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Natural Areas Inventory of Brunswick County, North Carolina

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Department of Botany
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AUGUST 1981

North Carolina
Coastal Energy Impact Program
Office of Coastal Management
North Carolina Department of Natural Resources
and Community Development

CEIP REPORT NO. 10

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A SURVEY OF NATURAL AREAS IN

BRUNSWICK COUNTY

NORTH CAROLINA

for

The North Carolina
Natural Heritage Program
Coastal Natural Area Inventory Project

by

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The preparation of this report was funded by a Coastal Energy Impact Program grant from the North Carolina Coastal Management Program, through funds provided by the Coastal Zone Management Act of 1972, as amended, which is administered by the Office of Coastal Zone Management, National Oceanic and Atmospheric Administration. The CEIP grant was part of NOAA grant NA-79-AA-D-CZ097.

August 1981

CEIP Report No. 10

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PREFACE

The North Carolina Office of Coastal Management and the North Carolina Natural Heritage Program, both units of the Department of Natural Resources and Community Development, have commissioned a series of natural areas inventories for ten counties in the coastal zone of this state. The Brunswick County inventory was conducted in 1981 and was financed by a Coastal Energy Impact Program (CEIP) grant. CEIP funded the Brunswick County inventory because of the potential environmental impacts of peat mining and other energy-related development.

The recommendations made in this report by Timothy D. Nifong are advisory. His inventory and recommendations are designed to help state and federal agencies, county officials, resource managers, landowners and developers work out effective land management and preservation mechanisms to protect the twenty-one outstanding or exemplary natural areas described in this report. Agencies such as the N.C. Division of Environmental Management, Division of Land Resources, Division of Marine Fisheries, Wildlife Resources Commission, the U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, National Marine Fisheries Service, and Environmental Protection Agency should find this report useful, as may university researchers, private consultants, and private conservation groups. The Office of Coastal Management will use the report in assessing permit applications and for federal and state consistency reviews.

Tim Nifong is an experienced field botanist with familiarity with the ecological resources of the project region. Nifong, previous to the survey, had been contracted by the Natural Heritage Program to inventory selected sites in Brunswick County. Those earlier survey reports were updated and included in this compilation. Nifong is a native resident of Wilmington and, at the time of this project, was a doctoral student in the botany program at the University of North Carolina at Chapel Hill. The investigator was well qualified to identify, describe, and evaluate the most outstanding natural areas of the county.

The project investigator was instructed to identify natural areas that contain highly unique, endangered, or rare natural features, or high-quality representations of relatively undisturbed natural habitats. Because of the

rich natural diversity of Brunswick County, it is important to note the investigator's cautionary note that he likely overlooked some significant sites. The investigator was instructed not to report extensively on the large expanse of brackish and salt marshes, that fringe most of the county's shoreline and which, for the most part, are ecosystems protected through state and federal regulatory programs. The report does not treat the State-owned portions of Baldhead (Smith) Island in much detail, although parts have since been designated as a National Estuarine Sancturay and registered as a North Carolina Natural Heritage Area. The investigator did not report on the great ecological importance of the 13,850-acre portion of the Green Swamp owned and managed as a sancturay by the North Carolina Nature Conservancy. Therefore, an excerpt from the Green Swamp Nature Preserve inventory and management plan, prepared by Hervey McIver for the Nature Conservancy, is included in this document. The investigator did not gain access to the Sunny Point Military Ocean Terminal, so we have included an evaluation of certain limesinks on the terminal prepared in 1976 by Dr. James F. Parnell, Professor of Biology at the University of North Carolina at Wilmington. Additionally, we have inserted information and figures which locate the principal colonial waterbird nesting sites, heronries, other shorebird breeding habitats, and sea turtle nesting beaches in Brunswick County.

The Office of Coastal Management, and the Coastal Resources Commission which it serves, implement the Coastal Area Management Act of 1974 (CAMA). Under this statute, the North Carolina Coastal Management Plan has been prepared and approved. It includes the definition and designation of various Areas of Environmental Concern (AEC). In some cases, AECs coincide with natural areas that are herein recommended for preservation or special management. In some cases, AECs may encompass other areas--such as marsh zone wetlands--which are not extensively treated in this inventory.

The Natural Heritage Program is most pleased to have had this opportunity to conduct this project for the Office of Coastal Management. The inventory has revealed a number of high quality natural areas that possess natural elements of national and statewide priority and are important parts of North Carolina's natural diversity. Some of the identified sites were previously unknown and undocumented by the state's scientific community. The Natural Heritage Program hopes that these areas will be protected for the benefits of present and future generations of North Carolinians and for the preservation of the state's truly exceptional natural heritage.

Charles E. Roe, Coordinator
N.C. Natural Heritage Program
November 18, 1982

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INTRODUCTION

Objectives

The fundamental objective of this contract was to delineate those "natural" (essentially, undeveloped) areas within Brunswick County which merit special consideration with regard to preservation, due to their significant biotic and/or abiotic features. As it applies here, "delineation" refers to initial identification of potentially significant areas, final selection of sites meriting further study through field reconnaissance, brief investigation of these areas to gather preliminary base-line data, and initial evaluation of each site.

"Significance" alludes to unusual or outstanding geologic or geomorphic features; areas which serve as habitat for one or more threatened or endangered species of biota; geographically unusual, or disjunct populations and/or assemblages; unusually extensive populations of a species; unusual or heretofore unknown combinations of plant species (community types), or outstanding examples of known community types; and concentrated areas of breeding habitat for one or more animal species. The level of significance of a natural area--local, state, regional, or national--varies with the number of the above listed elements of significance which pertain to the site and the relative importance and development of each of these elements.

Natural Vegetation of Brunswick County

It was decided early during work on the contract that in order to have the insight and perspective necessary to do a thorough job of determining what of the county's vegetation is significant in relation to the characteristic plant communities of the area, it was critical to have a thorough understanding of (1) what those communities are and what their overall condition is in terms of human disturbance, (2) how they relate to characteristic or significant landforms and geomorphic features, and (3) where the best intact example--if any remains--of each community exists within the county. Therefore, based on a thorough field reconnaissance of present-day vegetation types, previous experience within the area, and perspective from the literature and other sources, a classification of the natural vegetation of Brunswick

TABLE 1: NATURAL VEGETATION CLASSIFICATION

Brunswick County, North Carolina

I. AQUATIC PLANT COMMUNITIES

- A. Freshwater Pond Community
- B. Riverine/Estuarine Community

II. WETLAND PLANT COMMUNITIES

- A. Pond Margin Community
- B. Marshland Communities
 - 1. Salt Marsh
 - 2. Brackish Marsh
- C. Swamp Forest Community (Mixed Bottomland Hardwoods)
- D. Bay Forest Community
- E. Lowland Pine Communities
 - 1. Pocosin
 - 2. Flatwoods

III. TERRESTRIAL PLANT COMMUNITIES

- A. Barrier Island Beach Communities
 - 1. Dune Ridge Consocieties
 - 2. Swale and Flat Associates
- B. Maritime Forest Communities
 - 1. Mixed Coastal Hardwoods
 - 2. Southern Maritime Forest
- C. Pleistocene Sand Ridge Communities
 - 1. Coastal Scrub Forest
 - 2. Sandhills Associates (Upland Pine Forest)
- D. Upland Hardwood Community

County was developed (see Table 1).

Each division of the vegetation classification is described in general terms, and discussed with regard to its overall county distribution and its relation to geology and soils. Some of the vegetation types are, due largely to their structure and dynamics, admittedly heterogeneous; nevertheless, it is believed that the framework provided will lend overall perspective as to the county's complete natural vegetation, and consequently, will aid the reader in understanding and evaluating the individual natural area reports which follow.

The vegetation classification is divided into three habitats, or ecosystems--aquatic, wetland, and terrestrial. The definition of each ecosystem follows that of Radford et al. (1981, in press). Of the three habitats, wetland plant communities are by far the most extensive in acreage within the county, covering an estimated sixty to seventy percent of the land surface, while terrestrial plant communities cover most of the remainder of the county. True aquatic communities comprise only a small fraction of the county's vegetative cover, probably less than three percent.

I. AQUATIC PLANT COMMUNITIES

As noted, the extent of true aquatic plant communities within the county is very limited. They are restricted to lakes, ponds, sluggish portions of tidal streams, and limited areas within major river estuaries.

A. Freshwater Pond Community

The few old, man-made impoundments in the county, such as Orton Pond and Sandhill Creek impoundment, contain the most extensive aquatic populations in the area. However, although much smaller individually, freshwater pond vegetative communities occur most frequently within limesinks, such as those found in the Sunny Point--Orton--Boiling Springs Lakes region. Doline ponds are numerous in Brunswick County within those areas underlain by fossiliferous Eocene formations (e.g., the Castle Hayne formation), mostly in the eastern and southeastern portions of the county. In addition, oxbow lakes and meander scars, of relatively minor importance along the Brunswick County portion of the Waccamaw River drainage, may also contain aquatic communities. In most cases freshwater pond community types are not especially diverse, and are generally limited to various combinations of water

lily (Nymphaea odorata), duckweed (Lemna spp.), water fern (Azolla caroliniana), and other tiny aquatic species, although exceptions do occur (e.g., Orton Pond).

B. Riverine/Estuarine Community

Riverine and estuarine communities within the county have suffered greatly in recent decades due to development and fill, siltation, and pollution. No good examples of "marsh" aquatic communities with such characteristic species as pondweed (Potamogeton spp.), widgeon grass (Ruppia maritima), and water nymph (Najas guadalupensis) are known presently. However, Eagle Island, prior to extensive disturbance by the N. C. Department of Transportation and U. S. Army Corps of Engineers, was an excellent place to collect aquatic species (fidé A. E. Radford).

II. WETLAND PLANT COMMUNITIES

Wetland habitat has been divided into five vegetation types. Of these types it is the bay forest and lowland pine communities which constitute the majority of the county's mainland vegetative cover. Aside from present-day (Holocene) formations, such as the coastal island back-barrier flats and river floodplains, wetland communities are largely limited to four Pleistocene geomorphic surface features--the Green Swamp Shoal, backbarrier flats of the "Canepatch" sea, backbarrier flats of the "Socastee" sea, and Carolina bays (geomorphic landforms within the county interpreted from Dubar et al. 1976).

A. Pond Margin Community

These are essentially the transition areas between the deep-water portions of limesinks and other ponds, and the surrounding upland communities. If a canopy layer is present, pond cypress (Taxodium ascendens) is the characteristic dominant species, with swamp black gum (Nyssa sylvatica var. biflora) of lesser importance. Associated shrub and herb assemblages are diverse and quite variable, too numerous to list here (Dumond (1979) treats this subject in some detail). Soils are usually Haplaquods, but occasionally are Quartzipsamments or Humaquepts.

B. Marshland Communities

Two subdivisions are made here, based primarily on proximity of the area to ocean inlets, and consequently, on water salinity. The marshes, while not nearly so extensive as those of the northeast embayed portion of the North Carolina coast, are relatively large and diverse for this part of the state.

1. Salt Marsh:

Salt marsh communities occur along the Intracoastal Waterway and around the landward periphery of barrier, and to some extent, spoil, islands. The dominant species is smooth cordgrass (Spartina alterniflora), which often occurs in large, pure populations. The most extensive--and apparently, robust--stands occur within the marshes of the Smith Island complex. Soils are almost exclusively Typic Sulfaquents and Typic Psammaquents.

In addition, included within this category are the fairly broad salt flats dominated by halophytic species such as glasswort (Salicornia spp.), which occur to a significant extent on the backbarrier flats of Smith Island, and to a lesser extent behind other of the county's barrier islands. Because these are generally areas of oceanic storm overwash, "soils" are mixtures of shell fragments and unconsolidated sandy sediments.

2. Brackish Marsh:

Brackish marshes dominate the estuaries of the Cape Fear, Lockwoods's Folly, and Shallotte Rivers, along the tidal reaches of their tributaries, and to some extent behind most of the county's barrier islands. Of these areas, the most extensive and diverse brackish marshes occur at the mouth of Town Creek and northward, and within the intact western and northern portions of Eagle's Island, probably a late Pleistocene backbarrier flat (Dubar et al. 1976).

The dominant species in "seaward" brackish marshes is generally black needle rush (Juncus roemerianus), which occurs in tremendous pure populations along the lower reaches of the Lockwood's Folly and Shallotte Rivers, and on various creeks within the Smith Island complex. Soils here, though generally slightly higher elevationally than those in salt marsh areas,

are again Typic Sulfaquents and Typic Psammaquents.

Within the upper, less haline portions of the estuaries and on many of the associated tidal creeks, the marshes are more diverse, largely dominated by cattail (Typha spp.), giant cordgrass (Spartina cynosuroides), and saw grass (Cladium jamaicense), singly, or in combination, with wild rice (Zizania aquatica) occurring in widely scattered stands. Typic Medisaprists and Typic Psammaquents predominate among soil types.

C. Swamp Forest Community

Swamp forests border the county's blackwater rivers and their tributaries, on floodplains whose size is generally proportional to the size of the stream. Due to their fluvial (depositional) nature, soils throughout the community are highly variable, ranging from Typic Medisaprists to Humaquepts to Typic Ochraqults. Swamp forest tends to intergrade with bay forest in the Waccamaw River--Green Swamp region.

Mixed bottomland hardwoods usually predominate on the alluvial flats, typically consisting of a mixture, in varying proportions, of red maple (Acer rubrum), sweetgum (Liquidambar styraciflua), swamp black gum, ash (Fraxinus spp.), and cypress (Taxodium spp.). Cypress may be an integral component of the canopy, or emergent over it. A subcanopy layer of transgressive species is generally present. Although the dense shade of the canopy and subcanopy layers often precludes the occurrence of a shrub or herb layer except along stream margins or other openings, many exceptions occur. Dwarf palmetto (Sabal minor) is occasionally found in dense stands, and mixed herbs, such as false nettle (Boehmeria cylindrica), violets (Viola spp.), sedges (Carex spp.), and ferns may literally carpet the ground. In somewhat better drained areas, especially in the ecotone between swamp forest and surrounding uplands, bottomland laurel oak (Quercus hemisphaerica) and, occasionally, loblolly pine (Pinus taeda) may assume some importance among canopy species.

The most extensive stands of mixed bottomland hardwoods within the county occur along the Cape Fear River in northern Brunswick County, while the "best" stands from a lack of disturbance point of

view occur along the Juniper and Town Creek drainages.

D. Bay Forest Community

The bay forest community discussed is essentially that described by Kologiski (1977) in his Green Swamp study, and occurs on broad, flat interfluves within the county. Dominant canopy species are red maple, Atlantic white cedar (Chamaecyparis thyoides), loblolly bay (Gordonia lasianthus), sweet bay (Magnolia virginiana), red bay (Persea borbonia), pond pine (Pinus serotina), swamp black gum, and pond cypress, rarely in pure stand, but rather, typically in one of a seemingly endless array of combinations. A dense shrub--transgressive layer, forming a continuous "stratum" from near ground to canopy level, is dominated by "ericaceous" species, such as shining fetterbush (Lyonia lucida), gallberries (Ilex coriacea, I. glabra), blueberries (Vaccinium spp.), titi (Cyrilla racemiflora), and honey-cup (Zenobia pulverulenta). The ever-present laurel-leaved greenbrier (Smilax laurifolia) is abundant in all strata. Soils are generally Terric to Typic Medisaprists and Typic Humaquepts.

This community has historically been subject to relatively frequent fire, and it is largely this factor--along with post-fire seed sources--which has determined the present species composition of various sites. In addition, because of certain common factors--soil properties, fire frequency, moisture relations, etc.--swamp forest, bay forest, and pocosin at times may intergrade in a heterogeneous assemblage intermediate between "characteristic" community types of each, necessitating a somewhat arbitrary assignment into any single vegetation category.

The best intact example of this plant community occurs in the northwest portion of the Green Swamp, between highway NC 211 and S.R. 1342 (Prospect Ridge), but is at present rapidly being altered for eventual conversion to pine plantation.

E. Lowland Pine Communities

Lowland pine communities are the widespread wetland vegetation types which cover a large percentage of mainland Brunswick County, typically occupying low marine ridge and swale areas, Pleistocene backbarrier flats, and other broad interfluves. Both divisions

discussed are pyrohydroseres, succeeding to a mixed pine--hardwood community following drainage and/or fire exclusion. Much of this area has been converted to pine plantation in the recent past.

1. Pocosin:

The pocosin community is similar in many respects to the bay forest; for this reason, both are often considered simply phases of the same vegetation type. Pocosin is typically dominated by a pond pine canopy over a nearly impenetrable thicket of ericaceous shrubs and "bay" species twined together by laurel-leaved greenbrier. Soils here are generally slightly better drained than bay forest soils, with Medisaprists, Typic Humaquepts, and (especially) Typic Haplaquods predominating.

The most extensive intact examples of pocosin within the county occur in the southern portion of the Green Swamp lying immediately east of highway NC 211 and within the series of Carolina bays located north of highway NC 211 and west of highway NC 87.

2. Flatwoods:

Under natural conditions--frequent, "uninterrupted" fire, natural drainage, etc.--pine flatwoods were probably once one of the most extensive vegetation types within the region. The dominant canopy species is almost universally longleaf pine (Pinus palustris), while lower layer stratification is essentially a function of fire frequency. Frequent fires produce herbaceous communities with an open pine canopy, while infrequent fires result in a closed stand of pines over an open to closed layer of ericaceous shrubs. The "herbaceous" layer almost always includes wire grass (Aristida stricta) and creeping blueberry (Vaccinium crassifolium), a subshrub. This community occurs wherever less than well-drained mineral soils with a short hydro-period exist, if fire is not completely excluded. Typic, Aeric, and Ultic Haplaquod soils predominate here, while Aeric to Typic Paleaquults are less common.

This is a vegetation type within Brunswick County--and much of the state in general--which could easily be called "endangered,"

due to historical and continued, present-day development. The mineral soils respond well to conversion efforts, with minimal improvement, chiefly, drainage, necessary for agricultural or silvicultural utilization. Consequently, flatwoods have been converted from natural forest to alternative usages almost wholesale. In addition, with the advent of modern fire protection, extensive or frequent burning of these areas has largely been prevented, or at least, curtailed, and "natural" succession has resulted in loss of much of this unique habitat and associated species. As a result, good examples of the flatwood community are scattered and are generally small. For these reasons--coupled with the relatively large number of threatened and endangered species associated with pine flatwoods--a special effort was made to identify and reconnoiter all flatwood areas within the county.

III. TERRESTRIAL PLANT COMMUNITIES

A. Barrier Island Beach Communities

These communities are present to a greater or lesser extent on all of the county's barrier islands, but are best developed and much more extensive within the Smith Island complex.

1. Dune Ridge Consocieties:

The dune ridge consocieties, which in Brunswick County is almost exclusively dominated by sea oats (Uniola paniculata)--hence, consocieties--occurs on active dune fields of present-day barrier islands. Soils are essentially unconsolidated piles of shifting, windblown sandy sediments. The broadest active dune system within the county, and possibly within the state, up to 730 meters (800 yards) wide and 12 meters (40 feet) high, occurs on Bald Head Island (Parnell and Adams 1971).

2. Swale and Flat Associates:

This association is closely related to the dune ridge consocieties and perhaps better treated as a sub-unit of it. The community occurs on interdunal basins and in the ecotone between salt marsh/flat areas and dune fields. The heterogeneous vegetational assemblage includes both shrubs and herbs, and is

characterized by one or two dominants within any single area; it actually represents a successional, herb-to-shrub sequence, rather than a single vegetation type. Typical species here include salt-meadow cordgrass (Spartina patens), marsh elder (Iva spp.), groundsel-shrub (Baccharis halimifolia), and wax myrtle (Myrica cerifera). Soils are Aquic (implies partial wetland nature of the division) to Typic Udipsamments. Excellent examples of this vegetation type occur on Battery Island and other locations within the Smith Island complex.

B. Maritime Forest Communities

The "climax" communities of stabilized dunal areas subject to predominantly maritime influences--wind, salt stress, temperature amelioration, etc.--these communities are found on barrier islands and in some cases on the immediately adjacent mainland. Typic Udipsamments soils predominate.

1. Mixed Coastal Hardwoods:

This community occurs on somewhat sheltered, landward portions of the broader Brunswick barrier islands, and to some extent on the mainland immediately adjacent to the Cape Fear River. Dominant canopy species are live oak (Quercus virginiana) and laurel oak (Q. laurifolia), with or without loblolly pine. Characteristically, a subcanopy--shrub layer of transgressive oaks, Hercules'-club (Zanthoxylum clava-herculis), wax myrtle, yaupon (Ilex vomitoria), and other shrub species is present. Excepting the southeast portion of Bald Head Island and the other major islands within the Smith Island complex, most of the mixed coastal hardwoods community within the county has been developed for residential purposes.

2. Southern Maritime Forest:

The cabbage palmetto (Sabal palmetto) is the earmark of this community, which is limited in distribution within the county, and the state, to the three main (upland) islands of the Smith Island complex. Palmetto only rarely dominates the canopy, then occurring in small, open stands. It is more commonly an associate "gap" species, or occasionally codominant, with live oak and laurel oak. A dense subcanopy layer of transgressive oaks,

Hercules'-club, yaupon, cherry laurel (Prunus caroliniana), and other tall shrub species, supporting a dense liana layer, is characteristic. An herbaceous layer is often completely lacking due to the dense shade of the canopy and subcanopy layers; however, where present, the groundcover is generally either poison ivy (Rhus radicans) or partridge berry (Mitchella repens). This community is best developed on the northeast portion of Bald Head Island.

C. Pleistocene Sand Ridge Communities

The mainland sand ridge vegetation of the county, dominated by longleaf pine, occurs on Pleistocene ridges of various ages, which represent the barrier dune complexes of former sea level positions. Soils are chiefly Psammments. As with other pine-dominated communities within the county, the vegetation here is fire maintained (pyroseral) under natural conditions. These are the most xeric of the county's mainland vegetation communities.

1. Coastal Scrub Forest:

Occurring on the most recent barrier ridge system of the Brunswick County mainland (the Myrtle Barrier of Dubar et al. (1976)), this community typically has an open longleaf pine canopy over a subcanopy of mixed xeric oaks, and especially scrub live oak (Quercus geminata), which may dominate in extensive patches. Large areas of bare white sand are common, but wire-grass, sand spikemoss (Selaginella arenicola), (Stipulicida setacea), and various lichens are usually abundant. Characteristic soils are Typic Udipsammments.

The best intact examples of coastal scrub forest occur south of highway US 17, between Lockwood's Folly and Shallotte Inlets.

2. Sandhills Associates (Upland Pine Forest):

A longleaf pine/turkey oak (Quercus laevis)/wire-grass community type is the classic example of this vegetation category, and is characteristic for Brunswick County, although a longleaf pine canopy over mixed oaks--including bluejack oak (Quercus incana), turkey oak, dwarf post oak (Q. margaretta), and black-jack oak (Q. marilandica)--is also quite common. Typic to Spodic

Quartzipsamments, and to a much lesser extent, Typic Haplohumods, are the usual soil types.

The extent of this community, in a relatively intact state, is not great within the county. The largest acreage vegetated by sandhills occurs in the Orton--Boiling Springs Lakes area and northward, between highway NC 87 and the Cape Fear River, although notable examples of the community exist as isolated ridges immediately west of Bolivia and elsewhere within the county.

D. Upland Hardwood Community

Given the natural operative factors controlling vegetation within the county (e.g., fire, hydroperiod, etc.), upland hardwood communities are not extensive. However, with modern fire exclusion and large-scale drainage efforts, many areas, such as bottomland forest--upland forest ecotones, abandoned agricultural lands, and various man-disturbed sites, are apparently succeeding to a loblolly pine--mixed hardwoods (especially sweetgum) assemblage.

Natural upland hardwood sites in the county are largely restricted to the well-drained levee soils of some of the smaller streams, and in more extensive stand, to the downcut slopes and fluvial ridges bordering the Cape Fear River and some of its tributaries along the northern boundary of the county. Mixed oaks, especially southern red oak (Quercus falcata), white oak (Q. alba), and laurel oak, and hickories (Carya spp.) are the usual canopy dominants, over an open shrub layer of various ericads, and a sparse herb layer. Other variations among upland hardwood communities, such as the beech (Fagus grandifolia)--southern sugar maple (Acer saccharum ssp. floridanum) dominated community type of the Bryant Mill Creek--Greenbank Bluff area in extreme northwest Brunswick County, are rare¹.

APPROACH AND METHODS

The selection of sites to be investigated initially involved an examination of the North Carolina Natural Heritage Program's Brunswick County computer element file, along with the corresponding topographic quad sheets.

¹Kologiski (1977), however, notes that an 1870 survey of the timber resources of the Green Swamp lists beech among the common timber species.

Secondly, all pertinent USDA Soil Conservation Service and Agricultural Stabilization and Conservation Service aerial photographs were studied, coupled with a screening flight over the county. These efforts were followed by extensive field reconnaissance of potentially significant areas identified.

In addition, because it is not generally possible to identify every significant natural area by plane or with aerial photographs, a thorough vehicular reconnaissance of the county was undertaken. Every state and county maintained road was travelled at least once, and hundreds of miles of timber company access roads and other private roads were walked or driven. Further, a number of otherwise inaccessible potential areas were surveyed by boat.

In order to supplement my own field reconnaissance efforts, an attempt was made to seek assistance from others knowledgeable, or potentially so, of the county's natural resources. Letters explaining the contract objectives and soliciting assistance in identifying potential natural areas were sent to all high-school-or-above-level science instructors within the county, heads of various state and federal agencies (e.g., SCS, NCWRC, etc.), and a number of area field biologists. The result was a generally low level of expressed interest, and very few replies.

CONTRACT NATURAL AREA REPORTS

In addition to this introduction, the submitted contract survey report for Brunswick County consists of (1) a series of natural area summaries, (2) addenda to several earlier submitted Brunswick County natural area reports, (3) a summary of significant bird breeding habitat, (4) pertinent topographic quad sheets with significant areas mapped, and (5) a Brunswick County map and legend with all natural areas mapped.

Thirteen natural area summaries (preliminary reconnaissance reports) are presented. The format followed is a revised version of the North Carolina Natural Heritage Program contract specifications. Additions, deletions, and rearrangements of the specified format were made in order to present what was felt to be appropriate preliminary reconnaissance information in a logical order. The natural areas reported on are listed alphabetically:

1. Bald Head Creek Natural Area
2. Battery Island
3. Camp Branch Savannah

4. Drowned Bay Savannah
5. Gause Savannah
6. Green Pond Savannah
7. Greenbank Bluff
8. Henrytown Savannah
9. Long Bays Savannah
10. McKinzie Pond Marsh
11. Sandhills Creek Impoundment
12. Smithville Carolina Bay Complex
13. Waccamaw Island Savannah

Further, I submitted a number of reports dealing with significant natural areas in Brunswick County as a portion of two 1979 N. C. Heritage Program contracts. Addenda to seven of the eleven original reports are included according to new information gathered. They are as follows:

1. Big Cypress Bay
2. Big Island Savannah
3. Blue Pond Complex
4. Boiling Springs Lakes "Natural" Area
5. Orton Pond "Natural" Area
6. Piver Bays Bog
7. Spring Creek Pond.

In addition to the individual reports and addenda detailed here, several other papers dealing with significant natural areas in the county have either been prepared recently or are now in preparation. Although I have, both prior to and during the course of this contract, briefly surveyed several areas which fit this category, I have seen little point in duplicating the original efforts, and therefore refer the reader to the original reports for details on these significant areas. The areas involved and the dates of the reports are listed below²:

1. Bryant Mill Creek (1979)
2. Green Swamp Natural Area (1981)
3. Sunny Point Limesinks (1979).

NATURAL AREA SIGNIFICANCE

The statements of significance which are contained within each submitted natural area report pertain to those properties of the site which are clearly evident as significant features. However, because the field investigations specified in this contract constitute preliminary reconnaissance reports, rather than basic inventory, the accompanying reports should not be

²Complete references to these papers are provided in the "Literature Cited" section of this report.

Figure 1.
Significant Natural Areas
Brunswick County, North Carolina

High Priority Natural Areas $\triangle$

1. Bald Head-Smith Island Complex
2. Battery Island
3. Big Cypress Bay and Ponds
4. Big Island Savanna
5. Blue Pond-Little Blue Pond-Black Pond Limesink Complex
6. Camp Branch Savanna
7. Ferry Slip Island Pelican Colony
8. Green Swamp Preserve
9. Greenbank (Bryant Mill) Bluff
10. Long Bay's Savanna
11. Monks Island
12. Orton Pond
13. Smithville Carolina Bay Complex
14. Spring Creek Pond
15. Sunny Point Limesinks
16. Sunset Beach Wood Stork Ponds
17. Waccamaw Island Savanna

Local Priority Natural Areas $\circ$

1. Bird Island
2. Brunswick River at juncture with Cape Fear River (Alligator concentration area)
3. Boiling Springs Ponds
4. Drowned Bay Savanna
5. Gause Pond Savanna
6. Green Pond Savanna
7. Henrytown Savanna
8. McKinzie Pond Marsh
9. Sandhills Creek Impoundment
10. Sampson Pond Sinks
11. Pivers Bay Bog
12. Other island nesting sites for colonial waterbirds

interpreted as definitive statements of the total significance of any natural area. Further significance of any site may become apparent with additional investigation.

All natural areas reported on are worthy of preservation in their own right, and therefore, of special consideration in planning the future development of the county. Twelve of the thirteen natural areas reported on here--Bald Head Creek Natural Area, Battery Island, Camp Branch Savannah, Gause Savannah, Green Pond Savannah, Greenbank Bluff, Henrytown Savannah, Long Bays Savannah, McKinzie Pond Marsh, Sandhills Creek Impoundment, Smithville Carolina Bay Complex, and Waccamaw Island Savannah--because of their included elements of significance and the uniqueness of each individual area, are regarded as being of high priority, while one area--Drowned Bay Savannah--exhibits a lesser degree of significance (medium priority). In addition, of the other listed areas, Big Cypress Bay, Big Island Savannah, Blue Pond, Orton Pond "Natural" Area, Spring Creek Pond, and the Sunny Point Limesinks should also be given high priority in preservation efforts and land-use planning³.

The relative degree of protection merited by any individual natural area is dependent on the level of significance of the site, as well as upon site structure and dynamics. For example, some locally significant areas could withstand a multiple land use ethic, where such recreational activities as hunting, fishing and hiking are permitted, while maintaining site integrity. Other sites have such a high level of significance and/or are so fragile in nature or limited in extent, that outright protection with enforcement of strict usage regulations is mandatory to continued existence of the area.

As a last note, an appeal is order with regard to the content of this report. While an attempt was made to reconnoiter all portions of the county with equal thoroughness, and while every reasonable effort has been made to seek out and identify ALL significant natural areas worthy of conservation efforts, it is nevertheless probable that one, or several, significant sites may have been missed due to the relative inaccessibility of a few areas

³The Bryant Mill Creek site is considered to essentially be a part of the Cape Fear River bluff forest which includes Greenbank Bluff. Further, the Green Swamp Natural Area, owned by the North Carolina Nature Conservancy, are presumed to be protected, although usage of adjacent privately owned lands may ultimately affect the status of the Conservancy tract.

(both actual remoteness of the area and lack of owner cooperation may result in inaccessibility), and to the sheer extent of the county. For these reasons it is important that it NOT at this point be assumed that all significant natural areas in Brunswick County are known, and that it may now be safely "written off" as thoroughly explored with regard to significant sites.

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Figure 2: Known "natural" or other undeveloped areas containing threatened and endangered species, Brunswick County, N. C.

FIGURE 2: KNOWN "NATURAL" OR OTHER UNDEVELOPED AREAS
CONTAINING THREATENED AND ENDANGERED SPECIES,
BRUNSWICK COUNTY, NORTH CAROLINA¹

SITE NUMBER	SITE NAME	SPECIES OF CONCERN ²
1	Bald Head Creek Natural Area	<u>Sabal palmetto</u> Cabbage Palmetto
2	Big Cypress Bay	<u>Alligator mississippiensis</u> American Alligator <u>Anhinga anhinga</u> Water-turkey <u>Litsea aestivalis</u> Pondspice
3	Big Island Savannah	<u>Agalinis aphylla</u> Scale-leaf Gerardia <u>Coreopsis gladiata</u> Swamp Tickweed <u>Dionaea muscipula</u> Venus' Fly-trap <u>Habenaria integra</u> Yellow Fringeless Orchid <u>Picoides borealis</u> Red-cockaded Woodpecker <u>Rhynchospora breviseta</u> Short-bristled Beak-rush <u>Sarracenia rubra</u> Sweet Pitcher Plant <u>Sporobolus teretifolius</u> Wireleaf Dropseed
4	Blue Pond	<u>Litsea aestivalis</u> Pondspice
5	Camp Branch Savannah	<u>Parnassia caroliniana</u> Grass-of-Parnassus
6	East Beach (Smith Island)	<u>Caretta caretta</u> Atlantic Loggerhead Turtle
7	Green Pond Savannah	<u>Myriophyllum laxum</u> Loose Water-milfoil
8	Greenbank Bluff	<u>Parnassia grandifolia</u> Grass-of-Parnassus
9	Long Bays Savannah	<u>Aimophila aestivalis</u> Bachman's Sparrow <u>Fothergilla gardenii</u> Witch-alder <u>Picoides borealis</u> Red-cockaded Woodpecker
10	McKinzie Pond Marsh	<u>Alligator mississippiensis</u> American Alligator <u>Ludwigia repens</u> Creeping Ludwigia
11	Orton Pond Natural Area	<u>Alligator mississippiensis</u> American Alligator <u>Anhinga anhinga</u> Water-turkey <u>Picoides borealis</u> Red-cockaded Woodpecker <u>Potamogeton illinoensis</u> Pondweed <u>Rhynchospora pleiantha</u> Beak-rush
12	Sandhill Creek Impoundment	<u>Anhinga anhinga</u> Water-turkey
13	Smithville Carolina Bay Complex	<u>Picoides borealis</u> Red-cockaded Woodpecker
14	Ferry Slip Dredge Island	<u>Pelecanus occidentalis</u> Brown Pelican
15	Waccamaw Island Savannah	<u>Dionaea muscipula</u> Venus' Fly-trap <u>Lophiola americana</u> Lophiola

Lysimachia asperulaefolia Carolina Loose-
strife

Parnassia caroliniana Grass-of-Parnassus

¹Identification code by shape: (1) ○ --site contains threatened or endangered plant and animal species; (2) □ --site contains threatened or endangered species of plants only; (3) △ --site contains threatened or endangered species of animals only; and (4) ⬡ --site is not a recognized "Natural Area," but constitutes important breeding habitat for one or more threatened or endangered species.

²See the accompanying individual Natural Area reports for more complete information regarding the listed threatened and endangered species.

Figure 3: Significant bird
breeding habitat, Brunswick
County, N.C. "waterbirds."

FIGURE 3: SIGNIFICANT BIRD BREEDING HABITAT, BRUNSWICK COUNTY, N. C. "WATERBIRDS."

I. "Shorebirds:" (see Table 2)

<u>CODE</u>	<u>SITE NUMBER</u>	<u>SITE NAME</u>
○	1	(Cape Fear River)
"	2	(Cape Fear River)
"	3	(Cape Fear River)
"	4	(Cape Fear River)
"	5	(Cape Fear River)
"	6	New Inlet
"	9	(Long Point)
"	10	Monk's Island
"	11	Bowen Point
"	12	(Mad Inlet
"	13	(Mad Inlet)
"	14	Bird Island

II. "Heronries:" (see Table 3)

<u>CODE</u>	<u>SITE NUMBER</u>	<u>SITE NAME</u>
△	1	Juniper Creek
"	2	Lockwood's Folly
"	3	Orton Pond
"	4	Sandhills Creek
"	5	Shallotte
"	6	Twin Lakes
"	7	Battery Island (North)
"	8	Battery Island (South)

III. Osprey Nesting Sites: (see Table 4)

<u>CODE</u>	<u>SITE NUMBER</u>	<u>SITE NAME</u>
□	1	Big Cypress Bay
"	2	Blue Pond
"	3	Orton Pond
"	4	Sandy Hill Sinks

Table 2: Summary of colonial waterbird nesting sites, Brunswick County, North Carolina¹.

