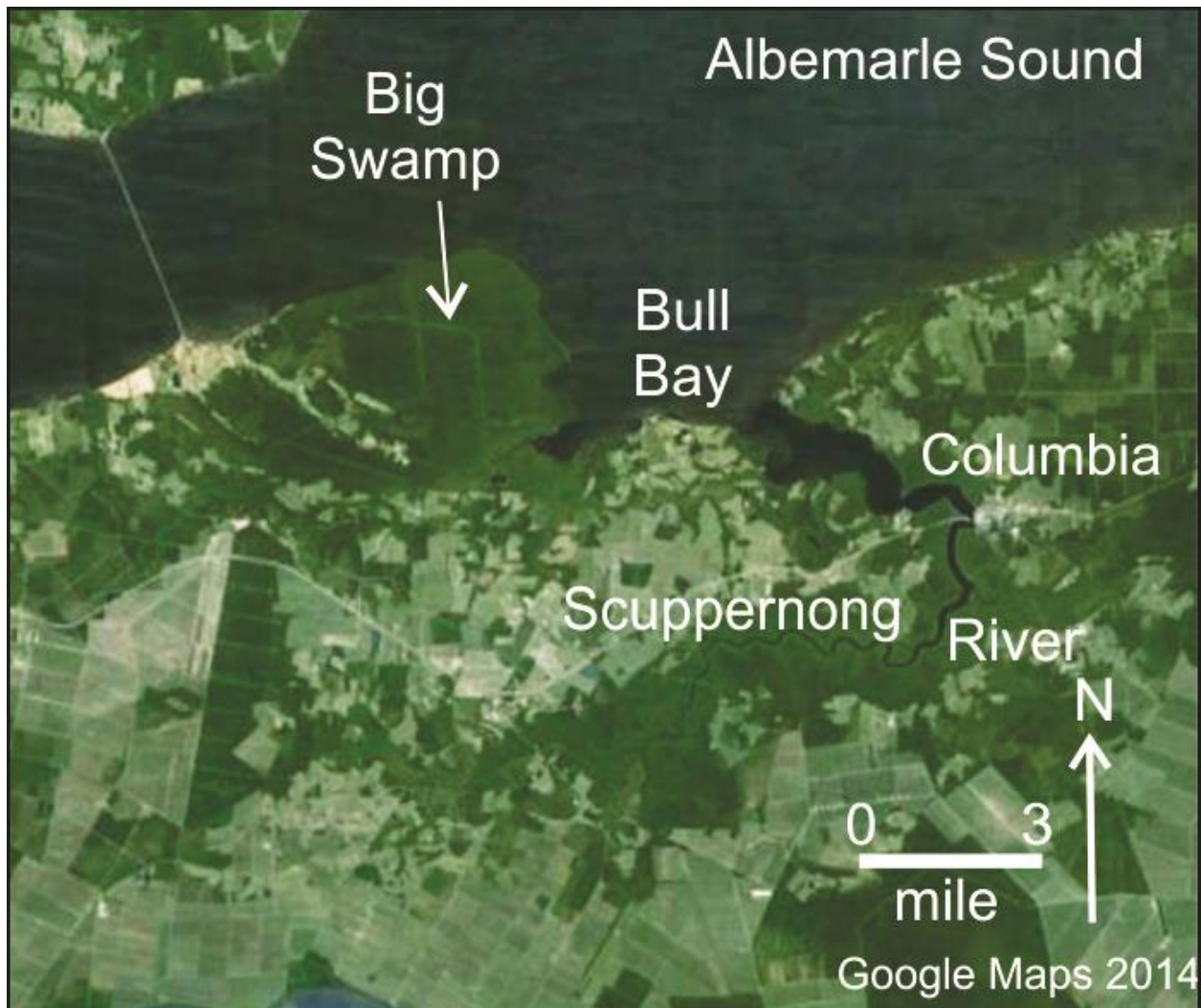


FIGURE 3-5. A 2014 aerial photograph mosaic shows Albemarle Sound, a drowned river estuary of the Roanoke River. The Scuppernong River, formerly a tributary to the Roanoke River during the last glacial maximum, was partially flooded in the downstream portion to form Bull Bay estuary during post-glacial sea-level rise. The flooded meanders of the Scuppernong River and its floodplain are still prominent as curved bends in the stretch from Bull Bay to Columbia, which is at the limit of current sea-level flooding. South and southwest of Columbia, the fresh, black-water Scuppernong River exhibits its old meander patterns within a broad riverine floodplain swamp forest (dark green). The aerial photograph is from Google (2014).



FIGURE 3-6. Photographs of Albemarle Sound show the estuarine water body that fills the lower portion of the Roanoke River valley. The Roanoke River was active across the entire Coastal Plain throughout the last glacial episode when the climate was cold, sea-level was substantially lower, and the coastline was seaward of its present location. Sea level has been rising and flooding up the eastern portion of the Roanoke River Valley to form Albemarle Sound since about 18,000 years ago when the global climate began to warm and the continental glacial ice began to melt. The abundant ghost trees and stumps along the perimeter of the Sound are evidence that sea level is still rising and flooding across the adjacent land surface. Trees cannot live below permanent water level.

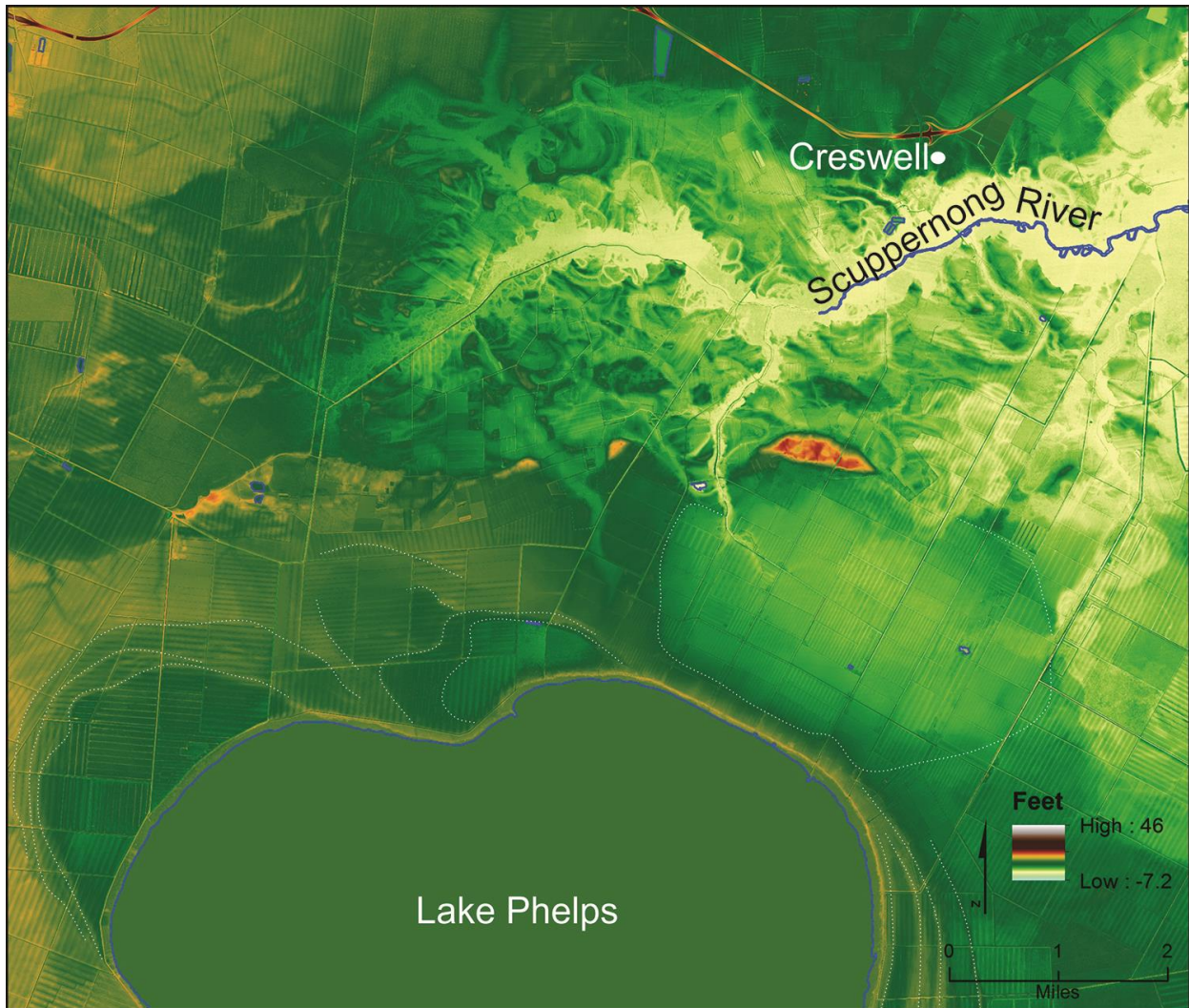


FIGURE 3-7. This color topography map shows the upper reaches of the Scuppernon River (~1 foot above mean sea level) and the broad modern floodplain (medium green, up to 4 feet above mean sea level). The floodplain contains abundant older river meanders that are no longer part of the main river channel. Notice that the Scuppernon floodplain is sharply incised into the adjacent dark green area (~5 to 10 feet above mean sea level). The up-stream portion of the river rises above sea level and is actively involved in headward erosion by the numerous small tributary channels. Notice the several arcuate paleo-shorelines around the northwest and east ends of Lake Phelps, which is a complex set of Carolina bays. Topographic data are from the 2015 North Carolina Floodplain Mapping Program.



FIGURE 3-8. The left panel shows the western Bull Bay swamp forest shoreline of the low-lying Big Swamp (see Figure 3-5), which is being eroded and drowned as sea-level slowly rises. The ghost forest results from permanent drowning causing all but cypress tree species to die. Cypress trees, however, do become stressed and ultimately die. The right panel shows the upper reaches of the black-water Scuppernong River with its broad floodplain. This riverine swamp forest is only flooded seasonally and, thus a wide range of wetland species thrive with a relatively stable shoreline.

B. Paleo-Shoreline Coastal Systems

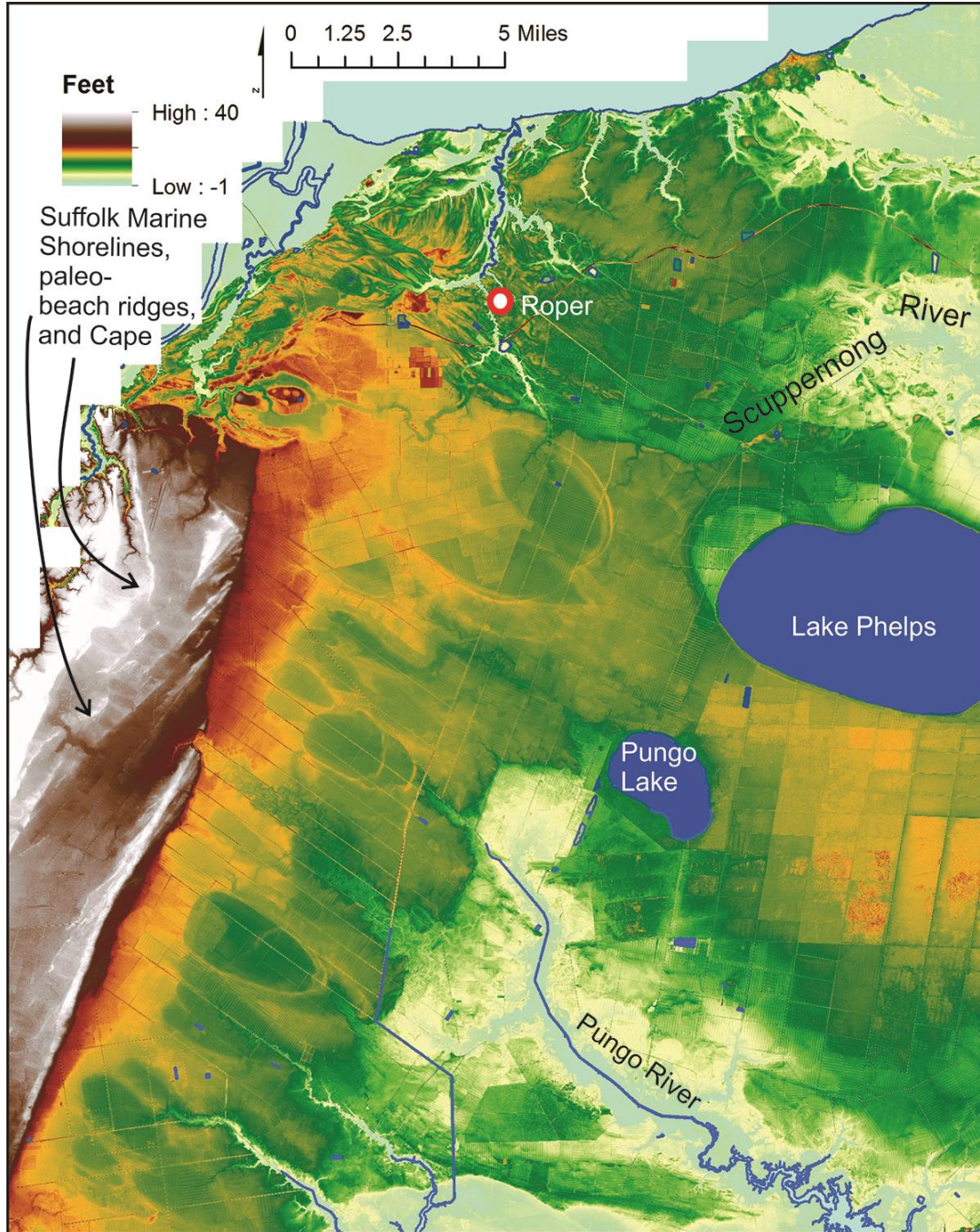


FIGURE 3-9. Paleo-Suffolk marine shorelines along the western map boundary consist of an erosional scarp cut into the east side of the dark red upland surface with a series of paleo-beach ridges and swales and a paleo-cape feature (white) deposited on top of the eroded, paleo-Suffolk shoreface surface (dark red, see Figure A-4). The Paleo-Suffolk Shoreline tide flat (red to orange to dark green) is a seaward-sloping marine mud flat on which a series of northwest-southeast oriented, shore perpendicular, oval depressions (Carolina bays) formed after this region became land. Notice that the Carolina bay depressions often consist of multiple overlapping curved sand ridges and that their southeast ends have

been breached by the headward erosion of incised tributary streams of the Pungo River. The straight line channel segments within this drainage system have been channelized. Also, notice the extensive window-pane network of ditches on both the paleo-Suffolk Shoreline tidal flat and the Scuppernong Pocosin to the south of Lake Phelps. Topographic data are from the 2015 North Carolina Floodplain Mapping Program.

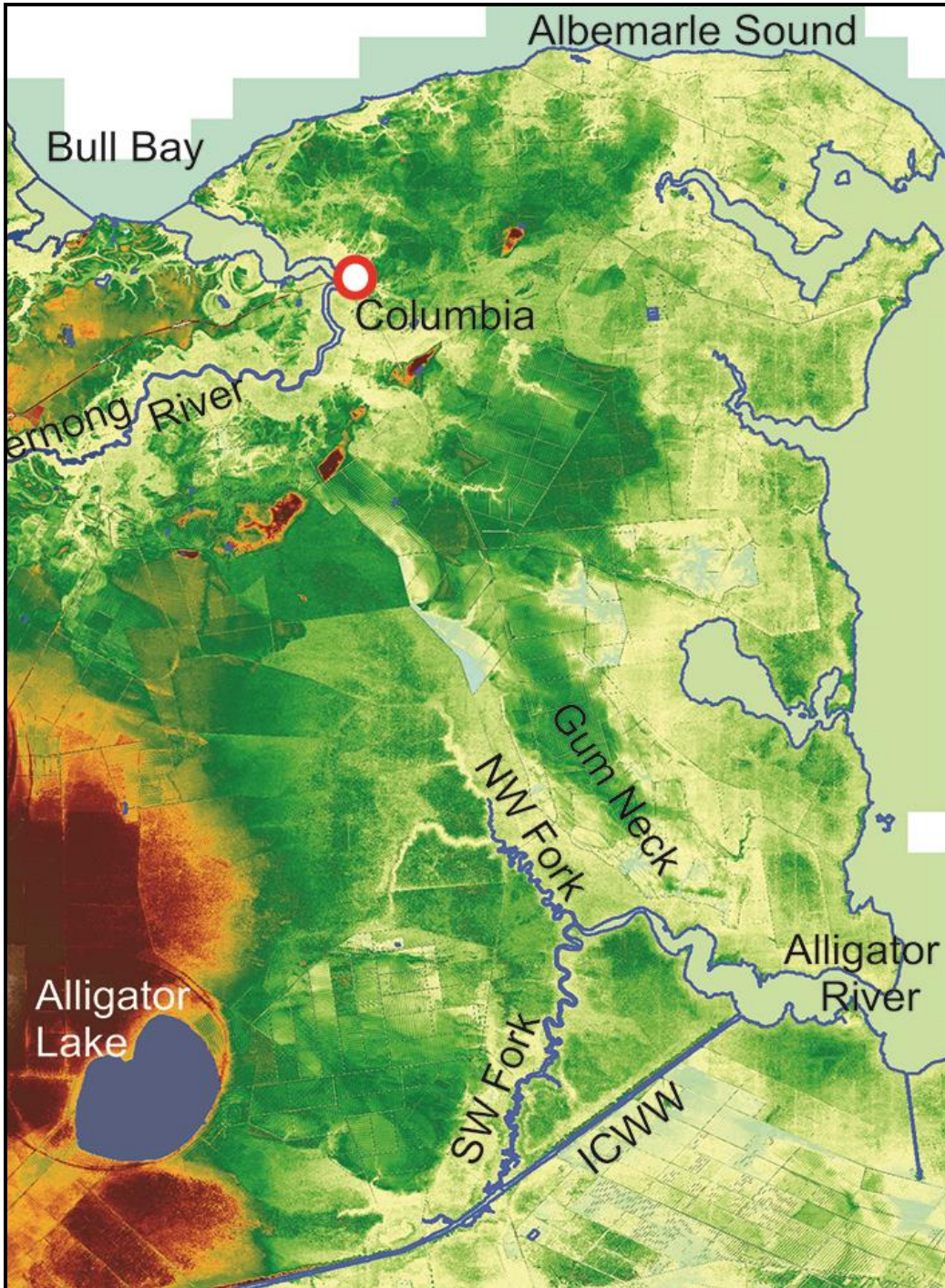


FIGURE 3-10. Gum Neck (light to dark green at ~1 to 4 feet elevation) is a sand ridge that forms the top of an ancient marine barrier island that formed between 100,000 and 75,000 years ago (see Figure A-3).

This paleo-barrier island has been almost buried by vertically and laterally accumulating fresh-water peat deposits growing in the Alligator drainage system in response to post-glacial rise in sea level. Notice that the Alligator River valley is a major estuary, except for the up-stream portion, which is in the early stage of flooding and still displays paleo-meander patterns similarly to the section of the Scuppernong River (see Figure 3-7) between Bull Bay and Columbia. The NW and SW Forks are up-stream of rising sea level and are actively involved in headward erosion. Topographic data are from the 2015 North Carolina Floodplain Mapping Program.

C. Scuppernong Pocosin Swamp Forest and Carolina Bay Lakes

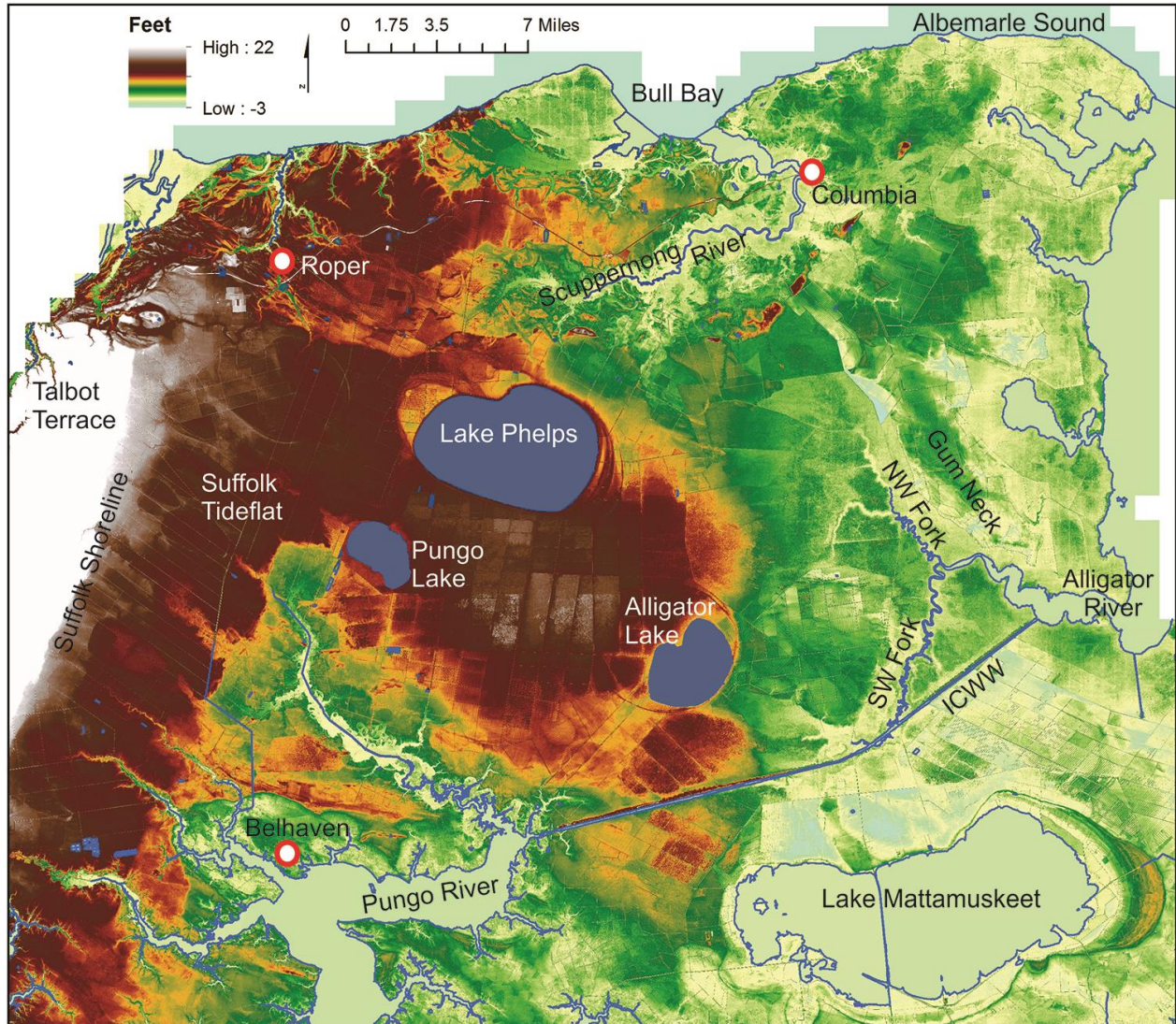


FIGURE 3-11. This color topography map shows several tributary drainages that have incised into the eastward sloping ramp of the paleo-coastal system—the Paleo-Suffolk Shoreline (gray at ~21 to 30 feet above sea level) and Paleo-Suffolk tidal flat (dark red to orange to dark green at ~5 to 20 feet above sea level; see Figure A-4). The four tributary streams and their floodplains (in various shades of pale green at ~1 to 4 feet above sea level) include the Scuppernong River in the northeast; the NW and SW Forks of the Alligator River in the east; and the Pungo River in the south. The headward erosion of the streams defined the existing inter-stream divide forming a “swamp on a hill” known as the Scuppernong Pocosin

(the dark red area in the center of the map at ~10 to 20 feet above sea level) with the three Carolina bay lakes (blue at ~6 to 10 feet above sea level). Topographic data are from the 2015 North Carolina Floodplain Mapping Program.

