

INVENTORY OF THE NATURAL AREAS
AND RARE SPECIES

OF

BRUNSWICK COUNTY,
NORTH CAROLINA

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SUMMARY

This inventory of the natural areas and rare species of Brunswick County was funded by the North Carolina Natural Heritage Trust Fund, and by a donation from Carolina Power & Light Company.

The purpose of the inventory was to identify the most significant natural areas, describe their features, and document the rare species associated with them. Habitat conditions, natural processes, and threats were also documented. This inventory is intended to provide guidance for land use decisions by the county government, conservation and land management organizations, and interested citizens. Field work was supervised by the North Carolina Natural Heritage Program, and carried out between April 1993 and November 1994. The inventory identifies 62 sites significant at the national, state, or regional level, as determined by criteria established by the Natural Heritage Program.

ACKNOWLEDGMENTS

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INTRODUCTION

OBJECTIVES

The primary objective of the Brunswick County natural areas inventory is to identify areas of outstanding natural significance. These areas contain the best examples of natural habitats and/or locations of rare plants and animals. Natural areas are resources that make North Carolina and its counties attractive to live in and to visit. These areas are critical for their recreational, ecological, educational, scientific, cultural, aesthetic, and environmental health values. Natural areas are reservoirs of biological diversity, sanctuaries for native plants and animals whose survival may be in jeopardy, and key resources for recreational activities. With ongoing population growth and land development in all parts of North Carolina, it is urgent that areas of outstanding natural significance be identified, and that efforts are made to protect these sites through the willing cooperation of land owners.

METHODS AND PROCEDURES

The methods employed in this inventory follow guidelines established by the North Carolina Natural Heritage Program (NHP), an agency in the Division of Parks and Recreation within the Department of Environment, Health, and Natural Resources. NHP maintains the state's primary database for rare plants and animals, high quality natural communities (ecosystem components), and outstanding natural areas.

The focus of the inventory was the identification and description of outstanding natural areas and high quality natural communities. Survey work in 1993 and 1994 also included the identification of rare plant species by the principal investigator, botanist Richard LeBlond. The scope of this inventory did not permit a systematic survey of the animals of Brunswick County during 1993 and 1994, and previous research was consulted for this information. It is anticipated that a systematic survey of rare animals will be conducted in Brunswick County in the near future.

The natural area inventory was designed to identify the highest quality natural areas and natural communities in Brunswick County. A **natural area**, while not necessarily undisturbed, substantially retains the natural character it would have without human influence. It is also an area of biological interest, usually because of a clustering of rare species or of exemplary natural communities, or both. Natural area boundaries are placed to encompass the ecological features of primary interest, and the areas that influence them the most. In some cases there are natural boundaries; in others, an artificial buffer is used. A **natural community** is defined as a distinct and reoccurring

assemblage of plants, animals, bacteria, and fungi naturally associated with each other and their physical environment. A natural area can contain one to several natural community types and sites. Although natural areas and natural communities do not need to contain rare species to be judged of high quality, they usually do. The natural area and natural community inventory also was designed to map locations, assess integrity, and make management recommendations for protection.

According to their size, natural areas are referred to in this report as "megasites," "macrosites," or "standard sites." **Megasites** are large, cohesive areas generally of a size greater than 100 square miles (64,000 acres). **Macrosites** are smaller areas, generally of 5 to 100 square miles (3,200 to 64,000 acres). **Standard sites** typically are smaller than 3,200 acres. Standard sites are usually referred to as "sites" unless greater clarification is needed. Frequently, sites occur in clusters. The occurrence of a site in association with other sites increases its potential long term viability and ecological significance. Such clusters are designated as macrosites or megasites, with the standard sites nested within them. These macrosites and megasites may contain lower quality lands that are not included in a standard site, but which provide ecologically important buffers and corridors.

Criteria used to determine significant sites were (1) the quality and significance of the natural features within an area, and (2) the overall integrity of the area. All natural communities and rare species known to occur within a site were documented, with detailed descriptions made of each exemplary natural community type. All identified sites were then ranked according to biological importance, using criteria developed by the NHP and The Nature Conservancy. Depending upon the global or statewide rarity of the most critical species and natural features at a site, it was ranked as having national, statewide, regional, or countywide significance. This report describes in detail those sites having national, statewide, or regional significance.

In addition to field surveys of known and potential sites, the inventory utilized existing rare species and natural area data maintained by the NHP, topographic quad maps prepared by the U.S. Geological Survey, soil maps prepared by the U.S. Natural Resources Conservation Service (formerly U.S. Soil Conservation Service), and aerial photographs made available by the U.S. Agricultural Stabilization and Conservation Service and N.C. Cooperative Extension Service. Knowledgeable individuals and organizations were also consulted. Report formats developed by the NHP were utilized for documenting rare species and significant natural areas.

GENERAL FEATURES OF BRUNSWICK COUNTY

INVENTORY AREA

The natural areas inventory covered by this report is confined to Brunswick County, North Carolina (Fig. 1). Brunswick County is located at the southeastern corner of the state along the state line with South Carolina. It is bordered by New Hanover County on the east, Pender County on the north, Columbus County on the northwest and west, Horry County in South Carolina on the southwest, and the Atlantic Ocean on the south. At 855 square land miles, Brunswick County is the sixth largest county in North Carolina. As of 1990, the population was 50,985, or 60 persons per square mile (SCD 1991), and approximately 74% of the land surface was forested (Johnson 1990).

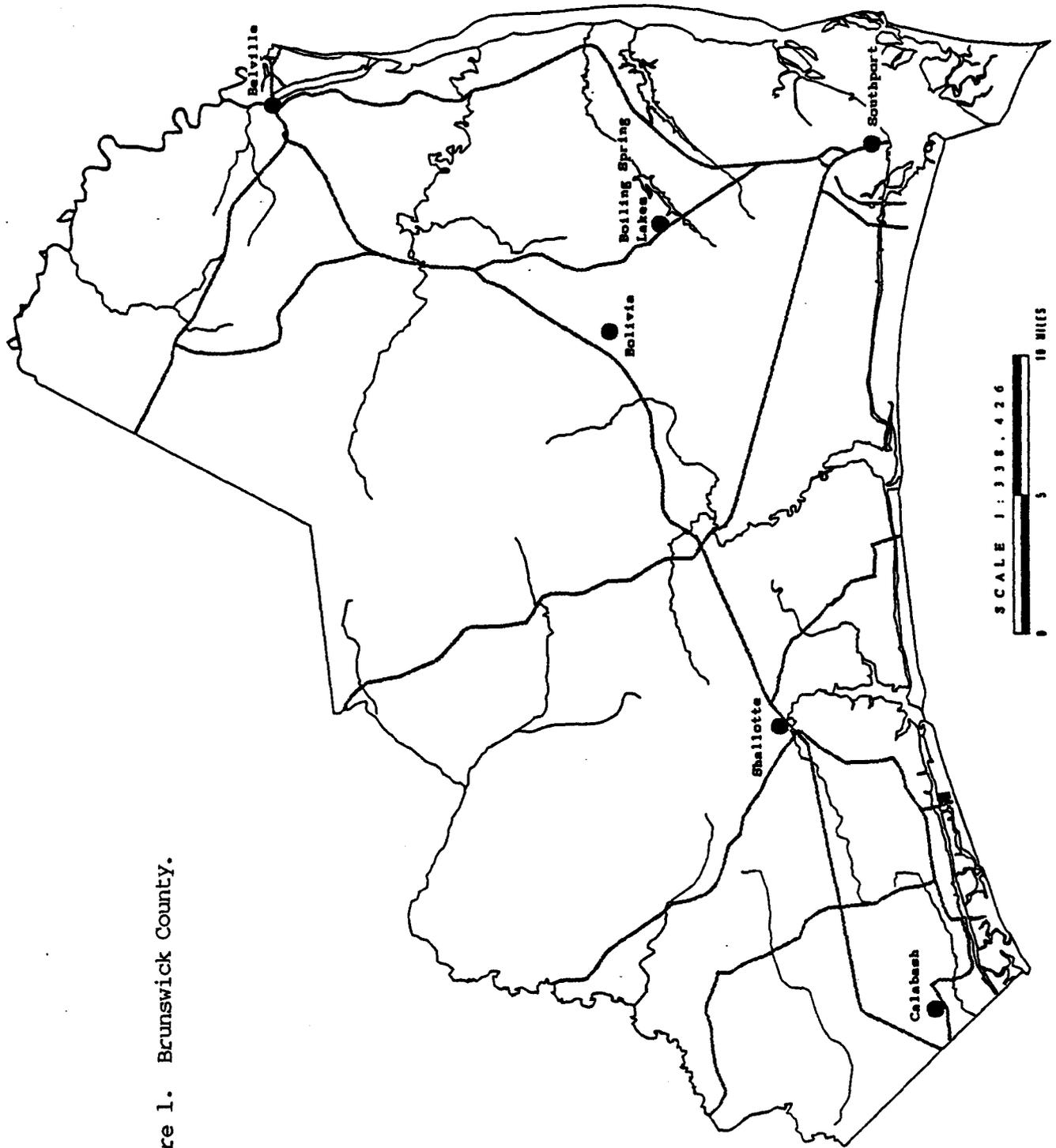
TOPOGRAPHY AND PHYSIOGRAPHY

Mainland Brunswick County is situated in the Coastal Plain Physiographic Province, in the Inner Coastal Plain Region of the Cape Fear Section. The coastal edge of the county is situated in the Barrier Island Region of the Cape Fear Section. The Coastal Plain Province includes all of North Carolina east and southeast of the fall line, which lies northeastward from Richmond County at the South Carolina border to Northampton County at the Virginia border. The fall line marks the boundary between the Coastal Plain and Piedmont provinces. The Cape Fear Section is that area lying southwest of the Cape Fear River and southeast of the fall line. The Inner Coastal Plain Region includes the mainland area of Brunswick County, all of Columbus and Robeson counties, and portions of Bladen, Cumberland, Harnett, Hoke, and Scotland counties.

The elevation gradient in Brunswick County is from sea level to 75 feet. Most of the county is nearly flat, with sharp relief restricted to intermittent bluffs along the Cape Fear and Waccamaw rivers (these bluffs approach 40 feet in elevation along the Cape Fear River). Low slopes are found along stream channels, and rolling terrain is associated with dry sandhill areas, particularly in the eastern part of the county near the Cape Fear River.

The land surface of Brunswick County is characterized by broad, flat terraces of unconsolidated sand, silt, clay, and peat in varying combinations. A significant physiographic feature of the county is the elevated ("domed") peatland. These are areas of extensive pocosin that are among the highest elevations in the county. Green Swamp is the most prominent of these, reaching 70 feet in elevation and covering about one-fifth of the county land surface. It is located north of Supply and extends northward into Columbus County. These peatlands support pocosin communities, and

Figure 1. Brunswick County.



often contain small upland areas or "islands" that support longleaf pine (*Pinus palustris*) communities.

These elevated peatlands are the primary water sources for most of the county's streams, and their elevated position is underscored by the fact that streams outflow in nearly all compass directions. Green Swamp is headwaters for streams flowing northward and eastward into the Cape Fear River, westward into the Waccamaw River, and southward into Lockwoods Folly and Shallotte rivers.

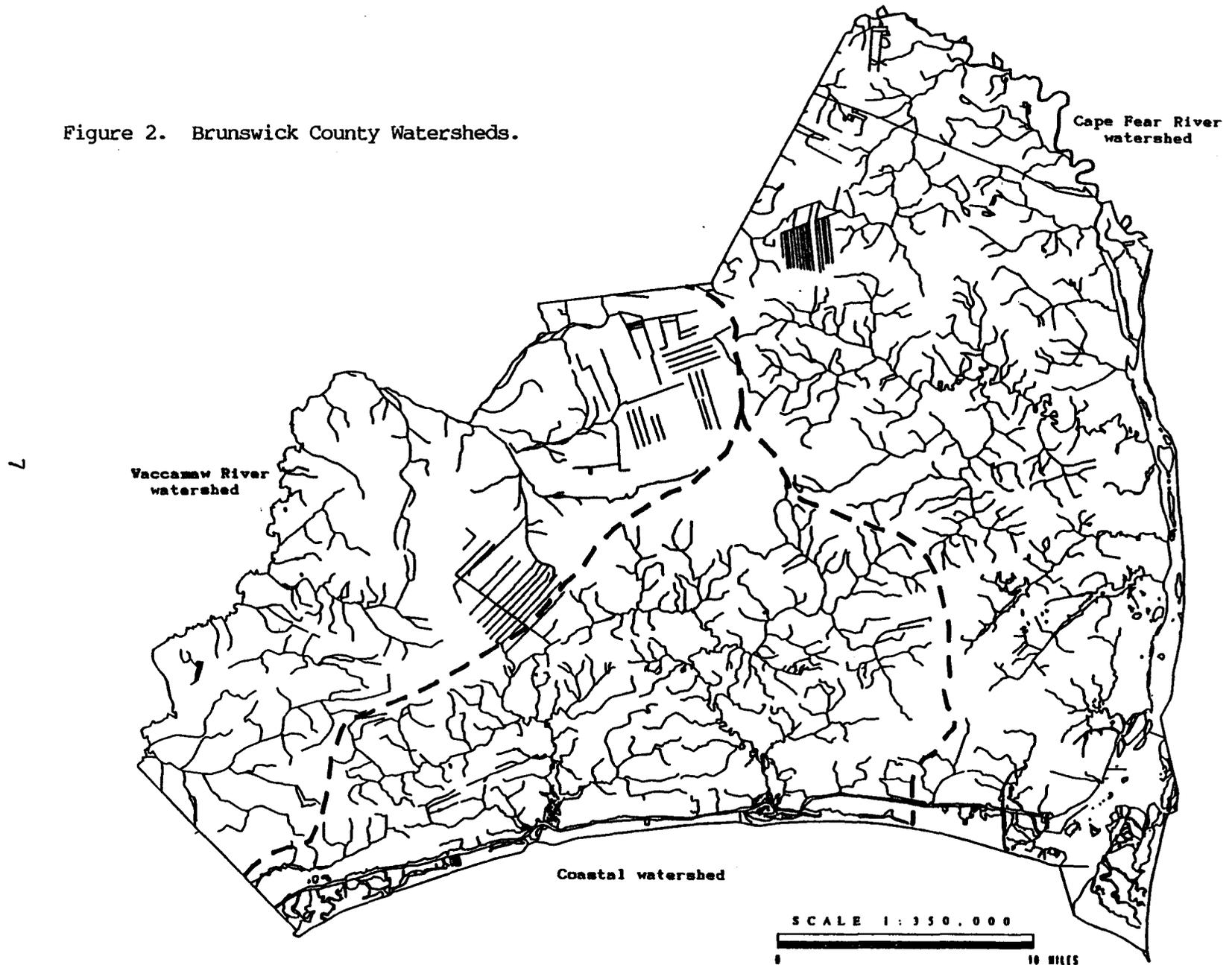
There are three primary watersheds in Brunswick County: the Waccamaw River, Cape Fear River, and Coastal watersheds. The approximate boundaries of these watersheds are shown in Figure 2. Except for the Cape Fear River, which is a brownwater river, all of the rivers and tributaries in Brunswick County are blackwater rivers. Because of its unusual and highly significant nature, the Waccamaw River watershed will be discussed in greater detail.

The Cape Fear River, with headwaters in the Piedmont, forms the northern and eastern boundary of the county. It drains an area approximately bounded by Green Swamp on the west and Boiling Spring Lakes--Wetland Complex along the southwest. The river is tidal for its entire length along Brunswick County, with tidal influence extending upstream into Bladen County. The waters are brackish to saline south of the Campbell Island area, and fresh northward. Major tributaries of the Cape Fear River in Brunswick County are Hood Creek, which originates in Little Green Swamp; Town Creek, with headwaters in Green Swamp; and Allen and Orton creeks, which originate in the Boiling Spring Lakes--Wetland Complex. Extensive areas of freshwater, brackish, and salt marshes occur along the river south from Cartwheel Branch, with tidal swamplands occurring northward (upstream).

The Coastal watershed drains most of the southern portion of the county west of Boiling Spring Lakes and south of Green Swamp. The Lockwoods Folly and Shallotte rivers are the major drainages in the Coastal watershed. The Lockwoods Folly River originates in Green Swamp, but is also fed by tributaries with headwaters in the Boiling Spring Lakes--Wetland Complex. Tidal flow in the Lockwoods Folly River extends upstream from its mouth at Sunset Harbor to near Supply. The tidal waters are brackish to saline south from near the confluence with Sandy Branch, and fresh northward. The Shallotte River originates in peatlands north and south of Grissettown, but is also fed by tributaries with headwaters in Green Swamp. Tidal flow extends upstream to just above the town of Shallotte. Tidal waters are brackish to saline south from near the confluence with Sharron Creek, and fresh northwestward. Both rivers support extensive areas of tidal marshes.

There are several much smaller drainages originating near the coast and flowing southward into the Atlantic Ocean that are not tributaries of the Lockwoods Folly or Shallotte rivers. Most

Figure 2. Brunswick County Watersheds.



prominent among these are Beaverdam Creek west of Southport, with headwaters in Boiling Spring Lakes--Wetland Complex; and Calabash River near Calabash, which flows westward into Little River in South Carolina from its headwaters in the Drowned Bay peatlands.

The Waccamaw River watershed drains the western and southwestern portions of the county. It is approximately bounded by Green Swamp on the east, and by Cawcaw Swamp and its tributaries along the southwest. Major tributaries of the Waccamaw River in Brunswick County include Juniper Creek, Wet Ash Swamp, and Cawcaw Swamp. Juniper Creek and Wet Ash Swamp originate in Green Swamp, and Cawcaw Swamp originates in the Cawcaw Bay peatlands. The Waccamaw River has its source in Lake Waccamaw in Columbus County, from where it flows southward into South Carolina. South from the confluence with Juniper Creek, the river forms the boundary between Brunswick and Columbus counties.

The Waccamaw River floodplain contains several landform features not found elsewhere in the county, and which are unusual for blackwater rivers. The floodplain is very large for a blackwater river, possessing features typically associated with a well-developed brownwater river floodplain (Schafale, et al. 1986). These features include channel bars, point bars and ridges, levees, oxbows, active and relict sloughs, and active and relict ridges and swales. It is believed that the Waccamaw River originated as a brownwater river flowing out of the Piedmont. About 75,000 years ago, an uplift along the Cape Fear Fault resulted in the beheading of the river, and the diversion of Piedmont waters into the Cape Fear River (Zullo and Harris 1979). This theory conforms with the present-day smallness of the Waccamaw River and its extensive floodplain, which is as much as two or more miles wide in areas with features more typical of brownwater rivers.

The physiography of the Waccamaw River and its floodplain varies considerably as it courses downstream from Lake Waccamaw. From the headwaters dam at Lake Waccamaw to near the confluence with White Marsh creek (a distance of about 10 river miles), the river courses through a large swamp complex with little topographic relief. The river bank is low along this stretch, and floodwaters quickly overflow and spread out in the floodplain swamp.

Downstream from the confluence with White Marsh creek, the bank of the Waccamaw River becomes more prominent and the river begins a complex series of meanders that continues into South Carolina. River width, depth, and flow rate become more variable, and flooding of adjacent habitat requires higher flood levels than in the swampy area upstream of White Marsh creek. The floodplain is characterized by terraces formed of ridge-and-swale systems associated with large meanders apparently made by a larger Waccamaw River during its life as a brownwater river. These older ridge-and-swale systems extend as much as a mile or more away from the river on either side. The present, smaller river continues to

create new meanders and smaller ridge-and-swale systems, with these superimposed on the older system. The result is a complex mix of new and old landforms supporting a great variety of natural community types.

There are other topographic features of Brunswick County that in their totality occupy a significant portion of the landscape, and frequently support critical biological communities. These include Carolina bays, relict dune ridges and swales, sandhills, limesink ponds, and features associated with coastal barrier islands.

Carolina bays are elliptical depressions usually oriented along a northwest/southeast axis, and surrounded by a low sand ridge called a bay rim. The size of Carolina bays is quite variable, ranging from a few to thousands of acres. The cause of their formation is still debated, but most appear to be over 100,000 years old. Several bay rims have been altered for agriculture or silviculture, and many bay basins have been ditched and drained. Bays that have not been drained usually support pocosin vegetation. Unaltered bay rims usually support longleaf pine communities. Carolina bays occur in many places in the county, and are very numerous in the Boiling Spring Lakes--Wetland Complex.

Relict dune ridge-and-swale systems formed by an ancient ocean shoreline occur on the mainland in the southern portion of the county. The most prominent example occurs in the Boiling Spring Lakes--Wetland Complex south of Boiling Spring Lakes. In this area, Carolina bays are superimposed on the ridges and swales, indicating that the bays are younger. The ridges and swales form a parallel series of more-or-less straight topographic features running approximately along a northeast/southwest axis. Although the elevational gradient between the ridges and swales is slight (usually 5 feet or less), they are easily distinguished by the different natural communities they support. Relict ridges are usually dominated by longleaf pine communities, and swales are dominated by pocosin or stream swamp.

Sandhills occur on the mainland in areas where relict dunes have been reshaped by wind and erosion, and occasionally by collapse of subterranean limestone deposits (see discussion of ponds below). They are characterized by gently rolling terrain and very dry (xeric) sandy soil, and support longleaf pine communities that are naturally low in species diversity. Depressions in sandhill areas frequently support wetland communities. The largest area of sandhills in the county occurs in the vicinity of highway NC 133 west of the Cape Fear River.

Limesink ponds occur where subterranean deposits of limestone have been dissolved by water, resulting in a collapse of overlying sand deposits. Wherever the surface collapse zone intercepts the water table, a pond forms. Limesink basins that only intersect the water table at its highest levels form vernal pools. These ponds support

a very diverse plant and animal community. They frequently occur in sandhill areas, but also occur on other landforms. Brunswick County contains one of the largest concentrations of Coastal Plain ponds between Massachusetts and Florida. The majority of ponds are located in the southeastern portion of the county within a 6-mile radius of Boiling Spring Lakes, where both the namesake spring and the ponds are evidence of unusually active ground water action in limestone.

One of the most complex and ecologically sensitive features of Brunswick County is the series of barrier islands located along the Atlantic shore. These islands are formed by shoreline transport and deposition of river sediments, and are by nature dynamic and constantly changing landforms. The islands often are separated by inlets associated with the mouths of rivers. Extensive marshes form in the protected tidal areas behind the islands, which is where the Intracoastal Waterway is located. The islands themselves contain a number of topographic features, including accreting spits, beaches, a usually continuous foredune, dune ridge-and-swale systems, irregular interior dune systems, sand flats, and interdune ponds. The barrier islands provide critical protection for mainland areas from erosion and storm damage. Because of their spectacular setting, these islands have been heavily developed residentially, which has impaired their natural protective functions.

Other important but smaller topographic features of Brunswick County include islands in the Cape Fear River, stream impoundments, and steep bluffs along the Cape Fear River. The Cape Fear River islands, several of which were created by dredge spoil deposition, provide nesting habitat for several coastal bird species. Prominent among these is Battery Island near the mouth of the river. Stream impoundments have created lake-size water bodies that provide important habitat for rare birds, reptiles, and mollusks. The largest of these impoundments are Orton Pond and Boiling Spring Lake. Steep, cliff-like bluffs occur along the Cape Fear River east of the Columbus County line. These bluffs contain limestone outcrops, and small areas are kept constantly moist by groundwater seepage. One of these bluffs supports the only county occurrence of the Piedmont/Coastal Plain Acidic Cliff natural community, the best example of this community type on the Coastal Plain.

GEOLOGY AND SOILS

The geology of Brunswick County is characterized by unconsolidated sand overlying layers of clayey sand and weakly consolidated marine shell deposits (coquina limestone known locally as "marl"). These sediments were deposited and reshaped during several cycles of coastal emergence and submergence from the Cretaceous period to the present. Wind and water have worked these deposits into the

current landforms. The Brunswick County landscape is dominated by broad, mostly flat interstream terraces. Other prominent geological features include numerous Carolina bays, rolling sandhills, relict dune ridges and swales, barrier islands, and landforms associated with the Waccamaw River floodplain.

Soil characteristics are among the most critical factors in determining natural community distribution and composition. Natural communities are directly influenced by soil chemistry, moisture, and texture. Many of the county's rarer natural community types are restricted primarily because of their association with uncommon soil types. Soils in Brunswick County range from nearly pure sand on dry ridges, bay rims, and sandhills, to organic mucks in pocosin and floodplain swamps. Soils on upland terraces typically are a mixture of sand and peat, and range from sandy to loamy textures. The only exposed rock in the county is coquina limestone ("marl"), which occurs on bluffs along the Cape Fear River. However, limestone is near the surface in some areas, where it influences biotic communities by reducing the acidity typical of most Brunswick County soils. These limestone-influenced soils support one of the rarest and most significant natural communities in North Carolina, the Pine Savanna Very Wet Clay Variant.

The moisture content of soil is particularly critical in determining the distribution of natural communities. Soil moisture is influenced by topography, substrate composition and texture, and elevation above groundwater. In concert with other factors such as fire, soil moisture influences natural community structure and composition. The majority of remaining natural community sites in Brunswick County occur on wet soils. This is primarily due to the conversion of drier sites to pine plantations and cropland.

CLIMATE

Brunswick County experiences hot and humid subtropical summers and cool, temperate winters with subfreezing periods. Snowfall is rare, averaging less than 1 inch per year. According to data recorded from 1951 to 1979 at Southport, the annual average temperature is 63.1°. Average temperature is highest in July (79.5°), and lowest in January (45.2°). The average daily maximum temperature in summer is 86°. The annual average precipitation in Southport is 54.81 inches, with 52% (29.03 inches) falling from May to September (Barnhill 1986).

The mild winters may be the primary influence resulting in the affinity of the plants and animals of Brunswick County with the southern Atlantic and Gulf Coast coastal plains. Many species are at their northern limit in southeastern North Carolina.

LAND USE

Approximately 74% of the land surface in Brunswick County is forested, and divided about equally between small woodlots and large tracts owned by paper companies. About 98% is privately owned. Of the forested land, about 57% is dominated by pine (Pinus spp.). Swamps contain about 24% of the forested land, with oaks (Quercus spp.), gums (Nyssa spp.), and cypresses (Taxodium spp.) dominating. The remaining forested land is mostly dominated by oak and pine or oak and hickory (Carya spp.) (SDC 1991; Johnson 1990). Although figures are not available, much of the forested land is managed for timber production. About 10% of the county is cropland, with corn, tobacco, and soybeans the main crops. The remainder of the land surface is beaches, marsh, and urban and industrial areas (Barnhill 1986).

NATURAL COMMUNITIES

A natural community is defined as a distinct and reoccurring assemblage of populations of plants, animals, bacteria, and fungi naturally associated with each other and their physical environment. A natural community thus combines biological and habitat elements. Only land in an approximately natural state is classified as a natural community. For example, the many loblolly and slash pine plantations in Brunswick County are not regarded as natural communities, as they are quite different from the communities that would have occurred under natural conditions. Natural community names and classification as used here are from Schafale (1994) and Schafale and Weakley (1990).

Natural communities are closely associated with specific soil types, which in turn are associated with physiography. For descriptive purposes, the natural communities are here grouped by the prominent physiographic features with which they most frequently occur in Brunswick County. The exceptions to this are the longleaf pine communities, which occur over a spectrum of wet-to-dry soil types, and are grouped together because of their strong biological and ecological relationships. The natural communities occurring in Brunswick County are, in order of discussion:

Maritime Communities

- Dune Grass
- Interdune Pond
- Maritime Evergreen Forest
- Maritime Shrub
- Maritime Wet Grassland
- Upper Beach

Tidal Wetland Communities

- Brackish Marsh
- Salt Flat
- Salt Marsh

Tidal Cypress--Gum Swamp
Tidal Freshwater Marsh

Mainland Coastal Edge Forests

Calcareous Coastal Fringe Forest
Coastal Fringe Evergreen Forest

Longleaf Pine Communities

Coastal Fringe Sandhill
Mesic Pine Flatwoods
Pine Savanna
Pine/Scrub Oak Sandhill
Wet Pine Flatwoods
Xeric Sandhill Scrub

Pocosin Communities

Bay Forest
High Pocosin
Low Pocosin
Pond Pine Woodland
Small Depression Pocosin

Blackwater River and Stream Floodplains and Low Terraces

Aquatic Community (Blackwater Subtype)
Coastal Plain Bottomland Hardwoods (Blackwater Subtype)
Coastal Plain Small Stream Swamp (Blackwater Subtype)
Cypress--Gum Swamp (Blackwater Subtype)
Cypress Savanna
Oxbow Lake
Sand and Mud Bar

Brownwater River Floodplain and Low Terraces

Coastal Plain Levee Forest (Brownwater Subtype)

Impoundments, Ponds, and Pools

Coastal Plain Semipermanent Impoundment
Small Depression Pond
Vernal Pool

Upland Hardwoods

Dry-Mesic Oak--Hickory Forest
Mesic Mixed Hardwood Forest (Coastal Plain Subtype)

River Bluff

Piedmont/Coastal Plain Acidic Cliff

Special Animal Habitats

Gull*Tern*Skimmer Colony
Osprey Nesting Area
Wading Bird and Shorebird Foraging Area
Wading Bird Rookery

Artificially Disturbed Habitats

roadside and powerline savannas

Maritime Communities

Maritime communities occur where there is a direct oceanic influence, such as salt spray and storm overwash (tidally influenced areas are treated separately as tidal wetland communities below). They occur on barrier islands and small areas of the mainland edge primarily near river mouths. These communities have adapted to a very dynamic area and endure considerable natural stress. Naturally limited, these communities have been further reduced by commercial and residential development.

The **Dune Grass** natural community occurs on the line of foredunes just behind the ocean beach, and on unstable sand dunes farther inland on barrier islands. The loose, shifting sand with its low water holding capacity and low nutrient reserves makes these environments habitable by only a handful of specialized plant species. Sea oats (Uniola paniculata) usually dominates.

The **Interdune Pond** is a freshwater pond community occurring on barrier islands. These ponds are geologically young and potentially subject to sand dune movement or salt water flooding, as well as salt spray. In Brunswick County, this community is characterized by areas of open water within emergent tall marsh vegetation dominated by such species as black needlerush (Juncus roemerianus), southern cattail (Typha domingensis), salt-marsh bulrush (Schoenoplectus robustus), and salt grass (Distichlis spicata). Common reed (Phragmites australis), an invasive and aggressive large grass, has also become a dominant in this habitat.

Maritime Evergreen Forest is found in sheltered, sandy upland areas of barrier islands, and is characterized by a well-developed canopy typically dominated by live oak (Quercus virginiana), sand laurel oak (Q. hemisphaerica), and loblolly pine (Pinus taeda). Cabbage palm (Sabal palmetto), rare in North Carolina, is a distinctive component of maritime forests in the Cape Fear area. Canopy height and community composition are restricted by such maritime influences as wind-born salt spray, and hurricanes can be particularly destructive. However, these are natural disturbances to which the community has adapted over time.

Maritime Shrub is characterized by distinctive scrubby, woody growth found on stabilized sand dunes, in drier dune swales, and on sand flats. The species composition is similar to that of the Maritime Evergreen Forest, but the stature of the Maritime Shrub community is lower, the stunted canopy trees typically not exceeding 15 feet in height. Live oak and coastal red cedar (Juniperus virginiana var. silicicola) are frequent dominants, with an understory formed by wax-myrtle (Myrica cerifera var. cerifera) and yaupon (Ilex vomitoria). Wax-myrtle sometimes forms pure

stands. This community occurs in areas that are more exposed than areas in which Maritime Evergreen Forest is found.

Maritime Wet Grassland occurs on low sand flats or in dune swales where the freshwater table is at or close to the surface for at least part of the year. Some areas may be flooded for substantial periods, and seawater overwash can occur. This community is densely vegetated by herbs, and has a high species diversity. Prominent species include fimbriies (Fimbristylis spp.), duneslack muhly (Muhlenbergia filipes), small whitetop sedge (Rhynchospora colorata), and three-square (Schoenoplectus pungens). This community occurs in small, scattered areas on barrier islands and the mainland coastal edge. It is extremely limited in Brunswick County, and has not been found in any of the identified standard sites described in this report.

Upper Beach occurs above the mean high tide line along the intertidal beach. This area is inundated only during spring tides and storm tides, but is moistened by salt spray between periods of inundation. The environment is very harsh for plants, with almost constant salt spray and with periodic flooding and reworking of sand during storms. A few, mostly annual, salt-tolerant herbs occur as sparse patches and scattered individuals on the sand, but they are instrumental in the formation of new dunes. Prominent species are sea rocket (Cakile edentula), seabeach sandmat (Chamaesyce polygonifolia), Carolina beach-thistle (Salsola caroliniana), and seabeach orach (Atriplex arenaria). The Upper Beach is a very dynamic community dependent on natural disturbance, and quickly succeeds to the Dune Grass community if protected from tidal and storm influences.

Tidal Wetland Communities

These communities occur in areas that are protected from oceanic wave action. They are found in areas regularly flooded during the normal tide cycle, and in areas that are intermittently flooded by wind-driven and spring tides. They are most abundant on low flats between the mainland and barrier islands, and along the shores and marsh islands of rivers with tidal flow: the Cape Fear, Lockwoods Folly, and Shallotte rivers. River tidal flow is extensive, with tidal influence extending up the Cape Fear River into Bladen County. Town Creek, a Cape Fear River tributary, experiences tidal flow for 20 or more creek miles. Tidal wetland communities are directly influenced by water salt content. Salt decreases upstream, and there are extensive stretches of river and creek tidal flow where the water is fresh, permitting the growth of tidally influenced forests and freshwater marshes. The relative position of these communities, moving from saltier to fresher waters, is: Salt FlatóSalt MarshóBrackish MarshóTidal Freshwater MarshóTidal Cypress--Gum Swamp. Because of gradual rising sea level these communities may be imperceptibly migrating upstream.

Brackish Marsh occurs in areas where tidal waters are partly diluted by fresh water, and are most abundant along the lower reaches of the rivers. Because of the salt influence, they are low in plant diversity, with black needle rush (Juncus roemerianus) typically dominating large areas. Salt meadow cordgrass (Spartina patens), giant cordgrass (S. cynosuroides), and sawgrass (Cladium jamaicense) often form large colonies, and a variety of smaller plants may occur in openings.

Salt Flat occurs in fairly small areas of slight depressions at the upper edge of salt or brackish marshes. Salt water floods these areas only occasionally. Once flooded, the water is trapped in the depression and evaporates, leaving salt concentrated in the soil. Vegetation is usually a sparse collection of extremely salt-tolerant plants such as salt grass (Distichlis spicata) and glassworts (Salicornia spp.). The centers of the depressions may be completely barren.

Salt Marsh occurs where tides regularly flood an area with undiluted sea water. This environment of repeated flooding and exposure and high salt levels is habitable by only a few plant species, but is very fertile and among the most biologically productive habitats in nature. Saltmarsh cordgrass (Spartina alterniflora) is always the dominant plant in this community, with few other plant species present.

Tidal Cypress--Gum Swamp occurs in freshwater tidal areas of rivers and large creeks. The community is dominated by swamp black gum (Nyssa biflora), water tupelo (N. aquatica), baldcypress (Taxodium distichum), and pondcypress (T. ascendens). Water ash (Fraxinus caroliniana) and Carolina red maple (Acer rubrum var. trilobum) are the dominant understory trees, and shrub and herb layers are usually sparse and low in diversity, but can be dense in canopy openings. This community is susceptible to canopy die-off from episodes of storm-driven saltwater intrusion.

Tidal Freshwater Marsh occurs in tidal areas with minute or no salt influence. It is most abundant in upstream tidal areas of the Cape Fear River, Town Creek, and Lockwoods Folly River. The vegetation is generally strongly zoned, with larger grasses and grass-like plants dominating patches. Two variants of this community are recognized: the Oligohaline Variant and the Freshwater Variant. The Oligohaline Variant, as its name indicates, has a very small amount of salt present in the water (much less than in the Brackish Marsh). Typical patch dominants are sawgrass, cattail (Typha spp.), and giant cordgrass. The Freshwater Variant has no salt present during the normal tide cycle. Dominant species include lanceleaf arrowhead (Sagittaria lancifolia), georgia spider-lily (Hymenocallis crassifolia), pickerelweed (Pontederia cordata), and green arrow-arum (Peltandra virginica). Tidal Freshwater Marsh has the highest species diversity of the tidal wetland communities, and some zones, particularly in the Freshwater Variant, are dominated by large, showy wildflowers. In some areas of the Lockwoods Folly

River and a few tributaries of the Cape Fear River, this community occurs with an impoverished cypress--gum canopy, which may indicate the gradual replacement of Tidal Cypress--Gum Swamp by Tidal Freshwater Marsh.

Mainland Coastal Edge Forests

Mainland coastal edge forest communities occur on flats and low hills near the coastal edge. They are similar to the Maritime Evergreen Forest found on barrier islands, but generally have a higher species diversity because their locations are more protected from the effects of salt spray. These forests, naturally uncommon, have been greatly reduced by coastal commercial and residential development.

Coastal Fringe Evergreen Forest occurs on moist sandy soil and is characterized by a canopy dominated by sand laurel oak, live oak, and loblolly pine. Common understory species include wild olive (Osmanthus americana), swamp red bay (Persea palustris), American holly (Ilex opaca), and yaupon. The shrub layer is often dense, and woody vines frequently are abundant. Herbs generally are sparse and low in diversity. This community is rare, and may be one of the most imperiled community types in the state.

Calcareous Coastal Fringe Forest occurs on mesic to dry-mesic sandy soil with a high shell content, which provides a calcareous influence. The forest canopy is diverse, with sand laurel oak, tuliptree (Liriodendron tulipifera), Carolina basswood (Tilia americana var. caroliniana), and native southern magnolia (Magnolia grandiflora) prominent. This community type is extremely rare and known from only two sites. The Brunswick County site has been decimated by recreational and residential development.

Longleaf Pine Communities

Longleaf pine communities occur on wet-to-dry sandy or sandy-loam soils. They once were the dominant natural forest types in the county. All of these communities are adapted to and maintained by frequent low intensity fire. Two of the dominant plants--longleaf pine (Pinus palustris) and wiregrass (Aristida stricta)--are dependent on fire for reproduction. Sustained periods without fire lead to development of a dense shrub understory, suppression of the herb layer, and buildup of the fuel load. The wetter communities (Pine Savanna, Wet Pine Flatwoods) have a much high herb diversity than the drier communities (Coastal Fringe Sandhill, Xeric Sandhill Scrub).

Coastal Fringe Sandhill occurs in dry sandy areas, primarily on rolling sandhill terrain and relict beach ridges. It is usually found within a few miles of the coast. The community is distinguished by a scrub oak subcanopy beneath the longleaf pine

canopy. Sand live oak (Quercus geminata) is the most frequent dominant, and turkey oak (Q. laevis) and sand laurel oak are often prominent. The shrub and herb layers are usually open to sparse, although the shrub layer can become dense without fire.

Mesic Pine Flatwoods occurs on moderately well-drained sandy soil. The most prominent remnants in Brunswick County are on upland rises in Green Swamp, where the community grades downslope to Pine Savanna and pocosin communities. Mesic Pine Flatwoods is characterized by an open canopy of mixed-age longleaf pine over a low shrub and moderately diverse herb layer. Wiregrass dominates the herb layer, and bracken fern (Pteridium aquilinum) often forms patches. Legumes (Fabaceae) and composites (Asteraceae) are often an important component of the herb layer. Because of the suitability of mesic soils for cropland, the Mesic Pine Flatwoods community has become very rare in North Carolina. The occurrences of this community in Brunswick County belong to the Coastal Plain Variant.

Pine Savanna occurs in flat areas that are saturated or even slightly flooded during the wetter parts of the year. Although longleaf pine usually dominates the canopy, pond pine (Pinus serotina) is often prominent and can be locally dominant. The herb layer is dominated by grasses and sedges, most typically wiregrass and Carolina dropseed (Sporobolus sp. 1). The herb layer usually contains many showy composites, orchids, and insectivorous plants. Southeastern North Carolina Pine Savannas have among the highest species diversity values at fine scales in temperate North America. More rare species are associated with Pine Savannas than any other community type in the state. Three Pine Savanna variants occur in Brunswick County: Wet Spodosol, Wet Ultisol, and Very Wet Clay. The Wet Spodosol Variant occurs on sandy soils and often exhibits a pocosin influence in its flora. The Wet Ultisol Variant occurs on loamy or clayey soils, and its flora indicates a broader moisture range than that for the Wet Spodosol Variant. The Very Wet Clay Variant occurs on clayey soils usually or always underlain by limestone ("marl"), and pondcypress can be prominent in the canopy. The herb layer is dominated by wireleaf dropseed (Sporobolus teretifolius) and Carolina dropseed. The Pine Savanna Very Wet Clay variant is extremely rare, known only from two small areas located along the Brunswick/Columbus and Onslow/Pender county lines.