Site Name	Quadrangle	Coordinates	Site Type ²	Nesting Species ³	Number of Nests	Comments
(Cape Fear R.)	Carolina Beach	34°00'N 77°57'W	DSD	LAAT STMA	728 1	-
(Cape Fear R.)	Kure Beach	33°58'N 77°57'W	DSD	STAL	7	-
(Cape Fear R.)	Kure Beach	33°56'N 77°51'W	DSU	PEOC STMA	- -	These two sites comprise the first--and only--records of Brown Pelicans nesting in southeastern North Carolina.
(Cape Fear R.)	Kure Beach	33°55'N 77°51'W	DSU	STMA PEOC LAAT	- - -	
(Cape Fear R.)	Kure Beach	33°56'N 77°51'W	DSU	GENI STHI LAAT	34 4 -	-
New Inlet	Kure Beach	33°54'N 77°56'W	BIB	RYNI STAL	59 22	One of only two "natural" (no human modification) nesting sites in county.
Battery Island (North)	Southport	33°54'N 78°01'W	NIM	BUAL	693	In conjunction with the next site, this is the largest nesting colony of wading birds in North Carolina.
				EGTH	450	
				HYTR	368	
				CAAL	144	
			PLF	PLFA	86	
				NYNY	75	
				FLCA	13	
Battery Island (South)	Southport	33°54'N 78°01'W	NIM	EUAL	1946	In conjunction with the preceding site, this is the largest nesting colony of wading birds in North Carolina.
				HYTR	240	
				EGTH	87	
				PLFA	72	
				FLCA	72	
				NYNY	28	
				BUAL	7	
				BUST	5	
(Long Point)	Shallotte-Holden Beach	33°55'N 78°22'W	DSD	CAAL	3	-
				STAL	12	
Monks Island	Shallotte-Holden Beach	33°55'N 78°23'W	DSD	STAL	427	This is the largest Least Tern colony in North Carolina.
				RYNI	28	
				GENI	19	
				STHI	9	

(Continued on next page).

Table 2: (Conclusion).

Site Name	Quadrangle	Coordinates	Site Type ²	Nesting Species ³	Number of Nests	Comments
Bowen Point	Shallotte-Holden Beach	33°55'N 78°15'W	MLM	STAL	28	-
(Mad Inlet)	Calabash	33°53'N 78°31'W	DSD	STAL	9	-
(Mad Inlet)	Little R.-Calabash	33°53'N 78°32'W	DSD	STAL	35	-
Bird Island	Little River	33°51'N 78°32'W	BIB	RYNI	22	One of only two "natural" (no human modification) nesting sites in county.

¹Source of the data contained in Table 2 is 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, Raleigh, N. C.

²"Site Types" are divided into five categories according to origin and/or physical characteristics, as follows:

- (1) BIB -- barrier island beach;
- (2) DSD -- dredged material (spoil), diked;
- (3) DSU -- dredged material (spoil), undiked;
- (4) MLM -- mainland site, modified with addition of dredged spoil material;
- (5) NIM -- natural island, modified with addition of dredged spoil material.

³"Nesting Species" are represented in Table 2 by an acronym created from the first two letters of the species generic name coupled with the first two letters of its specific epithet. The acronyms and species are as follows, listed alphabetically:

- (1) BUAL Bubulcus albus Cattle Egret
- (2) BUST Butorides stritus Green Heron
- (3) CAAL Casmerodius alba Great Egret
- (4) EGTH Egretta thula Snowy Egret
- (5) EUAL Eudocimus albus White Ibis
- (6) FLCA Florida caerulea Little Blue Heron
- (7) GENI Gelochelidon nilotica Gull-billed Tern
- (8) HYTR Hydranassa tricolor Louisiana Heron
- (9) LAAT Larus argentatus Herring Gull
- (10) NYNY Nycticorax nycticorax Black-crowned Night Heron
- (11) PEOC Pelecanus occidentalis Brown Pelican
- (12) PLFA Plegadis falcinellus Glossy Ibis
- (13) RYNI Rynchops niger Black Skimmer
- (14) STAL Sterna albifrons Least Tern
- (15) STHI Sterna hirundo Common Tern
- (16) STMA Sterna maxima Royal Tern

Table 3: Summary of Brunswick County, North Carolina heronries¹.

COLONY NUMBER AND NAME	QUAD-RANGLE	COORDINATES	NESTING SPECIES ²	NUMBER OF NESTS
(1) Juniper Creek	Exum	34°04'N 78°24'W	ARHE	3
(2) Lockwood's Folly	Lockwood's Folly	33°56'N 78°12'W	ARHE	3
(3) Orton Pond	Carolina Beach	34°03'N 77°58'W	ARHE ANAN	21 2
(4) Sandhills Creek	Carolina Beach	34°08'N 77°59'W	ARHE ANAN	44 1
(5) Shallotte	Shallotte	33°57'N 78°24'W	ARHE	16
(6) Twin Lakes	Calabash	33°56'N 78°31'W	ARHE	2
(7) Battery Island (North)	Southport	33°54'N 78°01'W	BUAL EGTH HYTR CAAL PLFA NYNY FLCA EUAL	693 450 368 144 86 75 13 2
(8) Battery Island (South)	Southport	33°54'N 78°01'W	EUAL HYTR EGTH PLFA FLCA NYNY BUAL BUST CAAL	1946 240 87 72 72 28 7 5 3

¹Sources of the data contained in Table 3 are (1) 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, Raleigh, N. C., sites 7 & 8; and (2) Soots, R. F., Jr. and J. F. Parnell. 1979. Inland heronries of North Carolina. The Chat 43: 10-16, plus additional study data, sites 1 - 6.

²"Nesting Species" are represented in Table 3 by an acronym created from the first two letters of the species generic name coupled with the first two letters of its specific epithet. The acronyms and species are as follows: (see Table 2 for acronyms for sites 7 & 8)

- (1) ANAN Anhinga anhinga Water-turkey
- (2) ARHE Ardea herodias Great Blue Heron.

Table 4: Summary of Osprey (Pandion halioetus) nesting sites containing two or more nesting pairs of adult birds, Brunswick County, North Carolina¹.

SITE NUMBER AND NAME	QUAD- RANGLE	COORDI- NATES	NESTING PAIRS
(1) Big Cypress Bay	Lockwood's Folly	33°58'N 78°11'W	5
(2) Blue Pond	Carolina Beach	34°05'N 77°59'W	2
(3) Orton Pond	Carolina Beach	34°03'N 77°58'W	61
(4) Sandy Hill Sinks	Lockwood's Folly	34°00'N 78°13'W	3

¹Sources of the data contained in Table 4 are (1) Personal observation of the author, 1979 - 1981, sites 1, 2, & 4; and (2) Henny, C. J. and A. P. Noltemeier. Osprey nesting populations in the coastal Carolinas. American Birds 29: 1073-1079, site 3.

Figure 4: Special Habitats -- Sea Turtle Nesting Beaches

The oceanfront beaches of the Smith Island Complex (Bald Head, Middle, and Bluff Islands) rank among the highest density nesting beaches in the state for Loggerhead Sea Turtles (*Caretta caretta*). The remaining beaches of Brunswick County are of medium significance on a state-wide basis for Loggerhead nesting. (Crouse, 1980, Sea Turtle Nesting Surveillance in North Carolina, 1980. N.C. Natural Heritage Program report for N.C. Wildlife Resources Commission).

Medium
Significance

High
Significance

NATURAL AREA INVENTORY FORM

Preliminary Reconnaissance Survey
Brunswick County, North Carolina

1. Natural Area Name: Bald Head Creek Natural Area
2. Location: Site is located along the northeast portion of Bald Head Island bounded by Bald Head Creek, ca. 0.4 mile west of East Beach.
3. Topographic Quadrangle Map Reference: Cape Fear 1:24000.
Coordinates: $33^{\circ}57'N$ latitude; $77^{\circ}58'W$ longitude.
4. Size: ca. 25.9 ha. (64 A.).
5. Elevation: 0 to 6 m (0 to 20 ft.).
6. Vegetation Classification Category: III.B.2. Southern Maritime Forest.
7. Investigator(s): Timothy D. Nifong
Box 29, Coker Hall, UNC
Chapel Hill, N. C. 27514
8. Access: Boat via Southport.

9. Site Description:

The community type here is essentially that described for southern maritime forest in the "Introduction" section of this paper. The site was located from the air, and constitutes the best known stand of cabbage palmetto (Sabal palmetto) within the Smith Island complex, and thus, within the state. Besides existing in several "pure" stands along Bald Head Creek, cabbage palmetto is a canopy codominant with laurel oak (Quercus laurifolia) and live oak (Q. virginiana) in some of the area, and an important reproducing associate canopy species throughout the rest of the site.

The gently undulating ridge and swale topography of relict dunes occurs throughout the Natural Area.

10. Ownership Summary:

a. Ownership type by percent area:

Type

Private	100	%
Public		%
Unknown		%

b. Number of owners: one (1)

c. Name(s) and address(es) of owner(s):

Walter R. Davis
% Bald Head Island Corporation
Southport, N. C.

11. Land Use Status:

a. Natural area usage category: no apparent usage to low intensity recreation.

b. Use of surrounding land:

(1) Undeveloped 100 %

(2) Developed: agricultural or silvicultural _____ %

(3) Developed: urban _____ %

12. Management Summary:

a. Current preservation status:

Category	%	Description of preservation status
4	100	Private land, protected by developer.

b. Threats:

Category	Description of threat
3	Development of area as resort/residential complex; construction of houses on already subdivided lots.

c. Management recommendations:

- (1) The Natural Area should remain totally in its natural state. As Parnell and Adams (1971)* noted, it is extremely important that the maritime forest understory NOT be cleared, as it is the "thicket" structure of the forest that mitigates against excessive windthrow of canopy trees during severe storms.
- (2) If the population of the island increases to projected levels, some type of access restriction to the site may prove necessary in order to protect the Natural Area site integrity.

*Parnell, J. F. and D. A. Adams. 1971. Smith Island: a resource capability study. Interim report. N. C. Sea Grant Publication, Wilmington.

13. Site Significance Summary:

- (1) The site is an excellent example of southern maritime forest, with a number of old growth live oaks (Quercus virginiana), and contains the best known stand of cabbage palmetto (Sabal palmetto), a threatened species within the state, and at the northern end of its range on Smith Island.

14. N. C. Natural Heritage Program Priority Rating:

High priority.

15. Field Reconnaissance Data Summary Sheet:

FLORA

Canopy: *Quercus virginiana*--*Q. Laurifolia*--*Sabal palmetto*

Juniperus virginiana

Prunus caroliniana

Quercus laurifolia

Q. virginiana

Sabal palmetto

Subcanopy: Mixed coastal "hardwoods"

Carpinus caroliniana

Cornus florida

Persea borbonia

Prunus caroliniana

Zanthoxylum clava-herculis

Transgressives: Mixed coastal "hardwoods"

Quercus laurifolia

Q. virginiana

Sabal palmetto

Shrubs: No dominants

Callicarpa americana

Erythrina herbacea (creek edge)

Ilex vomitoria

Myrica cerifera

Osmanthus americanus

Sabal minor

Herbs: No dominants to *Mitchella repens*

Elephantopus tomentosus

Galium pilosum

Mitchella repens

Vines: Mixed lianas

Gelsimium sempervirens

Parthenocissus quinquefolia

Rhus radicans

Smilax bona-nox

Ferns: No dominants

Asplenium platyneuron

Polypodium polypodioides

Creek "Edge" Species:

Baccharis halimifolia

Cenchrus sp.

Ipomoea sp.

Juncus roemerianus

Spartina patens

FAUNA

No list compiled

15. Field Reconnaissance Data Summary Sheet: (cont.)

SOIL SUBGROUP

Typic Udipsamments (as mapped by USDA - SCS; no core taken in field).

Figure 5. Bald Head Creek

NATURAL AREA INVENTORY FORM
Preliminary Reconnaissance Survey
Brunswick County, North Carolina

1. Natural Area Name: Battery Island
2. Location: Cape Fear River, ca. 0.5 miles southeast of Southport, N. C.
3. Topographic Quadrangle Map Reference: Southport 1:24000.
Coordinates: $33^{\circ}54'N$ latitude; $78^{\circ}01'W$ longitude.
4. Size: ca. 34.8 ha. (86 A.).
5. Elevation: 0 to 3 m (0 to 10 ft.).
6. Vegetation Classification Category: II.B.1. Salt Marsh/III.A.2.
Swale and Flat Associates/III.B.1.
Mixed Coastal Hardwoods.
7. Investigator(s): Timothy D. Nifong
Box 29, Coker Hall, UNC
Chapel Hill, N. C. 27514
8. Access: Boat via Southport.

9. Site Description:

Battery Island represents a natural island whose surrounding marshes have undergone some, although not drastic, modification in the past by the addition of dredged spoil material. Two upland, normally non-flooding areas occur on the "island," one at its southeast end, and one in the central portion of the island. These sites are dominated by dense thickets of "developing" mixed coastal hardwoods, and by areas where species transitional between the maritime thickets and swale and flat associates occur. Woody species such as live oak (Quercus virginiana), Hercules' club (Zanthoxylum clava-herculis), eastern red cedar (Juniperus virginiana), wax myrtle (Myrica cerifera), yaupon (Ilex vomitoria), and marsh elder (Iva frutescens) predominate. Canopy trees are approximately 6 to 8 meters in height, and transgressives of the listed species form subcanopy and shrub strata which are essentially continuous with the canopy layer. It is in these thickets that the well developed rookeries of the island are located (see Table 2 for species compositions and numbers).

The upland portions of the island are surrounded by smooth cord grass (Spartina alterniflora) salt marsh, which is especially extensive around the northernmost upland portion of the area. Swales, flats, and low ridges between the salt marsh and the upland maritime thickets are dominated by a mixture of grasses, especially salt-meadow cord grass (S. patens), sedges, and forbs (see "Swale and Flat Associates" in Introduction). Dense patches of giant reed (Phragmites communis) dominate a few of the dredged spoil material deposits around the upland island ridges.

10. Ownership Summary:

a. Ownership type by percent area:

Type

Private	<u> </u>	%
Public	<u>100</u>	%
Unknown	<u> </u>	%

b. Number of owners: one (1)

c. Name(s) and address(es) of owner(s):

State of North Carolina

11. Land Use Status:

a. Natural area usage category: Low intensity research and educational visits.

b. Use of surrounding land:

(1) Undeveloped 100 % (Surrounded by Cape Fear River channels and shallow bays).

(2) Developed: agricultural or silvicultural %

(3) Developed: urban %

12. Management Summary:

a. Current preservation status:

Category	%	Description of preservation status
2	100	Public land, informally recognized as a natural area.

b. Threats:

Category	Description of threat
4	No known immediate threat exists; however, the
	risk of an oil spill or other similar dis-
	turbance is always present.

c. Management recommendations:

- (1) Access to the island should be limited during the breeding seasons of the various colonial nesting species utilizing the island;
- (2) Because this is a natural, rather than a spoil, island, further deposits are unnecessary to stabilize the site; therefore, future deposition of spoil material should be prohibited, if it is not already.

15. Field Reconnaissance Data Summary Sheet:

FLORA

"Canopy": Mixed transgressive trees and tall shrubs

Baccharis halimifolia
Daubentonia punicea
Iva frutescens
I. imbricata
Ilex vomitoria
Juniperus virginiana
Myrica cerifera
Quercus virginiana
Zanthoxylum clava-herculis

Herbs:

Borrichia frutescens
Cakile harperi
Cynodon dactylon
Distichlis spicata
Oenothera sp.
Panicum sp.
Phragmites communis
Salicornia biglovii
S. virginica
Setaria magna
Solidago sempervirens
Spartina alterniflora
S. patens
Triplasis purpurea
Uniola paniculata

FAUNA

See summary Table 2; also see Parnell, J. F. and D. Adams. 1971.
Smith Island: a resource capability study. Interim report. N.C.
Sea Grant Publication, Wilmington.

SOIL SUBGROUP

No core taken.

13. Site Significance Summary:

- (1) Battery Island is significant for its well known wading bird rookery, and is the largest such heronry in North Carolina (Parnell, J. F. & R. F. Soots, Jr. 1979. Atlas of colonial waterbirds of North Carolina estuaries. UNC Sea Grant Publ. UNC-SG-78-10, Raleigh, N. C.) (see summary Table 2 for breeding bird data).

14. N. C. Natural Heritage Program Priority Rating:

High priority.

Figure 6. Battery Island

Name of area: Big Cypress Bay (Big Cypress Pond)

County: Brunswick

Location description: To reach Big Cypress Bay, travel south 4.3 mi. on Co. Rd. 1112 from its intersection with highway NC 211 east of Supply, to southeast heading jeep trail (last dirt road to the left before reaching curve to the right in Co. Rd. 1112); proceed east-southeast along jeep trail approximately 1.8 mi. Bay (Big Cypress Bay) containing pond network (see accompanying map) which constitutes Big Cypress Pond is north-east of jeep trail.

Elevation: 12.2 to 16.8m (40 to 55 ft.) above sea level.

Physiographic region: Atlantic Plain Province: Coastal Plain
Section: Sea Islands Downwarp

Topographic quad map reference: Lockwoods Folly 1:31680 (map attached).

Size: ca. 150 acres.

Ownership information: Weyerhaeuser Company
Hwy 74
Wilmington, N.C. 28401.

Report prepared by: Timothy D. Nifong
Box 29, Coker Hall
Dept. of Botany, UNC
Chapel Hill, N.C. 27514.

Other persons knowledgeable about site: Joseph Newman
Cape Fear Drive
Southport, N.C. 28461.

Current use and protection status:

The ponds within Big Cypress Bay are subject both to some hunting (primarily duck) and some fishing activities in season. Such activities constitute little apparent threat to nesting within the ponds of the bay by several bird species, or to the vegetational communities occurring within the bay.

The entire upland area surrounding the bay was cleared and replanted in pines (Pinus sp.) in the late 1960's. Because the several ponds which constitute Big Cypress Pond lie within an apparent irregular Carolina bay (Big Cypress Bay), the high water table and subsequent wet surface soil conditions impose a severe equipment limitation upon clearing and/or planting operations in the immediate area of the bay, and consequently, a buffer zone of varying width--depending upon how close to the edge of Big Cypress Bay that a particular pond lies--and vegetated by a pocosin community type (Pinus serotina/mixed evergreen and deciduous shrubs//Smilax laurifolia) has been left surrounding all of the pond areas proper, and covering most of the entire bay area.

Vegetation and plant communities:

Because of the relative inaccessibility to the network of ponds which

occur within the northwest end of Big Cypress Bay, except by way of boat, only the much more readily accessible pond grouping located within the southeast end of the bay was sampled and is reported on here. The northeast bay area ponds were visited, however, and appear to be very similar vegetationally to those ponds located at the southeastern end of the bay, which are discussed below. Further, the smaller ponds, or sinks, which occur in areas outlying the bay itself, are briefly discussed.

A word should be mentioned here regarding the abundant evidence that existed within the pond and bay vegetational communities, pointing to the frequent occurrence of, and important role of past fires in maintaining seral vegetation communities, and in shaping the ultimate species composition of these communities.

Southeastern bay area pond communities--

The ponds found near the southeast end of the Big Cypress Bay are relatively steep-walled, and contain water which is seasonally as much as 5m or more in depth. Vegetation surrounding the open water of the pond is quite obviously associated into zones, or community types, presumably based upon hydroperiod and/or seasonal water level fluctuations within the ponds. Water levels within the ponds, although they varied as much as 1.5m during the period of field reconnaissance, are fairly constant throughout the year, the ponds being spring-fed. Large areas of relatively deep, open water predominate towards the center of the ponds, with vegetation occurring zonally in the shallow water and pond rim areas as follows:

- 1) Water lily--banana plant. Nymphaea odorata--Nymphoides aquatica. Water lily, either alone or in combination with banana plant, occurs in the shallow water rim areas of the ponds, with the zone being more or less constantly inundated. Towards the outermost (shallowest) areas of this zone, or community type, duckweed (Lemna valvidiana) and purple bladderwort (Utricularia purpurea) may assume some importance.
- 2) Spike rush; marsh pennywort. Eleocharis sp.; Hydrocotyle umbellata. This is the first emergent zone, and typically consists of spike rush or marsh pennywort as single dominants, and occasionally as codominants. Various other herbaceous species, such as sedges (Cyperus sp.), proserpinaca (Proserpinaca pectinata), and winged-stem seedbox (Ludwigia decurrens) commonly occurred within this zone, which is seasonally inundated during periods of high water.
- 3) Pond grass. Sacciolepis striata. This pond grass zone occurs sporadically throughout the pond rim area, at times being absent, or singly dominating large patches. This zone may intrude upon those emergent herbaceous zones located above or below it in the pond rim vegetational sequence.
- 4) St. John's wort. Hypericum sp. This outermost herbaceous zone usually extended from the grassy zones below it to the dense shrub thicket encircling the pond above it, being some 1 to 2.5m in width. St. John's wort was occasionally displaced within this zone by some other herbaceous species, such as Virginia chain fern (Woodwardia virginica). In addition, scattered shrubs, such as button bush (Cephalanthus occidentalis), water willow (Decodon verticillatus), and dahoon (Ilex cassine), were frequently encountered within this zone.

Zones 2 through 4 were often found intermixed according to local microtopography in the occasionally extensive flats lying between pond areas, with St. John's wort often dominating large areas,

but with occasional extensive patches of spike rush, panic grass (*Panicum* sp.), diodia (*Diodia virginiana*), or other species occurring.

- 5) Mixed evergreen shrubs. This zone marked the beginning of the dense shrub thicket which bordered the ponds, extending from the pond rims to the surrounding upland areas planted in pines--some 6 to 60m or more--and throughout the interior of the bay. Fetter-bush (*Lyonia lucida*) and titi (*Cyrtilla racemiflora*) typically dominated this thicket community type, although dahoon often assumed importance proximal to the open pond rim area, and wax myrtle (*Myrica cerifera*) was occasionally dominant in the more upland areas of the zone.

Pond cypress (*Taxodium ascendens*) characteristically formed a ring encircling the ponds in the shallow water and/or wet flats areas, usually being most concentrated in zones 1 and 2, but frequently extending throughout zone 4 as well.

Outlying pond communities--

A number of the smaller outlying ponds, or sinks, surrounding Big Cypress Bay were visited, with observations made regarding plant species presence and distribution, and the overall condition of each pond recorded. Although a characteristic assemblage of "sink species" was present at many of the outlying pond sites (see accompanying Flora Species List), and vegetational zonation was still pronounced at a few of the visited locations, these ponds have for the most part been irreversibly damaged or largely destroyed. During the harvesting, clearing, and replanting operations within the upland areas surrounding these ponds, the pond cypress (*Taxodium ascendens*) canopies occurring within several of these small ponds were actually pushed over, with the ponds consequently being used as dump sites for cleared debris.

The only plant species occurrence of any significance among these ponds was the location of a small population of pondspice (*Litsea aestivalis*)--an endangered peripheral species which was not observed at any of the large ponds within the bay--around a small ephemeral pool which lies on the outer margin of Big Cypress Bay itself. The fact that this pond was located on the edge of the bay is the only probable reason that it too was not destroyed during clearing activities within the area.

Bay communities--

As was previously mentioned, most of the bay area is dominated by a *Pinus serotina*/mixed evergreen and deciduous shrubs//*Smilax laurifolia* community type, or by some close variation of this combination. A subcanopy layer comprised of mixed transgressive trees, e.g., red maple (*Acer rubrum*) and black gum (*Nyssa sylvatica* var. *biflora*) is present in many areas as well.

At several locations within the bay, pond pine was replaced by loblolly pine (*Pinus taeda*) in mature stand.

Upland communities--

The upland areas surrounding the bay are now largely dominated by immature "super pine" seedlings (*Pinus* sp.). These areas were, however, previously and naturally vegetated with a longleaf pine (*Pinus palustris*)/turkey oak (*Quercus laevis*) or mixed oak (*Quercus* sp.)//wiregrass (*Aristida stricta*) community on the drier ridge areas characterized by a typic to spodic quartzipsamment soil, and by a longleaf

pine flatwoods community--longleaf pine/scrub live oak (Quercus geminata)/wiregrass, longleaf pine/sand myrtle (Leiophyllum buxifolium)/wiregrass--creeping blueberry (Vaccinium crassifolium), etc.--in the flatter, inter-ridge areas typified by a spodic quartzipsamment to aeric haplaquod soil type. The pine flatwoods community bordered and graded into the pocosin type vegetation and accompanying typic haplaquod soils at the bay margins.

Physical features:

General description: Big Cypress Bay constitutes what appears to be an irregularly shaped Carolina bay, located in an area of well developed (lime) sinks, bordered by sandy ridges trending NW-SE in direction of alignment.

Topography--A NW-SE trending Carolina bay, Big Cypress Bay contains a series of irregularly shaped, moderately steep-walled depressions which are believed to be doline ponds resulting from subsurface solution of underlying limestone deposits, followed by a subsequent slumping of the surface area above the solution cavity. The Big Cypress Bay basin is surrounded by a series of sandy ridges extending in a general NW-SE direction; relief from the pond basin area to adjacent ridgecrests ranges to approximately 10m.

Geology--The surficial sediments are marine-deposited sands and clays of the Pamlico Terrace of Pleistocene age, overlying the Castle Hayne Limestone of Eocene age.

- Soils--(1) Lakeland series: a thermic, coated Typic Quartzipsamment; occupies the coarsest sandy upland ridges bordering Big Cypress Bay; longleaf pine/turkey oak/wiregrass community type.
- (2) Kureb series: a thermic, uncoated Spodic Quartzipsamment; occupies majority of the medium to fine-textured sandy upland areas surrounding Big Cypress Bay; pine flatwoods community.
- (3) Leon series: a sandy, siliceous, thermic Aeric Haplaquod; occupies bay--upland ridge interface; pine/mixed evergreen and deciduous shrubs, or mixed evergreen shrubs community types.
- (4) Murville series: a sandy, siliceous, thermic Typic Haplaquod; occupies bay interior and pond areas; pine/mixed evergreen and deciduous shrubs//laurel leaf sawbrier, mixed evergreen and deciduous shrubs, and pond cypress/mixed forbs and graminoids community types.

Rare plants and animals:

Litsea aestivalis. Pondspice. Endangered peripheral. Occurs in bay rim area adjacent to small ephemeral pond.

Alligator mississippiensis. American alligator. Endangered. Reportedly breeds at numerous localities within the Big Cypress Bay pond complex.

Anhinga anhinga. Water turkey. Threatened. Sighted regularly at both NW and SE pond areas. Reported to breed in the more isolated interior bay areas.

Haliaeetus leucocephalus. Bald eagle. Endangered. A nest of this species was reported for this area in 1972, although no adults were observed at that time. Believed possible that an osprey nest was mistaken for the nest of this species.

Pandion haliaetus. Osprey. Special concern. Breeds regularly at several locations within the Big Cypress Bay.

Sciurus niger. Southern fox squirrel. Special concern. Reported to occur occasionally within the refugia offered by the relatively impenetrable bay interior.

Publications and scientific references:

Blankenship, R.R. 1965. Reconnaissance of the ground-water resources of the Southport-Elizabethtown area, North Carolina. N.C. Dept. Water Res., Div. Ground Water, Ground-Water Bul. No. 6. 47 pp.

Daniels, R.B., et. al. 1978. Age of soil landscapes in the coastal plain area of North Carolina. Soil Sci. Soc. Am. J. 42: 98-105.

Radford, A.E., et. al. 1964. Manual of the Vascular Flora of the Carolinas. UNC Press. Chapel Hill, N.C. 1183 pp.

Site ecological significance:

The ecologically significant aspects of the Big Cypress Bay area are summarized:

- 1) The site constitutes one of a very few remaining relatively undisturbed limesink complexes, here located within an apparent Carolina bay.
- 2) The occurrence within the inner ponds of the bay of several groups of mature, probably untimbered stands of pond cypress (Taxodium ascendens), with scattered very large individuals.
- 3) The occurrence of the endangered peripheral shrub, pondspice (Litsea aestivalis), within the bay.
- 4) The importance of the site as a minor rookery for the great blue heron (Ardea herodias), and as a nesting area for several other species of birds, including osprey (Pandion haliaetus), a species of special concern, reportedly, water turkeys (Anhinga anhinga), and possibly at one time, the bald eagle (Haliaeetus leucocephalus), an endangered species.
- 4) Probable breeding of the endangered American alligator (Alligator mississippiensis) within the bay--pond complex.
- 5) Use of the bay interior, possibly as a refugia against outside hunting and/or habitat destruction pressures, by the Southern fox squirrel (Sciurus niger), an animal species of special concern.

Management recommendations:

The following "management" recommendations are offered to assist in determining the ultimate significance of the Big Cypress Bay area, and to aid in maintaining the integrity of its associated plant and animal assemblages at their present population condition and level:

- 1) Future encroachment of "timbering" operations upon the interior of the bay should be halted, with the currently existing buffer area surrounding the ponds maintained.

- 2) A thorough ground, water, and if possible, aerial survey of the pond network within the interior of the bay is recommended in order to determine the actual extent and composition of species usage of the bay--pond complex as a nesting area for different species of birds.
- 3) Restrictions on the usage of the area for fishing and other breeding season activities within the bay area should be imposed, if mandated, based on the findings of the suggested nesting survey. In addition, scheduling of future heavy equipment activities in the upland areas adjacent to the bay should be encouraged for the non-breeding season.
- 4) A determination of the extent of usage of the pond areas as an area of breeding habitat for the American alligator should be undertaken if possible, in order to help establish the eventual balance of human activity--exclusive wildlife usage of the Big Cypress Bay area that is appropriate for maintaining the natural integrity of the bay as prime wildlife habitat.

FLORA SPECIES LIST

Big Cypress Bay:

Southeastern bay area pond communities:

Trees:

Nyssa sylvatica var. *biflora*
Taxodium ascendens

Transgressives:

*Acer rubrum**
*Liquidambar styraciflua**

Shrubs:

Cephalanthus occidentalis
*Cyrilla racemiflora**
Decodon verticillatus
Ilex cassine
I. cassine var. *myrtifolia**
*I. glabra**
*Itea virginica**
*Lyonia ligustrina**
*L. lucida**
*Myrica cerifera**
Persea borbonia
Rubus sp.*
Vaccinium atrococcum

Herbs:

Forbs--

*Bidens discoides**
Diodea virginiana
Eleocharis melanocarpa
Habenaria repens
Hydrocotyle umbellata
Hypericum tubulosum
H. virginicum
Lachnanthes caroliniana
Lemna valvidiana
Ludwigia decurrens
Lycopus rubellus var. *angustifolius*
Nymphaea odorata
Nymphoides aquatica
Polygonum persicaria
Proserpinaca pectinata
Rhexia mariana
*Solidago fistulosa**
Utricularia purpurea
Xyris caroliniana
X. jupicai

Graminoids--

Cyperus erythrorhizos
Erianthus sp.
Hydrochloa caroliniensis
Panicum hemitonum

*These species primarily rooted and growing on cypress trunks and stumps.

Ferns and fern allies--

Panicum verrucosum
Sacciolepis striata
*Woodwardia areolata**
W. virginica

Vines:

*Rhus radicans**
*Smilax sp.**

Outlying pond communities:

Trees:

Nyssa sylvatica var. *biflora*
Taxodium ascendens

Transgressives:

Liquidambar styraciflua
Persea borbonia
Pinus taeda

Shrubs:

Ilex cassine
Litsea aestivalis
Lyonia lucida
Myrica cerifera
Vaccinium atrococcum
Viburnum nudum

Herbs:

Forbs--

Centella asiatica
Drosera intermedia
Eupatorium capillifolium
E. recurvans
Eupatorium sp.
Hypericum cistifolium
H. tubulosum
H. virginicum
Lachnocaulon minus
Lobelia nuttallii
Ludwigia bonariensis
Lycopodium rubellus var. *angustifolius*
Nymphaea odorata
Oldenlandia uniflora
Pluchea foetida
Rhexia mariana
Solidago sp.
Xyris jupicai

Graminoids--

Andropogon virginicus
Panicum verrucosum
Panicum sp.
Rhynchospora fascicularis
Sacciolepis striata

Big Cypress Bay

Figure 7. Big Cypress Bay

Name of area: Big Island Savannah

County: Brunswick

Location description: 5.7 miles north of Supply on the west side of highway NC 211.

Size: Approximately 50 acres (2 savannah areas)

Elevation: 18.3 m (60 ft.) above sea level.

Topographic quad map reference: Supply 1:31680 (map attached)

Ownership information: Federal Paperboard, Inc.
Bolton, N.C. 28423

Report prepared by: Timothy D. Nifong
Box 29, Coker Hall
Dept. of Botany, UNC
Chapel Hill, N.C. 27514

Edgar P. Roberts, Jr.
2710 Bartram Rd.
Winston-Salem, N.C. 27106

Other persons knowledgeable about site:

- 1) Joan Wolf
Dept. of Botany, UNC
Chapel Hill, N.C. 27514
- 2) Dr. Robert K. Peet
Dept. of Botany, UNC
Chapel Hill, N.C. 27514

Current use and protection status:

At the present time there is no known usage of the Big Island Savannah area of the Green Swamp. The scattered longleaf pine (Pinus palustris) canopy consists of widely spaced, relatively immature individual trees (average age is approximately 35 years) which are not of marketable size for timber. It is probable that the tract is too small and the trees too few to make harvesting of the area for pulpwood economically feasible.

Threats to the tract appear to be indirect, rather than direct, in nature. For instance, the pocosin vegetational community which borders the savannah on three sides, more or less, has recently been ditched in an apparent effort to drain the area and render it suitable for future tree planting activities. Because the Big Island Savannah is a wet savannah, with many mesic to semi-hydric plant species present, such drainage activities constitute a potentially serious threat to the future well-being and survival of certain characteristic species. In addition, it is probable that subsequent draining and/or clearing efforts in the adjacent pocosin community could inadvertently have a seriously damaging effect on the outer fringe of the savannah area, allowing invasion of the savannah by less than desirable weedy species.

The high species diversity and unique species assemblage of this area indicate that the savannah has undergone little or none of the man-caused disruption that often accompanies timber planting, maintenance, and harvest. In addition, the diversity characteristics of the savannah community present, coupled with charred tree trunks and other evidences of fire, indicate that the area has been burned frequently--probably annually or semi-annually--for

an extensive period of time.

Vegetation and plant communities:

The Big Island Savannah Natural Area is characterized by two principal plant communities, presumably due to the differences in depth to the soil water table associated with different soil types, and thus edaphic properties. A longleaf pine savannah community dominates the majority of the area in two separate plots, which are separated by and each bordered on three sides by a pond pine (Pinus serotina) pocosin.

A discussion of the community types follows:

- 1) Longleaf pine savannah. Pinus palustris/Aristida stricta--Mixed herbs. The very open canopy of this area is dominated exclusively by longleaf pine. While no subcanopy or shrub layer is present, characteristic pocosin shrubs, such as sweet bay (Magnolia virginiana) and red bay (Persea borbonia) occur as scattered individuals from root sprouts. The herb layer comprises a mixture of wiregrass (Aristida stricta), orange grass (Ctenium aromaticum), and other perennial graminoids and forbs too varied and too numerous to mention (see accompanying Flora Species List). It is as Wells (1932) so adequately expressed: "(here) Nature attains...her fullest, and most varied expression of loveliness in the form of wild flowers." From late winter until late fall, a continuous progression of bright and varied colors unfolds across the savannah, bordered by the deep greens of the pocosin shrubs, rendering this one of the most purely beautiful natural areas imaginable from an aesthetic point of view.
At various locations within the savannah community, usually in areas proximal to the savannah--pocosin ecotone, the mixed graminoids groundcover is somewhat displaced by giant cane (Arundinaria gigantea), which assumes dominance or codominance of the herbaceous layer.
- 2) Pond pine pocosin. Pinus serotina/Mixed evergreen shrubs//Smilax laurifolia. The open canopy of this area is dominated by pond pine, with an occasional pond cypress (Taxodium ascendens) or black gum (Nyssa sylvatica var. biflora) occurring as a canopy-sized tree. Scattered Atlantic white cedar (Chamaecyparis thycoides), loblolly bay (Gordonia lasianthus), and large transgressive red maples (Acer rubrum) occur as a highly localized subcanopy layer. The very dense shrub layer is dominated by titi (Cyrilla racemiflora) and staggerbush (Lyonia lucida) in association with other characteristic evergreen pocosin shrub species, with the deciduous white alder (Clethra alnifolia) occurring along the margins of the pocosin. The dense undergrowth is "tied together" by a tangling growth of laurel-leaved sawbrier (Smilax laurifolia), forming a nearly impenetrable thicket. Few herbs can successfully compete with the evergreen pocosin shrubs for the limited resources available, at least for any extensive period of time, and few herbs were noted. An exception was one or more of the species of pitcher plant (Sarracenia sp.), which were found within the pocosin community, and are known to sometimes exist for many years as suppressed individuals in pocosin areas that once existed as open shrub bogs or as wet savannah areas prior to the institution of a large degree of fire protection.

Physical features:

General description--The Big Island Savannah lies in an extensive flat, poorly-drained portion of the Green Swamp, and is thus relatively wet for much of the year.

Topography--The area is exceedingly flat, with relief in the area probably totalling much less than 1 m; however, seemingly insignificant changes in topography may result in marked differences in soil series, and thus, vegetational communities.