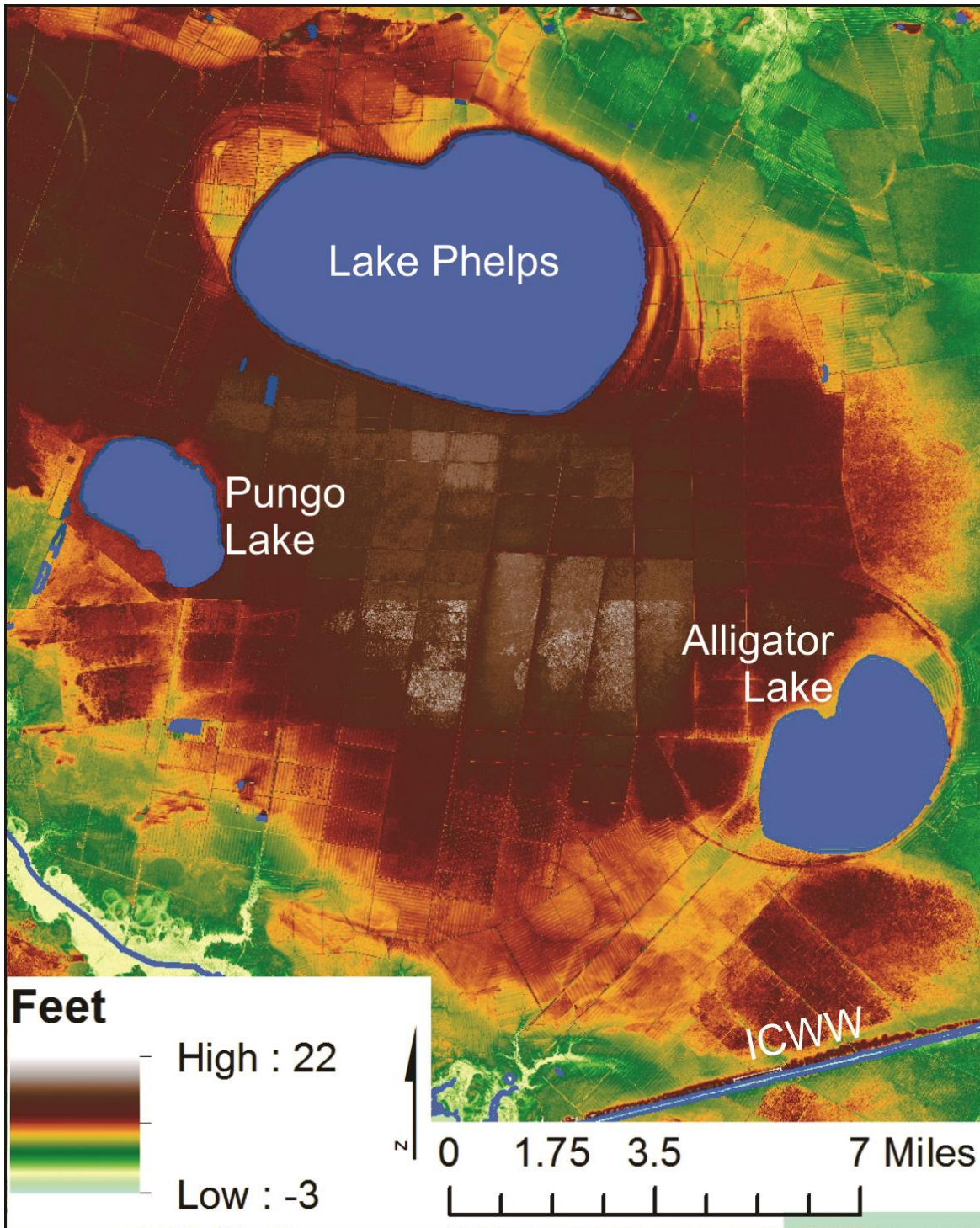


FIGURE 3-12. The Scuppernon Pocosin (dark red) is a swamp that occurs on the inter-stream divide of the Albemarle-Pamlico Peninsula (see Figures 2-2, 3-1 and 3-11). It is an accretionary dome of organic

peat that has grown ~5 to 10 feet vertically above the three Carolina bay lakes (Phelps, Pungo, and Alligator) that occur around the perimeter of the pocosin. Each of the lakes occupies a complex of superimposed Carolina bays of different shapes and sizes producing the heart-shapes. The Carolina bays occupied by Lake Phelps exhibit multiple paleo-shorelines consisting of alternating sand ridges and swales on the northwestern and eastern margins. Topographic data are from the 2015 NC Floodplain Mapping Program.

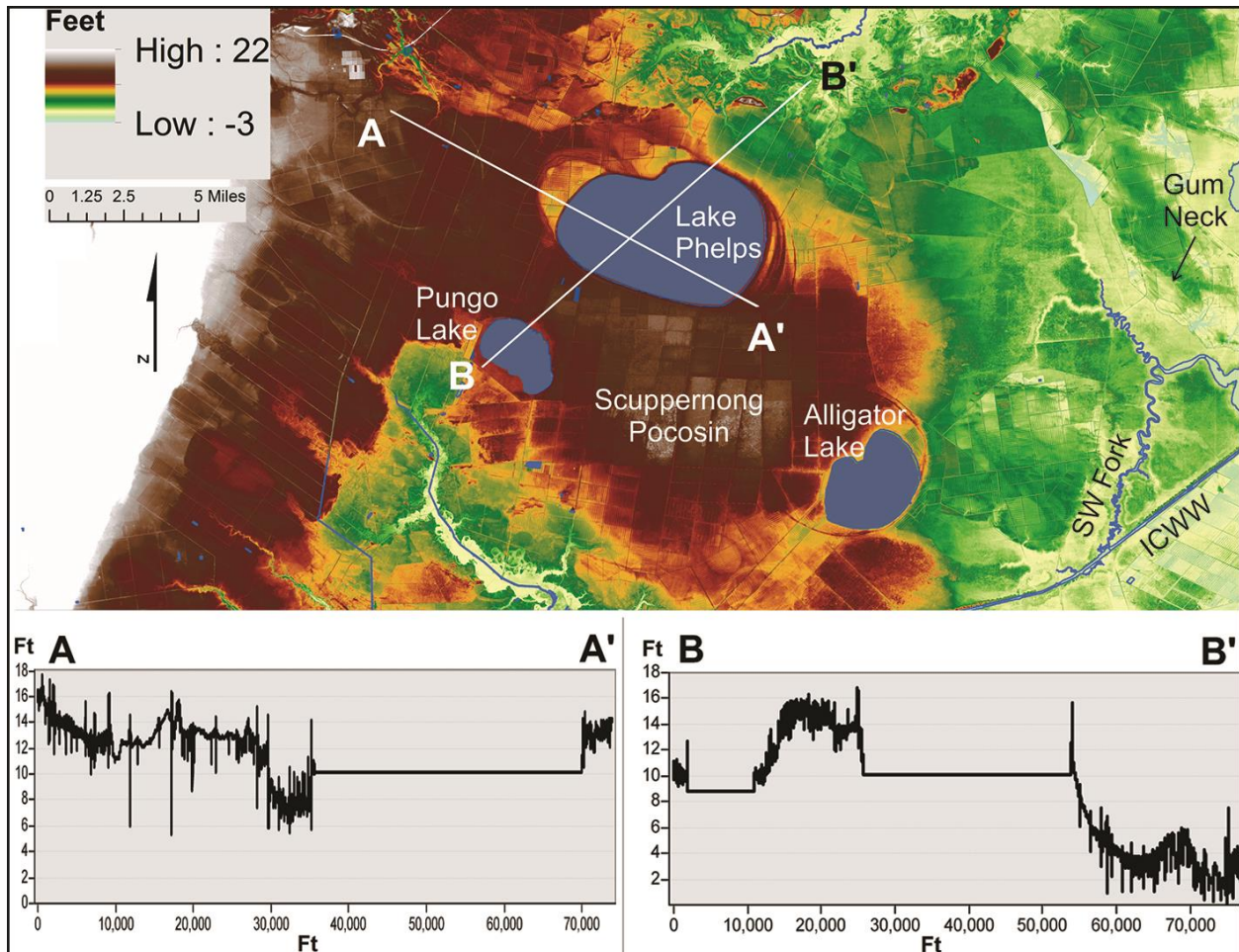


FIGURE 3-13. A close-up view of Figure 3-12 shows the locations of topographic profiles A-A' and B-B'. The lower left panel (A-A') shows the topographic (elevation) data from the Paleo-Suffolk tide flat (dark red at ~11 to 16 feet elevation), southeast across the paleo-Lake Phelps shoreline (yellow at ~7 to 10 feet elevation), across the modern Lake Phelps (blue at 10 feet elevation), and up onto the pocosin wetlands (dark red at ~12 to 15 feet elevation). The lower right panel (B-B') starts in the lower tide flat (red at ~9 to 11 feet elevation), extends northeast across Pungo Lake (blue at 9 feet elevation), rises steeply onto the upper pocosin wetlands (dark red at ~10 to 16 feet elevation), drops down to Lake Phelps (blue at 10 feet elevation), and descends abruptly onto the riverine swamp lands (green at ~1 to 4 feet elevation). Topographic data are from the 2015 North Carolina Floodplain Mapping Program.

D. Artificial Drainage System and Associated Road Dikes

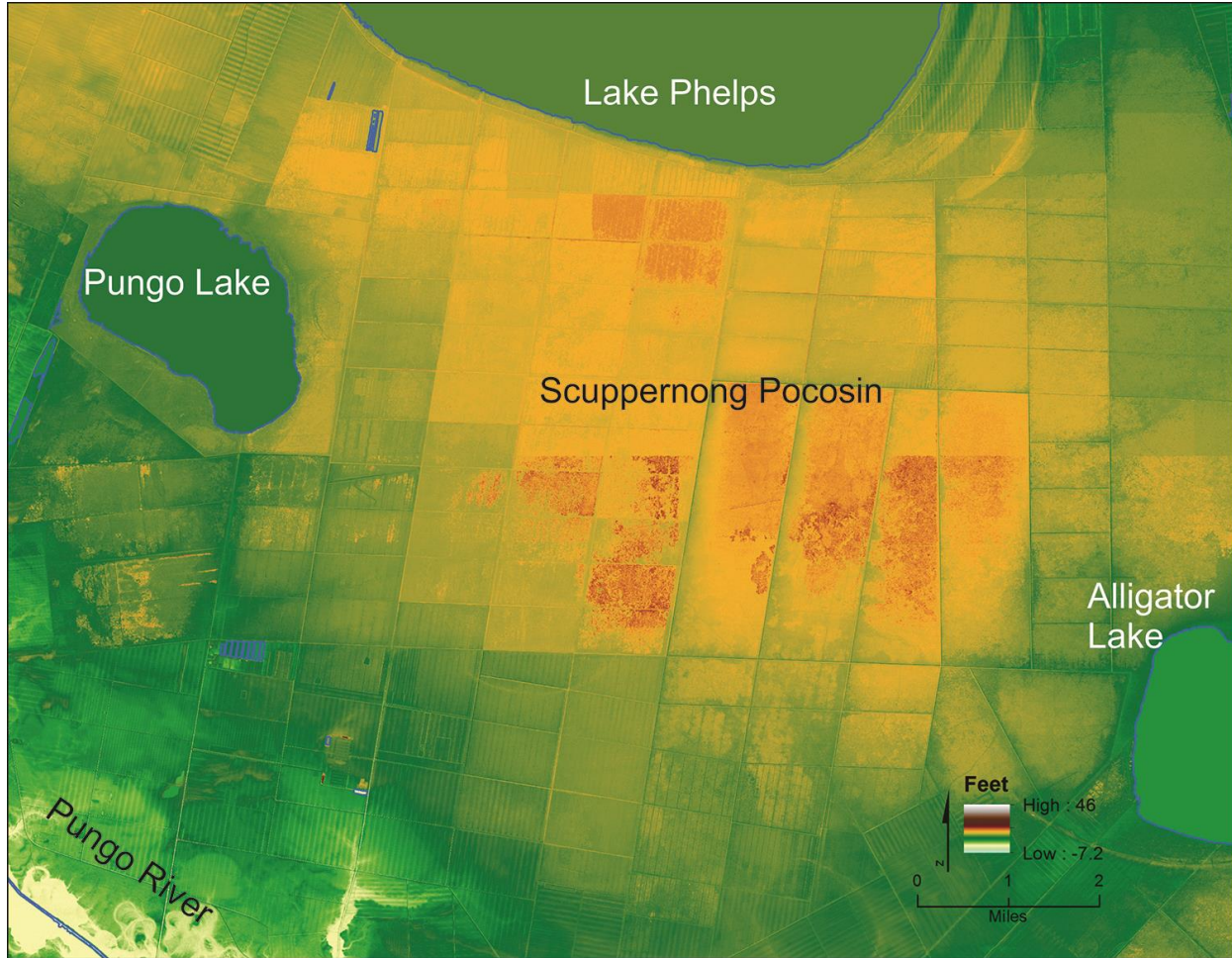


FIGURE 3-14. The color topography map shows the Scuppernong Pocosin area due south of Lake Phelps. The elevations above mean sea level are as follows: light green to dark green is ~5 to 10 feet; light yellow to orange is ~11 to 15 feet; and red is ~16 to 20 feet. The map shows three scales of ditching. The largest scale or main canals were dug ~10 to 15 feet deep and on a 1 mile grid. A secondary set of collector ditches were dug ~6 to 8 feet deep and on a ½ mile grid. The smallest field ditches were dug in the lower elevations for agricultural development and were ~5 feet deep and on a 330 foot grid. Notice the decline in land elevation immediately adjacent to the two larger-scale ditch sets. Topographic data are from the 2015 North Carolina Floodplain Mapping Program.

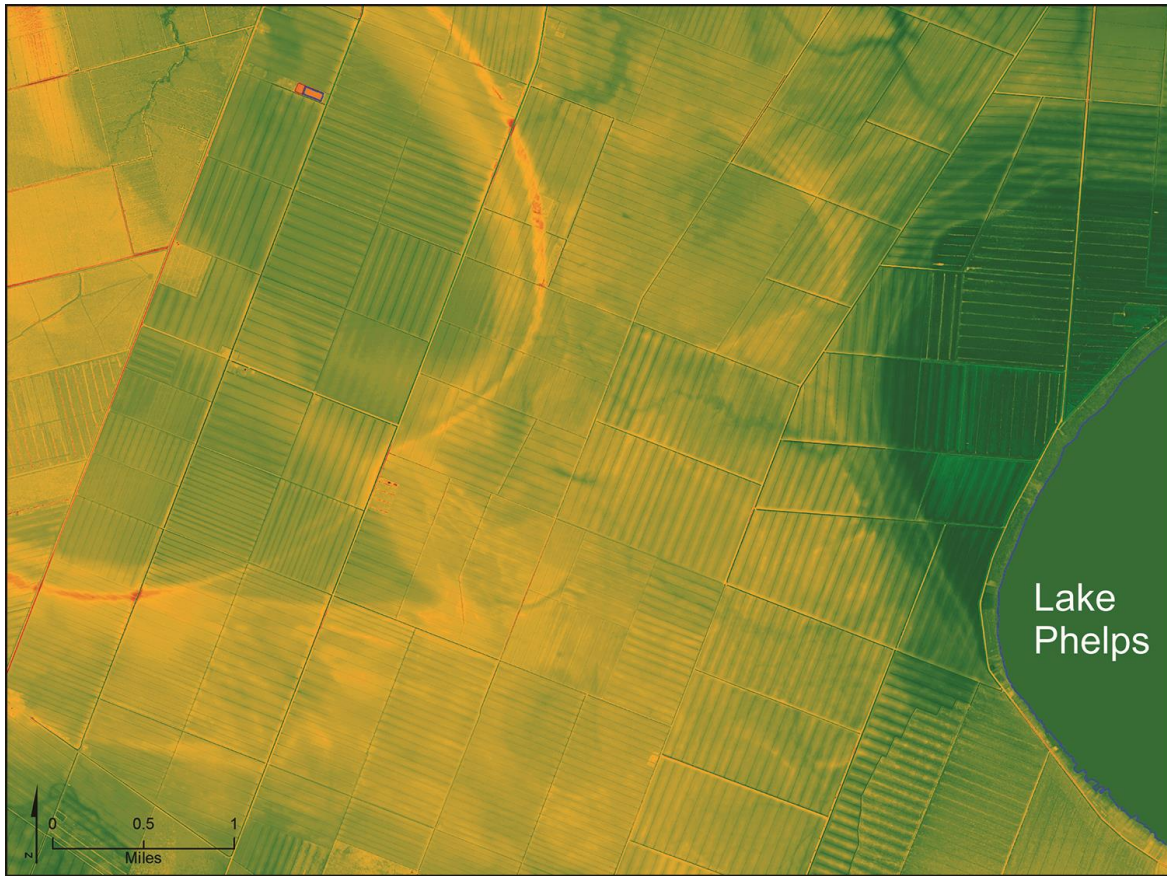


FIGURE 3-15. The color topography map due west of Lake Phelps (mid-green on the southeast map corner) shows three scales of ditching and draining of the former wetlands for agricultural and/or forestry production (see Figure 3-14). Notice the a) Lake Phelps paleo shoreline northwest of the lake (dark green), b) two large Carolina bay depressions that occur at slightly different and overlapping orientations along the western side of the map, and c) a small-sized bay depression between the two larger Carolina bays and Lake Phelps. All of the more intense yellow or orange areas represent lake paleo-shorelines or thin deposits of sheet sand. Topographic data are from the 2015 North Carolina Floodplain Mapping Program.



FIGURE 3-16. The left panel shows two intersecting main canals that were dug ~10 to 15 feet deep and on a 1 mile grid. The right panel shows a collector ditch that was dug ~6 to 8 feet deep and on a ½ mile grid. The fields are in agricultural production. Notice the lowered water tables relative to the former wetland surface.



FIGURE 3-17. The main canals and collector ditches excavated within the Albemarle-Pamlico Peninsula have either a highway, farm road, or field path adjacent to it that was built from the removed sediment.

E. Roanoke River Paleo-Braid-Plain Terraces

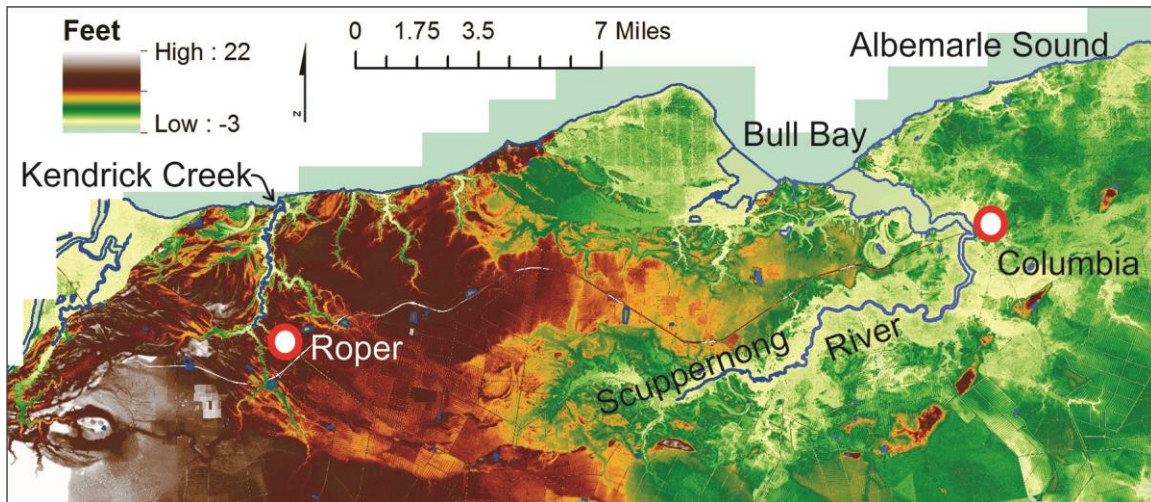


FIGURE 3-18. A color topography map shows the northern Albemarle-Pamlico Peninsula area from west of Roper to east of Columbia. Notice the curved sand ridges northwest of Roper that are part of the upper Paleo-Riverine deposits of the Roanoke River paleo-floodplain (see Figure A-4). The sand ridges west and northwest of Roper are dark red to orange and ~5 to 15 feet high separated by low wetland swales (green) that are ~0 to 4 feet in elevation. Modern tributary streams (e.g., Kendrick Creek) are incised down into these older riverine braid-plain deposits. The area west of Bull Bay includes the Big Swamp wetland forest (light green) that is ~0 to 4 feet high and consists of a lower Paleo-Riverine braid-plain terrace deposits of the Roanoke River that formed before the valley was flooded by rising sea level to produce Albemarle Sound. The lower terrace of Big Swamp is actively being drowned by the ongoing rise of sea level as indicated by the abundance of ghost forests (see Figures 3-6 and 3-8). Within these terrace

regions of the Paleo-Roanoke River deposits, the topography is dominated by rolling sand ridges with well-drained sandy soils. Topographic data are from the North Carolina Department of Transportation 2007 LiDAR.

4. CULTURAL HISTORY OF THE SCUPPERNONG COASTAL SYSTEM

Native American History

Data on the history of the Native Americans within the Scuppernong coastal system are primarily from Phelps (1983, 1989, and 2002), Holley (1989), Ward and Davis (1999), Pettigrew State Park, Somerset Plantation, and Pocosin Lakes Wildlife Refuge documents. The time of occupation by Native Americans is based on the age data associated with the archeological artifacts and is summarized as the cross-hatched boxes in Figure 4-1.

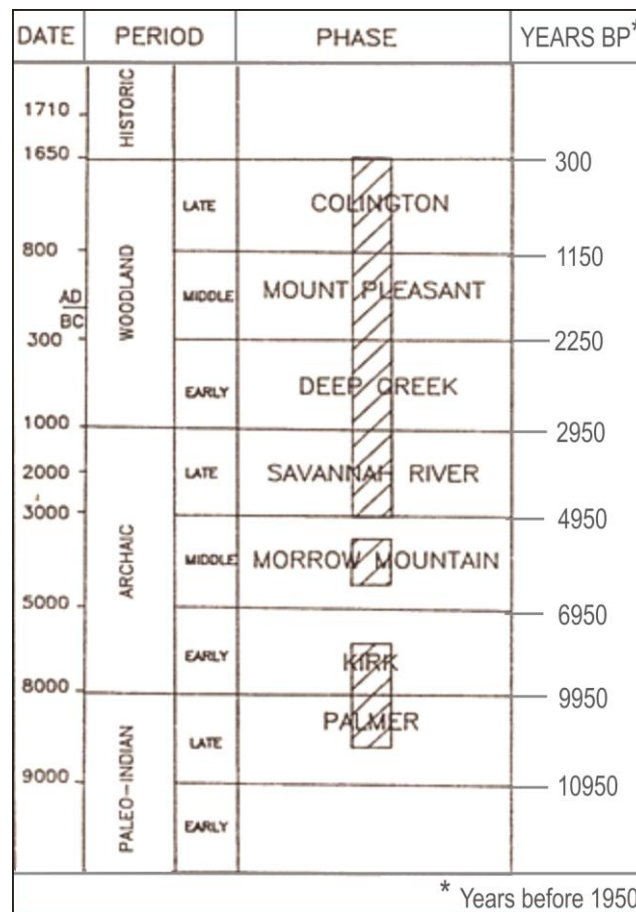


FIGURE 4-1. Lake Phelps culture sequence shows (in cross-hatched boxes) the time period and phases of human occupation by Native Americans in eastern North Carolina. Figure is modified from Phelps (1989, 2002).

10950-4950 BP (9000-3000 BC)	Artifacts in and around Lake Phelps suggest that the lake was utilized by Native Americans as early as the Palmer Phase of the Late Paleo-Indian Period. Small spear points were related to hunters and gatherers in temporary camps and hunting expeditions through the Early and Middle Archaic Periods dominated by cooler climate and coniferous forests.
5915 BP	Basal peat deposit cored along the southern rim of Lake Phelps was radiocarbon dated at 5915 BP +/- 195 years (Transect 2 Core 3 of Holley, 1989).
4950 to 2950 BP (3000-1000 BC)	Evidence of greater and more frequent use of the lake environment occurred for longer periods during the Late Archaic Period. Archeological sites include dug-out canoes and soapstone cooking vessels that were ultimately replaced by ceramic vessels found in excavations at Somerset Plantation. Three dug-out canoes were found in peaty mud on the lake bottom at the western end of Lake Phelps, the oldest dating to about 4,380 years BP (2430 BC). The climate continued to moderate with the environments surrounding the lake now consisting of cypress swamps and mixed deciduous forests on the sand ridges, with peat bogs away from the lake.
2950-1150 BP (1000 BC-800 AD)	The Early and Middle Woodland Periods represented a continuity of settlement from the Late Archaic Period. Stone artifacts were found with ceramic ware that had surface impressions of net, cord, and fabric, characteristic of the Deep Creek and Mount Pleasant Phases. Over thirty cypress dug-out canoes have been found in the shallow waters of Lake Phelps, nineteen of which belong to this period with dates ranging from 2090 to 1530 years BP (140 BC to 420 AD).
1150-300 BP (800-1650 AD)	The Native Americans of the Late Woodland Period were probably the ancestral culture of Carolina Algonkians who met the 16 th century European explorers. They were thought to be members of the Moratoc society who inhabited the southern side of Albemarle Sound between the Scuppernong and Roanoke rivers. Artifacts include ceramic ware, stone implements, and fishing gear characteristic of the Colington Phase. Three cypress canoes were recovered from the northern and western shores of Lake Phelps with two dates of 750 and 550 years BP (1200 and 1400 AD) (Figure 4-2).

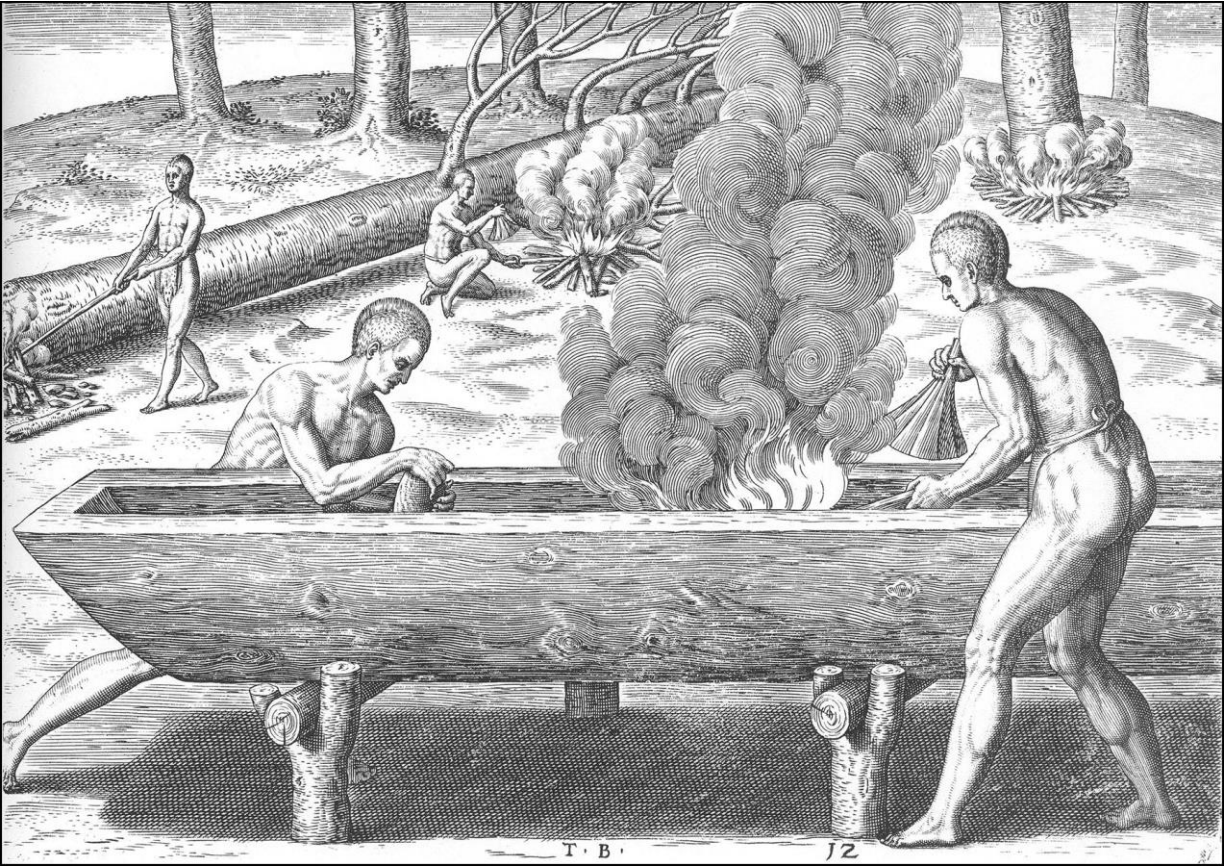


FIGURE 4-2. Native Americans burning out a cypress log to make a dug-out canoe as observed by the English colonists and recorded in de Bry's engravings of 1590 (Harriot, 1590).