Pine/Scrub Oak Sandhill occurs on well-drained sandy soil, and is characterized by an open longleaf pine canopy over a moderate to sparse mixed oak subcanopy. In the Brunswick County example, bluejack oak (Quercus incana) is the subcanopy dominant, and turkey oak is prominent. Sand laurel oak and sand post oak (Q. margarettae) are also present. The ground layer is moderately dense, with deerberry (Vaccinium stamineum) a prominent shrub, and wiregrass the herb dominant. This community type is known from a single occurrence in Brunswick County, which belongs to the Mixed Oak Variant.

Wet Pine Flatwoods resemble Pine Savannas in general structure, with an open pine canopy over a grassy ground cover with low shrubs when frequently burned. It typically occurs on flat areas that are not as wet or fertile as those that support the Pine Savanna. Longleaf pine is usually the dominant canopy tree, although loblolly pine can be prominent to dominant. Wiregrass is always the dominant herb, but herb diversity is lower than that found in Pine Savannas. Shrubs become dense if fire is excluded. Two variants of the Wet Pine Flatwoods community occur in Brunswick County: the Wet Spodosol Variant occurs on sandy soils, and the Wet Ultisol Variant occurs on loamy or clayey soils.

Xeric Sandhill Scrub occurs on the deepest and driest infertile sands of sandhills and ridges. It is distinguished by an open longleaf pine canopy over a scrub oak subcanopy dominated by turkey oak, with other scrub oaks few in number or absent. The shrub layer is usually sparse, and the herb layer is sparse to dense. Wiregrass and lichens often are the ground layer dominants. Most occurrences of this community in Brunswick County belong to the Coastal Fringe Variant, which frequently occurs with the Coastal Fringe Sandhill natural community, and is transitional to it.

Pocosin Communities

Pocosin communities are found on nearly flat, poorly drained areas and in large, shallow depressions such as Carolina bays. Peat deposits develop where the soil is saturated for long enough periods that organic matter cannot completely decompose. Once peat has developed, it acts as a sponge, raising water levels in the soil. Without decomposition, plant nutrients are tied up in organic matter and the soil is extremely infertile and acidic. The natural community types are determined by variation in wetness, depth of peat, and fire dynamics.

Bay Forest is found on saturated to seasonally flooded organic soils along the upper reaches of creeks draining large peatlands. It is characterized by a canopy dominated by loblolly bay (*Gordonia lasianthus*), sweetbay (*Magnolia virginiana*), swamp red bay, Carolina red maple, Atlantic white cedar (*Chamaecyparis thyoides*), pond pine, and swamp tupelo. The dense shrub layer includes fetterbush (*Lyonia lucida*), titi (*Cyrilla racemiflora*), maleberry (*Lyonia ligustrina*), and gallberry (*Ilex coriacea*).

High Pocosin occurs on saturated to seasonally flooded peats up to 1.5 meters deep in the interior portions of domed peatlands, and in larger peat-filled Carolina bays. It is distinguished by a dense shrub layer typically from 1.5 to 3 meters tall. Dominant shrubs include titi, fetterbush, and inkberry (*Ilex glabra*). Blaspheme-vine (*Smilax laurifolia*) is abundant, and honeycups (*Zenobia pulverulenta*) is often prominent following fire. Trees are also present, but are too scattered to form a canopy. The most common

trees are pond pine, swamp red bay, sweetbay, and loblolly bay. Herbs are sparse to absent.

Low Pocosin occurs on the deepest saturated to seasonally flooded peats in the interior of large domed peatlands and the largest peat-filled Carolina bays. Low Pocosin is distinguished by a dense shrub layer usually less than 1.5 meters tall. Dominant shrubs include honeycups, fetterbush, and titi. Blaspheme-vine is often abundant, and scattered, stunted trees are also present. Also occurring within the Low Pocosin habitat are pools and channels of open water that support such plants as leatherleaf (Chamaedaphne calyculata), Virginia chainfern (Woodwardia virginica), and yellow pitcher plant (Sarracenia flava). Herbs are otherwise sparse.

Pond Pine Woodland occurs on shallow organic deposits on the edge of peatlands and in shallow swales and Carolina bays, where tree roots can grow through the organic layer to reach mineral soil below. Pond pines are tall and often fairly dense, and the shrub layer is tall and thick, except where frequently burned. Loblolly bay frequently is prominent to codominant in the canopy. The dense shrub layer is dominated by gallberry, wax-myrtle, inkberry, and fetterbush. Blaspheme-vine is often abundant.

Small Depression Pocosin is found in small, isolated depressions typically less than 10 acres in size, and that are filled with saturated organic deposits or peaty sands. It is distinguished by a dense shrub layer dominated by such species as fetterbush, titi, inkberry, and gallberry. A sparse to dense canopy of such trees as pond pine, red maple, and swamp red bay may also be present.

Blackwater River and Stream Floodplains and Low Terraces

Blackwater rivers and streams have their headwaters in the Coastal Plain, and are so called because of the blackish appearance of the water, and contrasted with brownwater rivers that flow out of the Piedmont. All of the rivers and streams in Brunswick County are blackwater except for the Cape Fear River, which is a brownwater river. Because of the low relief, they are slow-moving waters with a very low sediment load, and thus the water is essentially clear. The darkness comes from tannic acid, a byproduct of organic decomposition in the swamps that feed the rivers and streams. (In small concentrations, the water is tea-colored, not black.) Over time, their floodwaters have worked and reworked the sediments of the channel and floodplain into a variety of landforms supporting distinctive natural community types. In Brunswick County, some of these communities are restricted to or are most extensive on the Waccamaw River.

The **Aquatic Community** consists of the permanently flooded portion of the stream or river channel. In most places it is characterized by slow-flowing water and a sandy or silty bottom. The permanently flooded portion of the channel is usually devoid of vegetation,

though beds of rooted or floating aquatic plants sometime occur along quiet edges and in backwaters. In the Waccamaw River, this community is the habitat for all of the rare fish globally restricted to the Waccamaw River system.

Coastal Plain Bottomland Hardwoods occurs on higher ground in the floodplain that is flooded for short durations with low flow velocity. Bottomland Hardwoods in Brunswick County are characterized by a mix of hardwood and conifer trees. Most prominent are laurel oak (Quercus laurifolia), red maple, loblolly pine, Atlantic white cedar, and overcup oak (Q. lyrata). Prominent understory species include American holly, swamp red bay, mayberry (Vaccinium elliotii), and titi. Cane (Arundinaria tecta) sometimes forms dense patches. The Waccamaw River floodplain is the only area in the state where Atlantic white cedar is an important component of Bottomland Hardwoods.

Coastal Plain Small Stream Swamp occurs on intermittently flooded alluvial mineral soils of small streams without well-developed alluvial landforms. The community is characterized by a mixed canopy of swamp tupelo, baldcypress, Carolina red maple, laurel oak, swamp chestnut oak (Q. michauxii), and loblolly pine. Prominent understory species include Carolina ash, ironwood (Carpinus caroliniana), swamp red bay, and American holly.

Cypress--Gum Swamp is found in broad swamps of the Waccamaw River floodplain known as backswamps, and in active and relict sloughs. Backswamps are frequently flooded broad areas extending away from the river behind the levee. Sloughs are former segments of the river channel that have been cut off by sediment deposition at the upstream end of the slough. Sloughs associated with the current river channel are frequently flooded and are known as active sloughs. The downstream end of active sloughs are often permanently flooded by river water, forming lobes in the channel called backwaters. Relict sloughs are older landforms now more isolated from the active channel. These sloughs flood less frequently than active sloughs, but some flood enough to support the Cypress--Gum Swamp community. The Cypress--Gum Swamp canopy is dominated by various mixtures of cypress (Taxodium spp.) and tupelo (Nyssa spp.), with scattered red maple. Carolina ash and water-elm (Planera aquatica) frequently are prominent in the understory.

An unusual community of uncertain classification, and tentatively assigned to the **Cypress Savanna** natural community, occurs in swales associated with ridge-and-swale systems in low terraces along the Waccamaw River. The geographically small and topographically low-profiled nature of these ridge-and-swale systems indicates that they were created by the deposition of alluvium by tributary streams rather than by the Waccamaw River itself. Cypress Savanna occurs on saturated to shallowly inundated mineral soils in the swales. It is characterized by an open to sparse pondcypress canopy over a moderate to dense herb layer. Titi forms a sparse to moderate subcanopy, and wax-myrtle is the dominant shrub. Longleaf

three-awn (*Aristida palustris*), redroot (*Lachnanthes caroliana*), and foxtail clubmoss (*Lycopodiella alopecuroides*) are prominent in the dense herb layer.

The **Oxbow Lake** community, uncommon in North Carolina, occurs in recently abandoned river channel meanders where sediment deposits have closed off the former channel meander at both ends, leaving a crescent-shaped or horseshoe-shaped water body. Although oxbow lake waters are still, they are periodically flushed by floodwaters. Still waters of oxbow lakes may support rooted and floating aquatic plants, and emergent cypress and gum trees. Over time, the oxbow lake will fill in and succeed to Cypress--Gum Swamp, but this process is slow because of the low sediment load of blackwater rivers.

Sediments deposited by the Waccamaw River along the sides of the channel form the **Sand and Mud Bar** natural community. These deposits occur within the normal river channel, and are exposed only during periods of below-average water levels. The bars typically are small, low, and flat. During periods of low water levels (drawdowns) in the river, the exposed bars are quickly vegetated by fast-growing and often very small flowering plants (quickness and smallness are adaptations to the brief periods of exposure). Because of the long periods of inundation, woody plants are unable to persist at these sites. A few large perennial herbaceous plants have been able to adapt to the bars because of well-developed underground storage systems. Red top panic grass (*Panicum rigidulum* var. *rigidulum*) is frequently the dominant large herb on bars. Water smartweed (*Polygonum punctatum*), another large herb, can also form large patches.

Brownwater River Floodplain and Low Terraces

The only brownwater river in Brunswick County is the Cape Fear River, which originates in the Piedmont. In contrast to blackwater rivers, brownwater rivers carry heavy loads of mineral sediment, particularly clay and silt. The water is generally near neutral in pH and high in nutrients. The deposition of sediment in the floodplain provides a periodic nutrient input that keeps the soils rich. Depositional topographic features such as natural levees are well-developed, with their size reflecting the size of the river. Only the Coastal Plain Levee Forest community is described here. The several tidal communities occurring along the river and its tributaries are described in the "Tidal wetland communities" section above.

Coastal Plain Levee Forest occurs on wet sandy soil along the edge of the Cape Fear River on low rises formed by floodwater sediment deposition. It is restricted to areas upstream of the tidal marsh areas. The levees in this area likely formed when sea level was lower and the river was free-flowing rather than tidal. The levee forest canopy is dominated by loblolly pine, tuliptree

(Liriodendron tulipifera), and sweet gum (Liquidambar styraciflua). Ironwood is the most prominent subcanopy tree, with river birch (Betula nigra) occurring on banks. Sedges (Carex spp.) are prominent in the moderate herb layer.

Impoundments, Ponds, and Pools

This category groups communities that occur in and around the edges of non-flowing water bodies. Permanently flooded ponds and temporarily flooded pools are primarily found in limesink depressions. Impoundments occur in beaver ponds, blocked embayments, and dammed streams.

In Brunswick County, the **Coastal Plain Semipermanent Impoundment** natural community occurs where streams have been dammed. All are characterized by relatively large, permanently flooded areas of open water supporting aquatic vegetation, and with emergent vegetation in shallower water near-shore. Marsh vegetation dominates the emergent zone, and pondcypress forms an emergent canopy in some impoundments. Aquatic vegetation includes water lily (Nymphaea odorata), watermilfoils (Myriophyllum spp.), pondweeds (Potamogeton spp.), and bladderworts (Utricularia spp.). Dominant emergent herbs include Torrey's nutrush (Scleria muhlenbergii), maidencane (Panicum hemitomon), Virginia horned beaksedge (Rhynchospora macrostachya), and sawgrass. American cupscale (Sacciolepis striata), large-flowered bur marigold (Bidens laevis), and swamp smartweed (Polygonum hydropiperoides) are prominent in some areas.

The **Small Depression Pond** community occurs in limesink depressions. These depressions are believed to have been created by subterranean collapse of limestone deposits, resulting in the slumping of overlying sand deposits. If the depression intersects groundwater, a pond forms. Because the pond surface is an exposed expression of the water table, pond levels rise and fall with groundwater fluctuations, typically rising in winter and spring, and falling in summer and fall. Some ponds may dry out during drought years. When water levels drop during the growing season, the exposed pond margins support a diverse herb layer with several rare plant species. Characteristic shoreline species include spadeleaf (Centella erecta), Wright's witch grass (Dichanthelium wrightianum), pinebarren rush (Juncus abortivus), southern bog clubmoss (Lycopodiella appressa), Mohr's boneset (Eupatorium mohrii), combleaf mermaidweed (Proserpinaca pectinata), and warty panic grass (Panicum verrucosum). Brunswick County contains the largest concentration of Small Depression Pond community occurrences between Massachusetts and Florida.

Slightly higher depressions flooded during winter and spring but without standing water during the growing season support the **Vernal Pool** natural community. These temporary pools are particularly

critical as amphibian breeding sites. Characteristic species include little bluestem (Schizachyrium scoparium), broomsedges (Andropogon spp.), switchcane (Panicum virgatum), and pinebarren rush.

Upland Hardwoods

Dry-Mesic Oak--Hickory Forest occurs on dry to mesic sandy soils on interstream terraces. The canopy is dominated by white oak (Quercus alba), red oak (Q. rubra), black gum (Nyssa sylvatica), and mockernut hickory (Carya tomentosa). Flowering dogwood (Cornus florida) and American holly are prominent in the subcanopy. Shrubs include hillside blueberry (Vaccinium pallidum) and American strawberry-bush (Euonymus americanus). There is only one documented occurrence of this community type in Brunswick County.

Mesic Mixed Hardwood Forest occurs on the mesic loamy sands of ravine slopes where blackwater creeks have eroded upland terraces. The forest canopy is dominated by American beech (Fagus grandifolia), southern sugar maple (Acer barbatum), white oak, and swamp chestnut oak. The subcanopy is dominated by flowering dogwood, sand hickory (Carya pallida), and American holly. Prominent shrubs include witch-hazel (Hamamelis virginiana), wild azalea (Rhododendron nudiflorum), and bigleaf snowbell (Styrax grandifolia). The open to sparse herb layer includes Christmas fern (Polystichum acrostichoides), woodrush (Luzula sp.), and bloodroot (Sanguinaria canadensis).

River Bluff

The **Piedmont/Coastal Plain Acidic Cliff** natural community occurs on bluffs along the Cape Fear River near the Brunswick/Columbus county line. The bluff face is very steep to vertical and portions are kept moist by groundwater seepage. The Acidic Cliff community at this site is highly unusual, as it is influenced by limestone outcrops. The vertical faces are bare in some places, and dominated by herbs, mosses, and liverworts in others. Large-leaved grass-of-parnassus (Parnassia grandifolia) is a patch dominant on the vertical faces. Non-vertical but steep faces support woody and herbaceous vegetation. Trees adapted to the steep slopes include loblolly pine, southern sugar maple, and American beech. Shrubs include sparkleberry (Vaccinium arboreum), wild hydrangea (Hydrangea arborescens), and wax-myrtle.

Special Animal Habitats

Special animal habitats in Brunswick County support critical nesting, rookery, and foraging areas for birds primarily associated with coastal waters. Some of these birds are rare, and others have suffered losses in availability of suitable habitat. Designation of special habitats contributes to keeping these species from becoming rare, or rarer. Special animal habitats occurring in Brunswick County are: **Gull*Tern*Skimmer Colony, Osprey Nesting Area, Wading Bird and Shorebird Foraging Area, and Wading Bird Rookery.**

Artificially Disturbed Habitats

Rare plant species occasionally occur along roadsides and in powerline corridors. Typically, two or more rare species are present at these artificially maintained sites. The plant association most frequently found at these sites in Brunswick County is that of the Pine Savanna. There is evidence that the savanna plant association and rare species are present because of conditions that pre-date road and powerline construction. The soil types at these sites are those that support the rare species' natural community, and often fragments of the natural community persist nearby. Because of the degree of artificial disturbance, these sites are not classified as natural communities, but they nonetheless provide critical habitat for rare species, and can serve as important seed sources if adjacent habitat is managed for natural community restoration. The most significant roadside and powerline rare species occurrences are treated as standard sites.

RARE PLANTS AND ANIMALS

Although lacking substantial topographic relief, Brunswick County nonetheless contains a significant amount of habitat diversity. Barrier islands, inland tidal reaches, nontidal freshwater wetlands, and terrestrial habitats support a variety of natural community types and a very diverse flora and fauna. All of these factors contribute to the largest number of rare animal and plant species of any county in North Carolina. A total of 59 rare animals have been recorded from the county (Table 1), comprising 5 mammals, 14 birds, 7 reptiles, 1 amphibian, 2 freshwater fishes, 5 marine and estuarine fishes, and 25 invertebrates (5 mollusks, 3 moths, 16 butterflies, and 1 annelid). A total of 112 rare plants are known from the county (Table 2), comprising 105 vascular seed plants and 7 nonvascular plants (3 mosses, 3 liverworts, and 1 lichen). Among these rare species are 22 federally designated animals and 22 federally designated plants.

Significant among these rare species are a few globally restricted to Brunswick County and adjacent areas. Rarest among these are the Greenfield ramshorn snail (Helisoma eucosmium) and the magnificent

rams-horn snail (Planorbella magnifica). The Greenfield ramshorn snail is currently known from a single world site, and the magnificent rams-horn snail is known from two sites. All three sites are in Brunswick County, in tributaries of the Cape Fear River. Another snail, the Cape Fear threetooth (Triodopsis soelneri), is known only from southeastern North Carolina: in Brunswick, New Hanover, Bladen, and Columbus counties. The Carolina pygmy sunfish (Elassoma boehlkei), a rare fish of the Waccamaw River drainage, is restricted to Brunswick and Columbus counties, and two adjacent counties in South Carolina.

Among rare plants, the current distribution of savanna indigo-bush (Amorpha georgiana var. confusa) is globally restricted to Brunswick and Columbus counties. Carolina atamasco lily (Zephyranthes sp. 1) is known only from Brunswick County and two adjacent counties in South Carolina. Savanna onion (Allium sp. 1) is globally restricted to one site in Brunswick County and four sites along the Pender/Onslow county line.

The rare plants and animals found in Brunswick County occur in a variety of habitats and natural communities, although individual species tend to be restricted to specific habitats. Coastal areas, including beaches and tidal rivers and marshes, are particularly critical for several rare bird, turtle, and fish species. However, it is an inland area of Brunswick County--Green Swamp--that stands out as one of the most remarkable areas for rare species and species diversity in the eastern U.S. A total of 42 rare species have been documented there, including 16 rare animals (3 mammals, 3 birds, 3 reptiles, 1 amphibian, and 6 invertebrates). Among the 26 rare plants are 3 orchids and the carnivorous Venus flytrap (Dionaea muscipula). The great majority of these rare species are associated with the Pine Savanna natural community. Pine savannas in Green Swamp have among the highest per acre species richness of any area in temperate North America.

Definition of Status and Rank Codes in Tables 1 and 2

Table 1 (rare animals) and Table 2 (rare plants) list all of the federal and state designated rare species documented in Brunswick County. The federal and state rarity status codes and global and state abundance ranks are given for each species in the tables. These status and rank codes are defined below (only those codes applying to rare species in Brunswick County are given). The code definitions and application to individual species are from LeGrand (1993) and Weakley (1993).

Status Codes (designated rarity)

Federal Status. As designated by the U.S. Fish and Wildlife Service (USFWS).

- E = Endangered. A species that is threatened with extinction throughout all or a significant portion of its range.
- T = Threatened. A species that is likely to become endangered in the foreseeable future.
- C2 = Candidate. A species for which there is some evidence of vulnerability, but for which there are not enough data to support listing as Endangered or Threatened at this time. Listing is "warranted but precluded by other pending proposals of higher priority." The USFWS is "directed to make prompt use of the emergency listing provisions if the well being of any such species is at significant risk."

State Status - Animals.

- E = Endangered. Any native or once-native species of wild animal whose continued existence as a viable component of the state's fauna is determined by the Wildlife Resources Commission to be in jeopardy, or any species of wild animal determined to be an Endangered species pursuant to the U.S. Endangered Species Act.
- T = Threatened. Any native or once-native species of wild animal which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range in North Carolina, or one that is designated as a Threatened species pursuant to the U.S. Endangered Species Act.
- SC = Special Concern. Any species of wild animal native or once-native to North Carolina which is determined by the Wildlife Resources Commission to require monitoring but which may be taken under regulations adopted under the provisions of Article 25 of Chapter 113 of the General Statutes.
- SR = Significantly Rare. Any other species which has not been determined as an Endangered, Threatened, or Special Concern species, but which exists in North Carolina in small numbers and has been determined to need monitoring. This is a N.C. Natural Heritage Program designation.
- SR* = Species is a game animal, and therefore by law cannot be listed for state protection as E, T, or SC.

State Status - Plants.

- E = Endangered. Any species whose continued existence as a viable component of the state's flora is in jeopardy. Endangered species may not be removed from the wild except when a permit is obtained for research, propagation, or rescue which will enhance the survival of the species. Sale or distribution of wild-collected Endangered species is not permitted.
- T = Threatened. Any species likely to become an endangered species within the foreseeable future. Regulations are the same as for Endangered species.

- SC = Special Concern. Any species which requires population monitoring, but which may be collected and sold under specific regulations. Special Concern species which are not also listed as Endangered or Threatened may be collected from the wild and sold under specific regulations. Propagated material only of Special Concern species which are also listed as Endangered or Threatened may be traded or sold under specific regulations.
- C = Candidate. Any species which, because of small numbers of populations, rare habitat, or distribution, may become threatened in the future; or a species suspected of being endangered or threatened, but for which sufficient information is not currently available to support such a status classification. This is a N.C. Natural Heritage Program designation.
- SR = Significantly Rare. Any other species which has been determined to be rare in North Carolina and in need of conservation and monitoring. This is a N.C. Natural Heritage Program designation.

Rank Codes (rangewide abundance)

Global Rank. This is based on a species' abundance rangewide, and is the best available scientific assessment of a species' rarity throughout its range.

- G1 = Critically imperiled globally because of extreme rarity or because of other factors making it especially vulnerable to extinction.
- G2 = Imperiled globally because of rarity or because of other factors making it very vulnerable to extinction.
- G3 = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single physiographic region) or because of other factors making it vulnerable to extinction.
- G4 = Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- G5 = Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- GU = Possibly in peril rangewide, but status uncertain; need more information.
- G? = Unranked, or rank uncertain.
- G_Q = A "Q" following a "G" rank indicates questionable taxonomic status.
- G_T_ = A "T" rank following a "G" rank indicates a subspecies or variety. For example, "G4T1" would apply to a subspecies or variety of a species with an overall rank of G4, but with the subspecies or variety warranting a rank of G1.
- G_G_ = A ranking involving two "G" numbers indicates a greater uncertainty or range of ranking. For instance, a

"G2G3" rank indicates that the species may be a G2 or a G3, but that existing data do not allow that determination to be made.

State Rank. This is based on a species' abundance throughout North Carolina, independently of the global rank (however, a state rank can never show a greater abundance than the global rank).

- S1 = Critically imperiled in North Carolina because of extreme rarity or because of other factors making it especially vulnerable to extirpation from North Carolina.
- S2 = Imperiled in North Carolina because of rarity or because of other factors making it very vulnerable to extirpation in North Carolina.
- S3 = Rare or uncommon in North Carolina.
- S4 = Apparently secure in North Carolina, with many occurrences.
- S5 = Demonstrably secure in North Carolina and essentially ineradicable under present conditions.
- SU = Possibly in peril in North Carolina, but status uncertain; need more information.
- S_B = Rank of the breeding population in the state. Used for migratory animals only.
- S_N = Rank of the non-breeding population in the state. Used for migratory animals only.
- SH = Of historical occurrence in North Carolina, perhaps not having been verified in the past 20 years, and suspected to be still extant.
- S? = Unranked, or rank uncertain.
- S_S_ = Same as "G_G_".

Table 1. Federal and State Designated Rare Animal Species Occurring in Brunswick County, North Carolina

Status codes followed by "*" are footnoted at the end of the particular animal group (e.g., mammals).

<u>SPECIES</u>	<u>STATUS</u>		<u>RANK</u>	
	<u>US</u>	<u>NC</u>	<u>G</u>	<u>S</u>
Mammals				
<u>Condylura cristata parva</u> star-nosed mole		SC*1	G5	S4
<u>Felis concolor concolor</u> eastern cougar	E	E	G4	SH
<u>Neotoma floridana floridana</u> eastern woodrat		T	G5T?	S1
<u>Trichechus manatus</u> manatee	E	E	G2?	S1N
<u>Ursus americanus</u> black bear		SR*2	G5	S3

*1 The star-nosed mole occurs in two distinct areas in North Carolina, one in the mountains, and the other in the Coastal Plain. It is of Special Concern in the Coastal Plain.

*2 The black bear is a game animal, and by law cannot be listed for State protection as Endangered, Threatened, or Special Concern.

Birds

<u>Aimophila aestivalis</u> Bachman's sparrow	C2	SC	G3	S3B, S2N
<u>Ammodramus henslowii</u> Henslow's sparrow	C2	SR	G4	S2B, S1N
<u>Anhinga anhinga</u> anhinga		SR	G5	S2B, SZN
<u>Charadrius melodus</u> piping plover	T	T	G3	S2B, S2N
<u>Columbina passerina</u> common ground-dove		SR	G5	S1B, S1N
<u>Falco peregrinus</u> peregrine falcon	E	E	G3	S1B, S2N
<u>Haliaeetus leucocephalus</u> bald eagle	E	E	G3	S1B, S2N
<u>Himantopus mexicanus</u> black-necked stilt		SR	G5	S2B
<u>Lanius ludovicianus</u> loggerhead shrike	C2	SC	G4	S2B, S3N

<u>SPECIES</u>	<u>STATUS</u>		<u>RANK</u>	
	<u>US</u>	<u>NC</u>	<u>G</u>	<u>S</u>
<u>Mycteria americana</u> wood stork	E	E*	G5	S1N
<u>Pelecanus occidentalis</u> brown pelican		SC	G5	S3B, S4N
<u>Picoides borealis</u> red-cockaded woodpecker	E	E	G2	S2
<u>Plegadis falcinellus</u> glossy ibis		SC	G5	S2B, S1N
<u>Porphyryula martinica</u> purple gallinule		SR	G5	S1B

* The wood stork is very rare in the U.S., but more common in the tropics.

Reptiles

<u>Alligator mississippiensis</u> American alligator	T	T	G5	S3
<u>Caretta caretta</u> loggerhead turtle	T	T	G3	S2B, S2N
<u>Chelonia mydas</u> green turtle	T	T	G3	S1B, SZN
<u>Crotalus adamanteus</u> eastern diamondback rattlesnake		SR	G5	S1
<u>Lepidochelys kempii</u> Atlantic Ridley turtle	E	E	G1	SAB, SZN
<u>Micrurus fulvius</u> eastern coral snake		SR	G5	S1
<u>Ophisaurus mimicus</u> mimic glass lizard		SC	G3	S2

Amphibians

<u>Rana capito capito</u> Carolina gopher frog	C2	SC	G4T?	S2
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Freshwater fishes

<u>Elassoma boehlkei</u> Carolina pygmy sunfish	C2	T	G1G2	S1S2
<u>Noturus sp. 2</u> broadtail madtom		SC	G2	S2

<u>SPECIES</u>	STATUS		RANK	
	<u>US</u>	<u>NC</u>	<u>G</u>	<u>S</u>

Marine and estuarine fishes

<u>Acipenser brevirostrum</u> shortnose sturgeon	E	E	G3	S1
<u>Eleotris pisonis</u> spinycheek sleeper		SR	G5	S2
<u>Gobionellus stigmaticus</u> marked goby		SR	G?	S2
<u>Hypsoblennius ionthas</u> freckled blenny		SR	GU	S2
<u>Microphis brachyurus</u> opossum pipefish		SR	G5	S1

Mollusks -- freshwater gastropods

<u>Helisoma eucosmium</u> Greenfield ramshorn snail	*	*	G1	S1
<u>Planorbella magnifica</u> magnificent rams-horn	C2	E	G1	S1

* The Greenfield ramshorn snail was believed to be extinct until rediscovered in Brunswick County in 1994.

Mollusks -- terrestrial gastropods

<u>Triodopsis soelneri</u> Cape Fear threetooth	C2	T	G2	S2
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Mollusks -- marine bivalves

<u>Busycon canaliculatus</u> channeled whelk		SR	G?	S?
<u>Busycon carica</u> knobbed whelk		SR	G?	S?

Insects -- moths

<u>Agrotis buchholzi</u> Buchholz's dart moth	C2	SR	G2G3	S1S3
<u>Euagrotis lubricans</u> slippery dart		SR	G5	SU
<u>Metarranthis lateritiaria</u> a geometrid moth		SR	G3G4	S1S3

STATUS

RANK

<u>SPECIES</u>	<u>US</u>	<u>NC</u>	<u>G</u>	<u>S</u>
Insects -- butterflies				
<u>Amblyscirtes alternata</u> least Florida skipper		SR	G3G4	S2?
<u>Amblyscirtes reversa</u> reversed roadside skipper		SR	G4	S3?
<u>Atrytone arogos arogos</u> arogos skipper	C2	SR	G4T3	S1
<u>Atrytonopsis loammi</u> loammi skipper		SR	GUQ	S1
<u>Calephelis virginiensis</u> little metalmark		SR	G4	S3?
<u>Erynnis martialis</u> mottled dusky wing		SR	G4	S3?
<u>Euphyes bimacula</u> two-spotted skipper		SR	G4	S2?
<u>Euphyes dukesi</u> Duke's skipper		SR	G3G4	S1?
<u>Fixsenia favonius</u> southern hairstreak		SR	G4Q	S1
<u>Hesperia attalus slossonae</u> dotted skipper		SR	G4T3	S1S3
<u>Megathymus yuccae</u> yucca skipper		SR	G4	S3?
<u>Mitoura hesseli</u> Hessel's hairstreak		SR	G3G4	S2?
<u>Papilio cresphontes</u> giant swallowtail		SR	G5	S2
<u>Phyciodes phaon</u> phaon crescent		SR	G5	S2?
<u>Problema bulenta</u> rare skipper	C2	SR	G2G3	S1?
<u>Satyrium kingi</u> King's hairstreak		SR	G3G4	S3?
Annelids				
<u>Chaetopterus variopedatus</u> parchment tube worm		SR	G?	S?

Table 2. Federal and State Designated Rare Plant Species Occurring in Brunswick County, North Carolina

<u>SPECIES</u>	STATUS		RANK	
	<u>US</u>	<u>NC</u>	<u>G</u>	<u>S</u>
Vascular plants - trees, shrubs, and herbs				
<u>Agalinis aphylla</u> scale-leaf gerardia		C	G3G4	S2
<u>Agalinis linifolia</u> flaxleaf gerardia		SR	G3G4	S2
<u>Agalinis virgata</u> branched gerardia		C	G3G4	S1
<u>Allium</u> sp. 1 savanna onion		C	G1	S1
<u>Amaranthus pumilus</u> seabeach amaranth	T	T	G2	S2
<u>Amorpha georgiana</u> var. <u>confusa</u> savanna indigo-bush	C2	T	G3T2	S2
<u>Andropogon mohrii</u> bog bluestem		C	G3?	S1
<u>Arnoglossum ovatum</u> savanna indian-plantain		SR	G4G5	S1
<u>Asclepias pedicellata</u> savanna milkweed		C	G3G4	S2
<u>Baccharis glomeruliflora</u> silverling		C	G4	S1
<u>Balduina atropurpurea</u> honeycomb head	C2	C	G2G3	S1
<u>Bulbostylis warei</u> Ware's hairsedge		C	G3G4	SH
<u>Carex decomposita</u> cypress knee sedge		SR	G3G4	S1
<u>Carex verrucosa</u> warted sedge		SR	G3G4	S1
<u>Cyperus dentatus</u> toothed flatsedge		C	G4	S1?
<u>Cyperus lecontei</u> Leconte's flatsedge		SR	G4?	S1
<u>Cyperus tetragonus</u> four-angled flatsedge		SR	G4?	S2
<u>Dichanthelium erectifolium</u> erectleaf witch grass		SR	G4	S2
<u>Dichanthelium oligosanthes</u> var. <u>scribnerianum</u> Scribner's witch grass		SR	G5T5	S1
<u>Dichanthelium</u> sp. 5 = <u>neuranthum</u> nerved witch grass		SR	G5	S1
<u>Dionaea muscipula</u> Venus flytrap	C2	C-SC	G3	S3

<u>SPECIES</u>	<u>STATUS</u>		<u>RANK</u>	
	<u>US</u>	<u>NC</u>	<u>G</u>	<u>S</u>
<u>Drosera filiformis</u> threadleaf sundew		SR	G5	S1
<u>Echinodorus parvulus</u> dwarf burhead	C2	C	G2	S1
<u>Eleocharis elongata</u> Florida spikerush		C	G5?	S1
<u>Eleocharis robbinsii</u> Robbins's spikerush		C	G4G5	S2
<u>Eleocharis rostellata</u> beaked spikerush		SR	G5	S2
<u>Epidendrum conopseum</u> green fly orchid		SR	G3G4	S2
<u>Eriocaulon aquaticum</u> seven-angled pipewort		SR	G5	S2
<u>Erythrina herbacea</u> coralbean		SR	G5	S1
<u>Eupatorium leptophyllum</u> limesink dog-fennel		C	G4G5	S1
<u>Fimbristylis perpusilla</u> Harper's fimbry	C2	T	G2	S1
<u>Galactia mollis</u> soft milk-pea		C	G4G5	S1
<u>Gelsemium rankii</u> swamp jessamine		SR	G5	S2
<u>Helenium brevifolium</u> littleleaf sneezeweed		C	G4	S1
<u>Helenium pinnatifidum</u> dissected sneezeweed		SR	G4	S2
<u>Helenium vernale</u> spring sneezeweed		SR	G3G4	S1
<u>Helianthemum corymbosum</u> pinebarren sunrose		SR	G4G5	S1
<u>Helianthemum georgianum</u> Georgia sunrose		C	G4	S1
<u>Ilex amelanchier</u> sarvis holly		SR	G3G4	S3
<u>Ipomoea imperati</u> beach morning-glory		SR	G5	S1
<u>Lachnocaulon beyrichianum</u> southern bogbutton		C	G2G3	S1
<u>Lechea torreyi</u> Torrey's pinweed		C	G4G5	S1
<u>Leptochloa fascicularis</u> var. <u>maritima</u> long-awned spangletop		SR	G5T3	S1
<u>Lilaeopsis carolinensis</u> Carolina grasswort		T	G3	S3
<u>Linum floridanum</u> var. <u>chrysocarpum</u> yellow-fruited flax		SR	G5T3?	S1

<u>SPECIES</u>	<u>STATUS</u>		<u>RANK</u>	
	<u>US</u>	<u>NC</u>	<u>G</u>	<u>S</u>
<u>Litsea aestivalis</u> pondspice	C2	C	G4G5	S2
<u>Lophiola aurea</u> golden crest		E	G4	S1
<u>Ludwigia alata</u> winged seedbox		SR	G3G4	S2
<u>Ludwigia lanceolata</u> lanceleaf seedbox		C	G3	S1
<u>Ludwigia linifolia</u> flaxleaf seedbox		SR	G4	S1
<u>Ludwigia suffruticosa</u> shrubby seedbox		SR	G5	S2
<u>Lysimachia asperulifolia</u> rough-leaf loosestrife	E	E	G3	S3
<u>Macbridea caroliniana</u> Carolina bogmint	C2	C	G2G3	S1
<u>Malaxis spicata</u> Florida adder's mouth orchid		SR	G3G4	S1
<u>Muhlenbergia torreyana</u> pinebarren smokegrass		E	G3	S1
<u>Myriophyllum laxum</u> loose watermilfoil	C2	T	G2G3	S1
<u>Oldenlandia bosci</u> Bosc's bluet		SR	G5	S1
<u>Panicum tenerum</u> southeastern panic grass		SR	G4	S2
<u>Parnassia caroliniana</u> Carolina grass-of-parnassus	C2	E	G2	S2
<u>Parnassia grandifolia</u> large-leaved grass-of-parnassus		C	G2G3	S1
<u>Peltandra sagittifolia</u> spoonflower		SR	G3G4	S2
<u>Pityopsis graminifolia</u> var. <u>graminifolia</u> silkgrass		SR	G5T5	S1?
<u>Plantago sparsiflora</u> pineland plantain	C2	E	G2	S1
<u>Platanthera integra</u> yellow fringeless orchid		T	G5	S1
<u>Platanthera nivea</u> snowy orchid		T	G5	S1
<u>Polygala hookeri</u> Hooker's milkwort		C	G3	S2
<u>Polygonum glaucum</u> seabeach knotweed		C	G3	S1
<u>Polygonum hirsutum</u> hairy smartweed		SR	G4G5	S1

STATUS

RANK

<u>SPECIES</u>	<u>US</u>	<u>NC</u>	<u>G</u>	<u>S</u>
<u>Ponthieva racemosa</u> shadow-witch orchid		SR	G4G5	S2
<u>Ptilimnium</u> sp. 1 Carolina bishopweed		C	G2	S1
<u>Rhexia aristosa</u> awned meadow-beauty	C2	T	G3	S3
<u>Rhexia cubensis</u> West Indies meadow-beauty		SR	G5	S1
<u>Rhynchospora alba</u> northern white beaksedge		C	G5	S2
<u>Rhynchospora breviseta</u> shortbristled beaksedge		C	G3G4	S1
<u>Rhynchospora decurrens</u> swamp forest beaksedge	C2	C	GH	S1
<u>Rhynchospora divergens</u> whiteseeded beaksedge		SR	G4	S1
<u>Rhynchospora globularis</u> var. <u>pinetorum</u> Small's beaksedge		SR	G5T3?	S1
<u>Rhynchospora odorata</u> fragrant beaksedge		SR	G4	S1
<u>Rhynchospora oligantha</u> feather-bristle beaksedge		C	G4	S2
<u>Rhynchospora pleiantha</u> coastal beaksedge		C	G3	S1
<u>Rhynchospora scirpoides</u> long-beak baldsedge		SR	G4	S2
<u>Rhynchospora thornei</u> Thorne's beaksedge	C2	C	G1	S1
<u>Rhynchospora tracyi</u> Tracy's beaksedge		SR	G4	S2
<u>Sabal palmetto</u> cabbage palm		SR	G5	S1
<u>Sabatia kennedyana</u> Plymouth gentian		T-SC	G3	S1
<u>Sagittaria isoetiformis</u> quillwort arrowhead		SR	G3G4	S2
<u>Sarracenia minor</u> hooded pitcher plant		SR	G4G5	S2
<u>Schoenoplectus etuberculatus</u> Canby's bulrush		SR	G3G4	S3
<u>Scirpus lineatus</u> drooping bulrush		C	G4	S2
<u>Scleria baldwinii</u> Baldwin's nutrush		C	G3G4	S1
<u>Scleria georgiana</u> Georgia nutrush		SR	G4	S2

<u>SPECIES</u>	<u>STATUS</u>		<u>RANK</u>	
	<u>US</u>	<u>NC</u>	<u>G</u>	<u>S</u>
<u>Scleria verticillata</u> savanna nutrush		C	G5	S1
<u>Seymeria pectinata</u> sticky afzelia		C	G4G5	SH
<u>Sideroxylon tenax</u> tough bumelia		C	G3?	S1
<u>Solidago gracillima</u> graceful goldenrod		SR	G4?	S1S2
<u>Solidago pulchra</u> Carolina goldenrod	C2	E	G3	S3
<u>Solidago verna</u> spring-flowering goldenrod	C2	E	G3	S3
<u>Spiranthes laciniata</u> lace-lip ladies'-tresses orchid		C	G4G5	S1
<u>Spiranthes longilabris</u> giant spiral orchid		C	G3	S1
<u>Sporobolus teretifolius</u> wireleaf dropseed	C2	T	G2?	S1
<u>Stylisma aquatica</u> water dawnflower		SR	G3G4	S1
<u>Thalictrum cooleyi</u> Cooley's Meadowrue	E	E	G1	S1
<u>Tofieldia glabra</u> Carolina asphodel	C2	C	G3	S3
<u>Trichostema</u> sp. 1 dune bluecurls	C2	C	G2	S2
<u>Tridens carolinianus</u> Carolina triodia		C	G2G3	S2
<u>Utricularia olivacea</u> dwarf bladderwort		T	G4	S2
<u>Vaccinium macrocarpon</u> cranberry		C	G4	S2
<u>Xyris brevifolia</u> short-leaf yellow-eyed-grass		SR	G4G5	S1
<u>Xyris elliotii</u> Elliott's yellow-eyed-grass		SR	G4	S1
<u>Xyris flabelliformis</u> savanna yellow-eyed-grass		C	G4	S1
<u>Yucca gloriosa</u> moundlily yucca		SR	G3	S2?
<u>Zepheranthes</u> sp. 1 Carolina atamasco lily		SR	G2?	S2?