Geology--The surficial sediments are marine-deposited sands and clays of the Talbot Terrace of Pleistocene age, overlying the Peedee Formation of Late Cretaceous age.

Rare plants and animals:

Agalinis aphylla. Scale leaf gerardia. Endangered peripheral.

Coreopsis gladiata. Swamp tickweed. Endangered peripheral.

Dionaea muscipula. Venus' flytrap. Threatened endemic; exploited.
A huge population exists here, consisting of many thousands of individuals.

Habenaria integra. Yellow fringeless-orchid. Threatened throughout.
A large population, probably consisting of in excess of one hundred individuals, exists on the savannah.

Rhynchospora breviseta. Short-bristled beak rush. Endangered peripheral.

Sarracenia rubra. Sweet pitcher plant. Threatened throughout; exploited.

Sporobolus teretifolius. Wireleaf dropseed. Threatened throughout.

Publications and scientific references:

Blankenship, R.R. 1965. Reconnaissance of the ground-water resources of the Southport--Elizabethtown area, North Carolina. N.C. Dept. Water Res., Div. Ground Water, Ground-Water Bul. No. 6: 47 pp.

Daniels, R.B., et. al. 1978. Age of soil landscapes in the coastal plain of North Carolina. Soil Sci. Soc. Am. J. 42: 98-105.

Kologiski, R.L. 1977. The phytosociology of the Green Swamp, North Carolina. N.C. Ag. Expt. Sta., Tech. Bul. No. 250. Raleigh, N.C.

Radford, A.E., et. al. 1964. Manual of the Vascular Flora of the Carolinas. UNC Press. Chapel Hill, N.C. 1183 pp.

Site ecological significance:

The ecologically significant features of the Big Island Savannah are summarized:

- 1) Occurrence of a highly unique, exceptionally high-diversity assemblage of species which has evolved into its present condition over an extensive period of time, and which is unknown to exist elsewhere (see attached copy of letter to N.C. Nature Conservancy).
- 2) Presence of a now unusual community type with a savannah-like aspect--Pinus palustris/Aristida stricta-Mixed herbs--a vegetation type which has all but disappeared with modern fire "protection."
- 3) Occurrence of an extremely large population of the commercially-exploited threatened endemic insectivorous species, Venus' flytrap (Dionaea muscipula).
- 4) Presence of a large population of yellow fringeless-orchid (Habenaria integra), threatened throughout its range.
- 5) Occurrence of scale leaf gerardia (Agalinis aphylla), an endangered peripheral species.
- 6) Presence of swamp tickweed (Coreopsis gladiata), an endangered peripheral species.
- 7) Presence of the short-bristled beak rush (Rhynchospora breviseta), an endangered peripheral species.
- 8) Occurrence of the sweet pitcher plant (Sarracenia rubra), a commercially-exploited insectivorous species which is threatened throughout its range.
- 9) Presence of a population of wireleaf dropseed (Sporobolus teretifolius), a perennial grass which is threatened throughout its range.

Management recommendations:

The following guidelines are viewed as essential to maintaining the Big Island Savannah in its natural state:

- 1) All vehicular traffic into the savannah itself or through a buffer area of yet to be determined, but appropriate, size should be prohibited under any circumstances; in addition, foot traffic through the savannah should be regulated to preclude soil compaction or other resultant damage which might over time alter portions of the savannah edaphic properties, and thus vegetation.
- 2) The sharp ecotonal interface area that occurs at the juncture of the savannah and pocosin communities is, based on field observation, and important wildlife usage area, and should be maintained, i.e., the pocosin buffer zone surrounding the savannah is extremely important, both from a wildlife usage and from a savannah protection standpoint, and should be maintained in its present condition.
- 3) The savannah area should be closely monitored to note at earliest occurrence any possible effects that the adjacent pocosin-draining ditches might possibly have on water relations in the moist savannah area; it is quite possible that the long term effects of this drainage may be such that a refilling of the ditches will be mandated in an attempt to restore as nearly as possible the original water table conditions within the area.
- 4) The savannah areas should be burned at least semi-annually, and the adjoining pocosin burned somewhat less frequently, in order to maintain the community species assemblages in their present condition.
- 5) The area should be given some kind of protection against removal of

certain of its unique species should public awareness of savannah increase to the point where such removal becomes a problem. A flourishing export business exploiting native populations of the Venus' flytrap (Dionaea muscipula) is known to exist in the area, with Brunswick County serving as a primary source area for the fly-trap, as well as some other characteristic savannah species.

FLORA SPECIES LIST*

Longleaf pine savannah:

Trees:	<i>Pinus palustris</i>
Shrubs:	<i>Gaylussacia frondosa</i> <i>Ilex coriacea</i> <i>I. glabra</i> <i>Magnolia virginiana</i> <i>Myrica cerifera</i> <i>M. heterophylla</i> <i>Persea borbonia</i> <i>Sorbus arbutifolia</i>
Subshrubs:	<i>Vaccinium crassifolium</i>
Transgressives:	<i>Acer rubrum</i> <i>Nyssa sylvatica</i> var. <i>biflora</i>
Herbs:	
Forbs--	<i>Agalinis aphylla</i> <i>A. obtusifolia</i> <i>Aletris farinosa</i> <i>Amorpha herbacea</i> <i>Asclepias lanceolata</i> <i>Aster paludosus</i> <i>A. pilosus</i> <i>A. squarrosus</i> <i>A. undulatus</i> <i>Balduina uniflora</i> <i>Baptisia tinctoria</i> <i>Calopogon barbatus</i> <i>C. pallida</i> <i>C. pulchellus</i> <i>Carduus virginiana</i> <i>Carphephorus tomentosus</i> <i>Chaptalia tomentosa</i> <i>Chondrophora nudata</i> <i>Cleistes divaricata</i> <i>Coreopsis gladiata</i> <i>Cuscuta</i> sp. <i>Desmodium tenuifolium</i> <i>Dionaea muscipula</i> <i>Drosera capillaris</i> <i>Elephantopus nudatus</i> <i>Erigeron vernus</i> <i>Eriocaulon compressum</i> <i>E. decangulare</i> <i>Eryngium integrifolium</i> <i>Eupatorium leucolepsis</i> <i>E. recurvans</i>

* Much thanks is expressed to Joan Wolf, who provided the bulk of the following species list.

Eupatorium rotundifolium
 Euphorbia curtisii
 Habenaria blephariglottis
 H. ciliaris
 H. cristata
 H. integra
 Helianthus angustifolius
 H. heterophyllus
 Heterotheca graminifolia
 Hypericum reductum
 H. stans
 Hypoxis hirsuta
 H. micrantha
 Lachnanthes caroliniana
 Lachnocaulon anceps
 Lespedeza capitata
 Liatris graminifolia
 Oxypolis ternata
 O. filiformis
 Pinguicula caerulea
 P. lutea
 Pleea tenuifolia
 Pogonia ophioglossoides
 Polygala cruciata
 P. hookeri
 P. lutea
 P. ramosa
 Prenanthes autumnalis
 Proserpinaca pectinata
 Rhexia alifanus
 R. lutea
 R. mariana
 Sabatia difformis
 S. gentianoides
 Sarracenia flava
 S. purpurea
 S. rubra
 Seymeria cassioides
 Sisyrinchium arenicola
 S. mucronata
 Solidago stricta
 Spiranthes praecox
 Tofieldia racemosa
 Trilisa paniculata
 Viola primulifolia
 V. septemloba
 Xyris ambigua
 X. caroliniana
 X. difformis

Graminoids--

Andropogon scoparius
 A. ternarius
 A. virginicus
 Aristida stricta
 A. virgata
 Arundinaria gigantea

Carex verrucosa
Ctenium aromaticum
Dichromena latifolia
Fimbristylis spadicea
Muhlenbergia expansa
Panicum longiligulatum
P. partoriense
P. strigosum
Rhyncospora baldwinii
R. breviseta
R. chapmanii
R. ciliaris
R. fascicularis
R. gracilentia
R. grayi
R. oligantha
R. plumosa
Scleria minor
S. pauciflora
Sporobolus teretifolius

Ferns and fern allies--

Lycopodium alopecuroides
L. appressum
L. carolinianum
Osmunda cinnamomea
O. regalis var. *spectabilis* (?)
Pteridium aquilinum
Woodwardia virginica

Vines:

Smilax glauca
S. laurifolia
S. walteri

Pond pine pocosin:

Trees:

Canopy--

Acer rubrum
Chamaecyparis thyoides
Nyssa sylvatica var. *biflora*
Pinus serotina
Taxodium ascendens

Subcanopy--

Gordonia lasianthus
Persea borbonia

Shrubs:

Clethra alnifolia
Cyrilla racemiflora
Ilex coriacea
I. glabra
Lyonia lucida
Sorbus arbutifolia

Subshrubs:

Vaccinium crassifolium

Herbs:

Forbs--

Sarracenia flava

Ferns and fern allies--

Woodwardia virginica

Vines:

Smilax laurifolia

S. walteri

Mosses:

Sphagnum sp.

Figure 8. Big Island Savannah

Figure 9. Big Island Savannah Community Types

Fauna Species List: Big Island Savannah

Chrysemys scripta - Yellow-bellied pond slider

Clemmys guttata - Spotted turtle

Terrapene carolina - Eastern box turtle

Ophisaurus ventralis - Eastern glass lizard

Aghistrodon contortrix - Southern copperhead

Carphophis amoenus amoenus - Eastern cottonmouth

Rhadinaca flavilata - Pine woods snake

Melanerpes erythrocephalus - Red-headed woodpecker

Bufo americanus - American toad

Bufo terrestris - Southern toad

Hyla cinerea - Green treefrog

Hyla crucifer - Spring peeper

Hyla femoralis - Pine woods treefrog

Hyla squirella - Squirrel tree frog

- Pseudacris nigrata - Southern chorus frog

Pseudacris ornata - Ornate chorus frog

Rana sphenacephala Southern leopard frog

Odocoileus virginianus - Whitetail deer

Reithrodontomys humilis - Eastern harvest rat

Scalopus aquaticus - Eastern mole

Sciurus carolinensis - Eastern gray squirrel

Sylvilagus floridanus - Eastern cottontail

Name of area: Blue Pond Complex

County: Brunswick

Location description:

- 1) Blue Pond--Blue Pond is reached by travelling 10.3 miles south on NC 133 from the junction of US 17--NC 133, to S.R. 1521 (dirt road); then right on S.R. 1521 1.35 miles to entrance gate to McKenzie Pond-Orton Wildlife Area access road; left (south) onto access road and continue 0.9 miles to gate at fork in road; continue 0.2 miles past gate to fork in road; Blue Pond is approximately 200 yards north on right-hand fork.
- 2) Little Blue Pond--Proceed to S.R. 1521 as above; travel 2.9 miles west on S.R. 1521 to dirt jeep trail; turn right (north) onto jeep trail and travel north 0.9 miles, where trail branches right; proceed east 0.2 miles along trail--Little Blue Pond is 21 yards northwest of trail.
- 3) Black Pond--Follow directions to Little Blue Pond as above; proceed approximately 0.15 miles on forest trail past Little Blue Pond; Black Pond is about 75 yards north of the trail, just over the crest of a sandy ridge.

Elevation:

- 1) Blue Pond--6.1-7.6m (20-25 ft.) above sea level.
- 2) Little Blue Pond, Black Pond--13.7-15.2m (45-50 ft.) above sea level.

Topographic quad map reference: Carolina Beach 1:24000 (map attached).

Ownership information:

- 1) Blue Pond-- Kenneth M. Sprunt
1726 Fairway Dr. or Orton Plantation
Wilmington, N.C. 28403 Clarendon, N.C. 28432
- 2) Little Blue Pond-- International Paper Co.
4354 Market St.
Wilmington, N.C. 28401
- 3) Black Pond-- International Paper Co.
4354 Market St.
Wilmington, N.C. 28401

Report prepared by: Timothy D. Nifong
Box 29, Coker Hall
Dept. of Botany, UNC
Chapel Hill, N.C. 27514

Other persons knowledgeable about sites: Joseph Newman
Cape Fear Dr.
Southport, N.C. 28461

Current use and protection status:

Blue Pond:

Blue Pond lies in the northwestern portion of the Orton Wildlife Management Area, and though privately owned is hence administered by the N.C. Wildlife Resources Commission. Although the public access road to the pond itself is blocked off, Blue Pond is still presumably open to fishing activities between the months of March and October. From October through March, the Wildlife Area is closed to the public and is used privately for hunting, primarily of ducks. Because the Orton Wildlife Management Area is neither well marked nor highly publicized, relatively few persons know or use the area to any great extent, and human impact has been relatively minimal.

An area to the west of Blue Pond shows evidence of having been clear cut or of some similar disturbance in recent years, though a buffer area between the disturbed plot and Blue Pond was left intact, and hence the overall effects of the disturbance appears to have been of no real consequence.

Greatly increased usage of the Blue Pond area by the public at large could have a number of detrimental effects upon the biota. The present amount of vehicular and/or foot traffic has largely destroyed the natural vegetational zonation of the southeast rim of the pond, and further damage of the relatively fragile rim ecosystem could be expected to increase proportional to any increase in the flow of traffic. In addition, excessive or constant fishing activities during the spring and early summer could cause the osprey (Pandion haliaetus) nesting there to abandon the site.

Little Blue Pond:

Little Blue Pond is currently subject to some hunting usage during duck and deer seasons with ^{no} apparent impact to the area. The pines which surround the western rim of the pools have been harvested, and the area subsequently cleared and replanted within the last decade, with relatively minimal effects to the pond. In addition, some cutting of the pond cypresses (Taxodium ascendens) surrounding the pond has occurred within the last few years for no apparent reason, with the intact logs remaining in place.

The area surrounding the pond is still relatively remote, and no immediate threats to the pond vegetational communities are apparent.

Black Pond:

Black Pond is subject to hunting usage similar to that of Little Blue Pond, with little lasting effect on the area. In this instance also, about one half of the pond is surrounded by an upland area which has recently been harvested, cleared, and replanted in pines. However, the pocosin community zone surrounding Black Pond is much wider (approximately 7 to 10 m) than that surrounding Little Blue Pond, and is nearly impenetrable around much of the rim, making this pond much less readily accessible than either Blue Pond or Little Blue Pond.

Vegetation and plant communities:

Discussion of vegetational communities will focus primarily on Blue Pond. Both Little Blue Pond and Black Pond were discovered too late in the course of the field work to allow a thorough sampling of the site; they were located in an attempt to identify ponds similar in nature to Blue Pond, using available aerial photography of the surrounding area.

Blue Pond:

The vegetation surrounding Blue Pond is divisible into a series of more or less concentric zones (see accompanying diagram) each of which may be termed a separate plant community in the sense of a distinct vegetational unit. The zones largely appear to correspond to a change in elevation (and thus hydroperiod) in moving up the slope. However, because the slope of the rim area is not constant in circling the pond, some zones are prolonged or extended outward at various locations, while other zones may be absent at that point. At its northeast corner, a blackwater stream drains into the pond from an adjacent pocosin area, allowing the intrusion of a pocosin type community into the normal pond vegetation. In addition, the upland vegetation types surrounding the pond differed substantially from the northeast to the southwest pond rim areas, as will be discussed more fully in the following section. Ten "communities" and/or zones are differentiated, eight of which are numbered to correspond to the zones listed beside each species in the accompanying Flora Species List.

- 0) Open water. The central portion of the pond consists of open water--Blue Pond is an acid blackwater pond--with no aquatic vegetation whatever encountered. The water level of the pond in late July was down approximately 45.7 cm (18 in.) from the seasonal (winter) high water mark.
- 1) Taxodium ascendens. An open canopy of large pond cypress (Taxodium ascendens) rings the pond to form a zone approximately 6 m in width. The average dbh (diameter at breast height) of the trees was 45.7 cm (18 in.) with the buttressed portion of several individual trees exceeding 2 m at water level. Although no trees were aged in this stand, it is clear by comparison with other areas that this is a mature stand of relatively old, if somewhat stunted pond cypress.
- 2) Litsea aestivalis/Sphagnum sp. A zone averaging about 15 m in width occurs next in the outward sequence of vegetation rings, characterized by a thick mat of sphagnum moss. The zone is normally flooded during periods of high water on the pond. Almost completely encircling the pond is a large population of pondspice (Litsea aestivalis) in a band ranging from 3 to 13 m in width. Pondspice is almost exclusively limited to occurrence in the sphagnum mat, possibly in relation to its requirement of the moss mat as an appropriate moisture-buffering nursery bed for pondspice seedlings. Three-ranked cane (Dulichium arundinaceum) occurs sporadically in the outer fringe of the sphagnum zone.
- 3) Mixed herbs. An open, savannah-like ecotonal area 5 to 10 m in width serves as a break between the tall zone of pondspice and the zone dominated by live oak (Quercus virginiana) which occurs immediately adjacent outwards from the ecotonal area. The important species here--panic grass (Panicum sp.), beak rush (Rhynchospora sp.), redroot (Lachnanthes caroliniana), meadow beauty (Rhexia mariana), and others--are relatively characteristic doline pond, or "sink," species for the region. The species are not mixed randomly within this zone, but are actually distributed fairly predictably, presumably according to hydroperiod, in "zones" within the larger zone.
- 4) Quercus virginiana/Mixed transgressives. Live oak--averaging approximately 30.5 cm (12 in.) dbh, with a recently dead live oak having a dbh of 114 cm (45 in.) and an adjacent living oak having a dbh of 99 cm (39 in.)--dominates the fairly closed canopy of this zone, or community, often in association with loblolly pine (Pinus taeda) or sweetgum (Liquidambar styraciflua), and occasionally in conjunction with black gum (Nyssa sylvatica var. biflora) and swamp

Figure 10. Blue Pond Plant Assemblages
BLUE POND

(Scattered evergreen
shrubs)/Woodwardia
virginica/Sphagnum
sp.

Open water

← Taxodium ascendens

↖ Cyrilla racemiflora--Lyonia lucida//Smilax laurifolia

Figure 11. Black Pond Plant
Assemblages

BLACK POND

Area recently cleared and
replanted in pines

Zone:

1
2
3
4
5

Pool 1:

Acer rubrum (D,E)
Andropogon virginicus (B)
Cyrilla racemiflora (D)
Drosera capillaris (B)
D. intermedia (B)
Dulichium arundinaceum (B)
Eleocharis sp. (A,B)
Eriocaulon sp. (E)
Ilex cassine var. *myrtifolia* (C)
Juncus sp. (B)
Lachnanthes caroliniana (B)
Litsea aestivalis (C)
Liquidambar styraciflua (E)
Lyonia lucida (D)
Nyssa sylvatica var. *biflora* (D,E)
Panicum sp. (B)
Panicum sp. (#2) (B)
Persea borbonia (D)
Pinus palustris (E--outer fringe)
P. taeda (E)
Polygala cymosa (B)
Quercus nigra (E)
Q. virginiana (D)
Rhexia mariana (B)
Rhynchospora fascicularis (B)
R. sp. (B)
Sacciolepis striata (B)
Smilax laurifolia (C,D)
Sphagnum sp. (A-C)
Taxodium ascendens (A)
Tillandsia usneoides (throughout)
Unidentified composite (B)

Carex verrucosa (2)
Cyrilla racemiflora (4)
Drosera intermedia (2,3)
Dulichium arundinaceum (2)
Ilex cassine (3)
I. cassine var. *myrtifolia* (3)
I. glabra (4)
Iris tridentata (2,3)
Lachnanthes caroliniana (2)
Liquidambar styraciflua (5)
Litsea aestivalis (3)
Lyonia lucida (4)
Nyssa sylvatica var. *biflora* (4)
Persea borbonia (4)
Pinus taeda (5)
Rhynchospora fascicularis (2)
R. sp. (2)
Sacciolepis striata (2)
Smilax laurifolia (3,4)
S. walteri (3,4)
Sphagnum sp. (1-3)
Taxodium ascendens (1)
Tillandsia usneoides (throughout)
Utricularia purpurea (1)
Vaccinium corymbosum (3,4)
Woodwardia virginica (2,3)
Xyris fimbriata (2,3)

Open water

Zone:

A
B
C
D
E

LITTLE BLUE POND

Figure 12. Little Blue Pond Plant
Assemblages

oak (Quercus hemisphaerica). Transgressives of these species mixed with scattered ericaceous shrubs form the understory layer within this zone. There is little herbaceous groundcover here. This is the last of the zones discussed that completely encircles the pond. It extends outward for approximately 4 m at the southern, constantly upsloping portion of the pond rim area, but extends outward as much as 30 or 40 m in the western rim portion, where a flat to slightly downsloping topography prevails upon reaching the elevational level of the live oak zone; this zone also extends outwards in a few other rim areas.

- 5) Quercus velutina/Vaccinium arboreum. This is a narrow zone in the southern, constantly upsloping portion of the rim. The canopy is dominated primarily by black oak (Quercus velutina) ranging up to 45.7 cm (18 in.) dbh, with an open shrub layer of large individuals of sparkleberry (Vaccinium arboreum).
- 6) Pinus taeda/Mixed oaks/Myrica cerifera. Again, this zone occurs primarily in the southern rim area. The canopy is dominated by loblolly pine averaging approximately 30.5 cm (12 in.) dbh, occasionally in conjunction with water oak (Quercus nigra). The subcanopy layer comprises a mixture of oaks, including dwarf post oak (Quercus margaretta), black oak, and towards the upper end of the zone, turkey oak (Quercus laevis). In addition, mockernut hickory (Carya tomentosa) assume importance in the understory in moving westward along the zone. Wax myrtle (Myrica cerifera) forms a low shrub layer, with few herbs occurring in the zone.
- 7) Pinus palustris/Mixed oaks/Aristida stricta. Towards the eastern portions of the pond rim, and in the northern rim area (following an outward extension of zone 4), the preceding loblolly pine/mixed oak zone grades into an upland community fairly typical of the surrounding area, characterized by an open canopy of longleaf pine (Pinus palustris), an understory layer composed of mixed oaks--turkey oak, dwarf post oak, and scrub live oak (Quercus geminata)--with an herbaceous layer dominated by wire grass (Aristida stricta).
- 8) Pinus serotina/Cyrilla racemiflora-Lyonia lucida/Smilax laurifolia. In the northeastern portion of Blue Pond, the small stream that enters from the adjacent pocosin provides a small area of habitat along the pond rim for a "typical" pocosin community. The canopy of this vegetational community is dominated by pond pine (Pinus serotina) in conjunction with an occasional pond cypress, underlain by a dense shrub layer dominated by titi (Cyrilla racemiflora), staggerbush (Lyonia lucida), and other typical evergreen bog shrubs, all intertwined by a tangle of sawbriars (Smilax sp.). It is interesting to note that the pondspice population extends along the stream and fairly deeply into the adjacent pocosin.
- 9) Quercus sp./Carya tomentosa--Mixed transgressives/Vaccinium sp. Although it was not sampled, an oak-hickory community extended along the upper rim portion and across the adjacent uplands at the southern end of Blue Pond. The closed canopy appeared to be largely dominated by black oak and southern red oak (Quercus falcata), underlain by a relatively dense subcanopy of mixed oak transgressives and mockernut hickory, with a scattered shrub layer dominated by various ericaceous species.

It should be noted in addition, for each of the above communities or zones listed, that the importance of the past role of fire in the maintenance of--and ultimate species composition of--the area was clearly

evidenced by the clumped arrangement of the oak trunks and of many of the shrub species stems, and by the charred remains of many stumps, including several large cypress stumps within the pond, 6 or 7 m in from shore.

Little Blue Pond:

An accompanying sketch of species presence, as well as species zonation and community distribution, is provided for the two pools at Little Blue Pond. Species assemblages in the two pools, separated by only 5 or 6 m during this period of low water in the pond (down an estimated 61 cm (24 in.) from the seasonal high water table), was strikingly different.

Black Pond:

A rough sketch of species distribution in and around Black Pond is provided, although it was discovered so late in the course of the field work, and its rim area proved to be so impenetrable as to hinder access to the interior, that it was not sampled. Rather, it was simply visited, with field notes made of the vegetational communities present.

Physical description:

General description--

- 1) Blue Pond is bordered by a series of hills and sandy ridges which support either an upland longleaf pine or upland oak--hickory community, while live oak--loblolly pine flats border the NE and SW portions of the pond rim.
- 2) Little Blue Pond lies on the western slope of a NW-SE trending ridge, and is entirely surrounded by a longleaf pine sandhills type community.
- 3) Black Pond lies near the summit on the N side of a NE-SW trending ridge, and is bordered on all sides by a longleaf pine sandhills community type.

Topography--The Blue Pond complex consists of four (Little Blue Pond is made up of two pools which are joined in times of high water) irregularly shaped, shallow depressions with gently sloping walls, which are thought to be doline ponds resulting from subsurface solution of the underlying Castle Hayne Limestone and subsequent slumping of the surface area above the solution cavity. The ponds are each surrounded by a series of mostly NE-SW trending, moderately sloping sandy ridges.

Geology--The surficial sediments are marine-deposited sands and clays of the Pamlico Terrace of Pleistocene age, overlying the Castle Hayne Limestone of Eocene age.

Rare plants and animals:

Litsea aestivalis (Pondspice): Endangered peripheral. The Blue Pond site comprises a huge population of pondspice--possibly the largest in North Carolina--of 200 to 300 individuals. The population is extremely robust and healthy, with individual plants ranging in height from 2 to 6m, and most mature individuals heavily fruited. Seedling reproduction in the area appears to be excellent.

The Little Blue Pond population of pondspice contains several dozen smaller, but healthy individuals.

Neotoma floridana (Eastern wood rat): Special concern. Breeds in surrounding upland areas.

Pandion haliaetus (Osprey): Special concern. Breeds in Blue Pond. One nest observed.

Sciurus niger (Fox squirrel): Breeds in mature longleaf pine uplands surrounding pond areas.

Publications and scientific references:

Blankenship, R.R. 1965. Reconnaissance of the ground-water resources of the Southport--Elizabethtown area, North Carolina. N.C. Dept. Water Res., Div., Ground Water, Ground-Water Bul. No. 6. 47 pp.

Daniels, R.B., et. al. 1978. Age of soil landscapes in the coastal plain of North Carolina. Soil Sci. Soc. Am. J. 42: 99-105.

Radford, A.E., et. al. 1964. Manual of the Vascular Flora of the Carolinas. UNC Press. Chapel Hill, N.C.

Site ecological significance:

The ecologically significant features of the Blue Pond complex are summarized for each of the three sites individually:

Blue Pond--

- 1) The site constitutes one of the few remaining doline ponds--or sinks--in the area which exists in such a relatively pristine condition.
- 2) Vegetational zonation in the rim area surrounding the pond is pronounced, with little indication of human disturbance.
- 3) The existence of a very large, healthy, reproducing population of the endangered peripheral shrub, pondspice (Litsea aestivalis) surrounding the pond.
- 4) The occurrence of a stand of large and very old--probably never timbered--pond cypress (Taxodium ascendens) fringing the pond.
- 5) The use of Blue Pond as a nest site by osprey (Pandion haliaetus), a bird species of special concern.

Little Blue Pond--

- 1) This site constitutes another doline pond site of excellent quality relative to others in the area, with pronounced zonation of the vegetation surrounding the pools.
- 2) The vegetational differences between the two closely adjacent pools that make up this pond are fairly striking, with no readily observable explanation for the differences, and stand as a good example of the high degree of species and community diversity that often occurs between closely adjacent doline ponds.
- 3) The occurrence of pondspice (Litsea aestivalis) around the rims of both pools.
- 4) The existence of an old growth stand of pond cypress (Taxodium ascendens) (average dbh of the trees was approximately 45.7 cm (18 in.), but one individual tree measured 127 cm (50 in.) dbh; annual rings from a cut stump measuring some 40.6 cm (16 in.) dbh numbered in excess of 115.

Black Pond--

- 1) The primary ecological significance of Black Pond would seem to lie in its stark vegetational contrast, from both a species and community point of view, to Blue Pond and Little Blue Pond, both of to which Black Pond is very similar in terms of location, topography, and relations to surrounding plant communities.
- 2) The existence of an old growth stand of pond cypress, which is rapidly disappearing from the area in mature stand.

Management recommendations:

The following recommendations are viewed as very important in maintaining the Blue Pond complex sites in their present state of excellent quality:

- 1) Exclusion of all vehicular and limitation of foot traffic in the rim areas of all three of the ponds, in order to preserve the vegetational zonation and species assemblages in the fragile rim ecosystem.
- 2) The use of Blue Pond should be further limited during the nesting season of the osprey (Pandion haliaetus), as proves to be necessary.
- 3) Protection of a buffer zone of appropriate width encircling each of the ponds should be undertaken in order to assure their relative isolation from future human activities or other variously caused environmental perturbations in the uplands surrounding the ponds.

- 4) Steps should be taken insofar as possible to assure that any possible drainage and/or other developmental activities in areas surrounding the ponds are minimal, in order to guarantee that the water relations of the ponds are not drastically altered, i.e., to assure that the water table is not lowered enough or drainage patterns redirected so as to cause the ponds to shrink or dry up completely--as has been observed to happen in adjacent coastal areas--thereby drastically affecting future survival of the majority of the pond rim species, which characteristically have hydroperiod-related distributions.
- 5) It is apparent that fire has played an important part in the development and/or maintenance of the pond rim vegetation, although its specific role is unclear; for this reason the area should be monitored with respect to plant communities and natural plant succession, to assure that the threatened and endangered doline pond species, as well as the characteristic sink species assemblages, are not displaced in the course of seral succession under conditions of fire exclusion from the pond rim areas.

3179

Pool 1
Pool 2

Little Blue Pond

Black Pond

BM

Entrance - Original

715 Blue Area

5'

3175

ALLEN

MC KINZIE
POND

ALLIPUT

3174

Figure 13. Blue Pond Complex Access
Map-1

Blue Pond

McKinzie Pond
Marsh

Figure 14. Blue Pond Complex Access
Map-2

FLORA SPECIES LIST

Blue Pond:

Zone Occupied:

Trees:

Canopy--

Liquidambar styraciflua (T*)	4
Nyssa sylvatica var. biflora (T)	4
Pinus serotina	8
P. taeda (T)	4,6
Quercus hemisphaerica (T)	4
Q. nigra (T)	6
Q. velutina (T)	5
Q. virginiana (T)	4
Taxodium ascendens (T)	1,8

Subcanopy--

Cornus florida	6
Ilex opaca	6
Quercus geminata (T)	7
Q. laevis	6,7
Q. margaretta	6,7

Shrubs:

Cyrilla racemiflora	8
Ilex glabra (T)	8
Litsea aestivalis (T)	2
Lyonia lucida (T)	4,8
L. mariana	4
Magnolia virginiana	4,8
Myrica cerifera (T)	6
Persia borbonia (T)	4,8
Vaccinium arboreum (T)	5,6
V. corymbosum (T)	8
V. stamineum (T)	4,6
V. sp.	4

Transgressives:

Acer rubrum	4,8
Carya tomentosa	6
Diospyros virginiana	4,6,7
Pinus palustris	7
Sassafras albidum	6,7

Herbs:

Forbs--

Centella asiatica	3
Drosera capillaris	3
D. intermedia	3
Eleocharis sp.	3
Hypericum cystifolium	3
Lachnanthes caroliniana	3
Lobelia nuttallii	3
Polygala cymosa	3
P. lutea	3,8
Rhexia mariana	3

*T indicates transgressives of that species present, indicating species reproductive success.

	<i>Utricularia biflora</i>	2
	<i>U. subulata</i>	3
	<i>Xyris ambigua</i>	3
	<i>X. sp.</i>	3
Graminoids--	<i>Andropogon virginicus</i>	3
	<i>Aristida stricta</i>	7
	<i>Carex verrucosa</i>	3
	<i>Dulichium arundinaceum</i>	2
	<i>Juncus</i>	3
	<i>Panicum</i>	3
	<i>P.</i>	3
	<i>Rhynchospora ciliaris</i>	3
	<i>R. fascicularis</i>	3
	<i>R. harveyi</i>	3
	<i>R. sp.</i>	3
	<i>Sacciolepis striata</i>	3
Vines:	<i>Gelsium sempervirens</i>	4
	<i>Rhus radicans</i>	4
	<i>Smilax laurifolia</i>	8
	<i>Smilax rotundifolia</i>	5
	<i>Vitis rotundifolia</i>	5
Epiphytes:	<i>Tillandsia usneoides</i>	throughout
Mosses:	<i>Sphagnum sp.</i>	2

Little Blue Pond:

Location: Pool 1 or Pool

Trees:		
Canopy--	<i>Liquidambar styraciflua</i>	1,2
	<i>Nyssa sylvatica var. biflora</i>	1,2
	<i>Pinus palustris</i>	1
	<i>P. taeda</i>	1
	<i>Quercus nigra</i>	1
	<i>Q. virginiana</i>	1
	<i>Taxodium ascendens</i>	1,2
Subcanopy-	<i>Cyrilla racemiflora</i>	1
Shrubs:	<i>Cyrilla racemiflora</i>	1,2
	<i>Ilex cassine</i>	2
	<i>I. cassine var. myrtifolia</i>	1,2
	<i>I. glabra</i>	2
	<i>Litsea aestivalis</i>	1,2
	<i>Lyonia lucida</i>	1,2
	<i>Persea borbonia</i>	1,2
	<i>Vaccinium corymbosum</i>	2
Transgressives:	<i>Acer rubrum</i>	1,2
Herbs:		
Forbs--	<i>Drosera capillaris</i>	1

	<i>Drosera intermedia</i>	1,2
	<i>Eleocharis</i> sp.	1
	<i>Eriocaulon</i> sp.	1
	<i>Iris tridentata</i>	2
	<i>Lachnanthes caroliniana</i>	1,2
	<i>Polygala cymosa</i>	1
	<i>Rhexia mariana</i>	1
	Unidentified composite	1
	<i>Utricularia purpurea</i>	2
	<i>Xyris fimbriata</i>	2
Graminoids--	<i>Andropogon virginicus</i>	1
	<i>Carex verrucosa</i>	2
	<i>Dulichium arundinaceum</i>	1,2
	<i>Juncus</i>	1
	<i>Panicum</i>	1
	P.	1
	<i>Rhynchospora fascicularis</i>	1,2
	R.	1,2
	<i>Sacciolepis striata</i>	1,2
Ferns and fern allies--	<i>Woodwardia virginica</i>	1,2
Vines:	<i>Smilax laurifolia</i>	1,2
	<i>S. walteri</i> (?)	2
Epiphytes:	<i>Tillandsia usneoides</i>	1,2
Mosses:	<i>Sphagnum</i> sp.	1,2
<u>Black Pond:</u>		
Trees:	<i>Nyssa sylvatica</i> var. <i>biflora</i>	
	<i>Taxodium ascendens</i>	
Shrubs:	<i>Clethra alnifolia</i>	
	<i>Cyrilla racemiflora</i>	
	<i>Ilex coriacea</i>	
	<i>I. glabra</i>	
	<i>Lyonia lucida</i>	
	<i>Magnolia virginiana</i>	
	<i>Persea borbonia</i>	
	<i>Quercus geminata</i> (edge)	
	<i>Zenobia pulverulenta</i>	
Herbs:		
Forbs--	<i>Polygala lutea</i>	
Ferns and fern allies--	<i>Woodwardia virginica</i>	
Vines:	<i>Smilax laurifolia</i>	
Epiphytes:	<i>Tillandsia usneoides</i>	
Mosses:	<i>Sphagnum</i> sp.	

Fauna Species List: Blue Pond Complex

Chelydra serpentina - Common snapping turtle
Chrysemys scripta - Yellow-bellied pond slider
Sternotherus odoratus - Slinkpot
Terrapene carolina - Eastern box turtle

Cnemidophorus sexlineatus - Six-lined racerunner
Eumeces fasciatus - Five-lined skink
Eumeces inexpectatus - Southeastern five-lined skink
Eumeces laticeps - Broad-headed skink
Ophisaurus attenuatus - Eastern slender grass lizard

Aghistrodon contortrix - Southern copperhead
Aghistrodon piscivorus - Eastern cotton mouth
Coluber constrictor - Black racer
Elaphe guttata - Corn snake
Elaphe obsoleta - Rat snake
Masticophis flagellum - Eastern coachwhip
Natrix erythrogaster - Red-bellied water snake
Tantilla coronata - Southeastern crowned snake
Thannophis sirtalis sirtalis - Eastern garter snake

Dendrocopus borealis - Red-cockaded woodpecker
Melanerpes erythrocephalus - Red-headed woodpecker

Acris gryllus - Southern cricket frog
Bufo americanus - American toad
Bufo quercicus - Oak toad
Bufo terrestris - Southern toad
Hyla crucifer - Spring peeper
Hyla squirella - Squirrel treefrog
Limnaeodius ocularis - Little grass frog
Pseudacris ornata - Ornate chorus frog
Rana clamitans clamitans - Bronze frog

Didelphis marsupialis - Opossum
Glaucomys volans - Southern flying squirrel
Microtus pennsylvanicus - Meadow vole
Neotoma floridans - Eastern wood rat
Odocoileus virginianus - Whitetail deer
Oryzomys palustris - Eastern rice rat
Reithrodontomys humilis - Eastern harvest mouse
Scalopus aquaticus - Eastern mole
Sciurus carolinensis - Eastern gray squirrel
Sciurus niger - Fox squirrel
Sylvilagus floridanus - Eastern cottontail
Sylvilagus palustris - Marsh rabbit

Name of area: Boiling Springs Lakes Natural Area

County: Brunswick

Location description: The community of Boiling Springs Lakes lies approximately 3.9 miles north of the NC 211--NC 87 junction on highway NC 87. The Boiling Springs Lakes Natural Area encompasses approximately 15 square miles and includes some 98 "natural" ponds (originally there was a slightly greater number of individual ponds, but closely adjacent ponds have been "consolidated" during development of the area in several instances), all lying to the east of highway NC 87 and west of highway NC 133.