1584-1587 AD

English exploration began in Roanoke Island and expanded into the associated coastal regions (Figure 4-3). The Indian village of Mequopen was mapped by the colonists on the south bank of the Scuppernong River, midway between Columbia and Creswell.



FIGURE 4-3. The John White-Theodor de Bry 1590 map of the Cape Hatorask barrier islands, Roanoke Island, Pamlico (left) and Albemarle sounds (center), and the Roanoke River (top center) and Chowan River (top right) drainage basins. The known Native American villages are indicated, including Meguopen (red star) on the south side of the Scuppernong River. The map was developed from the initial 1584 to 1587 explorations by the English colonists. Map is from Cumming (1988).

- 1711-1713 AD Tuscarora Indian War opened “North Carolina’s Land of Water” for settlement of the Coastal Plain and westward.
- 1715-1792 AD The Indians that remained on the Albemarle Peninsula were given a four square mile reservation adjacent to Lake Mattamuskeet on which to live. A small group of about 20 subsistence families were living there in 1731, which decreased to 8 to 10 individuals by 1755. In 1792 the last of the reservation land was sold and the remaining individuals disappeared as a distinct culture.

In summary, over 30 cypress dug-out canoes (Figure 4-4) were discovered buried in the shallow bottom of Lake Phelps. The longest canoe was about 37 feet in length. The canoes and associated artifacts were found primarily in finely laminated organic-rich clay and fine sand at Big Point in the shallow lake bottom (~ 1 m of water and <50 m from shore) in the northeastern portion from Big Point east to Old Canal (site 31WH12). Nineteen of the canoes have been radio-carbon age-dated. The dates range from the oldest at about 4380 years BP to the youngest at 550 years BP (2430 BC to 1400 AD). The archeological data and distribution of ages suggest that there was almost continuous seasonal utilization starting in about 4,400 years BP followed by periods of non-use when the canoes were buried for their preservation.



FIGURE 4-4. Photographs of two Native American cypress dug-out canoes in the bottom of Lake Phelps and a modern reconstruction of the historic canoes. Photographs are from the NC Division of Archives and History.

European and African American History

Data are primarily from Ruffin (1861), Cumming (1966, 1988), Lilly(1981), Richardson et al. (1981), Angley (1986), Redford (1988), Simpson (1990), Kirby (1995), Richards et al. (2012), McMullan et al. (in press), as well as J. Crow, S. Riggs, the NC Division of Archives and History, NC Division of State Parks, US Fish and Wildlife Service, and Tyrrell County. Check these resources for specific documentation.

1584-1587 ARRIVAL OF COLONISTS. English exploration of the Roanoke Island and associated coastal regions began (Figure 4-5). The Indian village of Meguopen was mapped by the colonists on the south bank of the Scuppernong River midway between Columbia and Creswell.



FIGURE 4-5. The John White-Theodor de Bry 1590 map of the inlets, barrier islands, and inland regions in the Roanoke Island and Albemarle Sound area. The map was developed from the initial 1584 to 1587 explorations by the English colonists and is from Cumming (1988).

- 1697 Thomas Pollock established a plantation in the lower portion of the Scuppernong River.
- 1702 Captain Thomas Blount built a mill dam on Kendrick's Creek at Roper.
- 1711-1713 TUSCARORA INDIAN WAR.** With this war, "North Carolina's Land of Water" was opened for settlement of the Coastal Plain and westward.
- 1722 The first capital of North Carolina was established in Edenton with shipping through numerous inlets that existed in the northern Outer Banks.
- 1723 Wimble received a patent for one square mile (640 acres) of land on the lower Scuppernong River where he was actively buying and selling property until about 1730.
- 1728 William Byrd surveyed the NC-VA boundary through the Great Dismal Swamp and proposed its drainage for agricultural development.
- 1729 Tyrrell County was established and initially included the present Washington and Dare Counties, along with a portion of Martin County.

1738

James Wimble map of 1738 labels the interior of the Albemarle-Pamlico Peninsula as the “wild desert wilderness” (Figure 4-6).

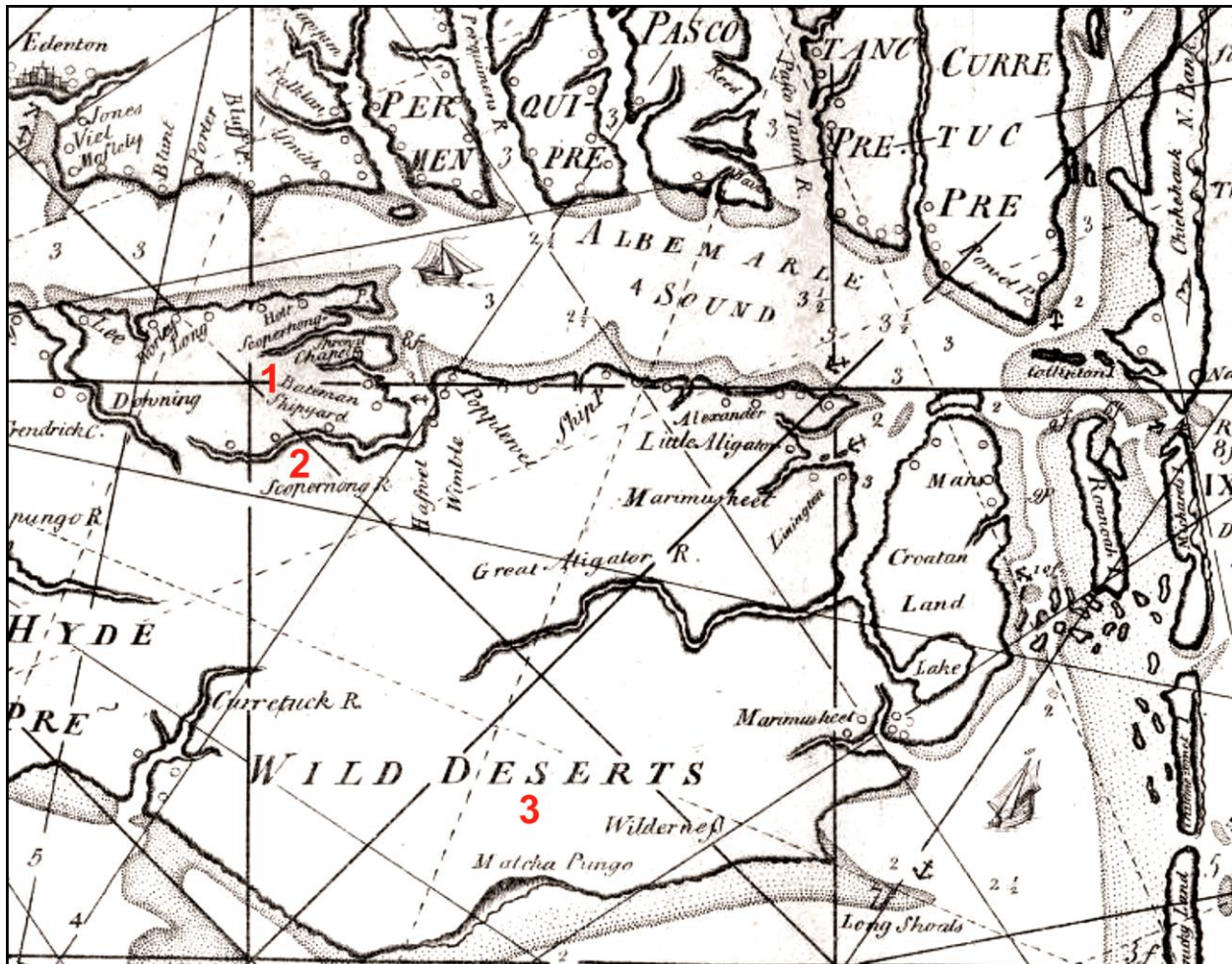


FIGURE 4-6. The Wimble map of 1738 indicates the presence of a shipyard (red #1) midway along the north bank of the Scuppernon River (red #2). Notice the greater degree of development along the northern shore of Albemarle Sound compared to the southern shore, while the interior of the Albemarle-Pamlico Peninsula is called the “wild desert wilderness” (red #3). Map is from Cumming (1966).

1755-1770 NC General Assembly designated the “Scuppernon Warehouse” and “Scuppernon River” as inspection sites for export commodities from Tyrrell County.

1755 Josiah Phelps and Benjamin Tarkington discovered Phelps Lake within “The Great Alegator Dismal Swamp” (Figure 4-7).



FIGURE 4-7. Photograph of the western shore of Phelps Lake with its dense forest growth.

Late 1750s Three ferry boats were operating at various locations along the Scuppernong River.

1777 The 1777 Collet map (utilizing the same survey base as the 1775 Mouzon map) shows the vast extent of “The Great Alegator Dismal Swamp” through most of the Albemarle-Pamlico Peninsula (Figure 4-8).

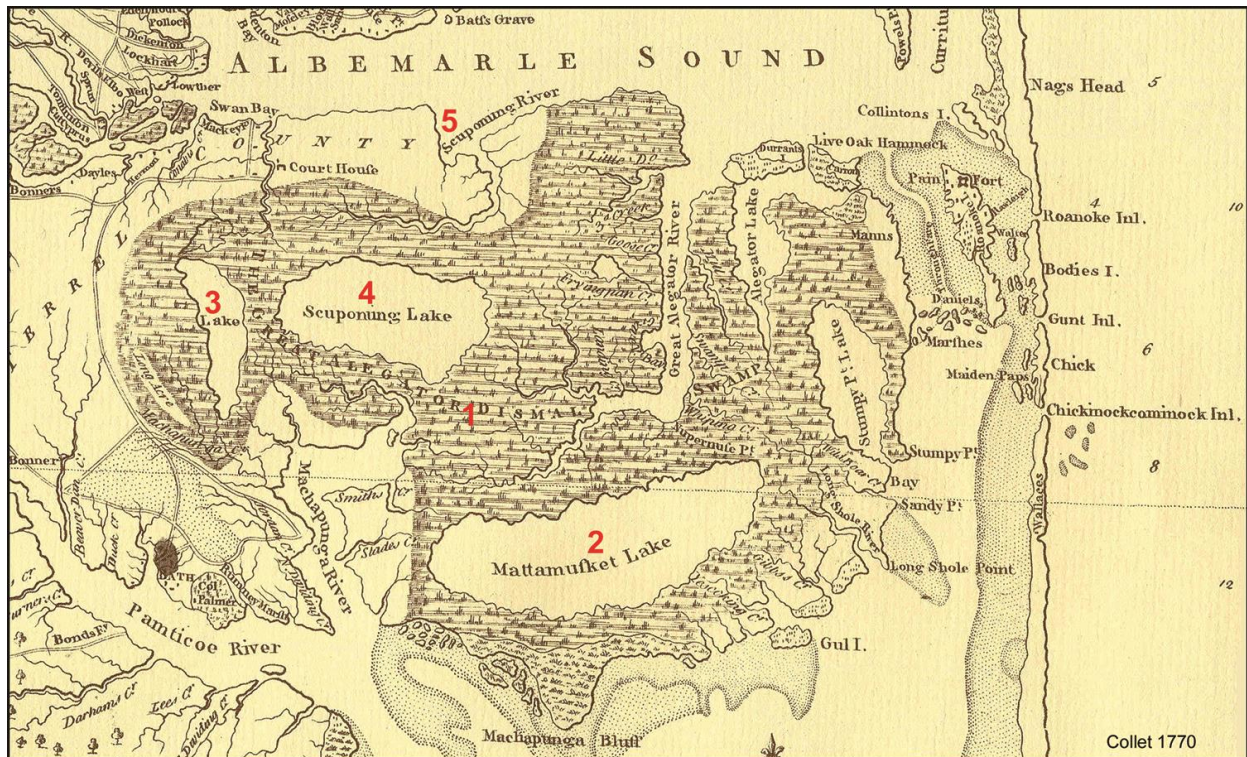


FIGURE 4-8. Map of the Albemarle-Pamlico Peninsula by Collet in 1770 shows the vast “Great Alegator Dismal Swamp” (red #1), three lakes (red #2, #3, #4), and the Scuppernong region including “Scuppernong Lake” (red #4) and “Scuppernong River” (red #5). The map is from Cumming, 1966.

1775-1783 AMERICAN REVOLUTIONARY WAR.

- 1784 The NC General Assembly gave authorization to drain Phelps Lake and farm the fertile lake bottom. The “Lake Company” was formed by Josiah Collins Sr., Nathaniel Allen, and Dr. Samuel Dickinson to acquire over 100,000 acres of swamp lands surrounding Phelps Lake for ditching and draining and to dig a canal from the Scuppernong River to Phelps Lake.
- 1784-1805 Construction began on the Dismal Swamp Canal from Chesapeake Bay to Albemarle Sound to create a dike that held water to the west and drained land to the east for agricultural development. The canal was completed and opened in 1805 for shipping from Albemarle Sound to the Chesapeake and beyond.
- 1785-1786 Josiah Collins Sr. sent one of his sailing ships (*Camden*) to West Africa and returned in June of 1786 with 80 enslaved African men, between ages of 20-25, to join about 30 American born slaves to dig the Somerset Canal between the Scuppernong River and Phelps Lake.
- 1787 Josiah Collins established Somerset Place along the northeast shore of Phelps Lake and named it after the county of his birth in England.

1788

Enslaved Africans completed construction of a six-mile long, 20 feet wide, and 4 to 6 feet deep “Somerset Canal” from the Scuppernong River at sea level to Phelps Lake, surveyed in at about 18 feet above sea level (Figure 4-9). The canal was critical for using large flat-bottom boats for the following purposes: to 1) ship construction and farming supplies into Lake Phelps; 2) ship timber, lumber, and shingles out of the swamp forests; and 3) ship agricultural crops out of the region. In addition, the canals were used to 4) flood and drain rice fields; 5) irrigate corn and wheat fields; 6) run a power station; and 7) run a saw mill and grist mill. The Scuppernong River had adequate depth for large, sea-worthy sailing vessels (up to 75 tons) to reach the mouth of the “Somerset Canal” for export shipping.

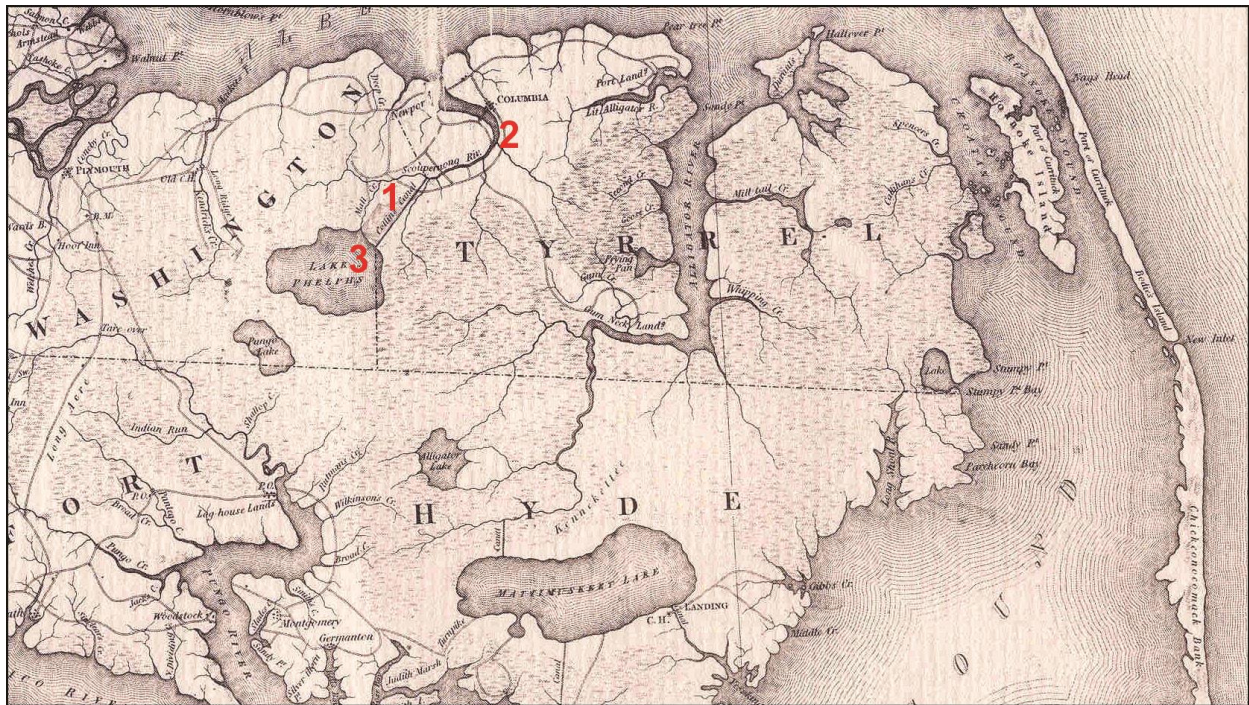


FIGURE 4-9. Map of the Albemarle-Pamlico Peninsula by MacRae and Brazier in 1833 shows the first canal known as the Collins Canal (red #1) that was dug from the Scuppernong River (red #2) to Lake Phelps (red #3). The map is from Cumming, 1966.

1788-1790 Rev. Charles Pettigrew moved to Lake Phelps and established the “Bonarva Plantation” on the lake shore east of the Somerset Canal and obtained rights to use the canal.

1775-1862 Back Landing, 4 miles up-stream on the Scuppernong River from the present town of Columbia, was the location of Spruill’s Chapel and the Upper Warehouse. It was also the center of trade and commerce on the River until the Civil War.

- 1793 Shallops Landing, 4 miles down-stream from Back Landing, was on the present site of Columbia. The NC General Assembly authorized the name change from Shallops Landing to Elizabeth Town.
- 1799 Elizabeth Town became the county seat of Tyrrell County.
- 1810 The name Elizabeth Town was changed to Columbia.
- 1819 With the death of his father, Josiah Collins Jr. took over operation of Somerset Place.
- 1819 Archibald Murphey proposed that North Carolina drain the eastern swamplands to rid the state of “noxious exhalations” to improve the public health and to reclaim land for agriculture.
- 1819-1826 North Carolina State Board of Internal Improvements promoted the drainage of swamp lands and construction of railroads and roads to open eastern NC.
- 1825 North Carolina established the State Literary Fund with all state-owned swamplands to be turned over to the fund for development and sale with the proceeds to be used for public education.
- 1830 Harvard educated Josiah Collins III, grandson of Josiah Collins Sr., and wife (Mary Riggs) assumed the management of Somerset Place and built the present mansion (Figure 4-10).



FIGURE 4-10. Photograph on the left shows the restored plantation house that was the home of Josiah Collins III at Somerset Place Ca. 1837. The right-hand panel shows (from left to right) the restored hospital, school house (which is the visitor’s center today), laundry, and cook house.

Late 1830s Draw-bridges were present at Columbia and at Creswell (Spruill’s Bridge).

1838-1842 Canals were dug by the State Literary Fund to Alligator, Pungo, and Mattamuskeet lakes to lowering the water table in the lakes by 5 feet and draining about 70,000 acres of the surrounding swamp lands for sale, as shown on the 1865 map in Figure 4-11 and in Figure 4-12.

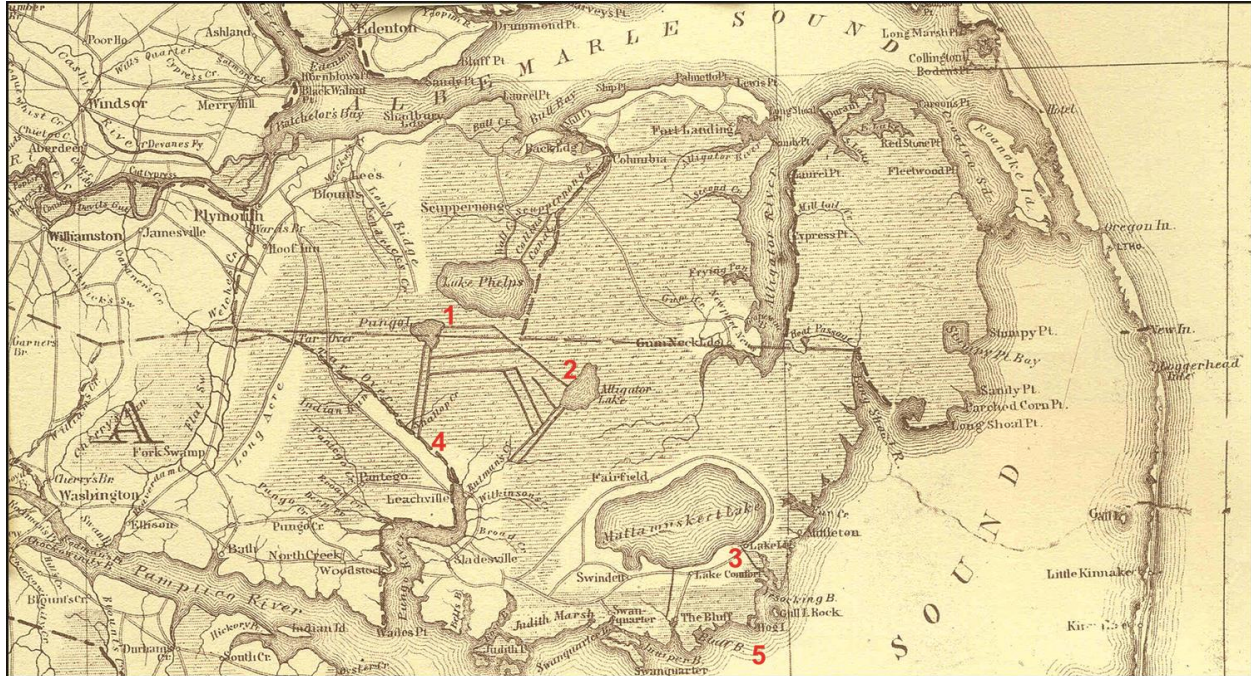


FIGURE 4-11. The map of the Albemarle-Pamlico Peninsula by the U.S. Coast Survey in 1865 shows multiple canals that were dug through the Scuppernon region and from Pungo (red #1), Alligator (red #2), and Mattamuskeet (red #3) lakes to the Pungo River (red #4) and Pamlico Sound (red #5), respectively. The map is from Cumming, 1966.



FIGURE 4-12. Photograph of the intersection of two primary canals designed to lower the water table by about 5 feet for agricultural development.

- 1860 Somerset Place had 328 slaves, 130 miles of drainage ditches, about 4,000 acres in agricultural production of corn and wheat (the money crops), another 500 acres in preparation, many farm animals, and vegetable gardens.
- 1861-1865** **AMERICAN CIVIL WAR.** Civil War led to plundering of Somerset Place with complete cessation of farming and subsequent decay into the post-war era.
- 1862 By April the Federal troops had captured the North Carolina coastal region and ventured up the Scuppernong River to the Somerset Plantation to burn bridges, destroy grain and grist mills, and steal fishing nets. Josiah Collins III had retreated to his second plantation in Hillsborough, NC and had armed guards escort 227 slaves to his third plantation, 120 miles inland in Franklin County.
- 1867 The Collins family failed to reconstitute the plantation following the Civil War and was forced to auction the entire plantation.
- 1870 The Southern Land Company of New York planned a development of 20 acre lots in the North Carolina Hyde Park Settlement on the dome crest of the Scuppernong Pocosin south of Lake Phelps and between Pungo and New lakes (Figure 4-13. This was a failed effort to tame the swamplands for urban development.