Nonvascular plants - mosses, liverworts, and lichens

<u>Campylopus carolinae</u> savanna campylopus moss	C2	C	G1	S1
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<u>SPECIES</u>	STATUS		RANK	
	<u>US</u>	<u>NC</u>	<u>G</u>	<u>S</u>
<u>Cheilolejeunea rigidula</u> a liverwort		SR	G5	S2
<u>Lejeunea bermudiana</u> a liverwort		SR	G3G4	SH
<u>Plagiochila ludoviciana</u> a liverwort		SR	G5	S1
<u>Sphagnum fitzgeraldii</u> Fitzgerald's peatmoss		SR	G2G3	S2S3
<u>Syrrhopodon incompletus</u> Cuban schliessmund moss		C	G5	S1
<u>Teloschistes flavicans</u> sunrise lichen		SR	G3G4	S1

Table 3. Natural Areas of National, Statewide, or Regional Significance in Brunswick County, North Carolina

Natural areas include megasites, macrosites, and standard sites. Standard sites can be included within macrosites or megasites, or they can stand alone.

RANK

- A = national significance
- B = statewide significance
- C = regional significance

	<u>RANK</u>
SOUTHEASTERN BRUNSWICK COUNTY MEGASITE	A
Boiling Spring Lakes--Wetland Complex	A
Military Ocean Terminal Sunny Point	A
Pleasant Oaks Plantation	A
Big Cypress Bay and Ponds	B
Boiling Spring Lakes--Limesink Complex	B
Hog Branch Ponds	B
Pretty Pond Limesink Complex	B
Southport Ferry Landing Forest	B
Sunset Harbor--Ash Swamp	B
White Spring Ponds Complex	B
Bethel Sandhills	C
Goose Landing	C
NC 133 Loosestrife Site	C
 Orton Plantation Macrosite	 A
Orton Pond	A
Orton Creek Savanna	B
Blue Pond	C
Orton Powerline Loosestrife Site	C
 WACCAMAW RIVER WETLANDS MEGASITE	 A
Waccamaw River Aquatic Habitat	A
Juniper Creek Floodplain	B
Waccamaw River Oxbow Site	B
Scippo Swamp Ridge-and-Swale Boggy Openings	C
 Middle Waccamaw River Macrosite	 A
Reeves Area Floodplain	B
Regan Ridge-and-Swale Boggy Openings	B
Waccamaw Island Savanna	B
Waccamaw River Ridge-and-Swale Boggy Openings	B
Waccamaw River Eleocharis Backwater	C

	<u>RANK</u>
Bald Head--Smith Island Complex Macrosite	A
Bald Head Island	A
Bluff Island and East Beach	B
Zekes Island Estuarine Sanctuary	B
Middle Island	C
Stand-alone Sites	
Battery Island	A
Green Swamp	A
Myrtle Head Savanna	A
Town Creek Marshes and Swamp	A
Battle Royal Bay	B
Big Neck Road at Millpond Bay	B
Brantley Island	B
Brunswick River/Cape Fear River Marshes	B
Bryant Mill (Greenbank) Bluff	B
Camp Branch Savanna Remnant	B
Colkins Neck Remnant	B
Lower Cape Fear River Aquatic Habitat	B
Lower Cape Fear River Bird Nesting Islands	B
Spring Creek Ponds	B
Sunset Beach Wood Stork Ponds	B
Alligator Branch Sandhill and Flatwoods	C
Bird Island	C
Boone Neck Maritime Forest	C
Drowned Bay Savanna	C
Fall Swamp--Middle River Limesink Complex	C
Henrytown Savanna	C
Lockwoods Folly River Tidal Wetlands	C
Long Bays Savanna and Carolina Bays	C
Sandy Branch Sand Ridge and Bay Complex	C
Secession Maritime Forest	C
Shalotte Creek Sandhills	C
Sturgeon Creek Tidal Wetlands	C

DISCUSSION

Brunswick County contains not only some of the most biologically significant areas in North Carolina, but along the entire U.S. Atlantic Coast. It supports more Federally Endangered or Threatened plant and animal species--15--than any other county in the state. It has the greatest diversity of natural communities in the state with 36 community types and subtypes. Brunswick County has the second highest number of rare species occurrences among North Carolina counties, and the second highest number of natural areas (sites). The county is a center of species diversity along the Atlantic Coast, with several species globally restricted to Brunswick County or adjacent areas. Some of the county's pine savannas have among the highest species richness of any similar-sized area in temperate North America. The concentration of Coastal Plain ponds is the largest along the Atlantic Coast between Massachusetts and Florida.

SUMMARY OF RESULTS

Natural Areas - Priority Clusters of Sites

According to their size, natural areas are referred to in this report as "megasites," "macrosites," or "standard sites." **Megasites** are large, cohesive areas generally of a size greater than 100 square miles (64,000 acres). **Macrosites** are smaller areas, generally of 5 to 100 square miles (3,200 to 64,000 acres). **Standard sites** typically are smaller than 3,200 acres. Standard sites are usually referred to as "sites" unless greater clarification is needed. Frequently, sites occur in clusters. The occurrence of a site in association with other sites increases its potential long term viability and ecological significance. Such clusters are designated as macrosites or megasites, with standard sites nested within them. These macrosites and megasites may contain lower quality lands that are not included in a standard site, but which provide ecologically important buffers and corridors.

(Special note must be made of two sites treated here as standard sites, but which technically are stand-alone macrosites. These are Green Swamp and Boiling Spring Lakes--Wetland Complex, and are macrosites because of their size. They have not been subdivided into smaller, standard sites because of the contiguousness of good quality habitat throughout. They are therefore equivalent to very large standard sites, and are treated as such here to insure a full description. Boiling Spring Lakes--Wetland Complex occurs within the Southeastern Brunswick County Megasite. Green Swamp does not occur within a megasite.)

A list of identified natural areas of national, statewide, or regional significance is contained in Table 3. These rankings are

based on the degree of rarity of rare species, number of rare species, quality and rarity of natural community types, and general condition. A total of two megasites, three macrosites, and 57 standard sites (Fig. 3) are described in the "Inventory of Sites" section of this report. Three site clusters are of particular significance: Southeastern Brunswick County Megasite, Waccamaw River Wetlands Megasite, and Bald Head--Smith Island Complex Macrosite (not included within a megasite). These three clusters contain 30 of the county's 57 identified standard sites, plus the three macrosites and two megasites.

Southeastern Brunswick County Megasite

The Southeastern Brunswick County Megasite (Fig. 4) consists of most of the southeastern quarter of the county. A variety of geomorphic formations contribute to the diversity of natural communities and species in this nationally significant megasite. Carolina bay rims, relict dunes, low interstream terraces, and sandhills support several types of longleaf pine communities. Also of great significance are the numerous limesink ponds occurring in the megasite, primarily in the area of Boiling Spring Lakes and Military Ocean Terminal Sunny Point. Among the natural communities are two extremely rare community variants: the Pine Savanna Pleea Flats Variant, and the Wet Pine Flatwoods *Leiophyllum* Variant. The majority of the known global distribution of these two community variants occurs within the megasite. The concentration of limesink ponds in the megasite is the largest along the Atlantic Coastal Plain north of Florida. The longleaf pine and limesink pond communities support many rare species.

Nationally significant sites within the Southeastern Brunswick County Megasite are: Orton Plantation Macrosite, Orton Pond, Boiling Spring Lakes--Wetland Complex Macrosite, Military Ocean Terminal Sunny Point, and Pleasant Oaks Plantation.

Waccamaw River Wetlands Megasite

The nationally significant Waccamaw River Wetlands Megasite (Fig. 5) consists of the entirety of the Waccamaw River floodplain from Lake Waccamaw in Columbus County to the South Carolina border. The Brunswick County portion of the megasite includes the floodplain features along the east side of the river from Juniper Creek Swamp southward. The river and its floodplain possess several significant features. The waters and adjacent wetlands of the river support many rare animal and plant species, including several fish, mussels, and snails globally restricted to the Waccamaw River system (most of these rare animals are restricted to the Columbus County portion of the megasite). Also of great significance are the rare plants and natural communities associated with landforms created by active river meanders, such as oxbow

lakes, sloughs, and point bars; and landforms created by the older river and its tributaries, particularly the unusual ridge-and-swale systems.

Nationally significant sites with the Waccamaw River Wetlands Megasite are: Waccamaw River Aquatic Habitat and Middle Waccamaw River Macrosite.

Bald Head--Smith Island Complex Macrosite

The Bald Head--Smith Island Complex Macrosite (Fig. 6) comprises a system of estuarine islands, barrier beaches and spits, tidal marshes and creeks, and open estuarine waters. This nationally significant macrosite is located along the east side of the mouth of the Cape Fear River, and is bounded by Federal Point along the north, and by the Atlantic Ocean along the east and south. The macrosite contains several maritime natural community types, some of which are rare and among the best examples known. Among the most significant features in the macrosite are the maritime forest communities found on the sand ridges. The area also provides habitat for many rare plants and animals, including five Federally Endangered or Threatened species.

The Bald Head--Smith Island Complex Macrosite contains one nationally significant standard site: Bald Head Island.

Stand-Alone Natural Areas

Green Swamp

Green Swamp (Fig. 7) comprises one of the most significant natural landscapes in North Carolina, containing extensive areas of high quality savanna, flatwoods, and pocosin habitat. This nationally significant stand-alone macrosite is located in the north-central portion of the county, and occupies a very large, broad, and flat terrace dominated by pocosin vegetation. The Pine Savanna natural community at Green Swamp has one of the highest per acre plant species richness of any area in temperate North America. Green Swamp supports populations of 26 rare plants and 16 rare animals.

Stand-Alone Standard Sites

There are 26 stand-alone standard sites scattered throughout the county (Fig. 8). These are sites that are too isolated to be grouped into macrosites or megasites. Collectively, they include a variety of habitats, natural community types, and rare plant and animals species. Among them are three nationally significant

Figure 3. Identified Natural Areas

----- boundary of megasites, and macrosites outside of megasites
 boundary of macrosites inside of megasites

- | | | |
|---|--|---|
| 1. Southeastern Brunswick County Megasite | 21. Waccamaw River Aquatic Habitat | 41. Big Neck Road at Millpond Bay |
| 2. Boiling Spring Lakes--Wetland Complex Megasite | 22. Juniper Creek Floodplain | 42. Brantley Island |
| 3. Military Ocean Terminal Ocean Point | 23. Waccamaw River Oxbow Site | 43. Brunswick River/Cape Fear River Marshes |
| 4. Pleasant Oaks Plantation | 24. Scipio Swamp Ridge-and-Swale Boggy Openings | 44. Bryant Mill (Greenbank) Bluff |
| 5. Big Cypress Bay and Ponds | 25. Middle Waccamaw River Macrosite | 45. Camp Branch Savanna Remnant |
| 6. Boiling Spring Lakes--Limesink Complex | 26. Reeves Area Floodplain | 46. Colkins Neck Remnant |
| 7. Hog Branch Ponds | 27. Regan Ridge-and-Swale Openings | 47. Lower Cape Fear River Aquatic Habitat |
| 8. Pretty Pond Limesink Complex | 28. Waccamaw Island Savanna | 48. Spring Creek Ponds |
| 9. Southport Ferry Landing Forest | 29. Waccamaw River Ridge-and-Swale Boggy Openings | 50. Sunset Beach Wood Stork Ponds |
| 10. Sunset Harbor--Ash Swamp | 30. Waccamaw River Eleocharis Backwater | 51. Alligator Branch Sandhill and Flatwoods |
| 11. White Spring Ponds Complex | 31. Bald Head Island--Smith Island Complex Macrosite | 52. Bird Island |
| 12. Bethel Sandhills | 32. Bald Head Island | 53. Boone Neck Maritime Forest |
| 13. Goose Landing | 33. Bluff Island and East Beach | 54. Drowned Bay Savanna |
| 14. NC 133 Loosestrife Site | 34. Zekes Island Estuarine Sanctuary | 55. Fall Swamp--Middle River Limesink Complex |
| 15. Orton Plantation Macrosite | 35. Middle Island | 56. Henrytown Savanna |
| 16. Orton Pond | 36. Battery Island | 57. Lockwoods Folly River Tidal Wetlands |
| 17. Orton Creek Savanna | 37. Green Swamp Macrosite | 58. Long Bays Savanna and Carolina Bays |
| 18. Blue Pond | 38. Myrtle Head Savanna | 59. Sandy Branch Sand Ridge and Bay Complex |
| 19. Orton Powerline Loosestrife Site | 39. Town Creek Marshes and Swamp | 60. Secession Maritime Forest |
| 20. Waccamaw River Wetlands Megasite | 40. Battle Royal Bay | 61. Shallotte Creek Sandhills |
| | | 62. Sturgeon Creek Tidal Wetlands |

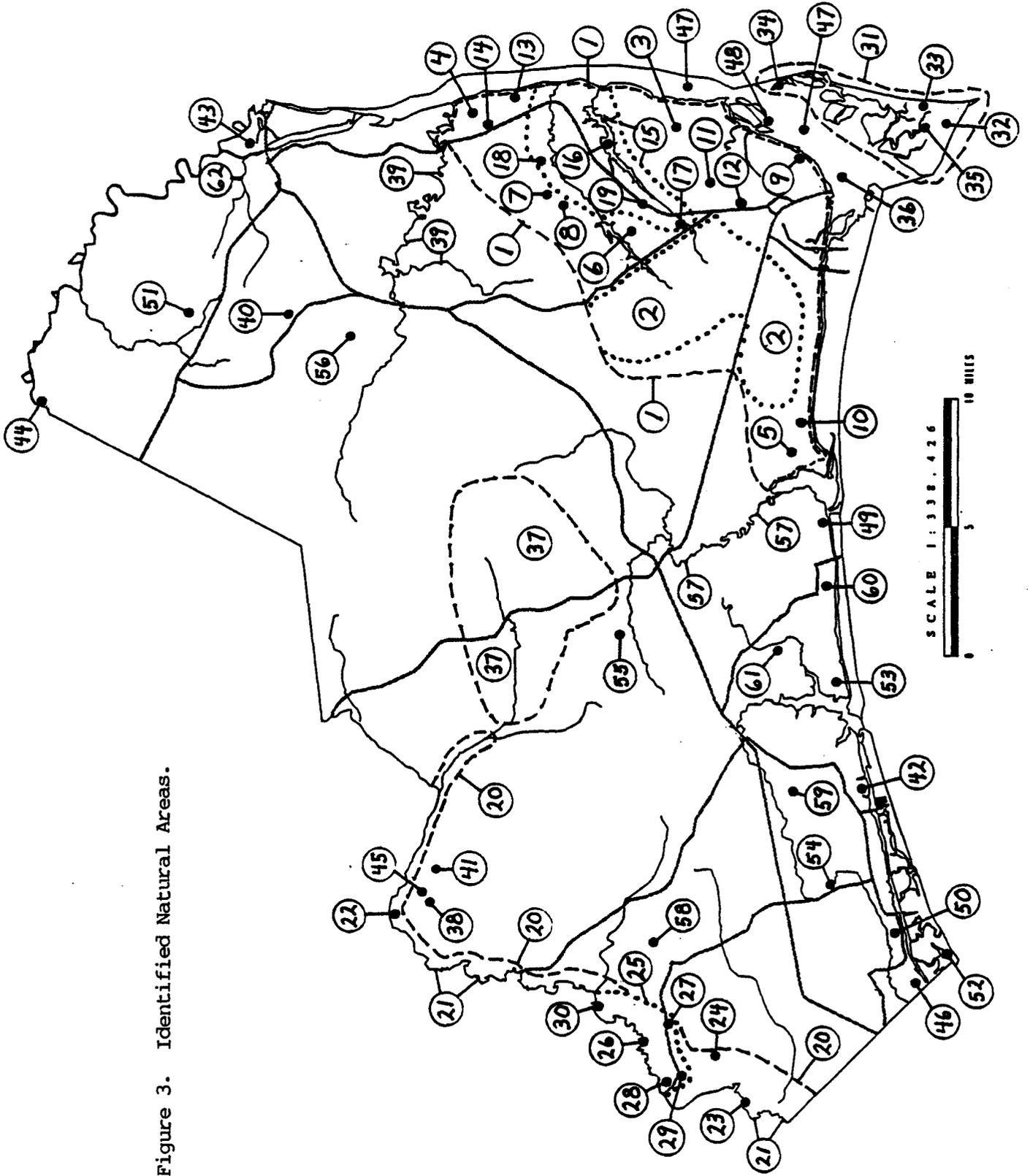


Figure 3. Identified Natural Areas.

Figure 4. Southeastern Brunswick County Megasite.

- boundary of megasite
 - boundary of macrosites inside of megasite
1. Southeastern Brunswick County Megasite
 2. Boiling Spring Lakes--Wetland Complex Macrosite
 3. Military Ocean Terminal Ocean Point
 4. Pleasant Oaks Plantation
 5. Big Cypress Bay and Ponds
 6. Boiling Spring Lakes--Limesink Complex
 7. Hog Branch Ponds
 8. Pretty Pond Limesink Complex
 9. Southport Ferry Landing Forest
 10. Sunset Harbor--Ash Swamp
 11. White Spring Ponds Complex
 12. Bethel Sandhills
 13. Goose Landing
 14. NC 133 Loosestrife Site
 15. Orton Plantation Macrosite
 16. Orton Pond
 17. Orton Creek Savanna
 18. Blue Pond
 19. Orton Powerline Loosestrife Site

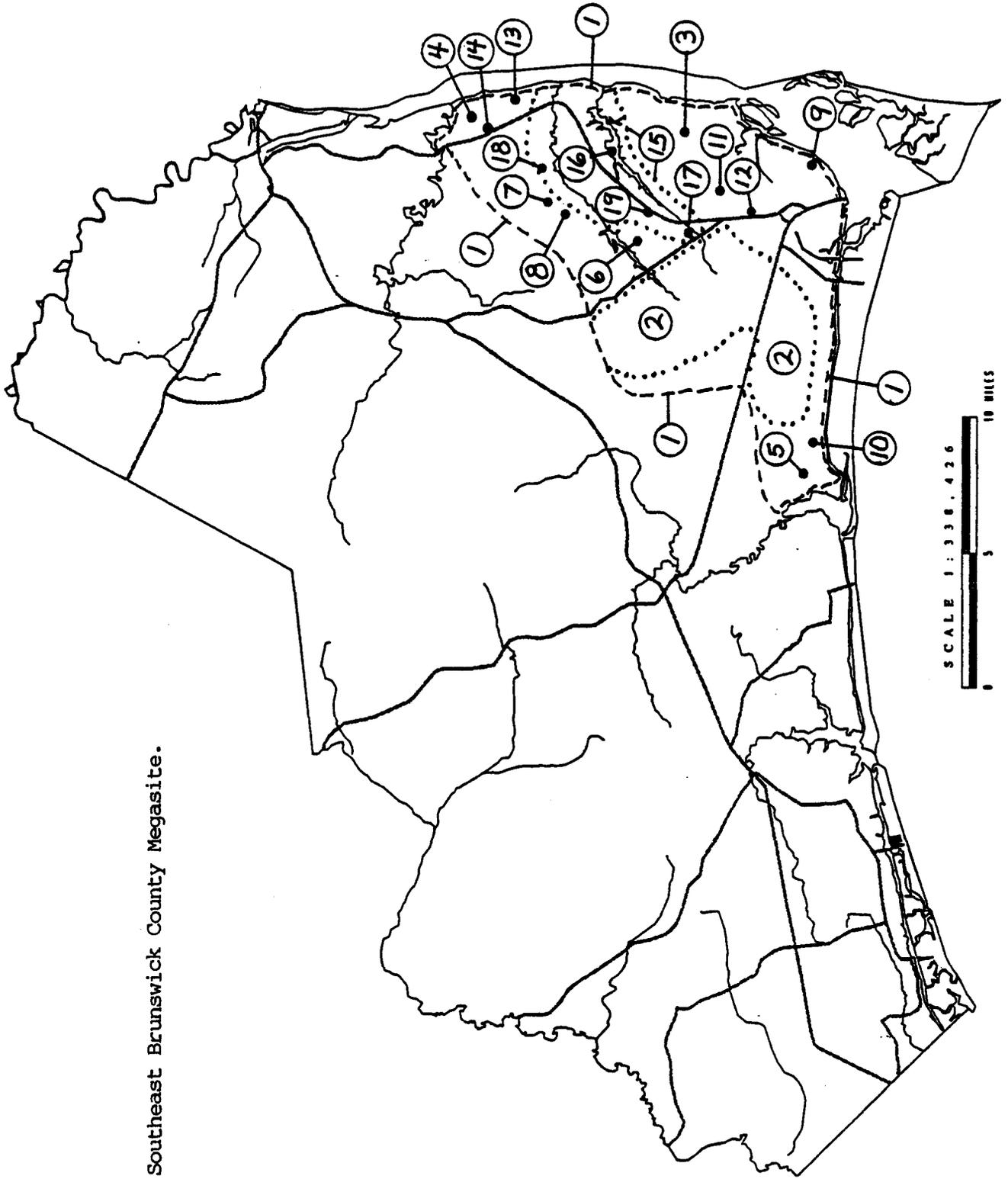


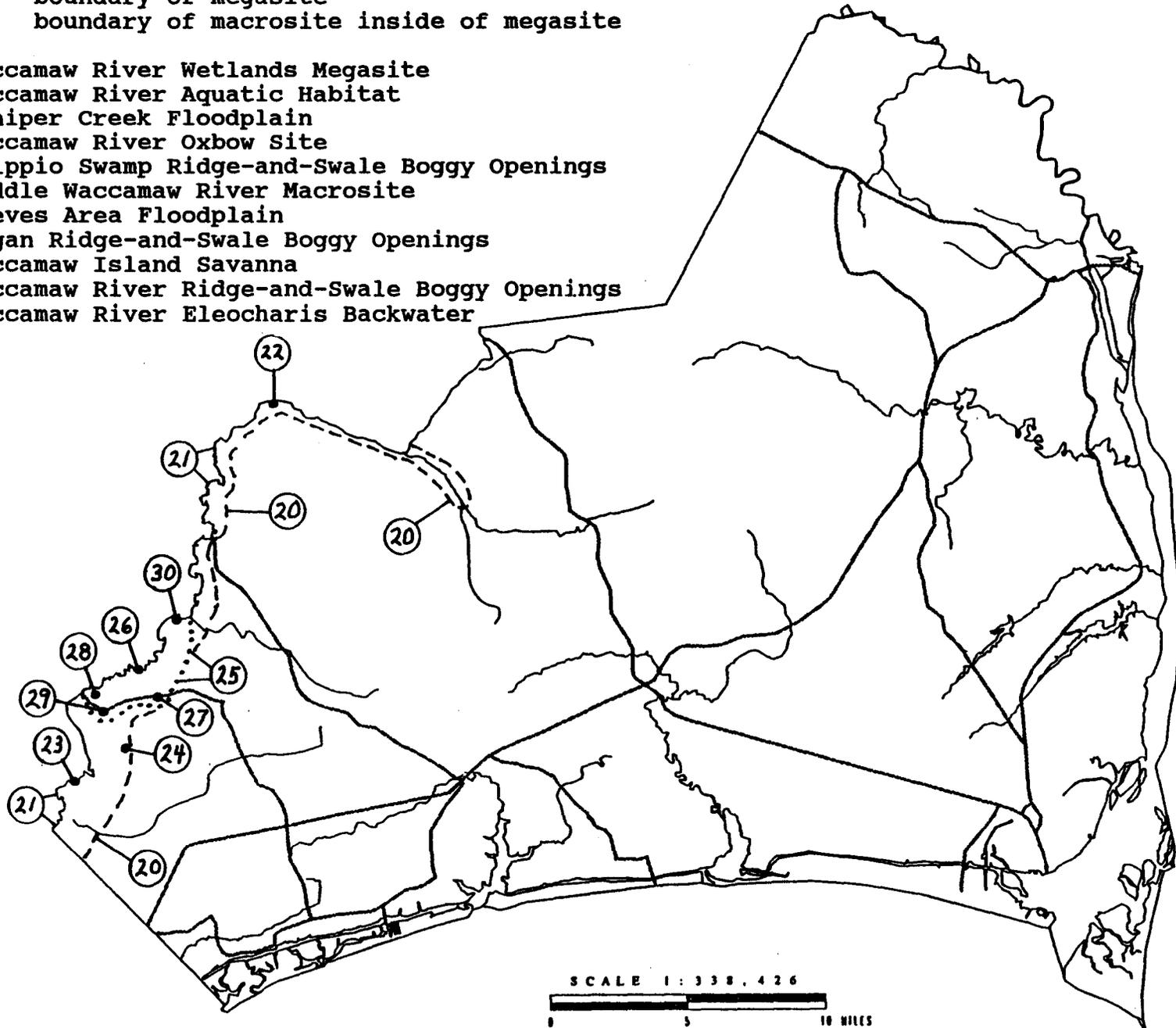
Figure 4. Southeast Brunswick County Megasite.

Figure 5. Waccamaw River Wetlands Megasite.

----- boundary of megasite
 boundary of macrosite inside of megasite

- 20. Waccamaw River Wetlands Megasite
- 21. Waccamaw River Aquatic Habitat
- 22. Juniper Creek Floodplain
- 23. Waccamaw River Oxbow Site
- 24. Scipio Swamp Ridge-and-Swale Boggy Openings
- 25. Middle Waccamaw River Macrosite
- 26. Reeves Area Floodplain
- 27. Regan Ridge-and-Swale Boggy Openings
- 28. Waccamaw Island Savanna
- 29. Waccamaw River Ridge-and-Swale Boggy Openings
- 30. Waccamaw River Eleocharis Backwater

51



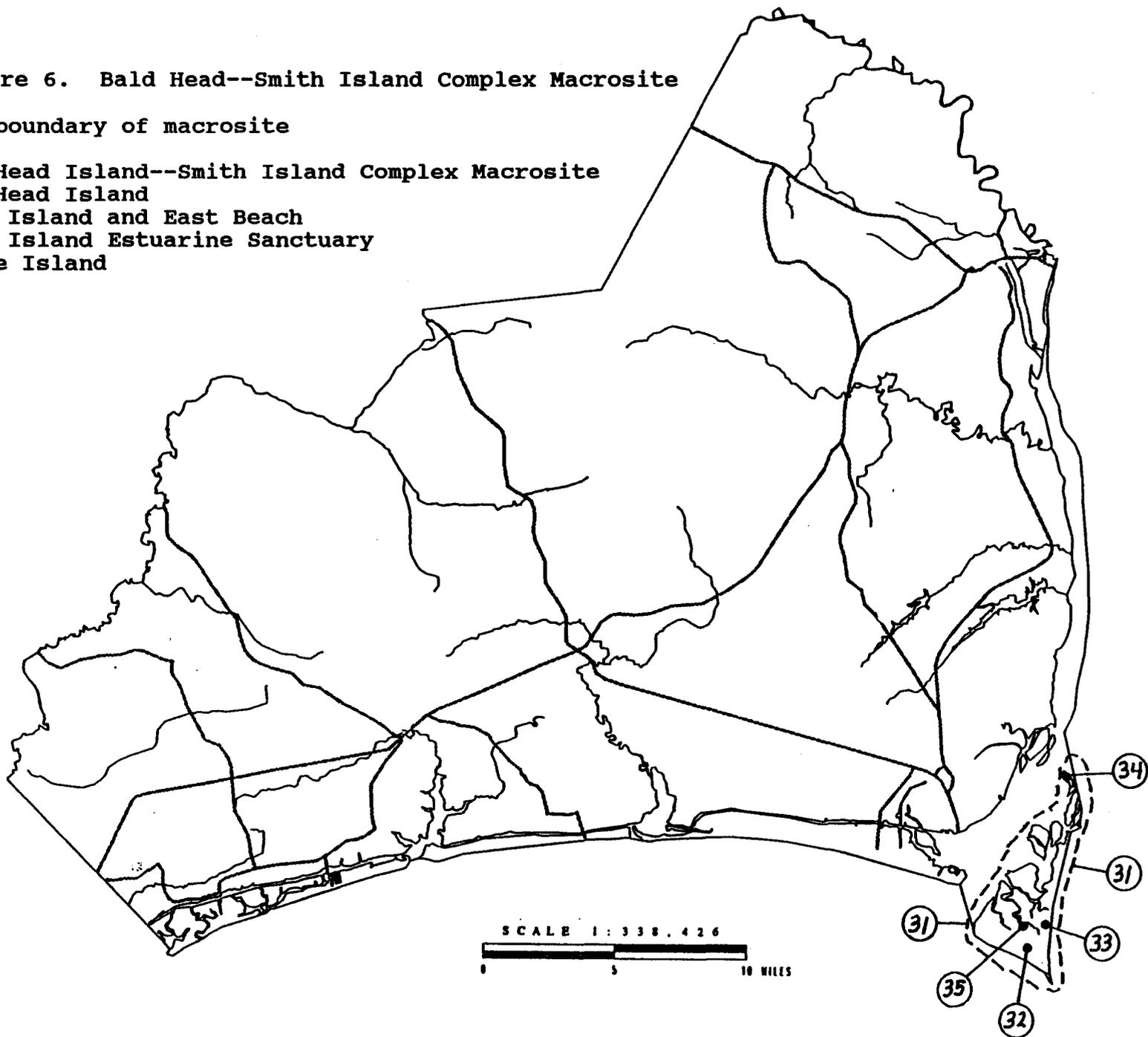
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Figure 6. Bald Head--Smith Island Complex Macrosite

----- boundary of macrosite

- 31. Bald Head Island--Smith Island Complex Macrosite
- 32. Bald Head Island
- 33. Bluff Island and East Beach
- 34. Zekes Island Estuarine Sanctuary
- 35. Middle Island

53



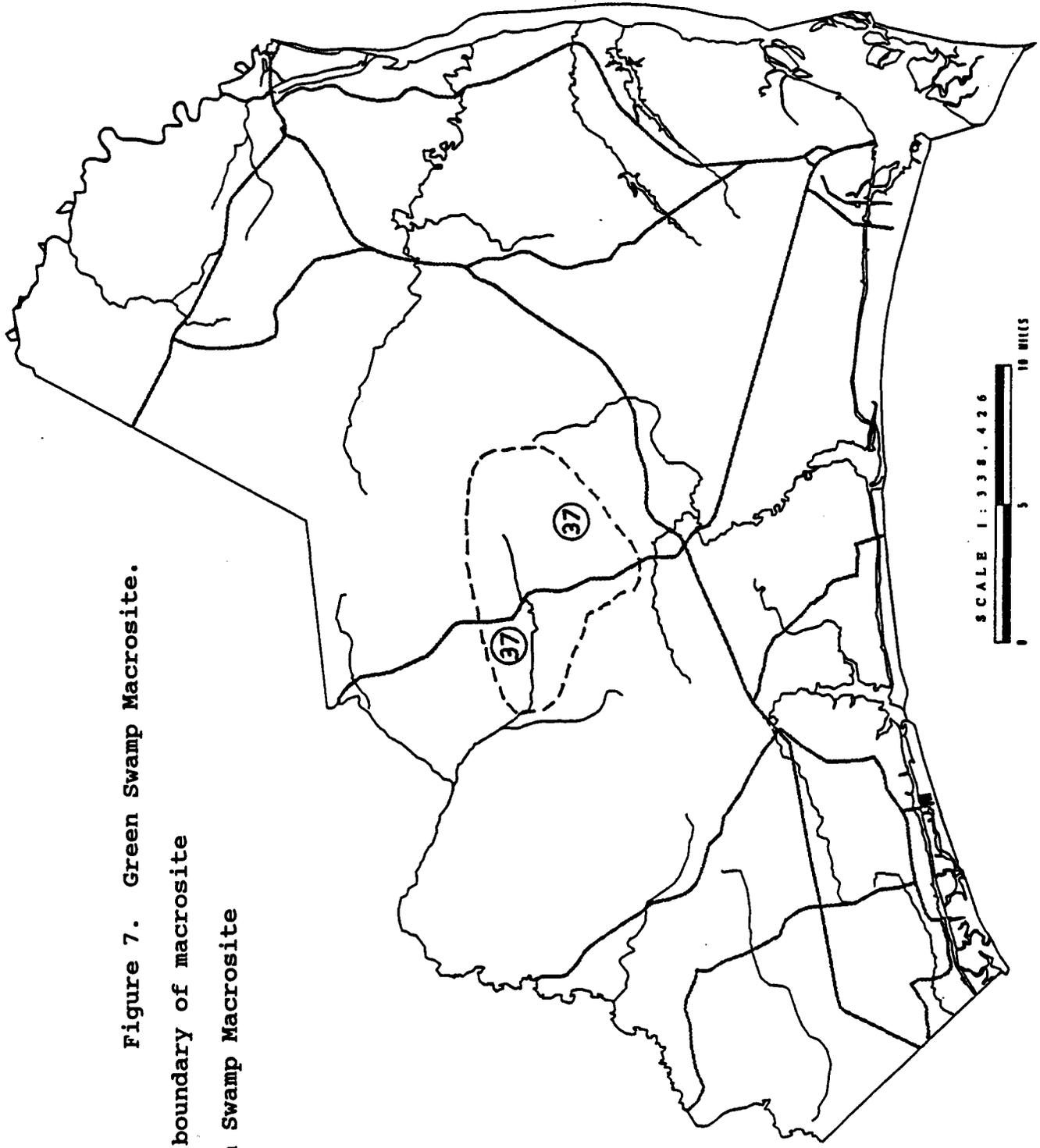


Figure 7. Green Swamp Macroosite.

----- boundary of macroosite

37. Green Swamp Macroosite

Figure 8. Other Natural Areas

36. Battery Island
38. Myrtle Head Savanna
39. Town Creek Marshes and Swamp
40. Battle Royal Bay
41. Big Neck Road at Millpond Bay
42. Brantley Island
43. Brunswick River/Cape Fear River Marshes
44. Bryant Mill (Greenbank) Bluff
45. Camp Branch Savanna Remnant
46. Colkins Neck Remnant
47. Lower Cape Fear River Aquatic Habitat
48. Lower Cape Fear River Bird Nesting Islands
49. Spring Creek Ponds
50. Sunset Beach Wood Stork Ponds
51. Alligator Branch Sandhill and Flatwoods
52. Bird Island
53. Boone Neck Maritime Forest
54. Drowned Bay Savanna
55. Fall Swamp--Middle River Limesink Complex
56. Henrytown Savanna
57. Lockwoods Folly River Tidal Wetlands
58. Long Bays Savanna and Carolina Bays
59. Sandy Branch Sand Ridge and Bay Complex
60. Secession Maritime Forest
61. Shallotte Creek Sandhills
62. Sturgeon Creek Tidal Wetlands

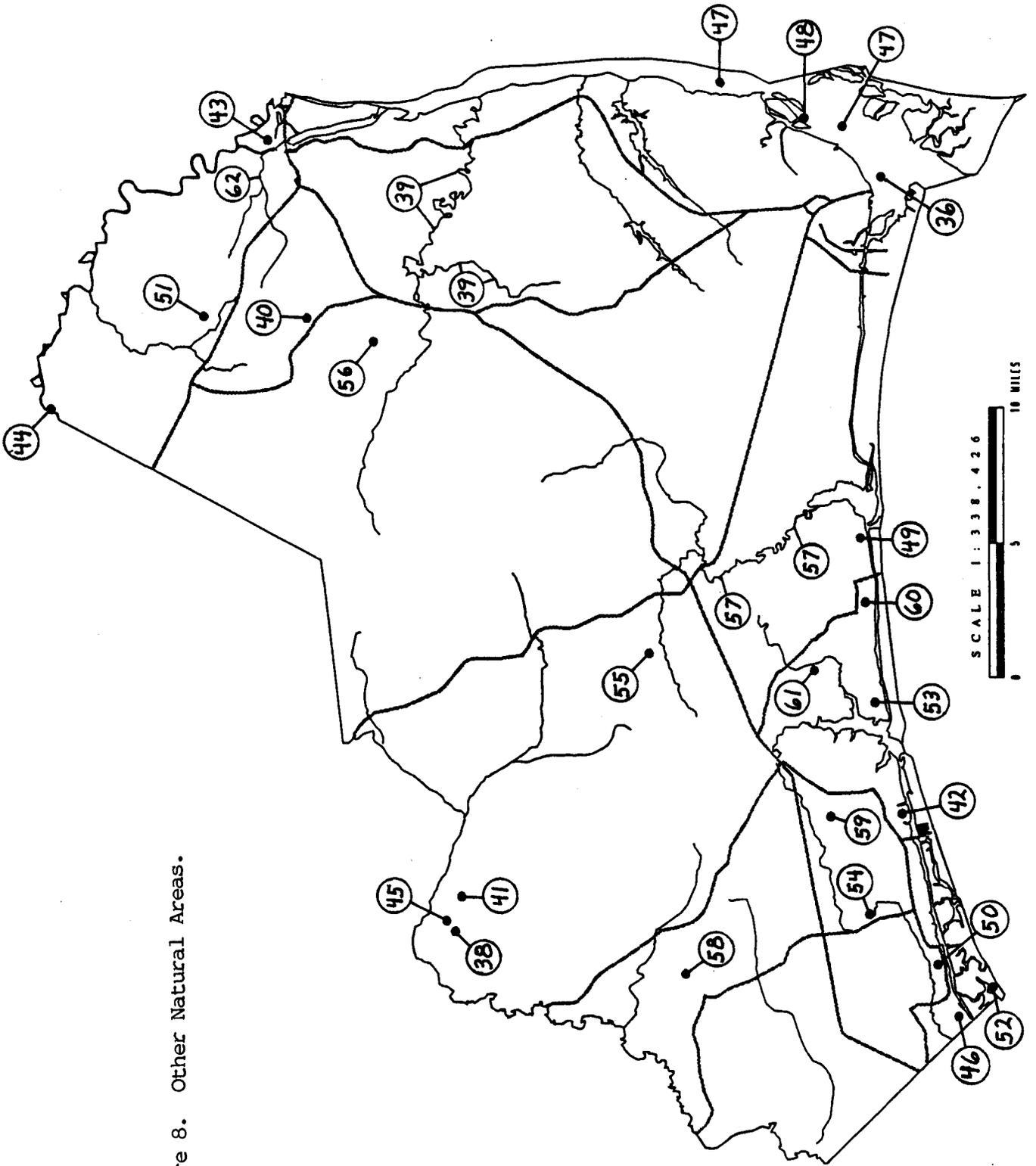


Figure 8. Other Natural Areas.

sites: Battery Island, Myrtle Head Savanna, and Town Creek Marshes and Swamp.

Sites Added From 1993/1994 Inventory Surveys

Fourteen nationally, statewide, or regionally significant standard sites first identified as such during the 1993/1994 inventory are included in the totals and descriptions. They are: Hog Branch Ponds, White Spring Ponds Complex, Bethel Sandhills, Goose Landing, Scipio Swamp Ridge-and-Swale Boggy Openings, Regan Ridge-and-Swale Boggy Openings, Town Creek Marshes and Swamp, Big Neck Road at Millpond Bay, Alligator Branch Sandhill and Flatwoods, Fall Swamp--Middle River Limesink Complex, Lockwoods Folly River Tidal Wetlands, Sandy Branch Sand Ridge and Bay Complex, Shallotte Creek Sandhills, and Sturgeon Creek Tidal Wetlands.

Rare Species

A total of 59 rare animal species and 112 rare plant species are known from Brunswick County (Tables 1 and 2). Of these, 11 rare plant species were first discovered in the county during the 1993/1994 inventory, including one species variety new to North Carolina, Scribner's witch grass (Dichantheium oligosanthos var. scribnerianum). Greenfield ramshorn snail (Helisoma eucosmium), officially listed as extinct, was rediscovered--and first discovered from Brunswick County--in 1994 by a biologist from the University of North Carolina-Wilmington. A plant known only historically throughout its range, swamp forest beaksedge (Rhynchospora decurrens), was rediscovered during the 1993/1994 inventory. A plant known only historically in North Carolina, cypress knee sedge (Carex decomposita), was also rediscovered during the inventory.