Elevation: 7.5 to 18m (25 to 60 ft.) above sea level.

Topographic quad map reference: Funston 1:31680 (map attached).

Ownership information:

1-65 ponds--Boiling Springs Lakes, Inc.
Boiling Springs Lakes, N.C. 28461

2-20 ponds--Kenneth M. Sprunt
1726 Fairway Drive or Orton Plantation
Wilmington, N.C. 28403 Clarendon, N.C. 28432

3-11 ponds--Ownership unknown, possibly International Paper Co.

4- 1 pond--Girl Scouts of America (Pretty Pond)

Report prepared by: Timothy D. Nifong
Box 29, Coker Hall
Dept. of Botany, UNC
Chapel Hill, N.C. 27514

Other persons knowledgeable about site: Edgar P. Roberts, Jr.
2710 Bartram Rd.
Winston-Salem, N.C. 27106

Current use and protection status:

The majority of the acreage in the Boiling Springs Lakes area is included within the confines of the city limits of the town of Boiling Springs Lakes (pop. 245, see map), and is thus administered by the Boiling Springs Lakes, Inc. land development company. Extending on both the east and west sides of highway NC 87, the tract owned by the development company is bordered to the north and northeast by paper company holdings (Weyerhaeuser and International Paper Co.), and to the southeast by Orton Plantation.

The entire tract is marked by a network of paved and unpaved roads and has been subdivided into lots, many of which are either occupied by mobile homes or have houses erected on them. A large artificial lake--Boiling Springs Lake--was created in 1960 at the inception of development in the area, by damming Allen Creek, which drains the entire upland area. In addition to this "primary" body of water, some 65 natural ponds, more or less, constitute the other "lakes" of the developed community. Waterfront lots have proved to be the choicest plots within the subdivision, and the majority of the houses are erected in these areas. While many of the dwellings front the main lake, most of the natural ponds also have one or more dwellings adjacent to them. Many

pond rims are consequently actually a portion of the adjacent landowner's backyard, and several ponds have piers built out into them. Almost all of the ponds, unless they are extremely densely vegetated by aquatics, are used for swimming, and if large enough, for boating.

Many relatively abrupt changes in the natural ponds of the area are apparent. Several of the ponds have been "regraded" during road construction to lessen wall steepness and give an access area for residents, or otherwise disturbed during construction of adjacent roads. The dividing ridges between small pools occurring in clusters have in some cases been excavated to form a single larger pond. In other instances ditches draining surrounding pocosin areas have been channelled into the nearest doline pond. Clear Pond, the largest of the natural ponds within the subdivision, is now connected by a canal to Boiling Springs Lake, which has resulted in enlargement of the pond by raising the depth of the water to a higher level. The pond is now used primarily for recreational purposes, including picnicking, swimming, and boating.

In addition to the more direct physical alteration of the natural ponds, it is increasingly apparent that more indirect, gradual changes are taking place as well in many of the ponds. The water in two of the ponds was noted to have an uncharacteristic greenish color, which often occurs in an area receiving an unusually high nutrient input, such as might occur from seepage from an adjacent septic field. Because of disturbance to the ponds during road construction and similar activities, mowing of rim areas surrounding "populated" ponds, and fairly intense recreational usage, the vegetational zonation so characteristic of these doline ponds in their natural state (presumably related to hydroperiod and natural plant succession) has been altered or has largely disappeared, with many ponds now surrounded almost exclusively by a relatively dense cover of Sacciolepis striata, which has apparently invaded the rim areas in many cases from adjacent roadside ditches and other low areas. Other, more subtle long term changes in the composition of the herbaceous vegetation of the pond rim areas might be predicted because of the probable alteration of groundwater relations in the area due to several sources, including the drainage of adjacent pocosin areas, impoundment of the primary natural drainage system within the area (Allen Creek), and the increased groundwater consumption via private wells that is accompanying the gradually increasing resident population.

The surrounding vegetational communities within the area might also be expected to gradually change over time, due primarily to the exclusion of fires from the area, because the pine (Pinus sp.) dominated vegetational communities which cover the tract are all dependent upon fire for their maintenance and perpetuation. In addition, as the area continues to grow, increased construction and drainage activity can be expected to produce further gradual, as well as immediate, changes in the vegetation.

With the exception of a few of the largest ponds occurring on the adjacent Orton property, the natural ponds on the Orton tract lie in an upland, long-leaf pine (Pinus palustris) dominated area, much of which was either timbered during the past spring, or in recent years. The result is that most of the ponds on the Orton tract adjoining the town of Boiling Springs Lakes have been extensively disturbed, and a few have been largely destroyed. Those ponds immediately adjacent to the subdivision are still surrounded by a fairly mature stand of second growth longleaf pines, although pond rim diversity is low, and a dense stand of Sacciolepis striata surrounding the ponds indicates a high probability of past disturbance in the area.

Ponds located to the north and northeast of the Boiling Springs Lakes subdivision include Pretty Pond--the largest of the doline ponds in the area

by far, which has for years been a camp and recreational facility of the Girl Scouts of America, and though an outstanding example of a natural lake, is relatively disturbed, and apparently offers little in the way of biological significance--and a number of extensively disturbed smaller ponds, which are located on paper company lands which have been recently harvested and subsequently replanted. One possible exception that bears mentioning is the relatively undisturbed pond located approximately one-quarter mile north of the Boiling Springs Lakes city limits on highway NC 87, about 70 m east of the highway, adjacent to the radio tower located there. Vegetation zonation is relatively distinct and species diversity appears high in comparison to the majority of other ponds in the area, although time did not permit sampling of the site.

Vegetation and plant communities:

The vegetational communities of the Boiling Springs Lakes area may be seen in the field to correspond to changes in the topography, and to edaphic changes that often accompany a shift in topographic position. Several different vegetational community types were noted, falling into three "working" categories--a lowland pond pine (*Pinus serotina*) community, an upland longleaf pine community, and several compositional variations of a longleaf pine flatwoods community cover type. In addition, the doline ponds and rim areas constituted a species and "community" complex in themselves. Each of these communities will be discussed in turn in the following section.

- 1) Pond pine pocosin. *Pinus serotina*/Mixed evergreen shrubs//*Smilax laurifolia*. The canopy in this area is dominated by an open stand of pond pine. While no developed subcanopy layer exists, species such as red maple (*Acer rubrum*), black gum (*Nyssa sylvatica* var. *biflora*), and red bay (*Persea borbonia*) stand emergent above the dense underlying shrub thicket. The shrub layer is in most areas dominated by titi (*Cyrilla racemiflora*) and/or sweet gallberry (*Ilex coriacea*), covered by a sprawling growth of laurel-leaved sawbrier (*Smilax laurifolia*). The height, and to some extent density, of the shrub layer is dependent upon the length of time since the last fire occurred in that particular tract (pyroperiod). In areas protected from fire for some time, the shrub layer is exceptionally dense and 3 m or more in height. In areas burned more recently, the shrub layer is usually much shorter and more open, with creeping blueberry (*Vaccinium crassifolium*) often dominating as a subshrub layer in the openings. Few or no herbaceous species are to be found in the pocosin, except in the more open areas, where the pocosin community may grade into one of the longleaf pine flatwood communities discussed in a later section.

These evergreen shrub bog communities generally occur over a peat soil in relatively flat, lowlying areas, where stream dissection is lacking, and drainage is consequently poor. Often the water table is perched by an impermeable subsurface hardpan layer. All of the pocosin communities within the Boiling Springs Lakes area have been ditched and drained. There is no evidence of any very recent fires within this community type.

- 2) Longleaf pine uplands. *Pinus palustris*/*Quercus laevis*/*Aristida stricta*. This is the familiar "sandhills" type coastal plain vegetational community of Wells and others. The open canopy of this vegetation type is dominated exclusively by longleaf pine. The subcanopy layer is most typically--and exclusively in the driest areas--dominated by turkey oak (*Quercus laevis*),

¹Wells, B.W. 1968 (reprint). The Natural Gardens of North Carolina. UNC Press. Chapel Hill.

though other relatively xeric species of oak may assume greater importance in a few areas. In addition, transgressive persimmon (Diospyros virginiana) and sassafras (Sassafras albidum) trees are commonly scattered throughout this community. The scattered herb layer is dominated solely by three-awn or wiregrass (Aristida stricta).

Two small areas were noted where the turkey oak subcanopy was absent, and a longleaf pine/ericalean shrub community type predominated, namely, a Pinus palustris/Gaylussacia frondosa and a Pinus palustris/Gaylussacia dumosa community.

These upland communities generally occur over a relatively deep, well-drained sandy soil, and consequently are usually the first areas to be developed; the majority of the dwellings in the Boiling Springs Lakes subdivision occur within this community type. Much of the area is vegetated in third or fourth growth longleaf pines approximately 17.8 cm (7 in.) dbh (diameter at breast height) and about 35 years in age. However, many areas exist which comprise relatively old second growth longleaf pines, often trees formerly "slashed" for turpentine. These are prime nesting habitat areas for the red-cockaded woodpecker (Dendrocopus borealis), and a number of cavity trees were noted within this community type.

Though evidence of frequent fires in past decades within this community are abundant, effects of a period of fire protection, such as very large individual turkey oaks or a thick litter layer, are also very apparent. It is probable that in the continued absence of fire a gradual change toward a more mesic community type will occur in the future.

- 3) Pine flatwood communities. This area was divided into three distinguishable, but intergrading, vegetational communities, with the species variation largely due to the soil water table relations of the plot. It is believed, based on field observations, that fire plays an extremely important role in the relatively short term, as well as long term, maintenance of these community types, and that gradual, or even relatively rapid in some cases, plant succession towards other community types is certain under conditions of continual fire protection. Each of these community types is discussed below, progressing from the wettest to the driest pine flatwood community types.

- a) Pine/shrub "savannah." Pinus palustris/Mixed evergreen shrubs/Vaccinium crassifolium-Aristida stricta. This area could readily be described as either "sparse pocosin," or "shrubby savannah." The open canopy here is dominated by longleaf pine, with the occurrence in the canopy of occasional pond pines. There is no subcanopy layer here, though loblolly bay (Gordonia lasianthus) may locally assume some importance, presumably in areas with relatively thick organic epipedons. The shrub layer is very open, consisting of scattered individuals 2 to 5m in height, and dominated by bitter gallberry (Ilex glabra) and sweet gallberry (I. coriacea), although most other typical pocosin shrub species are present and may assume codominance in a given area. The ground is typically carpeted with a creeping blueberry--wiregrass cover, though in one fairly sizable area the wiregrass was almost entirely replaced by a thick layer of rush-featherling (Pilea tenuifolia) as the dominant herb.

The primary extent of the pine/shrub "savannah" occurs west of highway NC 87, in an area where few streets exist to this point, and no dwellings have been constructed.

- b) Pine/sand myrtle flats. Pinus palustris/Leiophyllum buxifolium/Vaccinium crassifolium--Aristida stricta. The canopy here is very similar to that of the preceding community, consisting almost entirely

of longleaf pine. Although scattered pocosin shrubs do occur (bitter gallberry is particularly evident), the shrub layer is open and low, dominated by sand myrtle (Leiophyllum buxifolium). The ground layer, as in the preceding community, consists of creeping blueberry and wiregrass.

This area is drier than the pine/shrub "savannah" discussed above, with far fewer herbaceous species occurring here; in addition, scrub live oak (Quercus geminata) occasionally assumes importance as a low subcanopy or tall shrubby species in the drier portions of this community. In one small area, sand myrtle is largely replaced by wax myrtle (Myrica cerifera) in forming the low shrub layer.

- c) Pine/oak flats. Pinus palustris/Quercus geminata/Aristida stricta. Here again the open canopy layer is dominated by longleaf pine, but in conjunction with an open subcanopy layer consisting of scrub live oak in the relatively moist areas of this community, and a scrub live oak--turkey oak mixture in the drier, more upland areas. The herbaceous layer was very open, having a cover--almost exclusively--of wiregrass.

It should be reemphasized that almost every possible intergradation between the various flatwood communities discussed may be located, as well as intergrades between these community types and adjacent pocosin or "sandhill" community types, because edaphic, topographic, and hydrologic properties, and hence their reflection in vegetational communities present, change along a continuum, rather than discretely, in most instances.

- 4) Disturbed "communities." Pinus spp./Myrica cerifera/Andropogon virginicus. A relatively characteristic assemblage of species exists in the extensively disturbed (usually clearcut) areas. The canopy, if developed, typically consists of either loblolly (Pinus taeda) or longleaf pine, characteristically occurring with a scattered shrub layer of wax myrtle, and an herbaceous cover of broomsedge (Andropogon virginicus). Groundsel-shrub (Baccharis halimifolia) and dog-fennel (Eupatorium capillifolium) are other common weedy species in these areas.
- 5) Pond communities. The doline ponds occurring within the Boiling Springs Lakes area, assumed to have been formed as a result of subsurface solution of the underlying Castle Hayne Limestone, with consequent surface slumping², have as discussed undergone a great deal of disturbance. With regard to those "sinks" that do exist in relatively undisturbed condition from a vegetation standpoint, it would be impossible to go into a lengthy discussion of vegetational zonation and plant succession without benefit of a systematic collection of such areas, as well as the taking of other pertinent data. However, a list of characteristic species present in the pond rim areas is presented in the appended Species Flora List, and a number of general observations about the doline ponds in the Boiling Springs Lakes area follow.
- a) The ponds occur primarily within the upland (longleaf pine "sandhills" community type) pine areas, and occasionally in the drier portions of the pine flatwood communities discussed,
- b) The ponds of the Boiling Springs Lakes area are all clear water (as opposed to blackwater) ponds, with white sandy bottoms, and with no natural drainage into the pools from adjacent pocosin areas.

²Wheeler, W.H. 1979. Personal communication. Dept. of Geology, UNC-CH, Chapel Hill, N.C.

- c) None of the ponds within the Boiling Springs Lakes subdivision have pond cypress or black gum zones encircling their outer fringe areas, as do many of the ponds in the nearby Sunny Point area and in other nearby tracts. Those few ponds on Orton Plantation and paper company properties that do have tree rings have been either extensively disturbed or largely destroyed in timbering operations.
- d) Total species diversity in and around the sinks is relatively low as compared to total diversity among other groups of doline ponds observed in the surrounding coastal region, presumably due in part to the history of recent disturbance in the area since development was begun.
- e) The most striking vegetational diversity which occurs in moving from one pond to the next is seen in relation to the aquatic species. However, many of the ponds no longer--if they indeed ever did in the past--contain any aquatic vegetation.

Physical features:

General description--The Boiling Springs Lakes area includes a series of some 98 doline ponds trending NE-SW in direction of distribution.

Relief in the area is generally small, ranging to a maximum of about 5 or 6m. The area comprises and is surrounded by a number of relatively flat, pine dominated vegetational communities.

Topography--Nearly 100 irregularly shaped depressions with gently sloping to moderately sloping walls, and ranging from 5 to 500 m across the widest point, are to be found within the area. These ponds are believed to have resulted from surface slumping caused by subsurface solution of the underlying Castle Hayne Limestone.

Geology--The surficial sediments are marine-deposited sands and clays of the Pamlico Terrace of Pleistocene age, overlying the Castle Hayne Limestone of Eocene age.

Rare plants and animals:

An attempt was made in the Boiling Springs Lakes area to substantiate all of the old records of threatened and endangered plant species as are contained in the computer file of the N.C. Natural Heritage Program. I was, however, unable to relocate any of the old records. Most of the failures to substantiate the records relate to changes in habitat conditions within the area that have occurred with the progression of residential development of the tract since 1960. For example, the witch-alder (Fothergilla gardenii) reported from the Allen Creek area in 1950 has succumbed to the clearing and flooding of the area to form Boiling Springs Lake.

It is probable that loose water milfoil (Myriophyllum laxum), beakrush (Rhyncospora pleiantha), and other threatened and endangered species associated with doline ponds could be turned up by a systematic search of the 98 ponds in the area. However, due to the changes taking place in the ponds as discussed previously, in conjunction with the relatively advanced state of residential development of the area, such a search would probably prove to be pointless.

In contrast to the situation with regard to threatened and endangered species of plants, there is at least one animal, the endangered red-cockaded woodpecker, which is of special interest here. The Boiling Springs Lakes population of red-cockaded woodpeckers probably represents the largest breeding

population of red-cockaded woodpeckers in the county, and possibly in the area³. Although the actual size of the population is unknown at the present time, 18 cavity trees were observed distributed fairly evenly throughout the subdivision on both sides of highway NC 87, and on the adjacent Orton property. In addition, a pair of feeding adults was noted in a sandhills community type in mid-July.

Other animal species of special concern which are known to breed in the area include the Eastern wood rat (Neotoma floridana), and the fox squirrel (Sciurus niger).

Publications and scientific references:

Blankenship, R.R. 1965. Reconnaissance of the ground-water resources of the Southport-Elizabethtown area, North Carolina. N.C. Dept. Water Res., Div. Ground Water, Ground-Water Bul. No. 6. 47 pp.

Daniels, R.B., et. al. 1978. Age of soil landscapes in the coastal plain area of North Carolina. Soil Sci. Soc. Am. J. 42: 98-105.

Radford, A.E., et. al. 1964. Manual of the Vascular Flora of the Carolinas. UNC Press. Chapel Hill, N.C. 1183 pp.

³Parnell, J.F. 1979. Personal communication. Dept. of Botany, UNC-Wilmington, N.C.

Site ecological significance:

The significant features of the Boiling Springs Lakes area are summarized below:

- 1) Existence of a sizable population of the endangered red-cockaded woodpecker (Dendrocopus borealis) in the area, with the critical requirement in regard to the apparent necessity of a large tract of suitable habitat for feeding surrounding nest cavity sites still satisfied at this point.
- 2) Presence of a relatively mature longleaf pine/turkey oak/wiregrass community type over a large portion of the tract, representing excellent habitat for the fox squirrel (Sciurus niger), an animal species of special concern.
- 3) Occurrence of several relatively undisturbed doline ponds--among a very large, and until recently, undisturbed assemblage of sinks--with at the least excellent potential habitat in their rim areas, if the species do not currently occur there, for a number of associated threatened and endangered species of plants.

Management recommendations:

Management of an area as extensively developed as is the Boiling Springs Lakes area at this point--with future plans for a great deal of further development--is for obvious reasons very limited. Implementation of the following recommendations is possible within the existing framework of private ownership and development of area properties:

- 1) Existing nest cavity trees of the red-cockaded woodpecker should be surveyed and mapped, with a subsequent determination made of the actual population size and number of cavities currently utilized.
- 2) Because red-cockaded woodpeckers can co-exist fairly well with people if suitable territorial habitat is left intact, the woodpeckers pose little actual or potential threat to future development of the area, if such development is done in an intelligent and reasonable manner. For this reason it is believed that the ownership and/or management parties within the area should be informed of existing population size and locale, and encouraged to participate in an effort to preserve the red-cockades as a viable part of the overall environment of the region.
- 3) A survey of potentially undisturbed doline ponds outlying, but closely adjacent to, the Boiling Springs Lakes area should be made while the ponds may still exist in a relatively natural state (the pond located near the radio tower which is mentioned in the discussion of current use and protection status of the area would be included in this grouping).

FLORA SPECIES LIST

The various vegetational communities within the Boiling Springs Lakes area were surveyed at several locations. The following Flora Species List gives dominant and representative species for each layer of the communities encountered, but is by no means an exhaustive compilation of plant species present.

Pond pine pocosin:

Trees:	<i>Pinus serotina</i> <i>P. taeda</i>
Transgressives:	<i>Acer rubrum</i> <i>Gordonia lasianthus</i> <i>Nyssa sylvatica</i> var. <i>biflora</i>
Shrubs:	<i>Cyrilla racemiflora</i> <i>Ilex coriacea</i> <i>I. glabra</i> <i>Lyonia lucida</i> <i>Magnolia virginiana</i> <i>Persea borbonia</i> <i>Vaccinium corymbosum</i>
Subshrubs:	<i>Vaccinium crassifolium</i> (openings)
Herbs:	<i>Sarracenia flava</i>
Vines:	<i>Smilax laurifolia</i> <i>S. rotundifolia</i>
Mosses:	<i>Sphagnum</i> sp.

Longleaf pine uplands:

Trees:	
Canopy--	<i>Pinus palustris</i> <i>P. taeda</i>
Subcanopy--	<i>Castanea pumila</i> <i>Quercus geminata</i> <i>Q. laevis</i> <i>Q. margaretta</i> <i>Q. marilandica</i> <i>Q. velutina</i>
Shrubs:	<i>Gaylussacia dumosa</i> <i>G. frondosa</i> <i>Myrica cerifera</i> <i>Vaccinium tenellum</i>
Transgressives:	<i>Acer rubrum</i> <i>Diospyros virginiana</i> <i>Nyssa sylvatica</i> <i>Sassafras albidum</i>

Herbs:	
Forbs--	<i>Cnidoscopus stimulosus</i>
Graminoids--	<i>Aristida stricta</i>
Ferns and fern allies--	<i>Selaginella arenicola</i>
Pine flatwood communities:	
Trees:	<i>Pinus palustris</i> <i>P. taeda</i> <i>P. serotina</i>
Shrubs:	<i>Clethra alnifolia</i> <i>Cyrilla racemiflora</i> <i>Gaylussacia frondosa</i> <i>Ilex coriacea</i> <i>I. glabra</i> <i>I. opaca</i> <i>Leiophyllum buxifolium</i> <i>Magnolia virginiana</i> <i>Persea borbonia</i> <i>Quercus geminata</i>
Subshrubs:	<i>Vaccinium crassifolium</i>
Herbs:	
Forbs--	<i>Habenaria blephariglottis</i> <i>H. ciliaris</i> <i>Pleea tenuifolia</i> <i>Sarracenia flava</i> <i>S. purpurea</i> <i>Xyris</i> sp.
Graminoids--	<i>Aristida stricta</i> <i>Rhynchospora cephalantha</i> <i>R.</i> sp.
Pond "communities":	
Trees:	None
Shrubs:	<i>Quercus geminata</i> (outer rim area)
Herbs:	
Forbs--	<i>Bacopa caroliniana</i> * <i>B. monnieri</i> * <i>Brasenia schreberi</i> <i>Centella asiatica</i> <i>Drosera capillaris</i> <i>D. filiformis</i> <i>Eleocharis equisetoides</i> <i>Eriocaulon</i> sp. <i>Habenaria blephariglottis</i> <i>H. nivea</i> <i>Hydrocotyle umbellata</i>

Hydrocotyle verticillata*
Lachnanthes caroliniana
Lobelia nuttallii
Ludwigia alternifolia
Myriophyllum pinnatum
Nuphar luteum ssp. macrophyllum
Nymphaea odorata
Pogonia ophioglossoides
Polygala cymosa
P. lutea
Rhexia lutea
R. mariana
Utricularia biflora
Xyris fimbriata
X. sp.

* These records were kindly provided by Dr. A.E. Radford from collections made in the area in 1952.

Chelydra serpentina - Common snapping turtle
Chrysemys scripta - Yellow-bellied pond slider
Sternotherus odoratus - Slinkpot
Terrapene carolina - Eastern box turtle

Anolis carolinensis - Green anole
Cnemidophorus sexlineatus - Six-lined racerunner
Eumeces fasciatus - Five-lined skink
Eumeces inexpectatus - Southeastern five-lined skink
Eumeces laticeps - Broad-headed skink

Aghistrodon contortrix - Southern copperhead
Coluber constrictor - Black racer
Elaphe guttata - Corn snake
Elaphe obsoleta - Rat snake
Lampropeltis getulus - Eastern mole snake
Masticophis flagellum - Eastern coachwhip
Natrix faciata - Banded water snake
Natrix taxispilota - Brown water snake
Rhadinaea flavilata - Pine woods snake
Tantilla coronata - Southeastern crowned snake
Thannophis sirtalis sirtalis - Eastern ribbon snake

Dendrocopus borealis - Red-cockaded woodpecker
Melanerpes erythrocephalus - Red-headed woodpecker

Desmognathus fuscus - Northern dusky salamander

Plethodon glutinosus - Slimy salamander

Acris gryllus - Southern cricket frog

Bufo americanus - American toad

Bufo quercicus - Oak toad

Bufo terrestris - Southern toad

Hyla crucifer - Spring peeper

Hyla femoralis - Pine woods treefrog

Hyla gratiosa - Barking treefrog

Hyla squirella - Squirrel treefrog

Pseudacris ornata - Ornate chorus frog

Rana catesbeiana - Bullfrog

Rana sphenocephala - Southern leopard frog

Rana virgatipes - Carpenter frog

6

Didelphis marsupialis - Opossum

Glaucomys volans - Southern flying squirrel

Neotoma floridana - Eastern wood rat

Odocoileus virginianus - Whitetail deer

Oryzornys palustris - Eastern rice rat

Reithrodontomys humilis - Eastern harvest mouse

Scalopus aquaticus - Eastern mole

Sciurus carolinensis - Eastern gray squirrel

Sciurus niger - Fox squirrel

Sylvilagus floridanus - Eastern cottontail

Sylvilagus palustris - Marsh rat.

Figure 16. Boiling Springs Owners Map

NATURAL AREA INVENTORY FORM

Preliminary Reconnaissance Survey
Brunswick County, North Carolina

1. Natural Area Name: Camp Branch Savannah
2. Location: Site is located northwest of the intersection of S. R. 1335 with an unmarked dirt road 3.25 miles northwest of Exum.
3. Topographic Quadrangle Map Reference: Juniper Creek 1:24000.
Coordinates: $34^{\circ}08'N$ latitude; $78^{\circ}30'W$ longitude.
4. Size: ca. 31.2 ha. (77 A.).
5. Elevation: 14 m (45 ft.).
6. Vegetation Classification Category: II.E.2. Flatwoods.
7. Investigator(s): Timothy D. Nifong
Box 29, Coker Hall, UNC
Chapel Hill, N. C. 27514
8. Access: S. R. 1335 (see attached county road map).

9. Site Description:

Camp Branch Savannah is intermediate in wetness--and diversity--between Big Island Savannah (wetter and more diverse in species) and Gause Savannah (drier and less species rich). Longleaf pine (Pinus palustris) is the dominant canopy species over the major part of the savannah, although it is replaced by pond pine (P. serotina) in the western portion of the site. Canopy trees are relatively mature, with flat-top trees frequent.

A shrub layer is absent at the site, and the herbaceous layer dominants are generally orange grass (Ctenium aromaticum) and broom sedge (Andropogon virginicus), either alone, or in combination. Scattered among the dominant grasses is a diverse array of forbs (see accompanying "Field Reconnaissance Data Summary Sheet" for site species list).

It is evident from the fire-scarred trunks of canopy trees and the predominance of clumping among shrubs and transgressive small trees that this site has been burned relatively frequently in the past. In addition, the remnants of an old barbed wire fence indicate that the savannah was probably once grazed.

The site is bordered to the west by a pocosin community, to the northwest by an old field, to the east and northeast by a swamp forest community, and to the south by S. R. 1335.

10. Ownership Summary:

a. Ownership type by percent area:

Type

Private	<u>100</u>	%
Public	<u> </u>	%
Unknown	<u> </u>	%

b. Number of owners: two (2)

c. Name(s) and address(es) of owner(s):

Federal Paper Board Corporation, P. O. Box 338, Bolton, N. C.
28423;

David Spivey, Box 30, Freeland, N. C. 28440.

11. Land Use Status:

a. Natural area usage category: low intensity recreation (hunting)
to no apparent use.

b. Use of surrounding land:

(1) Undeveloped 80 %

(2) Developed: agricultural or silvicultural 20 %

(3) Developed: urban %

12. Management Summary:

a. Current preservation status:

Category	%	Description of preservation status
6	100	Private land, not protected by owners.

b. Threats:

Category	Description of threat
3	Timbering by owner(s), and subsequent clearing
	of site and replanting area as a pine planta-
	tion.

c. Management recommendations:

This site is in a relatively isolated portion of the county, and consequently, few problems are foreseen in relation to protection of the site integrity. Annual prescribed burning of the savannah site is the only recommendation offered to maintain present site quality.

13. Site Significance Summary:

- (1) The site represents the largest known orange grass (Ctenium aromaticum) dominated longleaf pine (Pinus palustris) savannah, and is a high quality site, with few intrusions.
- (2) The site contains a population of grass-of-Parnassas (Parnassia caroliniana), a rare species throughout the state.

14. N. C. Natural Heritage Program Priority Rating:

high priority.

15. Field Reconnaissance Data Summary Sheet:

FLORA

Canopy: *Pinus palustris*
Pinus palustris
P. serotina

Subcanopy: None

Transgressives: No dominants
Liquidambar styraciflua
Magnolia virginiana
Nyssa sylvatica
Symplocos tinctoria

Shrubs: No dominants
Gaylussacia dumosa
G. frondosa
Ilex glabra
Myrica cerifera var. *pumila*
M. heterophylla
Sorbus arbutifolia
Vaccinium atrococcum

Subshrubs: No dominants
Vaccinium crassifolium

Herbs: *Ctenium aromaticum* or *Andropogon virginicus* or CTAR--ANVI
Agalinis purpurea (?)
Aletris farinosa
Andropogon virginicum
Aristida stricta
Arundinaria gigantea
Asclepias longifolia
Aster squarrosus
Balduina uniflora
Baptisia cinerea
B. tinctoria
Carphephorus tomentosus
Centella asiatica
Crotolaria sp.
Ctenium aromaticum
Dichanthelium ensifolium (?)
Drosera capillaris
Erigeron vernus
Eriocaulon decangulare
Eupatorium rotundifolium
Eupatorium sp.
Eryngium yuccifolium
Hypericum lloydii
H. stans
Hypoxis hirsuta
Lachnanthes caroliniana
Lespedeza hirta
Pinguicula caerulea

15. Field Reconnaissance Data Summary Sheet: (cont.)

Herbs (cont.)

Polygala lutea
P. ramosa
Rhexia alifanus
Sarracenia flava
S. purpurea
Scutellaria integrifolia
Tephrosia hispidula
Tofieldia sp.
Trilisa paniculata
Xyris sp.
Zigadenus densus

Vines: No dominants

Gelsimium sempervirens
Smilax glauca
S. laurifolia

Ferns: No dominants

Pteridium aquilinum

Fern Allies: No dominants

Lycopodium appressum

FAUNA

Amphibians and Reptiles:

Eastern Glass Lizard (*Ophisaurus ventralis*)
Eastern Box Turtle (*Terrapene carolina*)

Birds:

Bobwhite (*Colinus virginianus*)
Common Grackle (*Quiscalus quiscula*)
Common Yellowthroat (*Geothlypis trichas*)
Fish Crow (*Corvus ossifragus*)
Great-crested Flycatcher (*Myiarchus crinitus*)
Pine Warbler (*Dendroica pinus*)
Prairie Warbler (*D. discolor*)
Prothonotary Warbler (*Protonotaria citrea*)
Red-eyed Vireo (*Vireo olivaceus*)
Rufous-sided Towhee (*Pipilo erythrophthalmus*)

SOIL SUBGROUP

Aeric Paleaquults.

Figure 17. Camp Branch Savannah

NATURAL AREA INVENTORY FORM

Preliminary Reconnaissance Survey
Brunswick County, North Carolina

1. Natural Area Name: Drowned Bay Savannah
2. Location: Site is northeast of the junction of highway NC 904 and S. R. 1163.
3. Topographic Quadrangle Map Reference: Shallotte 1:24000.
Coordinates: $33^{\circ}55'N$ latitude; $78^{\circ}30'W$ longitude.
4. Size: ca. 73.7 ha. (182 A.).
5. Elevation: 12 m (40 ft.).
6. Vegetation Classification Category: II.E.2. Flatwoods.
7. Investigator(s): Timothy D. Nifong
Box 29, Coker Hall, UNC
Chapel Hill, N. C. 27514
8. Access: Highway NC 904 and S. R. 1163 (see attached county road map).

9. Site Description:

Drowned Bay Savannah is characterized by a Pinus palustris/Mixed Pineland Shrubs/Vaccinium crassifolium--Aristida stricta community type, with the low shrub layer typically being dominated by bitter gallberry (Ilex glabra), and dangleberry (Gaylussacia dumosa) mixed with various other ericads and transgressive tall shrubs and small trees. In the eastern portions of the site, pond pine (Pinus serotina) assumes dominance in the canopy. Canopy trees here are relatively immature, being mostly 8 to 15 centimeters DBH, indicating that the site was timbered in the near past.

Herbaceous flora at the site does not appear at present to be particularly diverse, but this may in actuality be more apparent than real, considering the lengthy drought that has occurred in the southeast coastal plain, and the fact that, given the existing soil type of the savannah, this is a relatively mesic site.

It is apparent that fire has been frequent at the site, based on the number of charred stumps, the predominance of clumped shrubs, and fire scarring of all of the trunks of the canopy pines.

10. Ownership Summary:

a. Ownership type by percent area:

Type

Private	<u>100</u>	%
Public	<u> </u>	%
Unknown	<u> </u>	%

b. Number of owners: two (2), one principal.

c. Name(s) and address(es) of owner(s):

E. John Thorp, 18836 SW 35th St., Homstead, FL 33050;
Thomas Franklin Thorp, Rt. 1, Box 12, Alvin, S. C. 29427.

11. Land Use Status:

a. Natural area usage category: no apparent use; intrusion--two north - south plowed fire lanes.

b. Use of surrounding land:

(1) Undeveloped 40 %

(2) Developed: agricultural or silvicultural 40 %

(3) Developed: urban 20 %

12. Management Summary:

a. Current preservation status:

Category	%	Description of preservation status
6	100	Private land, not protected by owner.

b. Threats:

Category	Description of threat
3	Timbering by owner, drainage, and subsequent
	replanting as pine plantation; subdivision of
	area as residential lots and eventual develop-
	ment of area.

c. Management recommendations:

A program of prescribed, probably annual, burning of the area should be instituted here. No other immediate management problems are foreseen for this site.

13. Site Significance Summary:

- (1) This is the most extensive sandy soil longleaf pine (Pinus palustris) savannah in the county.

14. N. C. Natural Heritage Program Priority Rating:

local priority .

15. Field Reconnaissance Data Summary Sheet:

FLORA

Canopy: *Pinus palustris*
Pinus palustris
P. serotina

Subcanopy: None

Transgressives: No dominants

Acer rubrum
Ilex opaca
Magnolia virginiana
Nyssa sylvatica
Persea borbonia
Quercus geminata
Q. laevis
Q. nigra
Rhus copallina
Sassafras albidum

Shrubs: Mixed pineland shrubs

Clethra alnifolia
Gaylussacia dumosa
G. frondosa
Ilex coriacea
I. glabra
Lyonia lucida
L. mariana
Myrica cerifera var. *pumila*
Rhododendron atlanticum
Sorbus arbutifolia

Subshrub: *Vaccinium crassifolium*

Vaccinium crassifolium

Herbs: *Aristida stricta*
Andropogon virginicus
Aristida stricta
Arundinaria gigantea
Centella asiatica
Cleistes divaricata
Drosera capillaris
D. intermedia
Hypericum fasciculatum (?)
H. reductum
Iris verna
Lachnocaulon minus
Panicum sp.
Polygala lutea
Pyxidanthra barbulata
Rhexia alifanus
Scleria sp.
Sisyrinchium angustifolium
Trilisa paniculata
Utricularia subulata

15. Field Reconnaissance Data Summary Sheet: (cont.)

Herbs (cont.)

Xyris sp.

Vines: No dominants

Gelsimium sempervirens

Smilax laurifolia

Ferns: No dominants

Pteridium aquilinum

Woodwardia virginica

Fern Allies: No dominants

Lycopodium appressum

Mosses: No dominants

Sphagnum sp.

FAUNA

Birds:

Bobwhite (*Colinus virginianus*)

Brown-headed Nuthatch (*Sitta pusilla*)

Eastern Bluebird (*Sialia sialis*)

Great-crested Flycatcher (*Myiarchus crinitus*)

Pine Warbler (*Dendroica pinus*)

Rufous-sided Towhee (*Pipilo erythrophthalmus*)

Red-headed Woodpecker (*Melanerpes erythrocephalus*)

SOIL SUBGROUP

Aeric Haplaquods.