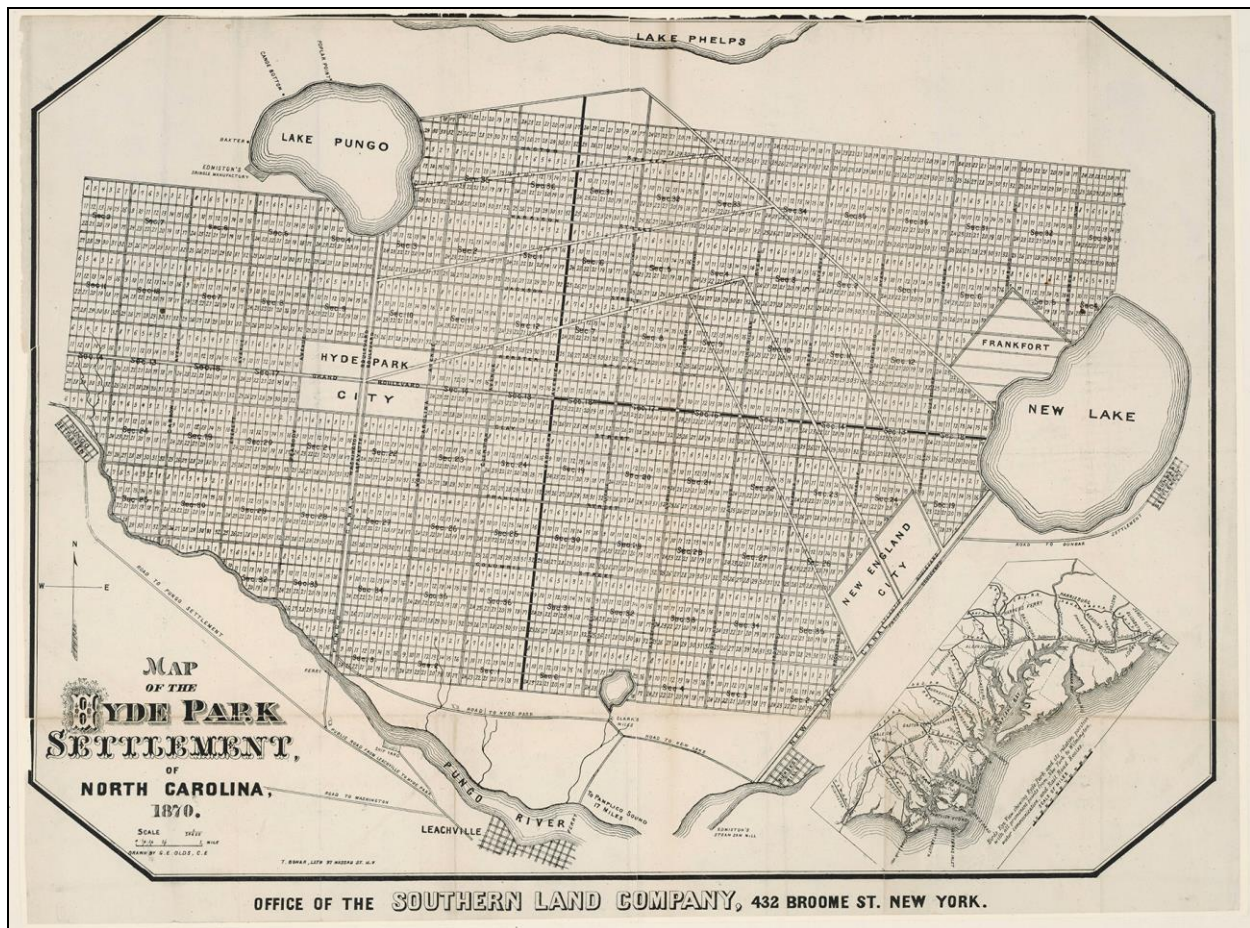


FIGURE 4-13. The 1870 plat map of the Southern Land Company of New York for their urban development in the Scuppernon Pocosin called “Hyde Park Settlement”.

- 1879-1885 A congressional resolution was passed to improve navigation of the Scuppernon River and included the following: 1) dredging of a 2,200 feet long and 9 feet deep channel through the bar at the river’s mouth, 2) dredging a turning basin at Spruill’s bridge and four meander cut-offs that rounded off eight sharp bends, and 3) removing shallow shoals and old schooners.
- 1880s-1910s Post-Civil War saw increased interest in timber production from the North Carolina swamplands. Timber companies (including Roper Lumber Co., Richmond Cedar Works, etc.) bought millions of acres of swamplands within the Albemarle Peninsula including the remaining lands held by the bankrupted State Literary Fund.
- 1894-1900 In 1894 there were two steamers from Edenton and Norfolk each made two trips per week discharging and picking up freight at Columbia, Simmons Landing, and Spruill’s Bridge (the traditional head of navigation) at 5, 11, and 18 miles up-stream from the river mouth. Sailing Vessels could travel up-stream to 1.5 miles above Spruill’s Bridge if there were no rafts of logs filling the river. The return

cargos were agricultural crops and vast amounts of lumber and shingles. By 1900 export was by two steamers each making three weekly trips, up to 25 schooners, and many barges that supported two new lumber mills and a large juniper log industry.

- 1900 The bar at the river's mouth was re-dredged to 1200 feet long, 150 feet wide, and 9 feet deep channel at the mouth of the Scuppernong River.
- 1908 Norfolk and Southern Railroad built a set of tracks east from Roper to Creswell and Columbia.
- 1909-1928 The North Carolina General Assembly passed a law to establish Water Drainage Districts. Fifty three Water Drainage Districts were established in North Carolina covering 700,000 acres of swamp.
- 1910 The Branning Manufacturing and Scuppernong Milling Co. of Columbia were producing up to 10 million feet of lumber per year.
- 1912 Establishment of the Blackland Test Farm in Wenona, which was replaced in 1943 by the Tidewater Research Station in Roper.
- 1912 The bar at the mouth of the Scuppernong River was again re-dredged to a 150 feet wide and 10 feet deep channel to Columbia, a 40 feet wide and 8 feet deep channel to Spruill's Bridge, and a 30 feet wide and 7 feet deep channel to the bridge at Cherry, 20 miles up-river.
- 1914 A Federal government inventory indicated 26 timber wharf facilities on the Scuppernong River: nine below Columbia, eleven at Columbia, three near Cross Landing, and two at Spruill's Bridge. Fourteen had adjacent warehouses and all but four had road connections. Four bridges crossed the river at Columbia, Cross Landing, Spruill's Bridge, and Cherry.
- 1914-1918 WORLD WAR I.**
- 1917 North Carolina Drainage Law was passed with the organization of the first Albemarle and Pantego Drainage Districts.
- 1920s A Rocky Mount bank obtained control of the Somerset Place and Pettigrew Bonarva properties.
- 1933 The north-south highway 94 was constructed between Columbia and Lake Mattamuskeet.
- 1937 The Federal Farm Security Administration acquired the Somerset Place and the Pettigrew Bonarva Plantations. The property was divided into 60-acre single farm

plots and became the New Deal's "Scuppernong Farms", a resettlement project for poor, white families from inland areas. However, the program failed.

1939 The federal government gave a 99 year lease for the Somerset Place facilities to the NC Department of Archives and History to administer and created Pettigrew State Park.

1939-1945 WORLD WAR II.

Post 1945 During the post WW II boom there was a world-wide demand for increased agricultural production and food crops. The availability of surplus earth-moving equipment from the military, led to increased efforts to ditch and drain wetlands of the Scuppernong region for farming.

1941-1981 Using aerial photographs, a NC legislative documented the clearing, ditching and draining of 156,000 acres (12.4% of the land area) in the Pamlico-Albemarle Peninsula had been cleared, ditched, and drained by 1941. By 1981 1,200,000 acres (29.6% of the land area) had been cleared, ditched, and drained.

1943 African-American Dorothy Spruill Redford was born to Louise Littljohn and Grady Spruill in Columbia, NC, "the hub, the big time ---- town in the woods" that was "hard on the Scuppernong River" (Redford, 1988).

Post-1945 Almost all of the major timber had been harvested on private swamplands and, thus, the timber companies sold their holdings to paper companies (e.g., West Virginia Paper and Pulp Co. which became West Virginia Corp. or Westvaco) for pine-pulp production. This drove the next period of extensive ditching and draining.

1947 The federal government formally deeded 203 acres of leased land over to NC for permanent establishment of Pettigrew State Park.

1950s The upper reach of the Pungo River was channelized to improve the drainage of swamp lands east of the Suffolk Shoreline.

1952-1953 West Virginia Corp. (Westvaco) was a major manufacturer of printing papers, packaging, and chemical by-products of paper production. In 1952-1953 Westvaco bought 302,291 acres of wetland timber in Dare, Tyrrell, and Hyde counties with the intent to turn this unproductive, cut-over, swampland into productive pulp forest (Figure 4-14).

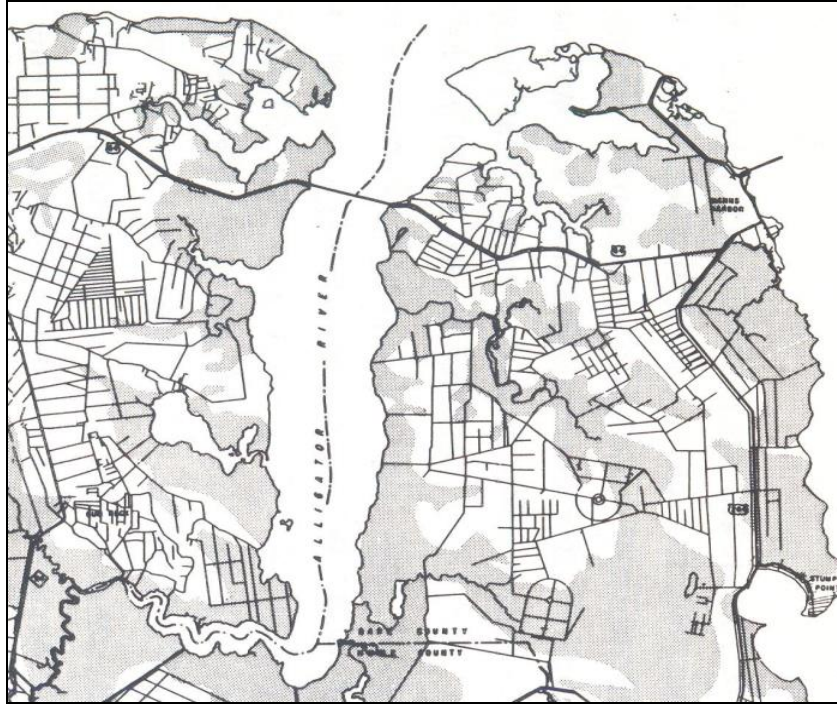


FIGURE 4-14. Drainage ditches existing by 1974-1976 within the Westvaco Corp. properties in Dare and Tyrrell counties. The figure is a portion of the map from Daniels, 1978 and shows the distribution of low wetlands and associated peat deposits in light gray color.

- 1954-1955 The Norfolk and Southern Railroad sold the last 300,000 acres it had acquired from Roper Lumber Co. in Washington, Hyde, and Tyrrell counties.

- 1955-1963 Much of the Norfolk and Southern Railroad's uncleared land was purchased by the Lake Phelps Farms primarily for land clearing and real estate development, however, without much success.

- 1962 The highway 64 bridges were built over the Alligator River and Croatan Sound to connect the Inner Banks with Roanoke Island and the Outer Banks of North Carolina.

- 1963 Development efforts of Lake Phelps Farms were terminated and much of their land was sold to Atlantic Farms and National Alfalfa Corp.

- 1963 The 12,000 acre Pungo Lake National Wildlife Refuge was established as a sanctuary for migratory waterfowl.

- 1967 The NC Division of State Parks transferred Somerset Place and its buildings over to the NC Division of Archives and History to manage.

- 1973-1978 The First Colony Farms (FCF) was established in 1973 by industrialist Malcolm McLean and went bankrupt in 1978. The intent of FCF was to systematically

transform the natural landscape into a massive row-crop and animal farm on an unprecedented scale. The initial FCF vision was to create a food production enterprise by being the lowest cost provider of beef, pork and chicken that were vertically integrated (Figure 4-15). Thus, all transportation and brokerage costs could be cut out of the food chain. The FCF management team was created to implement this “grand plan”.



FIGURE 4-15. Corn harvest time on a blacklands mega-farm field (Photo by K. Cherry in McMullan et al., in press). A “prairie gothic” grain storage business in the blacklands farm region.

1973 FCF purchased 373,000 acres (581 square miles) of land for \$60 million from the following landowners on the Albemarle-Pamlico Peninsula (Figure 4-16): Westvaco 307,000 acres of NC Woodlands in Tyrrell and Dare Counties for \$30 million; Atlantic Farms 40,000 acres, grain elevators, and equipment for \$17.5 million; 18,000 acres from Cy Rich Sr.; and Georgia Timberlands and 8,000 acres from National Alfalfa Corp.

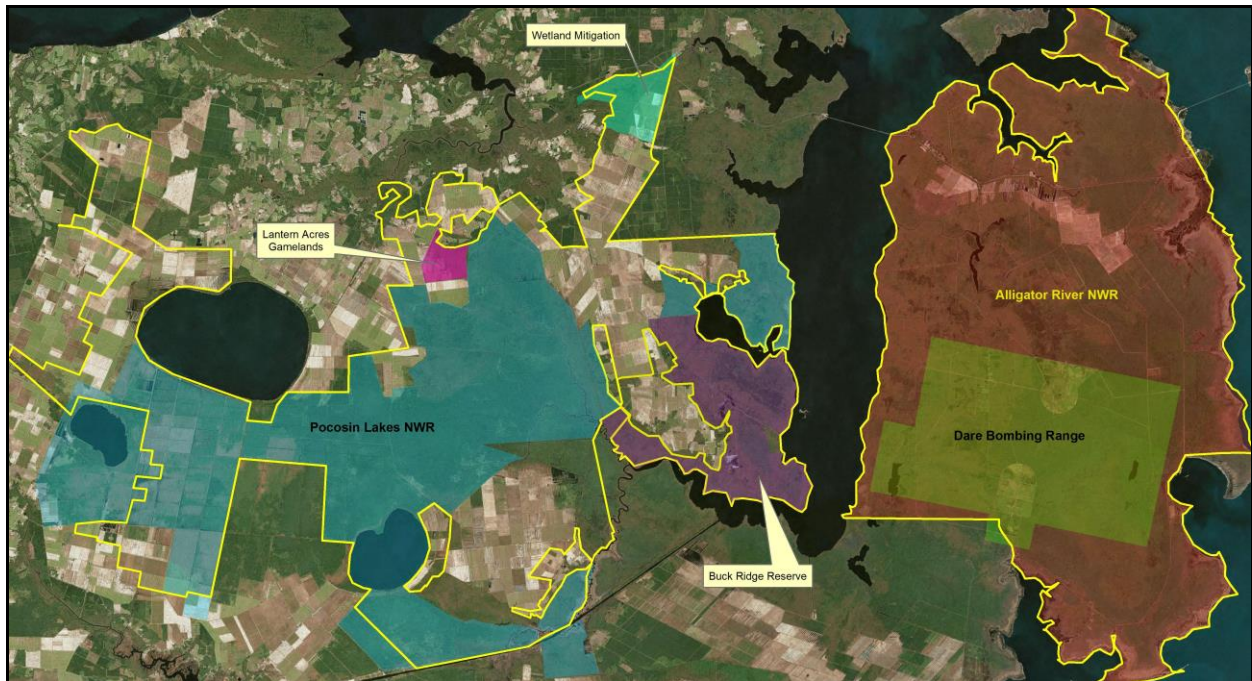


FIGURE 4-16. Satellite image shows a portion of the Albemarle-Pamlico Peninsula. The land area inside the yellow line represents the original 1973 land purchase of First Colony Farms. The colored areas display some subsequent land ownership that followed the 1978 bankruptcy sale of FCF. Figure is from McMullan et al. (in press).

- 1973 First US energy crisis occurred due to OPEC oil embargo on US.
- 1977 In the summer of 1977, Malcolm McLean decided to sell FCF lands and buy US Lines, a container shipping company. FCF farming ended in December 1977 after planting 29,945 acres in corn, soybeans, grain sorghum, and some wheat. A cattle feedlot, pig houses, and some chickens were also in place. The 45,150 acre Dare County Bombing Range was sold to the United States of America in a condemnation proceedings effective December 28, 1977.
- 1978 After major failures in ditching, draining, clearing, and farming the vast wetland system of the First Colony Farms was dissolved in 1978.
- 1975-1984 Following the oil embargo of 1973, what was left of the First Colony Farms went into a period of experimentation concerning the economic value of their extensive peatlands. This was the start of an experimental peat-mining program in 1978 to 1984 on 200 acres of peatlands in Washington County. Several other companies (Peat Methanol Associates, Phelps Peat Mine, Peat Fuels Inc., and American Peat) applied for State permits to mine peat in the same area as the First Colony Farms operation.
- 1978 C.C. Daniel of the USGS published the 1974 map of Albemarle-Pamlico Peninsula drainage system and deep organic soils (Figure 4-17).

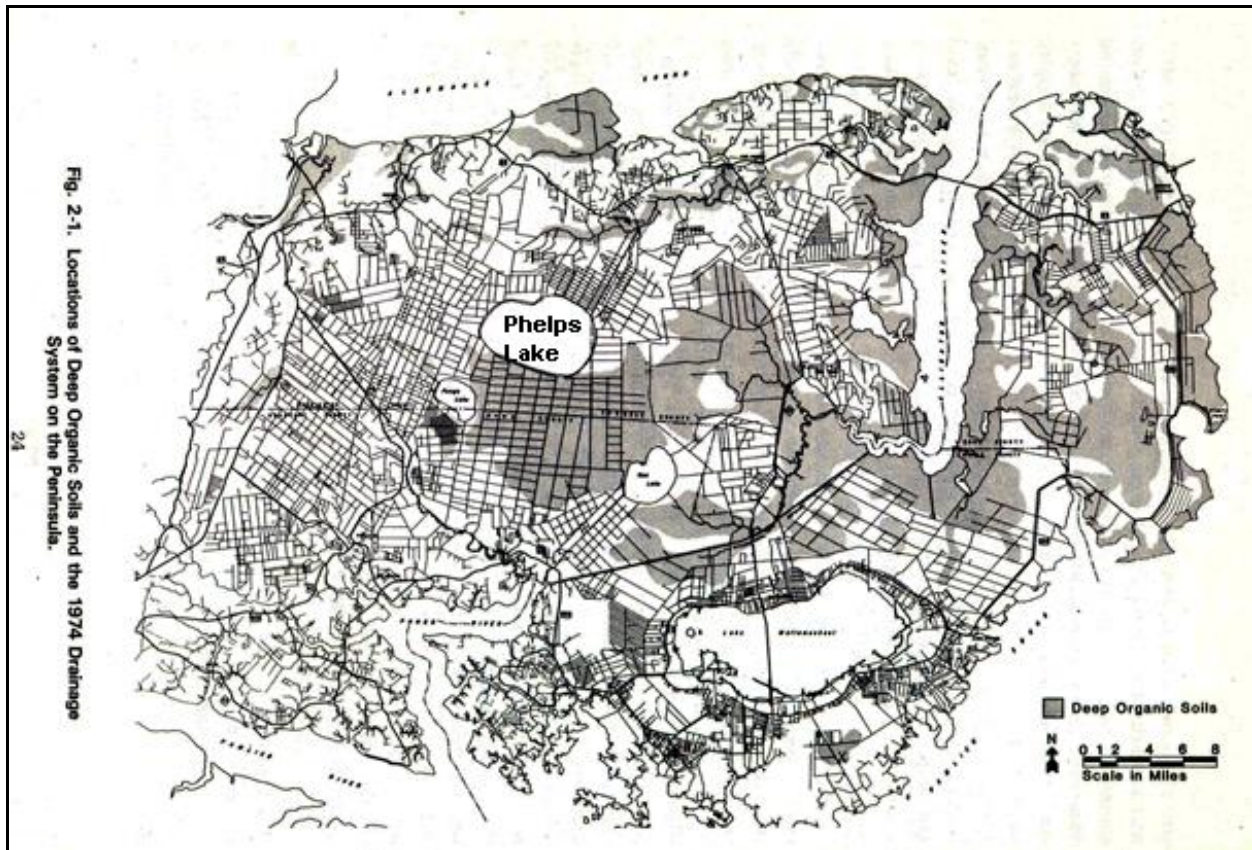


FIGURE 4-17. Map shows the vast network of dredged drainage canals that existed in the Albemarle-Pamlico Peninsula as seen on 1974-1976 aerial photographs. The constructed drainage includes 1) outfall canals constructed for farming and forestry in the 1800's, 2) drainage for agricultural development in the early 1900's, 3) mosquito and fire control ditches in the mid-1900's, and 4) agricultural collector canals and forestry ditches from 1950 to 1976. Map is from Daniels (1978).

- 1979 Second US energy crisis occurred due to the Iranian Revolution and Iran-Iraq war.
- 1980 Synfuels Corporation Act was established by President Carter and Congress to solve the energy crisis.
- 1981 North Carolina's PMA (Peat Methanol Associates) formed a partnership with the Synfuels program to produce methanol from peat mined on First Colony Farms (FCF) land. A \$250 million peat methanol plant was planned for location on 40 acres within the 15,000 acre peat mining permit area of FCF.
- 1982 Synfuels Corporation Act became operational in 1982, but was discontinued by President Reagan in 1986.

- 1986-1990 FCF's peat lands west of Lake Phelps were auctioned as part of the US Lines-McLean Industries Chapter 11 bankruptcy proceedings. These lands were acquired by The Nature Conservancy for conveyance to the US Fish and Wildlife Service and State of North Carolina as components of the National Wildlife Refuges and State Parks, respectively.
- 1986 The 200-year Somerset Homecoming reunion took place at Somerset Plantation on August 30, 1986 with over 2,000 black and white participants celebrating their common heritage.
- 1987 The Ingram peat study found that fuel-grade peat deposits cover about 677,000 acres of coastal North Carolina and contain about 500 million tons of fuel grade peat within the Albemarle-Pamlico Peninsula.
- 1988 The Somerset Homecoming: Recovering a Lost Heritage, by Dorothy Spruill Redford was published by University of North Carolina Press (1988).
“But there was more to do here at Somerset. Here was a place, a chance to build a monument to the lives and labor of my family, a monument that would remind others of what their families did at other places just like it all across the South. I could see a completely reconstructed, working plantation rising from this ground. The barn rebuilt as it once was, with oxen once again pulling carts. Water, clear and strong, flowing once again through the canal. The gardens lush and full. The church standing once more, its pews as they were when my ancestors sat in them. The tools wielded by the black artisans in place again. And the homes of the slaves themselves, standing and glowing with the aura of life that once filled their rooms.”
- 1990 The 113,000 acre Pocosin Lakes National Wildlife Refuge was established with the 93,000 acre donation by the Conservation Fund and Mellon Foundation that was added to the pre-existing Pungo Lake NWR. Over 200 species of birds, 40 species of mammals, and 40 species of reptiles and amphibians use the refuge habitats.
- 2004 The Nature Conservancy donated four tracts of land to the three large tracts purchased by North Carolina Division of State Parks for establishment of the Scuppernon River Section of Pettigrew State Park.

Today’s Demographics

TABLE 1: Selected demographic variables for the four counties, some portions of which are included within the Scuppernong coastal system of NC LOW. Data are from the U.S. Census Bureau and include the whole counties for 2013.

County	Total Population	Percentage Below Poverty Level %	Percentage Minorities Total/Blacks/Other %	Median Income \$
Hyde	5,730	25.6	40.2/ 30.0/ 10.2	42,279
Martin	23,704	23.2	48.7/ 43.2/ 5.5	36,111
Tyrell	4,105	20.8	47.9/ 36.6/ 11.3	34,216
Washington	12,765	23.7	56.2/ 49.2/ 7.0	34,936
Total/Average	46,304	23.3	48.3/ 39.8/ 8.5	36,885

5. ASSETS OF THE SCUPPERNONG COASTAL SYSTEM

Scuppernong Coastal System Assets

A. Natural Resource Assets

1. Unique landscape features and ecosystems of the Scuppernong coastal system
 - Albemarle Sound and Alligator River (drowned river estuaries)
 - Bull Bay (drowned tributary estuary)
 - Big Swamp and Mackey’s braid-plains (paleo-Roanoke River terraces with sand braid-bars and swamp forest swales)
 - Legion and Colonial Beach (Albemarle Sound eroding/drowning sediment bank shorelines)
 - Scuppernong, NW and SW Forks, and Pungo rivers and associated tributary streams (black-water tributary streams) and riverine swamp-forests
 - Phelps, Pungo, and Alligator lakes (Carolina bay lakes)
 - Suffolk shoreline and tidal flats (paleo-ocean embayment, beaches, and Carolina bay depressions)
 - Scuppernong pocosin (upland swamp forests—“swamp-on-a-hill”)
2. Diverse fauna and flora within the complex of ecosystems that occur in the SCS
 - Riverine wetlands that contain swamp forests of Atlantic white cedar, bald cypress, black gum, water tupelo, and red maple; with shrub layers composed of wax myrtle, ti-ti, and Virginia willow; and herb layers dominated by royal fern, lizard’s tail, and pitcher plants.
 - Non-riverine pocosin wetland communities containing a mixture of canopy trees including bald cypress, pond pine, black gum, sweetgum, and scattered Atlantic white cedar;

a shrub layer of sweet-bay magnolia, red bay, and red maple; and a lower layer of hydrophytic plants including ti-ti, fetterbush, sweet pepperbush, highbush blueberry, Virginia chain fern, netted chain fern, pitcher plants, and sedges.

Uplands with mineral soils support two distinct natural communities. Dry uplands contain hardwood forests of beech, white oak, yellow poplar, and loblolly pine that form the canopy, while American holly, ironwood, and witch-hazel form the sub-canopy. Lower wet areas support a wet hardwood forest of swamp chestnut oak, water oak, cherry bark oak, sweetgum, and swamp black gum while switch cane, Howe's sedge, New York fern, and lizard's-tail occur in the wet mossy soils.

The large fauna that occurs within the Scuppernong region is diverse and includes one of the largest concentration of black bears in southeastern US, the endangered red wolf, American alligator, river otter, bobcat, and white-tailed deer.

The avian fauna includes bald eagle, red-cockaded woodpecker, wood duck, American woodcock, osprey, along with many migratory species. The region also plays a vital role for the wintering tundra swans, snow geese, and many species of ducks.

The rivers and estuaries harbor a wide variety of fishes, a major crabbing industry, and the upper regions are spawning grounds for herring and other inland fisheries (Figure 5-1).



FIGURE 5-1. The left panel shows the “Full Circle Crab Co.” on highway 64 in Columbia, NC. The right panel is the symbol of one of the region’s major fisheries.

3. Vast black night-sky views in an awesome world of night sounds
 - Stars, constellations, and meteor showers for astronomy
 - Big-sky sunsets and sunrises
 - Thunder and lightning shows
 - Night sounds of wolves, frogs, and insects
4. Existing Trail Systems (are mostly in poor condition with respect to signage and information)
 - Paddle trails on the Scuppernong and Lower Alligator rivers, Kendrick Creek
 - Paddle trails on Lake Phelps
 - Hiking trails at Pettigrew State Park
 - Biking trails through regional roads

- 5. NC Wildlife Commission Facilities
 - Boat access-ramp system (Figure 5-2)
 - NC game lands
 - Mattamuskeet lodge



FIGURE 5-2. The North Carolina Wildlife Commissions boating access area at the Spruill Bridge Road that provides access to the Scuppernon River. This is one of hundreds of boat ramps that the Wildlife Commission provides in coastal North Carolina.