THREATS TO NATURAL AREAS

Impacts to Forest Communities

Clearcuts and conversion of native forests to pine or hardwood plantations severely impact or eliminate natural communities. However, the impact varies with intent. Clearing forests for cropland or land development obviously eliminates natural communities. Clearcuts of native forests that are allowed to regenerate may eventually succeed to the original natural community type, depending on such factors as degree of ground surface disturbance and invasion by opportunistic species. Clearcuts followed by site preparation for plantations can have severe impacts on the ability of natural communities to eventually recover. Plantation bedding is particularly disruptive, as soils and hydrology are heavily disturbed for long periods. In

pinelands, plantations and controlled regeneration usually result in a closed canopy, which shades out the herbaceous ground cover typical of naturally open longleaf pine communities. In hardwood forests, a dense canopy is natural, but clear-cutting usually leads to a shift in dominant species, with loblolly pine particularly opportunistic. Soil disturbances associated with logging can be very destructive to native forests. Heavy equipment on wet soils causes long-lasting ruts. Impacts from roller chopping and disking vary with intensity and natural community type. The importance of the herb layer and restricted reproductive requirements of wiregrass (Aristida stricta) make longleaf pine communities particularly susceptible to these practices.

Ditching and draining of low-lying forests "can change the hydrology of an area and significantly increase the rate and flow of stormwater runoff" (NCWQS 1994). By channeling surface runoff and groundwater away from an area, ditches greatly reduce the floodwater storage function of low-lying forests. The filtering function of these forests is also aborted, and sediment, nutrients, and toxins are directly channeled into lakes, streams, and rivers.

Fire suppression has a significant impact on longleaf pine communities (e.g., Pine Savannas, Wet Pine Flatwoods). These forests are naturally fire-adapted, and many species are dependent on fire for regeneration, particularly the dominant grasses. Lack of fire leads to the development of unnaturally dense shrub layers, and hardwood competition in the canopy. Plow lines in the ecotone between longleaf pine communities and adjacent wetlands alter soils and hydrology, and lead to changes in community structure and composition.

Impacts to Water Bodies

"Sediment is the most widespread cause of impairment to stream water quality and biological integrity" for blackwater rivers and streams in southeastern North Carolina (ibid.). Sediment can gradually fill lakes, ponds, and rivers, causing changes in shoreline configuration and impacting water flow in channels and adjacent floodplains. Sediment directly impacts aquatic populations, such as by clogging fish gills and altering the habitat of food sources. Sediment can also lead to increased drinking water treatment costs. "Sediment also serves as a carrier for other pollutants including nutrients (especially phosphorus), toxic metals and pesticides" (ibid.). The leading cause of sedimentation is runoff from agricultural land, ditched forest land, and urban areas. Many small ponds have been impacted by shoreline residential development.

Impacts to Maritime Areas

Barrier island landforms have been severely impacted, and their natural communities greatly reduced in size, by residential and commercial development. The protective functions these barrier features provide to the mainland during storms have also been impaired.

PROTECTION PRIORITIES

A variety of options exist for protecting natural areas and endangered species, ranging from private landowner initiatives to acquisition by private or public conservation agencies. In all cases, conservation works best when citizens are well-informed about the value of natural habitat and take an active role in its protection. In this spirit, governmental acquisition of natural areas by right of eminent domain is not a recommended option. Because land use problems usually cross property and political boundaries, planning, zoning, and land-use regulations can play an important protection role if supported by local citizens.

Conservation efforts should focus on the most significant areas. The highest priority areas in Brunswick County are the Southeastern Brunswick County Megasite, the Waccamaw River Wetlands Megasite, the Bald Head--Smith Island Complex Macrosite, and Green Swamp, a stand-alone macrosite. Portions of some significant natural areas in Brunswick County are already protected for their natural values. A large, high quality area of Green Swamp is owned by The Nature Conservancy, along with Myrtle Head Savanna. A voluntary management agreement between landowners and the N.C. Natural Heritage Program protects portions of Military Ocean Terminal Sunny Point, Orton Powerline Loosestrife Site, and the NC 133 Loosestrife Site. Three areas in the Bald Head--Smith Island Complex Macrosite are owned and managed by the State for protection of natural resources: Bald Head Island Coastal Reserve, Bald Head Island State Natural Area, and Zekes Island Estuarine Sanctuary.

Land Owner Protection Initiatives

The great majority of Brunswick County's natural areas are privately owned and are likely to remain so. Protection of these sites will require not only the good will but the active participation of landowners. Although in many cases the sites have remained in a natural state because of landowner actions to protect their values, owners may not be aware of the many options that can make conservation management more effective and less financially burdensome. This includes the continued management of forests for timber value.

Forest Stewardship Program

One state program that offers assistance in achieving forest management goals is the Forest Stewardship Program sponsored by a number of different state and federal agencies. This program is available to non-industrial private forest landowners holding a minimum of ten acres of forested land, and offers assistance in achieving three or more of the six following stewardship goals: (1) maintenance of forest health and productivity, (2) improvement of fish and wildlife habitat, (3) protection of water quality, (4) enhancement of soil productivity and minimalization of erosion, (5) maintenance and enhancement of aesthetic values, and (6) support for recreational activities. Examples of the management plans this program encourages include controlled burning, re-forestation in natural vegetation, and maintenance of vegetative buffer strips along watercourses.

Each Forest Stewardship Program management plan is tailored to the individual desires of the landowner. Enrollment is entirely voluntary and consists of a pledge by the landowner to abide by the plan. The landowner is also recognized and honored for participation in the program, and may receive property tax benefits if current use is reduced to the base level. Although certain tracts of forest may be left in a completely natural state under a Forest Stewardship Program plan, enrollment in the program assumes that at least part of the property will continue to be used for timber production, hunting leases, recreation, or some other use.

For more information, write to: Forest Stewardship Coordinator, Division of Forest Resources, P.O. Box 27687, Raleigh, NC 27611-7687.

Registry of Natural Areas Program

For owners who wish to preserve their entire tract in a natural state, another option is to register the site under the North Carolina Registry of Natural Areas Program administered by the N.C. Natural Heritage Program (NHP). There is no minimum acreage required for this program, and the land can be forested or open. However, the land must possess rare species, significant natural communities, or other exceptional natural values. Registry is open to all landowners, including timber companies, governments, civic groups, schools, and other institutions.

The registry program relies solely on voluntary agreements by landowners to preserve the registered area in a natural state. The landowner is recognized and honored for protection of significant elements of the state's natural heritage. Management advice may also be provided by the staff of the NHP. Registered sites additionally receive some degree of statutory protection from pipelines and transmission lines. Although there are currently no

tax benefits available for registration alone, the registry program has proven quite successful, and there are now several hundred registered natural areas throughout the state.

For more information, write to: N.C. Natural Heritage Program, Division of Parks and Recreation, P.O. Box 27687, Raleigh, NC 27611-7687.

Conservation Easement

The preceding options depend on voluntary, and thus changeable agreements with the landowner. Another flexible but more permanent option--one that can be transferred along with the property deed--is the conservation easement. In this increasingly popular conservation option, the owner retains the title to the property and continues to exercise certain property rights, including control of access to the public. Other rights, such the right to develop, log, or mine the site, are deeded over to a recognized conservation organization established to preserve such tracts in a natural state. Provisions of the conservation easement are enforceable in civil court, and legally specify certain rights and responsibilities of both the landowner and the recipient of the easement. Each easement is tailored to suit the unique characteristics of individual properties and the needs and desires of the landowner.

Although more restrictive than the Forest Stewardship Program and the Registry of Natural Areas Program, there are several reasons why this option may be preferred. It represents a greater degree of partnership between the landowner and a conservation group. Any costs involved in formulating and implementing management plans for the natural area can be shared, or even made the prime responsibility of the conservation organization. The easement is permanently attached to the property title, and passed along from one owner to another, from generation to generation. This may be the greatest benefit to an owner who desires to preserve a tract in its natural state in perpetuity. There may also be tax benefits. Limits on development and other uses of the tract may result in a reduction of estate, inheritance, and property taxes. Conservation easements are either sold or donated, depending on the circumstances of the landowner, the tract, and the receiving organization. If the easement is donated, it can also constitute a charitable contribution, allowing a deduction to be made on state and federal income taxes.

For more information, write to: North Carolina Coastal Land Trust, 313 N. Front St., Suite A, Wilmington, NC 28401. The Coastal Land Trust is a private non-profit organization.

Transfer of Ownership

When an owner of a high quality natural area does not wish to maintain an active involvement in its management and is willing to part with the tract, transfer of ownership through sale or donation to a conservation organization or agency is the simplest way of assuring permanent protection. As with the conservation easement, there may be several state and federal tax benefits associated with the transfer of property. The benefits vary depending on whether the transfer takes the form of a donation, bargain sale, or sale at fair market value. Title restrictions can be added, allow the transferring owner to contribute to the permanent management plans for the tract.

Two private conservation organizations that acquire natural areas either by donation or purchase are the North Carolina Coastal Land Trust (see "Conservation Easement" above for address) and the North Carolina Nature Conservancy, Carr Mill, Suite D12, Carrboro, NC 27510.

AREAS FOR ADDITIONAL SURVEY WORK

This report provides as complete a picture as possible of the significant natural areas of Brunswick County. It combines past knowledge of the county with information gathered during the 1993 and 1994 surveys. Additional survey work is needed for rare animal populations, to monitor the condition through time of known significant sites, and to locate potential new sites. The scope of the current inventory did not permit a complete survey of areas with limited or difficult access. Areas that should be investigated in future surveys include:

- floodplain forests along the Cape Fear River upstream from Lake Sutton (in New Hanover County);
- tidal wetlands along Hood Creek;
- Waccamaw River floodplain and low terraces (a large area that has been only partially surveyed);
- sandhills west of highway NC 133 and north of McKinzie Pond;
- uplands along Town Creek east of Winnabow, in the vicinity of the railroad crossing and Mallory Creek;
- mineral soil forests near the headwaters of Mulberry Branch and South Prong Wet Ash Swamp, north of Shallotte;
- Horse Pen Swamp and Clayton Bay area north of Freeland;
- sandhills southeast of the confluence of the Shallotte River and Sharron Creek;
- remnant maritime forest along the mainland coastal edge; and
- mineral soil forests east of Turkey Branch and west of Little Green Swamp.

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INVENTORY OF SITES

This section contains a description of all megasites, macrosites, and standard sites identified during the inventory. By their nature, megasites and macrosites are described in general terms. The descriptions of standard sites are more detailed, and include the following:

SITE NAME: name assigned to the site by the N.C. Natural Heritage Program.

SITE SIGNIFICANCE: whether the site is of national, statewide, or regional geographic significance. Sites of countywide or lesser significance are not described.

SIZE: in acres when known, usually estimated.

QUADRANGLE: the U.S.G.S. topographic quadrangle map(s) on which the site occurs.

LOCATION: placement of the site in relation to a known landform, such as a road, town, river, etc.

SIGNIFICANT FEATURES: biological and geophysical features that give the site its significance.

GENERAL DESCRIPTION: a description of the biological and topographical features of the site, focusing on the natural communities.

OWNERSHIP: name of owner given only when publicly owned, or privately owned by a conservation organization.

PROTECTION STATUS: type of protection provided, if any.

MANAGEMENT/PROTECTION RECOMMENDATIONS: brief discussion of threats and impacts, and recommendations for maintenance or restoration of natural conditions.

REFERENCES: literature and reports specific to the site.

SOUTHEASTERN BRUNSWICK COUNTY MEGASITE

The Southeastern Brunswick County Megasite consists of most of the southeastern quarter of the county. It is approximately bounded by Town Creek and Buck Road (SR 1518) on the north, Midway Road (SR 1500) and Sunset Harbor on the west, the Intracoastal Waterway on the south, and the Cape Fear River on the east. The megasite is characterized by broad upland terraces with low relief, and large pocosins. Small streams and their tributaries form channels in the terraces, and a few of the streams have been dammed, forming large impoundments.

A variety of geomorphic formations contribute to the diversity of natural communities and species in this nationally significant megasite. Small to large Carolina bays are scattered throughout. These features are elliptical basins surrounded by arcuate sand ridges called bay rims. The basins typically support pocosin communities, and the rims support communities dominated by longleaf pine (*Pinus palustris*). A relict dune ridge-and-swale system formed by an ancient ocean shoreline is found south of the Boiling Spring Lakes area. Like the Carolina bays, the dune ridges support longleaf pine communities, and the swales support pocosin, with streams forming in the larger swales. The megasite contains extensive areas of dry upland sandhills, especially in the eastern half. These sandhills also support longleaf pine communities, and contain a remarkable collection of limesink ponds. Communities shaped by maritime influences are found on the edge of the megasite along the Cape Fear River.

Several types of longleaf pine communities occur on the Carolina bay rims, relict dunes, low interstream terraces, and sandhills. Sites with wetter mineral soils support Pine Savanna (two variants) and Wet Pine Flatwoods (two variants). The Pine Savanna has among the highest species richness of any temperate North American natural community, and supports more rare species than any other community type in North Carolina. The drier sandhills support the Coastal Fringe Sandhill and Xeric Sandhill Scrub communities. The megasite contains the global majority of two longleaf pine community variants: the Pine Savanna Pleea Flats Variant, and the Wet Pine Flatwoods *Leiophyllum* Variant. Half or more of the known distribution of Coastal Fringe Sandhill in North Carolina occurs at the megasite.

Also of great significance are the numerous limesink ponds occurring in the megasite, primarily in the area of Boiling Spring Lakes and Military Ocean Terminal Sunny Point. These ponds support the Small Depression Pond natural community. This is the largest concentration of limesink ponds along the Atlantic Coastal Plain north of Florida, and the largest concentration of the Small Depression Pond community between Florida and Cape Cod. In spite

of their small size, the seasonally exposed margins of these ponds are very diverse, and support many rare species.

Nested within the Southeastern Brunswick County Megasite are 16 standard sites and two macrosites. The megasite, itself ranked of national significance, contains three nationally ranked standard sites:

Military Ocean Terminal Sunny Point,
Pleasant Oaks Plantation, and
Orton Pond.

Another eight standard sites are ranked of statewide significance:

Big Cypress Bay and Ponds,
Boiling Spring Lakes--Limesink Complex,
Hog Branch Ponds,
Pretty Pond Limesink Complex,
Southport Ferry Landing Forest,
Sunset Harbor--Ash Swamp,
White Spring Ponds Complex, and
Orton Creek Savanna.

Five standard sites are ranked of regional significance:

Bethel Sandhills,
Goose Landing,
NC 133 Loosestrife Site,
Blue Pond, and
Orton Powerline Loosestrife Site.

Both of the macrosites contained within the megasite--Orton Plantation and Boiling Spring Lakes Wetland Complex--are ranked of national significance. The Orton Plantation Macrosite contains four of the preceding standard sites: Orton Pond, Orton Creek Savanna, Blue Pond, and Orton Powerline Loosestrife Site. The Boiling Spring Lakes--Wetland Complex Macrosite has not been divided into standard sites.

Areas within the megasite not included within a standard site or macrosite have been determined to be of lesser significance, but important to the overall integrity of the area, such as by providing corridors for animal populations and insuring the integrity of standard sites and macrosites. Each of the standard sites and macrosites within the megasite is described in the following pages.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Boiling Spring Lakes--Wetland Complex

SITE SIGNIFICANCE: National **SIZE:** 14,800 acres

COUNTY: Brunswick

QUADRANGLE: Funston / Southport / Lockwoods Folly / Bolivia

LOCATION: West of the town of Boiling Spring Lakes, approximately bounded by highway NC 87 along the east, Wildwood Road along the north, and St. James Plantation and Ash Swamp along the south. The site is bisected west-to-east by highway NC 211. North of NC 211, the western boundary primarily occurs along the edge of plantations and developed land east of Midway Road (SR 1500). South of NC 211, the western boundary primarily occurs along the edge of plantations east of Sunset Harbor Road (SR 1112).

SIGNIFICANT FEATURES:

1. This stand-alone macrosite contains an outstanding assemblage of natural community types, including the global distributional majority of two community variants: the Wet Pine Flatwoods *Leiophyllum* Variant, and the Pine Savanna *Pleea* Flats Variant. Other community types and variants present are High Pocosin, Pond Pine Woodland, Pine Savanna Wet Spodosol Variant, Wet Pine Flatwoods Wet Spodosol Variant, Coastal Fringe Sandhill, and Xeric Sandhill Scrub Coastal Fringe Variant. The combination of all of these community types in fair to excellent condition over a large, contiguous area is remarkable, and not repeated elsewhere at this scale.
2. The site supports a Federally and State Endangered animal species, the red-cockaded woodpecker (*Picoides borealis*).
3. Six federally designated rare plant species occur at the site. These include one Federally and State Endangered species--rough-leaf loosestrife (*Lysimachia asperulifolia*)--and four Federal C2 Candidate species: savanna indigo-bush (*Amorpha georgiana* var. *confusa*), Venus flytrap (*Dionaea muscipula*), pondspice (*Litsea aestivalis*), and Carolina goldenrod (*Solidago pulchra*). Among these, Carolina goldenrod is State Endangered, savanna indigo-bush is State Threatened, Venus flytrap is State Candidate-Special Concern, and pondspice is State Candidate.
4. The site provides habitat for nine plant species designated as rare by the N.C. Natural Heritage Program (NHP). These include five State Candidates species: scale-leaf gerardia (*Agalinis aphylla*), savanna milkweed (*Asclepias pedicellata*), Hooker's milkwort (*Polygala hookeri*), shortbristled beaksedge

(Rhynchospora breviseta), and savanna yellow-eyed-grass (Xyris flabelliformis). Also present are four significantly rare plant species: warty sedge (Carex verrucosa), spoonflower (Peltandra sagittifolia), Fitzgerald's peatmoss (Sphagnum fitzgeraldii), and shortleaf yellow-eyed-grass (Xyris brevifolia).

5. The site contains many Carolina bays and relict dune ridges. These two geomorphic features co-occur in a large area south of the town of Boiling Spring Lakes, with the younger Carolina bays superimposed on the older relict dune ridges and intervening swales. This geomorphic co-occurrence is known from only five global sites, and the Boiling Spring Lakes--Wetland Complex area of co-occurrence appears to be the largest.
6. Eighteen plant species on the watch list maintained by the NHP occur at the site.

GENERAL DESCRIPTION: The Boiling Spring Lakes--Wetland Complex is a large area (about 23 square miles) of mostly flat terrain dominated by pocosins, primarily in small-to-large Carolina bays, relict dune swales, and stream swales. Pond Pine Woodland and High Pocosin are the dominant pocosin community types. Upland habitat occurs on the Carolina bay rims, relict dune ridges, and slightly elevated terraces. Upland habitat typically is only a few feet higher than the adjacent pocosin communities. Soil moisture varies widely in upland areas, as is indicated by the supported community types: Pine Savanna (two variants), Wet Pine Flatwoods (two variants), Coastal Fringe Sandhill, and Xeric Sandhill Scrub. For the most part, these upland communities are dominated by longleaf pine (Pinus palustris). Although the complex is dominated by wetlands, it is higher than most of the surrounding terrain and serves as headwaters for streams flowing east to the Cape Fear River, west to the Lockwoods Folly River, and south to the Intracoastal Waterway. Over most of the site, soils are poorly drained and are semi-permanently moist to saturated.

The pocosin communities occur on wet to saturated, nutrient-poor organic soils underlain by sand. The High Pocosin community primarily occurs on deeper peats in the central portions of Carolina bays, while the Pond Pine Woodland occurs on shallower peats near the perimeters of bays, and in swales and low flats. High Pocosin is distinguished by a sparse canopy of pond pine (Pinus serotina) and scattered loblolly bay (Gordonia lasianthus) and sweetbay (Magnolia virginiana). The shrub layer is dense and ranges from 5-15 feet in height. Dominant shrubs are fetterbush (Lyonia lucida), inkberry (Ilex glabra), titi (Cyrilla racemiflora), and honeycups (Zenobia pulverulenta). Blaspheme-vine (Smilax laurifolia) is abundant. Pond Pine Woodland is distinguished by an open to moderate canopy of pond pine with an understory of loblolly bay, sweetbay, and redbay (Persea

palustris). The dense shrub layer, more than 15 feet high when not recently burned, is dominated by fetterbush and inkberry. Prominent shrubs include titi, coastal sweet-pepperbush (Clethra alnifolia), gallberry (Ilex coriacea), and smooth highbush blueberry (Vaccinium formosum). Blaspheme-vine also is prominent.

Two forms of the Pine Savanna community occur on wet, sandy soil at the site: the Wet Spodosol Variant and the Pleea Flats Variant. Pine Savanna is characterized by an open longleaf pine and pond pine canopy over a mosaic of shrub and herb patches. Loblolly bay is a sparse but prominent subcanopy tree. Prominent shrubs include blue huckleberry (Gaylussacia frondosa) and sand-myrtle (Leiophyllum buxifolium). Dominant grasses include wiregrass (Aristida stricta) and Carolina dropseed (Sporobolus sp. 1). The Wet Spodosol Variant contains a very diverse herb layer, with grassleaf blazing-star (Liatris graminifolia), slender fragrant goldenrod (Euthamia tenuifolia), yellow meadow-beauty (Rhexia lutea), and savanna honeycomb-head (Balduina uniflora) prominent. The Pleea Flats Variant ground layer is dominated by rush-featherling (Pleea tenuifolia). Pine Savanna habitat is most extensive on low terraces southeast of the town of Boiling Spring Lakes. It is somewhat obscured in this area by dense shrub patches, apparently the result of fire suppression.

The two Wet Pine Flatwoods variants occur on wet, sandy soil of bay rims, relict dune ridges, and low upland terraces. The open canopy is dominated by longleaf pine, with pond pine and loblolly pine (Pinus taeda) prominent in places. The moderately dense ground layer is a mosaic of shrub and herb patches. Dominant shrubs are blue huckleberry, dwarf huckleberry (Gaylussacia dumosa), inkberry, sand-myrtle, and creeping blueberry (Vaccinium crassifolium). Wiregrass is the dominant herb, and pyxie-moss (Pyxidantha barbulata) is prominent. The Leiophyllum Variant differs from the Wet Spodosol Variant by having sand-myrtle as a dominant or codominant in the ground layer. As with the Pine Savanna, the well-developed shrub layer in the Wet Pine Flatwoods occurrences appears to be the result of fire suppression. Wet Pine Flatwoods occurrences are scattered throughout the site.

The highest bay rims, relict dune ridges, and upland terraces support two dry sand communities: Coastal Fringe Sandhill and Xeric Sandhill Scrub. Coastal Fringe Sandhill is characterized by an open to sparse canopy of longleaf pine and a moderate to sparse subcanopy of sand live oak (Quercus geminata). Prominent low shrubs include dwarf huckleberry, inkberry, yaupon (Ilex vomitoria), and wax-myrtle (Myrica cerifera var. cerifera). Wiregrass is the most frequent dominant in the sparse herb layer, with sandy-field beaksedge (Rhynchospora megalocarpa), little bluestem (Schizachyrium scoparium), and wireplant (Stipulicida setacea) prominent. Xeric Sandhill Scrub is characterized by an open canopy of longleaf pine, with loblolly pine occasionally prominent. The subcanopy is dominated by turkey oak (Quercus

laevis). The sparse ground layer is dominated by lichens (Cladonia spp.), with wiregrass and milk purslane (Chamaesyce maculata) prominent. Xeric Sandhill Scrub occurs on the highest and driest portions of rims, ridges, and terraces. These sandhill communities are most common in the vicinity of highway NC 211.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Primary impacts to the site are fire suppression and conversion of upland habitat to pine plantations. Deep ditching is primarily restricted to the area near the town of Boiling Spring Lakes, where much of the undeveloped habitat, including Carolina bay pocosins, has been subdivided into small lots. Prescribed burns are needed to restore the natural structure and composition of the fire-dependent communities at the site. Upland habitat converted to pine plantations--mostly slash pine (Pinus elliottii)--should be considered for restoration of indigenous communities, particularly if planted areas are unbedded. Ditches should be blocked to restore the area's natural hydrology.

REFERENCES:

- Carter, J.H., III. 1991. Longleaf pine survey of the Sandhills and southwestern Coastal Plain. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.
- LeBlond, R.J. 1994. Preserve design for Boiling Spring Lakes Wetland Complex, Brunswick County, North Carolina. North Carolina Nature Conservancy, Carrboro.
- Nifong, T.D. 1981. Smithville Carolina Bay Complex. In Natural areas inventory of Brunswick County, North Carolina, pp. 200-208. Coastal Energy Impact Program Report No. 10, N.C. Coastal Management Program.
- Taylor, A.Y., and S. Cooper. 1987. Ecological reconnaissance of Boiling Springs region of Brunswick County. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.
- West, E.D., and G.W. Shivar. 1971. A survey of bog communities in southeastern North Carolina. Department of Biology, University of North Carolina at Wilmington.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Military Ocean Terminal Sunny Point

SITE SIGNIFICANCE: National **SIZE:**

COUNTY: Brunswick / New Hanover

QUADRANGLE: Carolina Beach / Kure Beach / Southport / Funston

LOCATION: Along the Cape Fear River southeast of Boiling Spring Lakes and northeast of Southport.

SIGNIFICANT FEATURES:

1. This site supports 26 species of rare plants and animals, and contains areas of high quality natural communities.
2. Four rare animals have been documented from the site, all of which are Federally designated: American alligator (Alligator mississippiensis), red-cockaded woodpecker (Picoides borealis), Carolina gopher frog (Rana capito capito), and Cape Fear threetooth (Triodopsis soelneri). The red-cockaded woodpecker is Federally and State Endangered, and the American alligator is Federally and State Threatened. The Carolina gopher frog is a Federal C2 Candidate and State Special Concern amphibian, while the Cape Fear threetooth is a Federal C2 Candidate and State Threatened mollusk.
3. A total of 22 rare plant species have been found at the site, the majority of which are associated with the many limesink ponds present.
 - a. Among the rare plants are three Federally designated species: pondspice (Litsea aestivalis), rough-leaf loosestrife (Lysimachia asperulifolia), and loose watermilfoil (Myriophyllum laxum). Rough-leaf loosestrife is Federally and State Endangered, loose watermilfoil is a Federal C2 Candidate and State Threatened species, and pondspice is a Federal and State Candidate.
 - b. Among non-Federally designated rare plants, two are State Threatened: Carolina grasswort (Lilaeopsis carolinensis) and dwarf bladderwort (Utricularia olivacea).
 - c. Another five rare plants are State Candidates: savanna milkweed (Asclepias pedicellata), Robbins' spikerush (Eleocharis robbinsii), limesink dog-fennel (Eupatorium leptophyllum), southern bogbutton (Lachnocaulon beyrichianum), and coastal beaksedge (Rhynchospora pleiantha).

- d. An additional 12 plant species are significantly rare in North Carolina: erectleaf witch grass (Dichanthelium erectifolium), beaked spikerush (Eleocharis rostellata), flaxleaf seedbox (Ludwigia linifolia), shrubby seedbox (Ludwigia suffruticosa), southeastern panic grass (Panicum tenerum), spoonflower (Peltandra sagittifolia), hairy smartweed (Polygonum hirsutum), long-beak baldsedge (Rhynchospora scirpoides), Tracy's beaksedge (Rhynchospora tracyi), quillwort arrowhead (Sagittaria isoetiformis), Georgia nutrush (Scleria georgiana), and shortleaf yellow-eyed-grass (Xyris brevifolia).
4. The site supports high quality natural communities, including the rare Wet Pine Flatwoods Leiophyllum Variant, and the uncommon Small Depression Pond community types. The Wet Pine Flatwoods Leiophyllum Variant is globally restricted to southeastern North Carolina. The Small Depression Pond natural community is restricted to a few scattered regions along the Atlantic Coastal Plain, and this site contains one of the largest concentrations of ponds in North Carolina.

GENERAL DESCRIPTION: Military Ocean Terminal Ocean Point (MOTSU) is a Department of Defense installation with restricted access. As such, natural area surveys have been necessarily limited. Nonetheless, the limesink ponds at MOTSU have been studied, and biological studies have been and are currently being conducted. Much of the land surface has been converted for conduction of the mission of the installation, and portions have been used for the deposition of dredge spoil. In addition to the Small Depression Pond and Wet Pine Flatwoods Leiophyllum Variant communities, other natural communities are known to occur within that portion of MOTSU located in Brunswick County. These include the Pine Savanna and Wet Pine Flatwoods Wet Spodosol variants, and the Coastal Fringe Sandhill. Except for the Small Depression Pond, these communities are little-studied at MOTSU.

The Small Depression Pond community occurs in limesink depressions within the sandy uplands. These depressions are believed to have been created by subterranean collapse of limestone deposits, resulting in the slumping of overlying sand deposits. Ponds form where these depressions intersect groundwater. When water levels drop during the growing season, the exposed pond margins support a diverse herb layer with several rare plant species. Characteristic species include spadeleaf (Centella erecta), pinebarren rush (Juncus abortivus), southern bogbutton, witch grasses (Dichanthelium spp.), and beaksedges (Rhynchospora spp.).

OWNERSHIP: U.S. Department of Defense.

PROTECTION STATUS: A portion of the site is a Registered Natural Heritage Area.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Specific management and protection recommendations cannot be made until a natural areas inventory is conducted on the installation. In general, longleaf pine (Pinus palustris) communities--savannas, flatwoods, sandhills--are fire-adapted and should be burned every few years. Limesink basins supporting the Small Depression Pond community should be protected from surface disturbances, and from impacts to groundwater quality and volume.

REFERENCES:

Dumond, D.M. 1981. Botanical reconnaissance and vegetation survey of 55 ponds, Military Ocean Terminal Sunny Point, North Carolina. Report to Military Ocean Terminal Sunny Point and Army Corps of Engineers.

Nifong, T.D. 1981. Sunny Point Limesinks. In Natural areas inventory of Brunswick County, North Carolina, pp. 216-238. Coastal Energy Impact Program Report No. 10, N.C. Coastal Management Program.

Parnell, J.F. 1976. National landmark evaluation: the Sunny Point ponds. Report to U.S. National Park Service, Department of Interior, Atlanta, Ga.

Dry sands of upland terraces and ridges support the two sandhill communities. Coastal Fringe Sandhill is characterized by an open to sparse longleaf pine (*Pinus palustris*) canopy over an open to dense sand live oak (*Quercus geminata*) subcanopy, with other dry soil oak species prominent in the subcanopy. The low shrub and herb layers are open to sparse. Dwarf huckleberry (*Gaylussacia dumosa*) is prominent in the shrub layer, and wiregrass (*Aristida stricta*) dominates the herb layer. Xeric Sandhill Scrub is characterized by an open to moderately dense pine canopy over a moderate to dense oak subcanopy and open to sparse shrub and herb layer. Longleaf pine is the canopy dominant, and turkey oak (*Quercus laevis*) dominates the subcanopy. Collectively, several other oak species are prominent in the subcanopy. Blue huckleberry (*Gaylussacia frondosa*) is a frequent dominant in the shrub layer, and wiregrass is the herb layer dominant, though often sparsely so. Most of the area occupied by the sandhill communities has been disturbed by clearing and ground scrapes, but longleaf pine is regenerating at several microsites. Fire suppression is a controlling influence throughout the community's occurrence.

A few surface depressions known as limesinks occur at scattered localities at the site. They are thought to be caused by subterranean collapse of limestone deposits, resulting in the slumping of overlying sand deposits. These depressions intersect groundwater and support the Small Depression Pond community. When water level drops during the growing season, the exposed pond margins support a diverse herb layer with several rare plant species. The most frequent dominants are longleaf three-awn (*Aristida palustris*), Wright's witch grass (*Dichanthelium wrightianum*), and Tracy's beaksedge. Other prominent herbs include Torrey's nutrush (*Scleria muhlenbergii*), and spadeleaf (*Centella erecta*). Sparsely scattered low trees and shrubs are occasionally present. The site contains three excellent examples of this community type.

There are two occurrences of the Coastal Plain Semipermanent Impoundment at the site: Beaverdam Pond and Sand Hill Creek pond. Both habitats are dammed and permanently flooded, but the dominant flora differs. At Beaverdam Pond, the dominant emergent herbs are Torrey's nutrush, maidencane (*Panicum hemitomon*), Virginia horned beaksedge (*Rhynchospora macrostachya*), and sawgrass (*Cladium jamaicense*). The population of Torrey's nutrush, at about 5 acres in size, is perhaps the largest in the state. The Spring Hill Creek impoundment is characterized by open water surrounded by emergent, permanently flooded cypress forest and marsh vegetation. Pondcypress (*Taxodium ascendens*) is the forest dominant. American cupscale (*Sacciolepis striata*), large-flowered bur marigold (*Bidens laevis*), and swamp smartweed (*Polygonum hydropiperoides*) are prominent in the emergent marshes.

Wet mineral soils at the site support two longleaf pine-dominated communities: Pine Savanna and Wet Pine Flatwoods. Pine Savanna is

characterized by an open pine canopy and understory over a dense, herb-dominated ground layer. Longleaf three-awn and savanna muhly (Muhlenbergia expansa) are the dominant grasses, and cane (Arundinaria tecta) is an important woody species. This community was found at one microsite, which had been disturbed in the past, and is possibly of artificial origin. Wet Pine Flatwoods is characterized by an open pine canopy and understory over a moderately dense shrub and patchy herb ground layer. The shrub layer is dominated by inkberry (Ilex glabra) and creeping blueberry (Vaccinium crassifolium), with hairy highbush blueberry (V. fuscatum) prominent. Wiregrass dominates the patchy herb layer. Overall, this community is in fair to poor condition, with shrub domination indicating fire suppression; some microsites have been bedded.

Tidal marshes bordering the site along the Cape Fear River and Town Creek support the Tidal Freshwater Marsh Oligohaline community variant. These marshes are regularly to irregularly flooded by water with a very low salt content (classifiable as fresh rather than brackish). The dominant grasses and grass-like plants often form large, dense patches. Dominants include big cordgrass (Spartina cynosuroides), narrowleaf cattail (Typha angustifolia), common reed (Phragmites australis), alkali bulrush (Schoenoplectus robustus), and softstem bulrush (S. validus).

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Much of the sandhill area has been cleared, with portions converted to pine plantation, and other portions returning to longleaf pine communities. Maritime influenced habitat near the Cape Fear River has also been cleared in the past, with portions cleared of all undergrowth and the live oaks (Quercus virginiana) left standing. All of the longleaf pine communities exhibit the effects of fire suppression. To restore natural processes, structure, and composition, the longleaf sites should be burned every three to five years. Water levels in the two impoundments--Beaverdam Pond and Sand Hill Creek--are critical to the biota these systems support, and the dams should be kept in good repair. Vehicles should be prohibited from the Small Depression Pond habitat, as well as from other wetland areas.

REFERENCES:

- LeBlond, R.J. 1994. Site survey report: Pleasant Oaks Plantation. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.
- Nifong, T.D. 1981. Sandhills Creek Impoundment. In Natural areas inventory of Brunswick County, North Carolina, pp. 192-199.

Coastal Energy Impact Program Report No. 10, N.C. Coastal Management Program.

Schafale, M.P., and P. Weigl. 1988. Preliminary site reconnaissance survey: Pleasant Oaks Plantation. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

(Eleocharis sp.), marsh pennywort (Hydrocotyle umbellata), American cupscale (Sacciolepis striata), and St. John's-worts (Hypericum spp.). The ponds in the adjacent uplands are smaller and more shallowly sloped. Dominant herbs in the smaller ponds include Wright's witch grass (Dichanthelium wrightianum), maidencane (Panicum hemitomon), narrow-fruit horned beaksedge (Rhynchospora inundata), and Torrey's nutrush (Scleria muhlenbergii). Pondcypress (Taxodium ascendens) frequently forms a border around the larger ponds.

Forested portions of the bay basins are dominated by pond pine (Pinus serotina), with red maple (Acer rubrum) and swamp tupelo (Nyssa biflora) forming a subcanopy in some areas. The shrub layer is dominated by fetterbush (Lyonia lucida), titi (Cyrilla racemiflora), and wax-myrtle (Myrica cerifera var. cerifera).

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: The surrounding uplands, including the small limesink basins, have been impacted by plantation conversion and logging. The perimeter of the bay basins have also been partially logged in the past. To protect and restore natural processes, structure, and composition, the bay and limesink basins and surrounding area (buffer zone) should be left undisturbed.

REFERENCES:

Nifong, T.D. 1981. Big Cypress Bay. In Natural areas inventory of Brunswick County, North Carolina, pp. 41-49. Coastal Energy Impact Program Report No. 10, N.C. Coastal Management Program.

2. The red-cockaded woodpecker (Picoides borealis), a Federally and State Endangered bird, has been documented from the site.
3. The site contains high quality examples of the Small Depression Pond, Wet Pine Flatwoods Leiophyllum Variant, and Coastal Fringe Sandhill community types, although their condition has been impacted by residential development of the area. The examples of Wet Pine Flatwoods Leiophyllum Variant and Coastal Fringe Sandhill may be the most mature in the state.

GENERAL DESCRIPTION: Boiling Spring Lakes--Limesink Complex is characterized by flat to gently rolling terrain containing many depressions of variable size and depth supporting the Small Depression Pond community type. The surrounding terraces support wet-soil and dry-soil communities: Pond Pine Woodland, Wet Pine Flatwoods Leiophyllum Variant, and Coastal Fringe Sandhill. A large impoundment of Allen Creek--Boiling Spring Lake--is situated along the north side of the site. Most of the area has undergone or is undergoing residential development.

The site contains the largest concentration of limesink ponds in North Carolina. These ponded depressions are believed to have been created by subterranean collapse of limestone deposits, resulting in the slumping of overlying sand deposits. These depressions intersect groundwater and support the Small Depression Pond community. When water level drops during the growing season, the exposed pond margins support a diverse herb layer with several rare plant species. Characteristic shoreline species include spadeleaf (Centella erecta), Wright's witch grass (Dichanthelium wrightianum), pinebarren rush (Juncus abortivus), southern bog clubmoss (Lycopodiella appressa), Mohr's boneset (Eupatorium mohrii), combleaf mermaidweed (Proserpinaca pectinata), and warty panic grass (Panicum verrucosum).

The surrounding terraces are dominated by wet to dry pine communities. Large shallow depressions with a wet to saturated shallow organic layer support Pond Pine Woodland. This pocosin community is characterized by a pond pine (Pinus serotina) canopy over a sparse subcanopy of loblolly bay (Gordonia lasianthus) and redbay (Persea palustris). The dense shrub layer is dominated by titi (Cyrilla racemiflora), gallberry (Ilex coriacea), inkberry (I. glabra), and fetterbush (Lyonia lucida). Blaspheme-vine (Smilax laurifolia) is often abundant.

Wet mineral soils support the Wet Pine Flatwoods Leiophyllum community variant. It is characterized by an open canopy of longleaf pine (Pinus palustris) over a shrub layer dominated by sand-myrtle (Leiophyllum buxifolium) and inkberry, and an herb layer dominated by wiregrass (Aristida stricta). Creeping blueberry (Vaccinium crassifolium) and pyxie-moss (Pyxidantha

barbulata) are common. The presence of flattop trees with turpentine box scars is evidence that this is one of the most mature examples of the community type. Litter buildup and a shift towards shrub dominance of the ground layer indicate fire suppression.

Dry, sandy soils on the terrace support the Coast Fringe Sandhill community. The open canopy is dominated by longleaf pine, with a moderate sand live oak (Quercus geminata) and turkey oak (Q. laevis) subcanopy. The ground layer is dominated by wiregrass, with sandy-field beaksedge (Rhynchospora megalocarpa) and lichens (Cladonia spp., Cladina evansii) prominent. As with the Wet Pine Flatwoods, the presence of flattop trees with turpentine box scars is evidence that this is one of the most mature examples of the community type.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Virtually all ponds have some houses around the perimeter, though many houselots remain unbuilt. Pond margins have been locally impacted by recreational uses and vegetation clearing, which in turn affect sediment load and water quality throughout the pond. Weedy, alien species have invaded some ponds. Nonetheless, the flora typically associated with the Small Depression Pond community, including the rare species, is well represented at the site, and there is a high probability for success at several ponds if restoration is attempted.

Wet Pine Flatwoods and Coastal Fringe Sandhill communities are fragmented by residential development over much of the site, but blocks of areas remain in natural condition. These communities exhibit the effects of fire suppression, with litter buildup and a shift towards shrub dominance. These communities are naturally fire-maintained, and should be burned regularly if managed for natural processes, structure, and composition. There is evidence that the Pond Pine Woodland community is also fire-adapted if not fire-dependent. Residential development of the area restricts the use of fire, but undeveloped areas gridded by roadbeds and ditches may prove to be ideal sites for burning, with the ditches and roadbeds serving as firebreaks.

REFERENCES:

Nifong, T.D. 1981. Boiling Springs Lakes. In Natural areas inventory of Brunswick County, North Carolina, pp. 81-95. Coastal Energy Impact Program Report No. 10, N.C. Coastal Management Program.