Figure 18. Drowned Bay Savannah

NATURAL AREA INVENTORY FORM
Preliminary Reconnaissance Survey
Brunswick County, North Carolina

1. Natural Area Name: Gause Savannah
2. Location: Site is located ca. 400 m north of highway US 17, ca. 2.3 miles west of the junction of US 17 and highway NC 904.
3. Topographic Quadrangle Map Reference: Calabash 1:24000.
Coordinates: $33^{\circ}57'N$ latitude; $78^{\circ}32'W$ longitude.
4. Size: ca. 48.6 ha. (120 A.).
5. Elevation: 11 to 12 m (35 to 40 ft.).
6. Vegetation Classification Category: II.E.2. Flatwoods.
7. Investigator(s): Timothy D. Nifong
Box 29, Coker Hall, UNC
Chapel Hill, N. C. 27514
8. Access: Highway US 17 (see attached county road map).

9. Site Description:

Gause Savannah represents the drier end of the spectrum among clay soil savannahs. Young and medium sized longleaf pines (Pinus palustris) dominate the canopy, mostly in closed stand, with no subcanopy or shrub layers. The herbaceous layer appears to be almost pure wire-grass (Aristida stricta) at first glance, but upon closer examination, is clearly much more diverse. Because the spring of 1980 was the first time in several years that the area had been burned (fidé Freeman Gause), the wire-grass layer responded by growing and fruiting so prolifically that the old needles (leaves) and flowering stalks effectively obscure the actual diversity of the herbaceous flora (as indicated by the accompanying species list) over much of the site. Interestingly, approximately one-half of the site was re-burned in the spring of 1981, and with the combustion of last year's wire-grass above-ground biomass, the burned portion of the site stands in stark contrast against the unburned portion.

The savannah is bordered on all sides, more or less, except the northeast, by agricultural fields. It is actually the burning of these fields in the spring which has led to the frequent burning of Gause Savannah. Pine flatwoods and some pocosin border the site to the northeast.

10. Ownership Summary:

- a. Ownership type by percent area: Type
Private	<u>100</u> %
Public	<u> </u> %
Unknown	<u> </u> %
- b. Number of owners: six (6), one principal owner.
- c. Name(s) and address(es) of owner(s):
- Freeman Gause, Ash, N. C. 28420;
- George W. Gause, 15 Patten Place, Newark, N. J. 07112;
- Willie Hill, Ash, N. C. 28420;
- Jethro Hart, Ash, N. C. 28420;
- I. V. Cribb, Rt. 3, Box 35, Whiteville, N. C.;
- Harry Hill, Rt. 1, Box 210A, Ash, N. C. 28420.

11. Land Use Status:

- a. Natural area usage category: low intensity recreation (hunting) to no apparent use; intrusions--numerous plowed fire lanes in the northwest portion of the site, some dumping.
- b. Use of surrounding land:
- (1) Undeveloped 30 %
- (2) Developed: agricultural or silvicultural 70 %
- (3) Developed: urban %

12. Management Summary:

- a. Current preservation status:

Category	%	Description of preservation status
4	100	Private land, protected by owner.

Figure 19. Gause Savannah Ownership
Map

b. Threats:

Category	Description of threat
3	Timbering of the site, and either subsequent
	replanting of the area as a pine plantation,
	or clearing of the site for agricultural
	fields.

c. Management recommendations:

- (1) A program of annual prescribed burning should be instituted at the site;
- (2) Vehicular traffic into the savannah should be restricted;
- (3) Some of the myriad of seemingly unnecessary fire lanes in the northwestern portion of the savannah should probably be "regraded" in an attempt to restore the area to its approximate original contours;
- (4) The large population of hooded pitcher plants (Sarracenia minor) at the site should be monitored for possible exploitation, although this is unlikely, given the limited access into the area.

13. Site Significance Summary:

- (1) This site represents the only known "dry" clay soil (Aquic Paleudults) longleaf pine (Pinus palustris) savannah, and is an excellent example of such a savannah.
- (2) The site contains notably large populations of the following:
 - (a) Sarracenia minor (an exploited species);
 - (b) Baptisia cinerea.

14. N. C. Natural Heritage Program Priority Rating:

local priority

15. Field Reconnaissance Data Summary Sheet:

FLORA

Canopy: *Pinus palustris*
Pinus palustris
P. taeda

Subcanopy: None

Transgressives: No dominants

Acer rubrum
Diospyros virginiana
Liquidambar styraciflua
Nyssa sylvatica
Quercus marilandica
Q. nigra
Rhus copallina

Shrubs: No dominants

Clethra alnifolia
Gaylussacia dumosa
G. frondosa
Ilex cassine var. *myrtifolia*
I. coriacea
I. glabra
Magnolia virginiana
Myrica cerifera var. *pumila*
Quercus geminata
Q. pumila
Rubus sp.
Sorbus arbutifolia
Vaccinium tenellum

Subshrubs: No dominants

Vaccinium crassifolium

Herbs: *Aristida stricta*

Aletris farinosa
Andropogon virginicum
Aristida stricta
Arundinaria gigantea
Asclepias longifolia
Aster linariifolius
A. squarrosus
Baptisia cinerea
B. tinctoria
Coreopsis spp.
Ctenium aromaticum
Erigeron vernus
Eryngium yuccifolium
Eupatorium rotundifolium
Euphorbia curtisii
Iris sp.
Lespedeza hirta
Manisuris rugosa
Polygala ramosa

15. Field Reconnaissance Data Summary Sheet: ((cont.))

Herbs (cont.)

Psoralea sp.
Pterocaulon pycnostachyum
Rhexia alifanus
Sarracenia flava
S. minor
S. purpurea
Scutellaria integrifolia
Sisyrinchium angustifolium
Stylosanthes biflora
Tephrosia hispidula
Vernonia acaulis
Viola primulifolia
Xyris sp.

Vines: No dominants

Gelsimium sempervirens
Smilax glauca

Ferns:

Osmunda regalis
Pteridium aquilinum
Woodwardia virginica

FAUNA

Birds:

Brown-headed Nuthatch (*Sitta pusilla*)
Cardinal (*Cardinalis cardinalis*)
Carolina Wren (*Thryothorus ludovicianus*)
Common Yellowthroat (*Geothlypis trichas*)
Eastern Bluebird (*Sialia sialis*)
Eastern Wood Pewee (*Contopus virens*)
Great-crested Flycatcher (*Myiarchus crinitus*)
Rufous-sided Towhee (*Pipilo erythrophthalmus*)
White-eyed Vireo (*Vireo griseus*)

Mammal:

Eastern Cottontail (*Sylvilagus floridanus*)

SOIL SUBGROUP

Aeric Paleaquults to Aquic Paleudults.

Figure 20. Gause Savannah Access Map

NATURAL AREA INVENTORY FORM
Preliminary Reconnaissance Survey
Brunswick County, North Carolina

1. Natural Area Name: Green Pond Savannah
2. Location: Site is located east of highway NC 87 via dirt access road located 0.8 mile south of the entrance road to South Brunswick High School (0.2 mile north of the Orton Creek Bridge on highway NC 87).
3. Topographic Quadrangle Map Reference: Funston 1:24000/Southport 1:24000.
Coordinates: $34^{\circ}00'N$ latitude; $78^{\circ}02'W$ longitude.
4. Size: ca. 31.2 ha. (77 A.).
5. Elevation: ca. 11 to 12 m (35 to 40 ft.).
6. Vegetation Classification Category: II.E.2. Flatwoods/I.A. Fresh-water Pond Community.
7. Investigator(s): Timothy D. Nifong
Box 29, Coker Hall, UNC
Chapel Hill, N. C. 27514
8. Access: Highway NC 87 (see attached county road map).

9. Site Description:

Green Pond Savannah represents another significant variation of the longleaf pine (Pinus palustris) savannah within the existing spectrum of flatwood sites within Brunswick County and the North Carolina coastal plain as a whole. The canopy is dominated by relatively mature longleaf pines--some 20 to 25 cm DBH--over a low shrub layer of sand myrtle (Leiophyllum buxifolium), either alone, or with dwarf blueberry (Vaccinium tenellum) as a codominant. The shrub layer is in turn underlain by a "herbaceous" layer containing creeping blueberry (V. crassifolium) and wire-grass (Aristida stricta) as dominants.

Green Pond, which lies in the western, central portion of the site (see accompanying topographic quad sheet), is a relatively steep-walled limesink, one of the series of Sunny Point--Orton--Boiling Springs Lakes sinks. The extreme clarity of the water and the white sandy bottom of the pond tend to reflect aquatic vegetation (both algae and vascular plants), giving the water its "green" appearance. There is very little vegetation in or around the pond itself, excepting the population of loose water-milfoil (Myriophyllum laxum) within the sink, probably at least partially due to the relative steepness of the rim slope. The herbaceous and shrub layers of the savannah are much more open in the immediate vicinity of the pond, and large patches of bare white sand are frequent.

The site is bordered on the north by a pocosin community within an adjacent swale area, and to the east and south by a mixed pines--hardwoods community which is transitional--and also successional given the absence of recent fire--between the savannah community and the adjacent mixed bottomland hardwoods community which borders Orton Creek.

As with all of the Brunswick savannah sites, it is clear, based on observable evidences such as fire-scarred trunks, shrubs which are predominantly clumped, and charred stumps, that frequent fire has been largely responsible for the evolution and maintenance of the site in its open, savannah condition.

10. Ownership Summary:

a. Ownership type by percent area:

Type

Private	<u>100</u>	%
Public	<u> </u>	%
Unknown	<u> </u>	%

b. Number of owners: one (1)

c. Name(s) and address(es) of owner(s):

Lawrence G. Sprunt et al.
Box 3625
Wilmington, N. C. 28401.

11. Land Use Status:

a. Natural area usage category: low intensity recreation, e. g., swimming in Green Pond.

b. Use of surrounding land:

(1) Undeveloped 100 %

(2) Developed: agricultural or silvicultural %

(3) Developed: urban %

12. Management Summary:

a. Current preservation status:

Category	%	Description of preservation status
<u>4</u>	<u>100</u>	<u>Private land, posted by owner.</u>

b. Threats:

Category	Description of threat
3	Logging of the mature longleaf pine canopy.

c. Management recommendations:

- (1) This site is used as a shortcut by some in travelling from highway NC 87 to highway NC 133; all vehicular traffic within the savannah area should be discontinued, and the road blocked off at both ends;
- (2) A program of prescribed burning should be undertaken at the site; periodic, but not too frequent fire is probably desirable if the site is to be managed for its exceptionally large sand myrtle (Leiophyllum buxifolium) population;
- (3) Past hunting around, and swimming within, Green Pond has resulted in heavy littering and other abuse of the area; for this reason, future access to the site should probably be limited.

13. Site Significance Summary:

- (1) This is the largest sand myrtle (Leiophyllum buxifolium) population known within the Carolinas when considered in terms of number of individuals within a single community type, bounded by other communities (fidé A. E. Radford).
- (2) The site represents an excellent example of an unusual community type--Pinus palustris/Leiophyllum buxifolium/Aristida stricta.
- (3) Green Pond contains a sizeable population of the threatened species, loose water-milfoil (Myriophyllum laxum).
- (4) Green Pond is a good example of a steep-walled limesink.

14. N. C. Natural Heritage Program Priority Rating:

local priority

15. Field Reconnaissance Data Summary Sheet:

FLORA--Savannah

Canopy: *Pinus palustris*
Pinus palustris
P. serotina
P. taeda

Subcanopy: None

Transgressives: No dominants
Diospyros virginiana
Magnolia virginiana
Nyssa sylvatica
Persea borbonia
Quercus geminata
Q. laevis

Shrubs: *Leiophyllum buxifolium*
Gaylussacia dumosa
G. frondosa
Ilex glabra
I. opaca
Leiophyllum buxifolium
Lyonia lucida
L. mariana
Myrica cerifera var. *pumila*
Vaccinium tenellum

Subshrub: *Vaccinium crassifolium*
Vaccinium crassifolium

Herbs: *Aristida stricta*
Andropogon virginicus
Aristida stricta
Hypericum reductum
Pyxidanthera barbulata
Rhexia alifanus
Trilisa paniculata

FLORA--Pond

Canopy: None

Subcanopy: None

Transgressives: No dominants
Nyssa sylvatica var. *biflora*

Shrubs: None

Herbs: No dominants
Centella asiatica
Dichanthelium ensifolium (?) *Panicum*
Eriocaulon decangulare
Lachnocaulon minus
Rhexia mariana

15. Field Reconnaissance Data Summary Sheet: (cont.)

Herbs: (cont.)

Xyris sp.

Aquatics: Myrophyllum laxum

Myriophyllum laxum

SOIL SUBGROUP

Aeric Haplaquods: spodic horizon at 55 cm.

Green Pond
Savannah

Figure 21. Green Pond Savannah

ROAD CLASSIFICATION

Heavy-duty

Light-duty

Unimproved dirt

U. S. Route

State Route

12.8

ISNOW MARS

GREEN SWAMP NATURE PRESERVE
BRUNSWICK COUNTY, NORTH CAROLINA
(N 34°10', W 78°20')

Prepared for the
North Carolina Nature Conservancy
by
Hervey McIver
February, 1981

INTRODUCTION

The 13,850-acre Green Swamp tract, five miles north of Supply, N.C., in Brunswick County, was given to the North Carolina Nature Conservancy (NCNC) by Federal Paper Board Corp., Inc. (FPB) in 1977. The area contains a broad array of lower Coastal Plain ecosystems and wildlife habitats, many of which are becoming increasingly rare due to agricultural and forestry expansion. The vast majority of land is pocosin, a thick shrub community atop organic peat. Pocosin provides much open space and habitat for a number of large mammals including deer, black bear, bobcat, and reputedly, the eastern cougar.

More important, especially from a management/stewardship perspective, is the floral diversity of the swamp. Fifteen insectivorous plants, twelve orchids, seventeen endangered or threatened species, one plant--purple balduina (Balduina atropurpurea)--previously unrecorded in North Carolina, and twenty-one species of sphagnum are among the numerous plant species found within the property boundaries. Many of these are located in the approximately 230 acres of savannah scattered as "islands" along ridges within the tract. Expanses of green grasses and sedges laden with wildflowers beneath tall, straight, longleaf pines provide a beautiful and fascinating setting for researchers, educators, and casual observers. The longleaf pines provide food and nesting for the endangered red-cockaded woodpecker. The Green Swamp contains some of the finest examples of "wet" savannah in the nation.

Most of the property lies on a broad, flat, marine terrace between fifty and seventy feet above sea level. The southern edge lies along the Penholoway escarpment, an ancient shoreline. The land here is dissected by broad, shallow valleys, and the soils are generally drier. Two projections of the property extend into this scarp, the Myers-Clemmons area along N.C. Rt. 211 and the Beaverdam farther east. These tracts contain most of the 950 acres of pine plantations as well as several natural longleaf, loblolly, and bottomland hardwood stands, Carolina Bays, and a series of limestone (marl) sinks.

The significance of the Green Swamp as a natural area was recognized nationally by its designation in 1974 as a National Natural Landmark. Long before this acknowledgement, its remote beauty was appreciated by many local people, while educators, botanists, zoologists, and ecologists have utilized the swamp as an outdoor laboratory. Active management will be required to protect, maintain, and enhance the unique natural features and habitats of the Green Swamp. It is hoped that the following stewardship plan will supply basis and direction to continued management for many years to come.

ECOLOGICAL INVENTORY SUMMARY

Russell Kologiski's The Phytosociology of the Green Swamp and the National Park Service Green Swamp report elaborate many of the ecological features within the swamp. Much of the following general summary is taken from these sources, and they may be referred to for further information.

Abiotic Features

Geology

The Green Swamp is located on the Penholoway Terrace, one of a series of marine terraces formed as the Atlantic Ocean retreated across the Coastal Plain. It may also be a shoal system of deltic origin formed during the early Medial Pleistocene. NCNC's property is located in the southeast corner of the Green Swamp, approximately fifty to seventy feet in elevation. Detailed geological surveys of the swamp and NCNC's land have not been made. Pleistocene surficial deposits of sands and mixed clays twenty-five to thirty feet thick underlie the entire swamp. Beneath these deposits lies the Late Cretaceous Peedee Formation of clays with interbeds of calcareous sands. The Duplin and Waccamaw Marls of the Miocene age possibly lie between these two stratigraphic units.

The southern edge of the property borders a scarp, an ancient shoreline. Beneath surficial deposits here lies the Eocene Castle Hayne Limestone Formation. A series of sinks, including two large and several smaller ones in the Myers-Clemmons tract, have probably resulted from underground solution within this formation. Carolina Bays, unusual elliptical geomorphic features of the Atlantic Coastal Plain, are frequent along this southern edge. Evidence of bays within the pocosin is indicated from aerial photographs.

Topography

The topography of the Green Swamp is a function of beach formations developed during the last inundation, erosion since then, the build-up of peat, and the formation of Carolina Bays. The Conservancy's land lies on a broad, interstream northwest-southeast trending ridge at the terminous of the Waccamaw River and Cape Fear River divide. The formation of peat deposits began approximately 10,000 years ago in low, wet areas. Acting like a growing, spreading sponge, it developed laterally, overtopping many topographic highs. To the scanning eye the terrain appears flat, although the center is domed. Higher ridges and bay rims within the swamp outcrop as "islands." Map 1 displays these features. The property lies within the Supply, Bolivia, Honey Island, and Lewis Swamp, N.C. 1:24,000 topographic quad maps.

Map 1

Figure 22. Green Swamp Preserve

The escarpment along the southern edge gently slopes seaward with a network of shallow valleys and sand ridges. Most of the Carolina Bays within the property are found in the two projections in this area. These elliptical depressions are aligned on a northwest-southeast axis and form distinct topographic features on the landscape. The series of limestone sinks, two of which are over 100 feet in diameter, stand out in the southern part of the Myers-Clemmons tract.

Soils

The soils within the Green Swamp were mapped by Kologiski from vegetation analysis and FPB site data (Map 2). Soils are more varied than the generalized map indicates, with a number of soil series often located on single savannahs (Appendix K). Histosols, or deep peat soils, is the predominate soil order within the swamp. Along the ridges of the escarpment in the southern portions of NCNC land, the soils are generally sandy with more poorly drained mineral soils in the shallow valleys.

Peat is presently being mined experimentally for use as an energy source elsewhere in North Carolina. The Department of Energy-sponsored peat survey team out of the UNC/CH Geology Department will survey peat deposits and peat characteristics within NCNC's property in 1981. The Soil Conservation Service of Brunswick County will map the soils in the area during the early 1980's.

Hydrology

The original Green Swamp encompassed some 200,000 acres in Columbus and Brunswick Counties, extending throughout the lowland swamp forests and upland pocosin of the Waccamaw River drainage. NCNC's preserve lies on the broad, interstream flat between the Cape Fear River and Waccamaw River drainage systems. Driving Creek flows west from the swamp to the Waccamaw River. Smaller streams, often intermittent, flow from the pocosin east to the Cape Fear River via Town Creek and south to the Lockwoods Folly River. The vast peat areas and lower portions of savannahs are wetlands as classified by the U.S. Fish and Wildlife Service. The source of Driving Creek is an extensive, boggy area, locally termed the "soups" (Map 1). The probable source of water to this area is rainfall which drains laterally through the peat (Charles Daniels, USGS Hydrologist, personal communication). It is possible that the area is an aquifer discharge from lower stratigraphic units.

Hydrological dynamics within pocosins are little understood. Lateral flow within the peat is slow due to its low permeability. Surface flow during the high water season (winter and spring) is more rapid. FPB intends to place a

Map 2

Generalized Soil Map of the Green Swamp

GREEN SWAMP PRESERVE

Scale: 1:79200

1" = 100 chains

Pocosin soils (Histosols)	Savannah Soils
Dare-Dorovan series	Foreston-Wrightsboro series
Torhunta series	Leon series
Pamlico-Ponzer series	Lynchburg series
	Rains series

Figure 23. Green Swamp Preserve
Soils Map

Map 2

Key to the Generalized Soil Map of the Green Swamp

Pocosin Soils

Dare series - Dystic, thermic Typic Medisaprist

Dorovan series - Dystic, thermic typic medisaprist.

Deep, very poorly drained, extremely acid (pH=4.5 or less) organic soils.
Water table is at or near the surface most of the year.

Pamlico series - Sandy or sandy skeletal, siliceous, dystic, thermic
Terric Medisaprist.

Ponzer series - Loamy, mixed, dystic, thermic Terric Medisaprist.

Moderately deep, slow to moderate permeability, very poorly drained,
extremely to very strongly acid organic soils. The water table is at
or near the surface 6 to 12 months of the year.

Torhunta series - Coarse loamy, siliceous, acid, thermic Typic Humaquepts.

Moderately deep, moderately permeable, very strongly acid (pH=4.5-5.0),
very poorly drained loamy fine sand of partial fluvial origin.

Savannah Soils

Foreston series - Coarse loamy, siliceous, thermic Aquic Paleudult.

Wrightsboro series - Fine loamy, siliceous, thermic Aquic Paleudult.

Deep, Moderately permeable, very strongly acid, moderately well-drained
fine sandy loams. Water table is within 2.5 feet of the surface 2 to 6
months of the year.

Leon series - Sandy, siliceous, thermic Aeris Haplaquods.

Deep, rapidly permeable, very strongly acid, poorly drained fine sandy soils.
Water table is within 10 inches of the surface 2 to 4 months of the year.

Lynchburg series - Fine loamy, siliceous, thermic Aeris Paleaquult.

Deep, rapidly permeable, strongly acid, poorly drained sandy loam.

Rains series - Fine loamy, siliceous, thermic Typic Paleaquult.

Deep, moderately permeable, very strongly acid, poorly drained sandy loam.
Water table is within 12 inches of the surface 2 to 6 months of the year.

drainage canal along the northern border of NCNC's land. Due to the peat's low permeability, the water table is little affected beyond 200 feet from the ditch¹. However, this ditch would effectively eliminate any surface and subsurface flow entering the Conservancy's property, should such flow exist. Measures need to be taken to monitor stream flow within Driving Creek to determine any effects this canal may have on the swamp's hydrology over the long term (see Scientific Use--Research and Appendix D).

Biotic Features

Flora

The three major community types in the Green Swamp--the pocosin and bay forest, the savannahs, and the natural pine stands--have developed in association with their particular abiotic characteristics coupled with the pressure of disturbance, primarily a long history of fire. The floral display within the swamp includes a number of endangered and threatened species, insectivorous plants, and orchids (Tables 1 and 2).

The pocosin and bay forest of NCNC's property include several plant community types, all characterized by an organic peat soil and thick, almost impenetrable shrubs laced with the thorny laurel-leaf catbrier (Smilax laurifolia). The communities as defined and mapped by Kologiski include the Pine-Ericalean Pocosin in the wetter, deeper peats, Conifer-Hardwood Pocosin in shallower peats, and the Bay Forest along Driving Creek. The only location of Atlantic white cedar (Chamaecyparis thyoides) is a small, mixed, medium-aged stand by the creek near Rt. 211. The communities within the pocosin grade from one to another with no distinct boundaries.

The dynamics of the pocosin ecosystems are not fully understood, although changes in vegetational structure and composition do occur with time. Nutrient availability, depth of peat, hydroperiod (the effective time in which the water table is at or above ground surface), and fire history appear to play roles in community development. Fire exclusion or suppression would only allow increased organic litter build-up, making likely the possibility of an even greater future burn.

Savannahs are the most unique community and habitat within the Conservancy's land. Approximately 230 acres of savannah lands exist within the property. Ecosystematic inventories of five savannahs are found in Appendix K. Appendix L contains descriptions and partial species lists for the other savannah islands. The close proximity of the water table to the surface is crucial to the great diversity found there. Within the domed or ridged savannahs occur a number of

Table 1

Endangered and Threatened Plants

<u>Species</u>	<u>Common Name</u>	<u>Habitat</u>	<u>Status</u>
Agalinis aphylla	Scale-leaf gerardia	S	NC-EP
Amorpha georgiana	Georgian amorpha	S	NC-EP
Asclepias pedicellata	Stalked milkweed	S	NC-EP
Balduina atropurpurea	Purple balduina	S	First occurrence in N (EP in S. Carolina)
Coreopsis gladiata	Swamp tickweed	S	NC-EP
Dionea muscipula	Venus fly-trap	S	NC-TE, Expl., T 78 SM T-Fed
Fotherfilla gardenii	Dwarf fothergilla	P	NC-TP
Habenaria integra	Yellow fringeless orchid	S	NC-TT
Helenium pinnatifidum	Dissected sneezeweed	S	NC-EP
Lophiola americana	Golden crest	P	NC-EP
Lysimachia asperulaefolia	Rough-leaf loosestrife	S	NC-EP, 78 SM
Parnassia caroliniana	Carolina parnassia	S	NC-TP
Peltandra sagittaeifolia	Arrowleaf shieldwort	P	NC-TP
Pyxidanthera barbulata var. brevifolia	Well's pyxie-moss	S	NC-EE
Rhynchospora alba	White beakrush	P	NC-EP
Sarracenia rubra	Sweet pitcher plant	S&P	NC-TT, Expl., T fed
Sporobolus teretifolius	Wireleaf dropseed	S	NC-TT

S Savannah

P Pocosin

EE Endangered endemic

EP Endangered peripheral

TE Threatened endemic

TP Threatened peripheral

TT Threatened throughout

Expl. Exploited

NC Cooper, J.E., et. al., 1977. Endangered and Threatened Plants and Animals of North Carolina. N.C. Museum of Natural History, Raleigh.

78 SM Ayensu, E.S. and R.A. De Filipps, 1978. Endangered and Threatened Plants of the United States. Smithsonian Institute and World Wildlife Fund, Washington, D.C.

T Fed Threatened, Federal Register 40 (127): 27823-27924. July 1, 1975.

Table 2

Orchids found in the Green Swamp.

Calopogon barbatus

C. pallidus

C. pulchellus

Cleites divaricata

Habenaria blephariglottis

H. ciliaris

H. cristata

H. integra

Pogonia ophioglossoides

Spiranthes longilabris

S. praecox

S. grayi

Bearded grass-pink

Pale grass-pink

Grass-pink

Spreading pogonia

White fringed orchis

Yellow fringed orchis

Crested fringed orchis

Yellow fringeless orchis

Rose pogonia

Giant spiraled ladies' tresses

Grass leaved ladies' tresses

Little ladies' tresses

Insectivorous plants found in the Green Swamp.

Dionaea muscipula

Drosera capillaris

D. intermedia

Pinguicula caerulea

P. lutea

Sarracenia catesbaei (flava x purpurea)

S. flava

S. minor

S. purpurea

S. rubra

Utricularia cornuta

U. inflata

U. juncea

U. purpurea

U. subulata

Venus fly-trap

Sundew

Sundew

Butterwort

Butterwort

Pitcher Plant

Trumpet pitcher plant

Hooded pitcher plant

Purple pitcher plant

Sweet pitcher plant

Bladderwort

Bladderwort

Bladderwort

Bladderwort

Bladderwort

community types segregated concentrically according to moisture regime. The wetter communities alongside the pocosin display the greatest diversity. As many as fifty species of vascular plants have been noted here within a square meter.

The maintenance of the savannah communities is dependent upon disturbance, primarily the frequent occurrence of fire. Fire consumes shrubs and dead plant material which accumulates, thus freeing the many low, herbaceous species to sunlight. Additional disturbance has occurred during historic times. The cutting of the longleaf pine and their use in naval industries may have spurred herbaceous communities by reducing canopy shading. Early this century a garden grew on Bean Patch Island. Soil disturbance by crayfish and the digging of raccoons in wet areas exposes ground to the establishment of many plant species. The dynamics of these savannah communities are little understood, but various forms of disturbance have and are continuing to play roles in their development.

The Nature Conservancy has approximately 228 acres of dry site, second-growth natural tree stands on the two southern projections. These are broken down to 133 acres of longleaf pine, seventy-eight acres of loblolly, and seventeen acres of pine/upland hardwoods (scrub oaks, sweetgum, etc.). Most of these stands have had fire exclusion for a number of years, such that a thick shrub layer of varying height dominates below the tree canopy. The soils of the natural stands are generally drier than the wetter savannah lands, thereby lacking the floral diversity and array of rare species of the latter. However, these areas are suitable upland habitat for several animals including deer and bear. Two large limestone sinks and several smaller ones are located in the Myers-Clemmons tract. Although they have not been inventoried in detail, they do not seem to be significant in relation to other sinks in southeast North Carolina (Tim Nifong, UNC/CH Botany Department, personal communication).

Approximately 950 acres of loblolly and slash pine plantation exist on NCNC property, primarily in the Myers-Clemmons and Beaverdam tracts. About one-half of this acreage was planted in 1960/1961 on dry, sandy uplands with a poor site index. Twelve acres of loblolly pine planted in 1961 are in need of thinning at this time. The remaining plantation tracts are four-to-seven-year stands of various site indices.

Fauna

The various communities within the Green Swamp prove habitat to a number of animal species. Table 3 lists the rarer animals found in the NCNC natural area or noted in the Green Swamp. Additional faunal information and studies

Table 3

Rare Animals in the Green Swamp

Rare Animals in the Green Swamp		Siting	
Species	Common Name	Status ¹	NCNC GS
<u>Fish:</u>			
Elassoma (new species)	Pigmy sunfish		Driving Cr.
Lepomis marginatus	Dollar sunfish		Small Borrow Pits
<u>Amphibians and Reptiles:</u>			
Alligator mississippiensis	American alligator	E	X
Crotalus adamanteus	Eastern diamondback rattlesnake	E	X
Micrurus fulvius fulvius	Eastern coral snake	SC	X
<u>Birds:</u>			
Ciconiiformes			
Eudocimus albus	White ibis	SC	X
Nyctanassa violacea	Yellow-crowned night heron	SC	X
Nycticorax nycticorax	Black-crowned night heron	SC	X
Passeriformes			
Aimophila aestivalis	Bachman's sparrow	T	X
Dendroica petechia	Yellow warbler	SC	X
D. virens	Black-throated green warbler	SC	X
Helmitheros swainsoni	Swainson's warbler	SC	X
Lanius ludovicianus	Loggerhead shrike	SC	X
Protonotaria citrea	Prothonotary warbler	SC	X
Pelecaniformes			
Anhinga anhinga	Anhinga	T	X
Piciformes			
Picoides borealis	Red-cockaded woodpecker	E	X
Falconiformes			
Accipiter striatus	Sharp-shinned hawk	T	X
Buteo jamaicensis	Red-tailed hawk	SC	X
B. lineatus	Red-shouldered hawk	T	X
Cathartes aura	Turkey vulture	T	X
Circus cyaneus	Marsh hawk	Undet.	X
Coragyps atratus	Black vulture	T	X
Falco sparverius	American kestrel	T	X
Pandion haliaetus	Osprey	SC	X

Table 3 (cont.)

Species	Common Name	Status ¹	Siting	
			NCNC	GS
<u>Mammals:</u>				
Condylura cristata	Star-nose mole			X
Felis concolor (perhaps var. coryi)	Eastern cougar (Florida)	E		X
Lasiurus seminolus	Seminole bat	Undet.		X
Odocoileus virginianus (remnant of nearly extirpated southern population)	White-tailed deer		X	
Plecotus rafinesquii macrostis	Rafineque's big-eared bat	Undet.		X
Ursus americanus	Black bear	SC	X	

¹ As listed in Cooper, J.E., et. al., 1977. Endangered and Threatened Plants and Animals of North Carolina, N.C. Museum of Natural History, Raleigh.

are found in Appendices G, H, and I. Information on specific nesting or denning areas is needed to determine species status. Nesting and feeding trees for the red-cockaded woodpecker exist on Bean Patch Island and Shoestring Island. Bear and deer commonly feed on upland sites, although the pocosin supports some seasonal forage and supplies refuge.

LEGAL INFORMATION

The Conservancy's property has tax-exempt status in Brunswick County. The area is classified as forestland in the 1976 Brunswick County Land Use Plan. The land is leased to the North Carolina Wildlife Resources Commission as gameland and as a bear sanctuary. Copies of the letter granting tax-exempt status, the NCWRC lease, and the county land use plan map are on file at the NCNC office in Chapel Hill.

OBJECTIVES OF THE GREEN SWAMP STEWARDSHIP PLAN

A broad set of objectives is essential to the stewards of the Green Swamp, not only as directives for present decisions, but also as guidelines in approaching future problems which will inevitably arise. The objectives are:

1. To protect, maintain, and enhance the natural communities and features within the property including the savannahs, pocosin, and natural pine stands, and variations within these.
2. To protect and enhance unusual plant and animal species, including endangered or threatened species, insectivorous plants, orchids, and red-cockaded woodpecker.
3. To make the natural area available for educational and scientific use by teachers and researchers.
4. To make portions available to the general public for aesthetic appreciation.
5. To foster local interest in and appreciation of the natural qualities of the area.
6. To optimally maintain suitable existing pine plantations as sources of income for the Green Swamp and other NCNC stewardship programs.

The first two objectives are interrelated and of primary importance. Without the maintenance of the swamp's natural features, the remaining goals lose their purpose.

THREATS TO THE NATURAL FEATURES

Three major threats to the natural features of the Green Swamp exist. The first is the loss of many savannah plant species due to the long-term exclusion

of fire. In the absence of fire, shrubs and dead grass material will shade out many of the low-growing herbs. Shrub invasion is most critical in the savannah-pocosin ecotone, an excellent habitat for many significant herbaceous species. Aerial photographs taken in 1937 show more extensive open savannahs than at present. Roads and drainage canals coupled with wildfire suppression have, in general, reduced fire frequency and subsequently reduced the area of open savannah. Through a systematic program of prescribe burning, NCNC will be able to maintain its savannah lands and associated species and check encroachment by shrubs.

The second threat is the destruction of sensitive savannah communities through excessive trampling by visitors. The wetter portions are dense with species diversity, and one cannot help but step on a venus flytrap and other significant plants when walking through. Major destruction occurs when several persons successively travel the same path. With the limited area of these wet habitats along the savannah edges, a significant portion may be destroyed without careful guidance and monitoring of visitor use.

A severe threat is the theft of plants, either the venus flytrap and other commercially valuable species, or timber for firewood. Many persons have been seen collecting plants along Rt. 211, and timber trespass has been reported at a couple of localities. Dealing with plant collectors will involve the regular patrolling of sites most vulnerable to collection, primarily the savannahs along Rt. 211. Additional assistance in discovering and identifying collectors may be available from paper company employees, Forest Service personnel, hunters, and frequent visitors. Any persons found digging plants will be told to leave the property, after it is explained to them the damage they are causing. NCNC may wish to prosecute second offenders for trespassing. Dealing with the problem posed by large-scale plant collectors involves a degree of understanding for their situation. Many have minimal alternative income. Collectors may prove stubborn, and prosecution could evoke a violent reprisal such as arson. Such occurrences have been known to take place; thus, care and tactfulness is necessary on the part of the patroller. Protection of the venus flytrap under North Carolina law expired July 1, 1980. Presently, an alternative, more effective law is under consideration by the Plant Protection Section of the N.C. Department of Agriculture.

NATURAL AREA INVENTORY FORM

Preliminary Reconnaissance Survey

Brunswick County, North Carolina

1. Natural Area Name: Greenbank Bluff

2. Location: Site is a northwest--facing bluff along the Cape Fear River, and is accessible by foot, or more easily, by boat. From the water, Greenbank Bluff is located ca. 1.25 miles northeast of Neils Eddy landing (Columbus County; see accompanying topographic quad sheet). By foot, the site is ca. 2.0 miles west of S.R. 1422.

3. Topographic Quadrangle Map Reference: Acme 1:62500.

Coordinates: $34^{\circ}22'N$ latitude; $78^{\circ}10'W$ longitude.

4. Size: ca. 3.2 ha. (8.0 A.).

5. Elevation: 0 to 15 m (0 to 50 ft.).

6. Vegetation Classification Category: III.D. Upland Hardwood Community.

7. Investigator(s): Timothy D. Nifong
Box 29, Coker Hall, UNC
Chapel Hill, N. C. 27514

8. Access: Cape Fear River via Neils Eddy Landing.

9. Site Description:

Greenbank Bluff is the highest and steepest north--facing slope within Brunswick County (see Acme, 1:62500, topographic quad sheet). It is composed primarily of "greenish-black" clay, an outcropping of the underlying Peedee Formation exposed by riverine downcutting, and has an associated marl phase (Richards (1950)* notes that the Peedee Formation is composed mostly of sands, but that "calcareous or impure limestone" and shell fragments are frequent (p.10)).