B. Cultural History Assets

1. Historic places and features
 - Somerset Place
 - Slave-dug canal system
 - Native American artifacts and sites
 - Maritime history of sunken boats and wharves
 - Hertford Newbold-White House
2. Post-European American and African American Histories
 - Family Legacies (Collins, Pettigrews, Spruills, LittleJohn)
 - Ditching and Draining History of NC LOW
3. Villages within the Scuppernon region, each with its own history
 - Columbia, Creswell, Cherry, Cross Landing, Free and Easy, Alligator, Goat Neck, Newfoundland, Fort Landing, Phledger Landing, Pleasant View, Gum Neck, Frying Pan, Roper, Skinnerville, Colonial Beach, etc.
4. History of the extensive forest industry
 - Timber industry (cypress and Atlantic white cedar)
 - Shingle industry
 - Paper-pulp industry (mono-culture pine plantations)
5. Agricultural History
 - Ditching and draining
 - Blacklands soil agriculture
 - Sustainable farming to mega-farms
 - Role of ethnic populations

6. Future Potential of Sustainable Ecotourism

C. Existing Amenities

1. Refuges, Parks, and Historical Sites, Etc.

- Pocosin Lakes National Wildlife Refuge (Figure 5-3)
- Pocosin Lakes National Wildlife Refuge Visitors Center in Columbia
- Pettigrew State Park on Lake Phelps and Scuppernong River
- Somerset Place State Historic Site on Lake Phelps
- Tyrrell County Visitors Center in Columbia
- Pocosin Arts Center in Columbia
- Eastern 4-H Environmental Education and Conference Center
- Columbia Theater Cultural Resource Center
- Partnership for the Sounds in Columbia
- Red Wolf Coalition in Columbia



FIGURE 5-3. Entrance to Pocosin Lakes National Wildlife Refuge within the SCS. There are nine other National Wildlife Refuges within the NC LOW region and are only short distances from the Scuppernong region.

2. Lodging

- Brickhouse Inn, Lasseters Landing, and River House B & B's in Columbia
- Eastern 4-H Environmental Education and Conference Center
- Pocosin Arts-ECU Lodge in Columbia
- Dalton House Motel in Columbia
- Miss Lill's B & B in Creswell
- Campground at Pettigrew State Park

3. Restaurants

Old Salt Oyster Bar, Columbia Crossing, the Winery in Columbia
Full Circle Crab Co. on Wheels in Columbia
Creswell Café in Creswell

Regional Resource Assets

A large number of agencies and their resources already exist in northeastern “North Carolina’s Land of Water” coastal system that could be integrated into a National Heritage Area designation or an eco-park upon which the Scuppernong Program can be built. They include, but are not limited to the following.

1. US National Park Service
 - Cape Hatteras National Seashore
 - Cape Lookout National Seashore
 - Fort Raleigh National Historical Site
 - Wright Brothers National Historical Site
2. US Fish and Wildlife Service
 - Alligator River National Wildlife Refuge
 - Mattamuskeet National Wildlife Refuge
 - Swanquarter National Wildlife Refuge
 - Roanoke River National Wildlife Refuge
 - Great Dismal Swamp National Wildlife Refuge
 - Pea Island National Wildlife Refuge
 - Currituck National Wildlife Refuge
 - Cedar Island National Wildlife Refuge
 - Mackay Island National Wildlife Refuge
3. US Forest Service
 - Croatan National Forest
4. NC State Parks and Historic Sites
 - Jockey’s Ridge State Park
 - Goose Creek State Park
 - Cliffs of the Neuse State Park
 - Merchants Millpond State Park
5. County and city land and parks
6. Conservation organizations
 - North Carolina Coastal Federation
 - The Nature Conservancy
 - Conservation Fund
 - Sound River Foundations
 - Coastal Land Conservancy
 - Environmental Defense Fund
 - Sierra Club-Cypress & Croatan regional groups
7. Museums
 - Roanoke Island Aquarium

- NC Estuarium
- Estuarine Reserve System
- Aurora Fossil Museum
- Graveyard of the Atlantic
- Beaufort Maritime Museum
- Edenton
- Edenton State Historic Site
- Restored screw-pile lighthouse
- Plymouth
- Historical museums
- Reconstruction of screw-pile lighthouse
- 8. Scenic highways, byways, and trail systems
 - Mountains to the Sea Trail
 - Albemarle Historic Trail
- 9. Historic and pre-historic sites (buildings, archaeological ruins, maritime and military history)
- 10. Organizations such as the regional RC&Ds, Roanoke River Paddle Trails, Partnership for the Sounds, regional economic organizations, etc.
- 11. Private lands of both corporations and individuals which offer public access, are willing to be part of the educational-interpretive story of the area, and request to be part of the National Heritage Area or eco-park.

6. POTENTIAL NATURAL & CULTURAL ECO-TOURS

Different Approaches to Ecotourism Programs

1. The first approach would be to have local guides, equipment, and facilities as a day by day operation that would service the daily visitor. Participants would include the following:
 - Tourist day-trippers who are vacationing and staying on the Outer Banks
 - Inland residents passing through the region on Highway 64
 - Local individuals and organizations
 - Local school systems
 These participants would be dependent on securing their own meals and lodging either in or adjacent to the Scuppernon region.
2. The second approach would be to recruit outside groups of tourists for multiple-day educational field- and lecture-oriented natural and cultural history programs on specific topics. This approach would require a daily per person charge that would include the program, housing, and food, and could model itself after the very successful “Roads Scholar Program”.
3. The third approach would be to recruit specific interest groups to volunteer for defined projects and time periods. The third program approach can be well organized groups that work on a purely volunteer basis or they could be recruited as individuals who pay a fee to volunteer similar to the “Earth Watch Program” or many ecotourism centers.

Potential Within the Scuppernong Region

Both the second and third approaches would require lodging or camping facilities that would house the groups, supply meeting rooms, and provide excellent food. Some possible facilities already exist in or nearby to the Scuppernong region. All, however, would require various amounts of work to adapt them for such programs. The following are some possibilities.

1. Pocosin Arts/ECU Center-Columbia (Figure 6-1)
2. Eastern 4-H Environmental Education and Conference Center-Columbia
3. Pocosin Lakes NWR Visitor's Center-Columbia
4. National Wildlife Refuge Center-Roanoke Island
5. Mattamuskeet Lodge in Swan Quarter (Figure 6-2)
6. Somerset Place on Lake Phelps
7. Campgrounds at Pettigrew State Park on Lake Phelps
8. Spruill's Farm on Albemarle Sound and Academy Lodge at Mackeys
9. River Forest Manor in Belhaven (Figure 6-2)
- 10 Coastal Studies Institute in Wanchese
- 11 East Carolina University in Greenville



FIGURE 6-1. The Pocosin Arts Folk School has partnered with East Carolina University to build and operate the dormitory and classroom facility, shown in the right panel, in downtown Columbia.



FIGURE 6-2. The left panel is the Mattamuskeet Lodge of the NC Wildlife Commission located in Swan Quarter, NC. The right panel is the private River Forest Manor located on the Intracoastal Waterway in Belhaven, NC.

A. Eco-Tours: Day-Tripper Programs

1. Birding Trips (Bald Eagles, Tundra Swan, Snow Geese, Migratory Song Birds, etc.)
2. Hiking Trails (Pettigrew SP, Pocosin NWR, etc.)
3. Paddle Trails (Bull Bay, Deep Creek, Scuppernong River and tributaries, Lake Phelps)
4. Car Trails (paved roads and 4-wheel drive roads)
5. Biking Trails (paved roads and gravel/sand roads)
6. Small Craft Sailing waters (outer Scuppernong River, Bull Bay)
7. Nature Photography (fauna and flora of wetland ecosystems)
8. Wind surfing and sailing (Bull Bay and Albemarle Sound)
9. Black skies and night sounds (star gazing, wolf howls, and frog choruses)

B. Recreational Eco-Tours: Extended Programs

1. From the black-water river swamps to fringing ghost forests, and drowned river estuaries by kayak and canoe
2. Trail hiking (Mountains to the Sea, coastal landscapes and ecosystems, etc.)
3. Wilderness camping tours through the Scuppernong region
4. Biking tours through the back roads and ditch roads of the Scuppernong region
5. Sailing boat tours (from Columbia through Bull's Bay and into Albemarle Sound)
6. Power boat tours (from the rivers to the sea)

C. Educational Nature Eco-Tours: Extended Programs

1. Pocosin—Riverine—Estuarine origin and evolution
2. Wetland ecology: from upland pocosins to Carolina bays and riverine swamp forests
3. Birds and animals of the Inner Banks wetlands
4. Landscapes and their geologic history within the Scuppernong coastal system
5. Storms and water dynamics of the Scuppernong coastal system
6. Carbon storage and climate change: the role of peat pocosins and riverine swamp forests

D. Cultural History Eco-Tours

1. Wetlands: their origin, composition, and history of human modification
2. History of exploration, discovery, and economic development
3. Rivers and estuaries: the highways of down-east NC
4. Native American, Revolutionary, and Civil War histories
5. Archeological history of Native Americans
6. Maritime history: the sunken record
7. The Civil War in NC LOW
8. What happened to the “Lost Colony”?

E. Fishing and Hunting Eco-Tour Expeditions

1. Fishing on inland waters from lakes to black-water streams and trunk-rivers to salt-water estuaries
2. Fishing, shrimping, and crabbing on commercial boats in Albemarle-Pamlico Sounds
3. Fishing in offshore ocean waters
4. Seasonal hunting guides (ducks, geese, turkey, quail, deer, and bear, etc.)

F. Environment and Community Volunteer Eco-Tour Projects

1. National Park Service
2. National Wildlife Refuges
3. NC State Parks
4. NC Marine Fisheries
5. NC Aquariums
6. NC Museum of Natural Science
7. NC Coastal Federation
8. Land Conservancies
9. Albemarle-Pamlico National Estuary Partnership
10. Chambers of Commerce
11. Parks and Recreation Departments
12. Historical Restoration Projects

7. RESOURCE-BASED ECOTOURISM

Scuppernong Team: Stakeholder Working Group:

The Stakeholder Working Group will consist of the The Scuppernong Team of local and regional experts, program managers, and key public officials. The working group will flesh out those ideas that are practical, prioritize them, and then raise the funds necessary to implement the programs. The wildlife spectacle and the cultural history of the Scuppernong region are incredible potential attractions for visitors to this region if developed properly. However, it is essential to zero in on the realistic potential focal points of ecotourism and substantially improve visitor experiences in those areas. This requires that programs be developed in support of the community and with cooperation from respective management agencies and potential ecotourism organizations.

Suggested Approaches:

1. Build “The Scuppernong Story” around the following key concepts.
 - A. The fascination and mystery of the pocosins, Carolina bays, and black-water swamps
 - B. The origin and evolution of the geologic and ecologic landscape
 - C. The human history and its interdependence upon the natural resources of the SCS
 - D. The contributions and history of the Native American occupation, European settlement, and African enslavement

2. The Scuppernong coastal system already has critical elements in place upon which the new natural and cultural resource-based ecotourism can build upon. Figure 7-1 is a map that summarizes the existing state and federal land resources that are available within the SCS region.

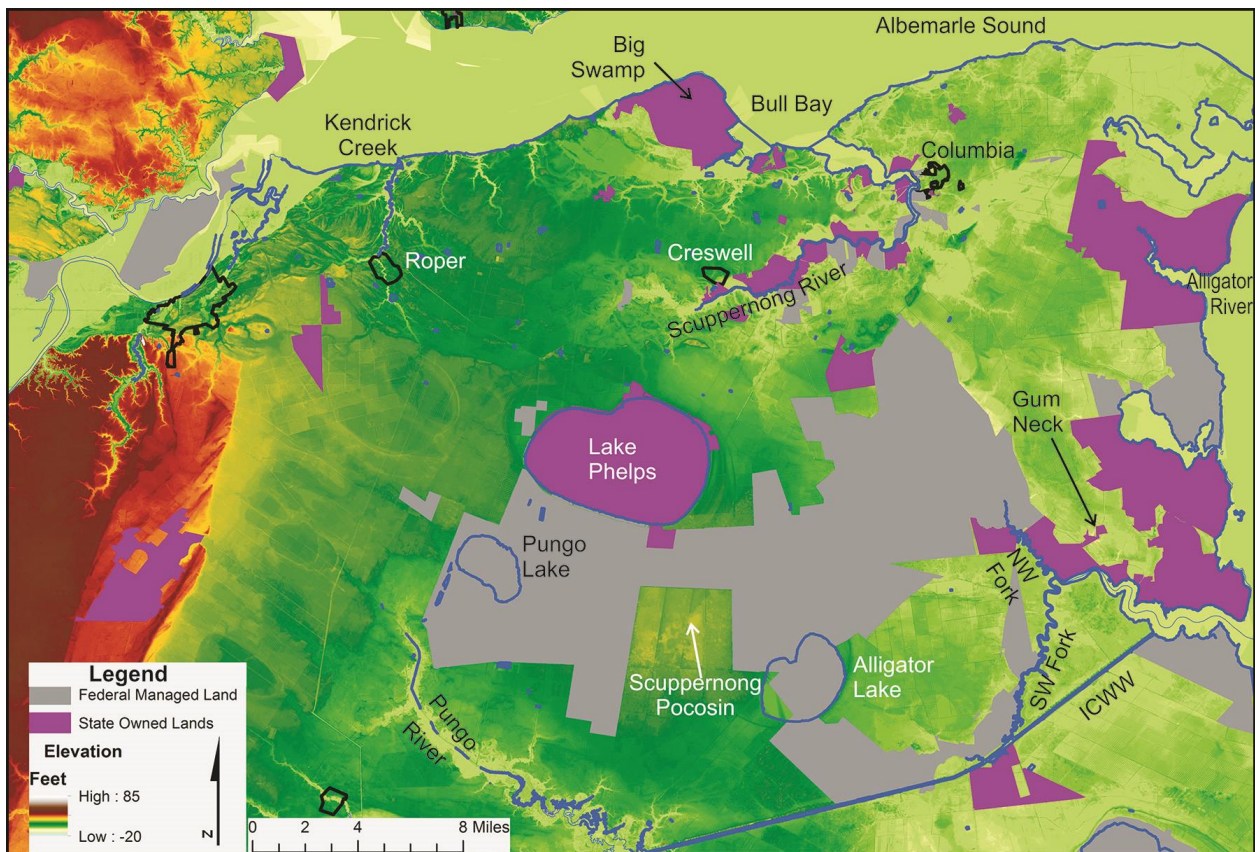


FIGURE 7-1. A color topography map shows the location of federal and state owned lands within the Scuppernong region. These lands are critical natural and cultural resources upon which a viable resource-based ecotourism economy can be developed.

3. Develop an expanded network of topical and transport trail systems which would incorporate all existing trails and programs (e.g., Freedom Trail, Charles Kuralt Trail, Historic Albemarle Trail, Wings over Water, Pettigrew State Park, Pocosin Lakes National Wildlife Refuge, Somerset Place, Mountains to the Sea, etc.). The new integrated regional trails for the Scuppernong region should be developed for car transport, kayak and canoes, hiking, and biking

(both road bikes and off-road bikes), Three proposed examples of topical trails include the following.

A. The “Scuppernong African American Trail” could start at a platform overlook at the original landing point on the banks of the Scuppernong River, travel on a boardwalk through the wild riverine swamp, and then go along the road beside the 6-mile long, hand-dug canal with stops at the site of the grist mills, and then on to Somerset Place on the shores of Lake Phelps. There would be appropriate parking areas, critical signage, maps, and story boards, and small kiosks with benches and occasional picnic tables along the route (Figure 7-2).



FIGURE 7-2. Two examples of kiosks recommended for telling “The Scuppernong Story” along the various proposed trail systems within the SCS.

B. The “Scuppernong Trail System” through the mysterious pocosins, Carolina bays, and black-water swamps of the Scuppernong coastal system (Figures 7-3, 7-4, 7-5, and 7-6). The trail outlined on Figure 7-3 is an example of a possible set of automobile, bike, and paddle trails that pass through the 1) complex of landscapes and multitude of ecosystems unique to the Scuppernong coastal system, 2) 125,000 year natural history and 11,000 year cultural history, and 3) include an educational component of both the natural and cultural resources of the varied wetland systems. The various components of the trail would start and end at an education visitor’s center with programs, maps, aerial photographs, and specific information on the regions unique geologic, ecologic, and cultural components.

C. Expand the Mountains to Sea Trail hiking trail, which now travels east along the Neuse River to Ocracoke, north along the Outer Banks, and ending at Jockey’s Ridge State Park. This trail should be developed to loop back west through Roanoke Island, the mainland and Scuppernong region (including Dare, Tyrrell, Washington, and Martin counties), along the Roanoke River to Roanoke Rapids, Medoc Mountain State Park, and tie back into the main trail at Falls of the Neuse. Hiking across the major water bodies of northeastern NC can be undertaken with a series of kiosks located at both sides of each long bridge and an associated group of trained “bridge taxi” drivers could be available by

phone to transport hikers across the bridges during certain time periods and at pre-determined fees.

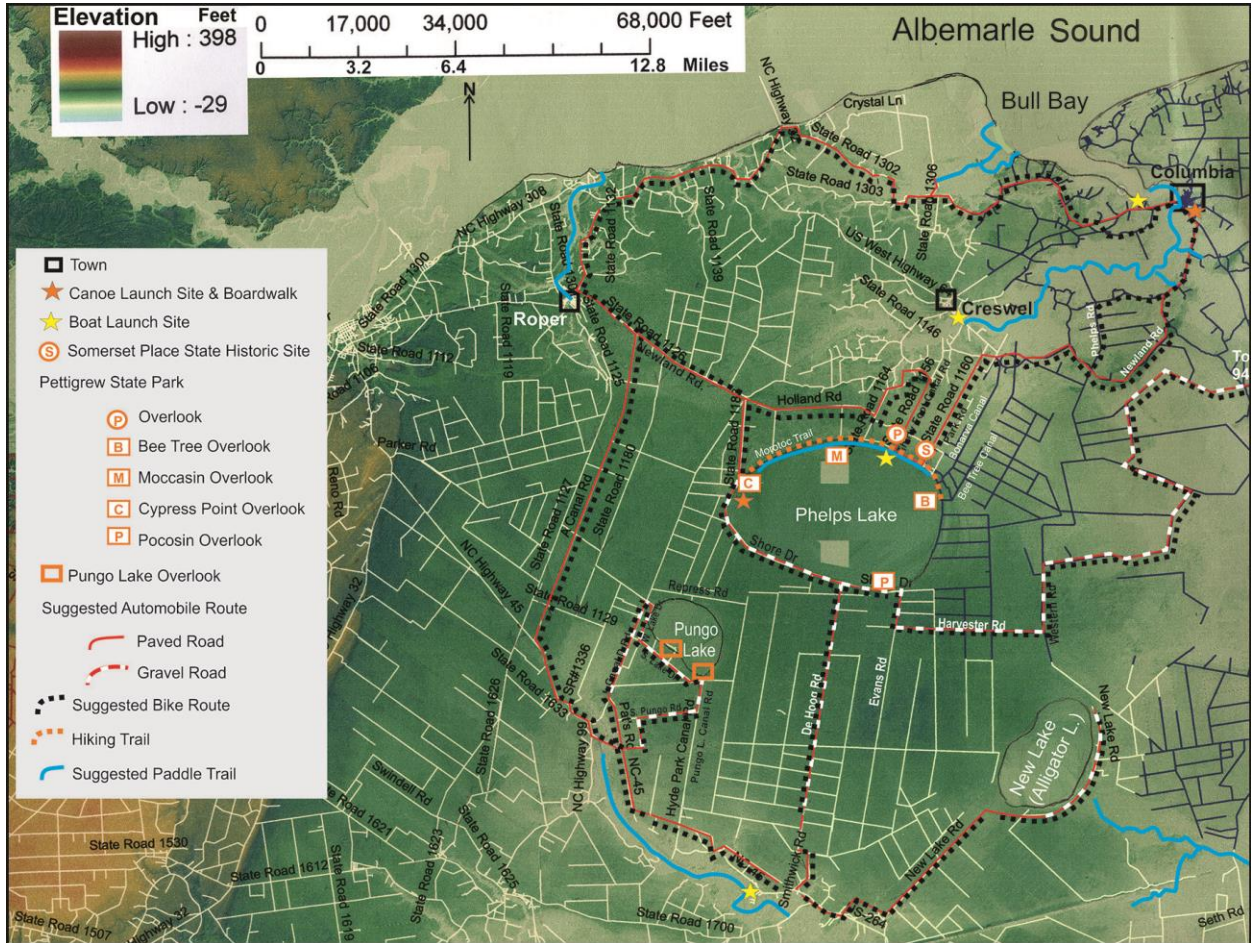


FIGURE 7-3. A color topographic map shows a suggested set of automobile, bike, and paddle trails with launch sites and overlooks called the “Scuppernong Trail System”. Formalizing this network would require additional access points, small parking areas, educational kiosks, and substantial signage.



FIGURE 7-4. A group of road bikers looking for the remote, paved roads within the Scuppernong Trail System.

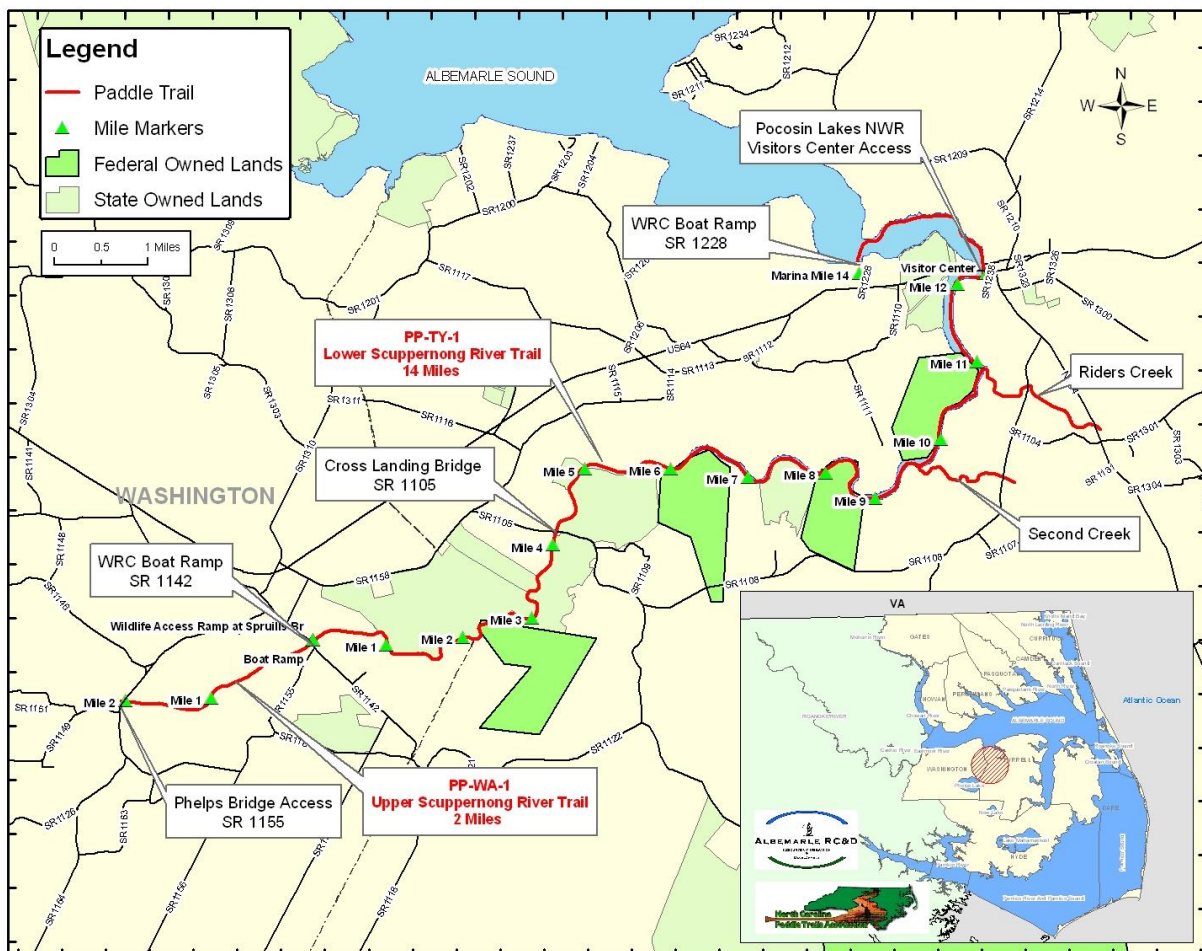


FIGURE 7-5. Map of the Scuppernong River paddle trail developed by the Albemarle Resource, Conservation, and Development Council and the North Carolina Paddle Trail Association (http://www.albemarleacd.org/paddle_trails.asp).



FIGURE 7-6. Map of the Alligator River paddle trail developed by the Albemarle Resource, Conservation, and Development Council and North Carolina Paddle Trail Association (http://www.albemarleacd.org/paddle_trails.asp).

4. Produce an integrated network of new land-based access points for developing the paddle trail system with parking, boardwalks (Figure 7-7), and ramps and piers for different types of small boats (Figure 7-8). Each site should also include well developed signage for wildlife, cultural, and historical information concerning the Scuppernon region.



FIGURE 7-7. Examples of boardwalks that provide access through the perimeter swamp-forest surrounding Lake Phelps and into the lake shoreline.

5. Develop an integrated network of new access ramps and piers for recreational kayaking, boating, sailing, and fishing on the many different kinds of water bodies that occur within the Scuppernong region (Figure 7-8).



FIGURE 7-8. Two examples of access docks for different kinds of boats and water bodies.