Schafale, M.P. 1987. Preliminary site reconnaissance survey: savanna on Fifty Lakes Road. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

Schafale, M.P., and A.S. Weakley. 1991. Notes on the current status of communities at Boiling Springs Lake Limesink Complex. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

pinebarren milkwort (Polygala cymosa), soft-headed pipewort (Eriocaulon compressum), ten-angled pipewort (E. decangulare), old-field broomstraw (Andropogon virginicus var. virginicus), and redroot (Lachnanthes caroliana). Characteristic aquatic and emergent species include water lily (Nymphaea odorata), maidencane (Panicum hemitomon), Florida spikerush, narrow-fruit horned beaksedge (Rhynchospora inundata), and southern cutgrass (Leersia hexandra).

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: The pond basins are in excellent, undisturbed condition except for marginal plowlines at two basins. Disturbance to the ground cover in adjacent uplands could lead to runoff and siltation of the pond basins. A roadbed transecting the site does not appear to directly impact the basins. To protect natural values, site should be managed to prevent impacts to water quality and volume, basin sedimentation, and shoreline habitat. This should include a no-disturbance buffer zone inland from the upper pond margin for a distance of at least 100 feet.

REFERENCES:

- LeBlond, R.J. 1993. Site survey report: Hog Branch Ponds. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.
- _____. 1994. Preserve design for Boiling Spring Lakes Wetland Complex, Brunswick County, North Carolina. North Carolina Nature Conservancy, Carrboro.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Pretty Pond Limesink Complex

SITE SIGNIFICANCE: Statewide **SIZE:** est. 600 acres

COUNTY: Brunswick **QUADRANGLE:** Funston

LOCATION: Limesink complex along east and west side of Pretty Pond Road (SR 1539) north from Sunny Point railroad crossing to and including Pretty Pond.

SIGNIFICANT FEATURES:

1. This site supports populations of 15 plant species rare in North Carolina, including a Federal C2 Candidate/State Special Concern species, Venus flytrap (*Dionaea muscipula*), and one State Threatened species, snowy orchid (*Platanthera nivea*). The site also contains five State Candidate species: Florida spikerush (*Eleocharis elongata*), limesink dog-fennel (*Eupatorium leptophyllum*), southern bogbutton (*Lachnocaulon beyrichianum*), coastal beaksedge (*R. pleiantha*), and savanna yellow-eyed-grass (*Xyris flabelliformis*). Eight species significantly rare in North Carolina occur at the site: flaxleaf gerardia (*Agalinis linifolia*), Leconte's flatsedge (*Cyperus lecontei*), erectleaf witch grass (*Dichanthelium erectifolium*), shrubby seedbox (*L. suffruticosa*), southeastern panic grass (*Panicum tenerum*), West Indies meadow-beauty (*Rhexia cubensis*), long-beak baldsedge (*Rhynchospora scirpoides*), and netted nutrush (*Scleria reticularis*).
2. The red-cockaded woodpecker (*Picoides borealis*), a Federally and State Endangered bird, has been documented from the site.
3. High quality examples of the Small Depression Pond community occur at the site.

GENERAL DESCRIPTION: Pretty Pond Limesink Complex consists of several small to moderately large ponds supporting the Small Depression Pond natural community. The largest is Pretty Pond at nearly 50 acres. Most of the site occurs within a residentially developed area, and the majority of the ponds are surrounded by houses and undeveloped houselots. Pretty Pond itself is the central feature of a Girl Scouts of America camp. Longleaf pine (*Pinus palustris*) community remnants occur within the site, but in general have been fragmented by house and road construction.

The ponded depressions are believed to have been created by subterranean collapse of limestone deposits, resulting in the slumping of overlying sand deposits. These depressions intersect groundwater and support the Small Depression Pond community. When water level drops during the growing season, the exposed pond

margins support a diverse herb layer with several rare plant species. Characteristic shoreline species include spadeleaf (Centella erecta), Wright's witch grass (Dichanthelium wrightianum), pinebarren rush (Juncus abortivus), southern bog clubmoss (Lycopodiella appressa), Mohr's boneset (Eupatorium mohrii), combleaf mermaidweed (Proserpinaca pectinata), and warty panic grass (Panicum verrucosum).

Several of the smaller ponds are steeply sloped at the margin, with water level fluctuating by as much as ten feet between high and low water periods. The margin at Pretty Pond is gradually sloped, perhaps caused by its greater fetch and wind-generated wave erosion of the shoreline. The shallow slope of the margin provides a greater area of exposure during drawdown, resulting in a greater species diversity.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Pond margins have been locally impacted by recreational uses and vegetation clearing, which in turn affect sediment load and water quality throughout the pond. Weedy, alien species have invaded some ponds. Nonetheless, the flora typically associated with the Small Depression Pond community, including the rare species, is well represented at the site, and there is a high probability for success at several ponds if restoration is attempted.

REFERENCES:

Nifong, T.D. 1981. Boiling Springs Lakes. In Natural areas inventory of Brunswick County, North Carolina, pp. 81-95. Coastal Energy Impact Program Report No. 10, N.C. Coastal Management Program.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Southport Ferry Landing Forest

SITE SIGNIFICANCE: Statewide **SIZE:** est. 250 acres

COUNTY: Brunswick **QUADRANGLE:** Southport / Kure Beach

LOCATION: North and south of the Southport-Fort Fisher ferry landing road (SR 1540), east of Old River Road (SR 1528).

SIGNIFICANT FEATURES:

1. This site contains a good example of the rare Coastal Fringe Evergreen Forest natural community. Good quality Coastal Fringe Sandhill and Brackish Marsh natural communities also occur at the site.
2. The American alligator (Alligator mississippiensis), a Federal and State Threatened reptile, has been documented from Price Creek at this site.

GENERAL DESCRIPTION: Southport Ferry Landing Forest occurs on a dry sandy terrace dissected by deep ravines, and bordered along the north side by Price Creek marshes. The high terrace supports the Coastal Fringe Sandhill natural community, and low ridges and ravine slopes support the Coastal Fringe Evergreen Forest community. A swamp community with pocosin elements occupies the ravine bottoms, and the Brackish Marsh community occurs along Price Creek.

Coastal Fringe Sandhill occurs on the highest, driest soils at the site. The open canopy is dominated by longleaf pine (Pinus palustris), while turkey oak (Quercus laevis) and sand live oak (Q. geminata) form a moderately dense subcanopy. Prominent shrubs include dwarf huckleberry (Gaylussacia dumosa), wax-myrtle (Myrica cerifera var. cerifera), and yaupon (Ilex vomitoria). The ground layer has been suppressed by lack of fire and consequent litter buildup. Oak-toes lichen (Cladina evansii) is common.

Coastal Fringe Evergreen Forest occurs on moist to mesic sandy soils of low ridges and ravine slopes. Prominent in the canopy are large, scattered loblolly pine (Pinus taeda), with mixed age classes of sand laurel oak (Quercus hemisphaerica), live oak, (Q. virginiana), and water oak (Q. nigra). American holly (Ilex opaca), yaupon (I. vomitoria), swamp red bay (Persea palustris), and sparkleberry (Vaccinium arboreum) are prominent in the understory.

Swamp forest occurs in the mucky soil floodplains of the ravines. Sweetgum (Liquidambar styraciflua) and red maple (Acer rubrum) are dominant in the canopy, and loblolly bay (Gordonia lasianthus) is

common in the understory. The moderately-to-very dense shrub layer is dominated by fetterbush (Lyonia lucida), gallberry (Ilex coriacea), inkberry (I. glabra), and cane (Arundinaria tecta). This community appears transitional between pocosin and hardwood swamp communities.

Brackish Marsh occurs in the mucky soils of tidal floodplains bordering Price Creek along the northern boundary of the site. Black needlerush (Juncus roemerianus) is the dominant species, grading upstream to narrowleaf cattail (Typha angustifolia) dominance.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: The sandhill areas appear to have experienced a long period of fire suppression, resulting in a buildup of litter. This has resulted in suppression of the herb layer, and an increase in the ground surface fuel load. Introduction of fire may prove difficult and risky, but is necessary for survival and restoration of the community. The Coastal Fringe Evergreen Forest community is naturally limited in extent, occurring sporadically from Brunswick to Carteret counties. It is rapidly disappearing to coastal development, and may be one of the most endangered community types in the state.

REFERENCES:

Weakley, A.S., and M.P. Schafale. 1988. Preliminary site reconnaissance survey: Southport Ferry Landing. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Sunset Harbor--Ash Swamp

SITE SIGNIFICANCE: Statewide **SIZE:** est. 1200 acres

COUNTY: Brunswick **QUADRANGLE:** Lockwoods Folly

LOCATION: East from the village of Sunset Harbor, off the north side of the Intracoastal Waterway.

SIGNIFICANT FEATURES: This site supports the very rare Coastal Fringe Evergreen Forest natural community. Coastal Fringe Sandhill and Vernal Pool communities also are present.

GENERAL DESCRIPTION: Sunset Harbor--Ash Swamp comprises low upland terraces intersected and partially surrounded by swamp forest. The upland terraces are dominated by Coastal Fringe Sandhill. The Vernal Pool community occurs in small depressions within the sandhill community. Coastal Fringe Evergreen Forest is limited to small areas along the edges of the terraces adjacent to swamp forest. The swamp forest has not been classified, and appears to be intermediate between pocosin and hardwood swamp forests.

Coastal Fringe Sandhill occurs on the dry sands of the terraces. The canopy is dominated by scattered, mixed-age longleaf pine (*Pinus palustris*) and loblolly pine (*P. taeda*). Sand live oak (*Quercus geminata*) and turkey oak (*Q. laevis*) are prominent in the open understory. Wiregrass (*Aristida stricta*) is the dominant herb in the ground layer, with lichens (*Cladonia* spp., *Cladina evansii*) and sandy-field beakrush (*Rhynchospora megalocarpa*) prominent. The open shrub layer includes dwarf wax-myrtle and common October-flower (*Polygonella polygama* var. *polygama*).

The Vernal Pool natural community occurs in small depressions within the sandhill community. The depressions typically are flooded by groundwater during winter and spring, but dry out during the growing season; thus, they are ideal breeding habitats for amphibians. The depressions are herb-dominated. Characteristic species include little bluestem (*Schizachyrium scoparium*), panic grass (*Panicum* sp.), clubmoss (*Lycopodiella* sp.), spadeleaf (*Centella erecta*), and peatmoss (*Sphagnum* sp.). A few scattered small swamp tupelos (*Nyssa biflora*) and loblolly pines also are present.

Coastal Fringe Evergreen Forest occurs in moist sands near the edge of the upland terraces. The moderately dense canopy is dominated by sand laurel oak (*Quercus hemisphaerica*), with loblolly pine, hickory (*Carya* sp.), water oak (*Q. nigra*), and live oak (*Q. virginiana*) prominent. The moderate to dense shrub layer is

dominated by yaupon (Ilex vomitoria), with wax-myrtle (Myrica cerifera var. cerifera) prominent.

OWNERSHIP: Private, except for a 205-acre state-owned parcel.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Much of the eastern portion of the site west of St. James Plantation has been impacted by deep drainage ditches, which influence upland as well as swamp communities. Near Sunset Harbor, portions of the upland terrace have been logged. To protect and promote natural processes, structure, and composition, the Coastal Fringe Sandhill community should be regularly burned. This will also reduce the fuel load and lessen the likelihood of high intensity wildfires.

REFERENCES:

Schafale, M.P., and A.S. Weakley. 1988. Preliminary site reconnaissance survey: Sunset Harbor Natural Area. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: White Spring Ponds Complex

SITE SIGNIFICANCE: Statewide **SIZE:** est. 250 acres

COUNTY: Brunswick **QUADRANGLE:** Southport

LOCATION: North and south of Access Road (to Military Ocean Terminal Sunny Point), east of White Spring Creek.

SIGNIFICANT FEATURES:

1. This site supports populations of nine rare plant species, including one Federal and State Candidate, pondspice (Litsea aestivalis). Another three State Candidate species are present: limesink dog-fennel (Eupatorium leptophyllum), southern bogbutton (Lachnocaulon beyrichianum), and coastal beaksedge (Rhynchospora pleiantha). Six species significantly rare in North Carolina occur at the site: erectleaf witch grass (Dichanthelium erectifolium), shrubby seedbox (Ludwigia suffruticosa), southeastern panic grass (Panicum tenerum), West Indies meadow-beauty (Rhexia cubensis), and long-beak baldsedge (Rhynchospora scirpoides).
2. The Carolina gopher frog (Rana capito capito), a Federal C2 Candidate/State Special Concern amphibian, has been documented from the site.
3. The site contains one of the best examples of the Small Depression Pond natural community in Brunswick County. High quality Vernal Pool and Coastal Fringe Sandhill communities are also present. In North Carolina, the co-occurrence of limesink ponds and Coastal Fringe Sandhill is restricted to a few sites in Brunswick, New Hanover, and Carteret counties.
4. Eleven plant species on the watch list maintained by the N.C. Natural Heritage Program occur at the site.

GENERAL DESCRIPTION: White Spring Ponds Complex comprises permanently to temporarily ponded limesink depressions within a dry sandy upland terrace with a rolling surface. The depressions support the Small Depression Pond and Vernal Pool natural communities, and the upland terrace supports Coastal Fringe Sandhill. The terrain varies from flat to gently rolling to steeply sloped around the depressions.

The depressions are believed to have been created by subterranean collapse of limestone deposits, resulting in the slumping of overlying sand deposits. These depressions intersect groundwater and support the Small Depression Pond community. When water level drops during the growing season, the exposed pond margins support

a diverse herb layer with several rare plant species. Characteristic species include spadeleaf (Centella erecta), pinebarren rush (Juncus abortivus), southern bogbutton, brown bogbutton (Lachnocaulon minus), coastal beaksedge, and Small's yellow-eyed-grass.

Depressions flooded during winter and spring but typically exposed during the growing season support the Vernal Pool natural community. These temporary pools are particularly critical as amphibian breeding sites. Characteristic species include little bluestem (Schizachyrium scoparium), other bluestems (Andropogon spp.), switchcane (Panicum virgatum), and pinebarren rush.

Coastal Fringe Sandhill occurs on the dry sands of the flat to rolling upland terrace. It is characterized by an open canopy of longleaf pine (Pinus palustris) over an open to moderately dense subcanopy of sand live oak (Quercus geminata) and turkey oak (Q. laevis). The ground layer is moderately to sparsely dominated by wiregrass (Aristida stricta). Other prominent herbs include sandhill chaffhead (Carphephorus bellidifolius) and sandy-field beaksedge (Rhynchospora megalocarpa). Lichens (Cladonia spp., Cladina evansii) often form large patches. Southern blueberry (Vaccinium tenellum) and common October-flower (Polygonella polygama var. polygama) are prominent shrubs. This community is transitional to the Xeric Sandhill Scrub Coastal Fringe Variant.

OWNERSHIP: Private, except for 71.5 acres owned by Military Ocean Terminal Sunny Point.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: The area has been scarred by roadbeds, limited off-road vehicle travel (including in some pond basins), and by commercial sand excavation. The overall quality of the limesink and sandhill communities is good to excellent, particularly when compared with the nearby Boiling Spring Lakes Limesink Complex. To protect the depression communities, vehicles should be prohibited from wet basins. Past fire is evident in some areas supporting Coastal Fringe Sandhill, which is a fire-adapted natural community.

REFERENCES:

Barick, F.B., and D.M. Dumond. 1992. Threatened and endangered species survey at proposed sand pit area owned by Bill and Lucille Laster near Sunny Point Army Terminal in Brunswick County, North Carolina. Letter report in N.C. Natural Heritage Program files, DPR, DEHNR, Raleigh.

Braswell, A.L. 1993. Status report on Rana capito capito LeConte, the Carolina gopher frog in North Carolina. Report to the North Carolina Wildlife Resources Commission, Raleigh.

LeBlond, R.J. 1994. Preserve design for Boiling Spring Lakes Wetland Complex, Brunswick County, North Carolina. North Carolina Nature Conservancy, Carrboro.

_____. 1994. Site survey report: White Spring Ponds Complex. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

pine dominates the canopy, and turkey oak dominates the subcanopy. Southern blueberry and dwarf thickets of sand live oak are prominent in the shrub layer. Wiregrass is the dominant herb.

Wet Pine Flatwoods *Leiophyllum* Variant occurs on moist sandy soil in low upland areas. It is characterized by a moderate to open pine canopy over a sparse hardwood subcanopy, moderately dense shrub layer, and sparse herb layer. Longleaf pine is the canopy dominant. Carolina red maple (*Acer rubrum* var. *trilobum*), American holly (*Ilex opaca*), sweetbay (*Magnolia virginiana*), and swamp tupelo (*Nyssa biflora*) form a sparse subcanopy. Sand-myrtle (*Leiophyllum buxifolium*) dominates the shrub layer. Other prominent shrubs include creeping blueberry (*Vaccinium crassifolium*) and gallberry (*Ilex coriacea*). The low sparse herb layer and prominence of pocosin species is likely the result of fire suppression.

The limesink depressions are believed to have been created by subterranean collapse of limestone deposits, resulting in the slumping of overlying sand deposits. These depressions intersect groundwater and support the Small Depression Pond community. The three depressions occurring at the site are flat-bottomed and partially filled, possibly from erosion caused by all-terrain vehicles. A portion of one basin continues to support the Small Depression Pond community. Characteristic species are Torrey's nutrush (*Scleria muhlenbergii*), white bluestem (*Andropogon capillipes*), and switchcane (*Panicum virgatum*).

Pond Pine Woodland occurs on wet to saturated soil with an organic surface layer in a bottomland depression. It is characterized by a moderate pine canopy over a moderately dense shrub layer. Pond pine (*Pinus serotina*) is the canopy dominant, and loblolly bay (*Gordonia lasianthus*) is prominent. Fetterbush (*Lyonia lucida*) and loblolly bay are prominent in the shrub layer. The community at this site is somewhat atypical, perhaps due to a very shallow organic layer.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: The site contains a fairly extensive area of sandhill communities (about 60 acres) in good condition with relatively large longleaf pine trees (18 inches maximum DBH). The sandhill communities are fire suppressed, which likely accounts for the dwarf thickets of sand live oak. Pond basins experience considerable all-terrain vehicle use impact, and the majority of the basin area is exposed sand flats. All-terrain vehicle use may have resulted in a partial filling-in of basins with sand. To protect and enhance natural processes, structure, and composition, the longleaf pine communities should be burned

regularly. All-terrain vehicles should be prohibited from wetland depressions.

REFERENCES:

LeBlond, R.J. 1994. Site survey report: Bethel Sandhills. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Goose Landing

SITE SIGNIFICANCE: Regional

SIZE: 130 acres

COUNTY: Brunswick

QUADRANGLE: Carolina Beach

LOCATION: Along lower Cape Fear River south of Sand Hill Creek, north of Liliput Creek, and east of Kendall Chapel.

SIGNIFICANT FEATURES:

1. This site contains an excellent example of the Small Depression Pond natural community, with five plant species significantly rare in North Carolina: flaxleaf gerardia (Agalinis linifolia), erectleaf witch grass (Dichanthelium erectifolium), West Indies meadow-beauty (Rhexia cubensis), Tracy's beaksedge (Rhynchospora tracyi), and Canby's bulrush (Schoenoplectus etuberculatus).
2. The site provides an important biological corridor between Pleasant Oaks Plantation to the north and Orton Plantation to the south.
3. Twelve plant species on the watch list maintained by the N.C. Natural Heritage Program occur at the site.

GENERAL DESCRIPTION: Goose Landing is a gently rolling upland terrace adjacent to Cape Fear River. Much of the site is dominated by a pine/hardwood forest appearing most closely related to Coastal Fringe Evergreen Forest, but intermediate to Coastal Fringe Sandhill. The terrace slopes somewhat abruptly above the edge of the bordering swamp and marshland along the Cape Fear River. The site also contains a three-basin pond supporting the Small Depression Pond community, and the Tidal Freshwater Marsh Oligohaline Variant community bordering the Cape Fear River.

The dominant upland forest is characterized by a moderate pine and pine/hardwood canopy over a moderately dense hardwood subcanopy, open understory, and sparse to open ground layer. Longleaf pine (Pinus palustris) dominates the canopy, and loblolly pine (P. taeda) and red hickory (Carya ovalis) are prominent. Turkey oak (Quercus laevis) and American holly (Ilex opaca) are patch dominants in the subcanopy. Prominent in the subcanopy are flowering dogwood (Cornus florida), water oak (Q. nigra), red hickory, live oak (Q. virginiana), and sand laurel oak (Q. hemisphaerica). Deerberry (Vaccinium stamineum) and sparkleberry (V. arboreum) are prominent in the shrub layer. In the ground cover, wiregrass (Aristida stricta) is prominent in open areas, and partridgeberry (Mitchella repens) is prominent in shaded areas. The transitional appearance of this community between Coastal

Fringe Evergreen Forest and Coastal Fringe Sandhill may be due to past disturbance, or to the rolling nature of the landscape and variability in soil moisture and richness, resulting in a range of intermediate community expressions. This community is best developed in the southern area of the site.

The Small Depression Pond community occurs in three contiguous basins that form a single water body during high water levels. It is characterized by ponded water with or without an open to sparse gum canopy, and supporting aquatic forbs and emergent graminoids. The ponded area is surrounded by a seasonally-exposed, herb-dominated margin and upland-transitional shrub border. The open to sparse canopy, when present, is exclusively swamp tupelo (Nyssa biflora). Water lily (Nymphaea odorata) is the dominant floating herb. Horsetail spikerush (Eleocharis equisetoides) is the dominant herb emerging from pond water. Prominent emergents include Carey's beaksedge (Rhynchospora careyana) and Canby's bulrush (Schoenoplectus etuberculatus). Characteristic species of the exposed margin include three-angle spikerush (Eleocharis tricostata), blackfruit spikerush (E. melanocarpa), and wrinkled jointgrass (Coelorachis rugosa). Prominent in the upland-transitional shrub border are titi (Cyrilla racemiflora), wax-myrtle (Myrica cerifera var. cerifera), and hairy highbush blueberry (Vaccinium fuscatum). The community at this site is remarkable for the number of rare and watch list plant species with large populations, several of which are dominant or prominent.

Tidal Freshwater Marsh Oligohaline Variant is dominated by tall, grass-like plants in tidally flooded mucky soil along the Cape Fear River. Prominent among these are narrowleaf cattail (Typha angustifolia), black needlerush (Juncus roemerianus), sawgrass (Cladium jamaicense), and big cordgrass (Spartina cynosuroides).

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Some of the upland terrace has been cleared for pastureland, and much of the northern one-third of the parcel has been cleared of understory. The southeastern one-fourth of the parcel is swampland behind a dike, which presumably was tidal marsh or tidal swamp prior to diking. The pond habitat is of excellent quality, and in undisturbed condition. To protect its natural processes, structure, and composition, a no-disturbance buffer zone should be established at least 100 feet inland from the shrub border around the pond margin. The upland forest adjacent to and south of the pond habitat is in good condition. Further study is needed to determine the natural role of fire and the ultimate allegiance of this forest to a classified community type.

REFERENCES:

LeBlond, R.J. 1994. Site survey report: Goose Landing. N.C.
Natural Heritage Program, DPR, DEHNR, Raleigh.

ORTON PLANTATION MACROSITE

The Orton Plantation Macrosite is located in southeastern Brunswick County along the Cape Fear River, northeast of Southport. It is approximately bounded by the town of Boiling Spring Lakes on the west, Military Ocean Terminal Sunny Point on the south, Cape Fear River on the east, and Allen Creek on the north. This nationally significant macrosite includes a large array of landforms and associated natural communities, and rare plants and animals. The topography, though lacking strong relief, is a complex mix of Carolina bays, relict dune ridges and swales, stream channels, and interstream terraces. Other topographic features include a large impoundment (Orton Pond), limesink depressions, and marshes along the Cape Fear River.

The topographic features of the Orton Plantation Macrosite support a large number of natural community types, a few of which are very rare or uncommon. The Wet Pine Flatwoods *Leiophyllum* Variant is restricted to southeastern North Carolina. The Small Depression Pond and Pine Savanna natural communities are restricted to scattered areas along the Coastal Plain. The longleaf pine communities found on bay rims and relict dune ridges are particularly important for the number of rare species they support. The Orton Pond impoundment contains a freshwater mollusk currently known from only one other site in the world.

Nested within the Orton Plantation Macrosite are four standard sites: Orton Pond, Orton Creek Savanna, Blue Pond, and Orton Powerline Loosestrife Site. Undeveloped portions of the macrosite outside of standard sites are important to the overall integrity of the area, such as by providing corridors for animal populations and insuring the integrity of the active river channel. Much of this area remains to be surveyed, and may contain additional significant sites. None of the macrosite has been surveyed in recent years, and the current condition of specific areas is unknown. Each of the standard sites is described in the following pages.

REFERENCES:

- Henry, C.J., and A.P. Noltemeier. 1975. Osprey nesting populations in the coastal Carolinas. *Am. Birds* 29:1073-1079.
- Nifong, T.D. 1981. Orton Pond. In Natural areas inventory of Brunswick County, North Carolina, pp. 173-184. Coastal Energy Impact Program Report No. 10, N.C. Coastal Management Program.
- Soots, R.F., Jr., and J.F. Parnell. 1979. Inland heronries of North Carolina. *CHAT* 43:10-16.

(V. crassifolium). This community contains one of the largest known occurrences of sand-myrtle in the state.

Green Pond occurs in a limesink basin believed to have been created by subterranean collapse of limestone deposits, resulting in the slumping of overlying sand deposits. The basin intersects the water table, resulting in the development of the Small Depression Pond natural community. Water level fluctuates seasonally, typically high in winter and spring, and low during the growing season. The flora of the seasonally-exposed margin is not as well developed as at other limesink ponds in the area, apparently due to the steep walls of the basin. The dominant aquatic plant is the very rare loose watermilfoil. Characteristic herbs of the exposed margin include spadeleaf (Centella erecta), ten-angled pipewort (Eriocaulon decanquale), and brown bogbutton (Lachnocaulon minus).

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: The longleaf pine community is naturally fire-dependent, and prescribed burns are necessary to maintain the community structure and composition. Vehicles should be prohibited from the pond basin.

REFERENCES:

Nifong, T.D. 1981. Green Pond Savanna. In Natural areas inventory of Brunswick County, North Carolina, pp. 121-128. Coastal Energy Impact Program Report No. 10, N.C. Coastal Management Program.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Charred trunks and stumps, including cypress stumps within the pond, indicate that fire may play an important role in vegetation structure and composition here. The pond basin is essentially undisturbed, with the cypress trees, though small, appearing to be very old. To protect the Small Depression Pond community, a no-disturbance buffer zone extending at least 100 feet outward from the upland edge of the basin should be established. Vehicles should be prohibited from wetland depressions.

REFERENCES:

Nifong, T.D. 1981. Blue Pond Complex. In Natural areas inventory of Brunswick County, North Carolina, pp. 63-80. Coastal Energy Impact Program Report No. 10, N.C. Coastal Management Program.

WACCAMAW RIVER WETLANDS MEGASITE

The Waccamaw River Wetlands Megasite consists of the entirety of the Waccamaw River floodplain from Lake Waccamaw in Columbus County to the South Carolina border. The Brunswick County portion of the megasite includes the floodplain features along the east side of the river from Juniper Creek Swamp southward. The river and its floodplain possess several significant features. The landforms created by the present-day river channel appear to be superimposed on landforms created by a much larger, ancient river. The waters and adjacent wetlands of the river support many rare animal and plant species, including several fish, mussels, and snails globally restricted (endemic) to the Waccamaw River system.

The physiography of the river and its floodplain varies considerably as it courses downstream from Lake Waccamaw. From the headwaters dam at Lake Waccamaw to near the confluence with White Marsh creek (a distance of about 10 river miles), the river flows through a large swamp complex with little topographic relief. The river bank is low along this stretch, and floodwaters quickly overflow and spread out in the floodplain swamp. The floodplain in this area does not exhibit the ridge-and-swale pattern characteristic farther downstream. It is possible that these ancient fluvial patterns are buried beneath the gradual buildup of peat deposits in the swamp, which may be influenced by input from Green Swamp to the east.

Downstream from the confluence with White Marsh creek, the bank becomes more prominent and the river begins a complex series of meanders that continues into South Carolina. River width, depth, and flow rate become more variable, and flooding of adjacent habitat requires higher flood levels than in the swampy area upstream of White Marsh creek. The floodplain is characterized by terraces formed of ridge-and-swale systems associated with large meanders apparently made by a larger Waccamaw River during a theorized ancient phase as a brownwater river. These older ridge-and-swale systems extend as much as a mile or more away from the river. The present, smaller river continues to create new meanders and smaller ridge-and-swale systems, with these superimposed on the older system. The result is a complex mix of new and old landforms.

Nested within the megasite are several smaller, standard sites, each of which contains significant biological and/or geomorphic features. Areas within the megasite not included within a standard site have been determined to be of lesser significance, but important to the overall integrity of the area, such as by providing corridors for animal populations and insuring the integrity of the active river channel. Each of the standard sites within the megasite is described in the following pages.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Waccamaw River Aquatic Habitat

SITE SIGNIFICANCE: National

SIZE: Variable and undeterminable due to constant change in site's geomorphology.

COUNTY: Brunswick / Columbus

QUADRANGLE: Juniper Creek / Old Dock / Freeland / Pireway / Longs

LOCATION: Active channel of the Waccamaw River (including Juniper Creek) to the South Carolina border.

SIGNIFICANT FEATURES:

1. This site supports populations of three rare animal species: American alligator (Alligator mississippiensis), Carolina pygmy sunfish (Elassoma boehlkei), and broadtail madtom (Noturus sp. 2). The American alligator is a Federal and State Threatened species. The Carolina pygmy sunfish is a Federal C2 Candidate/State Threatened freshwater fish globally restricted to the Waccamaw River drainage in North Carolina. The broadtail madtom is a State Special Concern freshwater fish globally restricted to the Waccamaw, Cape Fear, and Lumber river drainages in North and South Carolina.
2. Seven rare plant species occur within the active channel or in transitional habitat between the channel and adjacent developing swamp or levee forest.
 - a. Five rare plant species occur within the active channel of the river: dwarf burhead (Echinodorus parvulus), Harper's fimbry (Fimbristylis perpusilla), small-flowered hemicarpha (Lipocarpha micrantha), Bosc's bluet, (Oldenlandia boscii), and Plymouth gentian (Sabatia kennedyana). Harper's fimbry is a Federal C2 Candidate. Plymouth gentian is State Threatened-Special Concern, and dwarf burhead is a State Candidate. Small-flowered hemicarpha and Bosc's bluet are significantly rare in North Carolina.
 - b. Two rare plant species occur in transitional (ecotonal) habitat: sarvis holly (Ilex amelanchier), and swamp forest beaksedge (Rhynchospora decurrens). Swamp forest beaksedge is a Federal C2 Candidate. Sarvis holly is significantly rare in North Carolina.

3. The channel bars when exposed support an unusually diverse herb community containing many species not found along other blackwater rivers.

GENERAL DESCRIPTION: The Waccamaw River Aquatic Habitat includes the permanently inundated portion of the river channel plus the seasonally exposed shoreline. The upland border of the shoreline is more-or-less determined by where tree growth begins. The inundated portion of the channel contains poorly known but highly significant aquatic communities supporting several animal species endemic to the Waccamaw River drainage. When exposed, the shoreline provides habitat for the Sand and Mud Bar community, which supports a diverse herb community, including a few very rare plant species. During extreme drawdowns, limestone beds are exposed near the bottom of the river channel.

The active river channel contains several landforms: fishponds, meanders, backwaters, channel bars, and point bars. Point bar ridges and levees, although formed by the active channel, support forested communities and thus are not part of the aquatic habitat (they are described at other Waccamaw River sites). Unlike the other channel landforms, the ridges and levees are not inundated when river water levels are below flood-stage.

The aquatic communities are at least in part distinguished by river flow rates. Current velocity varies among the normal channel, fishponds, meanders, and backwaters. Fishponds are wide, deep, slow-flowing sections of river often a half-mile or more long. They are located along relatively straight stretches, primarily where the river flows through broad swamps in the upper river. Meanders are looping bends in the river that slow the current and cause sediment to be deposited on the inside (concave shore) of the meander. Backwaters are lobes in the channel located at the downstream end of active sloughs. The sloughs are former channel segments subsequently sealed off by sedimentation at the upstream end. Except during flooding, there is no flow in backwaters even though they are part of the river. The shallow margins of backwaters usually grade into Cypress--Gum Swamp.

These variable flow rates result in differing nutrient and sediment loads in river water, and in the composition of the channel bottom, which can be sandy, silty, or peaty. In areas with continuous flow, there is essentially no aquatic vegetation, but submersed vegetation may take hold in quiet waters. All of these factors are critical for the river's rare animal populations.

The Sand and Mud Bar community occurs on seasonally exposed channel bars and point bars. Because channel bars occur in straight river stretches with minimal resistance to current flow, they do not receive as much sediment as the point bars do. In fishponds, channel bars tend to become silty because the slow flow rate allows

fine sediment to settle out. Point bars are formed on the inside of meanders (convex shore of the river). Because the meander (bend) obstructs flow, point bars are the sites of the most active sediment deposition. The landward portions of point bars are thus higher in elevation than channel bars, and these higher portions undergo succession to the Coastal Plain Levee Forest community type.

During periods of low water levels (drawdowns) in the river, the exposed channel and point bars are quickly vegetated by fast-growing and often very small, annual flowering plants (quickness and smallness are adaptations to the brief periods of exposure). Because of the long periods of inundation, woody plants are unable to persist at these sites. A few large perennial herbaceous plants have been able to adapt to the bars because of well-developed underground storage systems. Red top panic grass (Panicum rigidulum var. rigidulum) is frequently the dominant large herb on both channel bars and point bars. Water smartweed (Polygonum punctatum), another large herb, can also form large patches. Frequent small herbs include Baldwin's spikerush (Eleocharis baldwinii), whorled pennywort (Hydrocotyle verticillata var. triradiata), creeping rush (Juncus repens), yellowseed pimpernel (Lindernia dubia var. anagallidia), and many-spiked flatsedge (Cyperus polystachyos var. texensis). Although point bars are higher than channel bars, the areas exposed during drawdowns tend to be more sparsely vegetated with fewer species than channel bars. This is probably due to the greater accumulation of sediment on point bars and the burial of vegetation. Rapid evaporation, lower fertility, and poorer stability of the sandy substrate of point bars may also be a factor.

Among the rare plants, Harper's fimbry, small-flowered hemicarpha, and Bosc's bluet are essentially restricted to the channel bars. Plymouth gentian occurs on both channel and point bars. Sarvis holly and swamp forest beaksedge can occur in the transition zone (ecotone) between the upper shoreline and adjacent forest.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: The condition of the river is critical for the rare species that occur at the site, since almost all are aquatic or stream-side inhabitants. These species depend on high water quality and natural fluctuations of water levels for survival. To protect water quality and natural flow levels, the swamp forests on both sides of the river need to be protected, as well as areas along the river itself. Water quality in Lake Waccamaw, and in waters flowing into the lake, directly bears on water quality in Waccamaw River. Elevated mercury concentrations have been found in largemouth bass and several other

species in the river, but there is no known point source or past cause for this contamination (NCWQS, 1994).

REFERENCES:

NCWQS. 1994. Lumber River basinwide water quality management plan. N.C Water Quality Section, DEM, DEHNR, Raleigh.

Schafale, M.P., H.E. LeGrand, and R.S. Marty. 1986. Waccamaw River natural areas inventory and preserve design. The Nature Conservancy and N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

Schafale, M.P., and C.E. Roe. 1987. Notes on a visit to the lower Waccamaw River in North Carolina. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Juniper Creek Floodplain

SITE SIGNIFICANCE: Statewide

SIZE: est. 7000 acres, roughly equally divided between Brunswick and Columbus counties

COUNTY: Brunswick / Columbus **QUADRANGLE:** Old Dock /
Juniper Creek

LOCATION: Along boundary between Brunswick and Columbus counties from confluence of Honey Island Creek to Waccamaw River.

SIGNIFICANT FEATURES:

1. Juniper Creek provides habitat for the Carolina pygmy sunfish (*Elassoma boehlkei*), which is endemic (globally restricted) to the upper Waccamaw River drainage. The Carolina pygmy sunfish is a Federal C2 Candidate/State Threatened freshwater fish.
2. The site supports populations of two rare plant species: sarvis holly (*Ilex amelanchier*) and Plymouth gentian (*Sabatia kennedyana*). Plymouth gentian is State Threatened-Special Concern. Sarvis holly is significantly rare in North Carolina.
3. Juniper Creek Floodplain is an extensive, mostly uninterrupted swamp system connecting Green Swamp to the Waccamaw River drainage.

GENERAL DESCRIPTION: Juniper Creek Floodplain, along with its major tributary, Honey Island Swamp, drains much of the northern half of Green Swamp westward into the Waccamaw River. The floodplain soils are deep muck from Honey Island Swamp downstream to near Juniper Creek Road (SR 1928) where the soil becomes wet to periodically inundated sandy loam. Explored areas support Cypress-Gum Swamp, with tupelo (*Nyssa* sp.) dominant and cypress (*Taxodium* sp.) prominent in the canopy. The moderately dense shrub layer is dominated by swamp red bay (*Persea palustris*), sweetbay (*Magnolia virginiana*), and titi (*Cyrilla racemiflora*). The swamp forest has been logged in recent decades, and most of the canopy is young, but small areas with mature canopy persist.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Juniper Creek Floodplain forest should be allowed to mature to protect this important natural corridor between Green Swamp and Waccamaw River, and to

protect the critical habitat the creek provides for the endemic Carolina pygmy sunfish.

REFERENCES:

Schafale, M.P., and A.S. Weakley. 1988. Preliminary site reconnaissance survey: Juniper Creek. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Waccamaw River Oxbow Site

SITE SIGNIFICANCE: Statewide

SIZE: est. 600 acres, about equally divided between Brunswick and Columbus counties.

COUNTY: Brunswick / Columbus **QUADRANGLE:** Longs / Calabash

LOCATION: Lower part of Waccamaw River, approximately three air miles south of highway NC 904.

SIGNIFICANT FEATURES:

1. The site provides habitat for five rare plant species: green fly orchid (Epidendron conopseum), Harper's fimbry (Fimbristylis perpusilla), Bosc's bluet (Oldenlandia boscii), swamp forest beaksedge (Rhynchospora decurrens), and Plymouth gentian (Sabatia kennedyana). Harper's fimbry and swamp forest beaksedge are Federal C2 Candidates. Plymouth gentian is State Threatened-Special Concern. Green fly orchid and Bosc's bluet are significantly rare in North Carolina. Harper's fimbry, swamp forest beaksedge, and Plymouth gentian are known only from the Waccamaw River drainage in North Carolina.
2. The site contains the greatest concentration of backwaters, active sloughs, and oxbow lakes along Waccamaw River in North Carolina.

GENERAL DESCRIPTION: The site contains several landforms associated with the active river channel: backwaters, channel and point bars, active sloughs, and oxbow lakes. Low elevation relict ridges and swales occur back from the river. The channel and point bars support the Sand and Mud Bar community. Cypress--Gum Swamp (Blackwater Subtype) occurs in the shallow parts of backwaters, in the active sloughs, and in swales (relict sloughs) away from the active channel. Relict floodplain ridges support Coastal Plain Bottomland Hardwoods (Blackwater Subtype).

Channel bars and point bars are depositional features within the active river channel that are exposed during water level drawdowns. Sandy to silty channel bars are formed along straight stretches of the river. Sandy point bars are formed on the inside of meanders (convex shore of the river). Both support the Sand and Mud Bar community, which is characterized by the absence of woody species, and dominance by small herbs that can reproduce quickly during the often brief drawdown periods. Baldwin's spikerush (Eleocharis baldwinii), yellowseed pimpernel (Lindernia dubia var. anagallidea), many-spiked flatsedge (Cyperus polystachyos var.

texensis), and one-flowered bluet (Oldenlandia uniflora) are common to locally dominant. Harper's fimbry, Plymouth gentian, and Bosc's bluet also occur in the Sand and Mud Bar community. The higher elevations of point bars often support colonies of red top panic grass (Panicum rigidulum var. rigidulum).

The Oxbow Lake community occurs on flooded peaty to mucky soil near active river meanders. Oxbow lakes are found in recently abandoned river channel meanders where sediment deposits have closed off the former channel meander at both ends, leaving a crescent-shaped or horseshoe-shaped water body. Although oxbow lake waters are still, they are periodically flushed by floodwaters. Over time, the lake will eventually fill in and succeed to Cypress--Gum Swamp. Still waters of oxbow lakes may support rooted and floating aquatic plants, and emergent cypress and gum trees.