The dominant community type immediately above the bluff is Mixed hardwoods--including southern sugar maple (Acer saccharum ssp. floridanum) and beech (Fagus grandifolia) most prominently--/Mixed transgressive hardwoods and shrubs/Christmas fern (Polystichum acrostichoides) or partridge berry (Mitchella repens). Moving northward or southward along the bluff (away from the exposed marl outcrop), beech and sugar maple largely give way to pines (Pinus spp.) and mixed oaks (Quercus spp.) in the canopy over mixed heaths (Vaccinium spp. and others) in the shrub layer. One notable area in the northwesternmost portion of the bluff site exhibits a dense groundcover of galax (Galax aphylla) and trailing arbutus (Epigaea repens) under the Mixed oaks--pines/Mixed heaths.

The crest of the bluff itself is covered with very large (to an estimated 25 cm DBH) wax myrtles (Myrica cerifera), most of which are rooted at the slope crest and "recumbent" down the slope due to erosion and slumping of the substrate material. Although piles of slumped material at the base of the bluff and freshly exposed faces on the "cliff" indicate that the site is not completely stabilized, it nevertheless appears to exist in a relative state of equilibrium.

Wild hydrangea (Hydrangea arborescens) in dense stand covers most of the bluff face. The very notable exception is a population of grass-of-Parnassus (Parnassia grandifolia) which carpets the slope in an expanse estimated at 2 m by 4 m in size. In addition, several large patches of scouring rush (Equisetum hyemale) cover portions of the toe area of the bluff.

*Richards, H. G. 1950. Geology of the coastal plain of North Carolina. Trans. Amer. Philos. Soc., Philadelphia, 40: 1-83.

10. Ownership Summary:

a. Ownership type by percent area:

Type

Private	<u>100</u>	%
Public	<u> </u>	%
Unknown	<u> </u>	%

b. Number of owners: two (2)

c. Name(s) and address(es) of owner(s):

Fred Keith, % Keith Realty, St. Pauls, N. C.

Sledge Chip Corporation, Box 523, Whiteville, N. C.

11. Land Use Status:

a. Natural area usage category: low intensity recreation to no apparent use.

b. Use of surrounding land:

(1) Undeveloped 100 %

(2) Developed: agricultural or silvicultural %

(3) Developed: urban %

12. Management Summary:

a. Current preservation status:

Category	%	Description of preservation status
4	100	Private land, protected by owners.

b. Threats:

Category	Description of threat
4	Development of area above bluff as low density
	"residential" area poses only known potential
	hazard.

c. Management recommendations:

This is an isolated area of the county, and little future management is foreseen under continuation of present site conditions other than continued restriction of access to the site.

13. Site Significance Summary:

- (1) The bluff is the location of a population of grass-of-Parnassas (Parnassia grandifolia), disjunct from the southwest mountains of the state, where it is rare.
- (2) The high quality Mixed southern hardwoods/Mixed transgressives/Polystichum acrostichoides community type above the bluff is unusual for the southeast coast portion of the state.
- (3) The large population of galax (Galax aphylla) above the bluff area is significant for the southeast coast location.
- (4) The site constitutes a high quality geologic outcrop, presumed to be the Pee Dee Formation of Cretaceous age.

14. N. C. Natural Heritage Program Priority Rating:

High priority.

15. Field Reconnaissance Data Summary Sheet:

FLORA--immediate bluff area only

Canopy: Mixed southern hardwoods (all species above bluff)

Acer saccharum ssp. *floridanum*

Fagus grandifolia

Juglans nigra

Quercus alba

Subcanopy: None

Transgressives: Not recorded

Shrubs: *Hydrangea arborescens*

Hydrangea arborescens

Myrica cerifera (crest of bluff)--tree sized here

Herbs: No dominants

Mitchella repens (above bluff)

Parnassia grandifolia

Ferns: *Polystichum acrostichoides*

Polystichum acrostichoides

Fern Allies: No dominants

Equisetum hyemale

Vines: No dominants

Lonicera sempervirens

FAUNA

None recorded

SOIL SUBGROUP

Not applicable.

Figure 24. Greenbank Bluff

NATURAL AREA INVENTORY FORM

Preliminary Reconnaissance Survey
Brunswick County, North Carolina

1. Natural Area Name: Henrytown Savannah
2. Location: Site is located at end of private timber company service road heading northwest from S.R. 1412, 0.7 mi. west of its junction with highway US 17.
3. Topographic Quadrangle Map Reference: Winnabow 1:24000.
Coordinates: $34^{\circ}11'N$ latitude; $78^{\circ}07'W$ longitude.
4. Size: ca. 21.5 ha. (53 A.).
5. Elevation: 14 to 20 m (45 to 65 ft.).
6. Vegetation Classification Category: III.C.2. Sandhills Associates/
II.E.2. Flatwoods.
7. Investigator(s): Timothy D. Nifong
Box 29, Coker Hall, UNC
Chapel Hill, N. C. 27514
8. Access: S.R. 1412 (see attached county road map).

9. Site Description:

Henrytown Savannah is best described as an upland longleaf pine (Pinus palustris) savannah. The site is not typical of extensive savannah sites within the region, which are usually found on Pleistocene backbarrier flats, but rather, is located on a gentle, 2 to 10 per cent slope. It is further notable that the savannah is not ecotonal, at least in the usual sense of the word, between the pocosin community which borders it to the south and west (downslope), and the upland sand ridge community which borders it to the north and east (upslope), as the drier portions of the site are at its southern end, and the savannah becomes more mesic in nature moving upslope.

Longleaf pine is the ever present canopy species. Downslope there is no subcanopy or shrub layer, and the open herbaceous layer is dominated by wire-grass (Aristida stricta) and xeric herbs alternating with patches of bare white sand. Upslope, a low shrub layer approximately 0.5 to 1 m in height is present, dominated by a mixture of "pineland" shrubs, especially dwarf huckleberry (Gaylussacia dumosa), squaw-huckleberry (Vaccinium stamineum), dwarf blueberry (V. tenellum), and bitter gallberry (Ilex glabra). Almost always creeping blueberry (V. crassifolium) and wire-grass form a carpet beneath the shrub layer.

Although the longleaf pines of the canopy are generally small or medium sized, mature round timber "flat-tops" are present at the site, indicating that recent cutting of mature pines has not occurred here, as it has on many adjacent sites. Abundant evidences of past fires, such as charred trunks and stumps, are present at the site.

10. Ownership Summary:

a. Ownership type by percent area:

Type

Private	<u>100</u>	%
Public	<u> </u>	%
Unknown	<u> </u>	%

b. Number of owners: three (3)

c. Name(s) and address(es) of owner(s):

Federal Paper Board Co., P.O. Box 338, Bolton, N. C. 28423;

International Paper Co., 4354 Market St., Wilmington, N. C. 28401;

Lizzie James, Rt. 2, Box 426, Leland, N. C. 28511.

11. Land Use Status:

a. Natural area usage category: low intensity, managed timberland, to no apparent use.

b. Use of surrounding land:

(1) Undeveloped 100 %

(2) Developed: agricultural or silvicultural %

(3) Developed: urban %

12. Management Summary:

a. Current preservation status:

Category	%	Description of preservation status
6	100	Private land, not protected by owners.

b. Threats:

Category	Description of threat
3	Timbering by owners and subsequent replanting
	as pine plantation.

c. Management recommendations:

A program of regular prescribed burning of the site should be instituted. Burning every three to five years should be sufficient, as this site is generally semi-xeric in nature, and does not therefore produce extremely large masses of above-ground biomass annually.

Drainage of peripheral areas offers little concern relative to this particular site, as the savannah itself is, atypically, naturally a well to somewhat excessively drained upland location. Further, because access to the area is so limited, little threat to the site from the public at large is foreseen.

13. Site Significance Summary:

- (1) This is one of only a very few extensive, upland (slope) savannahs known, and the only such one occurring over an Entic Haplohumud soil. In addition, the mesic, upslope portion of the site seems to represent an area of incipient sink or bay formation.

14. N. C. Natural Heritage Program Priority Rating:

local priority.

15. Field Reconnaissance Data Summary Sheet: (cont.)

FAUNA

Birds:

Cardinal (*Cardinalis cardinalis*)
Chimney Swift (*Chaetura pelagica*)
Common Yellowthroat (*Geothlypis trichas*)
Great-crested Flycatcher (*Myiarchus crinitus*)
Prairie Warbler (*Dendroica discolor*)
Rufous-sided Towhee (*Pipilo erythrophthalmus*)
White-eyed Vireo (*Vireo griseus*)

SOIL SUBGROUP

Entic Haplohumods: spodic horizon at 80 cm.

Figure 25. Henrytown Savannah

NATURAL AREA INVENTORY FORM

Preliminary Reconnaissance Survey
Brunswick County, North Carolina

1. Natural Area Name: Long Bays Savannah
2. Location: Site is located east of S. R. 1321, 0.7 mile south of its junction with S. R. 1322.
3. Topographic Quadrangle Map Reference: Freeland 1:24000.
Coordinates: $34^{\circ}01'N$ latitude; $78^{\circ}32'W$ longitude.
4. Size: ca. 21.9 ha. (54 A.).
5. Elevation: 20 m (65 ft.).
6. Vegetation Classification Category: II.E.2. Flatwoods.
7. Investigator(s): Timothy D. Nifong
Box 29, Coker Hall, UNC
Chapel Hill, N. C. 27514
8. Access: S. R. 1321 (see attached county road map).

9. Site Description:

Long Bays Savannah represents one of few remaining extensive longleaf pine (Pinus palustris), sandy soil savannah sites in the area. Though soils here are sandy throughout the profile, an underlying spodic horizon perches the water table, making this a much wetter site than soil texture alone would indicate it to be.

Canopy pines here are large in comparison with most savannah sites in the county, though DBH's were not measured. Although abundant evidence of past frequent fires is present, fire has been excluded from the site for several years, resulting in the growth of an open, mixed shrub layer, consisting of most of the "typical" evergreen and ericaceous "bay" shrub species (see "Preliminary Field Reconnaissance Data Summary Sheet" species list). This shrub layer stands at approximately 1 to 1.5 meters in height. The "herbaceous" layer dominants are creeping blueberry (Vaccinium crassifolium) and wire-grass (Aristida stricta).

The savannah site is essentially bordered on all sides by pond pine (P. serotina) pocosin, within a series of Carolina bays and connecting drainages. The boundary between pocosin and savannah tends to be rather abrupt, rather than ecotonal (gradual), in nature, although the latter situation is the usual case within the area.

10. Ownership Summary:

a. Ownership type by percent area:

Type

Private	<u>100</u> %
Public	<u> </u> %
Unknown	<u> </u> %

b. Number of owners: one (1)

c. Name(s) and address(es) of owner(s):

Canal Industries, Inc.
Box 830
Conway, S. C. 29526.

11. Land Use Status:

a. Natural area usage category: low intensity recreation to no apparent use.

b. Use of surrounding land:

- (1) Undeveloped 100 % (but approximately 25% of surrounding land recently subdivided into lots and presently for sale).
- (2) Developed: agricultural or silvicultural %
- (3) Developed: urban %

12. Management Summary:

a. Current preservation status:

Category	%	Description of preservation status
6	100	Private land, not protected by owner.

b. Threats:

Category	Description of threat
3	Drainage, logging of area, and subsequent
	replanting of site as pine plantation by
	owner.

c. Management recommendations:

- (1) A program of prescribed--probably annual--burning should be instituted at the site.
- (2) Drainage ditches peripheral to the site along its eastern boundary should be closed if possible to prevent long term changes in the site to some extent.

13. Site Significance Summary:

- (1) The site represents the most extensive high quality longleaf pine (Pinus palustris) savannah over a Haplaquod soil known in the region.
- (2) Three species of special concern were noted at the site:
 - (a) Witch-alder (Fothergilla gardenii) is present among the savannah shrub species.
 - (b) Red-cockaded Woodpeckers (Picoides borealis) were noted at the site, although no cavity trees were located; this species is on the federal list of endangered species.
 - (c) Bachman's Sparrow, (Aimophila aestivalis), a threatened species within the state, was present at the site.
- (3) An extremely large population of yellow star-grass (Hypoxis juncea), an infrequent savannah species within the state, occurs at this site.

14. N. C. Natural Heritage Program Priority Rating:

High priority.

15. Field Reconnaissance Data Summary Sheet:

FLORA

Canopy: *Pinus palustris*
Pinus palustris

Subcanopy: None

Transgressives: No dominants

Diospyros virginiana
Magnolia virginiana
Nyssa sylvatica
Persea borbonia
Pinus serotina
Rhus copallina
Sassafras albidum

Shrubs: Mixed pineland shrubs

Fothergilla gardenii
Gaylussacia dumosa
G. frondosa
Ilex coriacea
I. glabra
Kalmia angustifolia var. *caroliniana*
Lyonia ligustrina
L. mariana
Myrica cerifera var. *pumila*
M. heterophylla
Rhododendron atlanticum
Sorbus arbutifolia
Vaccinium atrococcum
V. tenellum

Subshrub: *Vaccinium crassifolium*
Vaccinium crassifolium

Herbs: *Aristida stricta*

Agalinis sp.
Andropogon virginicus
Arsitida stricta
Arundinaria gigantea
Carphephorus tomentosus
Dichanthelium ensifolium (?)
Drosera capillaris
Hypericum fasciculatum (?)
H. reductum
Hypoxis juncea
Juncus scirpoides
Polygala lutea
Pterocaulon pycnostachyum
Pyxidanthera barbulata
Rhexia alifanus
Scleria sp.

15. Field Reconnaissance Data Summary Sheet: (cont.)

Herbs: (cont.)

Trilisa paniculata
Utricularia subulata
Xyris sp.

Vines: No dominants
Smilax laurifolia

Ferns: No dominants
Osmunda cinnamomea
Pteridium aquilinum

Moss: No dominant
Sphagnum sp.

FAUNA

Birds:

Bachman's Sparrow (*Aimophila aestivalis*)
Bobwhite (*Colinus virginianus*)
Brown-headed Nuthatch (*Sitta pusilla*)
Common Flicker (*Colaptes auratus*)
Common Yellowthroat (*Geothlypis trichas*)
Great-crested Flycatcher (*Myiarchus crinitus*)
Pine Warbler (*Dendroica pinus*)
Prairie Warbler (*D. discolor*)
Red-bellied Woodpecker (*Melanerpes carolinus*)
Red-cockaded Woodpecker (*Picoides borealis*)
Rufous-sided Towhee (*Pipilo erythrophthalmus*)
Summer Tanager (*Piranga rubra*)

Mammal:

Eastern Cottontail (*Sylvilagus floridanus*)

SOIL SUBGROUP

Aeric Haplaquods.

NATURAL AREA INVENTORY FORM

Preliminary Reconnaissance Survey

Brunswick County, North Carolina

1. Natural Area Name: McKinzie Pond Marsh
2. Location: Site is reached by travelling 1.35 miles west on S. R. 1521 from its junction with highway NC 133 to the entrance to the Orton Wildlife Refuge, then south on dirt road 1.1 miles; site is northwest of landing at end of dirt road.
3. Topographic Quadrangle Map Reference: Carolina Beach 1:24000.
Coordinates: $34^{\circ}04'N$ latitude; $77^{\circ}59'W$ longitude.
4. Size: ca. 8.5 ha. (21 A.).
5. Elevation: 0 to 1.5 m (0 to 5 ft.).
6. Vegetation Classification Category: II.B.2. Brackish Marsh
7. Investigator(s): Timothy D. Nifong
Box 29, Coker Hall, UNC
Chapel Hill, N. C. 27514
8. Access: S. R. 1521 (see attached county road map).

9. Site Description:

McKinzie Pond Marsh is almost completely dominated by a single brackish--fresh water marsh species, saw grass (Cladium jamaicense). In a few places common cattail (Typha latifolia) assumes minor importance within the stand. Only three woody species were observed in the marsh--red maple (Acer rubrum), swamp dogwood (Cornus stricta), and swamp willow (Salix caroliniana). Individuals of these woody species range from immature to (more characteristically) fairly old--although stunted and small--and it is not clear whether succession or retrogression, if either, is taking place at the site.

The saw grass marsh occurs primarily along the north boundary of McKinzie Pond, and extends from the pond's edge to the upslope area of the surrounding uplands, which are dominated by mixed pine and oak woods (see "Blue Pond Complex" report, 1979, N. C. Natural Heritage Program files for description). To the east and west the marsh is bordered by typical mixed bottomland hardwoods (see "Introduction" for description).

McKinzie Pond itself is located at the point where Allen Creek becomes Lilliput Creek (see topographic quad sheet), and is in essence simply a broad, rounded basin within the creek drainage. Its origin is unknown, but it is suggested here that because it is located in a region of abundant limesinks underlain by the Eocene Castle Hayne Formation, that perhaps McKinzie Pond represents a limesink that was dissected by an active drainage system, or alternatively, a sinkhole occurring within an established drainage basin.

Observed vegetation within the open water of the pond is limited to scattered patches of cow-lily (Nuphar luteum) and duckweed (Lemna perpusilla).

10. Ownership Summary:

a. Ownership type by percent area:

Type

Private	<u>100</u>	%
Public	<u> </u>	%
Unknown	<u> </u>	%

b. Number of owners: one (1)

c. Name(s) and address(es) of owner(s):

Lawrence G. Sprunt et al.
Box 3625
Wilmington, N. C. 28401.

11. Land Use Status:

a. Natural area usage category: low intensity recreation (fishing).

b. Use of surrounding land:

(1) Undeveloped 100 %

(2) Developed: agricultural or silvicultural %

(3) Developed: urban %

12. Management Summary:

a. Current preservation status:

Category	%	Description of preservation status
4	100	Private land, posted by owner, and patrolled
		by agent for the N. C. Wildlife Resources
		Commission, by lease agreement.

b. Threats:

Category	Description of threat
4	No known threat exists under the present owner--
	NCWRC management agreement.

c. Management recommendations:

This area is currently given protection sufficient to ensure site integrity, and little site management is necessary or recommended.

13. Site Significance Summary:

- (1) The site represents the only essentially "landlocked" or "upland" (non-estuarine) saw grass (Cladium jamaicense) marsh known.
- (2) Two species of special concern occur at the site:
 - (a) Ludwigia repens (N. C. Heritage files);
 - (b) Alligator mississippiensis (on federal endangered species list).

14. N. C. Natural Heritage Program Priority Rating:

local priority.

15. Field Reconnaissance Data Summary Sheet:

FLORA

Canopy: None

Subcanopy: None

Transgressives: No dominants

Acer rubrum

Cornus stricta

Salix caroliniana

Shrubs: No dominants

Myrica cerifera

Rosa palustris

Herbs:

Carex sp.

Cladium jamaicense

Erianthus sp.

Lemna perpusilla (pond)

Ludwigia repens (N. C. Natural Heritage Program files)

Nuphar luteum (pond)

Scirpus sp.

Typha latifolia

Ferns: No dominants

Woodwardia virginica

FAUNA

No list compiled

SOIL SUBGROUP

Terric Medisaprists.

Blue Pond

McKinzie Pond
Marsh

Figure 27. McKinzie Pond Marsh

Name of area: Orton Pond Natural Area

County: Brunswick

Location description: Orton Pond is reached by travelling 12.4 miles south on highway NC 133 from its junction with highway US 17, to the point where the road forks; proceed 1.4 miles south on the left-hand fork (S.R. 1529), at which point the road crosses the Orton Pond dam. The Orton Pond Natural Area is bordered on the north and west by NC 133, on the south by the Sunny Point Military Ocean Terminal (MOTSU), and except in the immediate Orton Creek (dam) vicinity, on the east by S.R. 1529.

Elevation: Sea level to 15 m (50 ft.) above sea level.

Topographic quad map reference: Carolina Beach 1:24000 (map attached)

Ownership information: Kenneth M. Sprunt
1726 Fairway Drive or Orton Plantation
Wilmington, N.C. 28403 Clarendon, N.C. 28432

Report prepared by: Timothy D. Nifong
Box 29, Coker Hall
Dept. of Botany, UNC
Chapel Hill, N.C. 27514

Edgar P. Roberts, Jr.
2710 Bartram Road
Winston-Salem, N.C. 27106

Other persons knowledgeable about the site:

Dr. James F. Parnell
Dept. of Biology, UNC-W
Wilmington, N.C. 28401

Current use and protection status:

The entire Orton Pond area is privately owned and under private administration, and is zealously guarded against outside trespass or other unauthorized use of the area. It is probable that it is this very close attention which has allowed this unique area to remain in a relatively undisturbed state as compared to the surrounding area, and which has perpetuated the high site quality relative to vegetational communities, as well as actual and potential wildlife usage.

Orton Pond itself is used primarily for hunting and fishing by a small number of individuals, which has very little lasting impact on the area. No other human activities in the area are known, although it is probable that some merchantable timber either exists or has been harvested adjacent to the upper reaches of the pond.

It is quite possible that some future detrimental effects could occur among the plant and animal species assemblages that occupy the Tom's Branch arm of Orton Pond, as a result of saline contamination resulting from salt seepage into the groundwater from spoils material deposited by the U.S. Army Corps of Engineers in the drainage areas adjacent to Tom's

Branch on the nearby Sunny Point Military Ocean Terminal (MOTSU).

The Sampson Pond area contains a number of high quality doline pond sites, which exist in very good condition relative to other similar sites in the area. Sampson Pond was once used for swimming and other recreation on a small scale, but this use has apparently been largely discontinued in recent years. The ponds are all located in an area which is vegetated primarily by a stand of second growth longleaf pine (Pinus palustris), although other successional communities are present in surrounding tracts which have been disturbed at some time in the past. It is not known if there are future plans to harvest timber in the Sampson Pond area.

Vegetation and plant communities:

Any extensive discussion of Orton Pond Natural Area vegetational communities would be relatively meaningless, since access to the area was not granted by the landowner, and consequently, no vegetation sampling was possible. However, in viewing aerial photography of the Pond area in conjunction with field reconnaissance as was afforded from public roads, it appears likely that the most extensive upland plant communities, such as occur in the Sampson Pond area and in the upland areas west of Orton Pond, are very similar to those comparable communities described in the Boiling Springs Lakes area report, which deals with the directly adjacent area west of Orton Pond.

Known vegetational communities in the immediate vicinity of Orton Pond are somewhat unique, and in view of both the age of the pond itself and the topography of the immediately surrounding upland areas, a sampling of vegetational communities on and adjacent to the pond margins would probably be most interesting. Because the lake is relatively extensive and very old, huge beds of aquatic species, such as water shield (Brasenia schreberi), water milfoil (Myriophyllum heterophyllum), and yellow nelumbo (Nelumbo lutea) exist within the pond. Bald cypress (Taxodium distichum) occurs in dense stand along the margins of the pond, and as stunted individuals scattered throughout the pond. In addition, bluff areas to the north of the pond are vegetated by a relatively mature oak--hickory hardwood forest, as well as by mature stands of longleaf pine in some areas.

Physical features:

General description--Orton Pond, oriented in a SW-NE direction, resulted from the damming of Orton Creek. In its upper reaches the pond is flanked by a series of relatively steep bluffs. Towards the eastern end of the pond, a series of hills and low ridges occur interspersed with a series of shallow, irregularly-shaped depressions (e.g., Sampson Pond).

Topography--Both N- and S-facing bluffs surround much of Orton Pond. Relief ranges to 15 m in the pond's westernmost extensions, but is generally in the range of 6 m at the eastern pond margin. Ponds occurring near the SE end of Orton Pond have gently to moderately-sloping walls, and are believed to have resulted from subsurface solution of limestone deposits, followed by subsequent surface slumping.

Geology--The surficial sediments are marine-deposited sands and clays of the Pamlico Terrace of Pleistocene age, overlying the Castle Hayne Limestone of Eocene age.

¹Parnell, J.F. 1979. Personal communication. Dept. Biology, UNC-W, Wilmington, N.C. 28401.

Rare plants and animals:

Potamogeton illinoensis: Endangered peripheral. Occurs in area of the dam on Orton Pond.

Rhyncospora pleiantha: Endangered peripheral. From rim of doline pond north of Sampson Pond.

Alligator mississippiensis: Endangered. Breeds in creek areas of Orton Pond.

Anhinga anhinga: Threatened. Known to breed regularly at Orton Pond.

Dendrocopus borealis: Endangered. Mature cavity trees (longleaf pine) known to be located N and W of pond. Probably also occur S of Orton Pond in the Sampson Pond area. Fire protection of area believed to be having detrimental effects on appropriate habitat for this species.

Elliptio sp.: Special concern. Population may be threatened by saline contamination of groundwater in Tom's Branch area caused by dredged spoils disposal in upland area of the adjacent MOTSU property.

Microtus pennsylvanicus: Special concern. Breeding population in the area.

Neotorna floridans: Special concern. Breeding population in the area.

Pandion haliaetus: Special concern. 61 nesting pairs were observed on Orton Pond in 1971. Records of osprey nesting on pond date back to the turn of the century. Nesting occurs in bald cypress on Orton Pond and in the Orton Creek swamp just below the dam, as well as in pond cypress on Sampson Pond. Area believed extremely important as a refugia from which adjacent areas of suitable habitat might be colonized as population increases.

Sciurus niger: Special concern. Range of the fox squirrel is much reduced in the area due to timbering operations. Survival of the species critically related to the availability of mast from mature stands of longleaf pine, such as still remain in the Orton Pond--Sampson Pond area.

Publications and scientific references:

Blankenship, R.R. 1965. Reconnaissance of the ground-water resources of the Southport--Elizabethtown area, North Carolina. N.C. Dept. Water Res., Div. Ground Water, Ground-Water Bul. No. 6: 47 pp.

Daniels, R.B., et. al. 1978. Age of soil landscapes in the coastal plain of North Carolina. Soil Sci. Soc. Am. J. 42: 98-105.

Parnell, J.F. & R. Walton. 1972. Osprey reproductive success in southeastern North Carolina. In Transactions of the North American Osprey Research Conference, J.C. Ogden, ed. US Dept. Int. Nat. Park Serv. Washington, D.C.

Site ecological significance:

A summarization of the ecologically significant features of the Orton--Sampson Pond area follows:

- 1) Existence of a very old--and very large relative to other lakes in the area--body of freshwater, Orton Pond, in a relatively undisturbed state.
- 2) Presence within Orton Pond of at least one threatened or endangered plant species, the endangered peripheral aquatic, pondweed (Potamogeton illinoensis), and the probable occurrence of other such species at the site.
- 3) The current and historical importance of Orton Pond as a breeding area for many species of birds, of which the water turkey (Anhinga anhinga) is threatened, and the osprey (Pandion haliaetus) is a species of special concern; the osprey is also known to nest at Sampson Pond. The breeding habitat constituted by Orton Pond is believed to be critical to maintenance of current population levels of these species.
- 4) Use of the Orton Pond area by other animal species of significance, including the American alligator (Alligator mississippiensis), an endangered species, and one or more species of the pond spike (Elliptio sp.), a mollusk of special concern.
- 5) Existence of a number of high quality, relatively undisturbed doline ponds that exhibit marked vegetation zonation and high species diversity.
- 6) Presence of at least one endangered "doline pond species," beak rush (Rhynchospora pleiantha), with excellent areas of habitat present for the occurrence of other such "sink" species of special significance.
- 7) Importance of the mature longleaf pine forest surrounding much of the Orton--Sampson Pond area, known to contain a population of red-cockaded woodpeckers (Dendrocopus borealis), an endangered species, as well as known to constitute an area of critical habitat for several animal species of special concern--the fox squirrel (Sciurus niger), Eastern wood rat (Neotoma floridana)

Management recommendations:

Due to the incomplete database, relative to the entire extent of this ecologically diverse area, which exists to this point, in conjunction with the current exclusion from the area of most outside interests, it is felt that any attempt to outline management recommendations for the area would be premature and relatively useless.

It is hoped that those persons who use and control usage of the Orton Pond--Sampson Pond area will realize its extreme ecological importance, and continue to preserve it--as they largely have in the past--in its current, relatively undisturbed condition.

C O U N T Y

Figure 28. Orton Pond Access Map

Figure 29. Orton Pond and Sunny Point Limesinks

Green Pond
Savannah

Figure 30. Orton Pond (West End)

179

ROAD CLASSIFICATION

Heavy duty

Light duty

Unimproved dirt

U S Route

State Route

79.3
179

FLORA SPECIES LIST

The following species list contains either those species which were either relatively readily identifiable from a distance or occurred adjacent to public access roads through the area, and species records reported firsthand by reliable taxonomists, as access to the Orton Pond and Sampson Pond areas was not granted. Those species records which are marked with an asterisk were kindly provided to me by Dr. A.E. Radford, UNC-Chapel Hill, from a 1951 collection of the area.

Orton Pond Area:

Habitat:

<i>Bacopa caroliniana</i> *	marshy pond edge
<i>Brasenia schreberi</i>	floating aquatic
<i>Cambomba caroliniana</i> *	swamp edge
<i>Ceratophyllum echinatum</i> *	sandy pond edge
<i>Echinodorus cordifolius</i> *	swamp edge
<i>Habenaria repens</i> *	swamp edge
<i>Hydrochloa caroliniensis</i> *	swamp edge
<i>Ilex cassine</i> *	swamp edge
<i>Myriophyllum heterophyllum</i>	submersed aquatic
<i>Najas</i> sp.*	sandy pond edge
<i>Nelumbo lutea</i>	floating aquatic
<i>Nymphaea odorata</i>	floating aquatic
<i>Nuphar luteum</i> ssp. <i>macrophyllum</i>	floating aquatic
<i>Pontederia cordata</i>	marshy pond edge
<i>Potamogeton illinoensis</i>	pond edge
<i>Sagittaria graminea</i> *	swamp edge
<i>Taxodium distichum</i>	pond margins; scattered throughout pond
<i>Typha latifolia</i>	marshy pond edge

Sampson Pond Area:

Trees:

Nyssa sylvatica var. *biflora*
Pinus palustris
P. taeda
P. serotina
Taxodium ascendens

Shrubs:

Cephalanthus occidentalis
Cyrilla racemiflora
Ilex coriacea
I. glabra
Lyonia lucida
Magnolia virginiana
Myrica cerifera
Persea borbonia
Vaccinium arboreum
V. stamineum

Herbs:

Forbs--

Bartonia virginica
Burmannia biflora

	<i>Centella asiatica</i>
	<i>Drosera capillaris</i>
	<i>D. intermedia</i>
	<i>Eleocharis microcarpa</i>
	<i>Eriocaulon compressum</i>
	<i>E. sp.</i>
	<i>Hypericum reductum</i>
	<i>Lachnanthes caroliniana</i>
	<i>Ludwigia alternifolia</i>
	<i>Polygala cymosa</i>
	<i>P. lutea</i>
	<i>Rhexia lutea</i>
	<i>R. mariana</i>
	<i>Utricularia biflora</i>
	<i>U. fibrosa*</i>
	<i>Xyris sp.</i>
Aquatics--	<i>Brasenia schreberi*</i>
	<i>Cabomba caroliniana*</i>
	<i>Egeria densa*</i>
	<i>Myriophyllum heterophyllum*</i>
	<i>Najas guadalupensis*</i>
	<i>Nuphar luteum</i> ssp. <i>macrophyllum</i>
	<i>Nymphaea odorata</i>
	<i>Nymphoides aquatica</i>
	<i>Potamogeton sp.*</i>
Graminoids--	<i>Aristida stricta</i>
	<i>Carex comosa*</i>
	<i>Juncus sp.</i> (<i>elliottii</i> group)
	<i>Panicum verrucosum</i>
	<i>P. sp.</i>
	<i>P. sp.</i> (no. 2)
	<i>Rhynchospora filifolia</i>
	<i>R. harveyi</i>
	<i>R. pleiantha</i>
	<i>Sacciolepis striata</i>
	<i>Scleria ciliata</i>
Ferns and fern allies--	<i>Lycopodium alopecuroides</i>
	<i>L. appressum</i>
	<i>Woodwardia virginica</i>
Vines:	<i>Smilax laurifolia</i>
	<i>S. sp.</i>
Mosses:	<i>Sphagnum sp.</i>

Fauna Species List: Orton Pond Natural Area

Desmognathus fuscus - Northern dusky salamander

Plethodon glutinosus - Slimy salamander

Acris gryllus - Southern cricket frog

Bufo americanus - American toad

Bufo quercicus - Oak toad

Bufo terrestris - Southern toad

Hyla cinerea - Green treefrog

Hyla crucifer - Spring peeper

Hyla femoralis - Pine woods treefrog

Hyla squirella - Squirrel tree frog

Pseudacris ornata - Ornate chorus frog

Rana catesbeiana - Bullfrog

Rana clamitans clamitans - Bronze frog

Rana virgatipes - Carpenter frog

Didelphis marsupialis - Opossum

Glaucomys volans - Southern flying squirrel

Lynx rufus - Bobcat

Microtus pennsylvanicus - Meadow vole

Neotoma floridana - Eastern wood rat

Odocoileus virginianus - Whitetail deer

Oryzomys palustris - Eastern rice rat

Peromyscus gossypinus - Cotton mouse

Peromyscus nuttalli - Golden mouse

Procyon lotor - Raccoon

Reithrodontomys humilis - Eastern harvest mouse

Scalopus aquaticus - Eastern mole

Sciurus carolinensis - Eastern gray squirrel

Sciurus niger - Fox squirrel

Sigmodon hispidus - Common cotton rat

Sylvilagus floridanus - Eastern cottontail

Sylvilagus palustris - Marsh rabbit

Urocyon cinereoargenteus - Grey fox

Alligator mississippiensis - American alligator
Chelydra serpentina - Common snapping turtle
Chrysemys concinna - River cooter
Chrysemys scripta - Yellow-bellied pond slider
Clemmys guttata - Spotted turtle
Sternotherus odoratus - Stinkpot
Terrapene carolina - Eastern box turtle

Anolis carolinensis - Green anole
Cnemidophorus sexlineatus - Six-lined racerunner
Eumeces fasciatus - Five-lined skink
Eumeces inexpectatus - Southeastern five-lined skink
Eumeces laticeps - Broad-headed skink
Ophisaurus attenuatus - Eastern slender glass lizard
Ophisaurus ventralis - Eastern glass lizard

Aghistrodon contortrix - Southern copperhead
Aghistrodon piscivorus - Eastern cottonmouth
Carphophis amoenus amoenus - Eastern worm snake
Coluber constrictor - Black racer
Elaphe guttata - Corn snake
Elaphe obsoleta - Rat snake
Heterodon simus - Southern hognose snake
Lampropeltis getulus - Eastern mole snake
Masticophis flagellum - Eastern coachwhip
Natrix erythrogaster - Red-bellied water snake
Natrix faciata - Banded water snake
Natrix taxispilota - Brown water snake
Opheodrys aestivus - Rough green snake
Rhadinaea flavilata - Pine woods snake
Sistrurus miliarius - Carolina pygmy rattlesnake
Storeria occipitomaculata - Red-bellied snake
Thamnophis sauritus sauritus - Eastern ribbon snake
Thamnophis sirtalis sirtalis - Eastern garter snake

Anhinga anhinga leucogaster - Anhinga (water turkey)

Dendrocopus borealis - Red-cockaded woodpecker

Melanerpes erythrocephalus - Red-headed woodpecker

Pandion halioetus carolinensis - Osprey

Name of area: Piver Bays Bog

County: Brunswick

Location description: The Piver Bays Bog area is reached by travelling west 0.25 mi. on highway NC 130 from its juncture with Co. Rd. 1335. The bog is located approximately 15m south of NC 130.

Elevation: 18.3m (60 ft.) above sea level.

Physiographic region: Atlantic Plain Province: Coastal Plain
Section: Sea Islands Downwarp

Topographic quad map reference: Exum 1:31680 (map attached).

Size: ca. 1.5 acres.

Ownership information: International Paper Company (?)
Shallotte, N.C. 28459.

Report prepared by: Timothy D. Nifong
Box 29, Coker Hall
Dept. of Botany, UNC
Chapel Hill, N.C. 27514.

Other persons knowledgeable about site: Steve Leonard
Dept. of Biology
Florida State University
Tallahassee, Florida.

Current use and protection status:

There is currently no known usage of this area. However, because it is in a location and situation very similar to that of the Cypress Creek Bog--adjacent to highway NC 130 and partially within a power line easement, and on relatively non-productive paper company land--the Piver Bays Bog is subject to the same sorts of possible threats as is the Cypress Creek Bog area. These include possible use of herbicides by the power company to maintain power line right-of-way clearance, possible clearing and subsequent replanting of the area by the owner, and a possible widening of highway NC 130 (see Cypress Creek Bog Natural Area report).