6. Develop a network of camping platforms (Figure 7-9) within the Scuppernong coastal system similar to the Roanoke River (see <http://www.roanokeriverpartners.org/pf-home.aspx>)

- A. From the mouth of Bull Bay, Big Swamp and Deep Creek, up the Scuppernong River and its tributaries to the Cherry Bridge.
- B. Alligator Creek, Second Creek, and the Frying Pan
- C. Southern Alligator River and the SW and NW Forks of the Alligator River
- D. The natural portion of the Pungo River
- E. Shores of Lake Phelps



FIGURE 7-9. Examples of two camping platforms in the Roanoke River floodplain. Photographs are from the Roanoke River Paddle Trails website.

7. Develop critical infrastructure within the Scuppernong region necessary for a viable ecotourism economy. Unique types of camping within the Scuppernong region could include possibilities such as tree houses, yurts, small cabins, etc. (Figure 7-10).

(<http://www.canoesc.com/treehouses.html>).



FIGURE 7-10. Example of a tree house and simple cabin that can provide lodging facilities for ecotourism. Photographs are from the Internet.

A. Work with local residents to expand lodging opportunities in current housing, renovated tobacco barns, hunting cabins, unique camping adventures, venues like Air B & B's see <https://www.airbnb.com/>)

B. Investigate food trucks and local catering businesses as an option for providing seasonal dining and special group feed-outs at high attraction areas (Figures 7-11 and 7-12) (<http://blog.priceonomics.com/post/45352687467/food-truck-economics>).



FIGURE 7-11. Examples of a food truck that provides “meals on wheels” and shucking bar in a local seafood house that serves oysters and other types of seafood in season. The left panel is the seafood trailer of the “Full Circle Crab Co.” in Columbia. These specialty food venues are suitable for feeding ecotourism groups participating in the natural and cultural resources of the Scuppernong coastal system.



FIGURE 7-12. The left panel shows a food truck that can deliver a seafood feast to an ecotourism group at a campground or kayak landing, whereas the right panel shows an outdoor fish fry associated with a local seafood house.

C. Investigate farm to table dining options, along with vineyards and home brewpubs in the Scuppernong region (e.g., Chef and the Farmer is helping to transform downtown Kinston; see <http://organicconnectmag.com/project/chef-farmer-tobacco-farm-table/>).

8. Establish guides to key tourist opportunities based upon the specific seasons and their limitations (hunting, biting insects, heat, humidity, storms, etc.), as well as guides that tie “The Scuppernong Story” as major educational components into each different kind of trail system.

9. Build public restrooms (e.g., near Pungo Lake), supply adequate parking areas, and maintain access roads to key tourist locations at key locations along the different trails and for specific attractions (e.g., Allen Road from the south shore of Lake Phelps to the Pungo Unit of Pocosin Lakes National Wildlife Refuge).

10. Develop additional visitor and/or information centers that integrate and underscore the geologic, ecologic, and cultural history of the Scuppernong region.
 - A. Provide a shared visitor center between Somerset Place and Pettigrew State Park to tell “The Scuppernong Story”, as well as an interpretation center for the Scuppernong coastal system in Columbia.
 - B. Provide a small, staffed, seasonal visitor center at the Pungo Unit during prime winter months for waterfowl viewing
 - C. Provide additional public education on proper wildlife viewing etiquette and additional staff to monitor and assist with public viewing to ensure minimum disturbance to the wildlife (model after Bosque Del Apache National Wildlife Refuge in New Mexico <http://www.friendsofthebosque.org/>)
11. Work with local landowners to provide non-consumptive wildlife viewing opportunities (e.g., rental of photography blinds, waterfowl impoundments, parking, etc.).
12. Develop no hunting zones, similar to the Alligator River NWR, for areas of high public use for wildlife observation (like North Lakeshore Drive)
13. Explore possible funding sources for creating and improving infrastructure to support the development of ecotourism around the natural and cultural resources of the Scuppernong coastal system.

Addressing Potential Target Groups and Programs:

1. Nature photographers are a potentially important visitor group to this area if adequate resources are provided. The Carolina Nature Photographers Association (see <http://www.cnpa.org>) and other photography clubs and individuals already make annual trips to the region.
2. Bird watchers, people interested in nature in general, and the Friends of Pocosin Lakes NWR (see <https://www.facebook.com/PocosinLakes>) have conducted successful bear and waterfowl tours of the refuge. These could be continued with proper vehicles (ideally small buses with large viewing windows). Staffing and volunteer training are needed.
3. Build cultural and natural history tour programs around the rich heritage of development within the Scuppernong region: a) Native American archeology; b) European and African American history; c) import and export shipping and the resulting underwater archeology; d) the economic development of regional agriculture and forestry; e) hydrologic modification of the region and ecosystem evolution; f) landscape evolution through 125,000 years. Each of these represents a major story to be told.
4. Many local stories are just waiting to be told through programs, tours, and virtual field trips on the internet. For example, the NC Museum of Natural Sciences developed a program on American Shad along the Roanoke River that includes a traveling program called River Days.

The production includes interviews of long-term local residents and their associations with the river. This model could also be used for the Scuppernong region.

5. Capitalize on the proximity of Pocosin Arts Folk School and the Eastern 4H Conference Center for programming, lodging, art, culture, and food. Ideally, there would be a hotel or lodge developed in the Scuppernong region (e.g., Columbia, Lake Mattamuskeet Lodge, Mackeys Academy Lodge, Belhaven's River Forest Manor, etc.) that is centrally located to the natural and cultural resources of the Scuppernong region and other significant regional assets like Albemarle Sound; Pocosin Lakes, Alligator, and Mattamuskeet National Wildlife Refuges, Somerset Place and Pettigrew State Park, etc.

6. To broaden the scope of tourism possibilities, the arts community that is thriving at Pocosin Arts should be incorporated into regional programming and marketing. Opportunities also exist for combining art with the rich natural and cultural history of the region (e.g., nature journaling, field sketching, nature photography, weaving with natural materials, art based on natural themes, ceramics and basket weaving of Native Americans, etc.).

7. Develop a "bucket list" of major things to see and do while visiting the Scuppernong coastal system and utilize the "passport" concept to guide the visitors. Have you done the following?

- A. Seen our constellations, stars, and meteorite showers in a truly black night sky?
- B. Howled with the wolves or marveled with the night time insects and frogs?
- C. Gone fly-fishing in the many different waters of the Scuppernong coastal system?
- D. Stood in a 1786-1862 African slave cabin?
- E. Biked through the wilderness of a pocosin swamp forest?
- F. Seen black bears feeding in the corn fields?
- G. Watched a flock of tundra swans take flight from Pungo Lake at dawn?
- H. Eaten a local blue crab or a succulent oyster on the banks of Albemarle Sound?
- I. Been on a commercial fishing boat in Albemarle Sound?
- J. Walked among a grand stand of Atlantic white cedars?
- K. Savored a cluster of Scuppernong grapes picked directly from the vine?
- L. Camped on a village site of the Carolina Algonkians along the Lake Phelps shore?
- M. Paddle-boarded on the drowned tributary estuary of Bull Bay?
- N. Made an Algonkian cooking pot from local clays at the Pocosin Arts Center?
- O. Visited a "prairie gothic" mega-farm operation?
- P. Slept on a 125,000-year old ocean shoreline?
- Q. Photographed a broad cluster of 3-foot high, green pitcher plants?
- R. Shared a bottle of wine in a tree-house along the shores of the Alligator River?

- S. Walked the “Scuppernong African American Trail” from the banks of the Scuppernong River, on a boardwalk through the wild swamps, and beside the 6-mile long, hand-dug canal to the Somerset Place on the shores of Lake Phelps?
- T. Motored or biked the “Scuppernong Trail System” through the ethereal pocosins, Carolina bays, and black-water swamps of the Scuppernong coastal system?
- U. Ventured along the 11,000 year “Scuppernong Cultural History Trail”?
- V. Considered the origin of the hundreds of mysterious Carolina bays in the Scuppernong coastal system?
- W. Participated in the slave’s Jonkonnu observance during Christmas at Somerset Place?
- X. Paddled the awesome black-waters of the Scuppernong River or Deep Creek?



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APPENDIX A

GEOLOGIC HISTORY OF THE SCUPPERNONG LANDSCAPE

Climatic History and Geologic Framework

The geologic framework of the Scupperong coastal system (SCS) consists of a series of three-dimensional sediment units that are products of their physical environment, climatic conditions, and hydraulic events at the time of formation. These geologic units are complex products of changing depositional and erosional processes as the region fluctuate into and out of interglacial and glacial episodes. Integrating the two-dimensional landscape with subsurface geologic units within the SCS allows for interpretation of the changing environments of deposition and/or erosion (e.g., riverine, estuarine, shoreline, marine, etc.), changing climatic conditions (warm vs cold; wet vs dry; and fresh vs salt water, etc.), and time of formation of each geologic unit. The physical and chemical characteristics of each geologic unit in combination with the changing environmental conditions determines the resulting ecosystems. Superimposed upon both the geology and ecology are the modifications resulting from the arrival of humans and their subsequent environmental modifications (e.g., conflict events, ditching and draining, logging, agricultural development, mining, etc.).

Figure A-1 is a map that shows the location of the A-A' topographic profile across the North Carolina Coastal Plain as shown in Figure A-2. The Upper and Central portions of the Coastal Plain consist of the Sunderland, Wicomoco, and Talbot Pleistocene interglacial paleo-ocean shorelines and associated terraces from west to east. The surface of the Lower Coastal Plain constitutes the Pamlico Terrace that is bounded on the west by the Suffolk Shoreline and on the east by the Outer Banks barrier islands. The Suffolk Shoreline is eroded into the Talbot Terrace (Figures A-2 and A-4) that pre-dates the warm period of the previous interglacial high-stand (Figure A-3) about 125,000 to 75,000 years before present (BP) when the Suffolk Shoreline was formed. To the east of the interglacial Suffolk Shoreline was a large, shallow water, ocean embayment and what became the Pamlico Terrace was the sea floor.

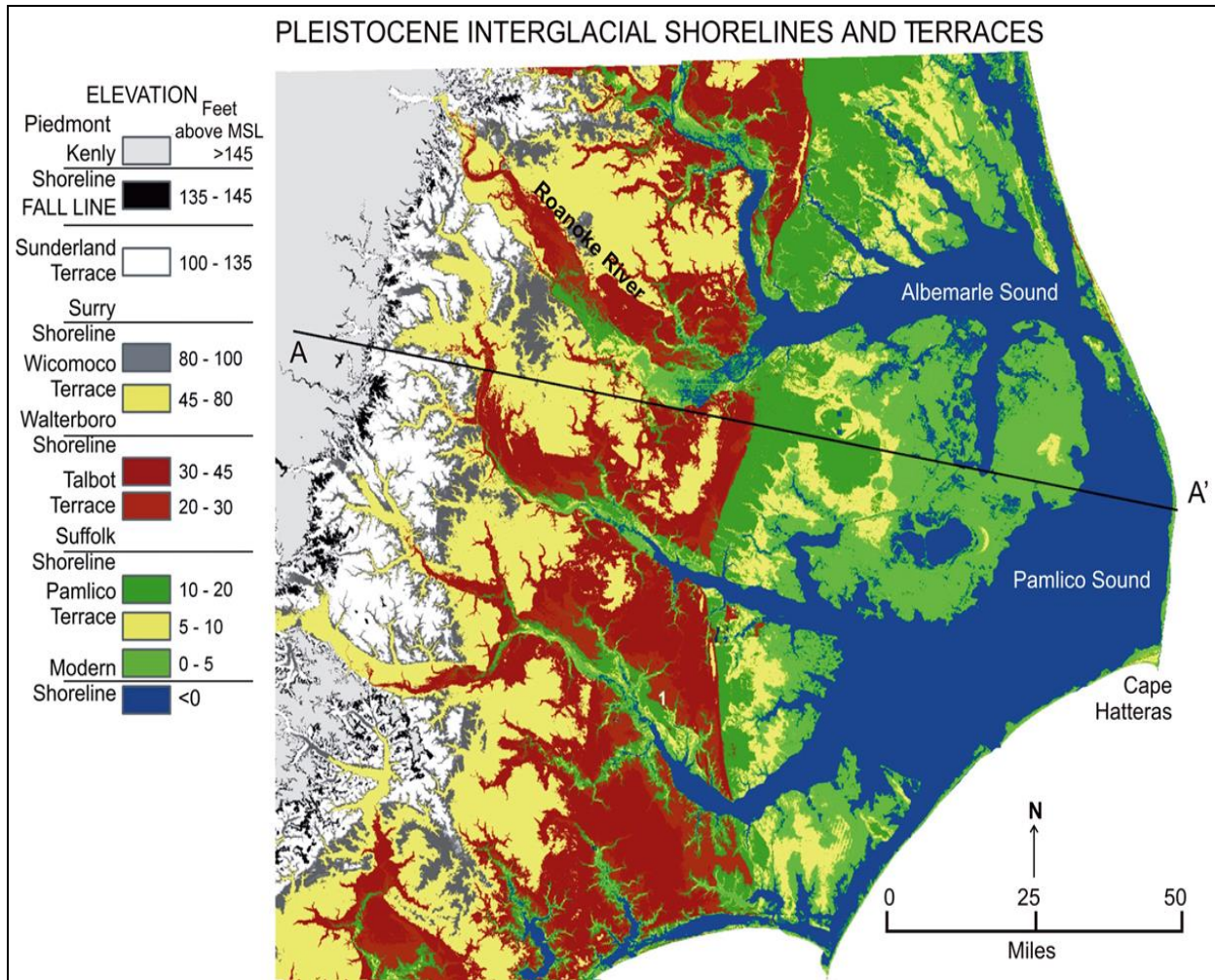


FIGURE A-1. This color topography map shows the land elevation for northeastern North Carolina. The location above mean sea level of the Pleistocene interglacial ocean shorelines and associated terraces are color coded. Topographic profile A-A' shown in Figure A-2 runs across the Coastal Plain from Rocky Mount (A) on the west to Rodanthe on the Outer Banks (A'). The black zone (Fall Line) on the western side of the map is the contact between the Piedmont Province (west) and Coastal Plain Province (east). Geologic data are from Farrell et al. (2013) and topographic map data are from the North Carolina DOT 2007 LiDAR.

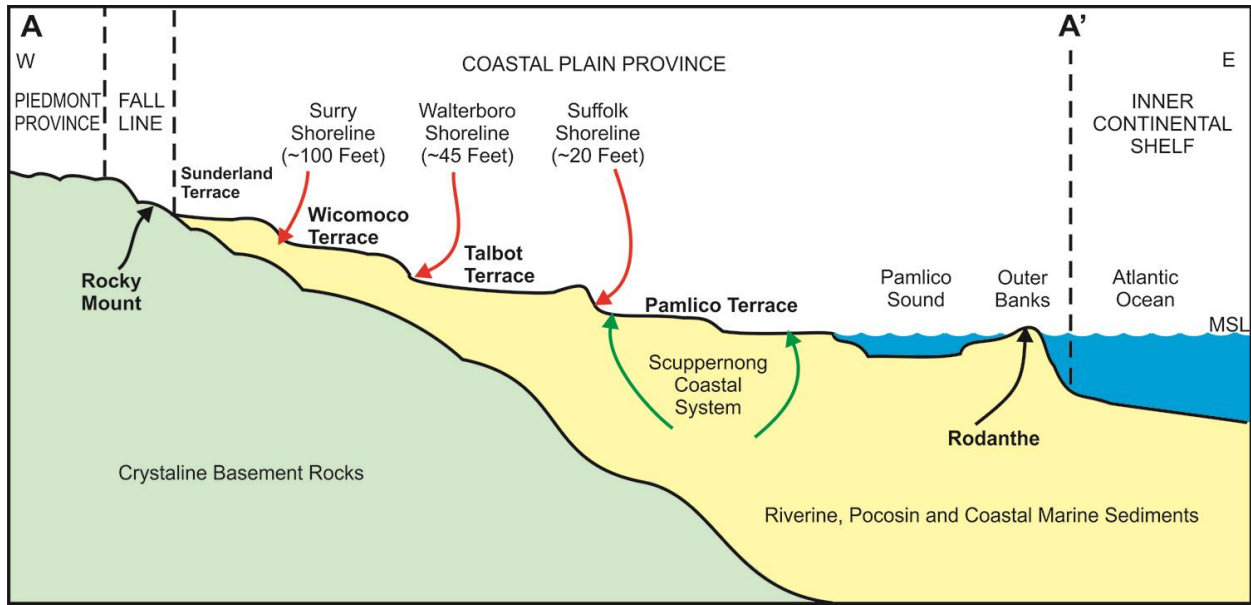


FIGURE A-2. A schematic west to east cross-section drawn across the northeastern North Carolina Coastal Plain from Rocky Mount on the Fall Line, through the Albemarle-Pamlico Peninsula to Rodanthe on the Outer Banks (see Figure A-1 for cross-section location). The SCS (green arrows) is shown as part of the Pamlico Terrace. Geologic data are from Farrell et al. (2013).

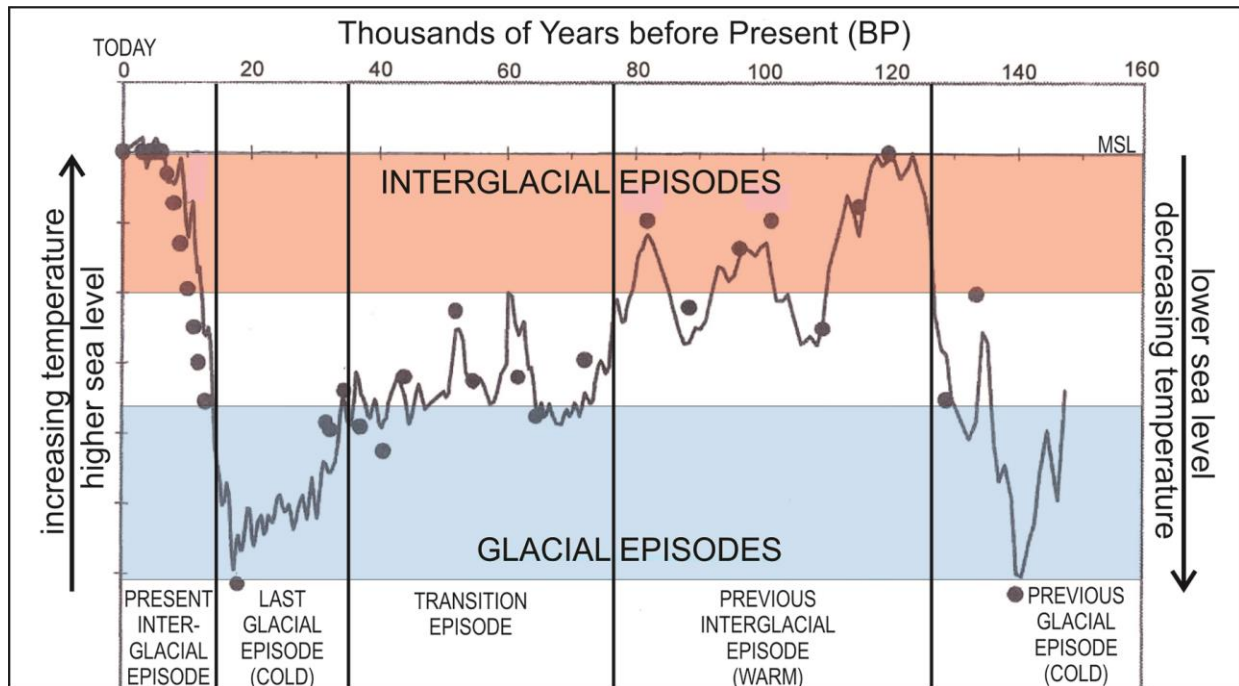


FIGURE A-3. Calibrated sea-level curve for the last 150,000 years based on oxygen isotope data from deep-sea cores. Black dots represent sea-level data from fossil coral terraces. High sea levels occur during warm climatic conditions with small continental ice sheets (red zone). Low sea levels occur during cold climatic conditions with widespread continental ice sheets. Modern

sea level MSL) is at the top of the red zone. The figure is modified from Pillans and Naish (2004).

The last 125,000 years of earth's history is the time frame involved in forming the modern Scuppernong landscape and ecosystems. Figure A-3 shows a plot of the location of changing sea level relative to today's mean sea level. This plot is based on global climate temperatures that were warmest when sea level was the highest (pink interglacial episodes) and coldest when sea level was the lowest (blue glacial episodes). From about 125,000 to 75,000 years ago, the earth was gripped in a climatic warm period of an interglacial episode (Figure A-3). This was followed by a slow transition zone (75,000 to 35,000 years ago) of cooling climate that reached its coldest period and lowest sea level during the last glacial maximum from about 35,000 to 12,000 years ago. By about 12,000 years ago, the climate was warming rapidly with a dramatic rate of sea-level rise. In addition, during the past 12,000 years there have been minor oscillations in global temperature along with a slow and ongoing net rise in sea level that has systematically flooded upwards and landwards onto the North Carolina Coastal Plain to produce our present landscape and its ecosystems.

Geologic History of the Scuppernong Landscape

Figure A-4 is a geologic map of the SCS showing the surficial landscape features. The geomorphic landscape features (see legend in upper left corner) are based on the integration of the detailed topography with the underlying geologic framework including stratigraphy, sediment composition, and age data. The area seaward of the scarp eroded into the east side of the Talbot Terrace and constitutes the Pamlico Terrace deposits that formed since 125,000 years ago BP (the previous interglacial warm period and high-stand episode (Figure A-3)).

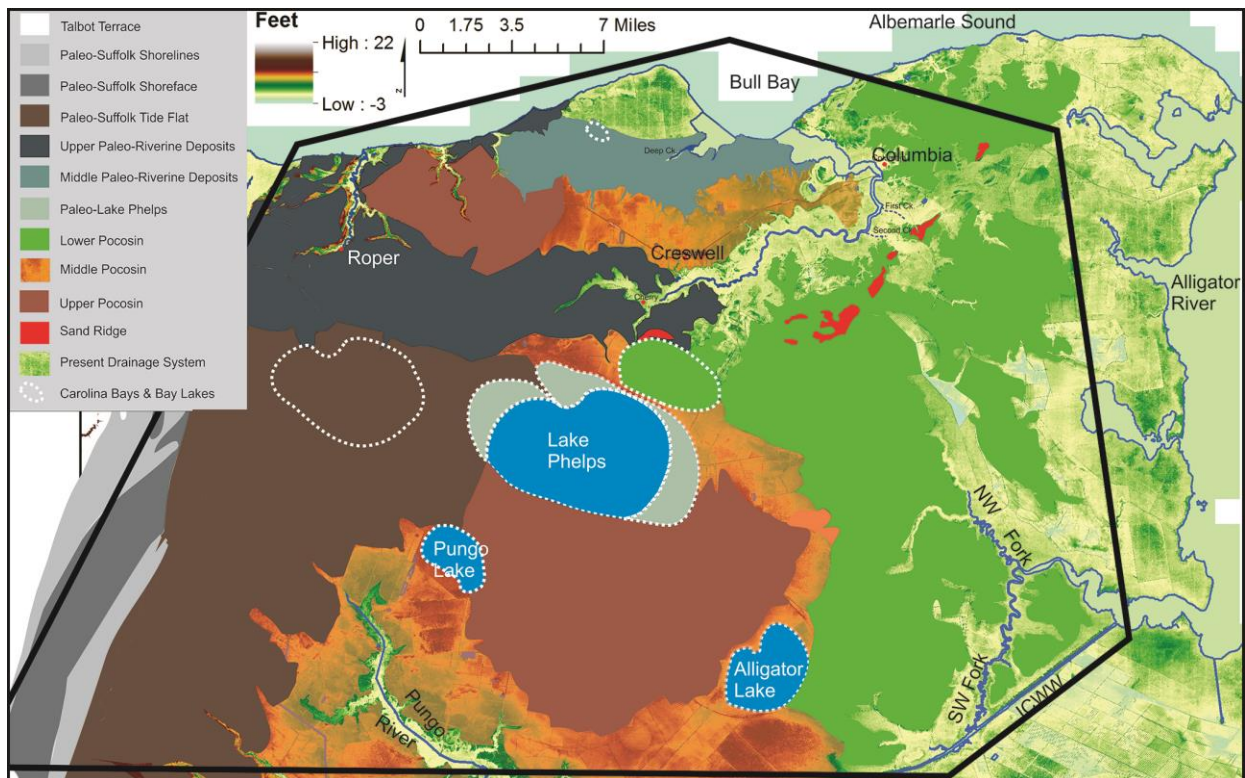


FIGURE A-4. This figure is a geologic map of the SCS region, as shown by the thick black line, within the North Carolina Land of Water (NC LOW). White indicates the Talbot Terrace which occupies the highest elevation along the western margin (30+ feet above mean sea level). Pungo Lake is 9 feet, Phelps Lake is 10 feet, and Alligator Lake is 6 feet above mean sea level. Topographic LiDAR data are from the 2015 North Carolina Floodplain Mapping Program.

1. 125,000 to 75,000 Years Ago: Previous Interglacial Episode

A. The Paleo-Suffolk Shoreline beach ridges, swales, and cape features were deposited on the Paleo-Suffolk Shoreface when sea level rose to ~20 to 25 feet above present sea level during the 125,000 to 75,000 year BP high-stand of sea level (Figures A-3 and A-4). A scarp was eroded into the older Talbot Terrace resulting in a strand-plain beach to which multiple beach ridges and associated swales and dunes (rising 20 to 40 feet above present sea level) were accreted eastwards. The beach ridges were formed by storm events and consist of pure white quartz sand similar to modern Pamlico Sound beaches.

B. Seaward of the Paleo-Suffolk Shoreline is the broad and shallow Paleo-Suffolk Tidal Flat that formed a vast eastward sloping ramp during the warm period of 125,000 to 75,000 years BP. The elevation of the tidal flat depositional surface ranges from about 20 to 18 feet above present sea level in the west to about 5 to 0 feet above present sea level along the NW and SW Forks of the Alligator River where open bay sediments accumulated. Deposition on the low-energy tidal and open bay flats was dominated by sequences of mud- and sandy-mud deposits. These areas are characterized by very poor vertical drainage.