Cypress--Gum Swamp is found on wet to periodically inundated loamy or mucky soil in shallow backwaters, active sloughs, and low elevation relict swales at the site. Backwaters are located at the downstream end of active sloughs, and form lobes of still water in the river channel. Active sloughs are former segments of the river channel that have been cut off by sediment deposition at the upstream end of the slough. Active sloughs carry flowing water during flood events. Lower elevation swales (relict sloughs), although farther from the active river channel, can also carry flood waters. The Cypress--Gum Swamp canopy is dominated by various mixtures of baldcypress (Taxodium distichum), pondcypress (T. ascendens), and swamp tupelo (Nyssa biflora). Carolina ash (Fraxinus caroliniana), water-elm (Planera aquatica), buttonbush (Cephalanthus occidentalis), and black willow (Salix nigra) are prominent in the understory. Spanish-moss (Tillandsia usneoides) and mistletoe (Phoradendron serotinum) are common epiphytes. The usually sparse herb layer includes swamp forest beaksedge. On low ridges between backwater swamps and the river channel, green fly orchid occurs as an epiphytic on overcup oak (Quercus lyrata) with resurrection fern (Pleopeltis polypodioides var. michauxiana).

Coastal Plain Bottomland Hardwoods occurs on wet to infrequently flooded loamy soil on low relict ridges back from the river. The canopy is dominated by laurel oak (Quercus hemisphaerica) and loblolly pine (Pinus taeda), with overcup oak, water oak (Q. nigra), red maple (Acer rubrum), sweetgum (Liquidambar styraciflua), and Atlantic white cedar (Chamaecyparis thyoides) locally prominent. The understory is dominated by canopy species, plus American holly (Ilex opaca), ironwood (Carpinus caroliniana), and swamp red bay (Persea palustris). Chainferns (Woodwardia spp.) and sedges (Carex spp.) are occasional in the sparse herb layer.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Some past logging is evident at the site, but overall the landforms and natural communities are in good condition. To protect the site's natural values, it should be left in its present condition.

REFERENCES:

Schafale, M.P., H.E. LeGrand, and R.S. Marty. 1986. Waccamaw River natural areas inventory and preserve design: Site 19. The Nature Conservancy and N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

Schafale, M.P., and C.E. Roe. 1987. Notes on a visit to the lower Waccamaw River in North Carolina. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

are quite striking on aerial photographs. The ridges support Wet Pine Flatwoods, and the swales support the Cypress Savanna association. Coastal Plain Bottomland Hardwoods occur on floodplain flats within the site.

Wet Pine Flatwoods Wet Ultisol Variant occurs in wet mineral soil on the low ridges. It is characterized by an open pine or moderately dense pine/oak canopy over an open to moderate shrub layer and open to sparse herb layer. The canopy is dominated by longleaf pine (*Pinus palustris*) or loblolly pine (*P. taeda*), with water oak (*Quercus nigra*) an occasional subdominant. Black gum (*Nyssa sylvatica*), sweetgum (*Liquidambar styraciflua*), live oak (*Q. virginiana*), and water oak are locally prominent in the subcanopy. Blue huckleberry (*Gaylussacia frondosa*) and southern blueberry (*Vaccinium tenellum*) are dominants or patch dominants in the shrub layer. Carolina dropseed (*Sporobolus* sp. 1), bracken fern (*Pteridium aquilinum*), and old-field broomstraw (*Andropogon virginicus* var. *virginicus*) are prominent in the herb layer. The composition of this community is quite variable, and differs from typical occurrences of Wet Pine Flatwoods elsewhere. This is likely due in part to the community's isolation within a large floodplain area.

The Cypress Savanna association occurs on very wet to seasonally inundated mineral soil in the swales between the ridges. Loblolly pine and pondcypress (*Taxodium ascendens*) dominate the open canopy. Wax-myrtle (*Myrica cerifera* var. *cerifera*), titi (*Cyrilla racemiflora*), and fetterbush (*Lyonia lucida*) are codominants in the moderate to sparse shrub layer. Redroot (*Lachnanthes caroliniana*) is a frequent dominant in the moderately dense herb layer, and longleaf three-awn (*Aristida palustris*) and Chapman's beaksedge (*Rhynchospora chapmanii*) are prominent. The rare plant species occurring at the site are most closely associated with this community type.

Coastal Plain Bottomland Hardwoods occurs on wet to periodically inundated loamy soil of floodplain areas. It is characterized by a moderate to moderately dense canopy and subcanopy over an open to sparse ground layer. Canopy dominants are laurel oak (*Quercus laurifolia*), swamp tupelo (*Nyssa biflora*), and loblolly pine. The subcanopy is dominated by canopy species plus red maple (*Acer rubrum*) and sweetgum. Horsesugar (*Symplocos tinctoria*), wax-myrtle, titi, and hairy blueberry (*Vaccinium fuscatum*) are prominent in the shrub layer. Chainferns (*Woodwardia* spp.) and sedges (*Carex* spp.) are prominent in the sparse herb layer.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Much of this site was heavily impacted by logging in 1994. Remnants of natural community and rare species habitat persist, and the site has recovery potential. Fire may be beneficial, but the fire history of the site is unknown. Ridge-and-swale boggy openings appears to be a very rare habitat, and efforts should be made to protect the three known occurrences, all in Brunswick County.

REFERENCES:

LeBlond, R.J. 1994. Site survey report: Scippio Swamp Ridge-and-Swale Boggy Openings. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

MIDDLE WACCAMAW RIVER MACROSITE

The Middle Waccamaw River Macrosite, located in both Brunswick and Columbus counties, includes Waccamaw River and floodplain features from the confluence with Gore Creek south to highway NC 904. This nationally significant macrosite comprises about 3500 acres, and includes a large array of landforms and associated natural communities, and rare plants and animals. Most prominent are the numerous and large ridge-and-swale systems. The macrosite also contains winding, interconnecting active sloughs, and the river in this area has a large number of meanders, channel bars, point bars, and backwaters. Because of this geomorphic diversity, most of the natural community types found in the Waccamaw River floodplain occur at this macrosite.

The most striking and critical feature in the macrosite is the large array of relict ridges and swales formed by the ancient, larger Waccamaw River. These ridge-and-swale systems now occur on terraces elevated above the floodplain of the present river, and support natural community types not found elsewhere along the river. Although much of the area has been logged, extensive natural habitat in good condition persists.

Nested within the Middle Waccamaw River Macrosite are five standard sites, two of which are mostly within Columbus County: Waccamaw River Eleocharis Backwater and Reeves Area Floodplain. The other three sites are located entirely within Brunswick County: Regan Ridge-and-Swale Boggy Openings, Waccamaw Island Savanna, and Waccamaw River Ridge-and-Swale Boggy Openings. The macrosite also includes a portion of the Waccamaw River Aquatic Habitat site, which extends from Lake Waccamaw to the South Carolina border.

Portions of the macrosite outside of standard sites have been determined to be of lesser significance, but important to the overall integrity of the area, such as by providing corridors for animal populations and insuring the integrity of the active river channel. Each of the standard sites is described in the following pages.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Reeves Area Floodplain

SITE SIGNIFICANCE: Statewide

SIZE: est. 760 acres, about 100 of which occur in Brunswick County.

COUNTY: Brunswick / Columbus

QUADRANGLE: Freeland

LOCATION: Active channel and floodplain of Waccamaw River downstream from Reeves Landing towards Beech Island. The majority of this site is located in Columbus County.

SIGNIFICANT FEATURES:

1. This site supports populations of three very rare plant species: Harper's fimbry (Fimbristylis perpusilla), Plymouth gentian (Sabatia kennedyana), and dwarf burhead (Echinodorus parvulus). Harper's fimbry is a Federal C2 Candidate. Plymouth gentian is State Threatened-Special Concern, and dwarf burhead is a State Candidate. All of the North Carolina occurrences of Harper's fimbry and Plymouth gentian are restricted to the Waccamaw River drainage.
2. Reeves Area Floodplain contains the greatest natural community diversity of any identified site along the Waccamaw River floodplain. There are good to excellent examples of virtually all of the landforms associated with the meander sections of the river, and with the relict ridge-and-swale terraces.

GENERAL DESCRIPTION: Reeves Area Floodplain consists of an irregularly meandering stretch of the active river channel, and a large ridge-and-swale system on terraces associated with the ancient, larger river. The active meander system is superimposed on the relict system. Channel and point bars along the river support the Sand and Mud Bar community. A former meander section of the river has been cut off from the active channel, and now supports the Oxbow Lake community. Active sloughs and low elevation swales (relict sloughs) support Cypress--Gum Swamp (Blackwater Subtype). Less frequently flooded swales and low ridges away from the river support Coastal Plain Bottomland Hardwoods (Blackwater Subtype). The highest ridges in the relict ridge-and-swale system appear to rarely or never flood, and these support Wet Pine Flatwoods (Wet Spodosol Variant) and Coastal Fringe Sandhill. Wet Pine Flatwoods and Coastal Fringe Sandhill communities are restricted to Columbus County at this site.

Channel bars and point bars are depositional features within the active river channel that are exposed during water level drawdowns. Sandy to silty channel bars are formed along straight stretches of

the river. Sandy point bars are formed on the inside of meanders (convex shore of the river). Both support the Sand and Mud Bar community, which is characterized by the absence of woody species, and dominance by small herbs that can reproduce quickly during the often brief drawdown periods. Baldwin's spikerush (Eleocharis baldwinii) and creeping rush (Juncus repens) are the dominant small herbs, and yellowseed pimpernel (Lindernia dubia var. anagallidea) is common. Harper's fimbry and Plymouth gentian also occur in the Sand and Mud Bar community. The higher elevations of point bars often support colonies of red top panic grass (Panicum rigidulum var. rigidulum).

The Oxbow Lake community occurs on flooded peaty to mucky soil near an active river meander. Oxbow lakes are found in recently abandoned river channel meanders where sediment deposits have closed off the former channel meander at both ends, leaving a crescent-shaped or horseshoe-shaped water body. Although oxbow lake waters are still, they are periodically flushed by floodwaters. Over time, the lake will eventually fill in and succeed to Cypress--Gum Swamp. Still waters of oxbow lakes may support rooted and floating aquatic plants, and emergent cypress and gum trees.

Cypress--Gum Swamp is fully developed on wet to periodically inundated loamy or mucky soil in active sloughs and low elevation relict swales at the site. Sloughs are former segments of the river channel that have been cut off by sediment deposition at the upstream end of the slough. Active sloughs carry flowing water during flood events. The relict swales are associated with meanders created by the ancient, larger river. Lower elevation relict swales, although farther from the active river channel, can also carry flood waters. In active sloughs, the Cypress--Gum Swamp canopy is dominated almost exclusively by baldcypress (Taxodium distichum). The understory is dominated by Carolina ash (Fraxinus caroliniana), water-elm (Planera aquatica), and buttonbush (Cephalanthus occidentalis), with occasional hawthorn (Crataegus aestivalis). Herbs are sparse to absent. In the low elevation relict swales, the Cypress--Gum Swamp canopy is dominated by pondcypress (Taxodium ascendens) and swamp tupelo (Nyssa biflora). The understory is dominated by Carolina ash, with lesser amounts of titi (Cyrilla racemiflora), myrtle dahoon (Ilex myrtifolia), fetterbush (Lyonia lucida), coastal sweet-pepperbush (Clethra alnifolia), and Virginia sweetspire (Itea virginica). Common vines include briars (Smilax spp.) and Carolina supplejack (Berchemia scandens). Spadeleaf (Centella erecta), sedges (Carex spp.), Virginia buttonweed (Diodia virginiana), and peatmoss (Sphagnum sp.) are occasional in the sparse herb layer.

Low elevation floodplain ridges in the modern floodplain and on the relict ridge-and-swale terraces support Coastal Plain Bottomland Hardwoods. The community occurs on wet to infrequently flooded loamy soil. The canopy is dominated by loblolly pine (Pinus

taeda), laurel oak (Quercus laurifolia), and Atlantic white cedar (Chamaecyparis thyoides). Water oak (Q. nigra), overcup oak (Q. lyrata), and red maple (Acer rubrum) are also prominent in the canopy. The understory is composed of young canopy trees, plus American holly (Ilex opaca), redbay (Persea palustris), and sweetbay (Magnolia virginiana). The dense shrub layer is dominated by mayberry (Vaccinium elliotii), titi (Cyrilla racemiflora), fetterbush (Lyonia lucida), coastal sweet-pepperbush (Clethra alnifolia), and Virginia sweetspire (Itea virginica). Common vines include briars (Smilax spp.) and muscadine (Vitis rotundifolia). The herb layer is essentially absent, with occasional partridgeberry (Mitchella repens).

Wet Pine Flatwoods occur on higher elevation ridges that probably never, or rarely, flood. These wet sandy ridges are located on a relict ridge-and-swale terrace away from the modern river floodplain. The canopy is dominated by longleaf pine (Pinus palustris) and loblolly pine. Prominent shrubs and small trees include live oak (Quercus virginiana), persimmon (Diospyros virginiana), sweetgum (Liquidambar styraciflua), inkberry (Ilex glabra), wax-myrtle (Myrica cerifera var. cerifera), blue huckleberry (Gaylussacia frondosa), and coastal sweet-pepperbush. The ground layer is dominated by wiregrass (Aristida stricta), with bracken fern (Pteridium aquilinum) and creeping blueberry (Vaccinium crassifolium) prominent at the higher elevations. The community is in fair condition, with lack of fire having resulted in canopy invasion by loblolly pine, and an increase in shrub density and ground litter. Lower, wetter portions of the community appear transitional to Pine Savanna.

An unusual Coastal Fringe Sandhill community example occurs on a high, dry sand ridge near the center of the site. The open canopy is dominated by loblolly pine, and live oak dominates the understory. Pine stumps that appear to have been boxed for turpentine are present, suggesting that the site was once dominated by longleaf pine. Prominent shrub layer species include American holly, fetterbush, inkberry, mayberry, and creeping blueberry. Species unusual for the community type include southern red oak (Quercus falcata) and wild olive (Osmanthus americana). The ground surface is bare sand except for patches of lichens and mosses. Spanish-moss (Tillandsia usneoides) and resurrection fern (Pleopeltis polypodioides var. michauxiana) are prominent epiphytes. The vegetation composition is not typical of Coastal Fringe Sandhill as it occurs elsewhere, and may be transitional to Coastal Fringe Evergreen Forest.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Most of the site has been impacted by previous logging, mainly for cypress. This earlier logging reduced the dominance of cypress in the wetter communities, but did not greatly alter the land or natural communities. Modern logging has had greater impact, with much of the higher relict ridge areas converted to dense, young pine stands. Forests on lower portions of the terrace vary in maturity, often with invasive canopy tree species. Logging roads are present in the northern and northeastern areas, along with deep drainage ditches that transport sediment into the river during low water levels. Despite the damage from logging, this site appears to be the least disturbed area in the middle part of the river, and most of its natural communities are intact. The site should not be logged if the natural communities, rare species populations, and river water quality are to be protected. Management for protection of natural values should also consider the blocking of ditches to restore natural hydrology, and to prevent erosion and river siltation impacts.

REFERENCES:

Schafale, M.P., H.E. LeGrand, and R.S. Marty. 1986. Waccamaw River natural areas inventory and preserve design: Site 15. The Nature Conservancy and N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Regan Ridge-and-Swale Boggy Openings

SITE SIGNIFICANCE: Statewide **SIZE:** est. 100 acres

COUNTY: Brunswick **QUADRANGLE:** Freeland

LOCATION: South of highway NC 904, 1.5 miles west of Regan.

SIGNIFICANT FEATURES:

1. This site supports populations of eight rare plant species: flaxleaf gerardia (Agalinis linifolia), erectleaf witch grass (Dichanthelium erectifolium), golden crest (Lophiola aurea), flaxleaf seedbox (Ludwigia linifolia), Bosc's bluet (Oldenlandia bosci), southeastern panic grass (Panicum tenerum), Baldwin's nutrush (Scleria baldwinii), and Georgia nutrush (Scleria georgiana). Golden crest is State Endangered, and Baldwin's nutrush is a State Candidate. The other species are significantly rare in North Carolina.
2. The ridge-and-swale boggy opening habitat is very rare, having been documented from only three sites in the state, all of which are in the Brunswick County portion of the Waccamaw River floodplain. The Cypress Savanna association occurring in the swales is a rare community type.
3. Eight plant species on the watch list maintained by the N.C. Natural Heritage Program occur at the site.

GENERAL DESCRIPTION: Regan Ridge-and-Swale Boggy Openings comprises a series of low ridges and swales formed by stream meanders on the broad Waccamaw River terrace. It is intersected by highway NC 904, and the site includes a borrow pond just south of the road. The swales support a diverse herb community most closely related to the Cypress Savanna community type. The ridges support a woody community intermediate between Coastal Plain Bottomland Hardwoods and Wet Pine Flatwoods or Pine Savanna. The ridge-and-swale system is bordered along the east, south, and west by Cypress--Gum Swamp (Blackwater Subtype). Although not a natural community, the borrow pond has a distinctive flora most closely related to the Small Depression Pond community type. The roadside ditches support a flora that appears to have been derived at least in part from the swale habitat.

Although pondcypress (Taxodium ascendens) is a minor component of the canopy, the swales support an herb association apparently classifiable to the Cypress Savanna. The community occurs on wet to seasonally inundated mineral soils, and is characterized by a sparse to moderate canopy and understory over a moderately dense herb layer. Loblolly pine (Pinus taeda) and swamp tupelo (Nyssa

biflora) are sparse canopy dominants. The understory is dominated by titi (Cyrilla racemiflora) and red maple (Acer rubrum). Characteristic herbs include foxtail clubmoss (Lycopodiella alopecuroides), longleaf three-awn (Aristida palustris), redroot (Lachnanthes caroliana), and broadleaf whitetop sedge (Rhynchospora latifolia).

The ridges support a variable community with elements of Coastal Plain Bottomland Hardwoods, Wet Pine Flatwoods, and Pine Savanna community types. This community occurs on wet mineral soils. Sampled areas have a pine canopy and oak/maple subcanopy over a moderate to open shrub layer and sparse herb layer. Loblolly pine is the most frequent canopy dominant, with longleaf pine (Pinus palustris), swamp tupelo (Nyssa biflora) and pondcypress also present. The subcanopy is dominated by water oak (Quercus nigra) and red maple, with some American holly (Ilex opaca). The shrub layer includes titi, huckleberries (Gaylussacia spp.), inkberry (Ilex glabra), fetterbush (Lyonia lucida), and swamp red bay (Persea palustris). The herb layer is sparsely dominated by Carolina dropseed (Sporobolus sp. 1).

The swamp slough surrounding the ridge-and-swale system supports Cypress--Gum Swamp on wet to periodically flooded loamy soil. It is characterized by a moderately dense cypress/gum canopy and moderately open maple subcanopy over a moderate shrub layer and sparse herb layer. Pondcypress and swamp tupelo are the canopy dominants. Loblolly pine and laurel oak (Quercus laurifolia) are prominent in the canopy. Red maple is dominant in the subcanopy. Prominent shrubs include fetterbush, coastal sweet-pepperbush (Clethra alnifolia), titi, and swamp doghobble (Leucothoe racemosa). Royal fern (Osmunda regalis var. spectabilis) and netted chainfern (Woodwardia areolata) are characteristic of the sparse herb layer.

Significant rare species habitat occurs along the highway and in the adjacent borrow pond at this site. Associated species indicate that the roadside habitat has been populated by the adjacent swale community. The borrow pond has affinities with the Small Depression Pond community, and with the Sand and Mud Bar community found along the active channel of the Waccamaw River.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Fire may be beneficial, but the fire history of the site is unknown. The site may also have been logged in the past, but clear-cutting is not evident. Ridge-and-swale boggy openings appears to be a very rare habitat, and efforts should be made to protect the three known occurrences, all in Brunswick County.

REFERENCES:

LeBlond, R.J. 1994. Site survey report: Regan Ridge-and-Swale Boggy Openings. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

The ridges are no more than 5 feet elevation above the adjacent sloughs. The ridge north of the highway is dominated by the Pine Savanna Wet Spodosol Variant, which grades to a slough to the north and east supporting Cypress--Gum Swamp. Swales containing Small Depression Pocosin also occur on the north ridge. The ridge south of the highway, and portions of the narrow ridge connecting the two larger ridges, supports Coastal Fringe Sandhill. The south ridge is surrounded by swamp sloughs.

Pine Savanna occurs on wet mineral soils of the north fluvial ridge, and floristically is most diverse on lower slopes and terraces adjacent to the surrounding swamp sloughs. The community grades to Coastal Fringe Sandhill on the higher portions of the ridge. The Pine Savanna is characterized by a canopy of longleaf pine (*Pinus palustris*) over an herb-dominated ground layer with scattered shrub patches. Much of the longleaf pine canopy has been logged. Wiregrass (*Aristida stricta*) is the dominant herb. Other prominent herb species include savanna muhly (*Muhlenbergia expansa*), toothache grass (*Ctenium aromaticum*), and Carolina dropseed (*Sporobolus* sp. 1). Inkberry (*Ilex glabra*) is a shrub patch dominant. All of the rare species at Waccamaw Island Savanna are found in the Pine Savanna community, or in the ecotone between the savanna and adjacent swamp. In addition to the rare species, a number of showy flowering plants are present, including pitcher plants, orchids, gentians, and meadow-beauties.

Depressions scattered in the savanna support Small Depression Pocosin on mineral soils with a thin organic layer. These depressions, typically less than an acre in size, produce dense thickets of pocosin shrubs and small trees. Characteristic species include titi (*Cyrilla racemiflora*) and myrtle dahoon (*Ilex myrtifolia*).

Coastal Fringe Sandhill occurs on dry sandy soils found on the south ridge, and on the narrow ridge connecting the two larger fluvial ridges. It is characterized by a longleaf pine canopy over a mixed-oak subcanopy and open ground layer. Prominent oaks are sand live oak (*Quercus geminata*), turkey oak (*Q. laevis*), sand post oak (*Q. margarettae*), and blackjack oak (*Q. marilandica*). Wiregrass dominates the ground layer, and little bluestem (*Schizachyrium scoparium*) is prominent. Dwarf wax-myrtle (*Myrica cerifera* var. *pumila*) is a scattered shrub. Most of this community has been impacted by logging and bush-hogging in recent years.

Much of the Cypress--Gum Swamp surrounding the ridges has been logged, and regenerating canopy trees are small. Pondcypress (*Taxodium ascendens*) is the canopy dominant. Swamp tupelo (*Nyssa biflora*), red maple (*Acer rubrum*), and Atlantic white cedar (*Chamaecyparis thyoides*) are prominent.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Most of the site has been impacted by logging, and portions of the drier ridge areas have been bush-hogged. The ridge communities have also been impacted by fire suppression. Roadbeds, a narrow powerline corridor, and plowlines also impact the site. To protect natural processes and community structure and composition, the canopy should be allowed to recover, and the ridge communities should be regularly burned.

REFERENCES:

LeBlond, R.J. 1994. Site survey report: Waccamaw Island Savanna. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

Nifong, T.D. 1981. Waccamaw Island Savanna. In Natural areas inventory of Brunswick County, North Carolina, 239-247. Coastal Energy Impact Program Report No. 10, N.C. Coastal Management Program.

Schafale, M.P., F. Annand, and M. Ward. 1989. Notes on the Waccamaw River valley, south of NC 904 and east of the river. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

Schafale, M.P., H.E. LeGrand, and R.S. Marty. 1986. Waccamaw River natural areas inventory and preserve design: Site 15. The Nature Conservancy and N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

deposition of alluvium by a tributary stream rather than by the Waccamaw River itself. The system is, however, located on the Waccamaw River terrace. This stream, which forms the southwestern border of the natural area, presumably has been migrating to the southwest over time, leaving behind more sediment and adding additional ridges and swales.

Cypress Savanna occurs on saturated to shallowly inundated mineral soils in the swales. It is characterized by an open to sparse pondcypress (*Taxodium ascendens*) canopy over a moderate to dense herb layer. Titi (*Cyrilla racemiflora*) forms a sparse to moderate subcanopy, and wax-myrtle (*Myrica cerifera* var. *cerifera*) is the dominant shrub. Threadleaf beakrush (*Rhynchospora filifolia*), pinebarren smokegrass, and longleaf three-awn (*Aristida palustris*) are dominant to prominent in the dense herb layer. It is possible that the graminoid dominance of the swales is the result of past logging or intense fire. The Cypress Savanna occupies the swales east of the small roadbed that bisects the site north-to-south. The swale areas west of the roadbed more closely approach a pine savanna or flatwoods association.

The wet mineral soils of the low ridges support an association intermediate between Coastal Plain Bottomland Hardwoods and Wet Pine Flatwoods. Loblolly pine (*Pinus taeda*), pond pine (*P. serotina*), and pondcypress are prominent in the canopy. Red maple (*Acer rubrum*) is a subcanopy patch dominant. Wax-myrtle and titi are shrub dominants, and pinebarren sandreed is a patch dominant in some open areas. Lower ridges are characterized by a dense tree and tall shrub canopy and understory with no herb layer development. Higher ridges have a more open canopy and understory, with a moderately developed herb layer.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Plowlines are present in some swales, and the presence of loblolly pine and red maple in the ridge flora may indicate past disturbance. It is possible that the graminoid dominance of the swales is the result of past logging or intense fire. A small roadbed bisects the site from north to south. The central area adjacent to the roadbed has been bedded and planted. Fire may be beneficial, but history of fire unknown. The site's logging history and fire frequency need to be determined.

REFERENCES:

LeBlond, R.J. 1994. Site survey report: Waccamaw River Ridge-and-Swale Boggy Openings. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

Schafale, M.P., H.E. LeGrand, and R.S. Marty. 1986. Waccamaw River natural areas inventory and preserve design: Site 15. The Nature Conservancy and N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Waccamaw River Eleocharis Backwater

SITE SIGNIFICANCE: Regional

SIZE: est. 400 acres, the majority of which is in Columbus Co.

COUNTY: Brunswick / Columbus **QUADRANGLE:** Freeland

LOCATION: About halfway between highways NC 130 and NC 904, extending southwest from the confluence of Gore Creek with Waccamaw River toward Reeves Landing.

SIGNIFICANT FEATURES:

1. Two very rare plant species have been documented from the site: Carolina bogmint (Macbridea caroliniana) and Plymouth gentian (Sabatia kennedyana). Carolina bogmint is a Federal C2 Candidate, and is known historically from the Columbus Co. portion of the site. Plymouth gentian is State Threatened-Special Concern, and in North Carolina is known only from the Waccamaw River drainage.
2. The site contains good examples of several landforms and natural community types associated with both the active river channel and a relict ridge-and-swale system formed by the ancient, larger river.

GENERAL DESCRIPTION: The site is bordered by Gore Creek and Gore Lake, a fishpond, along the northeast side, and by landforms associated with the active river channel along the southeast side. Active channel landforms include channel bars, point bars, point bar ridges, active sloughs, and oxbow lakes. Northwest of the river, and southwest of Gore Creek, is a relict ridge-and-swale system formed by the ancient river. Each of these landforms supports distinctive natural community types. The Sand and Mud Bar community occurs on channel and point bars. Point bar ridges support Coastal Plain Levee Forest (Blackwater Subtype). Isolated, water-filled meanders support the Oxbow Lake community. Cypress--Gum Swamp (Blackwater Subtype) occurs in active sloughs and low elevation relict swales. Coastal Plain Bottomland Hardwoods (Blackwater Subtype) occurs on relict floodplain ridges.

Channel bars and point bars are depositional features within the active river channel that are exposed during water level drawdowns. Sandy to silty channel bars are formed along straight stretches of the river. Sandy point bars are formed on the inside of meanders (convex shore of the river). Both support the Sand and Mud Bar community, which is dominated by small herbs that can reproduce quickly during the often brief drawdown periods. Baldwin's spikerush (Eleocharis baldwinii) and creeping rush (Juncus repens)

are the dominant small herbs. Plymouth gentian also occurs in the Sand and Mud Bar community. The higher elevations of point bars often support colonies of red top panic grass (Panicum rigidulum var. rigidulum).

Because the meander (bend) obstructs flow, point bars are the sites of the most active sediment deposition. The landward portions of point bars are thus higher in elevation than channel bars, and these higher portions undergo succession to Coastal Plain Levee Forest. The levee forest canopy is dominated by overcup oak (Quercus lyrata), laurel oak (Quercus laurifolia), and baldcypress (Taxodium distichum).

The Oxbow Lake community occurs on flooded sandy peat to mucky soils in recently abandoned river channel meanders where sediment deposits have closed off the former channel meander at both ends, leaving a crescent-shaped or horseshoe-shaped water body. Although oxbow lake waters are still, they are periodically flushed by floodwaters. Over time, the lake will eventually fill in and succeed to Cypress--Gum Swamp. Still waters of oxbow lakes may support rooted and floating aquatic plants, and emergent cypress and gum trees.

Cypress--Gum Swamp is fully developed on periodically flooded sandy peat to mucky soils in active sloughs and low elevation relict swales at the site. Sloughs are former segments of the river channel that have been cut off by sediment deposition at the upstream end of the slough. Active sloughs carry flowing water during flood events. The relict swales are associated with meanders created by the ancient, larger river. Lower elevation relict swales, although farther from the active river channel, can also carry flood waters. The Cypress--Gum Swamp canopy is dominated by swamp tupelo (Nyssa biflora), baldcypress (Taxodium distichum), and pondcypress (T. ascendens). The understory is dominated by Carolina ash (Fraxinus caroliniana) and water-elm (Planera aquatica).

Coastal Plain Bottomland Hardwoods occurs on wet soil of higher floodplain ridges away from active sediment deposition, and on relict ridges of the ancient river floodplain. These ridges are flooded only by the highest floods, if at all. The sand or loamy sand ridges are long and arcuate. The forest canopy is dominated by loblolly pine and laurel oak. Atlantic white cedar (Chamaecyparis thyoides), red maple (Acer rubrum), and overcup oak are prominent to sometimes dominant.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: The site contains good examples of natural communities associated with active and relict river and floodplain landforms. The site is vulnerable to logging, and roadbeds are present along the inland edges. The site should not be logged if the natural communities, rare species populations, and river water quality are to be protected.

REFERENCES:

Schafale, M.P., H.E. LeGrand, and R.S. Marty. 1986. Waccamaw River natural areas inventory and preserve design: Site 14. The Nature Conservancy and N.C. Natural Heritage Program, DPR, DEHNR.

BALD HEAD--SMITH ISLAND COMPLEX MACROSITE

The Bald Head--Smith Island Complex Macrosite comprises a system of estuarine islands, barrier beaches and spits, tidal marshes and creeks, and open estuarine waters. It is located along the east side of the mouth of the Cape Fear River, and is bounded by Federal Point along the north, and by the Atlantic Ocean along the east and south. The northern end of the macrosite occurs in New Hanover County, but the great majority, including all of Smith Island, is located in Brunswick County. The macrosite consists of all of Smith Island--including the sand ridges known as Bald Head Island, Middle Island, and Bluff Island--and Zekes Island Estuarine Sanctuary, which includes Zekes Island, No Name Island, and North Island. The nationally significant macrosite contains several maritime natural community types, some of which are rare and among the best examples known. The area also provides habitat for many rare plants and animals, including five Federally Endangered or Threatened species.

Among the most significant features in the macrosite are the maritime forest communities found on the Smith Island sand ridges. The Maritime Evergreen Forest occurs on all three of the sand ridges, and is the best developed and most extensive example in southeastern North Carolina. This forest is unusual in North Carolina because of the subtropical influence exhibited by such species as cabbage palm (Sabal palmetto). The Maritime Shrub community is also well-developed and includes components not seen in other areas. These woodland communities are subject to natural disturbances from storms, and the forest canopy was severely impacted by the 1984 hurricane. These storm blowdowns result in a complex natural successional pattern within the maritime forest.

Non-forested areas along the south and east sides of the Bald Head--Smith Island Complex Macrosite support Dune Grass and critical Upper Beach natural communities. The ocean beach along the east side of Smith Island is known as East Beach in the southern and central area, and as Bay Beach near the northeast end of Smith Island. Tidal marshes between the sand ridges and north from Bluff Island support Salt Flat and extensive Salt Marsh natural communities. An example of the Interdune Pond community occurs on Bluff Island.

Much of the western half of Bald Head Island--the southern-most of the sand ridges--has been altered by residential and golf course development. Much of the eastern half of Middle Island--located between Bald Head and Bluff islands--has also been impacted by residential development. Little artificial disturbance has occurred at Bluff Island, and its natural communities are in essentially pristine condition. The marsh communities likewise are essentially free of artificial disturbance.

Nested within the macrosite are four standard sites. They are, from north to south: Zekes Island Estuarine Sanctuary, Bluff Island and East Beach, Middle Island, and Bald Head Island. Portions of the macrosite outside of standard sites have been determined to be of lesser significance but important to the overall integrity of the area, such as by providing corridors for plant and animal populations, and by buffering critical features within the standard sites. Each of the standard sites is described in the following pages.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Bald Head Island

SITE SIGNIFICANCE: National **SIZE:** est. 1700 acres

COUNTY: Brunswick **QUADRANGLE:** Cape Fear / Kure Beach

LOCATION: Bald Head Island, forming the east shore of the mouth of the Cape Fear River.

SIGNIFICANT FEATURES:

1. This site contains one of the largest and best examples of the Maritime Evergreen Forest natural community, and includes extensive areas of dune, beach, and marsh communities. These natural communities support many rare plant and animal species.
2. Eight rare animal species have been documented from the site, including four federally designated animals.
 - a. The federally designated species are: peregrine falcon (Falco peregrinus), American alligator (Alligator mississippiensis), loggerhead sea turtle (Caretta caretta), and green turtle (Chelonia mydas). The peregrine falcon is a Federal and State Endangered species. The American alligator, loggerhead sea turtle, and green turtle are Federal and State Threatened. Bald Head Island contains the largest concentration of loggerhead sea turtle nests in the state, and is one of very few recurring green turtle nesting sites in North Carolina.
 - b. Another four animal species are rare in North Carolina: eastern woodrat (Neotoma floridana floridana), common ground-dove (Columbina passerina), southern hairstreak (Fixsenia favonius), and giant swallowtail (Papilio cressphontes). The eastern woodrat is a State Threatened mammal. The common ground-dove is a significantly rare bird in North Carolina, and the southern hairstreak and giant swallowtail are significantly rare butterflies. Bald Head Island contains the only current population of the southern hairstreak in the state.
3. Twelve rare plant species have been documented from Bald Head Island, consisting of nine vascular plants and three nonvascular plants.
 - a. Among these are two federally designated vascular plants: seabeach amaranth (Amaranthus pumilus) and dune bluecurls (Trichostema sp. 1). Seabeach amaranth is a Federal and

State Threatened plant, and dune bluecurls is a Federal and State Candidate. Dune bluecurls is globally restricted to the Atlantic shore of North and South Carolina, where the great majority of seabeach amaranth also occurs.

- b. Another seven vascular plant species are rare in North Carolina: silverling (Baccharis glomeruliflora), four-angled flatsedge (Cyperus tetragonus), nerved witch grass (Dichanthelium sp. 5 =Panicum neuranthum), beach morning glory (Ipomoea imperati), cabbage palm (Sabal palmetto), tough bumelia (Sideroxylon tenax), and moundlily yucca (Yucca gloriosa). Silverling and tough bumelia are State Candidate species. The others are significantly rare in North Carolina. Native stands of cabbage palm are known from only three areas in North Carolina, all in Brunswick County, and the Bald Head--Smith Island Complex population is by far the largest. Nerved witch grass is not currently known from any other site in the state. Tough bumelia is currently known in North Carolina only from the Bald Head--Smith Island Complex.
- c. Three rare nonvascular plant species occur at the site: Cuban schliessmund (Syrrhopodon incompletus), a liverwort (Cheilolejeunea rigidula), and sunrise lichen (Teloschistes flavicans). Cuban schliessmund, a moss, is a State Candidate. The liverwort and sunrise lichen are significantly rare in North Carolina.

GENERAL DESCRIPTION: Bald Head Island is the largest, youngest, and southern-most of the sand ridge islands forming the Bald Head--Smith Island Complex. It likely developed from Cape Fear River sediment deposition and subsequent sand spit formation. Cape Fear forms the southeastern tip of the island. Bald Head Island is bounded by dynamic ocean beaches along the east, south, and west sides, and by tidal marsh communities along the north side adjacent to Bald Head Creek. The northern and central interior of the island is dominated by Maritime Evergreen Forest, the western half of which has been substantially altered by residential and golf course development. The Maritime Shrub community occurs along the edges of the sand ridge, and on small upland hammocks in the tidal marsh adjacent to the north side of the ridge. Along the south side of the island, between the maritime forest and the ocean, is a narrow but lengthy area of open dunelands supporting the Dune Grass natural community. The western half of the dune area also has been substantially altered by residential and golf course development. The dynamic ocean beach along the southern and eastern edges of the island supports the Upper Beach community. Because of its exposure, the island is vulnerable to and frequently hit by storms. This results in a complex successional pattern in the natural communities, particularly in the maritime forest.

The Maritime Evergreen Forest is unusual by having a distinctive subtropical influence, as indicated by such species as cabbage palm, tough bumelia, and southern hairstreak butterfly. The forest canopy was substantially damaged during a hurricane in 1984, and affords a rare opportunity to witness large-scale canopy impact and recovery in this community type. The pre-hurricane old growth forest canopy was dominated by live oak (Quercus virginiana) and sand laurel oak (Q. hemisphaerica). An estimated 50-80% of the canopy trees were killed by the hurricane, but old canopy oaks measuring nearly 6 feet in diameter at breast height survive. Cabbage palm is a prominent component of the canopy and subcanopy, and loblolly pine (Pinus taeda) is locally prominent in the canopy. Other prominent subcanopy trees include upland red bay (Persea borbonia), wild olive (Osmanthus americana), Carolina laurel-cherry (Prunus caroliniana), and flowering dogwood (Cornus florida). Shrub and vine growth is dense in the large openings created by storm blow-downs. Prominent shrub layer species include subcanopy trees and yaupon (Ilex vomitoria). Prominent vines are poison-ivy (Toxicodendron radicans), saw greenbrier (Smilax bona-nox), horsebrier (S. rotundifolia), and muscadine (Vitis rotundifolia).

Maritime Shrub occurs on low slopes along the edges of the Bald Head Island sand ridge, on the more exposed eastern end of the ridge, and on the small upland hammocks in the marsh along the north side of the ridge. The species composition is similar to that of the Maritime Evergreen Forest, but the stature of the Maritime Shrub community is lower, the stunted canopy trees typically not exceeding 15 feet in height. Live oak and coastal red cedar are frequent dominants, and loblolly pine and ironwood are usually absent. Of interest are sparsely vegetated sandy openings within the Maritime Shrub habitat that are dominated by lichens (Cladonia spp., Cladina evansii). Other typical species include pinweeds (Lechea mucronata, L. pulchella var. 1), queendevil (Hieracium gronovii), flatsedges (Cyperus retrorsus var. retrorsus, C. grayi), and Nash's witch grass (Dichanthelium sp. 3 =lancearium).

The Dune Grass community occurs in the dune system along the south side of the island. This community is dominated by grasses: sea oats (Uniola paniculata) and bitter panic grass (Panicum amarum). Other prominent species include trailing wild bean (Strophostyles helvula) and dune pennywort (Hydrocotyle bonariensis). This community is naturally impacted by beach erosion, wind, storms. The sand binding plants of the Dune Grass community trap blowing sand, causing the dune to build up higher and eventually stabilizing it. These plants also form new dunes by trapping blowing sand on flat areas.

The Upper Beach community occurs along the southern and eastern edges of the island above mean high tide to the toe of the primary (seaward-most) dune. This zone is inundated only during spring tides and storm tides, but is moistened by salt spray between

periods of inundation. The vegetation is sparse and characterized by a small number of species, including several succulents and annuals. Prominent species are sea rocket (Cakile edentula), seabeach sandmat (Chamaesyce polygonifolia), Carolina beach-thistle (Salsola caroliniana), and seabeach orach (Atriplex arenaria). The Upper Beach is a very dynamic community dependent on natural disturbance, and quickly succeeds to the Dune Grass community if protected from tidal and storm influences. The Upper Beach at this site provides critical habitat for two Federally and State Threatened species: the loggerhead sea turtle and seabeach amaranth.

OWNERSHIP: Private and public. The Bald Head Island Coastal Reserve is owned by the N.C. Division of Coastal Management.

PROTECTION STATUS: The Bald Head Island Coastal Reserve, a 173-acre parcel of maritime forest, is managed for protection of its natural values.

MANAGEMENT/PROTECTION RECOMMENDATIONS: The protected area of Bald Head Island provides an excellent opportunity to monitor successional patterns in Maritime Evergreen Forest. The unprotected portions of the island, including all of the open dune area, are developed or potentially impacted by development. Consideration should be given to the protection of a sizeable area of open dunes, particularly areas supporting extensive rare plant populations, and areas adjacent to turtle nesting sites.