Vegetation and plant communities:

With respect to vegetational communities, the Piver Bays Bog is very similar to the Cypress Creek Bog area occurring some 15 miles northwestward. The primary difference relates to the fact that the Piver Bays Bog lies adjacent to NC 130 at a point where the road dissects the inner portions of a series of adjacent Carolina bays; consequently, there is much less of an extended, raised flat surrounding the Piver Bays Bog than surrounds the Cypress Creek Bog, and the vegetational communities surrounding the Piver bog are thusly somewhat more homogeneous than those plant communities surrounding the Cypress Creek Bog. The bog vegetation and the surrounding bay

vegetation are discussed below. It should be mentioned at the outset that, as is usually the case in coastal plain vegetational communities, abundant evidences, e.g., charred stumps and tree trunks, clustered stem arrangements, etc., indicate the important role played by fire in the past development and maintenance of the bog and surrounding bay communities.

Bog communities--The vegetation combinations found within the bog itself may be divided into three community types:

- 1) Black gum. Nyssa sylvatica var. biflora. Dwarfed black gum approximately 2m in height and 5 to 6 cm dbh (diameter at breast height), and having swollen bases, dominate much of the bog, with nothing, other than occasional pockets of sphagnum moss (Sphagnum sp.), growing below the gum. Water within the bog (pond) is deepest here, seasonally to 40cm.
- 2) Black gum/diffuse rush. Nyssa sylvatica var. biflora/Juncus diffusissimus. The water level is slightly shallower within this community type, and black gum forms an open canopy over diffuse rush. Sphagnum moss may or may not be present as a ground-covering mat.
- 3) Diffuse rush--yellow-eyed grass--beak rush. Juncus diffusissimus--Xyris fimbriata--Rhynchospora chalarocephala. A combination of diffuse rush and yellow-eyed grass share dominance in these treeless areas. Beak rush may share dominance within this community type, or may dominate it altogether. Sphagnum moss usually covers the surface of the ground here.

In addition, the presence of a large and occasionally dense, healthy, reproducing population of sweet pitcher plant (Sarracenia rubra) should be mentioned as occurring within the bog community at various scattered localities, characteristically growing on thick sphagnum mats.

Disturbed savannah community--A brief mention should be made of the vegetation which exists between the bog and highway NC 130, in the power line right-of-way. A disturbed--the area is mowed--mixed evergreen shrubs/mixed graminoids community type occurs here in a zone some 10 to 15m in width.

Surrounding bay communities--The bog (pond) area itself is surrounded by an open, pine flatwoods community, which gradually changes to a denser, fairly typical "bay community" in moving further outwards from the bog in any direction. Each of these areas is discussed below:

- 1) Pond pine/mixed evergreen shrubs/creeping blueberry-wiregrass. Pinus serotina/mixed evergreen shrubs/Vaccinium crassifolium--Aristida stricta. This flatwoods community, which immediately surrounds the bog, is characterized by an open canopy layer of scattered pond pines, with individual trees averaging approximately 12 to 16cm dbh. The tall, open shrub layer is composed of mixed evergreen shrubs (see accompanying Flora Species List), with bitter gallberry (Ilex glabra) and sweet gallberry (Ilex coriacea) occasionally occurring as the shrub layer codominants. A mixture of creeping blueberry and wiregrass forms the "herbaceous" layer.
- 2) Pond pine/mixed evergreen shrubs//laurel-leaf sawbrier. Pinus serotina/mixed evergreen shrubs//Smilax laurifolia. This is the "typical" dense pocosin community that dominates most of the inner (Carolina) bay area which borders Piver Bays Bog. Floristically it is similar to the pine flatwoods community just previously discussed, but it is different from that community in the fact that no herbaceous layer is present within this latter discussed community type, due to the thick shrub layer which is "tied" together into a nearly impenetrable thicket by a tangling growth of laurel-leaf sawbrier (Smilax

laurifolia).

Physical features:

General description--Piver Bays Bog is a shallow, elliptical depression with a slight E-W orientation, located within the dense pocosin community of a NW-SE trending Carolina bay.

Topography--The bog itself is some 0.5m lower in elevation than the surrounding landscape, normally containing standing water for almost the entire year; the surrounding bay area is extremely flat, with relief totalling much less than 1m.

Geology--The surficial sediments are marine deposited sands and clays of the Pamlico Terrace of Pleistocene age, most likely overlying the Pee Dee Formation of Late Cretaceous age.

Rare plants and animals:

Dionaea muscipula. Venus' flytrap. Threatened endemic; exploited.

Marshallia grandiflora. Great marshallia. Endangered peripheral. Reported from the Piver Bays Bog by Kologiski and Connette in their 1973 N.C. Natural Areas Survey, this record could not be substantiated in the field. However, because the species blooms in late spring, and the Piver bog was visited in late summer, it is possible that this species could occur within the bog area and pass unnoticed. This record, if substantiated, represents a significant disjunction, as the species is known only from a few bogs in Henderson and Granville Counties, N.C. within the Carolinas.

Sarracenia rubra. Sweet pitcher plant. Threatened throughout; exploited. This location represents one of the largest, most concentrated populations of sweet pitcher plant known in the area.

Publications and scientific references:

Blankenship, R.R. 1965. Reconnaissance of the ground-water resources of the Southport-Elizabethtown area, North Carolina. N.C. Dept. Water Res., Div. Ground Water, Ground-Water Bul. No. 6. 47 pp.

Daniels, R.B., et. al. 1978. Age of soil landscapes in the coastal plain area of North Carolina. Soil Sci. Soc. Am. J. 42: 98-105.

Radford, A.E., et. al. 1964. Manual of the Vascular Flora of the Carolinas. UNC Press. Chapel Hill, N.C. 1183 pp.

Site ecological significance:

The ecologically significant features of the site are summarized:

- 1) The occurrence of a relatively undisturbed, inner bay bog community, an increasingly rare phenomenon on the southeastern coastal plain of the state where extensive ditching and draining activities have occurred.
- 2) Possible locality for Marshallia grandiflora, an endangered peripheral species known only from the mountains of the Carolinas.
- 3) The occurrence of a large, healthy, reproducing population of Sarracenia rubra, a species that is threatened throughout its range.

- 4) Presence of Dionaea muscipula, a threatened and commercially-exploited endemic species.

Management recommendations:

The management guidelines formulated for the Piver Bays Bog area are in essence identical to those suggested with regard to the Cypress Creek Bog Natural Area. Consequently, the guidelines are summarized below, but are not repeated here in detail (see Cypress Creek Bog Natural Area report):

- 1) Responsible parties should be contacted in order to insure the future survival of the bog community and a surrounding buffer zone of appropriate size.
- 2) The area should be periodically burned to maintain the fire-dependent vegetational communities in their present state.
- 3) The bog area should be monitored and protected from removal of its threatened and endangered species, if such action should prove necessary.

FLORA SPECIES LIST

Piver Bays Bog:

Trees:

Pinus serotina

Transgressives:

Acer rubrum

Nyssa sylvatica var. *biflora*

Pinus palustris

Shrubs:

Clethra alnifolia

Cyrilla racemiflora

Gaylussacia frondosa

Gordonia lasianthus

Ilex cassine

I. coriacea

I. glabra

Leucothoe racemosa

Lyonia lucida

L. mariana

Magnolia virginiana

Myrica cerifera

M. heterophylla

Persea borbonia

Rhus copallina

Sorbus arbutifolia

Vaccinium atrococcum

V. stamineum

V. tenellum

Subshrub:

Vaccinium crassifolium

Herbs:

Forbs--

Agalinis virgata (?)

Aletris farinosa

Carphephorus tomentosus

Centella asiatica

Chondrophora nudata

Coreopsis angustifolia

Dionaea muscipula

Drosera intermedia

Eriocaulon decangulare

Eupatorium album

E. pilosum

E. recurvans

Heterotheca nervosa

Hypericum cistifolium

H. reductum

H. stans

Lachnanthes caroliniana

Lobelia nuttallii

Ludwigia sp.

Marshallia grandiflora*
Polygala lutea
P. ramosa
Rhexia alifanus
R. mariana
Sabatia difformis
Sabatia sp.
Sarracenia flava
S. rubra
Solidaga sp.
Trilisa paniculata
Utricularia juncea
Utricularia sp.
Xyris ambigua
X. fimbriata

Graminoids--

Andropogon ternarius
A. virginicum
Aristida stricta
Arundinaria gigantea
Juncus diffusissimus
J. scirpoides
Muhlenbergia inexpansa
Panicum sp.
Rhynchospora cephalantha
R. chalorocephala
R. chapmanii
R. fascicularis

Ferns and fern allies--

Lycopodium appressum
L. carolinianum
Woodwardia virginica

Vines:

Gelsimium sempervirens
Smilax glauca
S. laurifolia
Vitis rotundifolia

Mosses:

Sphagnum sp.

*Reported for this location by Kologiski and Connette in their 1973 N.C. Natural Areas Survey; record was not substantiated in the field.

NATURAL AREA INVENTORY FORM

Preliminary Reconnaissance Survey

Brunswick County, North Carolina

1. Natural Area Name: Sandhill Creek Impoundment
2. Location: Upper end of creek crosses highway NC 133 0.25 mile north of its junction with S. R. 1521; Sandhill Creek runs northeastward from this point.
3. Topographic Quadrangle Map Reference: Carolina Beach 1:24000.
Coordinates: $34^{\circ}06'N$ latitude; $77^{\circ}57'W$ longitude.
4. Size: ca. 78.6 ha. (194 A.).
5. Elevation: 1.5 to 3 m (5 to 10 ft.).
6. Vegetation Classification Category: I.A. Freshwater Pond Community;
II.C. Swamp Forest.
7. Investigator(s): Timothy D. Nifong
Box 29, Coker Hall, UNC
Chapel Hill, N. C. 27514
8. Access: Highway NC 133 (see attached county road map).

9. Site Description:

Sandhill Creek Impoundment is, like Orton Pond, the man-made lake of an old plantation. The impoundment here is, however, shallower than Orton Pond, and relatively little "open" water exists at the site; swamp forest extends well out into the impoundment. The swamp forest thus created is dominated by swamp black gum (Nyssa sylvatica var. biflora) and pond cypress (Taxodium ascendens), with little else approaching canopy size. In open areas water lily (Nymphaea odorata) and duckweed (Lemna spp.) cover the surface of the water.

The Sandhill Creek drainage is located within the Orton--Boiling Springs Lakes area Pleistocene barrier sand ridge region, and is, therefore, surrounded on all sides by upland pine forest. In the southern portion of this upland pine community the dominant community type is, as might be predicted, Pinus palustris/Mixed Oaks (Quercus incana, Q. laevis, and Q. margaretta)/Mixed Pineland Shrubs/Aristida stricta; however, it is interesting to note that storax (Styrax grandifolia) is abundant among the ericads of the open shrub layer.

The often broad ecotone area between the impoundment itself, and the surrounding upland longleaf pine community, is dominated by a dense thicket of swamp forest/bay forest type species, including red maple (Acer rubrum), red bay (Persea borbonia), swamp black gum, and pond cypress among the canopy species, and shining fetter-bush (Lyonia lucida), sweet gallberry (Ilex coriacea), and titi (Cyrilla racemiflora) in the shrub and "subcanopy" layers. The shrub, sub-canopy, and canopy layers tend to merge in a continuum of size classes in this ecotonal area.

10. Ownership Summary:

a. Ownership type by percent area:

Type

Private	<u>100</u>	%
Public	<u> </u>	%
Unknown	<u> </u>	%

b. Number of owners: one (1)

c. Name(s) and address(es) of owner(s):

Town Creek Timber Company, 810 DuPont Bldg., Miami, FL 33131.

11. Land Use Status:

a. Natural area usage category: low intensity recreation; managed for wildlife.

b. Use of surrounding land:

(1) Undeveloped 100 %

(2) Developed: agricultural or silvicultural %

(3) Developed: urban %

12. Management Summary:

a. Current preservation status:

Category	%	Description of preservation status
4	100	Private land, protected by owner.

b. Threats:

Category	Description of threat
3	Disturbance from clearing adjacent uplands and
	replanting in pines; possible industrial
	development.

c. Management recommendations:

- (1) Public access to the impoundment should continue to be restricted during the spring nesting season of the birds breeding in the Sandhills Creek rookery;
- (2) A buffer zone of some undetermined width should be maintained surrounding the creek drainage basin, to ensure the protection of water quality and preclude siltation and pollution from construction or silvicultural practices.

13. Site Significance Summary:

(1) The site represents significant animal breeding habitat, summarized below:

(a) The site represents an inland heronry containing breeding populations of both Great Blue Herons (Ardea herodias) and Anhingas (Anhinga anhinga), a threatened species in the state (see summary Table 3).

(b) The American Alligator (Alligator mississippiensis) is relatively abundant at the site, and breeds in the impoundment (fidé J. Newman, Brunswick Co. NCWRC agent); the alligator is on the federal endangered species list.

(2) The site contains a good example of a swamp black gum (Nyssa sylvatica var. biflora)--pond cypress (Taxodium ascendens) swamp, with a number of old growth trees.

14. N. C. Natural Heritage Program Priority Rating:

local priority.

15. Field Reconnaissance Data Summary Sheet:

FLORA

Canopy: *Nyssa sylvatica* var. *biflora*--*Taxodium ascendens*
Liquidambar styraciflua
Nyssa sylvatica var. *biflora*
Taxodium ascendens

Subcanopy: Mixed bay species to No dominants
Acer rubrum
Persea borbonia

Transgressives: Mixed bay species to No dominants
Acer rubrum
Liquidambar styraciflua
Magnolia virginiana
Nyssa sylvatica var. *biflora*
Persea borbonia
Taxodium ascendens

Shrubs: Mixed bay species to No dominants
Clethra alnifolia
Cyrilla racemiflora
Gaylussacia frondosa (ecotone)
Ilex coriacea (ecotone)
Lyonia lucida
Myrica cerifera (ecotone)
Rhus vernix
Sorbus arbutifolia (ecotone)

Herbs: *Nymphaea odorata*--*Lemna* sp. in open pond areas
Azolla caroliniana (pond)
Lemna spp. (pond)
Nymphaea odorata (pond)
Xyris sp.

Vines: No dominants
Smilax laurifolia

Ferns: No dominants
Osmunda cinnamomea

FAUNA

Birds:

Carolina Wren (*Thryothorus ludovicianus*)
Common Flicker (*Colaptes auratus*)
Great Blue Heron (*Ardea herodias*)
Great Egret (*Casmerodius albus*)
Great-crested Flycatcher (*Myiarchus crinitus*)
Northern Parula (*Parula americana*)
Pileated Woodpecker (*Dryocopus pileatus*)
Pine Warbler (*Dendroica pinus*)
Prairie Warbler (*D. discolor*)
Prothonotary Warbler (*Protonotaria citrea*)

15. Field Reconnaissance Data Summary Sheet: (cont.)

Birds: (cont.)

Red-bellied Woodpecker (*Melanerpes carolinus*)

Robin (*Turdus migratorius*)

Snowy Egret (*Egretta thula*)

Wood Duck (*Aix sponsa*)

Yellow-throated Warbler (*Dendroica dominica*)

SOIL SUBGROUP

No core taken.

Figure 32. Sandhill Creek Impoundment

NATURAL AREA INVENTORY FORM

Preliminary Reconnaissance Survey
Brunswick County, North Carolina

1. Natural Area Name: Smithville Carolina Bay Complex
2. Location: Access roads; (1) dirt road heads north from highway NC 211 2.1 miles west of junction of NC 211 and NC 133; (2) dirt road heads west from highway NC 87 1.4 miles south of the junction of the entrance road to South Brunswick High School and NC 87.
3. Topographic Quadrangle Map Reference: Southport 1:24000.
Coordinates: ca. $33^{\circ}59'N$ latitude; $78^{\circ}04'W$ longitude.
4. Size: ca. 1977.6 ha. (4883 A.).
5. Elevation: 11 to 22 m (35 to 55 ft.).
6. Vegetation Classification Category: II.E.1. Pocosin/ II.E.2. Flat-woods/ III.C.2. Sandhills Associates.
7. Investigator(s): Timothy D. Nifong
Box 29, Coker Hall, UNC
Chapel Hill, N. C. 27514
8. Access: Highways NC 211 and NC 87 (see attached county road map).

9. Site Description:

The Smithville Carolina Bay Complex includes a series of dozens of small and large Carolina bays, associated sand rims, and Pleistocene (presumably marine) low ridge and swale topography. The bays themselves are almost invariably vegetated by pond pine (Pinus serotina) dominated "low pocosin." The pines are generally small--probably as a response to both frequent or severe fire and nutrient poor conditions--mostly 4 to 5 meters in height, with DBHs of 10 to 15 centimeters or less, forming a very open canopy. Although scattered tall shrubs and transgressive "bay" trees 2 to 3 meters in height are present, the shrub layer is generally about 1 meter in height, and is dominated by a mixture of shining fetter-bush (Lyonia lucida), titi (Cyrilla racemiflora), bitter gallberry (Ilex glabra), and, occasionally, other species, twined together into a dense thicket by laurel-leaved catbrier (Smilax laurifolia).

In a few bays the pond pines in the canopy are much larger, usually accompanied by an increased dominance of "bay" trees (see "Pocosin" in Introduction), indicating a probable lack of fire for a number of years. Swale areas within the complex also tend to be dominated by a similar pocosin community type.

The sand rims, where undisturbed--several have been planted in what appears to be a slash pine (Pinus elliottii) hybrid by the owners--are dominated by an open longleaf pine (Pinus palustris) canopy, over a mixture of turkey oak (Quercus laevis) and scrub live oak (Q. geminata) in the subcanopy layer. A shrub layer is absent, and the herbaceous layer usually consists of open to sparse cover by wire-grass (Aristida stricta) and mixed forbs, such as stipulicida (Stipulicida setacea) and St. John's sand-wort (Hypericum reductum).

Bay--rim ecotones and low ridge areas tend to be similar vegetationally, and are floristically the most interesting areas within the bay complex. Longleaf pine is the canopy dominant with no subcanopy, usually over a scattered shrub layer of either gallberry (Ilex spp.) or sand myrtle (Leiophyllum buxifolium), the latter often in dense stand. The ground beneath the shrub layer is almost invariably covered with a mixture of wire-grass and creeping blueberry (Vaccinium crassifolium). One very notable exception occurs in the case of a number of low ridge and swale interface areas, in which rush-featherling (Pleea tenuifolia) dominates the herbaceous layer to the exclusion of everything else. The largest such area observed measured approximately 800 meters (0.5 mi.) in length by an average 30 meters (15 to 60 m) in width.

Canopy pines in these "flatwoods" areas are some of the largest observed in the county during the course of this contract, being mostly old-growth flattops, and four Red-cockaded Woodpecker (Picoides borealis) cavity trees were located among these. In addition, as noted, sand myrtle may dominate here in extensive populations, occurring both on the interbay flats and low ridges within the area. These extensive sand myrtle populations, the large rush-featherling "flat," and the Red-cockaded Woodpecker nest trees are identified on the accompanying topographic quad sheets.

10. Ownership Summary:

a. Ownership type by percent area:

Type

Private	<u>100</u>	%
Public	<u> </u>	%
Unknown	<u> </u>	%

b. Number of owners: three (3)

c. Name(s) and address(es) of owner(s):

Boiling Springs Lakes Corp., Boiling Spring Lakes, N. C.

Lawrence G. Sprunt et al., Box 3625, Wilmington, N. C. 28401

Weyerhaeuser Co., Plymouth, N. C. 27692

11. Land Use Status:

a. Natural area usage category: (1) low intensity recreation; (2) Intrusions--(a) utility corridors (power line right-of-way), (b) small planted and managed pine "plantations" on some bay rims, (c) trash dumps adjacent to highway NC 87.

b. Use of surrounding land:

(1) Undeveloped 70 %

(2) Developed: agricultural or silvicultural 30 %

(3) Developed: urban %

12. Management Summary:

a. Current preservation status:

Category	%	Description of preservation status
6	70	Private land, not protected by owner.
4	30	Private land, posted and patrolled by owner.

b. Threats:

Category	Description of threat
3	Drainage of bays; logging of areas with mature pines, and subsequent replanting as pine plantation; very recent (April '81) intrusions (land clearing) indicate possible development in the near future.

c. Management recommendations:

- (1) It is especially important that frequent prescribed burning of the entire area be continued in order to ensure maintenance of existing community diversity and animal habitat.
- (2) Vehicular traffic on the single access road through the area--it connects highways NC 87 and NC 133--should be restricted by some means to prevent further dumping of trash within the complex.

13. Site Significance Summary:

- (1) Rush-featherling (Pleea tenuifolia) is widely scattered and infrequent in its occurrence within the southeast; it is not known to dominate areas in a savannah-like condition elsewhere (fidé A. E. Radford). The site is, therefore, very significant both from a community type and population perspective.
- (2) The complex contains excellent examples of "savannah" communities over marine (Pleistocene) ridge and swale topography.
- (3) The complex represents possibly the largest expanse of near coast, relatively undisturbed (undrained) Carolina bays within the state; further, these bays are excellent examples of "pocosin type" bays.
- (4) The population of sand myrtle (Leiophyllum buxifolium) here, when considered in its entirety, is probably the largest population of the species in North Carolina. Sand myrtle is not known in extensive populations on the state's coast north of Brunswick County.
- (5) The complex area contains four known cavity trees of the Red-cockaded Woodpecker (Picoides borealis), which is on the federal list of endangered species.
- (6) The Smithville bay complex represents significant wildlife habitat, both in terms of its sheer size (it is one of the largest intact pocosin areas in the county) and diversity of available habitats.

14. N. C. Natural Heritage Program Priority Rating:

High priority.

15. Field Reconnaissance Data Summary Sheet:

FLORA--Carolina bays

Canopy: *Pinus serotina*
Pinus serotina

Subcanopy: None

Transgressives: No dominants
Acer rubrum
Gordonia lasianthus
Liquidambar styraciflua
Magnolia virginiana
Nyssa sylvatica var. *biflora*
Persea borbonia

Shrubs: Mixed pineland shrubs
Clethra alnifolia
Cyrilla racemiflora
Gaylussacia frondosa
Ilex coriacea
I. glabra
Lyonia lucida
Myrica cerifera
Sorbus arbutifolia

Herbs: No dominants
Andropogon virginicus
Aristida stricta
Arundinaria gigantea
Eriophorum virginicum
Lachnanthes caroliniana
Lobelia nuttallii
Pleea tenuifolia
Polygala lutea
Proserpinaca pectinata
Sarracenia flava
S. purpurea
Xyris sp.

Vines: *Smilax laurifolia*
Smilax laurifolia

Ferns: No dominants
Woodwardia virginica

Mosses: No dominants
Sphagnum sp.

FAUNA

Birds:

Carolina Chickadee (*Parus carolinensis*)
Common Yellowthroat (*Geothlypis trichas*)
Eastern Bluebird (*Sialia sialis*)
Fish Crow (*Corvus ossifragus*)
Great-crested Flycatcher (*Myiarchus crinitus*)

15. Field Reconnaissance Data Summary Sheet: (cont.)

Birds: (cont.)

Prairie Warbler (*Dendroica discolor*)
Prothonotary Warbler (*Protonotaria citrea*)
Red-cockaded Woodpecker (*Picoides borealis*)
Rufous-sided Towhee (*Pipilo erythrophthalmus*)
Yellow-breasted Chat (*Icteria virens*)
Yellow-throated Warbler (*Dendroica dominica*)

Mammals:

Fox squirrel (*Sciurus niger*)

SOIL SUBGROUPS

Carolina bays:

Typic Haplaquods to Terric Medisaprists

Flats and low ridges:

Aeric Haplaquods

Bay rims:

Typic to Spodic Quartzipsamments

FLORA--Bay rims

Canopy: *Pinus palustris*

Pinus palustris

Subcanopy: Mixed Oaks

Quercus geminata

Q. incana

Q. laevis

Transgressives: No dominants

Diospyros virginiana

Shrubs: No dominants

Gaylussacia dumosa

Ilex glabra

I. opaca

Leiophyllum buxifolium

Lyonia mariana

Subshrub: No dominants

Vaccinium crassifolium

Herbs: No dominants

Aristida stricta

Cnidoscolus stimulosus

Dichanthelium sp.

Hypericum reductum

Polygonella polygama

Pyxidanthera barbulata

Stipulicida setacea

Ferns: No dominants

Pteridium aquilinum

Figure 33. Smithville Carolina Bay Complex

Name of area: Spring Creek Pond

County: Brunswick

Location description: Spring Creek Pond is reached by travelling south 6.85 mi. on Co. Rd. 1115 from its junction with highway NC 211, to its intersection with Co. Rd. 1119; proceed southeast (left) 1.10 mi. on Co. Rd. 1119 to its intersection with Co. Rd. 1120; travel 0.10 mi. west (right) on Co. Rd. 1120 to driveway on left (south) side of road; turn left into driveway and proceed south 0.10 mi. to last brick house on left; travel south along trail (extension of driveway; accessible only by foot) from house approximately 290m. Pond is left of trail approximately 40m through a dense pocosin-like shrub thicket.

Elevation: 6.1m (20 ft.) above sea level.

Physiographic region: Atlantic Plain Province: Coastal Plain
Section: Sea Islands Downwarp

Topographic quad map reference: Lockwoods Folly 1:31680 (map attached).

Size: Pond itself is 2 acres in size; with surrounding buffer area 1/8 mi. in width, area is ca. 10 acres in size.

Ownership information: Cecil Holden
Brown's Landing
Supply, N.C. 28462.

Report prepared by: Timothy D. Nifong
Box 29, Coker Hall
Department of Botany, UNC
Chapel Hill, N.C. 27514.

Other persons knowledgeable about site: None known.

Current use and protection status:

There is no known present usage of this relatively isolated, inaccessible pond, or of the area immediately surrounding it, although some hunting activity in season--which poses little or no threat to the integrity of the vegetational communities present--is suspected. The pond and surrounding upland area are protected from vehicular traffic by the owner, which has largely precluded any outside intrusion into the pond vicinity.

Vegetation and plant communities:

Spring Creek Pond is a nearly round, shallow, marshy depression, encircled by a dense thicket of evergreen shrub species occurring to the water's edge, while the surrounding uplands are vegetated by pine (Pinus sp.)/oak (Quercus sp.) flatwoods interspersed with broad sandy ridges occupied by a longleaf pine (Pinus palustris)/turkey oak (Quercus laevis)/wiregrass (Aristida stricta) vegetational community.

The vegetational composition of the pond community itself is most striking. The pond is shallow, with the water being approximately 0.5m

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Spring Creek Pond vegetation.

Figure 34. Spring Creek Pond
Vegetation

and relatively constant in depth from rim to center, and contains a horse-tail spike rush (Eleocharis equisetoides)/water lily (Nymphaea odorata) community type nearly throughout. There are two separate black gum (Nyssa sylvatica var. biflora) "domes" near the center of the pond, with stunted black gum also dominating as a canopy layer in the immediate pond rim area. A sparse inner "zone" of button bush (Cephalanthus occidentalis) rings the pond rim area within the Eleocharis equisetoides/Nymphaea odorata community, and also occurs in a sparse "zone" encircling the black gum domes near the center of the pond. Tall beak rush (Rhynchospora inundata) assumes codominance with the horsetail spike rush in bands along the outer edge of the pond.

Cypress (Taxodium sp.) domes are not uncommon in shallow, marshy ponded areas of the outer coastal plain of north Carolina, but no cypress were observed at Spring Creek Pond, and black gum entirely replaces cypress in the domes here. These domes are not islands, and the water surrounding the bases of the gums comprising the domes is for the most part as deep as the water of the adjacent surrounding pond, with the area apparently inundated for the entire year except in periods of extreme drought. In the micro-habitat afforded by crevices in the swollen bases of the black gum "canopy" of the dome areas, seedlings of several of the evergreen shrub species present in the pond rim area--especially fetter-bush (Lyonia lucida)--have sprouted, and in places have attained a large size, giving a thicket-like appearance to the domes.

The dense pocosin vegetation that surrounds the pond forms a zone 5 to 7m in height and 15 to 30m in width, and is dominated either by mixed evergreen shrubs (see accompanying Flora Species List), or often, almost exclusively by fetter-bush. Dahoon (Ilex cassine) is sometimes the predominant shrub along the rim of the pond.

In moving outwards from the pond, the dense pocosin-like shrub thicket becomes increasingly open, and the evergreen shrub community grades into an open pine flatwoods community. The vegetation here usually consists of a scattered canopy layer of pond pine (Pinus serotina), underlain by an open to dense subcanopy layer of scrub live oak (Quercus geminata). The shrub and/or herbaceous layer combinations existing in conjunction with the Pinus serotina/Quercus geminata canopy/subcanopy are many, most importantly including /dwarf blueberry (Vaccinium tenellum), /dwarf huckleberry (Gaylussacia dumosa), /dangleberry (Gaylussacia frondosa), /creeping blueberry (Vaccinium crassifolium)--wiregrass (Aristida stricta), and /wiregrass. In addition, scrub live oak may predominate by itself in some areas, forming dense thickets.

To the north, east, and south of the pond, the pine flatwoods community eventually gives way to the coarse sand ridge vegetational communities characteristic of the region, predominantly longleaf pine/turkey oak (Quercus laevis)/wiregrass, but including a longleaf pine/mixed oaks/ wiregrass community type. The pine flatwoods community extends outward west of the pond (see accompanying map).

Physical features:

General description--Spring Creek Pond, nearly circular in outline, is located in a low flat between E-W trending sandy ridges (probably relict dunes of Pleistocene age). The pond may have been formed by the blockage of the drainage which forms the upper reaches of Spring Creek, probably in conjunction with slumping of the surface caused by subsurface solution of underlying limestone or marl deposits.

Topography--East-west trending sandy ridges surround the pond on three sides, with a broad flat extending outward from the western end of

the pond between ridges. Local relief ranges to 4m, from pond basin to upland ridgetops.

Geology--The surficial sediments are marine deposited sands and clays of the Pamlico Terrace of Pleistocene age, probably overlying the Castle Hayne Limestone of Eocene age, and possibly overlying the Duplin Marl of Late Miocene age.

- Soils--(1) Pond area and surrounding flatwood communities: Leon series; a sandy, siliceous, thermic Aeric Haplaquod.
(2) Adjacent upland ridges: Wando series; a mixed, thermic Typic Udipsamment.

Rare plants and animals:

Sciurus niger. Southern fox squirrel. Special concern. Signs indicating presence of the fox squirrel were noticeable throughout the upland area surrounding the pond, and one individual was observed within the dense shrub thicket which surrounds the pond.

No other threatened or endangered plant or animal species were collected or observed in the Spring Creek Pond area. However, individual longleaf pines of sufficient size and age to be utilized for nesting by the red-cockaded woodpecker (Dendrocoptes borealis) were numerous along the ridge south of the pond, although no actual cavity trees were sighted.

Publications and scientific references:

Blankenship, R.R. 1965. Reconnaissance of the ground-water resources of the Southport-Elizabethtown area, North Carolina. N.C. Dept. Water Res., Div. Ground Water, Ground-Water Bul. No. 6. 47 pp.

Daniels, R.B., et. al. 1978. Age of soil landscapes in the coastal plain area of North Carolina. Soil Sci. Soc. Am. J. 42: 98-105.

Radford, A.E., et. al. 1964. Manual of the Vascular Flora of the Carolinas. UNC Press. Chapel Hill, N.C. 1183 pp.

Site ecological significance:

The ecologically significant features of the Spring Creek Pond area are outlined:

- 1) The community type which occurs within the 2-acre pond--Eleocharis equisetoides/Nymphaea odorata--is not present elsewhere in Brunswick County, and is unknown for other locations in the southeastern coastal plain of North Carolina.
- 2) The two highly unusual black gum domes located at the center of Spring Creek Pond have been observed in a less well developed state at one other disturbed location within the county, but no such other domes are known to exist within an undisturbed pond community elsewhere in the county, nor in the entire region.

Management recommendations:

There are apparently no immediate threats to the integrity of the vegetational communities comprising this unusual plant assemblage; however, with the rapid rate at which similar coastal tracts throughout the region are being developed and "urbanized," the Spring Creek Pond area is already in the apparent position of representing a parcel of prime residential property.

FLORA SPECIES LIST

Spring Creek Pond:

		<u>Zone*:</u>
Trees:		
Canopy--	Nyssa sylvatica var. biflora	1
	Pinus palustris	3
	P. serotina	2
Subcanopy--	Quercus geminata	2,3
	Q. incana	2,3
	Q. laevis	3
Transgressives:	Acer rubrum	1,2
	Diospyros virginiana	3
	Cephalanthus occidentalis	1
Shrubs:	Clethra alnifolia	2
	Cyrilla racemiflora	1,2
	Gaylussacia dumosa	2
	G. frondosa	2
	Gordonia lasianthus	1,2
	Ilex cassine	1
	I. coriacea	1,2
	I. glabra	1,2
	Eyonia lucida	1,2
	L. mariana	2
	Magnolia virginiana	2
	Myrica cerifera	1,2
	Persea borbonia	1,2
	Rhus vernix	1
	Sorbus arbutifolia	2
	Vaccinium arboreum	2,3
	V. atrococcum	1,2
	V. tenellum	2
Subshrubs:	Vaccinium crassifolium	2
Herbs:		
Forbs--	Eleocharis equisetoides	1
	Eriocaulon decangulare	2
	Heterotheca nervosa	3
	Hypericum reductum	2,3
	Lachnocaulon minus	2
	Polygala lutea	2
	Rhexia mariana	2
	Trilisa paniculata	2
	Utricularia purpurea	1
	Xyris sp.	2
Graminoids--	Andropogon virginicus	2

*Zones are as follows: (1) basin area; (2) surrounding flatwood communities; (3) surrounding ridge communities (see accompanying map of pond and surrounding area).

	<i>Aristida stricta</i>	2,3
	<i>Arundinaria gigantea</i>	2
	<i>Dulichium arundinaceum</i>	1
	<i>Erianthus</i> sp.	1
	<i>Juncus diffusissimus</i>	2
	<i>Panicum hemitonum</i>	1
	<i>Rhynchospora inundata</i>	1
	<i>Rhynchospora</i> sp.	2
Ferns and fern allies--	<i>Woodwardia virginica</i>	1
Vines:	<i>Smilax laurifolia</i>	1,2
	<i>Smilax</i> sp.	1
Mosses:	<i>Sphagnum</i> sp.	1
	Unidentified moss	2
Lichens:	<i>Cladium</i> sp.	2,3

ring Creek
nd

Figure 35. Spring Creek Pond

NATURAL LANDMARK BRIEF

Site:

Sunny Point Limestone Sinks, Brunswick County
North Carolina

Description:

There are five ponds in the recommended group. They range from about one-half acre to almost five acres. The ponds are of disputed origin (commonly called limestone sinks), are limited to the southeastern states, and, and many are being drained or destroyed by development. They comprise a unique ecosystem with a diverse and interesting flora. Many species of aquatic plants appear to be restricted to these ponds. Ponds in southeastern North Carolina contain several plants on the proposed U. S. rare and endangered species lists.

Ownership:

The recommended ponds are located entirely within the boundaries of the Sunny Point Military Ocean Terminal owned by the United States Army.

Proposed by:

Theme/Subtheme classification 6, 24, 32/Dc, Eab, Na

Significance:

The major significance of this very limited aquatic ecosystem is the unique flora. These ponds contain several species of rare plants with very restricted ranges.

Land Use:

Sunny Point is a munitions terminal for the United States Army. The ponds are in the buffer zone in an area managed for timber production and wildlife. Nearby areas have been diked for the disposal of dredge spoil removed from shipping channels and turning basins.

Dangers to Integrity of the area:

Nearby parts of the terminal property have been diked for the disposal of dredge spoil. Several ponds have been destroyed by salt water seeping from beneath the dike. Without designation as natural landmarks this fate could befall the recommended ponds.

Special Conditions:

Access is very tightly controlled by the military authorities. No general public access is available.

Studied by:

James F. Parnell, Professor of Biology
Biology Department
University of North Carolina at Wilmington
Wilmington, North Carolina 28401

Evaluator:

James F. Parnell, Ph.D.

Professor

Department of Biology

University of North Carolina at Wilmington

Wilmington, North Carolina 28401

Phone: (919) 791-4330 ext. 287

Theme Study:

6, 24, 32/Dc, Eab, Na

Sources of Information:

1. Personal communication with Mr. David DuMond of Rt. 2 Box 451-D, Wilmington, North Carolina 28401.
2. Personal communication with Col. Walter Daniels, Base Commander and Mr. Eugene Tomlinson, Jr., Chief of Services, Sunny Point Military Ocean Terminal, Wilmington, North Carolina, 28401.
3. Ground observations of the site on 25 April 1976 and aerial observations on 28 April 1976.

Location:

The Sunny Point Military Ocean Terminal is located in Brunswick County, North Carolina at 34° 02' North and 77° 57' West. The site is in the northeastern corner of the property. It is east of Highway 133 just off the Cape Fear River.

Significant Statement

These small natural upland ponds are restricted to a limited geographic region. Their origin is uncertain, but their flora is unique and of considerable interest to botanists. A number of plants of very limited distribution occur in these ponds. The series of ponds at the Sunny Point Military Ocean Terminal is quite characteristic of certain stages of this community type. They are in a protected area and should remain as good examples of this rare ecosystem.