2. 75,000 to 35,000 Years Ago: Transition Episode

A. From about 75,000 to 35,000 years BP (Figure A-3) the warm interglacial episode transitioned towards the cold climate of the last glacial maximum. During this transition period the climate cooled, ice sheets began to accumulate on the northern two-thirds of the North American continent and portions of northern Europe and Asia. Withdrawal of water from the global oceans resulted in a slightly lowered sea level. The Atlantic Ocean shoreline withdrew eastward from the Scuppernong region, the Pamlico Terrace, and ultimately off the entire continental shelf. Compared to today, this newly exposed land temporarily doubled the size of the subaerial Coastal Plain of North Carolina.

3. 35,000 to 12,000 Years Ago: Last Glacial Episode

A. During the last glacial maximum, from about 35,000 to 18,000 years BP (Figure A-3), the climate in the Scuppernong region cooled and dried to arid and semi-arid conditions. This resulted in a severely reduced vegetative cover and exposed land surface making it more susceptible to erosion. Wide, shallow, and highly braided trunk valleys of the Roanoke and Tar Rivers formed in response to extreme storm events that discharged high levels of rainfall and sediment, and caused floods that far exceeded the severity of modern floods. This resulted in deposition of multi-tiered braid-plain terrace deposits of sands and gravels. The Roanoke River braided river system eroded the northern flank of the Albemarle Peninsula producing a series of sand and gravel braid-terraces with different elevations. A few of these braid-terraces are still preserved along the northern flank of the Albemarle Peninsula and are mapped as Upper and Middle Paleo-Riverine Deposits in Figure A-4. These two deposits are locally called the Plymouth and Mackey's braid-plain and have gently rolling topography with deep sand soils. The lower elevation of the Big Swamp braid-plain to the east, is characterized with ghost forests that are presently being drowned by the ongoing rise of sea level.

B. The drop of about 410 feet in sea level in North Carolina during the last glacial maximum substantially increased river gradients and caused the trunk-rivers and their tributary drainage systems to undergo headward erosion as they incised into the previously deposited shoreface sediments of the previous interglacial episode. The cold, stormy climate, with minimal vegetative cover during the last glacial maximum, resulted in frequent flooding of the Carolina bay depressions. Wave activity in the lakes reworked sand sediments to build small shoreline rims, thus allowing more water to be impounded. Carolina bay shorelines were breached as the incised channels eroded across the tide flat and open bay marine sediments of the previous interglacial period and ultimately intersected the bay rims, draining the lakes.

C. The shallow Paleo-Suffolk Tidal Flats are characterized by a series of small (1 by 3 miles), shore-perpendicular oriented, Carolina bay depressions. The slightly deeper portions of the open marine bay are generally characterized by larger (2 by 5 miles) and more complex Carolina bays. All Carolina bays formed on the tide-flat surface of marine mud, however, the specific character of each bay depended on water depth, wind waves and currents, and sand supply. At some point in their formation the Carolina bays were shallow lakes with different sized sand rims along the shorelines.

D. The Scuppernong River became incised along the north portion of the Scuppernong pocosin, the NW and SW Fork of the Alligator River along the east, and the Pungo River to the south. As a result of shoreline breaching, most of the Carolina bays today are extremely shallow bay depressions. However, a few of the larger and complex Carolina bays have not yet been breached by any tributary stream and occur today as Carolina bay lakes (e.g., Phelps, Pungo, Alligator, and Mattamuskeet Lakes). These bay lakes formed lower on the Paleo-Shoreface slope and had access to greater volumes of sand for formation of large and multiple, shoreline deposits. As the climate shifted into temperate conditions with smaller storm systems (the current interglacial episode in Figure A-3), the bay lake perimeters became stabilized with a dense vegetative cover.

4. 12,000 to 0 Years Ago: Present Interglacial Episode

A. The last 12,000 years represents the current interglacial episode (Figure A-3). Five major changes were in progress.

1. The global climate had warmed to the point where it shifted from the “ice-house” of the last glacial episode to the “hot-house” of the modern temperate climatic zone.
2. The climate shifted from an arid and semi-arid, storm-dominated system to a temperate climate with a weaker storm regime and a more regular annual rainfall pattern.
3. A denser vegetation cover developed on the landscape.
4. The coast line migrated upward and landward across the continental shelf to its present location as a result of sea-level rise, substantially decreasing stream gradients across the Coastal Plain.
5. As sea level approached its modern location, the lower reaches of the river valleys were flooded to form the modern drowned-river estuaries, but the barrier island system was still substantially seaward of its present location.

B. By about 9,000 years ago, the warming climate and rising sea level caused stream gradients to decrease and fresh water to flood the lower reaches of river and stream valleys. The changing climatic conditions led to shifts from multiple braided channels to meandering channel systems, and finally to the vegetatively bound channels with development of broad floodplains and associated swamp forest wetlands by about 6,000 years ago. Consequently, peat deposition was initiated in the floodplains on top of the pre-existing riverine braid-plains formed during the last glacial maximum.

C. By about 6,000 years ago, continued climate warming and sea-level rise caused marine water to flood upward into the lower river valleys and began to form the modern drowned-river estuaries, as well as the interstream divide pocosins.

1. The floodplain swamp forests were drowned in succession by fresh, brackish, and salt water estuaries with their fringing marshes and accumulating peat deposits. As flooding continued, the estuarine water bodies increased in size, depth, and wave energy and deposited estuarine mud and sand on top of the former river valley sediments.

2. The undissected upland areas that were essentially flat and underlain by marine clays deposited by the Paleo-Suffolk Shoreface and Tidal Flat (see Figure A-4), maintained wetland habitats that became vegetatively bound by dense shrub-scrub. Through time, these habitats accreted organic matter vertically independent of sea level. This encouraged wetland swamp forest and shrub-scrub vegetation to slowly spread out over the clay deposits in the low uplands adjacent to the streams. The swamp forest vegetation continued to increase the holding capacity of water and subsequently a peat substrate expanded well beyond the former tributary drainages. The process continued to migrate upward with the constructive accumulation of organic peat that extended onto the inter-stream divide forming today's classic Scuppernong Pocosin or "swamp on a hill".

D. During the last 225 years, the vast wetlands within the SCS were ditched and drained for economic recovery of the natural resources and land-use alteration of the uplands. These processes not only dramatically changed the hydraulic regime and ecologic composition, but probably increased the natural fire risk due to permanent lowering of the water table. These activities caused the vertical growth of pocosins to be terminated, and in many cases the peat deposits are severally oxidized and subsiding.

In summary, the Scuppernong Pocosin swamp forests formed on top of marine clay-rich sediments deposited during the marine occupation of the Paleo-Suffolk Shoreline (see Figure A-4) during the previous interglacial episode. During the subsequent last glacial maximum, tributary streams incised the flanks of the Albemarle-Pamlico interstream divide, which survived as a topographically high erosional remnant. As the climate warmed during the modern interglacial period, increased amounts of water were held on these low sloping, upland clay surfaces. A thick growth of shrub-scrub, swamp forest vegetation developed and produced abundant organic matter that accreted vertically. Thick peat soils accumulated to produce the geologically and ecologically different blackland soils than the peat deposits that formed in riverine valley floodplains or sea level dependent estuarine marshes. Table A-1 summarizes the evolutionary history of the Scuppernong coastal system.

TABLE A-1. SUMMARY OF THE GEOLOGIC EVOLUTION OF THE SCUPPERNONG COASTAL SYSTEM

- 1. WARM INTERGLACIAL EPISODE (125,000 to 75,000 yrs BP)**
OCEAN SHORELINE SCARP ERODED INTO TALBOT TERRACE
SUFFOLK SHORELINE BEACH DEPOSITS (SAND RIDGES, SWALES, & CAPE FEATURES)
TIDAL FLATS (MARINE MUD & SAND)
- 2. TRANSITION EPISODE (75,000 to 35,000 yrs BP)**
COOLING CLIMATE & FALLING SEA LEVEL
INITIAL INCISEMENT OF DRAINAGE SYSTEM INTO MARINE MUD SURFACE
- 3. COLD GLACIAL EPISODE (35,000 to 12,000 yrs BP)**
FORMATION OF BRAIDED TRUNK RIVERS
INCISION & HEADWARD EROSION OF TRIBUTARY STREAM SYSTEM
FORMATION OF COMPOUND CAROLINA BAY DEPRESSIONS & THEIR BREACHING BY HEADWARD EROSION OF STREAMS
FORMATION OF CAROLINA BAY LAKES
POCOSIN INTERSTREAM DIVIDE COMPOUND LAKES
BLOCKED DRAINAGE LAKES
- 4. WARM INTERGLACIAL EPISODE (12,000 yrs BP to PRESENT)**
WARMING CLIMATE, RISING SEA LEVEL, & VEGETATING THE LANDSCAPE
RIVER CHANNEL TRANSITIONS—BRAIDED TO MEANDERING TO VEGETATIVELY BOUND
FLOODING UP RIVER VALLEYS WITH DECREASING RIVER GRADIENTS
BUILDING MODERN ESTUARINE & BARRIER ISLAND COASTAL SYSTEM
POCOSIN FORMATION
PEAT ACCRETION & BURIAL OF CAROLINA BAYS
NE NC: FORM ON REMNANT INTERSTREAM DIVIDES
SE NC: FORM IN REMNANT ESTUARINE EMBAYMENTS
HUMAN ARRIVAL IN NORTHEASTERN NORTH CAROLINA
MODIFICATION OF NATURAL WETLAND SYSTEM FOR AGRICULTURE AND FORESTRY

APPENDIX B

ECOLOGICAL PERSPECTIVE OF THE SCUPPERNONG REGION

The ecosystems of the Scuppernong region (Figure B-1) are far more diverse than one might imagine based on the seemingly little topographic relief of the region. However, the small variations of land topography are critical as they interface with different types of aquatic systems to produce various landscapes with high biodiversity and variants in ecosystem services. This land-water interface has historically and continues to work together with natural and human disturbances to foster contrasts in ecological condition and resultant expression of ecosystem services.



FIGURE B-1. Photograph of the black-water Scuppernong River and its associated floodplain swamp forest.

The regions' ecosystems represent continuums that are evolving in response to rapid rates of human modification (ditching and draining) and the high-energy natural climate system dynamics (e.g., precipitation, droughts, river floods, storm surge, and sea-level rise). Each ecosystem supplies its own suite of ecosystem services and represents potential components of a healthy social system, as well as a viable and sustainable ecotourism economy. Thus, to maximize both the social and environmental resources into the future it is critical that a solid

scientific understanding be integrated with the management policies of an expanding natural resource-based economy.

Ecological Resources of the Scuppernong Coastal System

The Scuppernong region is situated within the middle of the Albemarle-Pamlico Peninsula, which has the lowest people population in North Carolina, but one of the largest wildlife populations with extremely diverse habitats. The natural ecosystems range from old growth forests to scrub-shrub pocosins, Carolina bay lakes, black-water streams, riverine swamp forests, and open-water estuaries. Integrating the highly diverse natural landscape with the cultural history of the Scuppernong coastal system, and building upon the already established framework consisting of Pettigrew State Park, Somerset Place, and Pocosin Lakes National Wildlife Refuge represent an ideal blend of nature, history and recreation.

The riverine ecosystems of the Scuppernong region are black-water rivers and tributary streams within broad floodplain swamp forests. The drainage basins are relatively short but extremely rich in natural values. The river channels meander to and fro within the floodplain often with stands of Atlantic white cedar (*Chamaecyparis thyoides*) in each bend. The swamp forest canopy is dominated by gum (*Nyssa sylvatica*) with a shrub layer chiefly composed of titi (*Cyrilla racemiflora*) and Virginia willow (*Itea virginica*). The herb layer is dominated by royal fern (*Osmunda regalis*) and lizard's tail (*Saururus cernuus*). Wildlife is abundant within these riverine ecosystems.

The lower reaches of the black-water rivers support a tidal swamp ecosystem (Cypress-Gum Subtype), dominated by bald cypress (*Taxodium distichum*), swamp black gum (*Nyssa biflora*), water tupelo (*Nyssa aquatica*), and red maple (*Acer rubrum*). Wax myrtle (*Morella cerifera*) is common in the shrub layer. In recent years, much of this forest is dying as a result of ongoing rise of sea level and the consequent brackish water intrusion. These former swamp forests are slowly becoming “ghost forests” with their conversion to marsh lands, which can be seen adjacent to the estuarine shorelines and for miles upriver from the estuaries. Many of the stands of Atlantic white cedar are threatened by the impact of rising water levels.

The nonriverine pocosin wetland community contains a mixture of canopy trees including bald cypress, pond pine (*Pinus serotina*), swamp black gum, sweetgum (*Liquidambar styraciflua*), red maple, and scattered Atlantic white cedar. The sub-canopy is very dense and contains swamp black gum, sweetbay magnolia (*Magnolia virginiana*), red bay (*Persea palustris*), and red maple. The shrub layer is composed of hydrophytic shrubs such as ti-ti (*Cyrilla racemiflora*), fetterbush (*Lyonia lucida*), sweet pepperbush (*Clethra alnifolia*), and black highbush blueberry (*Vaccinium fuscatum*). The ground layer contains Virginia chain-fern (*Woodwardia virginica*), netted chainfern (*W. areolata*), and sedges (*Carex* spp.).

Scattered among the Scuppernong wetlands are areas dominated by mineral soils that support two distinct natural communities. On the drier uplands is a Mesic Mixed Hardwood Forest featuring beech (*Fagus grandifolia*), white oak (*Quercus alba*), yellow poplar (*Liriodendron tulipifera*), and loblolly pine (*Pinus taeda*) in the canopy, while American holly (*Ilex opaca*), ironwood (*Carpinus caroliniana*), and witch-hazel (*Hamamelis virginiana*) occur in the subcanopy. Lower and wet areas support a nonriverine Wet Hardwood Forest community of

swamp chestnut oak (*Quercus michauxii*), water oak (*Q. nigra*), cherrybark oak (*Q. pagoda*), sweetgum, and swamp black gum. Switchcane (*Arundinaria tecta*), Howe's sedge (*Carex howei*), New York fern (*Thelypteris noveboracensis*), and lizard's-tail (*Saururus cernuus*) occur in wet mossy soil.

The fauna that occur within the Scuppernong region are diverse and include black bear (*Ursus americanus*), American alligator (*Alligator mississippiensis*), red wolf (*Canis rufus*), river otter (*Lontra canadensis*), bobcat (*Lynx rufus*), bald eagle (*Haliaeetus leucocephalus*), red-cockaded woodpecker (*Picoides borealis*), wood duck (*Aix sponsa*), and the American woodcock (*Scolopax minor*). The rivers harbor a wide variety of fishes, and its upper regions are spawning grounds for river herring and other coastal fisheries.

The Scuppernong region contains one of the largest concentrations of black bear in the southeastern United States. The U.S. Geological Survey's Cooperative Wildlife Research Unit at Virginia Tech estimated the black bear population in 2005 to be between 370 and 500, with a density on good habitat of three to four bears per square mile. The region also plays a more vital role in the yearly cycle of wintering tundra swans than any other state on the East Coast. Approximately 65,000 to 75,000 thousand swans migrate to northeastern North Carolina (mostly to the Albemarle-Pamlico Peninsula) to take advantage of the abundant habitats found in the estuaries, lakes, and farm lands.

The North Carolina Natural Heritage Program designated most of the U.S. Pocosin Lakes National Wildlife Refuge as a "Significant Natural Heritage Area". The North Carolina Division of Water Resources designated many of the creeks and rivers within the Scuppernong region as "swamp waters". Tributaries to the Alligator River are "outstanding resource waters". The Pungo River and creeks on the south side of the Albemarle Sound are "nutrient sensitive waters". The North Carolina Division of Marine Fisheries and Wildlife Resources Commission have designated the Scuppernong River, Lake Phelps, and neighboring water bodies as anadromous fish spawning habitats. The Scuppernong region is considered to be a critical wildlife corridor between the U.S. Alligator River National Wildlife Refuge to the east and the lower portion of the U.S. Roanoke River National Wildlife Refuge to the west.

Ecosystem Services

It is useful to think of ecosystems as providing services to the people of North Carolina and the Scuppernong Region. This concept is called "ecosystem services" (de Groot et al. 2002, Millennium Ecosystem Assessment 2005). The services arise from normal functioning of ecosystems and highlight how those functions serve people. For example, production of plant biomass is a major process occurring within most ecosystems. Thus, photosynthesis and the resultant primary production are important functions of these ecosystems. The service provided comes when people use this production for food, timber and other wood products. Also, the trees, shrubs, and low lying plants function to provide habitat for the diversity of animals and microbes. These organisms also serve people through food and reasons for recreational use of the ecosystems.

Numerous aspects of the well-being of people are, therefore, perceived as explicitly being derived from natural processes within ecosystems. Within the Scuppernong region ecosystem services of interest to us include the following.

1. Habitat for wildlife and a diverse assortment of species
2. Provision of timber, food, and other materials
3. Nutrient and sediment removal with water quality protection
4. Shoreline protection from storms
5. Carbon sequestration
6. Recreational and aesthetic opportunities

Individual wetlands within the Scuppernong region have been recognized for providing numerous important ecosystem services. For example, as nitrogen-rich agricultural groundwater infiltrates a riparian wetland within the watershed, biogeochemical processes may convert fertilizer nitrogen to a gaseous form. This reduces nutrient loading to the Scuppernong and Albemarle Sound and helps improve water quality. Thus, a normal function of the wetland ecosystem provides a valued service.

Each ecosystem type has its own suite of services and manner by which each function acts. An obvious example of differences is to consider a riparian wetland versus a desert. The former may be involved in shoreline protection and removal of sediments and nutrients not exercised by the latter. Perhaps more subtle are differences in more similar ecosystems. A pocosin sequesters carbon through peat formation differently than a riparian wetland swamp.

Ecosystem functions and services are vulnerable to both natural and human perturbations. Natural variability may be found through inter-annual weather patterns, especially storms. Human impacts of them arise most dramatically when ecosystems are converted entirely to other types (e.g., forest to agricultural field, or wetland to marina). But larger scale impacts occur through such factors as upstream activities and climate change. One can assess vulnerability and resilience to perturbations in the context of impacts to ecosystems services. This approach is both holistic and germane to linking natural response to human interests.

The region can be broadly zoned as upland, wetland, and water. Numerous ecosystems then exist within each zone. These ecosystems result from the combined history of geological, ecological and human forces. Interesting contrasts in the conditions of these ecosystems are found within the Scuppernong region. These contrasts help highlight the ecosystem services provided and how they are impacted by disturbance. They may serve as opportunities for observational and experimental studies, and be of interest for ecotourism. Here are some examples of such contrasts.

1. Shoreline protection: Swamp forests provide a buffer from storms to upland properties. As waves and storm surge reach the swamp edge and move through the swamps, energy is dissipated. One result of this buffering is often seen in downed trees and standing dead tree snags along the shoreline (Figure B-2). Swamp forests facing north or northeast demonstrate this effect and contrasts with shorelines facing other directions.



FIGURE B-2. Evidence of storm effects causing blow-downs along the swamp-forest shoreline in Bull Bay.

2. Carbon sequestration: Sequestration of carbon is seen as a significant process to reduce increases in atmospheric carbon dioxide concentrations and thus limit climate change. Pocosins are peatlands capable of sequestering carbon into organic matter. Peat is highly organic soil. The organic matter comes from plant production. Many soils allow air and its oxygen to penetrate and promote aerobic decomposition of much of this organic matter. Wetlands, including pocosins, have soils that tend to be saturated with water for a considerable period during the year. The water limits penetration of oxygen, and decomposition is slower and anaerobic. This allows the accumulation of organic matter (i.e., carbon sequestration). Unfortunately, hundreds of thousands of acres of pocosin wetland have been ditched and drained in attempts to farm the land (Figure B-3). Ditching and draining promotes oxidation of peat and removal of the accumulated organic matter. National Wildlife Refuges and State Parks have begun the important work of restoring of this vital carbon sink. As hydrology is restored, the raised water table deters ground fires and subsequent removal of organic matter. The preservation and restoration activities of Pocosin Lakes National Wildlife Refuge provide an excellent opportunity to see ecosystems with various abilities to deliver this service.

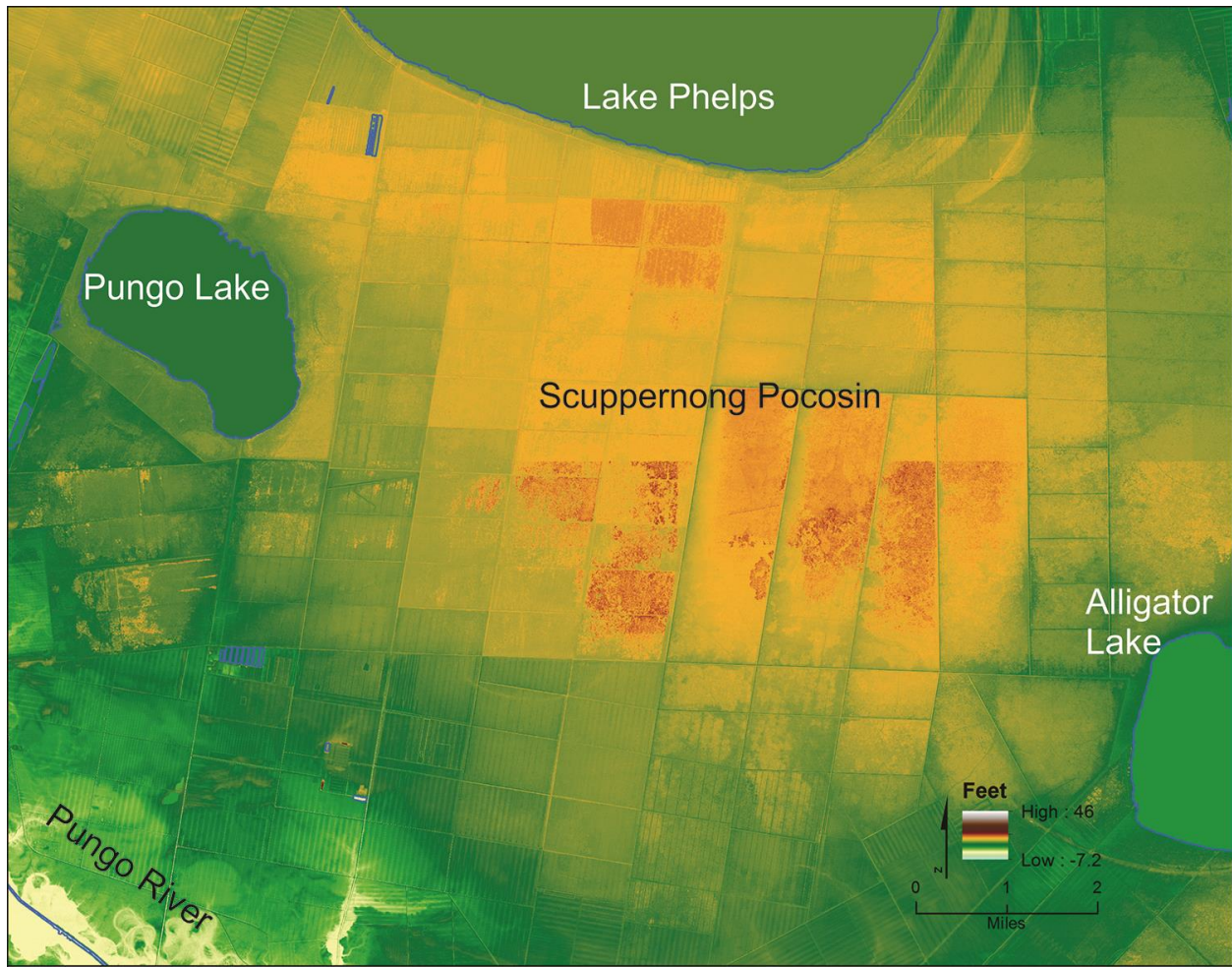


FIGURE B-3. The color topography map shows the Scuppernong pocosin area due south of Lake Phelps. The elevation above mean sea level is as follows: light green to dark green is ~5 to 10 feet; light yellow to orange is ~11 to 15 feet; and red is ~16 to 20 feet. The map shows three scales of ditching. The largest scale or main canals were dug on a 1 mile grid, the secondary set of canals called collector ditches were dug on a ½ mile grid, and the smallest field ditches were dug in the lower elevations for agricultural development on a 330 foot grid. Notice the decline in land elevation immediately adjacent to the two larger scale sets of ditches. Topographic data are from the 2015 North Carolina Floodplain Mapping Program.

3. Recreational opportunities: Paddling and fishing are two forms of recreation that use the creeks of the region. Sports people desire a pristine environment to maximize their experiences. But the creeks of the region are subject to degradation (Figure B-4). Alligator weed can dominate the water in some creeks and prevent easy access. Further, cyanobacterial blooms occur on some creeks. The blooms cover the water with a scum and can be a health hazard. Creeks with and without blooms or alligator weed provide a contrast of how these taxa can limit this service.



FIGURE B-4. Left panel shows a heavy growth of alligator weed blocking a tributary to the Scuppernong River. Right panel shows a blue-green algal bloom within the sediment-rich water of a primary drainage canal flowing from the upstream agricultural lands into the Scuppernong River.

4. Water quality protection: Riparian wetlands and vegetated buffers separating agricultural fields and waterways reduce water pollution (Figure B-5). Both nutrients and sediments can be captured within these buffers. Plants take up both nitrogen and phosphorus. Nitrogen is also removed within the wetlands by being converted to gas via denitrification. Phosphorus is also trapped as vegetation slows surface water movement and particulate sediments drop to the soil surface. The region has sites that can evidence these buffers or not.



FIGURE B-5. Riparian swamp forest vegetation of the riverine floodplains help to limit nutrient and sediment runoff from entering the black-water streams.

5. Habitat: The rich biodiversity of the region is recognized, but the habitat for this biodiversity can be jeopardized in numerous ways. One contrast that exemplifies this jeopardy is edge-of-lake vs sea-level controlled swamp forests (Figure B-6). Accelerated rates of sea-level rise have fostered the death of trees in the latter areas. These “ghost forests” are most easily seen at the edge of the swamps in the sounds and major rivers. Such death is not seen for similar trees bordering the pocosin lakes. Also, many species (see below) reside in upland forests and pocosins. These areas contrast with the agricultural fields that have replaced these areas.