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- Lopazanski, M.J., and J.P. Evans. 1988. Preliminary site reconnaissance survey: Bald Head Island. N.C. Division of Coastal Management, DEHNR, Raleigh.
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- Mayes, C.H. 1984. The flora of Smith Island, Brunswick County, North Carolina. M.S. Thesis, University of North Carolina-Wilmington.
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Nifong, T.D. 1981. Bald Head Creek. In Natural areas inventory of Brunswick County, North Carolina, pp. 26-33. Coastal Energy Impact Program Report No. 10, N.C. Coastal Management Program.

Schafale, M.P., C.C. Frost, T.R. Wentworth, and V. Sewell. 1988. Preliminary site reconnaissance survey: Bald Head Island. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Bluff Island and East Beach

SITE SIGNIFICANCE: Statewide **SIZE:**

COUNTY: Brunswick **QUADRANGLE:** Cape Fear

LOCATION: On east side of the Bald Head--Smith Island Complex, north of Middle and Bald Head islands.

SIGNIFICANT FEATURES:

1. This site contains several examples of maritime communities: Dune Grass, Interdune Pond, Maritime Shrub, Maritime Evergreen Forest, Salt Flat, Salt Marsh, and Upper Beach. The Interdune Pond community is very rare in coastal southeastern North Carolina, and the Maritime Shrub community exhibits variation not seen elsewhere.
2. The loggerhead sea turtle (Caretta caretta) is known to breed at the site. The loggerhead sea turtle is Federally and State Threatened.
3. The site supports populations of nine rare plant species: four-angled flatsedge (Cyperus tetragonus), pinebarren sunrose (Helianthemum corymbosum), long-awned spangletop (Leptochloa fascicularis var. maritima), winged seedbox (Ludwigia alata), cabbage palm (Sabal palmetto), tough bumelia (Sideroxylon tenax), sunrise lichen (Teloschistes flavicans), dune bluecurls (Trichostema sp. 1), and moundlily yucca (Yucca gloriosa). Dune bluecurls is a Federal and State Candidate, and tough bumelia is a state candidate. The others are significantly rare in North Carolina. Dune bluecurls is globally restricted to the Atlantic shore of North and South Carolina. Tough bumelia is currently known in North Carolina only from Bluff Island and nearby Bald Head Island. Native stands of cabbage palm are known from only three sites in North Carolina, all in Brunswick County, and the Bald Head--Smith Island Complex population is by far the largest. Bluff Island and East Beach contains the only known Brunswick County occurrences for pinebarren sunrose and long-awned spangletop.

GENERAL DESCRIPTION: Bluff Island and East Beach comprises an area containing an upland sand ridge, an interdune pond, ocean beach and dune habitat, and tidal areas containing marsh habitat and small upland hammocks. The sand ridge (Bluff Island) is the northernmost and oldest of the three ridges forming the Bald Head--Smith Island complex. It likely developed from Cape Fear River sediment deposition and subsequent sand spit formation. The ridge supports Maritime Evergreen Forest and Maritime Shrub natural communities. A ponded depression about 10 acres in size is located in the

central and eastern portion of the ridge, and supports the Interdune Pond natural community. A dune system along the east side of the site above East Beach supports the Dune Grass community. The tidal marsh between Bluff Island and Middle Island contains Salt Marsh and Salt Flat communities. Small upland hammocks within the marsh support the Maritime Shrub community. The dynamic ocean beach along East Beach supports the Upper Beach community.

Higher elevations on the Bluff Island sand ridge support a well-developed and nearly pristine Maritime Evergreen Forest. Although the community was impacted by the 1984 hurricane, this kind of disturbance is one of the natural processes to which the community is adapted. Maritime Evergreen Forest is characterized by canopy of live oak (Quercus virginiana), sand laurel oak (Q. hemisphaerica), cabbage palm, and loblolly pine (Pinus taeda). Prominent in the subcanopy are coastal red cedar (Juniperus virginiana var. silvicicola). Dominant in the subcanopy are wild olive (Osmanthus americana), Carolina laurel-cherry (Prunus caroliniana), yaupon (Ilex vomitoria), and ironwood (Carpinus caroliniana). Dense vine growth is dominated by saw greenbrier (Smilax bona-nox), poison ivy (Toxicodendron radicans), and coral honeysuckle (Lonicera sempervirens). Herbs are sparse in the thickly littered ground layer.

Maritime Shrub occurs on low slopes along the edges of the Bluff Island sand ridge, on the more exposed eastern end of the ridge, and on the small upland hammocks in the marsh along the south side of the ridge. The species composition is similar to that of the Maritime Evergreen Forest, but the stature of the Maritime Shrub community is lower, the stunted canopy trees typically not exceeding 15 feet in height. Live oak and coastal red cedar are frequent dominants, and loblolly pine and ironwood are usually absent. Of interest are sparsely vegetated sandy openings within the Maritime Shrub habitat that are dominated by lichens (Cladonia spp., Cladina evansii). Other typical species include pinweeds (Lechea mucronata, L. pulchella var. 1), pinebarren sunrose, flatsedges (Cyperus retrorsus var. retrorsus, C. grayi), and Nash's witch grass (Dichanthelium sp. 3 =lancearium).

The Interdune Pond community on Bluff Island occupies a long depression between sand ridges. Most of the basin is dominated by marsh vegetation, within which are mucky ponded openings. Marsh areas are dominated by common reed (Phragmites australis). Other prominent marsh plants are black needlerush (Juncus roemerianus), southern cattail (Typha domingensis), salt-marsh bulrush (Schoenoplectus robustus), and salt grass (Distichlis spicata). In the ponded openings, long-awned spangletop and a small spikerush (Eleocharis ?parvula) are patch dominants. There is some evidence that common reed dominance of the marsh is of recent origin (after 1974), and may indicate an increase in salinity.

The Dune Grass community occurs in the dune system located between the forested ridges and the ocean beach to the east. It is characterized by sparsely vegetated exposed sand. The dominant plant is sea oats (Uniola paniculata). Other prominent species include trailing wild bean (Strophostyles helvula), bitter panic grass (Panicum amarum), and dune pennywort (Hydrocotyle bonariensis). This community is naturally impacted by beach erosion, wind, storms. The sand binding plants of the Dune Grass community trap blowing sand, causing the dune to build up higher and eventually stabilizing it. These plants also form new dunes by trapping blowing sand on flat areas.

The Salt Marsh community dominates regularly flooded flats located along the tidal creeks north and south of the Bluff Island sand ridge. Saltmarsh cordgrass (Spartina alterniflora) and black needlerush form extensive zones, usually to the exclusion of other vascular plants.

The Salt Flat community occurs in exposed areas within the Salt Marsh where tidal sea water pools and then evaporates, thereby increasing the salinity. It is believed that these open areas are created by the deposition of organic debris during storm tides and the die-off of buried saltmarsh cordgrass and black needlerush. The Salt Flat openings are dominated by salt grass, saltworts (Salicornia spp.), and stunted saltmarsh cordgrass.

The Upper Beach community occurs along East Beach above mean high tide to the toe of the primary (seaward-most) dune. This zone is inundated only during spring tides and storm tides, but is moistened by salt spray between periods of inundation. The vegetation is sparse and characterized by a small number of species, including several succulents and annuals. Prominent species are sea rocket (Cakile edentula), seabeach sandmat (Chamaesyce polygonifolia), Carolina beach-thistle (Salsola caroliniana), and seabeach orach (Atriplex arenaria). The Upper Beach is a very dynamic community dependent on natural disturbance, and quickly succeeds to the Dune Grass community if protected from tidal and storm influences. The Upper Beach at this site provides critical breeding habitat for the Federally and State Threatened loggerhead sea turtle

OWNERSHIP: Public and private. Portions within the Bald Head Island State Natural Area are owned by the N.C. Division of Parks and Recreation.

PROTECTION STATUS: Most of the site is within the Bald Head Island State Natural Area.

MANAGEMENT/PROTECTION RECOMMENDATIONS: The site and the communities it supports are naturally dynamic, with storms and tides influencing both the topography and natural community

structure. This site contains some of the most pristine examples of maritime community types, and artificial disturbances should be avoided if natural values are to be maintained. Particularly vulnerable are the privately owned small upland hammocks within the marsh.

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- McCormick, J.F., and R.R. Sharitz. 1973. Plant communities of Smith Island, North Carolina. The ASB Bulletin 20(2):69 ff.
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Upland areas support Dune Grass and Maritime Shrub communities, and the intertidal marshes support the Salt Marsh community. Only the Salt Marsh is of high quality, and it is dominated by saltmarsh cordgrass (*Spartina alterniflora*), with black needlerush a patch dominant near the upland edge of the marsh.

OWNERSHIP: N.C. Division of Coastal Management.

PROTECTION STATUS: The site is a Dedicated State Nature Preserve.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Zekes Island Estuarine Sanctuary is currently managed for the protection and preservation of its natural values.

REFERENCES:

Coastal Zone Management. 1982. Environmental assessment: North Carolina National Estuarine Sanctuary System. National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

Schafale, M.P. 1990. Notes on Zekes Island and adjacent marshes and barrier spit. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

Taggart, J.B. 1982. Natural resource inventory, significance, and management recommendations for Zekes, No Name, and North Islands. Memorandum of March 11, 1982, to Tom Wells, N.C. Division of Parks and Recreation, DEHNR, Raleigh.

PROTECTION STATUS: A small portion is protected under a conservation easement to the Bald Head Conservancy.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Much of the eastern half of the Middle Island sand ridge has been impacted by residential development, and a roadbed transects the length of the island. All of the ridge remaining in natural condition is vulnerable to development. Protection of undeveloped habitat will require the willing cooperation of owners.

REFERENCES:

Evans, J.P., and M.J. Lopazanski. 1988. Preliminary site reconnaissance survey: Middle Island. N.C. Division of Coastal Management, DEHNR, Raleigh.

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Mayes, C.H. 1984. The flora of Smith Island, Brunswick County, North Carolina. M.S. Thesis, University of North Carolina-Wilmington.

McCormick, J.F., and R.R. Sharitz. 1973. Plant communities of Smith Island, North Carolina. The ASB Bulletin 20(2):69 ff.

quality Maritime Dry Grassland occurs on low barrier dunes and sand spits that have formed along the edges and ends of the island.

The Salt Marsh is dominated by saltmarsh cordgrass (Spartina alterniflora). The small area of Maritime Evergreen Forest consists of a canopy of live oak (Quercus virginiana) over a tall shrub layer of yaupon (Ilex vomitoria) and coastal red cedar (Juniperus virginiana var. silicicola). The Maritime Shrub community is characterized by a moderate to dense stand of tall shrubs dominated by yaupon and coastal red cedar, with toothache tree (Zanthoxylum clava-herculis) prominent. Maritime Dry Grassland is dominated by saltmeadow cordgrass on barrier dunes and sand spits, and hammock swallow-wort (Cynanchum angustifolium) is prominent. On the artificial soil of spoil deposits, the dry grassland community is dominated by such species as camphorweed (Heterotheca subaxillaris), firewheel (Gaillardia pulchella), common ragweed (Ambrosia artemisiifolia), and a blackberry (Rubus sp.). Dune bluecurls is a patch dominant in some spoil areas of the Maritime Dry Grassland community.

OWNERSHIP: N.C. Department of Environment, Health, and Natural Resources; leased to the National Audubon Society.

PROTECTION STATUS: Registered Natural Heritage Area, managed for the protection of its wildlife resources.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Battery Island is currently managed for the protection of its wildlife resources and natural values.

REFERENCES:

LeBlond, R.J. 1994. Site survey report: Battery Island. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

Parnell, J.F., and D.A. McCrimmon, Jr. 1984. 1983 supplement to atlas of colonial waterbirds of North Carolina estuaries. UNC Sea Grant Publication UNC-SG-84-07.

Parnell, J.F., and R.F. Soots, Jr. 1979. Atlas of colonial waterbirds of North Carolina estuaries. UNC Sea Grant Publication UNC-SG-78-10.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Green Swamp

SITE SIGNIFICANCE: National **SIZE:** 15,722 acres

COUNTY: Brunswick

QUADRANGLE: Bolivia / Honey Island / Lewis Swamp / Supply

LOCATION: East and west of highway NC 211, from 2 to 10 miles north of the town of Supply.

SIGNIFICANT FEATURES:

1. Green Swamp comprises one of the most significant natural landscapes in North Carolina, containing extensive areas of high quality savanna, flatwoods, and pocosin habitat. The Pine Savanna natural community at Green Swamp has one of the highest per acre plant species richness of any area in temperate North America.
2. The site supports populations of 26 rare plants and 16 rare animals. Latin and common names, and Federal and State rarity status for each rare species are provided in a table at the end of this site description.
 - a. Among the rare animals are two Federally and State Endangered species: eastern cougar (Felis concolor couguar) and red-cockaded woodpecker (Picoides borealis). The American alligator (Alligator mississippiensis) is Federally and State Threatened, and another four animal species are Federal C2 Candidates: Bachman's sparrow (Aimophila aestivalis), Henslow's sparrow (Ammodramus henslowii), Carolina gopher frog (Rana capito capito), and Cape Fear threetooth mollusk (Triodopsis soelneri).
 - b. Among the rare plants, rough-leaf loosestrife (Lysimachia asperulifolia) is Federally and State Endangered, and another five species are Federal C2 Candidates: savanna indigo-bush (Amorpha georgiana var. confusa), Venus flytrap (Dionaea muscipula), Carolina grass-of-parnassus (Parnassia caroliniana), Carolina goldenrod (Solidago pulchra), and Carolina asphodel (Tofieldia glabra). The site contains the only North Carolina record for honeycomb head (Balduina atropurpurea), a State Candidate species.

GENERAL DESCRIPTION: Green Swamp occupies a very large, broad, and flat terrace. Relative to the surrounding landscape, Green Swamp is perched, or higher in elevation, and serves as headwaters for streams flowing west to the Waccamaw River, north and east to the

Cape Fear River, and south to Lockwoods Folly River. The swamp extends northwestward to Lake Waccamaw in Columbus County, and once covered perhaps as much as 200,000 acres. Most of the original swamp has been ditched and converted to pine plantations.

The Green Swamp site consists of a large remnant of the original swamp that remains in essentially natural condition. Most of the habitat is dominated by pocosin communities that occur on saturated organic soils. Within the large swamp areas are rises of elevated mineral soils. These wet to mesic sandy rises support Pine Savanna and Mesic Pine Flatwoods natural communities. An upland terrace along the southeast side of the site contains small depressions supporting Small Depression Pocosin and Small Depression Pond communities.

The pocosin communities include Low Pocosin, High Pocosin, Pond Pine Woodland, and Bay Forest. Low Pocosin occurs centrally within the large pocosin habitat, and is characterized by a dense shrub layer usually less than 1.5 meters tall. Dominant shrubs include honeycups (Zenobia pulverulenta), fetterbush (Lyonia lucida), and titi (Cyrilla racemiflora). Blaspheme-vine is often abundant, and scattered, stunted trees are also present. Also occurring within the Low Pocosin habitat are pools and channels of open water known as "The Soups," and which support such plants as leatherleaf (Chamaedaphne calyculata), Virginia chainfern (Woodwardia virginica), Walter's sedge (Carex striata), yellow pitcher plant (Sarracenia flava), and peatmosses (Sphagnum spp.). Herbs are otherwise sparse.

The High Pocosin community surrounds the central Low Pocosin habitat. High Pocosin is distinguished by a dense shrub layer typically from 1.5 to 3 meters tall. Dominant shrubs include titi, fetterbush, and inkberry (Ilex glabra). Blaspheme-vine is abundant, and honeycups is often prominent following fire. Trees are also present, but are too scattered to form a canopy. The most common trees are pond pine (Pinus serotina), swamp red bay (Persea palustris), sweetbay (Magnolia virginiana), and loblolly bay (Gordonia lasianthus). Herbs are sparse to absent.

Pond Pine Woodland occurs where the peat layer is shallower near the outer perimeter of the pocosin habitat, and around the edges of the upland rises. It is distinguished by an open to dense canopy of pond pine and a dense understory reaching 5 or more meters in height (though shorter following fire). The dense shrub layer dominants include titi, fetterbush, inkberry, gallberry (Ilex coriacea), maleberry (Lyonia ligustrina), blue huckleberry (Gaylussacia frondosa), and coastal sweet-pepperbush (Clethra alnifolia). Swamp red bay, sweetbay, and loblolly bay are frequently prominent. Herbs are sparse to absent except in openings.

The Bay Forest community is found along the upper reaches of creeks draining the pocosin. It is characterized by a canopy dominated by loblolly bay, sweetbay, swamp red bay, Carolina red maple (Acer rubrum var. trilobum), Atlantic white cedar (Chamaecyparis thyoides), pond pine, and swamp tupelo (Nyssa biflora). The dense shrub layer includes fetterbush, titi, maleberry, and gallberry. This community is transitional to Peatland Atlantic White Cedar Forest where small patches dominated by Atlantic white cedar are found. The Peatland Atlantic White Cedar Forest community is dependent on a very specific fire regime and has become very rare in North Carolina. Portions of the Bay Forest community may represent successional replacement of the cedar forest.

Two longleaf pine (Pinus palustris) communities occur on the upland rises within the broad pocosin habitat: Pine Savanna and Mesic Pine Flatwoods. These rises are characterized by wet to mesic mineral soils of sand or sandy loam, rather than by the saturated organic soils of the pocosins. However, the difference in elevation between these rises and the adjacent pocosins are at most only a few feet.

Pine Savanna occurs on wet to seasonally saturated mineral soils on the lower-elevation upland rises, and around the perimeters of the higher rises. Green Swamp contains the best examples of the Pine Savanna community in North Carolina, and it has been found to possess one of the highest species richness of any area in temperate North America. It is characterized by an open canopy of mixed-age longleaf pine over a dense and diverse herb layer dominated by wiregrass (Aristida stricta), Carolina dropseed (Sporobolus sp. 1), toothache grass (Ctenium aromaticum), and savanna muhly (Muhlenbergia expansa). Pond pine is sometimes a prominent component of the canopy. The great majority of rare species occurring within the site are found in the Pine Savanna community. The herb diversity and density at Green Swamp is the direct result of ongoing prescribed burning, which approximates natural fire frequency and seasonality.

Central areas of the higher upland rises support Mesic Pine Flatwoods. These grade downslope to Pine Savanna, and are characterized by an open canopy of mixed-age longleaf pine over a low shrub and moderately diverse herb layer. Dominant low shrubs include inkberry and blue huckleberry. Wiregrass dominates the herb layer, and bracken fern (Pteridium aquilinum) often forms patches. Because of the suitability of mesic soils for cropland, the Mesic Pine Flatwoods community has become very rare in North Carolina.

The upland terrace along the southeast side of the site contains limesink depressions supporting the Small Depression Pocosin and Small Depression Pond communities. These limesink depressions are believed to have been created by subterranean collapse of limestone deposits, resulting in the slumping of overlying sand deposits.

Peat-filled depressions contain the Small Depression Pocosin community. It is characterized by an open canopy of pond pine or loblolly pine (Pinus taeda). Carolina red maple, pondcypress (Taxodium ascendens), and swamp tupelo sometimes form a subcanopy. The dense shrub layer is dominated by titi and fetterbush, with hairy highbush blueberry (Vaccinium fuscatum) and inkberry prominent.

The Small Depression Pond community forms where deeper depressions intersect the water table, resulting in standing water throughout most years. Water table fluctuations typically result in exposure of pond margins during the growing season. Unlike most Coastal Plain ponds, which produce high diversity herb growth along the margins, the ponds along the southeast side of Green Swamp are bordered by swamp vegetation, with pondcypress, swamp tupelo, and titi dominant. Herb development in these ponds is thus restricted, and the greatest herb diversity is found in shallow water and on mats of floating peat.

OWNERSHIP: The Nature Conservancy.

PROTECTION STATUS: The site is owned and managed specifically for the protection of natural communities, rare species, and ecological processes.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Management practices, particularly the replication of the natural fire process, have resulted in the maintenance and enhancement of a large, high quality natural area, including the best examples of the Pine Savanna community in North Carolina.

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TABLE OF RARE PLANTS AND ANIMALS AT GREEN SWAMP,
BRUNSWICK COUNTY, NORTH CAROLINA

RARE PLANTS

<u>COMMON/LATIN NAMES</u>	<u>FEDERAL STATUS</u>	<u>STATE STATUS</u>
Vascular plants		
<u>Agalinis aphylla</u> (scale-leaf gerardia)		Candidate
<u>Amorpha georgiana</u> var. <u>confusa</u> (savanna indigo-bush)	Candidate	Threatened
<u>Andropogon mohrii</u> (bog bluestem)		Candidate
<u>Arnoglossum ovatum</u> (savanna indian-plantain)		Significantly Rare
<u>Asclepias pedicellata</u> (savanna milkweed)		Candidate
<u>Balduina atropurpurea</u> (honeycomb head)		Candidate
<u>Dionaea muscipula</u> (Venus flytrap)	Candidate	Candidate-Special Concern
<u>Eriocaulon aquaticum</u> (seven-angled pipewort)		Significantly Rare
<u>Helenium pinnatifidum</u> (dissected sneezeweed)		Significantly Rare
<u>Lophiola aurea</u> (golden crest)		Endangered
<u>Ludwigia linifolia</u> (flaxleaf seedbox)		Significantly Rare
<u>Lysimachia asperulifolia</u> (rough-leaf loosestrife)	Endangered	Endangered
<u>Parnassia caroliniana</u> (Carolina grass-of-parnassus)	Candidate	Endangered
<u>Peltandra sagittifolia</u> (spoonflower)		Significantly Rare
<u>Platanthera integra</u> (yellow fringeless orchid)		Threatened
<u>Platanthera nivea</u> (snowy orchid)		Threatened
<u>Polygala hookeri</u> (Hooker's milkwort)		Candidate
<u>Rhynchospora alba</u> (northern white beaksedge)		Candidate

<u>COMMON/LATIN NAMES</u>	<u>FEDERAL STATUS</u>	<u>STATE STATUS</u>
<u>Rhynchospora breviseta</u> (shortbristled beaksedge)		Candidate
<u>Rhynchospora oligantha</u> (feather-bristle beaksedge)		Candidate
<u>Rhynchospora scirpoides</u> (long-beak baldsedge)		Significantly Rare
<u>Solidago pulchra</u> (Carolina goldenrod)	Candidate	Endangered
<u>Spiranthes longilabris</u> (giant spiral orchid)		Candidate
<u>Tofieldia glabra</u> (Carolina asphodel)	Candidate	Candidate
<u>Vaccinium macrocarpon</u> (cranberry)		Candidate

Nonvascular plants

<u>Sphagnum fitzgeraldii</u> (Fitzgerald's peatmoss)		Significantly Rare
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RARE ANIMALS

<u>COMMON/LATIN NAMES</u>	<u>FEDERAL STATUS</u>	<u>STATE STATUS</u>
Mammals		
<u>Condylura cristata parva</u> (star-nosed mole)		Special Concern
<u>Felis concolor couguar</u> (eastern cougar)	Endangered	Endangered
<u>Ursus americanus</u> (black bear)		Significantly Rare
Birds		
<u>Aimophila aestivalis</u> (Bachman's sparrow)	Candidate	Special Concern
<u>Ammodramus henslowii</u> (Henslow's sparrow)	Candidate	Significantly Rare
<u>Picoides borealis</u> (red-cockaded woodpecker)	Endangered	Endangered

Reptiles

<u>COMMON/LATIN NAMES</u>	<u>FEDERAL STATUS</u>	<u>STATE STATUS</u>
<u>Alligator mississippiensis</u> (American alligator)	Threatened	Threatened
<u>Crotalus adamanteus</u> (eastern diamondback rattlesnake)		Significantly Rare
<u>Ophisaurus mimicus</u> (mimic glass lizard)		Special Concern
Amphibians		
<u>Rana capito capito</u> (Carolina gopher frog)	Candidate	Special Concern
Terrestrial gastropods		
<u>Triodopsis soelneri</u> (Cape Fear threetooth)	Candidate	Threatened
Moths		
<u>Agrotis buchholzi</u> (Buchholz's dart moth)		Significantly Rare
<u>Euagrotis lubricans</u> (slippery dart)		Significantly Rare
<u>Metarranthis lateritiaria</u> (a geometrid moth)		Significantly Rare
Butterflies		
<u>Amblyscirtes alternata</u> (least Florida skipper)		Significantly Rare
<u>Calephelis virginensis</u> (little metalmark)		Significantly Rare

- c. Another eight plants significantly rare in North Carolina occur at the site: flaxleaf gerardia (Agalinis linifolia), savanna indian-plantain (Arnoglossum ovatum), dissected sneezeweed (Helenium pinnatifidum), yellow-fruited flax (Linum floridanum var. chrysocarpum), whiteseeded beaksedge (Rhynchospora divergens), Small's beaksedge (R. globularis var. pinetorum), Georgia nutrush (Scleria georgiana), and graceful goldenrod (Solidago gracillima). Yellow-fruited flax is currently known from only two sites in North Carolina, and this is the only site in Brunswick County. Whiteseeded beaksedge is known from only four sites in North Carolina. Small's beaksedge is known from five sites in the state, and this is the only site in Brunswick County.
3. A significantly rare butterfly, the Dion skipper (Euphyes dion), has been documented from the site.
4. Sixteen plant species on the watch list maintained by the N.C. Natural Heritage Program occur at the site, including the only Brunswick County record for iris-leaf yellow-eyed-grass (Xyris iridifolia).

GENERAL DESCRIPTION: Myrtle Head Savanna occurs on poorly drained fine sandy loam that is wet to saturated throughout most of the year. The habitat is dominated by the Pine Savanna Very Wet Clay natural community variant, with small and scattered canopy trees, small swamp depressions of trees and tall shrubs, and large open areas dominated by dense herb vegetation. The open areas are grass-dominated and hummocky, and the flat ground surface is composed of hydric soils exhibiting a calcareous influence from subterranean limestone ("marl") deposits. Although the site has been previously logged, the canopy is regenerating, and the very diverse herb association is of high quality. The site is surrounded by clearcuts and pine plantations.

The savanna community is characterized by an open pine canopy over an open and patchy shrub understory and dense herb ground layer. The site was logged within the past 20 years, and scattered small longleaf pines (Pinus palustris) and pond pines (P. serotina) dominate the canopy, with pondcypress (Taxodium ascendens) and swamp tupelo (Nyssa biflora) prominent in the swamp depressions. The dense herb layer is dominated by grasses and sedges. Wireleaf dropseed (Sporobolus teretifolius) is dominant, and toothache grass (Ctenium aromaticum), savanna muhly (Muhlenbergia expansa), and beaksedges (Rhynchospora spp., particularly feather-bristle beaksedge) are prominent. The savanna retains its high species diversity and complement of rare species, but the condition has been impacted by past logging, fire suppression, roadbeds, and off-road vehicle use.

OWNERSHIP: The Nature Conservancy.

PROTECTION STATUS: Site owned and managed for protection and enhancement of natural values.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Myrtle Head Savanna is owned by The Nature Conservancy, and managed for protection and enhancement of natural values and processes.

REFERENCES:

LeBlond, R.J. 1992. Vascular flora inventory of Myrtle Head Savanna, Brunswick County, North Carolina. N.C. Nature Conservancy, Carrboro.

groundwater, with perhaps occasional flooding during spring tides or storm tides. These swamps thus exhibit a greater floral diversity suggestive of the non-tidal Cypress--Gum Swamp. In the Tidal Freshwater Marsh Freshwater Variant community downstream from the railroad bridge, cypress and gum form a moderate to sparse canopy, similar to the occurrence of this variant along Lockwoods Folly River near Supply, and along Sturgeon Creek near Leland. The trees are small, and the majority of the cypress trees are dead or dying, suggesting that the appearance of marsh vegetation is relatively recent. Its appearance may be due to storm surge effects (including salt intrusion), or possibly rising sea level.

Tidal Cypress--Gum Swamp, the dominant natural community over most of the floodplain, is characterized by a dense canopy over a moderate to dense subcanopy and an open to moderately dense understory and ground layer. Swamp tupelo (Nyssa biflora) is the dominant canopy tree, and baldcypress (Taxodium distichum) is a subdominant. Pondcypress (T. ascendens) is prominent. The subcanopy is dominated by Carolina ash (Fraxinus caroliniana). Cane (Arundinaria tecta) often dominates large areas of the shrub layer. Millet beaksedge (Rhynchospora miliacea) is a frequent patch dominant in the herb layer, and sedges (Carex spp.) are prominent. In general, the Tidal Cypress--Gum Swamp community is of excellent quality with no observed disturbances. Several pondcypress trees along Town and Rice creeks are very large, averaging 2.5-3 feet in diameter, with the largest to 5 feet in diameter. These may be virgin "shake" trees with naturally twisted trunks caused by wind exposure, and avoided by loggers. The uncommon southern rein orchid (Platanthera flava var. flava) is found in this community along Rice Creek.

Tidal Freshwater Marsh Freshwater Variant occurs infrequently to regularly flooded tidal areas along Town Creek downstream from the railroad bridge. It is unusual in having a moderate to sparse tree canopy over the herbaceous ground layer. The canopy is dominated by pondcypress and swamp tupelo. Wax-myrtle (Myrica cerifera var. cerifera) and swamp rose (Rosa palustris) are prominent shrubs. Dominant herbs include lanceleaf arrowhead (Sagittaria lancifolia) and southern wild rice (Zizaniopsis miliacea). Other prominent herbs include pickerelweed (Pontederia cordata), dotted smartweed (Polygonum punctatum), and camphorweed (Pluchea odorata var. odorata).

About 1.5 miles west of the highway NC 133 bridge, the marsh changes to Tidal Freshwater Marsh Oligohaline Variant, which is influenced by a slight salt content (but much less than is found in brackish water). This community variant is dominated by tall grass-like plants: big cordgrass (Spartina cynosuroides), narrowleaf cattail (Typha angustifolia), common reed (Phragmites australis), alkali bulrush (Schoenoplectus robustus), and softstem bulrush (S. tabernaemontani). Three-square bulrush (Schoenoplectus pungens) is prominent.

OWNERSHIP: Private; tidal waters are state-owned.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Almost all of the surrounding uplands are in agricultural and pine farm use. The creek shorelines are locally impacted by boat landings and house yards at a few scattered localities. There is also localized disturbance from railroad and powerline crossings. Marshes downstream from highway NC 133 have been ditched and diked for historical rice plantations, and have not been included within the site boundary. The interests and plans of floodplain property owners need to be determined. The site should be analyzed for any impacts from adjacent upland uses. The upland ecotone between swamp and adjacent agricultural lands should be analyzed for condition and any remnant natural communities (such as mesic hardwoods).

REFERENCES:

LeBlond, R.J. 1994. Site survey report: Town Creek Marshes and Swamp. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

The Wet Pine Flatwoods and Pine Savanna communities occur on the slopes of the sandy bay rims, and on low-profiled sand ridges within the interior of the bay basins. Both are characterized by a canopy of pond pine and longleaf pine (Pinus palustris) that was greatly reduced by the wildfire. Lack of frequent fire has resulted in a dense shrub layer in most areas, which is dominated by blue huckleberry (Gaylussacia frondosa), inkberry (Ilex glabra), and creeping blueberry (Vaccinium crassifolium). The herb layer is patchy in both communities. The Wet Pine Flatwoods herb layer is dominated by wiregrass (Aristida stricta). The Pine Savanna herb layer is characterized by the prominence of such wetter soil species as Carolina dropseed (Sporobolus sp. 1), rush-featherling (Pleea tenuifolia), and yellow pitcher plant (Sarracenia flava).

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: The site is in need of frequent fire. The previous wildfire temporarily benefitted the herb layer, but subsequent fire suppression has resulted in a shrub dominance of the herb layer. It is likely that a previous period of fire suppression caused a buildup of the fuel load, resulting in severe canopy consumption during the wildfire. The site is bordered by pine plantation along the northeast, and by houselots along the southeast.

REFERENCES:

- LeBlond, R.J. 1991. Report of survey of the Greene tract in Battle Royal Bay, Brunswick County, North Carolina. N.C. Nature Conservancy, Carrboro.
- Lynch, J.M. 1991. Trip report: Wilmington and Brunswick Co., N.C. Files, 9/27/91 report of visit to the Greene tract, N.C. Nature Conservancy, Carrboro.
- Schafale, M.P. 1992. Site survey report: Battle Royal Bay. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Big Neck Road at Millpond Bay

SITE SIGNIFICANCE: Statewide **SIZE:** 1 acre

COUNTY: Brunswick **QUADRANGLE:** Juniper Creek

LOCATION: West side ditch and shoulder of Big Neck Road (SR 1335),
2 miles north of Exum.

SIGNIFICANT FEATURES: This site supports populations of eight rare plant species: flaxleaf gerardia (Agalinis linifolia), savanna indian-plantain (Arnoglossum ovatum), flaxleaf seedbox (Ludwigia linifolia), pineland plantain (Plantago sparsiflora), whiteseeded beaksedge (Rhynchospora divergens), feather-bristle beaksedge (Rhynchospora oligantha), Baldwin's nutrush (Scleria baldwinii), and Georgia nutrush (Scleria georgiana). Pineland plantain is a Federal C2 Candidate and State Endangered species, and is currently known from only four sites in North Carolina. Baldwin's nutrush is a State Candidate, and the others are significantly rare in North Carolina. Whiteseeded beaksedge is known from only four sites in North Carolina, and Baldwin's nutrush from five sites.

GENERAL DESCRIPTION: Big Neck Road at Millpond Bay consists of a roadside powerline corridor, ditch, and shoulder with a diverse savanna herb and shrub association, without canopy. The ditch is periodically flooded for extended periods. The soil type suggests that the site is a remnant of savanna habitat which may have occurred here prior to alteration of the area to pine plantation and cropland. The road shoulder savanna association is characterized by a diverse savanna plant association, with savanna muhly (Muhlenbergia expansa) a subdominant.

OWNERSHIP: N.C. Department of Transportation.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Maintenance mowing of the roadside powerline corridor promotes herb dominance of the site by cutting back woody growth, a condition maintained by fire in natural circumstances. Mowing during the growing season can interfere with plant flowering and seed production, and inhibit a plant's ability to photosynthesize and store nutrients. These impacts can be avoided by mowing during winter dormancy, or mitigated by not mowing every year. Ideally, roadside and powerline microsites should be burned instead of mowed.

REFERENCES:

LeBlond, R.J. 1994. Site survey report: Big Neck Road at Millpond Bay. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Brantley Island

SITE SIGNIFICANCE: Statewide **SIZE:** est. 150 acres

COUNTY: Brunswick **QUADRANGLE:** Shallotte

LOCATION: On mainland opposite Ocean Isle Beach, east and west of Duck Pond Road (SR 1154) south of highway NC 179.

SIGNIFICANT FEATURES: This site contains a good example of the rare Coastal Fringe Evergreen Forest natural community.

GENERAL DESCRIPTION: The Brantley Island site is an interstream upland terrace located along the north side of the Intracoastal Waterway. The terrace grades downslope to stream channels along the east and west sides of the site. The upland supports the Coastal Fringe Evergreen Forest natural community, and the stream channels support the Coastal Plain Small Stream Swamp (Blackwater Subtype). Slopes between the upland terrace and stream channels support a mesic community transitional to the very rare Calcareous Coastal Fringe Forest natural community.

Coastal Fringe Evergreen Forest occurs on mesic to wet sandy soils. It is characterized by a moderately dense canopy dominated by a mixture of loblolly pine (*Pinus taeda*), sand laurel oak (*Quercus hemisphaerica*), water oak (*Q. nigra*), and live oak (*Q. virginiana*). Dominant shrubs include yaupon (*Ilex vomitoria*) and swamp red bay (*Persea palustris*). American holly (*I. opaca*), red buckeye (*Aesculus pavia*), sassafras (*Sassafras albidum*), and wild olive (*Osmanthus americana*) are prominent. Prominent vines include saw greenbrier (*Smilax bona-nox*) and muscadine (*Vitis rotundifolia*). Pipsissewa (*Chimaphila maculata*) and arrowleaf heartleaf (*Hexastylis arifolia*) are the most common herbs.

The slopes between the upland terrace and stream channels support an unusual association transitional to Calcareous Coastal Fringe Forest. The canopy is composed of sand laurel oak, water oak, shumard oak (*Quercus shumardii*), cherrybark oak (*Q. pagoda*), Carolina basswood (*Tillia americana* var. *caroliniana*), and hickory (*Carya* sp.). The sparse understory includes ironwood (*Carpinus caroliniana*) and black cherry (*Prunus serotina*).

Coastal Plain Small Stream Swamp occurs in the stream channel floodplains, and is characterized by a canopy composed of tuliptree (*Liriodendron tulipifera*), Carolina red maple (*Acer rubrum* var. *trilobum*), elm (*Ulmus* sp.), ash (*Fraxinus* sp.), and shumard oak. The well-developed herb layer includes partridgeberry (*Mitchella repens*), Virginia avens (*Geum virginianum*), netted chainfern

(Woodwardia areolata), cinnamon fern (Osmunda cinnamomea), and jack-in-the-pulpit (Arisaema triphyllum).

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Mainland maritime forests have always been limited in area because of the relatively small acreage of appropriate habitat. Substantial portions have been lost to residential and commercial development along the coast. To protect the natural values at this site, the forest canopy should remain intact and unfragmented.

REFERENCES:

Schafale, M.P. and A.S. Weakley. 1988. Preliminary site reconnaissance survey: Brantley Island. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Brunswick River/Cape Fear River Marshes

SITE SIGNIFICANCE: Statewide **SIZE:** est. 3200 acres

COUNTY: Brunswick / New Hanover

QUADRANGLE: Castle Hayne / Wilmington

LOCATION: Tidal marshes along the Cape Fear and Brunswick rivers, from approximately one-half mile south of highway US 74/76 northward to about 1.2 miles north of Seaboard Coast Line railroad crossing.

SIGNIFICANT FEATURES:

1. This site supports the only current occurrence of Carolina bishopweed (Ptilimnium sp. 1 = P. macrospermum) in North Carolina. The only other known occurrences are in tidal marshes in the Great Pee Dee River in South Carolina, and the Savannah River in Georgia.
2. Two rare animals have been documented from the site: American alligator (Alligator mississippiensis) and rare skipper (Problema bulenta). The American alligator is a Federally and State Threatened reptile. Rare skipper is a Federal C2 Candidate and State significantly rare butterfly.
3. The site contains an extensive area of high quality Tidal Freshwater Marsh Freshwater Variant, the largest such area in North Carolina.

GENERAL DESCRIPTION: Brunswick River/Cape Fear River Marshes comprises an extensive area of regularly flooded tidal flats. The area is upstream of the normal reach of salt water, and the flats support the Tidal Freshwater Marsh Freshwater Variant natural community. Large portions of the area have been altered by ditching, diking, and roadbed construction.

Tidal Freshwater Marsh Freshwater Variant is characterized by dense to open stands of tall grass-like herbs over a layer of low grass-like herbs and wildflowers. Dominant tall (3-6 feet) herbs include narrowleaf cattail (Typha angustifolia), sawgrass (Cladium jamaicense), and softstem bulrush (Schoenoplectus tabernaemontani). Common reed (Phragmites australis), an aggressive invasive in disturbed habitat, has become dominant in altered areas. Dominant low (1-3 feet) herbs include green arrow-arum (Peltandra virginica), lanceleaf arrowhead (Sagittaria lancifolia), pickerelweed (Pontederia cordata), and shoreline sedge (Carex hyalinolepis). Creeping spikerush (Eleocharis fallax), three-

square bulrush (Schoenoplectus pungens), and alkali bulrush (S. robustus) are prominent.

OWNERSHIP: Private and state-owned.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Large portions of the site have been directly impacted by land-altering activity. Areas remaining in essentially natural condition have been impacted, or are potentially impacted, by hydrologic changes resulting from such alterations as ditching and diking. To protect the structure, composition, and processes of the tidal marsh natural community, maintenance or restoration of the area's natural hydrology is essential. Dredging and spoil deposition should be prevented wherever possible.

REFERENCES:

LeBlond, R.J. 1995. Site survey report: Brunswick River/Cape Fear River Marshes. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

Schafale, M.P., and A.S. Weakley. 1991. Site survey report: Cape Fear Marshes. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Bryant Mill (Greenbank) Bluff

SITE SIGNIFICANCE: Statewide **SIZE:** est. 565 acres

COUNTY: Brunswick **QUADRANGLE:** Acme

LOCATION: Along the Cape Fear River east of the Columbus County line, and including most of the watershed of Bryant Mill Creek.

SIGNIFICANT FEATURES:

1. This site contains one of the most unusual and significant examples of the Piedmont/Coastal Plain Acidic Cliff natural community in North Carolina.
2. Three rare plant species are known from the site: Florida adder's mouth orchid (Malaxis spicata), large-leaved grass-of-parnassus (Parnassia grandifolia), and shadow-witch orchid (Ponthieva racemosa). Large-leaved grass-of-parnassus is a State Candidate, and this site is one of only two occurrences on the Coastal Plain for this species. Adder's mouth and shadow-witch orchids are significantly rare in North Carolina, and adder's mouth is currently known from only four sites in the state.