These ponds are of national significance as good examples of a rare and interesting ecosystem of limited geographic extent. Of particular importance is the probable occurrence of such rare aquatic plants as the bladderwort (Utricularia olivaceae), Litsea aestivalis, Lindera melissaefolium, Myriophyllum laxum, and Lacnocaulon beyrichianum. All of the above are on the proposed national list of threatened and endangered plants (Smithsonian 1975).

The Sunny Point Ponds

The Sunny Point ponds represent several stages in the range of conditions described in the previous section. Those suggested for inclusion in the Natural Landmarks Program include ponds fringed by pond cypress with relatively deep water centers, ponds bordered by a mixture of cypress and pine with emergent shrub zones and shallow bog-like ponds without woody vegetation.

While extensive observations have not been made at Sunny Point, the key floral elements are present. One of these ponds, for example, is adjacent to the site where Beal and Quay (1968) initially collected the first North Carolina specimen of Utricularia olivaceae. Myriophyllum laxum is known to occur in the Sunny Point ponds and several other rare plants are known from nearby ponds and are probably present at Sunny Point.

The Sunny Point ponds also appear to have the typical vertebrate components. Birdlife is abundant. Wood Ducks, Ospreys, and a variety of long-legged waders have been observed in the ponds. Small songbirds including Prothonotary and Yellow-throated Warblers are regular summer residents where cypress fringes occur.

Five ponds are being recommended as a natural landmark. They were specifically chosen to represent a variety of conditions often seen in such communities. All are in relatively close proximity (see the enclosed map). They

appear to be the best representatives on the Sunny Point property, although a number of others are present. If the ponds are designated as a natural landmark buffer zones of about 100 meters out from the pond edges should be included. It should be recommended that these buffers be maintained in natural vegetation if possible. Two ponds are adjacent to roads. If roadbanks are kept vegetated this should prevent silting.

Size:

The proposed natural landmark consists of five small ponds. They range in size from approximately one-half acre to about five acres.

Boundaries:

All ponds are within the boundaries of the Sunny Point Military Ocean Terminal. The ponds are located near the northeast corner of the property.

Correspondent:

Col. Walter Daniels, Commander
Sunny Point Military Ocean Terminal
Wilmington, North Carolina 28401
(919)-763-6581

Land Use:

Sunny Point serves the U. S. Army as a munitions terminal. Much of the tract is a buffer zone without extensive development. While conditions are relatively natural, most of the uplands are managed for timber production and wildlife. Visitor use is very limited, but some public hunting and fishing are allowed. Public access is strictly controlled.

Dangers to Integrity of area:

The major threat to the integrity of the proposed site is the deposition of dredge spoil. In recent years it has become necessary to dispose large volumes of spoil on upland sites. This involves materials removed from shipping channels

and turning basins associated with the primary function of the facility. A large upland area near the ponds recommended for natural landmark status has been diked, and dredge spoil in a saline water mixture has been deposited. There has been some seepage of salt water from beneath the dike. This has destroyed or damaged the natural vegetation in several sinks near the dike. Minor damage is apparent in one sink recommended by this study. The other four appear not to have been damaged. They appear to be far enough away to be out of danger. Several potential sinks were damaged and rejected because of the loss of natural vegetation.

This impoundment is expected to serve for about ten years. A new impoundment is under construction near the southern end of the property. Its use will not endanger the selected ponds.

Designation of the proposed ponds as a natural landmark should ensure that this area will not be considered for future disposal sites.

The high degree of protection from human damage offered by the location within a tightly controlled area should be helpful in protecting the rare plant species associated with the ponds.

Description of Natural Values

These ponds are scattered throughout southeastern North Carolina. While it is generally recognized among ecologists that they represent unique natural communities of great interest, no detailed studies have been accomplished. Mr. David Dumond of Wilmington, North Carolina has, however, been making observations on the natural history of these ponds for about two years. His work represents the only attempt to characterize these ponds. He has prepared a preliminary report which includes observations on the Sunny Point ponds as well as others in Brunswick, New Hanover, and Pender counties. Mr DuMond's report is included with his permission.

Upland Natural Ponds in the Coastal Plain of Southeastern North Carolina

David DuMond
Route 2, Box 451-D
Wilmington, N. C.

Scattered through southeastern North Carolina are several hundred natural ponds of generally unknown origin. These ponds are particularly apparent where they occur in sandy upland woods composed of longleaf pine (Pinus palustris), turkey oak (Quercus laevis), and wire grass (Aristida stricta) in Brunswick, New Hanover, and Pender counties. Matrix terrestrial vegetation is not limited to this type.

Origin Hypothesis:

Several hypotheses, both published and unpublished, have been generated by geologists as to the origins of these ponds.

The most widely known idea relates the depressions with deep, subsurface solution of limestone (marl), with subsequent slumping of surface sands (Bain 1970 and LeGrand 1973). This hypothesis does not go on to give any explanation for their continued existence. Another hypothesis relates their continued existence to illuviation and deposition of finely divided organic detritus which forms an effective "plug" in subsurface sand interstices. Another idea suggests the ponds occur over ancient (Pleistocene) clay or muck deposits, laid down during periods of higher ocean stands.

A recent idea regarding formation suggests that the depressions are ancient wind deflation pits (Personal Communication with Dr. Victor Zullo, Department of Geology, University of North Carolina at Wilmington, Wilmington, N. C.).

A published theory (Smith 1931) relates some natural ponds in South Carolina to solvent action on subsurface pans formed by illuviation in ancient sandy soils. As portions of the relict pans have gone into solution, the surface sands have slowly subsided.

None of these ideas except, perhaps, the last explain both origin and continued existence of the ponds over the entire range of their variability. It may be that several factors are responsible for their origin.

Physical Expressions:

The ponds (or depressions) vary in extent from small fractions of acres to many acres. Pretty Pond in eastern Brunswick County

and Silver Lake in central western New Hanover County are probably the largest. The smallest known to me are less than 30 feet wide from rim to rim. Ponds may occur singly or in groups of 2 to 10.

The depressions range in depth from greater than 10 feet to less than 1 foot with respect to surrounding terrain. In the deeper ones, water may persist at the level of the normal rim for nearly the entire year, or it may occupy a small portion of the bottoms for only a few months of the year.

The variation in the steepness of the side slopes is great. A range between 45° and less than 10° has been noted. The steeper slopes seem to be excessive in terms of the normal angles of repose for surrounding sands. There is only a fragment of evidence that such angles are being reduced through time, though it certainly seems reasonable that they should. One small, deep depression at Sunny Point Military Ocean Terminal showed some upper side slope erosion as there were visible signs that shrub or tree stems had been uprooted and fallen to the bottom.

From subjective observation, the larger the pond, the greater the surface asymmetry. Small round depressions and ponds exist, but large round ponds do not. Intermediate-size ponds are generally ovoid.

One point seems clear. All ponds are expressions of very local water table aquifers. In this way they function as windows for viewing localized water table equilibria. In some areas

where these local water tables are continuous with drainage lines, the ponds occur at the origins of the most headward dendrites of drainage patterns. Most ponds have no surface drainage at all. Evaporation and subsurface losses must, in the latter situations, be responsible for observed seasonal water-level reductions.

Biology:

The biology of upland ponds in North Carolina has received only scant attention. A paper by Beal and Quay (1968) dealt with the taxonomy and ecology of a diminutive bladderwort known as Utricularia olivacea. In North Carolina this species is found only in the upland natural ponds in the coastal plain. Its entire world range is represented by only six other areas, two in South America, one in Cuba, one in Florida, one in Georgia, and one in New Jersey. Beal and Quay related this unusual distribution to the migration routes of aquatic and wading birds.

Several other species of vascular plants are also known only from these pond habitats in North Carolina, though their total ranges extend outside this state. These are (Personal Communication from A. E. Radford, University of North Carolina, Chapel Hill, North Carolina):

Myriophyllum laxum

Eleocharis equisetoides

Rhynchospora tracyi

Nymphoides aquatica

Eleocharis robbinsii

Four species, recently suggested for the national list of endangered and threatened plant species (Smithsonian Institution 1975), occur in or around the margins of upland natural ponds. They are;

Litsea aestivalis

Lindera melissaefolium

Myriophyllum laxum

Lacnocaulon beyrichianum

Although these species are also known from other states, they represent real rareness in North Carolina. These are species known to be wholly or partially dependent upon one kind of habitat, but the habitat has generally received very little scientific attention.

There is no biological way to describe a typical upland natural pond. The habitat complexes vary in response to many factors. Basically there are two major categories of ponds, those containing pond cypress (Taxodium ascendens) with several other tree and shrub species, and those which are open. Fire and direct disturbance by man, particularly as a result of off-the-road vehicular traffic and litter deposition, may be primarily responsible for this variation.

Left undisturbed, there may be a series of successional changes that progress from ponds with sandy margins to ponds containing pond cypress and shrubs such as titi (Cyrilla racemiflora). This, of course, is dependent upon the depth of the pond, its seasonal water level fluctuations, steepness

of the pond side-slopes, and time.

Some ponds contain a central stand of pond cypress and gum (Nyssa sylvatica var. biflora), but no marginal arborescent vegetation. Fire as well as other disturbances are probably factors in this expression.

The intermediate phase of development seems to be represented by many ponds where the surrounding upland vegetation gives way to a series of concentric rings of herbaceous vegetation that represent increasing permanence of hydric conditions toward the center of the pond. Again, water level fluctuations, slope, and time are important factors. The most permanent hydric situation, of course, is open water.

Below is an annotated list of vascular plant species which have been seen growing in or along the edges of these natural upland ponds. Among these are many species which are relatively rare in North Carolina. The list is a result of casual inventory and should in no way be considered exhaustive.

Alismataceae

Sagittaria graminea Michx.

Sagittaria teres S. Wats. Reported by A. E. Radford

(Personal Communication, 1972)

Apiacea

Centella asiatica (L.) Urban. Common around ponds with open sandy margins.

Aquifoliaceae

Ilex cassine L. Scattered around some more open pond margins.

Ilex glabra (L) Gray. Common constituent of pond margins heavily vegetated by shrubs.

Asteraceae

Aster dumosus L. Uncommon along moist margins.

Chaptalia tomentosa Vent. Seen at one pond in Brunswick County. Moist margins.

Eupatorium capillifolium var. leptophyllum (DC) Ahles. Sandy margins, frequently in shallow water.

Pluchea foetida (L.) DC. Occasional, particularly where margins have been disturbed.

Burmanniaceae

Burmannia capitata (Gmel.) Mart. Quite frequent in low grasses around open sandy margins.

Commelinaceae

Aneilema nodiflorum (L.) Kunth. 1 occurrence in a shallow woodland pond in New Hanover County.

Cyperaceae

Carex walteriana Bailey. Rooted in floating peat (Sphagnum sp.) where bog-like conditions prevail.

Dichromena latifolia Baldw. Uncommon, Scattered ponds.

Eleocharis equisetoides (Ell.) Torr. Scattered ponds

Eleocharis robbinsii Oakes. Rare. Floating in open, perennially wet depressions.

Eleocharis tricostata Torr. 1 pond. New Hanover
County.

Eleocharis sp. Species not determined. Sandy margins.

Fuirena squarrosa Michx. Frequent around grassy margins.

Rhynchospora pleiantha (Kukenth.). Gale. Obscure,
but present around many grassy margins.

Rhynchospora tracyi Britt. More or less constantly
flooded, usually central portions of ponds.

Scleria reticularis Michx. Not frequent, but occurring
around grassy margins.

Cyrillaceae

Cyrilla racemiflora L. Common where a shrub periphery occurs.
Either scattered or dense.

Droseraceae

Drosera capillaris Poir. Sandy, open, seasonally flooded
margins.

Drosera intermedia Hayne. Constantly flooded portions of
ponds in a thin veneer or organic matter.

Eriocaulaceae

Eriocaulon decangulare L. Sandy margins.

Eriocaulon compressum Lam. Flooded, sandy pond bottoms.

Lachnocaulon beyrichianum Sporleder. Supposed presence
in association with upland natural ponds based on
Radford, et. al. (1968), page 267.

Gentianaceae

Bartonia verna (Michx.) Muhl. Common around sandy,
sparsely vegetated margins.

Bartonia virginica (L.) BSP. Infrequent around wet,
sandy margins.

Nymphoides aquatica (J. F. Smel.) Kintz. A floating
aquatic depending on nearly constantly standing
water in shallow ponds.

Sabatia difformis (L.) Druce. Wet, sandy margins.

Haemodoraceae

Lachnanthes caroliniana (Lam.) Dandy. Sandy margins
frequently with a thick growth of grasses and sedges.

Haloragaceae

Myriophyllum laxum Shuttlew. ex Chapm. Submerged
aquatic with emergent leaves; in water of shallower
ponds. Brunswick County only, as yet.

Myriophyllum pinnatum (Walt.) Blume. BSP. Submerged
in a cluster of disturbed ponds in New Hanover
County. Likely much more common.

Proserpinaca palustris L. Submerged and emergent in
heavily disturbed ponds.

Lauraceae

Lindera melissaefolium (Walt.) Blume. Reported from
Bladen County in association with natural ponds
(Melvin 1954).

Litsea aestivalis (L.) Fern. Occasionally tall shrub
growing peripheral to some ponds.

Lentibulariaceae

Pinguicula caerulea Walt. Occasional on the sandy,
grassy margins of some ponds.

Utricularia inflata var. minor (L.) Chapm. Submerged
and emergent aquatic more characteristic of
somewhat disturbed ponds.

Utricularia olivacea Wright ex Griseb. Floating
aquatic, particularly in association with U.
purpurea in scattered ponds.

Utricularia purpurea Walt. Floating in shallower waters
where depressions have a heavy accumulation of organic
matter, but are open to light.

Utricularia subulata L. Terrestrial in marginal sandy
and sparsely grassy areas.

Utricularia spp. Others present but not specifically
identified.

Lobeliaceae

Lobelia nuttallii R. & S. Sandy margins; frequently
with a thick growth of grasses and sedges.

Lycopodiaceae

Lycopodium sp. Not identified. Present where wet
savannah-like conditions prevail.

Melastomataceae

Rhexia spp. Not specifically identified; present where
savannah-like conditions prevail.

Nymphaeaceae

Nuphar advena (Ait.) Ait. Fairly common where water
depths reach 2 to 3 feet at the lowest.

Nymphaea odorata Ait. Centers of ponds or areas where
water depths of 2 to 3 feet are maintained. Uncommon.

Nyssaceae

Nyssa sylvatica var. biflora (Walt.) Sarg.

Common marginal tree, occurring usually singly or in small groups in or around shallower ponds.

Onagraceae

Ludwigia palustris (L.) Ell. Occurring occasionally in somewhat disturbed ponds.

Poaceae

Amphicarpum purshii Kunth. Radford et. al. 1968

Andropogon virginicus L. Common on open, wide margins of shallower ponds not inundated in late summer.

Eragrostis elliottii S. Wats. Occasional on margins of open grassy type escaping inundations during summer.

Eragrostis refracta (Muhl.) Scribn. Occasional around moist, sandy margins.

Erianthus giganteus (Walt.) Muhl. Frequently found around shallow marshy borders.

Hydrochloa caroliniensis Beauv. Floating in submerged mats in perennial ponds.

Leersia hexandra Swarts. Emergent mats in perennial ponds.

Panicum dichotomiflorum Michx. Sandy margins.

Panicum erectifolium Nash. Open sandy margins not subject to flooding.

Panicum hemitomon Schult. Disturbed perennial ponds.

Panicum tenerum Beyr. ex Trin. Flooded edges.

Panicum verrucosum Muhl. Sandy margins not subject to summer flooding.

Polygalaceae

Polygala lutea L. Moist sandy margins.

Polygala ramosa Ell. Wet margins.

Polygonaceae

Polygonum hydropiperoides var. opelousanum (Riddell
ex Small) Stone. Shallow water of perennially
wet ponds.

Scrophulariaceae

Bacopa caroliana (Walt.) Robins. Not seen by me.

Taxodiaceae

Taxodium ascendens Brongn. Usually dominant where
ponds are surrounded by trees.

Violaceae

Viola lanceolata L. One pond. Unusual location in
organic soil of small stand of Taxodium ascendens
in the central portion of a pond. Seen blooming
in October.

Xyridaceae

Xyris jupicai Rich. Wet or flooded margins.

Xyris smalliana Nash. Frequent where sanannah-like
conditions have developed.

I have accumulated some observations over a three year
period on the use of these ponds by vertebrates. The ponds
seem to be very important feeding and breeding sites for a
variety of amphibians and reptiles. Bird species of a wide
variety forage in the depths and edges of the ponds.

Such ponds are probably important for mammals, but the only observations are indirect--from tracks left in the soft sand. Raccoon (Procyon lotor), White-tailed Deer (Odocoileus virginianus), and Otter (Lutra canadensis) are the only mammals that I have seen utilizing the ponds.

Following is a list of vertebrates that have been seen using these upland ponds.

Birds:

Pied-billed Grebe (Podilymbus podiceps)

Great Blue Heron (Ardea herodias)

Green Heron (Butorides virescens)

Little Blue heron (Florida caerulea)

Great Egret (Casmerodius albus)

Glossy Ibis (Plegadis falcinellus)

White Ibis (Eudocimus albus)

Wood Duck (Aix sponsa)

Fulvous Tree Duck (Dendrocygna bicolor)

Red-tailed Hawk (Buteo jamaicensis)

Marsh Hawk (Circus cyaneus)

Sparrow Hawk (Falco sparverius)

American Woodcock (Philhela minor)

Common Snipe (Capella gallinago)

Greater Yellowlegs (Totanus melanoteucus)

Lesser Yellowlegs (Totanus flavipes)

Eastern Kingbird (Tyrannus tyrannus)

Amphibians

Broken-striped Newt (Notopthalmus viridescens dorsalis)

Two-lined Salamander (Eurycea bislineata cirrigera)

Pine-woods Treefrog (Hyla femoralis)

Squirrel Treefrog (Hyla squirella)

Green Treefrog (Hyla cinerea)

Little Grass Frog (Limnaoedus ocularis)

Southern Cricket Frog (Acris gryllus gryllus)

Southern Chorus Frog (Pseudacris nigrita nigrita)

Brimley's Chorus Frog (Pseudacris brimleyi)

Bullfrog (Rana catesbiana)

Carpenter Frog (Rana virgatipes)

Southern Leopard Frog (Rana utricularia)

Spadefoot Toad (Scaphiopus holbrooki)

Narrow-mouthed Toad (Gastrophryne carolinensis)

Reptiles

Several unknown Turtles

Eastern Glass Lizard (Ophisaurus ventralis)

Green Anole (Anolis carolinensis)

Broad-headed Skink (Eumeces laticeps)

Banded Water Snake (Natrix fasciata)

Red-bellied Snake (Storeria occipitomaculata)

Eastern Garter Snake (Thamnophis sirtalis sirtalis)

Hognose Snake (Heterodon sp.)

Northern Black Racer (Coluber constrictor)

Eastern Coachwhip (Masticophis flagellum)

NATURAL AREA INVENTORY FORM

Preliminary Reconnaissance Survey
Brunswick County, North Carolina

1. Natural Area Name: Waccamaw Island Savannah
2. Location: Site is located adjacent to and north of highway NC 904,
0.25 miles south of the Waccamaw River bridge.
3. Topographic Quadrangle Map Reference: Fireway 1:24000.
Coordinates: $34^{\circ}01'N$ latitude; $78^{\circ}38'W$ longitude.
4. Size: 4.5 ha. (11 A.).
5. Elevation: 9 to 12 m (30 to 40 ft.).
6. Vegetation Classification Category: II.E.2. Flatwoods.
7. Investigator(s): Timothy D. Nifong
Box 29, Coker Hall, UNC
Chapel Hill, N. C. 27514
8. Access: Highway NC 904 (see attached county road map).

9. Site Description:

The Waccamaw Island Savannah is an extremely diverse savannah site in terms of available microhabitats, and consequently, in terms of plant species richness. This is true due largely to the fact that the savannah occurs on a fluvial "island" within the swamp forest adjacent to the Waccamaw River, and exemplifies the ridge and swale topography typical of the area. Though the canopy dominant is longleaf pine (Pinus palustris) throughout, the herb and shrub species assemblages range from very mesic associations on the clay soils of the swales to semi-xeric ones on the sandier ridge soils, with obvious and interesting zonation of some species resulting.

The site community type is open Pinus palustris/Mixed herbs, with shrub and transgressive tree species occurring sporadically. In the swale areas, the herbaceous flora is extremely variable, consisting of a mixture of wire-grass (Aristida stricta) and a varied array of forbs, including large populations of several insectivorous species, such as Venus' flytrap (Dionaea muscipula) and pitcher plants (Sarracenia spp.). The drier ridge (essentially, eastern) portion of the island exhibits a decrease in herbaceous diversity, and a mixture of wire-grass and pine-woods beard tongue (Penstemon australis) predominates (at least vernaly).

As noted, the island is surrounded by swamp forest, here largely dominated by swamp black gum (Nyssa sylvatica var. biflora), with pond cypress (Taxodium ascendens) and Atlantic white cedar (Chamaecyparis thyoides) being of some importance. Swamp willow (Salix caroliniana) is abundant along the boundary of the swamp forest community with the island savannah.

Within the savannah itself, the scattered pines of the canopy are relatively mature, as indicated by the frequency of flat-top trees. Evidences of frequent past fires are abundant at the site, which was burned this spring (1981) as well.

10. Ownership Summary:

a. Ownership type by percent area:

Type

Private	<u>100</u>	%
Public	<u> </u>	%
Unknown	<u> </u>	%

b. Number of owners: one (1)

c. Name(s) and address(es) of owner(s):

Waccamaw Paradise, Inc.
Rt. 1, Box 303
Hallsboro, N. C.

11. Land Use Status:

a. Natural area usage category: (1) No apparent use to low intensity recreation; (2) Intrusions: highway NC 904 dissects the island, and forms the southern boundary of the natural area.

b. Use of surrounding land:

(1) Undeveloped 100 %

(2) Developed: agricultural or silvicultural %

(3) Developed: urban %

12. Management Summary:

a. Current preservation status:

Category	%	Description of preservation status
4	-	Private land, posted by assumed lessee, Mr.
		Henry C. Hughes of Loris, S. C.

b. Threats:

Category	Description of threat
3	Timbering and replanting in pines; widening of
	highway NC 904; possible development as part
	of vacation--hunting lodge complex.

c. Management recommendations:

- (1) Annual prescribed burning of the site should continue;
- (2) All vehicular traffic on the island, excepting the single access road which traverses it, should be strictly prohibited;
- (3) Because the site contains at least four highly exploited insectivorous species--Venus' flytrap (Dionaea muscipula), a threatened endemic; trumpets (Sarracenia flava); pitcher-plant (S. purpurea); and hooded pitcher-plant (S. minor)--as well as a number of other rare and/or threatened and endangered plant species, populations of these notable plants should be monitored to ensure their protection and continued survival;
- (4) It is possible, due to the relatively fragile nature of some of the wetter portions of this site and the ready public access to the area, that some form of restricted access will prove necessary in the future.

13. Site Significance Summary:

- (1) This is a very high quality site and the only known example of a fluvial ridge and swale savannah in the state.
- (2) The site contains a number of plant species of special concern--endangered, threatened, rare, exploited--which are listed below:
 - (a) *Dionaea muscipula*
 - (b) *Lophiola americana*
 - (c) *Lysimachia asperulaefolia*
 - (d) *Parnassia caroliniana*
 - (e) *Sarracenia minor*.
- (3) Extremely large populations of two exploited species exist at the site. These are pitcher plant (*Sarracenia purpurea*), with a hundred or more individuals at the site, and hooded pitcher plant (*Sarracenia minor*), with an estimated hundred and fifty individuals. This is the largest population of hooded pitcher plant known in the state (fidé A. E. Radford).

14. N. C. Natural Heritage Program Priority Rating:

High priority.

15. Field Reconnaissance Data Summary Sheet:

FLORA

Canopy: *Pinus palustris*
Pinus palustris
P. taeda
Taxodium ascendens

Subcanopy: None

Transgressives: No dominants
Acer rubrum
Diospyros virginiana
Liquidambar styraciflua
Magnolia virginiana
Nyssa sylvatica var. *biflora*
Quercus geminata
Q. marilandica
Q. nigra

Shrubs: No dominants
Clethra alnifolia
Cyrilla racemiflora
Gaylussacia dumosa
Ilex glabra
Myrica cerifera var. *pumila*
Quercus pumila
Rubus sp.

Subshrub: No dominants
Vaccinium crassifolium

Herbs: Mixed herbs
Aletris farinosa
Aristida stricta
Asclepias lanceolata
A. longifolia
Aster squarrosus
A. tortifolius (?)
Baptisia cinerea
Calopogon pallida
C. pulchellus
Carphephorus tomentosus
Centella asiatica
Coreopsis falcata
Ctenium aromaticum
Dichanthelium ensifolium (?)
Dichromena latifolia
Dionaea muscipula
Drosera capillaris
Erigeron vernus
Eriocaulon decangulare
Eupatorium rotundifolium

15. Field Reconnaissance Data Summary Sheet: (cont.)

Herbs: (cont.)

Fimbristylis sp.
Juncus platyphyllus
Lachnanthes caroliniana
Lachnocaulon minus
Lespedeza hirta
Lobelia nuttallii
Lophiola americana
Lysimachia asperulaefolia
Muhlenbergia inexpansa
Parnassia caroliniana
Penstemon australis
Polygala lutea
P. ramosa
Pterocaulon pycnostachyum
Rhexia alifanus
R. mariana
Sarracenia flava
S. minor
S. purpurea
Scutellaria integrifolia
Sisyrinchium angustifolium
Solidago odora
Tephrosia hispidula
Trilisa paniculata
Vernonia acaulis
Viola primulifolia
Zigadenus densus

Vines: No dominants

Gelsimium sempervirens
Smilax glauca

Ferns: No dominants

Osmunda regalis
Pteridium aquilinum
Woodwardia virginica

Fern Allies: No dominants

Lycopodium appressum

FAUNA

Birds:

Carolina Wren (Thryothorus ludovicianus)
Fish Crow (Corvus ossifragus)
Pine Warbler (Dendroica pinus)
Prairie Warbler (D. discolor)
Prothonotary Warbler (Protonotaria citrea)
Tufted Titmouse (Parus bicolor)
White-eyed Vireo (Vireo griseus)

15. Field Reconnaissance Data Summary Sheet: (cont.)

SOIL SUBGROUP

Swales:

Aeric Paleaquults

Ridges:

No cores taken.

TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN
DECLINATION, 1946

INDEX TO BOUNDARIES

- North Carolina
A. Columbus County
1. South Williams Township
2. Williams Township
3. Lees Township
4. Bug Hill Township
B. Brunswick County
5. Waccamaw Township
South Carolina
C. Horry County
6. Simpson Creek Township

INDEX TO ADJOINING SHEETS

Sheet 5252 II SW falls within NI 17-6.
AMS V501, 1:250,000

Figure 38. Waccamaw Island Savannah

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PIREWAY, N. C., S. C.

N3400-W7837.5/7.5

APPENDIX A: ADDENDA TO PREVIOUSLY SUBMITTED¹ BRUNSWICK
COUNTY NATURAL AREA REPORTS.

Big Cypress Bay

Since submission of the original 1979 contract report, the entire interior area of the bay has been explored. The vegetational communities throughout are similar to those already detailed in the earlier contract report, with the dominant interior community type in terms of areal extent being pond cypress (Taxodium ascendens)/swamp black gum (Nyssa sylvatica var. biflora)/dahoon (Ilex cassine var. myrtifolia). Notably large populations of several infrequent species--water-spider orchid (Habenaria repens), cassena (Ilex cassine var. cassine), and bladderwort (Utricularia fibrosa)--occur around the northwest bay area sinks and within the interior bay forest.

The importance of the site as breeding habitat for a number of "special concern" bird species was probably underestimated in the original report, and needs to be further inventoried.

Big Island Savannah

Savannah area 2 (see topographic map accompanying original report) and the adjacent pocosin area which occurs between this tract and savannah area 1 (the main portion of Big Island Savannah) were drained, clear-cut, burned, and plowed during the summer of 1980. As a result, Big Island Savannah is now surrounded on three sides (highway NC 211 borders the savannah on the fourth side) by intensively managed pine plantation. The effects of such disturbance on the local hydrology cannot be predicted precisely, but it is probable that the savannah itself will gradually become drier as a result of further lowering of the area water table.

Big Island Savannah is clearly the largest, most diverse clay soil savannah presently known, not only within the county, but also, within the state. The importance of the site as representing a nearly "extirpated" portion of our natural heritage cannot be overemphasized. Unfortunately, the outlook for the future of the site does not presently look particularly bright.

Blue Pond

During the winter of 1980, the longleaf pine (Pinus palustris) forest adjacent to Little Blue and Black Ponds was clearcut, burned, and plowed by the owner, with a great deal of disturbance resulting within the pond communities, greatly lowering the site qualities. Blue Pond itself, under different ownership, remains in excellent condition.

An additional pair of nesting osprey (Pandion halioetus) was present at Blue Pond during the 1981 nesting season.

¹The reports referred to were originally submitted in 1979 as portions of two contract inventory agreements with the N. C. Natural Heritage Program.

Boiling Springs Lakes "Natural" Area

As noted in the original report, the largest concentration of Red-cockaded Woodpeckers (Picoides borealis) in the county, both in terms of population size and density, occurs within the Boiling Springs Lakes development, and the American Alligator (Alligator mississippiensis) is common throughout the tract. Both species are on the federal list of endangered species. Additionally, it has since been verified that several threatened plant species occur within the area. These include pine barrens dog-fennel (Eupatorium capillifolium var. leptophyllum), pondspice (Litsea aestivalis), and loose water-milfoil (Myriophyllum laxum).

It is suggested that some effort be made toward preservation of these significant biotic elements, e. g., educating the developers and individual owners of the value of their lands as breeding habitat for a number of threatened and endangered species. However, due to the multiple ownerships of the various sites concerned, previous and present-day developmental activities, heavy recreational use of the area, and other related factors, the value of the tract as a potential natural area must be considered very low.

Orton Pond Natural Area

When considered in its entirety, i. e., in terms of the 1979 report, expanded to include the Brunswick Town area limesinks, Orton Pond Natural Area is clearly one of the most significant areas in Brunswick County and within the state. Verified threatened and endangered species present include (alphabetically):

Alligator mississippiensis American Alligator
Anhinga anhinga Water-turkey
Eleocharis robinsii Dwarf Spike-rush
Picoides borealis Red-cockaded Woodpecker
Potamogeton illinoensis Pondweed
Rhexia cubensis Meadow-beauty
Rhynchospora tracyi Tracy's Beak-rush
Utricularia olivacea Dwarf Bladderwort.

In addition, the natural area contains exceptionally high quality geomorphic examples of limesinks with a great variety of vegetational community types, extremely important breeding habitat for two "special concern" species of birds--the Osprey (Pandion halioetus) and Great Blue Heron (Ardea herodias)--as well as the threatened Water-turkey, and extensive populations of a number of aquatic species infrequent in the region.

Piver Bays Bog

The original contract report concerned with the bog site warned that the threat of destruction of the natural area from development of adjacent lands as pine plantation was great. The site was destroyed during 1980 as a result of activities by its owners in converting the adjacent pocosin area to pine plantation. This is extremely unfortunate in light of the importance of the bog's large sweet pitcher plant (Sarracenia rubra) population, and in light of the fact that destruction of the site was unnecessary for successful silvicultural use and management of the adjacent pocosin.

Instead, destruction of the site resulted more from ignorance of its significance, rather than necessity or intent to disturb the bog site.

Spring Creek Pond

The longleaf pine (Pinus palustris)/Mixed oaks (Quercus spp.) community which surrounds Spring Creek Pond is one of the best, if not the best, example of undisturbed Coastal Scrub Forest (see Introduction, Table 1) occurring within the county. When considered in conjunction with the merits of the pond community itself, this fact greatly increases the significance of the site as a natural--and research--area.

Appendix B: Other Significant Special Habitats in
Brunswick County

1. Sea Turtle Nesting Beaches (See Figure 4 on p. 25).
2. Wood Stork (Mycteria americana) Feeding Area.

A small flock of post-breeding dispersants from Georgia and Florida regularly occur during late summer in the vicinity of two freshwater ponds near Sunset Beach. These ponds are located on the north side of County road 1186 near the Intracoastal Waterway. This is the northernmost locality on the Atlantic coast where this species occurs regularly. (LeGrand, 1980, Southern Atlantic Coast Region, American Birds 34:886). See Calabash topographic quadrangle for location of feeding area.

CEIP Publications

1. Hauser, E. W., P. D. Cribbins, P. D. Tschetter, and R. D. Latta. Coastal Energy Transportation Needs to Support Major Energy Projects in North Carolina's Coastal Zone. CEIP Report #1. September 1981. \$10.
2. P. D. Cribbins. A Study of OCS Onshore Support Bases and Coal Export Terminals. CEIP Report #2. September 1981. \$10.
3. Tschetter, P. D., M. Fisch, and R. D. Latta. An Assessment of Potential Impacts of Energy-Related Transportation Developments on North Carolina's Coastal Zone. CEIP Report #3. July 1981. \$10.
4. Cribbins, P. S. An Analysis of State and Federal Policies Affecting Major Energy Projects in North Carolina's Coastal Zone. CEIP Report #4. September 1981. \$10.
5. Brower, David, W. D. McElyea, D. R. Godschalk, and N. D. Lofaro. Outer Continental Shelf Development and the North Carolina Coast: A Guide for Local Planners. CEIP Report #5. August 1981. \$10.
6. Rogers, Golden and Halpern, Inc., and Engineers for Energy and the Environment, Inc. Mitigating the Impacts of Energy Facilities: A Local Air Quality Program for the Wilmington, N. C. Area. CEIP Report #6. September 1981. \$10.
7. Richardson, C. J. (editor). Pocosin Wetlands: an Integrated Analysis of Coastal Plain Freshwater Bogs in North Carolina. Stroudsburg (Pa): Hutchinson Ross. 364 pp. \$25. Available from School of Forestry, Duke University, Durham, N. C. 27709. (This proceedings volume is for a conference partially funded by N. C. CEIP. It replaces the N. C. Peat Sourcebook in this publication list.)
8. McDonald, C. B. and A. M. Ash. Natural Areas Inventory of Tyrrell County, N. C. CEIP Report #8. October 1981. \$10.
9. Fussell, J., and E. J. Wilson. Natural Areas Inventory of Carteret County, N. C. CEIP Report #9. October 1981. \$10.
10. Nyfong, T. D. Natural Areas Inventory of Brunswick County, N. C. CEIP Report #10. October 1981. \$10.
11. Leonard, S. W., and R. J. Davis. Natural Areas Inventory for Pender County, N. C. CEIP Report #11. October 1981. \$10.
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13. Creveling, Kenneth. Beach Communities and Oil Spills: Environmental and Economic Consequences for Brunswick County, N. C. CEIP Report #13. May 1982. \$10.

CEIP Publications

14. Rogers, Golden and Halpern, Inc., and Engineers for Energy and the Environment. The Design of a Planning Program to Help Mitigate Energy Facility-Related Air Quality Impacts in the Washington County, North Carolina Area. CEIP Report #14. September 1982. \$10.
15. Fussell, J., C. B. McDonald, and A. M. Ash. Natural Areas Inventory of Craven County, North Carolina. CEIP Report #15. October 1982. \$10.
16. Frost, Cecil C. Natural Areas Inventory of Gates County, North Carolina. CEIP Report #16. April 1982. \$10.
17. Stone, John R., Michael T. Stanley, and Paul T. Tschetter. Coastal Energy Transportation Study, Phase III, Volume 3: Impacts of Increased Rail Traffic on Communities in Eastern North Carolina. CEIP Report #17. August 1982. \$10.
19. Pate, Preston P., and Jones, Robert. Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina. CEIP Report #19. December 1981. \$1.00.
25. Wang Engineering Co., Inc. Analysis of the Impact of Coal Trains Moving Through Morehead City, North Carolina. CEIP Report #25. October 1982. \$10.
26. Anderson & Associates, Inc. Coal Train Movements Through the City of Wilmington, North Carolina. CEIP Report #26. October 1982. \$10.
27. Peacock, S. Lance and J. Merrill Lynch. Natural Areas Inventory of Mainland Dare County, North Carolina. CEIP Report #27. November 1982. \$10.
28. Lynch, J. Merrill and S. Lance Peacock. Natural Areas Inventory of Hyde County, North Carolina. CEIP Report #28. October 1982. \$10.
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33. Sorrell, F. Yates and Richard R. Johnson. Oil and Gas Pipelines in Coastal North Carolina: Impacts and Routing Considerations. CEIP Report #33. December 1982. \$10.
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