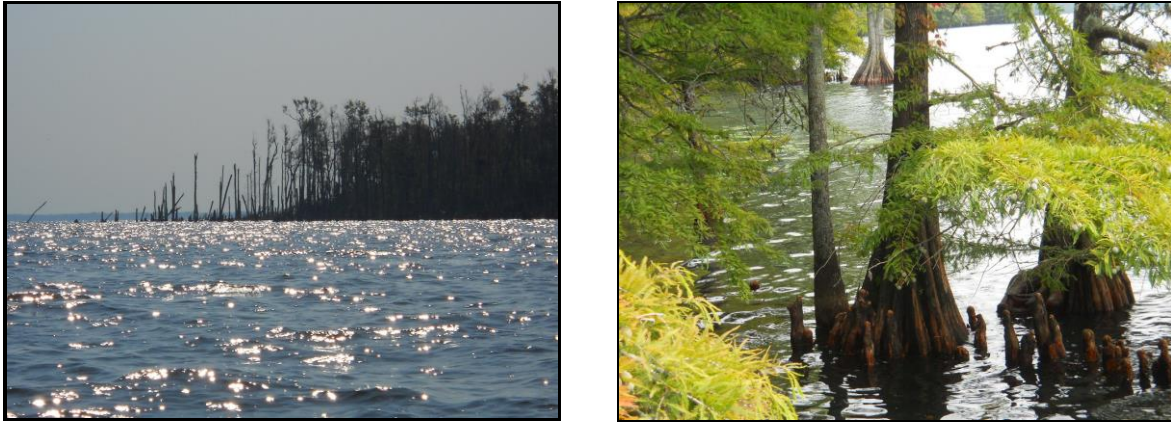


FIGURE B-6. The left panel shows a ghost forest at the edge of a riparian swamp forest resulting from rising sea level that permanently drowns the lower portions of the adjacent uplands. The right panel shows a submerged edge along the shoreline of Phelps Lake. Bald cypress, unlike other swamp forest tree species in the left panel, is capable of with-standing permanent flooding by fresh water.

Biodiversity

North Carolina is ranked ninth in the US in terms of the number of species found within its boundaries (McKerrow et al., 2006). Much of the diversity of vertebrate (excluding fish) species in NC are found within its Coastal Plain as shown in red, pink, purple, and dark blue on Figure B-7. The Scuppernong drainage basin falls within areas of NC that are thought to be particularly diverse (Figures B-7, B-10, B-13, B-14, and B-15), likely due to the high concentration of natural areas managed by Federal (e.g., Wildlife Refuges), State (Pettigrew State Park, NCSU Research Forest), and non-government organizations (The Conservation Fund, etc.).

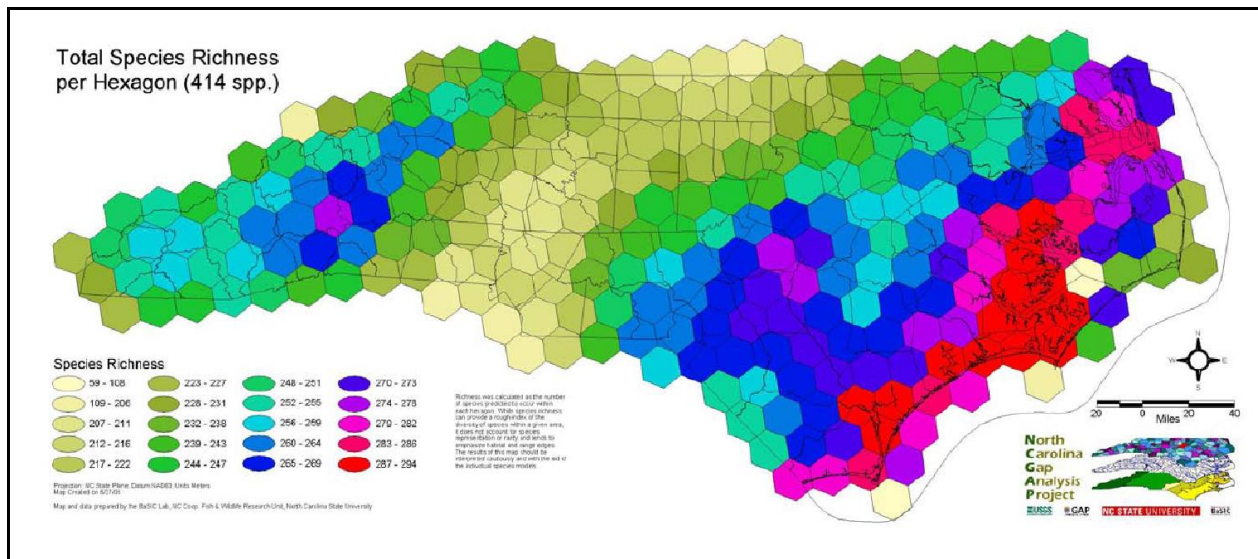


FIGURE B-7. Number of vertebrate species (except fish) expected to be found within North Carolina. Expected numbers are based on the predicted distributions of 414 species that are known to reside/breed in North Carolina. Map is from McKerrow et al. (2006).

The high diversity of vertebrate species within the Scuppernong drainage includes a relatively large number of bird and reptile species (Figure B-8). The waterways of the Scuppernong River and surrounding creeks and lakes provide roosting and foraging habitat for overwintering migratory waterfowl. Hundreds of thousands of birds comprised of approximately 25 species descend on the region in the winter months (November-February). The birds also attract predators; bald eagles and harriers are a common sight in the winter; and golden eagles are spotted occasionally. The Pocosin Lakes NWR has a species list of more than 200 birds overall.



FIGURE B-8. Upper left panel: winter tundra swans; upper right panel: summer osprey with supper; lower left panel: summer American alligator; and lower right panel: summer cane brake or timber rattlesnake. Photographs A and D are by M. Dunn, B and C are from flickr.com.

The diversity of mammals (Figure B-9) and amphibians within the Scuppernong drainage basin is greater than observed in most areas within North Carolina. Much of the diversity of amphibians is represented by frogs and toads which can produce thrilling choruses at night under the correct environmental conditions (warm and rainy nights around May). Furthermore, there are several large (up to 3 feet long) and secretive salamanders (e.g., *Amphiuma* or conger eels, and greater and lesser sirens) that make their home in the swamps, ditches and ponds in eastern NC. Black bears are found across the entire state of NC but they are found in particularly high densities in and around the wildlife refuges in the Scuppernong River drainage basin.



FIGURE B-9. Black bears and river otters are common mammals of the Scuppernong region. Photographs are by M. Dunn.

Areas in and around the Scuppernong drainage basin are home to several species that are currently (red cockaded woodpecker, red wolf, northern long-eared bat, west Indian manatee, red knot) or, until recently (American alligator and bald eagle), listed on the US endangered and threatened species list (Figure B-10). A recently described species of leopard frog is also thought to occur within the Scuppernong River drainage, but this has yet to be officially confirmed.

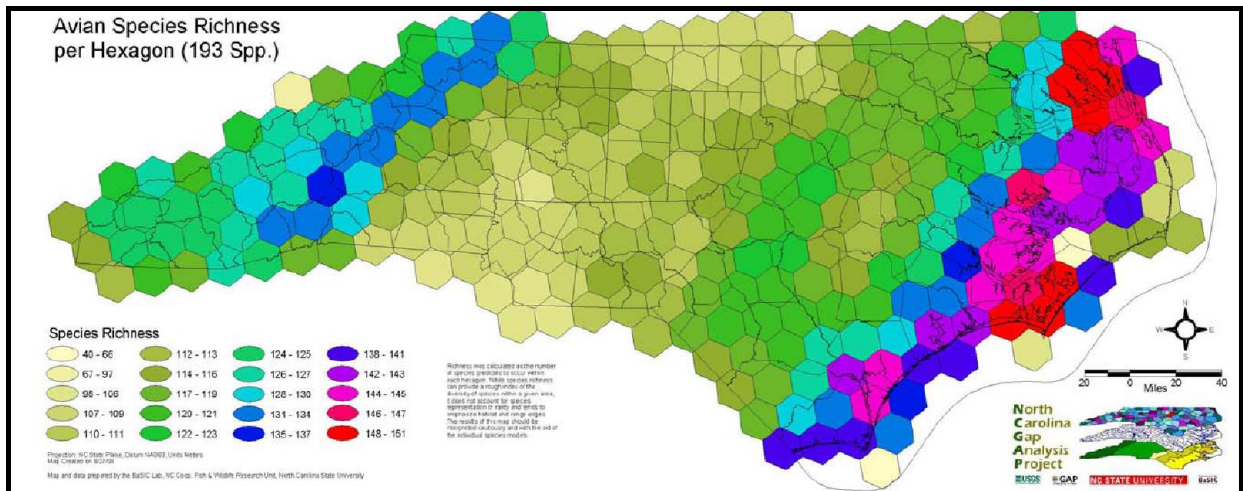


FIGURE B-10. Number of bird species expected to be found in different areas within NC. Expected numbers are based on the predicted distributions of 193 species that are known to reside/breed in NC. Map is from McKerrow et al. (2006).



FIGURE B-11. The formerly endangered bald eagle by E. Hessel and the presently endangered red-cockaded woodpecker by the US Marine Corps.

Two unique kinds of habitat that can support particularly interesting kinds of biodiversity in the Scuppernong drainage basin are pocosins and Carolina bays (Figure B-12). Pocosins are unique habitats found only along the coastal plain from southeastern Virginia, through North Carolina and into South Carolina, with North Carolina encompassing the majority of the area. The vegetation is characterized by a shrubby understory with a scattered pond pine overstory. The ground is covered by a surface of peat (partially decayed organic matter that is nutrient poor) that varies in depth from one to three meters. The shallower peat supports taller vegetation, known as high pocosin. In areas with deeper peat, some plants cannot reach the nutrient rich mineral layer, leading to stunted growth known as low pocosin. Carnivorous plants (several species of pitcher plants, sundews, and bladderworts) thrive in this nutrient-poor environment (Figure B-12). An interesting population of red cockaded woodpecker is found in local pocosins as they prefer to nest in pine trees that occur in areas without a thick over-story of trees.



FIGURE B-12. Left panel shows the typical Scuppernong pocosin vegetation. The right panel shows a classic Carolina bay habitat with abundant yellow pitcher plants (Photograph by K. Cherry in McMullan et al., in press).

Carolina bays are another kind of habitat with a narrow distribution (coastal areas stretching from Delaware to Florida) but occur most commonly in North and South Carolina. Carolina bays are isolated wetlands that occur in elliptical depressions that are generally a few

feet deep with a sandy rim (especially along the northwest and southeast edges). Many Carolina bays only hold water for a portion of a year, but these habitats support a large diversity of animals (especially amphibians, reptiles and birds) and plants. For example, 60% of the rare and threatened plant species found at the Savannah River Ecology Lab in South Carolina are found in Carolina bays. **Thus, the Scuppernong region contains numerous ecosystem types, which in turn possess numerous species across most major taxa. It is truly an undiscovered ecological jewel.**

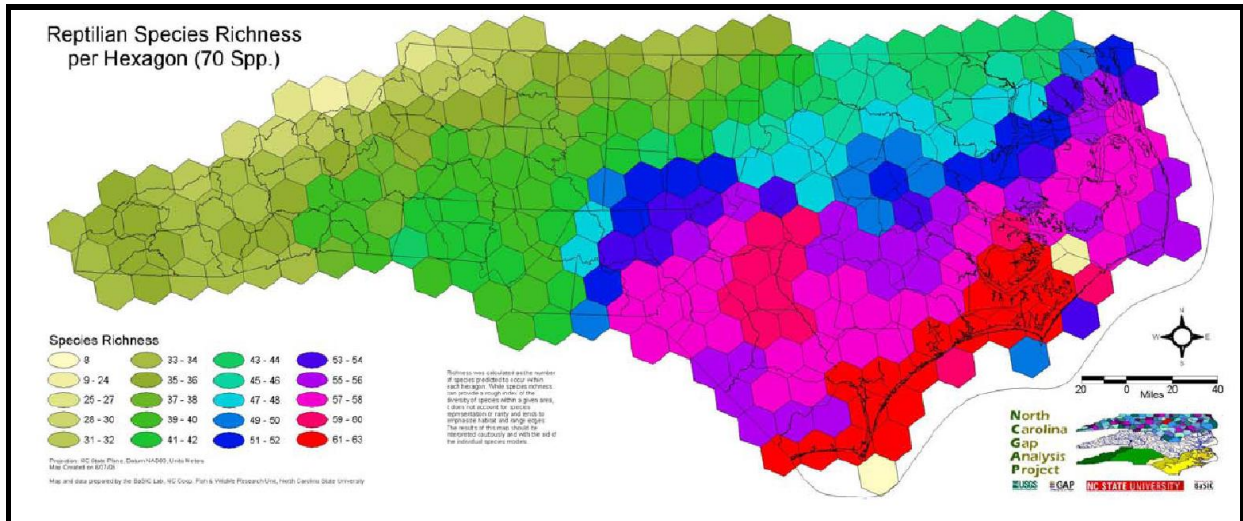


FIGURE B-13. Number of reptile species expected to be found in different areas within NC. Expected numbers are based on the predicted distributions of 70 species that are known to reside/breed in NC. Map is from McKerrow et al. (2006).

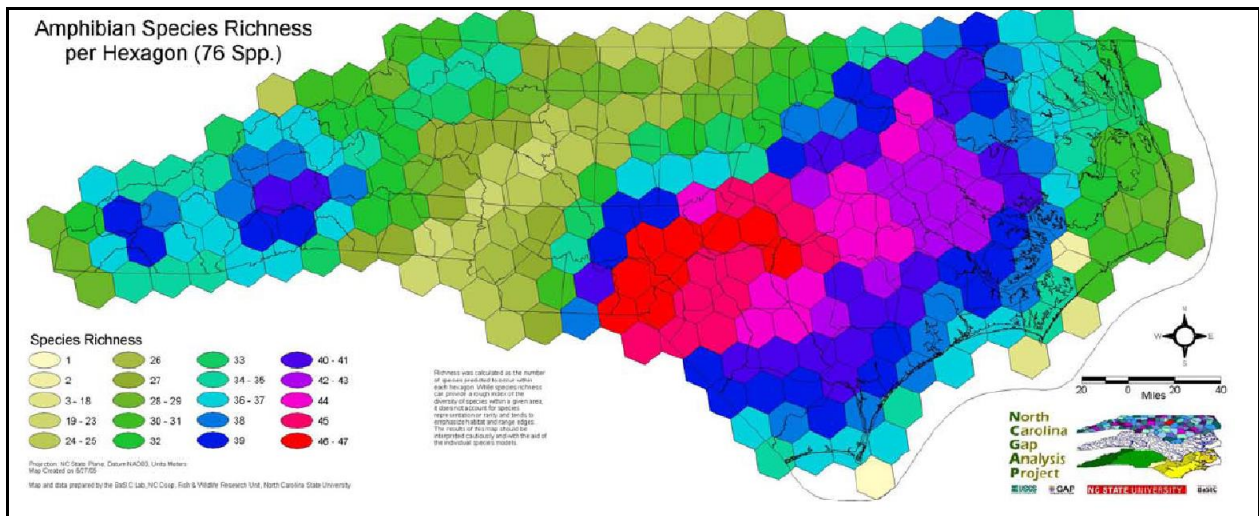


FIGURE B-14. Number of amphibian species expected to be found in different areas within NC. Expected numbers are based on the predicted distributions of 76 species that are known to reside/breed in NC. Map is from McKerrow et al. (2006).

APPENDIX C

NORTH CAROLINA LAND OF WATER (NC LOW)

DEVELOPING A SUSTAINABLE, RESOURCE-BASED ECONOMY IN NORTH CAROLINA'S LAND OF WATER COASTAL SYSTEM IN THE 21ST CENTURY

Visit the NC LOW Website (nclandofwater.org)

NC LOW MISSION STATEMENT

The North Carolina Land of Water (NC LOW) economic initiative in northeastern NC is to undertake activities that will 1) contribute to long-term, sustainable economic development based on the natural resources and cultural history of the region; 2) integrate the diverse areas of the Inner and Outer Banks regions for their mutual benefit; and 3) enhance the quality of life for NC LOW's citizens.

NC LOW COASTAL REGION

The NC LOW program is dependent upon the successful integration of the region's geologic dynamics, biological ecosystems, and the human culture and history (Figure C-1). NC LOW is both a geographic region (Fig. 2) and an economic initiative based upon the unique natural resources and cultural history of the region. The natural and human history of the NC LOW region is a product of the continual interplay of the geological, ecological, and human processes operating within NC's dynamic coastal system. Based upon a recently completed, decade-long \$7 million geologic research program led by East Carolina University and the US Geological Survey, we know that the NC LOW coastal system (Figure C-2) is a complex network of interdependent ecosystems dominated by changes resulting from ongoing processes of climate change, including sea-level rise and recurrent high energy storms. These energetic processes of change have molded North Carolina's human history, continue to significantly impact the present culture, and will have a heavy imprint on our future coastal culture and economy.

NC's LAND OF WATER

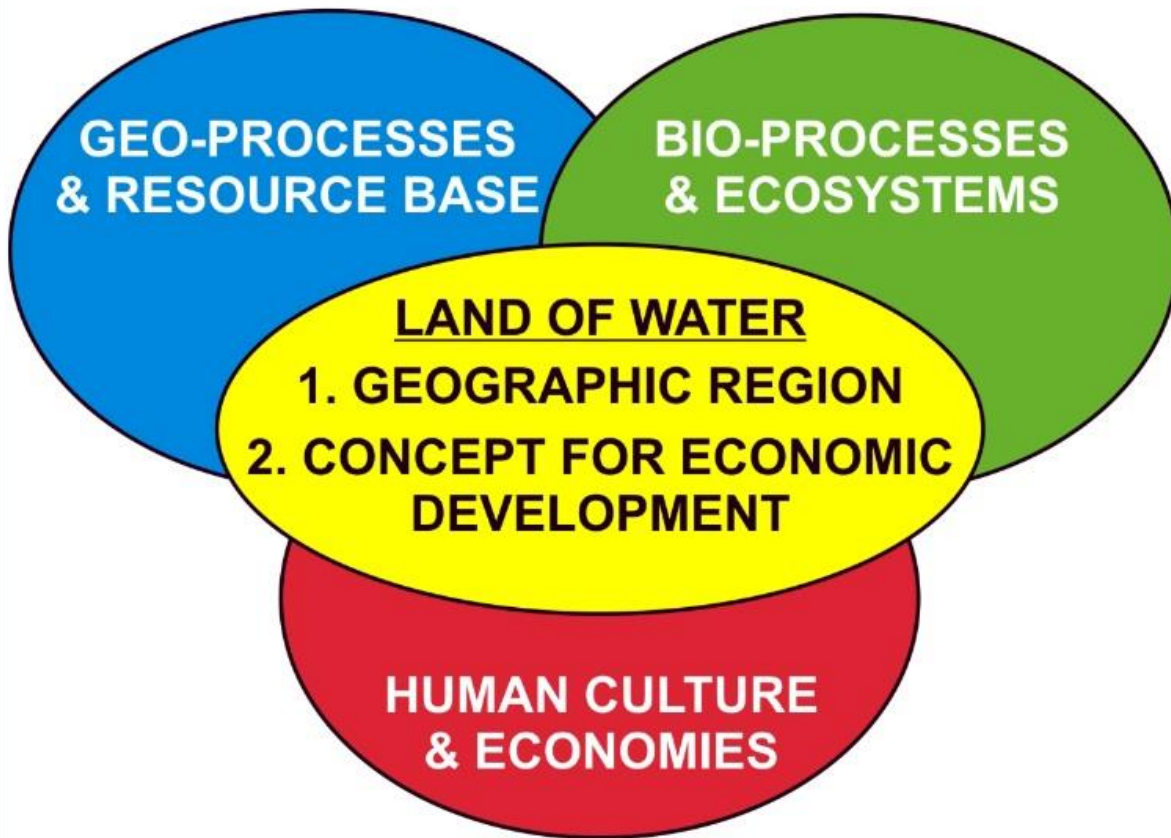


FIGURE C- 1. The figure shows the integration of overlapping components that define North Carolina's NC LOW coastal system.

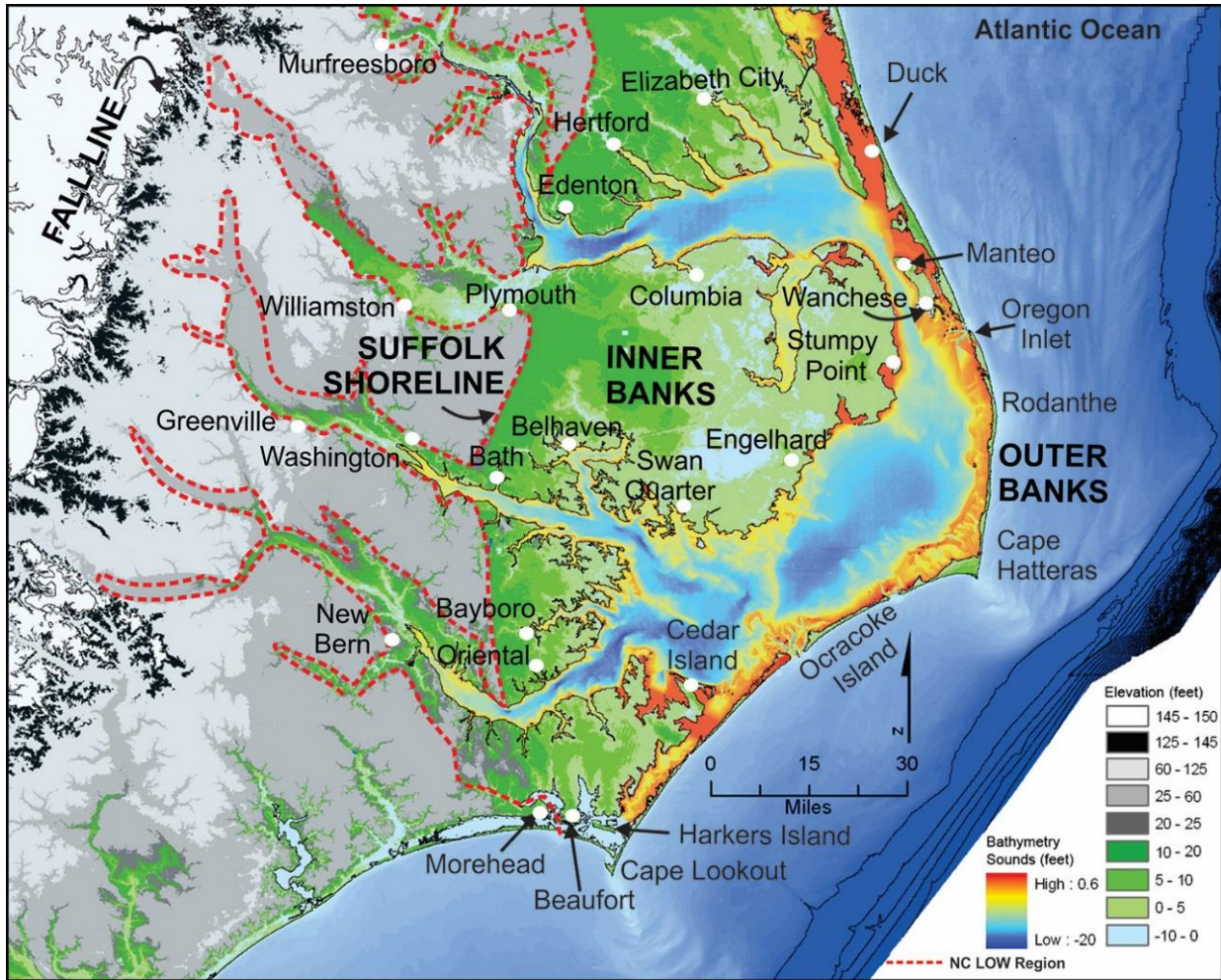


FIGURE C-2. This color topography (land elevation) and bathymetric (water depth) map of the North Carolina Land of Water (NC LOW) coastal system includes the Inner and Outer Banks of northeastern North Carolina. The area defined as NC LOW occurs between the red dashed line (the Suffolk Shoreline and associated river bottoms) on the west and the Outer Banks barrier islands on the east. Land elevations and water depth are color-coded as indicated in the legend. The locations of some major towns are indicated. The black zone (Fall Line) on the western side of the map is the contact between the Piedmont Province (west) and Coastal Plain Province (east). Topographic data are from NC DOT's 2007 LiDAR.

GOALS OF THE NC LOW PROGRAM

Four major goals represent the general framework for the NC LOW initiative. Implementation of these goals will contribute to development of a sustainable, natural resource-based economy for North Carolina's future and improve the quality of life within the NC LOW region by enhancing educational levels and facilitating job creation.

1. INTEGRATE INTERACTIONS BETWEEN REGIONS OF NC LOW COASTAL SYSTEM: Integrate the communities and regions of NC LOW to facilitate economic growth and help build a spirit of common interest.

2. DEFINE NEW NC LOW ECONOMIC INITIATIVES AND STRATEGIES: Identify sustainable economic opportunities that build on the inter-dependence of the region's natural resources and human history and culture.

3. IMPLEMENT NATURAL RESOURCE- AND CULTURAL HISTORY-BASED NC LOW EDUCATIONAL PROGRAMS: Establish mechanisms for developing educational programs that integrate the natural resources and human history and culture of the NC LOW coastal system for the public and K-16 school system, as well as economically driven educational tourism programs.

4. ENHANCE SCIENTIFIC UNDERSTANDING OF NC LOW COASTAL SYSTEM CHANGE: Investigate and monitor critical coastal ecosystems in order to 1) enhance our knowledge base of the coastal dynamics, 2) monitor the components and processes of change, and 3) ensure that both economic and policy decisions have a solid scientific base.