GENERAL DESCRIPTION: Bryant Mill (Greenbank) Bluff comprises a complex of topographic features. Most striking is the nearly vertical bluff along the shore of the Cape Fear River, which supports the Piedmont/Coastal Plain Acidic Cliff community. Downstream from the bluff, the river floodplain broadens, and the river channel is bordered by a low levee. This levee produces the Coastal Plain Levee Forest (Brownwater Subtype) natural community. Another three community types are associated with the watershed of Bryant Mill Creek, which enters the Cape Fear River at the north end of the bluff. The creek floodplain supports the Coastal Plain Small Stream Swamp. Slopes above the floodplain of the creek and its tributaries support the Mesic Mixed Hardwood Forest (Coastal Plain Subtype). Terrace summits between the creek tributaries contain Dry-Mesic Oak--Hickory Forest.

The river bluff at this site is an excellent example of a bluff type containing a geological sediment layer known as the Pee Dee Formation, and one of only two such occurrences of this bluff type in Brunswick County. The bluff face is very steep to vertical and portions are kept moist by groundwater seepage. The Acidic Cliff community at this site is also influenced by narrow limestone beds. The vertical faces are bare in some places, and dominated by herbs, mosses, and liverworts in others. Large-leaved grass-of-parnassus is a patch dominant on the vertical faces. Non-vertical but steep faces support woody and herbaceous vegetation. Trees adapted to

the steep slope include loblolly pine (*Pinus taeda*), southern sugar maple (*Acer barbatum*), and American beech (*Fagus grandifolia*). Shrubs include sparkleberry (*Vaccinium arboreum*), wild hydrangea (*Hydrangea arborescens*), and wax-myrtle (*Myrica cerifera* var. *cerifera*).

The Coastal Plain Levee Forest occurs on wet sandy soil along the edge of the river on low rises formed by floodwater sediment deposition. The levees in this area likely formed when sea level was lower and the river was free-flowing rather than tidal. The levee forest canopy is dominated by loblolly pine, tuliptree (*Liriodendron tulipifera*), and sweet gum (*Liquidambar styraciflua*). Ironwood (*Carpinus caroliniana*) is the most prominent subcanopy tree, with river birch (*Betula nigra*) occurring on banks. Sedges (*Carex* spp.) are prominent in the moderate herb layer.

Coastal Plain Small Stream Swamp occurs in the saturated loamy to mucky soils of the Bryant Mill Creek floodplain. The habitat floods for short durations during rainfall, and is kept continuously saturated by groundwater seepage. Prominent canopy trees include baldcypress (*Taxodium distichum*), swamp tupelo (*Nyssa biflora*), water tupelo (*N. aquatica*), laurel oak (*Quercus laurifolia*), and sweet gum. Ironwood is the dominant subcanopy tree, with American holly (*Ilex opaca*) and southern sugar maple prominent. Common spicebush (*Lindera benzoin*) is a prominent shrub, and climbing hydrangea (*Decumaria barbara*) is a common woody vine. Sedges (*Carex* spp.) are prominent in the open to moderately dense herb layer.

Mesic Mixed Hardwood Forest occurs on the mesic loamy sands of ravine slopes along the creek and its tributaries, and on the summit of the river bluff. It is characterized by a canopy dominated by American beech, southern sugar maple, white oak (*Quercus alba*), and swamp chestnut oak (*Q. michauxii*). The subcanopy is dominated by flowering dogwood (*Cornus florida*), sand hickory (*Carya pallida*), and American holly. Prominent shrubs include witch-hazel (*Hamamelis virginiana*), wild azalea (*Rhododendron nudiflorum*), and bigleaf snowbell (*Styrax grandifolia*). The open to sparse herb layer includes Christmas fern (*Polystichum acrostichoides*), woodrush (*Luzula* sp.), and bloodroot (*Sanguinaria canadensis*).

Dry to mesic sandy soils on flat terrace summits between stream channel ravines support Dry-Mesic Oak--Hickory Forest. The canopy is dominated by white oak, red oak (*Quercus rubra*), black gum (*Nyssa sylvatica*), and mockernut hickory (*Carya tomentosa*). Flowering dogwood and American holly are prominent in the subcanopy. This is the only documented occurrence of this community type in Brunswick Co.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Large adjacent tracts have been logged or are in pine plantation. A graded roadbed leads to the site, and a footpath locally impacts the bluff summit. To protect the natural values of the site, forests on the interstream terraces and along ravine slopes should be left in a natural condition. Of critical importance is the integrity of vegetation and soils on the river bluff cliff and summit. Even small disturbances could lead to erosion and slumping due to the steepness of the bluff face.

REFERENCES:

Nifong, T.D. 1981. Greenbank Bluff. In Natural areas inventory of Brunswick County, North Carolina, pp. 150-156. Coastal Energy Impact Program Report No. 10, N.C. Coastal Management Program.

Nifong, T.D., and J.B. Taggart. 1981. Vegetation of the Peedee formation along the Cape Fear River corridor, North Carolina. Department of Botany, University of North Carolina, Chapel Hill.

extensively ditched, the impact is less severe in the northern portion, where a diverse savanna association persists, with little impact from invasive species. Conversely, the southern portion, which has been bedded as well as ditched, is dominated by disturbance-adapted species. The savanna grades eastward into a partially cleared swamp forest. The ecotone formed by the savanna and swamp contains several of the site's rare plant species.

Pine Savanna Very Wet Clay Variant occurs on poorly drained fine sandy loam that is wet to saturated throughout most of the year. The savanna is characterized by a patchy shrub layer and dense herb cover (the canopy has been clearcut). Titi (Cyrilla racemiflora) and inkberry (Ilex glabra) are shrub patch dominants. Savanna muhly (Muhlenbergia expansa) and wireleaf dropseed are patch dominants in the herb layer. The ecotone between the savanna and swamp communities is characterized by a pondcypress (Taxodium ascendens) canopy over a moderately dense shrub layer with herb openings.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Although this site has been disturbed by logging and ditching, a high quality savanna remnant persists in fair condition, with very good restoration potential. To protect and enhance natural values, the site should be burned regularly, and ditches should be blocked to restore the natural hydrology.

REFERENCES:

- Kologiski, R.L., and E.G. Connette. 1973. North Carolina natural areas survey reporting form: "1335 Savanna." Files, N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.
- LeBlond, R.J. 1994. Site survey form: Camp Branch Savanna Remnant. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.
- Nifong, T.D. 1981. Camp Branch Savanna. In Natural areas inventory of Brunswick County, North Carolina, pp. 96-103. Coastal Energy Impact Program Report No. 10, N.C. Coastal Management Program.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Colkins Neck Remnant

SITE SIGNIFICANCE: Statewide **SIZE:** est. 5 acres

COUNTY: Brunswick **QUADRANGLE:** Little River

LOCATION: Along the North Carolina/South Carolina border at Colkins Neck, north of the Intracoastal Waterway.

SIGNIFICANT FEATURES: This site contains the remnant of one of only two known global occurrences of the Calcareous Coastal Fringe Forest (the other is located in Onslow County, N.C.).

GENERAL DESCRIPTION: Colkins Neck Remnant contains a small but significant fragment of the very rare Calcareous Coastal Fringe Forest. Most of the original forest community has been replaced by golf course and residential development. The dry-mesic to mesic sandy soil has a high shell content, which provides a calcareous influence. The forest remnant is characterized by a moderately dense canopy over a moderate subcanopy and moderate to dense shrub layer and open herb layer. The mature canopy is diverse, with sand laurel oak (Quercus hemisphaerica), tuliptree (Liriodendron tulipifera), Carolina basswood (Tilia americana var. caroliniana), and native southern magnolia (Magnolia grandiflora) prominent. Carolina basswood is a rare tree on the Coastal Plain of North Carolina.

Prominent subcanopy trees include swamp red bay (Persea palustris), American holly (Ilex opaca), black gum (Nyssa sylvatica), southern sugar maple (Acer barbatum), and flowering dogwood (Cornus florida). Wax-myrtle (Myrica cerifera var. cerifera), dwarf palmetto (Sabal minor), red buckeye (Aesculus pavia), yaupon (Ilex vomitoria), and beautyberry (Callicarpa americana) are prominent shrubs. Frequent herbs include partridgeberry (Mitchella repens), Christmas fern (Polystichum acrostichoides), tall nutrush (Scleria triglomerata), Bosc's witch grass (Dichanthelium boscii), and a bedstraw (Galium sp.).

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: The forest remnant is threatened by residential and recreational development in the area. The Calcareous Coastal Fringe Forest, which differs significantly from the other known occurrence, may well be lost here.

REFERENCES:

North Carolina Vegetation Survey. 1992. Unpublished maritime forest vegetation data, surveys of June 13, 1992: Team 2/Plot 84 and Team 4/Plot 81.

Schafale, M.P., and A.S. Weakley. 1988. Preliminary site reconnaissance survey: Colkins Neck. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Lower Cape Fear River Aquatic Habitat

SITE SIGNIFICANCE: Statewide

COUNTY: Brunswick / New Hanover

QUADRANGLE: Castle Hayne / Wilmington / Carolina Beach / Kure Beach / Southport

LOCATION: The Cape Fear River from its downstream confluence with the Brunswick River south to Smith Island.

SIGNIFICANT FEATURES:

1. This site provides critical habitat for three Federally Endangered or Threatened animals: manatee (Trichechus manatus), American alligator (Alligator mississippiensis), and shortnose sturgeon (Acipenser brevirostrum). The manatee and shortnose sturgeon are Federally and State Endangered, and the American alligator is Federally and State Threatened.
2. Four estuarine fish species that are significantly rare in North Carolina occur at the site: spinycheek sleeper (Eleotris pisonis), marked goby (Gobionellus stigmaticus), freckled blenny (Hypsoblennius ionthas), and opossum pipefish (Microphis brachyurus).

GENERAL DESCRIPTION: The Lower Cape Fear River Aquatic Habitat includes the open tidal waters of the Cape Fear River and its tributaries south from the confluence with the Brunswick River to the Cape Fear River mouth at Smith Island. Estuarine open water communities are much less extensive in the southeastern portion of the state, and are less well known than in the Albemarle and Pamlico sounds. The aquatic habitat includes communities dominated by submerged vascular plants and sessile animals such as oysters. Other communities have no sessile organisms, and are dominated by fish and mobile invertebrates.

OWNERSHIP: State of North Carolina.

PROTECTION STATUS: None

MANAGEMENT/PROTECTION RECOMMENDATIONS: Estuarine open water communities are particularly susceptible to water pollution. Excess nutrients, sediment, bacteria, and toxic chemicals can come from such sources as polluted tributaries, shoreline developments, onshore land disturbances, dredging, spoil deposition, and ships. These can have serious impacts on aquatic communities. Dredging and spoil deposition can also impact water flow and alter salt and nutrient balances. Additional research is needed to determine the

structure and composition of the natural communities in the aquatic habitat, and to determine the extent and effects of artificial alterations.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Lower Cape Fear River Bird Nesting Islands

SITE SIGNIFICANCE: Statewide

COUNTY: Brunswick / New Hanover

QUADRANGLE: Kure Beach / Carolina Beach

LOCATION: Islands within the lower Cape Fear River, southward from opposite Orton Creek to opposite the Southport Ferry Landing.

SIGNIFICANT FEATURES:

1. This site comprises one of the most important colonial water bird nesting areas in North Carolina, supporting breeding populations of five rare bird species: snowy egret (*Egretta thula*), tricolored heron (*E. tricolor*), brown pelican (*Pelecanus occidentalis*), black skimmer (*Rynchops niger*), and gull-billed tern (*Sterna nilotica*). The gull-billed tern is State Threatened, and the black skimmer is significantly rare in North Carolina. The snowy egret, tricolored heron, and brown pelican are State Special Concern species. The breeding population for the brown pelican at this site is the largest in the state.
2. Several Gull*Tern*Skimmer Colony and Wading Bird Rookery special habitats have been designated at this site, each providing critical breeding habitat for several colonial bird species.

GENERAL DESCRIPTION: Lower Cape Fear River Bird Nesting Islands comprises several islands within the active channel of the river which are used by colonial water birds for nesting. Brown pelicans nest in large numbers, along with several species of terns, particularly royal and sandwich terns. These islands, together with nearby Battery Island to the south, contain the largest population of colonial water birds in North Carolina. Most of these islands have been created from dredge spoil, and several are devoid of vegetation.

OWNERSHIP: N.C. Wildlife Resources Commission.

PROTECTION STATUS: Portions are within a Registered Natural Heritage Area.

MANAGEMENT/PROTECTION RECOMMENDATIONS: These islands are currently managed for their wildlife values.

REFERENCES:

- Parnell, J.F., and D.A. McCrimmon, Jr. 1984. 1983 supplement to atlas of colonial waterbirds of North Carolina estuaries. UNC Sea Grant Publication UNC-SG-84-07.
- Parnell, J.F., and R.F. Soots, Jr. 1979. Atlas of colonial waterbirds of North Carolina estuaries. UNC Sea Grant Publication UNC-SG-78-10.
- Weakley, A.S., and C. Shelton. 1980. Natural area inventory form: Ferry Slip Island. Files, N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Spring Creek Ponds

SITE SIGNIFICANCE: Statewide **SIZE:** est. 350 acres

COUNTY: Brunswick

QUADRANGLE: Holden Beach / Lockwoods Folly

LOCATION: Mainland coast along north side of the Intracoastal Waterway, opposite Lockwoods Folly Inlet. Site is located south of Seashore Road (SR 1120), from Stanley Road (SR 1119) westward to an unnamed stream lying east of Ferry Road (SR 1115).

SIGNIFICANT FEATURES:

1. This site contains one of the best examples of the very rare Coastal Fringe Evergreen Forest natural community.
2. Three rare plant species have been documented from Spring Creek Ponds: erectleaf witch grass (Dichantheium erectifolium), West Indies meadow-beauty (Rhexia cubensis), and long-beak baldsedge (Rhynchospora scirpoides). All three species are significantly rare in North Carolina.

GENERAL DESCRIPTION: Spring Creek Ponds comprises a flat to slightly irregular upland terrace containing a few limesink depressions, bordered along the northeast by Spring Creek, and along the west by an unnamed creek. The uplands support a mosaic of sandhill and maritime forest habitats. Deep sand areas are dominated by disturbed Coastal Fringe Sandhill and Xeric Sandhill Scrub habitat. Lower areas to the south support the Coastal Fringe Evergreen Forest natural community. The limesink depressions support the Small Depression Pond community. The site is partially bisected by Holden Plantation Road, which lies 0.25 mile north of and parallel to the Intracoastal Waterway. Most of the Coastal Fringe Evergreen Forest lies south and west of this road. A group of small ponds is located just north of this road about 0.1 mile east of the road's southward turn towards the beach at the west end. A larger pond occurs at the headwaters of Spring Creek.

Coastal Fringe Evergreen Forest occurs on mesic to dry sandy soil. It is characterized by a moderately dense oak and pine canopy over a moderately open to moderately dense subcanopy and shrub layer, and sparse herb layer. Canopy dominants are live oak (Quercus virginiana), sand laurel oak (Q. hemisphaerica), and loblolly pine (Pinus taeda). In the shrub layer, yaupon (Ilex vomitoria) is a dominant, fetterbush (Lyonia lucida) is a patch dominant, and wax-myrtle (Myrica cerifera var. cerifera) is prominent. The sparse herb layer includes pipsissewa (Chimaphila maculata),

partridgeberry (Mitchella repens), and variable witch grass (Dichanthelium commutatum).

The Small Depression Pond community occurs in depressions believed to have been created by the collapse of subterranean limestone deposits and the slumping of overlying sand deposits. Where these depressions intersect groundwater, ponds form. Typically, groundwater levels drop during the growing season, exposing the sandy, peaty, and mucky shores of the ponds, and supporting a diverse plant community. The pond basins are herb dominated except for patches of swamp tupelo (Nyssa biflora), with a border dominated by a moderately open pine canopy and moderately dense shrub layer. Dominant herbs include narrowfruit beaksedge (Rhynchospora inundata), maidencane (Panicum hemitomon), warty panic grass (P. verrucosum), and pitted nutrush (Scleria muhlenbergii). Peatmoss (Sphagnum cuspidatum) is a patch dominant, and horsetail spikerush (Eleocharis equisetoides) and water lily (Nymphaea odorata) are prominent. Loblolly pine, titi (Cyrilla racemiflora), fetterbush, and hairy highbush blueberry (Vaccinium fuscatum) are border dominants.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: The majority of the upland area north and northwest of Holden Plantation Road is dominated by sandhill communities in poor condition. Longleaf pine has been removed from much of the site, and replaced by loblolly pine. Growth of sand live oak (Quercus geminata) is dense, apparently the result of logging and/or fire suppression. Prescribed burns are necessary to restore the sandhill communities, and longleaf pine may have to be re-introduced.

Mainland maritime forests have always been limited in area because of the relatively small acreage of appropriate habitat. Substantial portions have been lost to residential and commercial development along the coast. To protect the natural values of the Coastal Fringe Evergreen Forest at this site, the forest canopy should remain intact and unfragmented.

The pond habitat is of excellent quality, and in undisturbed condition. To protect its natural processes, structure, and composition, a no-disturbance buffer zone should be established at least 100 feet inland from the shrub border around the pond margins.

REFERENCES:

LeBlond, R.J. 1994. Site survey report: Spring Creek Ponds. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

Nifong, T.D. 1981. Spring Creek Pond. In Natural areas inventory of Brunswick County, North Carolina, pp. 209-215. Coastal Energy Impact Program Report No. 10, N.C. Coastal Management Program.

Schafale, M.P., and A.S. Weakley. 1988. Preliminary site reconnaissance survey: Spring Creek Ponds area. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Sunset Beach Wood Stork Ponds

SITE SIGNIFICANCE: Statewide **SIZE:** est. 900 acres

COUNTY: Brunswick **QUADRANGLE:** Calabash

LOCATION: Ponds, impoundments, and uplands in the vicinity of Twin Lakes at Sunset Beach, north of the Intracoastal Waterway. The site is approximately bounded by highway NC 179 along the east and south, by Calabash River along the north, and by a road along the west shore of Twin Lakes.

SIGNIFICANT FEATURES:

1. This site contains the northernmost global locale where the Federally and State Endangered wood stork (Mycteria americana) regularly occurs. Two other rare animal species also occur at the site: American alligator (Alligator mississippiensis) and anhinga (Anhinga anhinga). The American alligator is Federally and State Threatened, and the anhinga is significantly rare in North Carolina.
2. Two rare plant species have been documented from the site: Carolina atamasco lily (Zephyranthes sp. 1) and Scribner's witch grass (Dichantheium oligosanthes var. scribnerianum). Both species are significantly rare in North Carolina. Carolina atamasco lily is known from about 10 global sites, all located in Brunswick County and adjacent Horry and Georgetown counties in South Carolina. This site contains the largest known population over the limited global range of the species. Scribner's witch grass was first discovered in North Carolina at this site, and is currently known from only one other site in the state.

GENERAL DESCRIPTION: Most of the Sunset Beach Wood Stork Ponds site has been developed for residential and recreational uses, with a golf course occupying much of the site. Twin Lakes, two interconnected ponds each about 25 acres in size, were formed by impounding portions of former salt marsh. The site also includes two impoundments formed by roadbeds across Calabash River and one of its tributaries. Much of the upland area appears to have supported Coastal Fringe Evergreen Forest prior to development, and remnant forest canopy persists on unbuilt houselots, but the understory has been cleared. The ponds and impoundments and their shores are the habitat for the three rare animals found at the site. The two rare plants are found in remnant, disturbed mainland maritime forest habitat within the residential areas.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: To protect the wildlife values and functions of the ponds and impoundments, wooded buffer strips should be maintained around the shores to provide roosting or nesting sites for the birds, as well as protective cover for wildlife. Dead trees should be allowed to remain standing, as they are often used as roosting sites by wading birds, and nesting sites by ospreys (Pandion haliaetus). Pumping of water from the ponds for golf course irrigation should avoid causing the ponds to dry out, and the use of chemicals on lawns and fairways near the ponds should be avoided or minimized. Consideration should be given to the restoration of mainland maritime forest in unbuilt areas.

REFERENCES:

- LeBlond, R.J. 1994. Notes on the distribution, habitat, and taxonomy of Zephyranthes sp. 1 in Brunswick Co., North Carolina. Files, N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.
- LeGrand, H.E., Jr. 1988. Twin Lakes - Calabash Creek wildlife habitat. Files, N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

herbs. Longleaf pine is the canopy dominant. The sparse subcanopy includes sweetbay (Magnolia virginiana), black gum (Nyssa sylvatica), and water oak (Quercus nigra). Dominant shrubs include creeping blueberry (Vaccinium crassifolium), blue huckleberry (Gaylussacia frondosa), inkberry (Ilex glabra), and Coastal sweet-pepperbush (Clethra alnifolia). Swamp red bay (Persea palustris) and persimmon (Diospyros virginiana) are prominent in the shrub layer. Wiregrass and bracken fern (Pteridium aquilinum) are herb layer dominants.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: The site should be burned regularly to maintain and enhance natural values and processes. Lack of fire has resulted in an increase of woody growth. The large Leon soil area in the northern portion of the site should be systematically surveyed for rare species.

REFERENCES:

LeBlond, R.J. 1994. Site survey report: Alligator Branch Sandhill and Flatwoods. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

SITE DESCRIPTION: Brunswick County Inventory Report, 1995

SITE NAME: Bird Island

SITE SIGNIFICANCE: Regional

SIZE: 148 acres (in North Carolina)

COUNTY: Brunswick

QUADRANGLE: Little River

LOCATION: Barrier island off the southwest end of Bald Beach, bordered by Mad Inlet along the northeast, and Little River Inlet along the southwest. The southwest end of the island is in South Carolina.

SIGNIFICANT FEATURES:

1. This site supports breeding populations of two rare animal species: loggerhead sea turtle (Caretta caretta) and black skimmer (Rynchops niger). The loggerhead is Federally and State Threatened. The black skimmer, a State Special Concern bird, was last observed nesting on the island in 1977.
2. Seabeach amaranth (Amaranthus pumilus), a Federal and State Threatened rare plant, occurs on the island.
3. Bird Island is one of very few undeveloped barrier islands remaining in North Carolina, and the only undeveloped barrier island in Brunswick County.

GENERAL DESCRIPTION: Bird Island is slightly more than 1 mile long and from 0.1-0.4 mile wide. The island comprises marshes, dunes, beaches, and shrub thickets. The most prominent natural communities are Salt Marsh, Upper Beach, Dune Grass, and Maritime Shrub.

Salt Marsh occurs on intertidal flats in the interior and backside of the island in areas protected from wave action. The community is dominated by saltmarsh cordgrass (Spartina alterniflora).

The Upper Beach community occurs along the oceanward side of the island. It is located in front of the primary dune system above mean high tide, but is inundated by spring tides and storm tides. This dynamic, naturally disturbed area is sparsely vegetated by such species as sea rocket (Cakile edentula), seabeach sandmat (Chamaesyce polygonifolia), Carolina beach-thistle (Salsola caroliniana), and seabeach orach (Atriplex arenaria).

The Dune Grass natural community occurs at scattered locations, primarily on higher dunes in the island's interior sections. It is most frequently dominated by sea oats (Uniola paniculata). Other prominent species include bitter panic grass (Panicum amarum),

saltmeadow cordgrass (Spartina patens), and trailing wild bean (Strophostyles helvula).

Maritime Shrub occurs on stabilized dunes and in protected dune swales. It is characterized by dense shrub growth, with wax-myrtle (Myrica cerifera var. cerifera) and groundsel-tree (Baccharis halimifolia) often dominant.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Bird Island is under active consideration both for residential development and for preservation of natural values. In both cases, consideration should be given to potential impacts in undeveloped areas from recreational use of the island by visitors or residents. This includes impacts pedestrian traffic might have on bird or turtle nesting sites, and erosion impacts to dune areas.

REFERENCES:

- Gant, M.L. 1994. Letter of July 8, 1994, to Ms. Ann B. Deaton. Ecological Services, USFWS, Raleigh, N.C.
- Moul, R., and L. Baldwin. 1992. Memorandum of August 28, 1992, to the Sunset Beach Planning Board: status report on Bird Island AEC nomination. Land Management Group, Inc., Wilmington, N.C.
- Taggart, J.B. 1994. Memorandum of August 29, 1994, to Evan Brunson, N.C. Division of Coastal Management, DEHNR: visit to Bird Island (Brunswick County) on August 25, 1994. N.C. National Estuarine Research Reserve, Center for Marine Science Research, University of North Carolina at Wilmington.
- Tingley, C. 1993. Bird Island in Brunswick County -- a study of the appropriateness and feasibility of state acquisition. N.C. Division of Parks and Recreation, DEHNR, Raleigh.
- Weakley, A.S. 1989. Natural features of Bird Island, North and South Carolina. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

having longleaf pine and herbs as prominent components, apparently due to the basin's shallowness and limited organic soil development. These basins may have supported Wet Pine Flatwoods or Pine Savanna before modern fire suppression.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: The site is impacted by plowlines, and by large clear-cuts and deep ditches along the north side. Pine plantation and residences occur along the south, with pine plantations to the east. The west side is bordered by NC 904 and fields. The area to the north is apparently under development. To maintain and promote natural conditions, the flatwoods and pocosin habitat should be burned regularly.

REFERENCES:

Carter, J.H. 1991. Rare species assessment for Brunswick County water system improvements. Camp Dresser and McKee Inc., Ten Cambridge Center, Cambridge, MA 02142.

LeBlond, R.J. 1994. Site survey report: Drowned Bay Savanna. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

Nifong, T.D. 1981. Drowned Bay Savanna. In Natural areas inventory of Brunswick County, North Carolina, pp. 104-111. Coastal Energy Impact Program Report No. 10, N.C. Coastal Management Program.

Schafale, M.P., and A.S. Weakley. 1991. Notes on Drowned Bay Savanna. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

the canopy dominant, and turkey oak (Quercus laevis) dominates the subcanopy. Prominent shrubs include blue huckleberry (Gaylussacia frondosa), southern blueberry (Vaccinium tenellum), and staggerbush (Lyonia mariana). Carolina jessamine (Gelsemium sempervirens) is an important component of the sparse herb layer. Fire has been suppressed for many years, resulting in large shrub patches, heavy litter buildup, and low herb cover.

The Small Depression Pond community occurs in depressions believed to have been created by the collapse of subterranean limestone deposits and the slumping of overlying sand deposits. Where these depressions intersect groundwater, ponds form. Typically, groundwater levels drop during the growing season, exposing the variably sandy, peaty, and mucky shores of the ponds, and supporting a diverse plant community. The plant community is characterized by an aquatic-emergent herb zone grading upslope through a seasonally exposed herb-dominated margin. The steeper basins tend to be shrub-bordered at the upland edge. Water lily (Nymphaea odorata) dominates the aquatic zone at some ponds, with Small's yellow-eyed-grass (Xyris smalliana) a patch dominant. Creeping rush (Juncus repens) and Baldwin's spikerush (Eleocharis baldwinii) dominate exposed muck. Important species in the margin zone include spadeleaf (Centella erecta), switchcane (Panicum virgatum), meadow-beauties (Rhexia spp.), redroot (Lachnanthes caroliana), and Wright's witch grass (Dichanthelium wrightianum). The ponds in the northeastern portion of the site, between Fall Swamp and Middle River, are the largest, with the highest diversity and most rare species.

The Small Depression Pocosin natural community occurs in wet depressions with a shallow organic layer. It is characterized by a sparse pine or bay canopy over a dense shrub layer. Pond pine (Pinus serotina) is the canopy dominant, with loblolly bay (Gordonia lasianthus) a subdominant at some basins. Prominent shrubs include blue huckleberry, inkberry (Ilex glabra), gallberry (I. coriacea), fetterbush (Lyonia lucida), and titi (Cyrilla racemiflora).

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: A long period of fire suppression in the upland Xeric Sandhill Scrub community has resulted in increased shrub growth, litter buildup, and suppression of the herb community, particularly wiregrass (Aristida stricta). Fire is needed to restore natural balances and reduce the fuel load, but must be done gradually. To protect the limesink communities, a no-disturbance buffer zone should be established at least 100 feet outward from the upland transition zone.

REFERENCES:

- Braswell, A.L. 1991. Site survey report: Hatcher property. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.
- LeBlond, R.J. 1994. Site survey report: Fall Swamp--Middle River Limesink Complex. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.
- Nifong, T.D. n.d. Fall Swamp--Middle River Ponds. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.
- Schafale, M.P., and A.S. Weakley. 1991. Site survey report: Royal Oak Swamp Limesink Complex and Sandhills (Hatcher tract). N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

palustris). Prominent shrubs include inkberry (Ilex glabra), southern blueberry (Vaccinium tenellum), and creeping blueberry (V. crassifolium). Wiregrass (Aristida stricta) is the dominant herb. The Wet Pine Flatwoods community occupies upland flats in a mosaic with Xeric Sandhill Scrub and Pond Pine Woodland associations. Except in the bays and swales, elevation gradients do not appear to account for community distribution, with Wet Pine Flatwoods occasionally grading slightly downslope to Xeric Sandhill Scrub. This unusual condition is possibly related to hydrological influences, such as areas of perched water.

Xeric Sandhill Scrub Coastal Plain Variant occurs on the driest upland sandy soil at the site. It is characterized by an open pine canopy and oak subcanopy over a sparse to moderate shrub and herb layer. Longleaf pine is the canopy dominant, with turkey oak (Quercus laevis) forming the subcanopy. Blue huckleberry is a subdominant to patch dominant in the shrub layer. Wiregrass is the dominant herb, and Nash's witch grass (Dichanthelium sp. 3 =Panicum lancearium) is prominent. This community occurs in a mosaic with Wet Pine Flatwoods.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Much of the upland area canopy has been thinned in recent years, with slash left on the ground in places. Even-age canopy stands occur in some areas. However, the ground cover is in good condition over the majority of the site, and longleaf pine is regenerating. The Xeric Sandhill Scrub area north of the streambed flowing into Beaverdam Creek has been heavily impacted by recreational vehicle use. The site needs regular burning to maintain and restore natural community structure and processes.

REFERENCES:

- LeBlond, R.J. 1994. Site survey report: Henrytown Savanna. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.
- Nifong, T.D. 1981. Henrytown Savanna. In Natural areas inventory of Brunswick County, North Carolina, pp. 151-157. Coastal Energy Impact Program Report No. 10, N.C. Coastal Management Program.
- Schafale, M.P., and A.S. Weakley. 1991. Site survey report: Henrytown Savanna. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

cypress--gum canopy and subcanopy over a sparse to absent shrub layer, and a moderate to dense layer of showy herbs. Pondcypress (Taxodium ascendens) and swamp tupelo (Nyssa biflora) are the canopy dominants. Lanceleaf arrowhead (Sagittaria lancifolia) is the dominant marsh herb, with Georgia spiderlily (Hymenocallis crassifolia) a subdominant to codominant. Other prominent herbs include narrowleaf cattail (Typha angustifolia), shoreline sedge (Carex hyalinolepis), pickerelweed (Pontederia cordata), and green arrow-arum (Peltandra virginica). In some areas, trees along the river edge create patches of slightly higher ground which support pockets of more swamp-like vegetation, but are otherwise surrounded by marsh vegetation, which in some places extends more than 100 feet inland from the river. Some of the Freshwater Variant marsh sites have open, treeless areas, but a sparse to moderately dense cypress--gum canopy is characteristic of most of the tidal marsh areas. In most areas, the cypress trees appear dead or dying, and most gum trees appear stunted. It is possible that these areas are former Cypress--Gum Swamps in transition to freshwater marsh, perhaps the result of storm surge salt intrusion, or rising sea level. However, the small size of most canopy trees suggests that they may be successional to storm surge events.

The Tidal Cypress--Gum Swamp community occurs adjacent to the tidal marsh community, either behind it, or along the river behind a low levee between marsh areas. It is characterized by a moderately dense to dense cypress--gum canopy over a moderate subcanopy, and open to sparse shrub and herb layer. Baldcypress (Taxodium distichum) and swamp tupelo are the most frequent canopy dominants. Carolina red maple (Acer rubrum var. trilobum) and Carolina ash (Fraxinus caroliniana) are prominent in the subcanopy. Wax-myrtle (Myrica cerifera var. cerifera) is a prominent shrub, and lizard's-tail (Saururus cernuus) is a patch dominant in the herb layer. Some areas of Cypress--Gum Swamp forest lying behind the levee appear to have been cut off from regular tidal flooding. These sites may be more properly classified as nontidal Cypress--Gum Swamp (Blackwater Subtype).

The communities downstream from the Tidal Freshwater Marsh Freshwater Variant and Tidal Cypress--Gum Swamp habitats have not been analyzed. These include the Tidal Freshwater Marsh Oligohaline Variant, Brackish Marsh, and Salt Marsh. All appear in good condition, and the Brackish Marsh and Salt Marsh are extensive. Characteristic dominant species in the Oligohaline Variant marsh are sawgrass (Cladium jamaicense), big cordgrass (Spartina cynosuroides) and cattails (Typha spp.). Black needlerush (Juncus roemerianus) is the Brackish Marsh dominant, and saltmarsh cordgrass (Spartina alterniflora) is the Salt Marsh dominant.

OWNERSHIP: Private; tidal waters are state-owned.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: The river channel and floodplain appear to be in essentially undisturbed condition in this area away from the NC 211 bridge. Higher lands east of the bridge on the north side, and west of the bridge on the south side, have been disturbed by clearings and roadbeds. Upland areas away from roads and near the river have not been explored. Powerboat traffic likely influences shoreline erosion and the distribution of sediments, and introduces petro-chemicals and trash into the tidal communities. An enforced speed limit will help reduce wave erosion and sedimentation impacts in the floodplain. Appropriate issues for study include recreational boating wake impacts, and the potential of the site for scenic river designation.

REFERENCES:

LeBlond, R.J. 1994. Site survey report: Lockwoods Folly River Tidal Wetlands. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

Wet Pine Flatwoods Wet Spodosol Variant occurs on wet sandy soil of bay rims and low ridges. It is characterized by an open to moderate pine canopy over a matrix of moderate to dense shrub and herb associations. Longleaf pine (*Pinus palustris*) is the dominant canopy tree. Blue huckleberry (*Gaylussacia frondosa*), inkberry, Carolina sheeplaurel (*Kalmia carolina*), and wax-myrtle (*Myrica cerifera* var. *cerifera*) are shrub subdominants to patch dominants in the ground layer. Wiregrass (*Aristida stricta*) is the dominant herb, and bracken fern (*Pteridium aquilinum*) is a patch codominant herb.

Coastal Fringe Sandhill occupies drier sandy soils on bay rims and low ridges. It consists of an open pine canopy and oak subcanopy over a sparse shrub layer and sparse to moderate herb layer. The canopy is dominated by longleaf pine, with turkey oak (*Quercus laevis*) and sand live oak (*Q. geminata*) forming a subcanopy. Sand post oak (*Q. margarettae*) and persimmon (*Diospyros virginiana*) are prominent in the subcanopy. The ground layer is dominated by wiregrass.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: The site does not appear to have burned recently, but community structure suggests at least occasional past fires. There are localized impacts from roadbeds and excavations, and some areas of Wet Pine Flatwoods have been impacted by pinestraw raking. Small canopy tree size indicates the site was logged in the past, and some even-aged stands are present. Some ditches are present, mostly around Pond Pine Woodland pocosin areas. The area is surrounded by pine plantations and cropland. The site is in need of regular prescribed burning. Pine straw raking has caused significant damage locally, and should be prohibited if natural processes and structure are to be protected.

REFERENCES:

- LeBlond, R.J. 1994. Site survey report: Long Bays Savanna and Carolina Bays. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.
- Nifong, T.D. 1981. Long Bays Savanna. In Natural areas inventory of Brunswick County, North Carolina, pp. 158-165. Coastal Energy Impact Program Report No. 10, N.C. Coastal Management Program.
- Schafale, M.P., and A.S. Weakley. 1991. Site survey report: Long Bays Savanna. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

Schafale, M.P., R. Duncan, S. Duncan, and L. Earley. 1993.
Additional notes on Long Bays. N.C. Natural Heritage Program,
DPR, DEHNR, Raleigh.

Sweetbay (Magnolia virginiana) is a sparse dominant in the subcanopy. Fetterbush (Lyonia lucida) is the dominant shrub, and honeycups (Zenobia pulverulenta) and blaspheme-vine (Smilax laurifolia) are prominent.

Wet Pine Flatwoods Wet Spodosol Variant occurs on wet sandy soil as an ecotonal community between the sandhill and pocosin communities, and is influenced by them because of its narrowness and position. It is characterized by an open to moderately open pine canopy over a sparse subcanopy and a moderate to moderately dense shrub and herb layer. Longleaf pine is the canopy dominant. Blue huckleberry (Gaylussacia frondosa) and inkberry (Ilex glabra) are prominent shrubs. The ground layer is dominated by wiregrass and creeping blueberry, and bracken fern (Pteridium aquilinum) is important.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Because of access limitations, only the central area of the site was explored. The northeast and southwest portions of the site appear to be in essentially natural condition, although the northeast area shows some disturbed areas (roadbeds, clearings). There are localized impacts in the central area around the larger Carolina bays from roadbeds and a few trash piles. A residential development is located along the north, with commercial operations and clearings along the south. The site should be surveyed for rare species following fire, and this may be an appropriate site for study of the role of fire in the Coastal Fringe Sandhill community.

REFERENCES:

- Carter, J.H., III. 1991. Longleaf pine survey of the Sandhills and southwestern Coastal Plain. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.
- LeBlond, R.J. 1994. Site survey report: Sandy Branch Sand Ridge and Bay Complex. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

layer, but appearing suppressed by a buildup of litter. Lichens (Cladina evansii, Cladonia spp.) dominate patches, and sandy-field beaksedge (Rhynchospora megalocarpa) is prominent.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: Mainland maritime forests have always been limited in area because of the relatively small acreage of appropriate habitat. Substantial portions have been lost to residential and commercial development along the coast. To protect the natural values at this site, the forest canopy should remain intact and unfragmented. Coastal Fringe Sandhill needs regular fire to reduce the fuel load (litter buildup, increase in woody vegetation density) and suppression of the herb layer.

REFERENCES:

LeBlond, R.J. 1994. Site survey report: Secession Maritime Forest. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

North Carolina Vegetation Survey. 1993. Unpublished maritime forest vegetation data, survey of June 8, 1993: Team 2/Plot 106.

Weakley, A.S., and M.P. Schafale. 1988. Preliminary site reconnaissance survey: west Holden Beach mainland - Secession Maritime Forest. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

coriacea) and dwarf azalea (Rhododendron atlanticum) are prominent in the shrub layer. Wiregrass dominates the ground layer with creeping blueberry (Vaccinium crassifolium). Although ecotonal in position, this community is broad enough in some areas to produce an essentially full expression of the community type. Portions of this community have burned recently.

Pond Pine Woodland occurs in the drainage swales, in saturated soil with a shallow organic layer. It is characterized by an open to moderately dense pine canopy over a moderately dense subcanopy and dense shrub layer. Pond pine is the canopy dominant, with sweetbay and swamp red bay prominent in the subcanopy. The dense shrub layer is dominated by gallberry and fetterbush (Lyonia lucida). Full community development apparently is restricted by the narrowness of the swales and the shallowness of the organic soil layer. Portions of this community have burned recently.

OWNERSHIP: Private.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: The natural communities are of very good quality, and in good condition except for lack of fire. This has resulted in a buildup of litter, increased woody growth, and suppression of herb growth. Fire is needed to reduce the fuel load and restore the natural structure (a fire in 1994 burned one stream swale and adjacent low slopes, but did not reach into the sandhill community). A few plowlines, scrapes, and trash piles along roadbeds are present, and there are a few one-half to one-acre loblolly pine (Pinus taeda) stands, but the area otherwise appears undisturbed. The site is surrounded by residential and agricultural development, and the private road along the west side of the site has been regraded and widened.

REFERENCES:

LeBlond, R.J. 1994. Site survey report: Shallotte Creek Sandhills. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.

freshwater marsh, perhaps the result of storm surge salt intrusion, or rising sea level.

OWNERSHIP: Private; tidal waters are state-owned.

PROTECTION STATUS: None.

MANAGEMENT/PROTECTION RECOMMENDATIONS: The floodplain appears to be undisturbed except for the road crossings, upland edge impacts, and very few ditches near the confluence with Brunswick River. Most of the adjacent uplands have been residentially or industrially developed. To preserve the natural values of the marsh and swamp communities, the floodplain should be protected from adjacent upland impacts.

REFERENCES:

LeBlond, R.J. 1994. Site survey report: Sturgeon Creek Tidal Wetlands. N.C. Natural Heritage Program, DPR, DEHNR, Raleigh.